Tacis

Traceca Corridor

Traffic and Feasibility Studies - TNREG 9803

Module D :

Navigation Channel for Turkmenbashi Port

Part 2 :

Maintenance and improvement recommendations

February 2001

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

(Adjusted by the Monitoring Team in December 2000)

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

Overall objective: To ensure continued accessibility to the Port of Turkmenbashi

Project purpose:

- To carry out a situation study of the access channel.
- To propose a maintenance plan for the channel.
- To prepare investment proposals for capital dredging and/or (navigational or dredging) equipment.

Planned outputs: A regular dredging maintenance plan, to be accepted by the Beneficiary, including investment recommendations.

Project activities: *Determination of the existing situation and the environment including a.o.*

- Review of previous consultants' reports and mission notes.
- Collecting of existing charts and maps to describe the geography of the bay and the channel system.
- Collection and verification of existing data to determine natural conditions (hydraulic, meteorological, geophysical).
- 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.
- Review the port's capacity to correctly maintain and dredge the access channel.
- Interviews with vessel operators.
- Identification of port services and equipment for assisting vessels during passage of the channel (pilot service, pilot vessels, radio equipment….).
- Identification of alternative 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.
- Relevance of international standards in so far as they concern Turkmenbashi port access, including water depth parameters, lighting requirements, etc.

Maintenance and improvement recommendations

- Recommend and justify possible operational improvement measures with respect to safety and continuity of operations, costs, benefits, environmental aspects.
- 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 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.

Target group(s):	Users of Turkmenbashi Port
Project start 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 February 2001

2. Conclusion and summary: investment and maintenance plan

2.1 Dredging requirements

To comply with international standards the Turkmenbashi navigation channel should be 110 m wide and 6.5 m deep, following dimensions of CSC ferries and those of large oil-tankers calling at Ufra. Current cross-sections in the channel are bowl-shaped with maximum depths in the range of 7 to 9 m along a narrow strip, whereas depths are generally limited to 4-5 m close to navigation buoys. Capital dredging works are therefore required.

In the channel mouth actions of oblique currents, of waves and of powerful sediment drift lead the Consultant to recommend a channel width much larger than 110 m, close to 300 m.

Besides, to provide a slight safety margin in case of decrease in the Caspian Sea level, a design water depth of 7 m looks preferable. The Caspian level has been rather stable since 1995; should it drop in the coming years, then the channel bottom should be deepened accordingly.

On such bases initial amounts of sediment to be dredged are approximately 1,750,000 m3 of sand, in the mouth area, and 4,000,000 m3 of silt mud, in the bay area. Maintenance requirements should be around 30,000 m3 of sand in the mouth and 10,000 m3 of mud in the bay.

A complete hydrographic survey is to be performed before planning capital dredging works, by the mean of a dedicated equipment which is depicted farther. After completion of the initial dredging campaign, hydrographic surveys ought to be carried out on a quarterly interval basis, and after any storm likely to drift significant quantities of sand inside the channel throat. Dredging maintenance operations should be decided as soon as hydrographic surveys reveal any significant restriction of channel cross-section (say more than 15% obstruction).

2.2 Navigation aids

Serious improvements are urgently needed in the field of navigation aids. Old buoys have to be replaced, as well as alignment beacons. A radar is also desirable, to enable efficient control of vessel traffic, whilst several ancillary appliances should be supplied, such as a GMDSS receiver and modern VHF sets. This entails implementation of on-site training courses for the attention of operating and maintenance staff.

Most of the equipment will be covered by a grant issued by the European Commission. The equipment is scheduled to be supplied in 2001.

2.3 Dredging and surveying equipment

The port already owns a bucket excavator and two barges which are adequate for carrying out the required dredging works. However, condition of the equipment is not satisfactory and all vessels have to be overhauled. The dredger also needs some additional electrical and positioning appliances.

Nothing is currently available in Turkmenbashi for performing hydrographic surveys; as a consequence a complete set of bathymetric equipment is to be provided. It will consist of vessel-based equipment (which can be installed onboard the Ulker launch), of a modern tidal gauge and of office computer system enabling to plot hydrographic charts. Channel charts will not only be useful for the port, they should also be forwarded to the relevant Authorities to update nautical charts which are used by vessel navigators.

2.4 Environmental aspects

In the past all dredged material was dumped into the open sea in an official dedicated area north of the channel mouth. As the study showed that sediments to be dredged in the channel throat are clean sands, the Consultant advises to use them to create a beach close to Turkmenbashi city, and/or to take advantage of these sands to reinforce the Awaza beach, outside the bay. As far as bay mud is concerned, it should be proposed to dump it into the bay, since the material indeed originates from the bay; in case this cannot be accepted by the Ministry in charge of Environmental Affairs, a suitable offshore dumping site should be investigated (the former one, being located north-west of the mouth, allows too rapid transfer of dumped material towards the channel).

The following chapter 7 also contains recommendations to the port regarding additional surveys to be undertaken prior to issuance of the dredging permit, mainly focussing on potential pollution of sediments.

2.5 Financing the works

The investment cost of improvement works has been estimated as follows:

Item	Cost in USD
Renewal & improvement of navigation aids (mainly buoys, alignment beacons & radar)	381,780
Hydrographic survey equipment, hydrographic and environmental surveys	17,280
Overhaul of dredging equipment (dredger, barges & anchor boat)	87,840
Capital dredging works (5 to 6 million m3 of sand and mud)	1,458,000
Total	1,944,900

The European Commission, under its Tacis-Traceca Programme, has already committed to finance the major part of the navigation aid improvement, for an amount of USD 307,530, which leaves USD 1,637,370 to be funded by TML (however, mainly consisting of dredging works to be carried out by the port own equipment).

Besides, the annual cost for maintaining and operating of the channel should be close to USD 467,385, including depreciation (amortisation).

Considering the rates levied by TML for channel maintenance and for navigation aids, on the one hand, and the projected vessel traffic, on the other hand, TML should recover the following annual incomes from this accounting source (in USD):

	in year 2001	in year 2005	in year 2010
low traffic hypothesis	1,072,000	1,239,000	1,305,000
high traffic hypothesis	1,080,000	1,562,000	1,824,000
medium traffic hypothesis	1,078,000	1,493,000	1,643,000

Comparative computations made on the basis of these costs and revenues lead to the conclusion that TML should be able to improve and to maintain Turkmenbashi navigation channel on its own, taking into consideration the European Commission grant.

However, for the time being channel revenues are used to cover expenses which are not related to channel maintenance, and recent TML annual accounts even show global profits close to zero. The Port Institutional Development Programme, which is being implemented by Haskoning, recommends to set up an analytical accounting system which should enable to make the situation clearer.

3. Improvement and maintenance of the channel mouth

3.1 General

Improvement of navigation conditions in the channel mouth may consider that the average quantity of sand drifting along the outer coast of the spit is close to 30,000 m3 per annum, and that most of that material comes from the north.
Any mean to alleviate the impact of that drift is to be considered, including systems likely to partly block sand drift, such as traps and groins. In 1990 Caspmorniiproekt already discussed these issues (ref. 3) but no further action was undertaken, partly because of the rising sea level, partly because of the collapse of the Soviet Union.

3.2 Sand traps

Two designs were proposed by Caspmorniiproekt in 1990; both can still be considered. The first one, which is referred to as a "side pocket" is a pit dug out on the northern bank of the channel mouth, aiming at receiving enough sand to entail a reduced dredging maintenance (see figure 1). The second one, "sand traps", consists in digging two pits along the channel banks in order to trap drifting material out of the guaranteed navigation width of the channel (see figure 2), therefore increasing the time period between dredging operations.

The design of the side pocket widens the channel on its northern bank, the trapezoidal hollow receiving drifted sand straight from the northern coast. Proposed length, width and depth of the pit would allow holding back of 64,000 m3. Assuming that about 70% of drifted material would be blocked in that pocket, required maintenance dredging would be reduced to 10,000 m3 per year, whilst the pit should be emptied each three years. Initial dredging of such a pocket would depend on real hydrography, which is still to be thoroughly investigated; an amount of 100,000 m3 is a rough estimate, 10% more than the quantity foreseen in 1990. Should such works be undertaken, then a huge volume of high quality sand would be made available, which might mitigate the cost of the operation.

Sand traps on both sides of the channel aim at a similar result, sand coming back from the southern part of the spit being equally blocked out of the navigation area. It can be assumed that 80% of drifted sand would thus be kept out of the channel, therefore reducing annual dredging to 6,000 m3. On the other hand excavation of these traps would also generate 100,000 m3 of good sand, emptying of the pits should be carried out each three years.

These traps, which would undoubtedly reduce maintenance works in this sensitive part of the channel, would however require significant initial earthworks as well as regular scrapping out.

3.3 Protection groin in the open sea

A groin, reaching water depths of 3 m and running out of the northern shoreline of the spit as shown on figure 3, would intercept a significant part of the long-shore sediment drift.
The design proposed in 1990 by Caspmorniiproekt shows a 500 m long dam rooted on the spit and jutting towards south/south-east with a 20° angle with the channel axis. Groin slopes were designed with a protection made of quarry stones weighing up to 500 kg, which seems a bit light. Groin length was apparently designed according to wave heights, close to 2.3 m near the shore.
It can be assumed that this groin would divert or block 60% of the drifted sand, allowing to reduce annual dredging to 10,000 m3 in the mouth area.
It can also be considered that the groin would partly shelter the mouth from wave action, which would benefit to navigation safety.
Unfortunately such a huge groin would not only be expensive but would become sand-saturated after a few years of lifetime. Then the channel would lose its sediment protection, unless sand is regularly removed from the northern side of the groin (which is not easy with a 3.6 m draft dredger).

Another groin design had been proposed by Caspmorniiproekt, consisting of a short detached groin which was supposed to be connected to the shore by the mean of a sand tombolo. Such a weak structure would quickly be endangered by storms.

3.4 Recommendation

The Consultant is of the opinion that feasibility of these sand pockets, sand traps and groins faces a major adverse problem: any construction which would be planned in this area would have to be built on top of thick layers of recent and unconsolidated sands, and along an unstable shoreline. There is probably no bed-rock at a reasonable depth. Groin foundation would be over-expensive and unreliable, as proved by movements of sunk vessels in the vicinity of the channel mouth, as well as by collapsed navigation aid buildings (photo n°2).

Instead of implementing such projects the Consultant recommends to widen the slit in the spit area, and to carry out regular maintenance dredging. Because of the actual possibilities of intensive and repeated dredging along the slit already performed through the spit, it would be possible to alleviate the inconvenient of the permanent accumulation of drifting sands in this part of the channel. This could be achieved using the existing dredger and its annexes, provided that adequate overhaul, training programme and maintenance are undertaken.

According to international standards, width of the channel bottom should be 110 m for a one-way traffic lane (6 times the beam of the widest vessels, the Dagestan ferries, which beam is 18.3 m) and 165 m for a two-way traffic lane (9 times the biggest beam). However, in such a dangerous throat, with untidy waves and currents, and high tendency to lateral migration, it is advisable to design a much safer width, say 300 m, and to prohibit vessel crossings. A design minimum depth of 7 m will provide with a reasonable keel clearance (max. vessel draught is 5.3 m).

Increasing the effective width of the channel up to 300 meters over 1,5 km length through the spit would provide a buffer to the inconvenience linked to the instability of the banks along the present narrow slit. The effect would be similar to the one which may be provided by a sand-trap, yet with a substantial increase in navigation safety.

Initial dredging works, assuming a widening of 150 additional meters along the 1,5 km length of the section, and the fact that half part of the material has to be taken out of the spit shore at an average level of +2 and of -2 for the second half of the length, would represent amounts of 1350 and 750 cubic meters per linear meter of channel. Construction of a convenient slope, say 1/2 in the medium size sand, would add 81 and 25 m3 per linear meter to these figures. Such a rough estimate leads to a total amount of 1,750,000 m3.

Obviously such a solution implies development of a regular maintenance dredging programme of about 30,000 m3 per year, failing which the morphology of the mouth would come back to the current one after a few years.

On the other hand it has to be kept in mind that all the material considered in this section is a medium sized sand of high geotechnical quality, fully devoid of fine particles: it is a very clean beach sand, and dumping it into the open sea as waste deposit would be an aberration. The cost of initial dredging as well as of maintenance dredging would be mitigated if the extracted material could be used to create and maintain a beach within the bay, for instance in front of the western part of the city of Turkmenbashi, where young people already use to bath. It may be added that this sand would not only remain along the coast in the city area, due to absence of drifting currents on the northern shore of the bay, but also would be kept in a reasonably unpolluted condition, due to action of short breaking waves. The amount of dredged material made available by maintenance works would allow to regularly refill the new beach.

Apart from beach creation and nourishment, this sand could be used for building purposes (production of concrete, among others), bearing in mind that salinity of Caspian waters and sands is very low.

4. Improvement of the channel inside the bay

4.1 General

Within the bay area, i.e. on the muddy part of the channel bottom, widening works along the existing track have to be taken in account since the fully available width is only in the range of 50 to 90 m whereas, according to international standards, width of the channel bottom should be 110 m for a one-way traffic lane (see § 3.4)*. Given the current Caspian Sea level, water depths along the channel axis are everywhere sufficient, in the range of 7.0 to 8.8 m (max. vessel draught is only 5.3 m). A design depth of 7 m will provide a comfortable keel clearance, as well as some margin in case of slight drop in the sea level. Should the average sea level decrease by more than 0.7 m, then the channel would need additional deepening (for the time being the level is stable).

Except in the vicinity of the bay entrance, where sands are scattered by currents, the whole length of the channel bottom is dug out in a fine muddy material, subject to slow sedimentation due to settling down of suspended particles originating from remote areas within the bay.

Improvement of navigability in this section should therefore be easier than in the sand spit area, a greater stability of bottom depths being likely to be forecast after completion of capital dredging works, despite a natural tendency to creeping and slumping on the silty banks.

Apart from widening the existing channel, the following chapter comments on possibilities of rehabilitating the existing southern route, as well as designing a new southern access.

** It doesn't seem worth designing a two-way lane, first because of the low traffic level (around ten vessels per day, in and out), then because of crossing-collision risks, lastly because of quantities of capital dredging.*

4.2 Widening the existing channel

At least in the bay area, from the port sites up to the vicinity of the sand spit, any increase in the width of the channel should not entail any significant change in the required maintenance rates, provided that slope of channel banks do not exceed the stability limit of the bottom material, which should be approximately 1 to 4.

As for the initial volume of sediment to be extracted, assuming that the current average channel width is 70 m and that the future width will be 110 m, the required dredging volume should be close to 4,000,000 m3, including the two port branches.

Unlike sand of the spit area, all bay material is poor quality silty mud which should be dumped as far as possible from the channel: in the southern part of the bay if a deposition area can be accepted, or outside the bay, in the open sea, despite the length of the transport route. In this latter case, selection of a new dumping area has to be carefully studied since the existing one, north of the channel entrance, is inadequate. To reduce the possibility of recycling of the material, that area must be situated clearly south of the channel and at a depth preventing from remobilization of silt, the instability of such material increasing enormously under open sea wave conditions.

4.3 Rehabilitating the existing southern route

Still occasionally used in stormy conditions, the southern channel uses the natural aperture between the south of the Turkmenbashi spit and the Cheleken spit as a way out to the open sea, despite the increase in sailing time (to/from Baku: 35 extra nautical miles, to be added to a total journey of 180 miles). This way was the only access to Krasnovodsk port prior to the construction of the present channel, opened through the peninsula in 1956.

Because this channel was entirely dug out in the bay silts and in the middle of smoothly and regularly increasing natural depths towards the south, its maintenance, free of any drift process, would be easier than that of the present main channel.

However, although this option would be more adequate from a pure sedimentological point of view, the additional sailing time it would entail has already pushed the Turkmenbashi Port Authority and the main Shipping Companies (CSC and TML) to reject it.

4.4 A new southern access

Following the same tendency, it is worth pointing out that in the southern part of the bay no hindrance is to be found between the port facilities and the 18 km wide strait which is the natural entry of the bay.

It could therefore be possible to design an entirely new channel running straight from the port down to the 7 m contour line, close to the bay entrance, avoiding the bend of the present channel as well as the bend at the connection with the existing southern route.

No different problem than in the inner part of the existing channel would arise as for maintenance of this new channel, whilst continuous earthworks on the slit through the sand spit would be avoided, like in the former option.

However, such a straight route inside the bay would run over less favourable depths than the existing southern channel and happens to be closer to continental sediment sources. Siltation rates would therefore be higher.

5. Improvement to navigation aids

A tender dossier was recently completed regarding improvement of navigation aids for the ports of Baku, Dubendi, Aktau and Turkmenbashi. The present project takes into account the equipment included in this dossier and complements it when needed. Following items, which were not in the tender, were included into the project:

- Placement of buoys, including concrete sinkers and steel chains (this should be covered by TML).
- Synchronisation of gate buoys (by the mean of radio links between connected buoy lights).
- Rehabilitation of leading marks.
- Construction of the radar antenna support.
- Training of port staff for operation and maintenance of navigation aids.

5.1 Buoys

Existing buoys are in such bad condition (corrosion, lights) that it is advisable to replaced them. They can be replaced by bigger units allowing to reduce the quantity of buoys: according to the attached scheme, the existing 39 buoys can be replaced by 16 buoys:

- Two cardinal buoys (a north one and a south one) marking the entrance of the traffic separation system.
- A landfall buoy at the exit of the traffic separation system, fitted with Racon (Racon allows vessel radars to identify the buoy by a Morse code letter).
- Three pairs of lateral buoys along section 1 of the channel, inside the bay.
- A junction buoy at the cross-road between section 2 and section 3.
- Six lateral buoys on sections 2 and 3.

Cardinal buoys and landfall buoy should be of a similar type as the "tail-tube buoy" shown in the attachments, made of polyethylene, focal height being 4.5 m above sea level and day-night visibility range of 4 miles.

Other buoys should be similar to the "proximity" type shown in the attachments, made of polyethylene, focal height being 2.3 m above sea level and day-night visibility range of 4 miles.

The 4 mile visibility range has been selected to allow captains to catch sight of a pair of buoys as soon as they reach the previous one. Moreover, to make the gates more visible at night, each pair of buoys will be fitted with synchronised lights flashing simultaneously.

Buoy maintenance should include quarterly inspections (wiping solar panels and lenses, battery control, lamp replacement on lamp changers), annual checking of mooring lines and five-year complete overhauls (replacement of mooring lines, replacement of batteries, buoy cleaning and repainting of steel parts).

The Racon requires a specific quarterly inspection for checking its battery and its connections.

5.2 Leading marks

It doesn't look necessary to rehabilitate all initial leading marks (see attached figure). Lines H2' and H3' may be deleted, provided that lines H1, H2 and H3 are properly fitted with day-mark panels, as depicted on the "daymarks" attachment. Lights of H1, H2 and H3 are already in operating condition, they can be re-used.

5.3 Radar

At the moment the harbour master's watchmen are not able to control the whole channel, they can simply watch a short stretch in the vicinity of the city. The only way to overcome the problem is to install a radar system.

As far as the antenna is concerned, from a technical point of view the best location is on the slope of Ufra hill, close to H1 northern beacon, since this would permit to easily elevate the antenna up to approximately 30 m above sea level, which is the required height to reach the traffic separation system, 15 nautical miles away (see attached scheme, with 15 mile radius circle). Besides, the territory is secured and electricity is available. However, it seems that the Port Authority would prefer to place the antenna on top of the future administrative four-storey building, or at the ferry terminal, to have it closer. It must be stressed that the latter locations would require supporting towers and, should the administrative building be selected, two portal cranes and a lighting tower would create some radar shadows.

The radar system which is proposed in the tender dossier is of Arpa type, 3 cm X-band (same type as vessel-based radars), which is an economical option. A VTS radar, able to be connected to a computer and allowing to identify vessels equipped with AIS*, would have been more convenient but also significantly more expensive (euro 290,000 instead of euro 110,000).

The radar display monitor must be installed inside the harbour master's premises.

** AIS will soon be imposed by the IMO, and all riparian States of the Caspian are members of the IMO*

5.4 Other navigation aid related equipment

In addition to the above essential items, miscellaneous equipment items are worth being included in the project. A first set is to be installed in the harbour master's premises:

- A GMDSS receiver.
- A new VHF-MW radio receiver.
- A complete computer equipment, notably to record vessel moves.
- Wind measurement equipment (speed and direction).
- A barometer, a thermometer, a marine watch and binoculars.

Other items consist of portable VHF sets, tool sets, various spare parts and a GPS for the buoy tender.

5.5 Spare parts and staff training

A complete set of spare parts has to be supplied, especially for buoy maintenance: lamps, lanterns, solar panels, batteries, charge regulators, radar reflectors, photocells, lamp changers, flashers, flash synchronisers and mooring lines.

Lastly, a training programme is needed for employees who will operate and maintain navigation aid equipment. These courses should cover on-site training of operational staff during installation of equipment, as well as training of maintenance technicians in the port workshop.

6. Dredging and surveying equipment

6.1 Dredging equipment

As the Sagadam dredger was seldom used since it arrived in Turkmenbashi, in 1994, and because of the frequent problems encountered by the crew during operations, the Consultant recommends that the dredger manufacturer (Leninskaya Kuznitsa Shipyard, Kiev) carries out an inspection of the vessel and provides technical assistance to the captain, to the chief electrician and to the chief mechanic prior to any overhaul or new dredging operation.
It can already be foreseen that dry-docking the vessel will be advised, as it was never dry-docked since its delivery, in 1994. It is certainly required to clean and to repaint the hull, as well as to inspect and overhaul all underwater appliances. For such purpose the vessel will have to be tugged to Baku, because the capacity of the Turkmenbashi dry-dock (around 300 tonnes) is too weak to accommodate the dredger, which gross tonnage reaches 1,100 tonnes.
It is also known that some electric panels have to be replaced and that a GPS system is needed (no positioning system is currently available onboard).

The two barges and the anchor boat also need to be inspected and overhauled. This can easily be carried out in the Turkmenbashi shipyard.

6.2 Surveying equipment

Currently the port of Turkmenbashi doesn't own any piece of equipment allowing to perform hydrographic surveys. In the future the port needs to be equipped with a complete surveying equipment to allow proper planning of dredging operations, control of dredging results as well as regular surveillance of water depths in the whole navigation channel. This includes vessel-based equipment, a modern port tidal gauge and suitable office facilities.

The Ulker launch looks perfect for carrying out hydrographic surveys. It should be fitted with the following new appliances:

- An echo-sounder able to measure water depths with 10 cm accuracy, suitable for hard and soft sea-beds. A wave compensator is not required; this is an expensive device which may be avoided since surveys can be planned during calm periods.
- A GPS positioning system. This relatively cheap equipment, which operates with satellites and offers a positioning accuracy of a few decimetres, has recently become the standard electronic positioning system.
- A computer system correlating digitised depth data with positional data.

The port tidal gauge has to be connected by radio link to the vessel-based system in order to enable real-time correction of measured water depths.

Lastly, the port engineering department has to be equipped with computer hardware and software allowing to draw bathymetric maps and channel cross-sections, as well as to compute required dredging volumes.

Provision for initial staff training is included in the cost estimates.

7. Environmental recommendations

In the absence of international conventions fully covering inland waterways, such as the Caspian, the International Dredged Material Assessment Framework (DMAF) is recommended for evaluation of the proposed dredging and disposal operations. The following sections follow the DMAF.

7.1 Evaluation of the need for dredging and disposal

The major part of the proposed dredging project is within the so-called ‘capital’ dredging category, and will be implemented particularly to improve navigation through the Turkmenbashi spit and within Turkmenbashi bay. Safety of shipping in the bay, especially regarding manoeuvring room, requires widening of the dredged channels to the Port of Turkmenbashi and the Ufra Oil Terminal. The proposed project does not appear to meet any of the criteria listed in the OSPAR (Oslo-Paris Convention) Guidelines for the Management of Dredged Material for exempting the material from further characterisation.

The Consultant estimated that approximately 4 million m3 of silt bottom sediment must be removed from the bay. Furthermore, regular annual maintenance dredging will remove 10,000 m3 of silt sediment. The spit area must also be widened, through initial removal of 1.5 to 2 million m3 of clean sand, and annual maintenance dredging of 30,000 m3 of sand.

This material can possibly be disposed in the bay itself, most of which is part of the Khazar Nature Preserve. Alternatives include disposal at current shore sites around the bay, and a site on the sea side of the spit. The current disposal site on the sea side to the west of the spit is inappropriate, as prevailing wave action carries the sediments back to the area of the channel through the spit.

7.2 Dredged material characterisation

Migration of contaminants in the dredged material to surrounding waters, soil and air, endangering aquatic and terrestrial ecosystems and human health, may occur during the dredging operations as well as subsequent to disposal. This underlines the need for reliable characterisation of this material. The following factors support the need for more precise characterisation (particularly chemical) of the dredged material in the spit area and the bay:

- Confirmed presence of oily substances in the sediments.

- Possible presence of phenols and other substances based on traffic of crude oil and petroleum products to/from the Ufra Oil Terminal. This concern is heightened by the absence of any treatment facility for ballast and bilge water at the Port of Turkmenbashi, and the inadequate capacity and poor state of the oil/water separator and waste water treatment station for ballast and bilge water at the Ufra Oil Terminal.
- Questions regarding the analytical methods used for the previous characterisation efforts, in 1990, with respect to chemical analysis, and related to whether the samples taken are representative.
- Possible threats to the Khazar Nature Preserve or possible shoreline disposal sites if concentrations of various pollutants are found to be high. If the presence of pollutants are below safe limits, the threats to the preserve are likely to be minimal, as there is little or no current in the bay that might otherwise carry sediments disturbed by the dredging operations to sensitive parts of the bay.
- There is little 'flushing' of contaminants in the water and sediment in the bay, which would normally lead to long term build up of the same. However, there is significant water flow in the area of the spit, and thus more mixing of clean and contaminated sediments, which could mean lower overall concentration of contaminants in that area.

In addition to testing for oily substances and phenols, tests should be considered for polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and heavy metals. These contaminants, which are relatively insoluble and immobile in the anaerobic alkaline environment common to most sediments, tend to become more mobile and soluble during dredging operations. Tests for pH, calcium carbonate equivalent, cation exchange capacity, salinity, sodium adsorption ratio, and electrical conductivity should be considered, as appropriate.

Biological tests should be conducted if necessary, and depending on the presence of chemical contaminants and the disposal options. They might include the following:

- Acute toxicity
- Chronic toxicity
- Potential for bio-accumulation
- Potential for tainting

If the above assessment results in findings indicating high levels of contaminants, Government Authorities should consider implementing evaluation of the sources of these contaminants and methods for controlling the same.

7.3 Evaluation of disposal options

In addition to the possibility of finding a more appropriate sea disposal site, south of the channel mouth, the dredged material from the bay, which has been characterised as silty and muddy sediment, may be dispersed in the bay itself, where the relative lack of current would ensure that the material does not return to the dredged channel. The material could also be used for restoration and establishment of wetlands, terrestrial habitats, nesting islands and fisheries.

As bathing takes place around the bay, the dredged material from the spit area, which consists of clean sandy material, could be used for land creation and improvement, beach nourishment (in the vicinity of Turkmenbashi city or in Awaza), offshore berms, capping material or fill. Any of these alternatives would have the added benefit of mitigating the costs of dredging (the dredging is expected to take 2 to 3 years). However, a significant part of the coastal zone around the bay consists of wetlands that may support fish breeding and breeding of sea birds and other bird species, even those close to the port of Turkmenbashi. Alternatively the sand could be used for construction purposes, especially for concrete production.

Pending characterisation of the dredged sediments, further investigation is recommended as follows:

- The possible impacts on wildlife in and around the bay, should bay dredged material be disposed in the bay itself. Promising sites should be selected and investigated.
- The status of wetlands around the bay, particularly around the port of Turkmenbashi and Ufra Oil Terminal (regarding their function as breeding grounds for fauna and flora).
- Current bathing areas and the possible impacts of adding artificial beach area on flora and fauna at these sites and in adjoining areas. Physical impacts should also be examined, for example changes in the water regime.
- Possible use of sand for concrete production, as well as costs and benefits, of using the dredged material removed from the spit area in concrete production. Assessment of the possible use of the material for other construction purposes should also be implemented. Any impacts related to the transport of the sediments should be examined.
- Assessment of the need for treatment of the dredged material, dependent on the intended management option (including disposal). Treatment would be required for reducing the amount of contaminants in the dredged material to satisfy regulatory or other applicable standards and guidelines. It ranges from separation techniques, for example separation of contaminated fine-grained fractions from relatively clean sand, to incineration.

7.4 Sea disposal site selection

Alternative sea disposal sites to the current site should be evaluated. Open sea disposal generally includes unrestricted placement on flat or gently sloping sea beds in the form of mounds or placement within depressions for lateral containment. The evaluation of possible sites should take into account the following in order to ascertain the possible fate and effects of the disposed material:

- Potential impact of wave action on the disposed sediments.
- Physical and chemical characterisation of the dredged sediments (physical data is already available, whilst chemical parameters are to be investigated). Open water disposal generally involves clean or mildly contaminated material. Highly contaminated material might also be considered for open sea disposal if appropriate control measures are applied (for example providing a cap of clean material to provide isolation from the benthic environment).
- The physical, chemical and biological characteristics of the sea bed at the proposed sites (including hydrography, redox status, benthic biota).

- Proximity to areas of natural beauty, recreation, subsistence (especially fishing), spawning, shipping lanes.

7.5 Environmental impact assessment

The expected consequences of the dredging and disposal options must be outlined in order to provide the basis for approval or rejection of the project, and if approval, for defining environmental monitoring requirements. This assessment should integrate findings regarding characteristics of the dredged material and conditions at the proposed disposal site. The assessment must take into account the possible impacts on human health, sensitive ecological zones and economic activities.

A baseline survey is essential for this analysis. Possible impacts are measured against the baseline state of areas effected by the dredging operations and disposal of the dredged material. Information regarding whether the disposal site is retentive (that is, disposed material will remain within the vicinity of the site) or dispersive are critical to the choice of sea bed disposal sites. The impacts of disposal on suspended solids levels and the possibility of smothering benthic organisms in the dumping area must also be considered. Substances may undergo physical or chemical changes when disposed at a particular site, with resulting impacts. Impacts can be minimised by ensuring that the dredged material and the sediments in the receiving area are similar.

The Consultant notes that the relatively new and unused bucket dredger present at the port, which will be used for the proposed dredging activities, should have relatively low impacts on the environment in terms of disturbing the surrounding sediments and dispersing sediment and contaminants in the bay. Nevertheless, a review of possible applicable and feasible dredging technologies and their relative impacts on the environment ought to be implemented. Furthermore, the existing bucket dredger should be assessed to determine whether modifications might be made that would reduce overdredging, minimise the suspension of bed material, and in general reduce the impacts on the surrounding environment. This is particularly critical for the dredging operations in the spit area, where currents exist, as opposed to the bay, which is more or less stagnant.

7.6 Permit issue

The permit is an important tool for sea disposal or other uses of dredged material, in addition to management of dredging operations. The permit normally requires that:

- Only those materials that have been characterised and found acceptable for the designated disposal option, based on impact assessment, may be dumped.
- The material must be disposed at the selected site.
- Any preferred dredging or disposal management techniques identified during the impact analysis are carried out.
- Any monitoring requirements are fulfilled and the results reported to the permitting Authority.

TML should apply for a permit covering all capital dredging works as well as further maintenance works foreseen in this project, including use of sand for creation and nourishment of beach(es) and dumping of mud on the sea-bed of the bay (otherwise at an offshore area located south of the channel throat).

7.7 Monitoring

A monitoring plan should be developed once the dredging plan and selection of the disposal site have been finalised. This plan must include specification of:

- Baseline conditions
- Monitoring during the course of the dredging and disposal operations
- Post-operational monitoring
- Feedback throughout the dredging operations and subsequent to completion of the same

The monitoring plan should include but not be limited to the following:

- Monitoring of turbidity in the area of the dredging and disposal operations
- Monitoring of physical and chemical characteristics of the dredged material
- Frequency and location of sampling
- Guidelines on management of data

8. Financing the works

8.1 Objectives and methodology

The objectives of the following analysis are to evaluate TML ability to self-support the channel rehabilitation works and to reimburse the loan that TML may contract to complete the rehabilitation.

A basic assumption is that rehabilitation works will be carried out according to the agreement which foresees that Tacis will provide a grant of approximately euro 341,000 for supply of navigation aids and sets of spare parts for their maintenance. The port of Turkmenbashi is supposed to finance the rest of the works, either by itself or through a loan. The anticipated sharing out of the works is shown in the first annex 3 table.

Throughout this financial analysis, the channel and the navigation aids are considered as a specific cost-centre called “Channel Centre” and all charges and revenues have been tentatively separated from the other port activities. This situation differs from the current one but it fits with all recent EBRD recommendations regarding Turkmenbashi port management.

All financial projections comply with prevailing port conditions and make use of past TML financial statements. Amounts are converted in USD with a fixed rate of 1 USD to 5,200 Manats.

The assessment includes three steps:

- Calculation of profit and loss statements over the ten coming years, which determines the capacity of channel services to be self-supporting.
- Estimation of projected cash-flow for the same period, in order to assess the capacity to finance the project and to refund a potential loan.
- Estimation of financial contribution of the Channel Centre to the overall financial performance of TML.

8.2 Project cost

The first annex 3 table details the investment cost and the financing allocation of the project elements. Capital dredging prices take into account amortisation of dredging equipment (USD 5.5 million, over 20 years) as well as costs for crew members (USD 30,000 per year) and for gas-oil and lubricants (USD 26,000 per year). Dredging productivity is supposed to be in the range of 1.5 to 2.0 million m3 per year, which is realistic after equipment overhaul and staff training (ref. report of November 2000).

Table 1: Investment and financing sources *(figures in USD, using 1 euro = 0.9 USD)*

Item description	Total	TRACECA grant	TML
A. Navigation aids and ancillary works	381,780	307,530	74,250
B. Survey equipment and survey works	17,280	0	17,280
C. Dredging equipment	87,840	0	87,840
D. Capital dredging works	1,458,000	0	1,458,000
Total	1,944,900	307,530	1,637,370

8.3 Profit and loss statement

a. Income statement

Operating revenues are based on the present tariff structure, taking into account the 50% discount agreed between TML and CSC for their ferries.

The Channel Centre is supposed to get two sources of income:

- Channel maintenance fees. The new tariff is USD 0.027 per m3 as proposed in the recent Scott Wilson's Port Tariff Study. This tariff is based on the ship volume, multiplying the overall length by the breadth and by the moulded depth.

- Buoy maintenance fees. The new tariff is USD 0.014 per m3, the volume being computerised in the same way as above.

Income figures have been computed for each traffic scenario (see details in the annex 3 tables).

Table 2: Income statements in thousands USD

Sources of income	Year 2001	Year 2005	Year 2010
Pessimistic scenario			
From ferries	358	380	400
From general cargo vessels	57	62	68
From tankers	657	797	837
Total	1,072	1,239	1,305
Optimistic scenario			
From ferries	365	644	752
From general cargo vessels	58	73	92
From tankers	657	845	980
Total	1,080	1,562	1,824
Medium scenario			
From ferries	364	602	652
From general cargo vessels	57	71	84
From tankers	657	820	907
Total	1,078	1,493	1,643

In year 2010 the annual income should thus be in the range of USD 1.3 to 1.6 million.

Note: compared to the contents of the report of November 2000, present traffic figures slightly differ. This is due to correction of some arithmetic mistakes, also to correction of average ferry loads (1800 tonnes per call instead of 2000 tonnes).

b. Operating expenses

Charges include maintenance of channel depths and of navigation aids, financial charges related to the potential loan that might be needed to balance the lack of cash-flow during the investment period, as well as overheads and depreciation of the equipment.

- Maintenance and operating costs

The annual maintenance cost is not depending on the traffic and is considered as a fixed cost. It includes the labour cost of workers and crew members, the cost of repair and spare parts for navigation aids, that of maintenance for the dredger and the barges, of bathymetric surveys and of annual dredging activity to maintain channel depths. Depreciation of equipment parts is computed separately, assuming that depreciation is linear and based on a 20 year lifetime.

Table 3: Annual maintenance cost of the channel and navigation aids (see details in annex 3)

Item description	Cost in USD
Maintenance of navigation aids	14,130
Maintenance of survey equipment and annual survey works	24,300
Maintenance of dredging equipment	23,175
Annual dredging works	38,800
Depreciation of dredging equipment	275,000
Depreciation of navigation aids	19,080
Depreciation of capital dredging works	72,900
Total operating costs (depreciation excluded)	*100,405*
Total operating costs (depreciation included)	467,385

- <u>Overhead expenses</u>

10% of TML administrative and management expenses are allocated to the Channel Centre, taking the labour force distribution as key parameter. In 1999 the total amount of administrative expenses was USD 1,241,000, therefore USD 125,000 are allocated to initial overhead expenses for the Channel Centre (further allocations are assumed to grow together with the traffic).

- <u>Financial charges</u>

The Consultant considers that most of the works can be carried out by TML staff and equipment. However, in some traffic hypotheses negative cash-flows can occur and the Channel Centre may need a loan to support the deficit. It is assumed that the conditions of this loan would be as follows:

Duration: 10 years
Interest rate: 6.5 %

- <u>Total expenses</u>

Table 4: Projected yearly expenses (in thousands USD)

Item description	2001	2005	2010
Total operating costs (depreciation excluded)	100,405	100,405	100,405
Overheads	128,750	145,000	168,000
Depreciation	275,000	366,980	366,980
Total operating expenses	229,155	612,385	635,385

c. Gross operating profit before taxes

The following table 5 compares operating profits before taxes.

Table 5: Gross operating profits (in thousands USD)

Scenario / Year	2001	2005	2010
Pessimistic	843	627	670
Optimistic	851	950	1,189
Medium	850	880	1,007

This table clearly shows that the Channel Centre is potentially able to generate high profits.

8.4 Projected cash-flow

Projected yearly cash-flow has been computed for each traffic scenario.

a. Gross potential cash-flow

The gross potential cash-flow before taxes is the sum of the gross operating profit and of depreciation. It is positive for all traffic scenarios. Taxes on profit and possible loan repayments have been deducted from this gross potential cash-flow.

b. Taxes on profits

Taxes on profit were computed according to the existing fiscal rules that set the taxes to 50 % of the profit amount. Actually, this allocation of taxes to the Channel Centre will depend on TML global financial results. Calculating such tax out of the Channel Centre activity supposes that overall TML activity is profitable.

c. Investment cost

The following annual expenses have been considered, taking into account the required implementation time period:

in 2001: USD 327,474
in 2002: USD 654,948
in 2003: USD 654,948

d. Loan refunding

In case of negative net cash-flow it is assumed that the Channel Centre receives a loan to finance the deficit. Actually this only happens in the sensitivity test.

e. Net potential cash-flow

Deducting taxes on profit, investment costs and loan refunding from the gross cash-flow, the net potential cash-flow is calculated.

f. Sensitivity test

As a sensitivity test it was considered that ferry traffic might be restricted because of lack of cargo originating from Uzbekistan. Because of the competition with Aktau port, in connection with the projected railway line linking Aktau to the Uzbek cotton region, there might be a diversion of cotton traffic in favour of Aktau. In this case it was considered that year 2010 ferry calls would respectively be limited to 400, 520 and 490 calls in the pessimistic, optimistic and medium scenarios (instead of 510, 960 and 835 calls). These restricted cases are called “reduced scenarios”. Reduced net profits are shown in table 6. The only case requiring a loan is the pessimistic one.

Table 6: net cash-flows (in thousands USD)

Cash-flow elements	2001	2002	2003	2004	2005	2010
Pessimistic scenario						
full	93	9	15	675	680	702
reduced	*93*	*- 17*	*- 16*	*640*	*642*	*654*
Optimistic scenario						
full	98	17	35	709	842	961
reduced	*98*	*17*	*35*	*709*	*723*	*788*
Medium scenario						
full	97	14	24	689	807	871
reduced	*97*	*14*	*24*	*689*	*698*	*736*

This table shows that net cash-flows are high and that consequently the Channel Centre should easily support the rehabilitation works.

8.5 Conclusion of the financial assessment

This financial assessment only shows the contribution of the so-called "Channel Centre" to TML overall activity. From this analysis it can be thought that the Channel Centre should be self-supporting and profitable. Its contribution should always be very positive, even in the "pessimistic & reduced" traffic hypothesis.

However, as it was pointed out in the report of November 2000, revenues from channel dues don't seem to be readily available for financing channel works, since recent TML accounts reveal global profits close to nil. The Port Institutional Development Programme, which is being implemented by Haskoning, recommends to set up an analytical accounting system which should enable to make the situation clearer.

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Enclosures: Annex 1 to Annex 4

Annex 2

maps and figures

Available on the TRACECA website : www.tareca.org (0.348 MB)

The map of the TRACECA area is available on the TRACECA website : www.traceca.org

ABBREVIATIONS & ACRONYMS

- AIS — Automated Identification System
- BSL — Baltic Sea Level
- cm — centimetre
- CSC — Caspian Shipping Company
- CSL — Caspian Sea Level
- dm — decimetre
- dwt — dead weight tonnage
- EA — Environmental Assessment
- EBRD — European Bank for Reconstruction and Development
- EIA — Environmental Impact Assessment
- EPS — Electronic Positioning System
- g — gram
- GMDSS — Global Maritime Distress Safety System
- GNP — Gross National Product
- GPS — Global Positioning System
- IALA — International Association of Lighthouses Authorities
- IMDG — International Maritime Dangerous Goods Code
- IMO — International Maritime Organisation
- kg — kilogram
- 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
- 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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