NON-TECHNICAL SUMMARY

Introduction

The company CFM ("Caminhos de Ferro de Moçambique" - *Mozambique Railways)* intends to dredge the Access Channel to the Port of Beira, with the intention of returning it to its original dimensions, allowing, once again, 50.000 DWT ships to enter, and allowing for the revitalisation of new ship movement in the Port of Beira.

As such, to initiate the process of the environmental impact assessment, at the end of April, 2006, CFM submitted information to the National Office of Environmental Impact Assessment (DNAIA) instructing of the Process of Environmental Impact Assessment of the Dredging of the Access Channel to the Port of Beira Project.

With this document as reference, DNAIA classified the project as being of Category B, requiring the submission of a ***Simplified Environmental Study (SES*)**, after the approval of the respective Terms of Reference. The Terms of Reference were submitted by CFM in June, 2006, having being approved by the Sofala DPCA (Provincial Office for Environmental Coordination) in June, 2006.

In October, 2006, CFM contracted CONSULTEC – Consultores Associados Lda to conduct the Simplified Environmental Study of the Dredging of the Access Channel of the Port of Beira.

This SES contains, apart from this Non-Technical Summary, a Main Report integrating the following aspects:

- Description of the project and its location
- Legal framework
- Environmental diagnostic, with a brief description of the environmental status
- Identification and assessment of Impacts and Mitigation Measures
- Environmental Management Plan, with monitoring of the predicted impacts, necessary programmes and contingency plans for accidents

During the elaboration of the Environmental Diagnostic, project stakeholders were consulted, namely local fisherman and the Beira Municipality.

Project Description

The city of Beira was founded in 1884 as a military base with a naval port. The existence of this navel port, from the beginning, has accompanied and contributed to the economic development of the city and the central region of the country in general. The city is located on the western bank of the River Pungue Falls, and the port is situated approximately 20km from the open see (Figure 1).

The port activities are intimately dependant on the functioning of the Access Channel and the free transit of the Port's ships. Due to its location in the River Pungue and Buzi estuaries and the highly dynamic coastal zone, and the high consequential quantity of sediments left in the bay, periodic maintenance of the navigation channels through dredging is fundamental.

Figure 1 – Satellite image of the city of Beira and the location of the port. The estuary of the Access Channel to the port can be seen in the darker parts and in the clearer parts the sedimention *in the channel. (Adapted from Google Earth, 2006)*

However, due to drainage and maintenance constraints, the Channel Access to the port presently finds itself with high levels of sedimentation**,** putting at risk the normal functioning of the Port of Beira.

Because of this, CFM intends to conduct an Emergency Dredging, considered indispensable for the future sustainable functioning of the port whose Access Channel would be returned to its original dimensions. This is one presumption that is linked to the economic growth of the city of Beira, of the province, of the country, and of the country's hinterlands, namely, Zimbabwe, Malawi, Zambia and the DRC.

In the short term, the hope is to increase the number of vessels that could reach the port and diminish the waiting time, increasing the economic activity of the port. In the medium to long term, it is hoped the this economic impulse can improve the economic activities in the entire city, linked directly or not to the port, and therefore improving economic activities in the province and the country's central zone, with the increase of commercial traffic in Beira's commercial corridor.

Background

Dredging of large proportions was conducted for 19 months to deepen the Access Channel of the Port of Beira In 1989. This project deepened the existing channel of -0.6m to the depth of -0.8m and removed more than 10,000.00 m^3 of sediment.

Part of the dredged materials in this operation were left in the sea in pre-established deposit locations; other parts of the dredging were used by the port – most of the sediment was deposited in the area in which Terminal 11 and the Nova Beach can presently be found.

To maintain this channel functioning, frequent maintenance dredging would be necessary, of close to 2.5 million m^3 of sediments per year due to the high sedimentation rate in this estuary. However, the natural sedimentary dynamic of the coast, and the absence of appropriate dredges to remove this volume of annual sediment, does not allow for the maintaining of the Channel's dimensions.

At present, due to the substantial sedimentation that has been happening in the last few years, and due to the inability to conduct adequate dredges, the depth of the channel has reduced from -0.8 m to -0.4 m and from a varying width of 200 to 135 metres, to 75 metres in most of the channel. In the zones where the sedimentation appears most critical, Channel naval displacements can be seen, at the Macuti curve the vessels navigate at about 350 metres further south of the original Channel.

In the figure below the Access Channel and its different sections cab be seen; in align with the original 1989 sketch. The grey zones schematically represent the potential zones for dredge material disposal. The most critical areas of sedimentation are found in the Macuti bank – in the sections E12, E11, E10, and E9 of the Channel – and in the E8 section. Within the actual Port, sections E5 and E15 are found to be full of sediment, being sometimes one metre above the level of the sea.

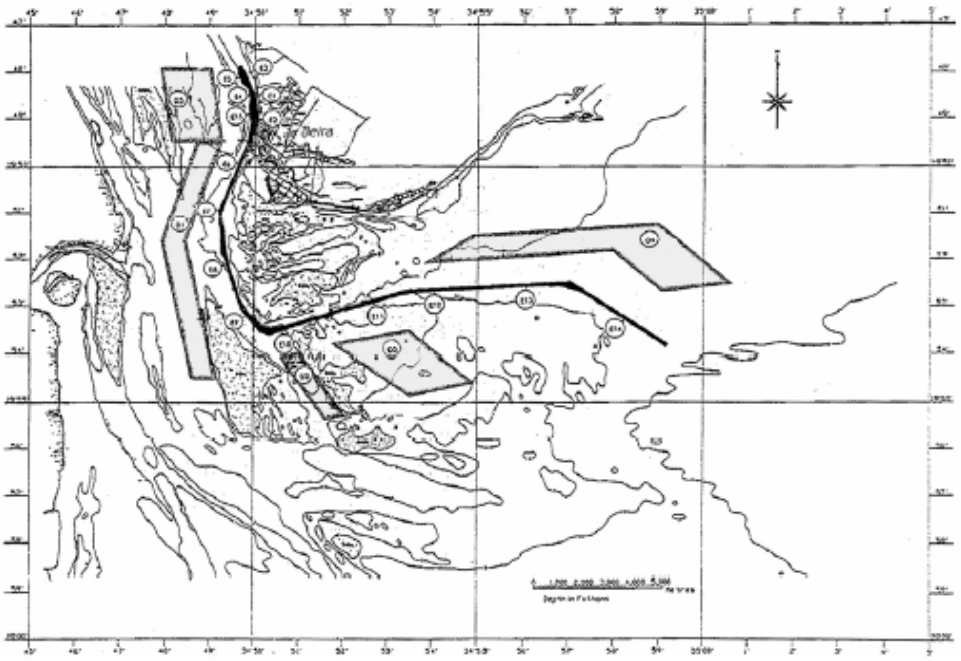

Figure 2 – Sketch with the location of the Channel Access Sections and the deposit zones for dredging material (grey zones D1-D4) (adapted JICA, 1998)

Some studies have already taken place concerning the Beira estuary, amongst them, one completed by the Japanese International Cooperation Agency (JICA) in 1998, was conducted whilst considering maintenance and improvement of the Beira Access Channel.

This study evaluated in detail various environmental factors of the Channel and modelled its sedimentary dynamic, as well as analysing the sediment. This detailed analyses of the sediment did not identigy significant quantities of heavy metals, toxic materials or nutrients and reached the conclusion that it was free of contamination and did not represent danger of environmental contamination to the organisms.

Dredging Technologies

The present technology utilised by EMODRAGA in the maintenance of the Channel is hydraulic, with self-transporting suction drainage that function with a material suction system and they are the most appropriate for removing fine and slightly compacted sediments as found in the Channel.

The suction is done through a large sucking mouthpiece, with two dust suckers at the extremities of the movable arms which can be regulated relative to the depth of the hole. The self-moving dredges have tanks (cisterns) of the changing depth, where the material is dredged and deposited, then being transported to the sea where it is unloaded, eliminating the need for barges. These hydraulic dredges, in sucking the sediment, bring with them a large quantity of water. As the dredging tanks fill, it is necessary to eliminate this excessive water making it overflow out of the vessel – this process is designated as *overflow*.

However, this technology is inappropriate for removing certain more dense sediments found in the channel, especially in the zone of the Macuti Curve. For this reason, the necessity of acquiring other dredging techniques has been predicted to execute the drainage in the Channel.

It is estimated that the time necessary to open the Channel is predicted at being a total dredging time of between 12 and 18 months. The times predicted for the dredging are directly linked to the type of equipment to be utilised by the contracted companies. However, it is predicted that this will be most intense in the critical zones of the Macuti Curve – between 8 and 10 months of permanent activity (24hours/dia) – and in the less sedimented zones, close to 12 to 16 hours, in parallel with the more sedimented zones, during the entire time of the dredging.

Dredging Disposal Sites

Generally, there are three alternatives for the dumping of the dredging material. Them being: disposing them in the open sea, depositing them on-land in a confined location, and the beneficial utilisation of them for land or civil construction.

The maintenance dredging materials have usually been deposited in zones D1, D2, D3, D4 and D5 (see figure 2). The surveys conducted by INAHINA demonstrate that the only appropriate zone for receiving the dredged materials is zone D4 – that is located 12km from Section E9 of the Channel, and approximately 23km from the Port.

The depositing on-land of sediments from the dredging in most cases is conducted by pumping the dredged material directly to the depositing site. For this alternative, it necessary that the on-land deposit zones allow ships to arrive close by or sufficiently close to pump the sediments.

Generally, CFM predict that the potentially useful materials will be deposited on land, except when the dredging is conducted a large distance from land. It is predicted that part of this dredged material will be used for the Port of Beira port expansion. The volume of potentially usable materials, remaining after the port expansion, could be utilised for civil construction by the Beira Municipality.

Environmental Description

The environment of the studied area is classified as dryland vegetation, being characterised by two seasons – dry (April to October) and wet (November to March). In accordance with INAM, the hottest month is January (with a medium temperature of 27.7 º C) and the coldest month is July (20.6 º C), the average annual temperature is 24.6º C.

The city of Beira extends over a coastal plain. The geomorphologic conditions in most areas are associated with processes of erosion and active sedimentation from coastal environments and environments of rivers meeting the sea, with the most notable areas permanently inundated or under seasonal control of the sea.

The most important hydrographical basins in this system are Buzi (drainage area of 29.720km2), Pungue (31,151 km2) and the Zambezi (1,385,500 km2), due to the large sedimentary deposits that feed the adjacent beaches.

The sediments of the Port Access Channel are predominately sandy through its entire length. These fine sediments found are referred to as suppliers of the Pungue River. It is believed that the quality of these sediments is still within the standards examined in 1998.

Sofala Bay (Baía de Sofala) is a system of shallow waters, whose medium depth doesn't exceed 10 metres. Its topography at depth is characterised by an active sedimentary dynamic: a high level of discharge supplied by the rivers Pungue and Buzi associated with powerful energy from the sea that create zones of intense sedimentation or erosion.

The currents in Sofala Bay are controlled by the seas and are strongly affected by winds. In the study area, the currents were extremely strong due to the elevated amplitude of sea variations that occur in the bay. The currents in the centre of the bay, however, are shown to be strongly affected by the topography at depth, and the principal current follows the direction of the Access Channel. These sea currents along the Channel are influenced by seasons. The sea currents are slightly more intense during humid seasons than in the dry season.

In regards to erosion in this zone, various factors interfere in the process of the beaches gaining and losing sediment and amongst these the most notable are the waves and currents, the sea currents and the open sea currents directed towards the

coast. The waves, by acting directly around the beaches, when they break, are considered the most significant erosion factor along the coast. When the waves are very intense, particularly during cyclones or times of bad weather, they further dominate the process of sediment loss, resulting in erosion along the coastline.

The most notable vegetation along the adjacent coast to the River Pungue Estuary are the mangrove trees, and cane that require large amounts of water in their lower parts for their development. Due to the high level of natural turbulence in the water that characterises the estuary, there is no aquatic vegetation.

Regarding the fauna, it is worth noting the clam, for its commercial value. In accordance with the Bata study (2006), the most important species, *Meretrix Meretrix*, can be found along the sand banks of the Pungue falls in front of the Commercial Port.

In the zone in front of the fishing centre of Régulo Luís there are occurrences of various species of prawns as is also the case in other parts of the Pungue estuary and adjacent areas. Nevertheless, a particularity of note for that area is the occurrence of the specific habitat for the prawn *P. monodon,* at the level of the River Pungue estuary and its outskirts. Other places don't exist where this type can be found.

The species *Fenneropenaeus inducus* and *Metapenaeus monoceros* constitute 99% of the number of prawns in the Pungue estuary. Normally these prawns have an adult sea phase and a juvenile coastal or estuary phase and the cycle is complete with one year.

Various economic activities are developed in the Pungue River estuary area. Notably fishing and maritime transport, it can be seen at disembarkation points on the beaches that there are as many transport boats as fishing boats.

The exploitation of fishing resources involves equal amounts of industrial fishing and artesanal. The estuary is the stage to intense artesanal fishing that catches various fish species, cephalops and crustations, including highly commercially valuable "peneídoes" prawns.

Regarding port activity, the Port of Beira, being responsible for the movement of various products, constitutes a vital element in the Beira Corridor which is the spine of the country's central region. Since the city was founded the port has always been linked to its development.

Environmental and Social Impacts

Regarding the sea and coastal physical environment, the potential impacts are related to:

- Impacts on the Bay's batimetry and circulation
- Coastal erosion impacts
- Dispersion of lifted sediment
- Increasing turbidity of the estuary's water

These impacts will be direct and indirect impacts generated in the operation phase – dredging and depositing of dredged materials.

The potential impacts to the Ecology would be derived from:

- Descrease in the rates of photosynthesis, as a result of the increase of turbidity
- Reduction of the ability of the *P.Monodon* prawn to bury itself, as a result of the increase of turbidity
- Increase in productivity, due to the increase in the availability of nutrients
- Contamination of aquatic fauna, namely *M.Meretrix* clams, as a result of the disturbing and raising of toxic materials in the water column
- Asphyxiation of benthic organisms and young *M. Monoceros* prawns, as a result of the disposing of dredged materials

These impacts will be direct and indirect impacts generated in the operation phase – dredging and depositing of dredged materials.

Predicted potential impacts on social-economic activities are in the most part positive, such as:

- Effects on Fishing
- Effects in the rehabilitation of city structures
- Effects on Port activity

The related negative impacts predicted are:

- Impacts on maritime traffic
- Impacts on fishing

In the matrix presented in Table 1, each impact is attributed a classification, being the parameters in considering the following:

Character:	Positive (+)	Time Frame:	Immediate
	Negative (-)		Short term
			Medium and long

			term
Area of Influence:	Immediate	Relevance:	Slightly relevant
	Local		Relevant
			Very relevant
Probability	Certain	Duration:	Permanent
	Very probable		Temporary
	Probable		
	Slightly probable		

Table 1 – Analysis of the impact of the project matrix

Environment	Impact	Operation Phase	Character (+/-)	Probability	Time frame	Area of Influence	Relevance	Duration	Can be Mitigated?
Physical Environment	Change in batimetry and hydrodynamics	**Dredging**	-	Probable	Immediate	Local	Relevant	Permanent	Yes
	Increase in the volume of inflow from the Pungué River passing through the Channel		-	Probable	Immediate	Local	Slightly relevant	Permanent	
	Increase of the disturbance and raising of sediment		-	Certain	Immediate	Immediate	Slightly relevant	Temporary	
	Increase in Coastal Erosion		-	Probable	Immediate	Local	Relevant	Permanent	Yes
	Decrease in the transport of sediment from the open sea to the coast		-	Probable	Immediate	Local	Relevant	Permanent	Yes
	Increase in the volume of sea sediment being deposited in the coastal estuary – open sea		-	Very Probable	Immediate	Local	Slightly Relevant	Permanent	
	Raising of sediment and dispersion of lifted sediment	***Overflow***	-	Certain	Immediate	Immediate	Slightly relevant	Temporary	
	Increase in water turbidity		-	Very Probable	Immediate	Immediate	Slightly relevant	Temporary	
	Increase of nutrients and pollutant in the water column		-	Very Probable	Immediate	Immediate	Slightly relevant	Temporary	
	Increase in water turbidity	**Transport**	-	Probable	Immediate	Immediate	Slightly relevant	Temporary	
	Raising of sediment		-	Probable	Immediate	Immediate	Slightly relevant	Temporary	
	Change in ocean batimetry	**Depositing**	-	Very Probable	Immediate	Immediate	Slightly relevant	Permanent	
	Increase in the raising of sediment		-	Certain	Immediate	Immediate	Slightly relevant	Temporary	

Environment	Impact	Operation Phase	Character (+/-)	Probability	Time frame	Area of Influence	Relevance	Duration	Can be Mitigated?
	Dispersion of lifted sediment		-	Probable	Immediate	Local	Slightly relevant	Temporary	
	Increase in the turbidity of water due to the depositing of a large volume of dredged materials		-	Certain	Immediate	Immediate	Slightly relevant	Temporary	
Biological Environment	Reduction in the rates of photosynthesis, as a result of an increase in turbidity	**Dredging, Overflow e Deposit**	-	Probable	Immediate	Immediate	Relevant	Temporary	
	Reduction in the capacity of the *P. Monodon* prawn to bury itself, as a result of the increase of turbidity		-	Slightly Probable	Immediate	Immediate	Relevant	Temporary	Yes
	Increase in productivity, due to the increase availability of nutrients		+	Probable	Short term	Local	Relevant	Temporary	
	Contamination of aquatic fauna, namely *M. Meretrix* clams, as a result of the raising of toxic materials in the water flow		-	Slightly Probable	Short term	Local	Very relevant	Temporary	
	Suffocating of benthonic organisms and young *M. Monoceros* prawns, as a result of deposing dredged materials	**Deposit**	-	Very Probable	Immediate	Immediate	Relevant	Temporary	Yes
	Difficulty in the movement of the *M. Monooceros* prawn as a result of the creation of barriers created by the depositing of dredged materials		-	Slightly Probable	Short term	Immediate	Relevant	Temporary	Yes
Socio-economic Environment	Restriction of the physical space used for fishing	**Dredging, Overflow and transport**	-	Slightly Probable	Immediate	Immediate	Slightly relevant	Temporary	
	Disturbances in maritime traffic		-	Slightly Probable	Immediate	Local	Slightly relevant	Temporary	Yes
	Increase of nutrients in the water increases the productivity of the system and consequently the amount of catches		+	Probable	Immediate	Immediate	Slightly relevant	Temporary	

Environment	Impact	Operation Phase	Character (+/-)	Probability	Time frame	Area of Influence	Relevance	Duration	Can be Mitigated?
	Impacts on the ecosystem could affect the resources and consequently affect the catches		-	Probable	Immediate	Local	Relevant	Temporary	
	Improvement of structures and establishment of sensitive zones with dredged materials deposited on land	**Deposit**	+	Certain	Immediate	Local	Relevant	Permanent	
	Revitalisation of Port activities		+	Certain	Immediate	Local	Relevant	Permanent	
	Revitalisation of the Municipal economy, and that of the Province, Central Zone, and country	**Post operations**	+	Very Probable	Short & Medium Term	Local	Relevant	Permanent	

Mitigation Measures

In the EIA report a list of mitigation measures is presented to minimize the negative impacts and increase the eventual positive impacts of the dredging. This list was later passed on to the Environmental Management Plan, indicating in which phase they should be implemented and who should be responsible for their implementation.

The highlights of the recommended measures are listed below:

- Drainage materials consisting predominately of sand (and potentially usable) should always be disposed, whenever possible, on land. The unused material in the port expansion should be used for civil works construction.
- The sediments to be deposited in the sea should preferably be disposed near Zone D4. They should not be used in depositing zones D1 and D5, as they are located close to clam catchment areas. During the wet season dredging in zones D1 and D2 should be avoided and the first miles of zone D4 (from Regulo Luis), to avoid affecting the prawns.
- Analysis should be done on the quality of existing sediments in the zone around the port before beginning the dredging. Water quality analysis should be done before, during, and after the dredging to evaluate possible clam contamination.

Conclusion

The emergency dredging of the Port of Beira Access Channel would have a very significant positive impact on the port activities and for the City of Beira population, once it allows for a better (and faster) access to maritime traffic which will progressively stimulate port activities, contributing to an increase of economic development for the city in the medium to long term, for the entire province, and the country's central region.

In direct terms, the possible utilization of the dredged materials in the City of Beira for civil construction, wetland zones, or refilling of sands on beaches, bring additional benefits to the development of the city. The highlight would be the use of drainage materials in wetland zones as it would, on one side, contribute to the improvement of health conditions, reducing the rates of illness related to water, but also make new space available for the expansion of the city.

Throughout this study some potential negative impacts were identified, namely those related to coastal erosion, aquatic fauna, and with affects on artesanal fishing. However, these effects weren't considered significant.

Regarding coastal erosion, in accordance with JICA's conclusions (1998), based on hydrodynamic models developed at that time, the depth of the Access Channel wouldn't bring significant differences to the levels of erosion currently being experienced.

In ecological terms, the fact that the Sofala Bay already has high levels of turbidity and is continually subject to maintenance dredging reduces the potential ecological impacts. On the other hand, the available information regarding the quality of sediments in Beira indicates that they are not contaminated, reducing the risk of affecting marine organisms. Either way, dredging always carries a certain sensibility, in terms of the collection of clams a precautionary attitude is recommended in the port area.

This simplified Environmental Study includes measures that will minimise these impacts, including recommendations relative to the depositing areas of the drained materials and additional measures to diminish the coast's susceptibility to erosion, recommending also, the analysis be conducted to determine the quality of sediment, as well as the monitoring of the quality of water in the immediate area of the port.

For these measures to be effective, it is very important that CFM work thoroughly with other institutions, namely the Beira Municipality and the Sofala Provincial Office for Environmental Coordination, principally to determine the potential uses of dredged materials deposited on land and possible disposing locations.

It is concluded that the Emergency Dredging of the Port of Beira Access Channel would have a very significant positive impact in terms of socio economics and that the impacts on the biophysical environment could be mitigated through the implementation of mitigation measures contained in the Environmental Management Plan.