Feasibility Studies for the Development of Ferry Services in the Lagos Metropolitan Area, Nigeria

Consultancy Services

Lagos Metropolitan Area Transport Authority (LAMATA)

31 January 2008

Final Report Rev 0

9R8908.21

ROYAL HASKONING

A COMPANY OF

ROYAL HASKONING

HASKONING NEDERLAND B.V.
MARITIME

Hoofdweg 490
P.O. Box 8520
Rotterdam 3009 AM
The Netherlands
+31 (0)10 286 54 32 Telephone
+31.10.2201.005 Fax
info@rotterdam.royalhaskoning.com E-mail
www.royalhaskoning.com Internet
Arnhem 09122561 CoC

Document title	Feasibility Studies for the Development of Ferry Services in the Lagos Metropolitan Area, Nigeria Consultancy Services
Document short title	LAMATA Final Report
Status	Final Report Rev 0
Date	31 January 2008
Project name	Development Ferry Services Lagos
Project number	9R8908.21
Client	Lagos Metropolitan Area Transport Authority (LAMATA)
Reference	9R8908.21/R004/TEL/Rott

Drafted by	Kees Beets, Cornelis van Dorsser, Anton Driesse, Theun Elzinga, Hans Pos, Hans van der Spek, Nynke Venema, Matilde van der Zel	
Checked by		
Date/initials check	Dirk Heijboer	…….
Approved by		
Date/initials approval	René Zijlstra	…….

CONTENTS

EXECUTIVE SUMMARY

Introduction

1. The Lagos State Government has designed the Lagos Urban Transport Project (LUTP) as their primary instrument for addressing the issues of chronic traffic congestion that plague metropolitan Lagos. The Lagos Metropolitan Area Transport Authority (LAMATA) is the executing agent for the LUTP. One of the components of the LUTP is the promotion of water transportation as this would contribute to improving modal diversity within an integrated urban transport system as well as assist in reducing traffic congestion.

Feasibility Study for Ferry Operations

2. For this purpose LAMATA has concluded a consultancy contract with Royal Haskoning from the Netherlands who works in close association with Haskoning Engineering Consultants (Nigeria) Ltd and Challenge International Associates (Nigeria) Ltd to conduct feasibility studies for the development of ferry services in Lagos with an emphasis of private sector participation.

Socio Economics Surveys

3. Socio economic surveys have been carried out in spring 2007 to make an inventory of the present ferry services, to identify Origin – Destination (O – D) and travel demand for future services, to identify the geographic spread of potential ferry traffic, and finally to identify ferry users' requirements.

4. These surveys included (1) commuter surveys, (2) passenger surveys, (3) operator surveys, (4) and traffic and ferry counts. These surveys have been supplemented by Focussed Discussion Groups in the metropolitan area. In total some 2,900 interviews have been held for this purpose. The surveys have been held nearby waterfront facilities (landings) and at highly congested road areas (refer Figure A).

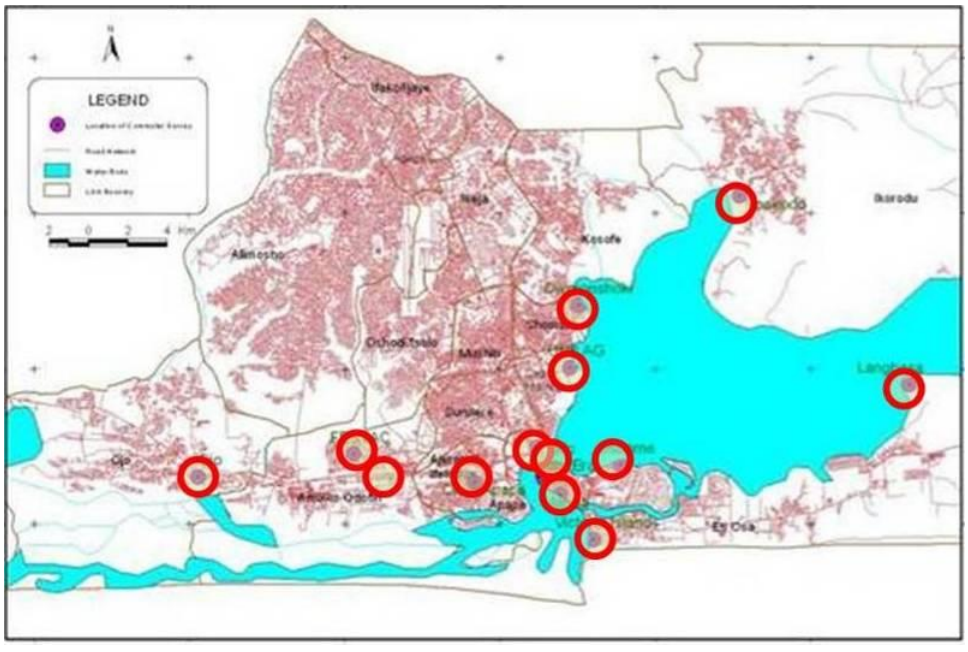


Figure A – Locations for the Commuter Surveys

5. The survey results clearly showed that by far the most important destination for potential passenger traffic would the Central Business District (CBD) comprising Lagos Island, Ikoyi, and Victoria Island. Main areas of origin for these passengers are central Lagos, Ikorodu and Victoria Island / Lekki area. Daily commuters particularly comprise business people, labour and traders. The surveys further showed that ferry services would specifically be required during working days (Mondays to Fridays) between 6 am and 8 pm.

Selected Ferry Lines

6. Priority ferry lines have been selected in close consultation with LAMATA and other Lagos State Government authorities – refer Figure B. These lines particularly contribute in relieving most heavy traffic congested areas, are easy to implement, and have low competition with other public transport modes such as the Bus Rapid Transit (BRT). Other selected ferry lines are shown in Figure C.

Figure B – Priority Ferry Lines and Terminals

Figure C – Other Ferry Lines and Terminals

Ferry Passenger Forecasts

7. Forecasts for ferry passengers travelling to/from the CBD have been derived from above surveys and earlier traffic counts for the Lagos metropolis. The expected daily number of passengers for the ferry lines is shown in Figure D. It is thereby to be noted that there is a pronounced peak in the morning (between 7am and 10am to CBD) and the afternoon (between 4pm and 7pm from CBD)

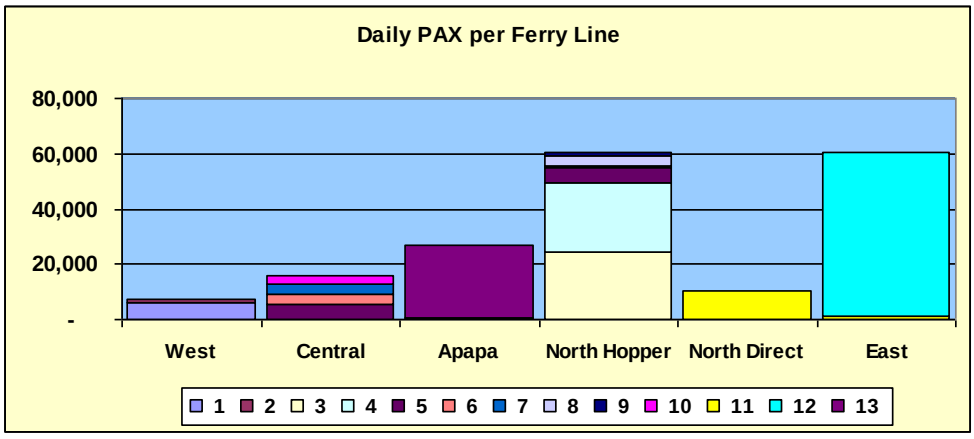


Figure D – Daily Numbers of Passengers for Main Ferry Lines

Ferry Terminals

8. Suitable ferry terminals have been identified through a Measure of Effectiveness matrix and these have been inspected by the Consultants to assess the required rehabilitation or new construction works. Requirements for Park-and-Ride and ticketing / waiting facilities have been inventoried. Alternative options for the conceptual designs for the ferry terminals have been prepared. An artist impression of a terminal with a floating pontoon has been shown in Figure E at the end of the Executive Summary.

Bill of Quantities (BoQ)

Detailed BoQ have been prepared for all ferry lines and terminals followed by estimating the required investment costs. A summary is included in Table A.

[million Naira]	Priority Lines	Other Lines
Terminals	483	417
Ferry Routes	2,109	3,424
Totals	2,593	3,841

Table A – Investment Costs for LAMATA Ferry Lines [million Naira]

Hydro-graphic Surveys

9. Further, reconnaissance hydro-graphic surveys along the potential main ferry routes (refer Figure F) have been taken in March 2007. The results have been used to refine ferry routes and terminal locations as well as to initially assess the required volumes for dredging.

Figure F – Routes Surveyed

10. The surveys indicated that the route from Marina to Lasu (Ojo) in the west is wide and deep. The canal between Festac and Oke Afa in central Lagos however is very shallow and often hindered by water hyacinth (refer Figure G). On the route from Marina to Oworonsoki along the western side of the Lagoon the previous island used for the construction of the Ibrahim Babangida Bridge (IBB) would offer excellent opportunities as ferry terminal (refer Figure H). Further, limited dredging would be needed for the ferry lines leading to Ikorodu and Badore / Ijede.

Figure G – Canal leading to Oke Afa

Figure H – IBB Island: Future Ferry Station

Dredging of Ferry Routes

11. An assessment for the dredging volumes along the main ferry lines is presented in Figure I. Dredged sandy material can be used for landfill at the ferry terminals. However, if the dredged material would be polluted, due care is required in selecting appropriate dumping sites. For the latter consultation with and approval from Lagos authorities is required such as LASEPA.

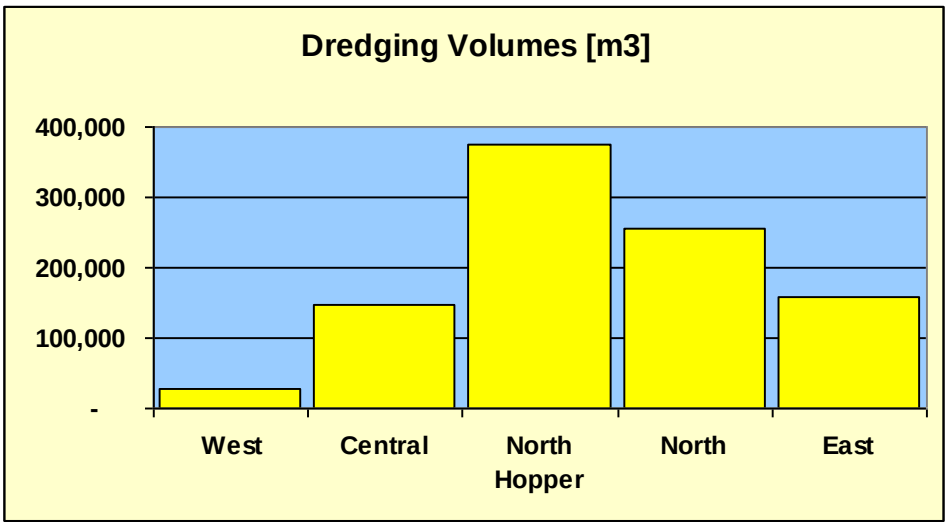


Figure I – Dredging Volumes along the Main Ferry Lines

Ferry Types

12. Various types and sizes of ferries (refer Figure J) have been considered for operating on Lagos waters. Criteria applied in the selection of preferred ferries included prevailing marine conditions (wind, waves, currents), water depths, presence of bridges, presence of water hyacinth and plastic bags, required carrying capacity, and sailing frequencies. Safety of passengers is a key issue and therefore all passengers will be seated inside the ferry and all ferries will carry adequate number of life jackets.

Figure J – Examples of Ferry Types

Operational and Financial Analyses

13. The required number of ferries has been determined for each ferry line taking into account: ferry type, PAX capacity, sailing speed, and passenger forecasted demand in the peak as well as in the off-peak. Subsequently, the sailing schedules have been determined.

14. Thereafter, financial analyses have been made to assess the financial performance for each line and to select the preferred ferry type yielding the best results. Applied ferry tariffs are governed by the price of competing public transport plus an allowance for value of time since ferry transport results in shorter travel times. Ferry revenues follow from the applied tariffs and number of PAX transported. Further, an allowance for additional revenues from other ferry services has been applied. Costs items for the ferry operations comprise investments (depreciation), fuel, staffing, maintenance, insurance, and concession fees.

15. Financial Internal Rate of Return (fIRR) calculations have been based on a 5-year concession period. The analyses showed that a 120 PAX high speed ferry (refer Figure J – left) yields the best financial results with a fIRR ranging between 15% and 17% for the East, North Direct and Five Cowry Creek Line. To achieve a minimum fIRR of 11% a tariff increase of 20% to 30% is required on the other ferry lines. It is hereby to be clearly noted that these results are strongly governed by the residual values of the ferries after 5 years.

Initial Environmental Examination (IEE)

16. An IEE has been made for this project meeting State and Federal as well as international funding (e.g. World Bank IFC) requirements. Three scenarios have been evaluated, i.e. (1) future condition without ferries, (2) future condition with ferry operations, but without environmental and social mitigation measures, and (3) future condition with ferries but now with environmental and social mitigation measures in place.

17. Environmental and social impacts can be: direct / indirect, minor / major, significant, reversible / irreversible, have a short / long duration, may impact a small or large area, and have a low / high probability of occurrence. One of key issues identified is the tremendous pollution along the routes and on the Lagos Lagoon (refer Figure K).

Figure K – Example of Pollution

18. Close co-operation with the Lagos State Waste Management Board and LASEPA is required during the implementation of the LAMATA Ferry Project. In the IEE required mitigation measures have been defined and an initial HSES plan has been prepared.

Institutional Arrangements

19. The functions and responsibilities of the various agencies and institutions having an impact on the ferry operations have been assessed. Agencies reviewed included LAMATA, LAMDA, NIWA, LSFSC, NIMASA, LASTMA, LSWTDC, and LASEPA. It has been concluded that (1) LAMATA should be empowered with a stringer legal authority for ferry operations, and (2) that the roles and responsibilities of the agencies should be clearly demarked and established in new laws.

Public – Private – Partnership (PPP)

20. A PPP assessment has been made for the ferry operations in Lagos and it has been concluded that the ferry operations can best be carried out by the private sector to ensure efficient and effective ferry services. LAMATA would thereby be responsible for dredging the navigation channels and construction of terminals (buildings, jetties).

21. Key issues for concession contracts for the ferry operations have been identified (including the definition of Key performance Indicators) followed by considerations on commercial structuring and preferred tendering procedures. Finally, an organigram for LAMATA has been drafted to meet the PPP in this sector.

Figure E – Example for a Ferry Terminal Layout (overleaf)

0 INTRODUCTION

0.1 Background

Lagos is the most populated city in Africa with a population of about 15 million. The city is the economic nerve centre of Nigeria and plays host to headquarters of financial institutions, multinational corporations, government para-statals, international institutions, embassies, etc. Further, Lagos metropolitan area contains a large manufacturing and service sector. The Central Business District (CBD) is located on Lagos Island with three bridges connecting it to the mainland and other bridges connecting to southern islands.

Transportation within Lagos metropolis is essentially road based, but is however a major problem. High population coupled with the lack of adequate infrastructure has resulted in heavy traffic congestion within the city. Travelling within Lagos is reported taking double and sometime triple the normal time. This is not only an economic loss in terms of productive man-hour spent in traffic hold up, it also makes the cost of doing business in Lagos highly prohibitive.

To address this worsening problem, there is an urgent need to diversify Lagos transportation base. Lagos is blessed with abundant water resources that could be harnessed to offer fast, safe, comfortable and cheaper water transportation service. Water transportation in the Metropolitan Lagos could be a very sustainable business.

The Lagos State Government (LSG) has therefore embarked on an ambitious program of policy reforms and investments to promote and facilitate the provision of water transport aimed at realising its potential to becoming an attractive mode of transport within an integrated urban transport system in Lagos.

The LSG has designed the Lagos Urban Transport Project (LUTP) as the primary instrument to address the issues of chronic traffic congestion that plague the metropolitan Lagos. The components of the LUTP include

- Capacity building of the institution hosting the LUTP, strengthening the capacity of existing transport agencies, in particular the Lagos State Ministry of Transportation, and other relevant agencies.

- Road network efficiency improvement, which includes maintenance and rehabilitation measures in Lagos Metropolitan area.

- Bus services enhancement: Lagos Metropolitan Area Transport Authority (LAMATA) is expected to establish an effective regulatory framework for bus services provision by the private sector and other modes of public transport (rail mass transit and water transport).

- Water transport promotion: this component contributes to improving modal diversity within an integrated urban transport system by promoting the enhanced provision and use of water transport, i.e. increased utilization of the waterways, which is the focus of this study.

0.2 The LAMATA Ferry Project

In their letter dated 05 January 2006, LAMATA invited Royal Haskoning to submit a proposal for providing consultancy services for the feasibility studies for the development of ferry services in the context of the Lagos Urban Transport Project.

Following an extensive evaluation process, Royal Haskoning (i.e. Haskoning Nederland BV) was selected as the winner of the bidding contest. On 18 October 2006 Royal Haskoning was invited by LAMATA for a meeting to clarify the proposal and negotiate the contract arrangement. Ultimately a contract was prepared and signed on 28 December 2006.

In order to execute the project properly Royal Haskoning has teamed up with Haskoning Engineering Consultants (Nigeria) Ltd and Challenge International Associates (Nigeria) Ltd (CIAL). The overall project organisation for this project is reflected in Figure 0.1.

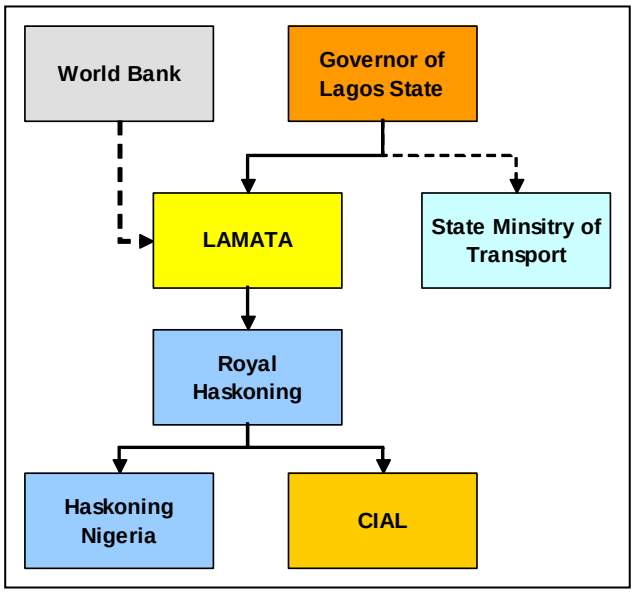


Figure 0.1 – LAMATA Ferry Project Organisation

The key project events are the following:

- 08 February 2007 – Kick-off meeting at LAMATA Head Office in Lagos.
- 19 April 2007 – Submission of Final Inception Report
- 24 April 2007 – 1st Stakeholders' Meeting at the Ikeja Airport Hotel
- 11 May 2007 – Submission First Stakeholders' Meeting Proceedings
- 14 July 2007 – Submission of Interim Report
- 08 August 2007 – Project presentation to the Governor of Lagos
- 23 August 2007 – Submission of Bill of Quantities and Investment Costs report
- 30 October 2007 – Submission of updated BOQ and CAPEX report
- 01 November 2007 – Submission of Paper "Towards Effective Ferry Operations in Lagos"
- 14 November 2008 – Submission of Financial Analyses Report

This Report comprises the overall results of the LAMATA Ferry Project.

0.3 Objectives LAMATA Ferry Project

The objectives for this project as included in the Terms of Reference read as follows:

[Quote]

The objective of the study is to ascertain the viability of potential commuter routes in the Lagos Metropolitan Area by identifying the existing and potential waterways for the provision of transport services, assess their existing and potential utilization, and develop institutional framework and procurement strategy necessary to procure and operate routes deemed viable, determine the technical, economic and financial feasibility of investments to be implemented.

For ease of co-ordination and monitoring, the study has been divided into three phases and the objective of each phase is outlined below.

Phase I
This phase deals with the general assessment of water transportation in Lagos including policy, institutions and regulations.

(a) Review of all available studies and information on water transportation in Lagos

(b) Review the organizations and legislations / policy that impact on the water transport sector and recommend measures for simplification, streamlining and co-ordination

Phase II
This phase cover feasibility studies for the proposed water transportation in Lagos Metropolitan Area and the study includes:

(a) A comprehensive analysis of the current water transportation (formal and informal) services in Lagos, determination of the adequacy of capacity and services including problems and prospects

(b) An estimation of the level and composition of current and future capacity requirement

(c) Market potential analysis to determine current and future capacity requirements

(d) Identification and analysis of potential ferry service routes and park and ride scheme

(e) Detailed feasibility study of viable routes and park and ride scheme including technical, financial, and economic studies

(f) Conduct infrastructural analysis to determine the state of existing infrastructure and further infrastructural requirements to support water transport

(g) Carry out conceptual designs of facilities and equipments arising from (f) above including associated cost estimate

(h) Determine operational needs in terms of engineering requirements, dredging requirements, navigational requirements and aids, terminal facilities etc. and prepare preliminary cost estimate

(i) Propose vessel specifications, fleet size and develop operational performance requirements to meet the potential demand and conditions of each route

(j) Estimate vessel acquisition cost and financing options

(k) Perform financial analysis to examine cost and revenue structure of the proposed ferry service along potentially viable routes

Phase III

Phase III of the study examines private sector participation (PSP) strategy, rationalization of the Lagos State Ferry Service (LSFS) and the socio and environmental impacts of the proposed water transportation services.

(a) Development of the overall strategy to attract private sector participation (PSP) in the operation of the potentially viable routes and the park and ride scheme

(b) Detailed study of the socio and environmental impacts of the proposed water transportation services and mitigation plans

(c) Assessment of Lagos State Ferry Service (LSFS) for rationalization

[Unquote]

0.4 Scope LAMATA Ferry Project Report

This report describes the results of all the above project phases and addresses the following project tasks:

- Collate and review and set-up of a Stakeholders' Forum (Task 1)
- Market potential analysis (Task 2)
- Preliminary development of ferry services (Task 3)
- Infrastructure analysis (Task 4)
- Conceptual designs and costs estimates (Task 5)
- Operations analysis (Task 6)
- Ferry servicing modelling Task 7)
- Financial analyses (Task 8)
- Social and environmental issues (Task 9)
- Institutional arrangements (Task 10)
- Private sector participation (Task 11)
- Lagos State Ferry services (Task 12)

1 COLLATE AND REVIEW AND SET-UP OF STAKEHOLDERS' FORUM (TASK 1)

1.1 Data Collection and Review

The LAMATA Ferry Project commenced with an extensive collection and review of data for this project.

In addition, the Consultants had several interviews with organisations and institutions involved with public and ferry transport in Lagos Metropolitan area. Further, visits to existing and potential sites for ferry operations have been made as well as rides on existing ferry routes. Key results of this data collection and review process have been reported in the Inception Report of 19 April 2007.

1.2 Project Meetings

During this LAMATA Ferry Project several meetings and additional site visits have been made by the Consultants to fully understand the local conditions and development opportunities for a successful implementation of ferry services in Lagos.

1.3 Stakeholders' Forum

Also a Stakeholders' Forum has been established for this Consultancy Project with the aim to fully understand present ferry operations and restrictions, present findings of this project and discuss how vibrant inland waterway ferry services can be implemented in Lagos with an emphasis on private sector participation.

The following key events have been taken place in relation to consulting Stakeholders:

- 24 April 2007 – 1st Stakeholders' Meeting. The proceedings of this meeting have been included in Appendix 1C to this report
- 08 August 2007 – Presentation of interim results to the Governor of Lagos and his Advisory Team. At this meeting the priority ferry routes have been selected.

2 MARKET POTENTIAL ANALYSES (TASK 2)

2.1 Introduction

For the market potential analysis an extensive socio – economic survey programme[1] has been carried out to prepare an:

- Inventory of present ferry services
- Identify Origin – Destination and travel demand
- Identify the geographic spread of potential ferry traffic
- Identify potential ferry users' requirements

The surveys included the following components:

- Commuter survey
- Passenger survey
- Operator survey
- Passenger and boat ferry count
- Focal Discussion Groups

A detailed report of these surveys and subsequent analyses has been included in Appendix 2A to this report. The main findings are summarised below.

[1] This section of the report describes the results of the socio – economic surveys, whilst the growth forecasts and potential demand for ferry services ahs been described in Section 3 below.

2.2 Commuter Survey

The socio – economic commuter survey has been conducted in communities located close to water transport facilities and parallel to primary road arteries in the metropolis. The locations of the areas where the 2,369 of commuter interviews have been held are indicated in Figure 2.1.

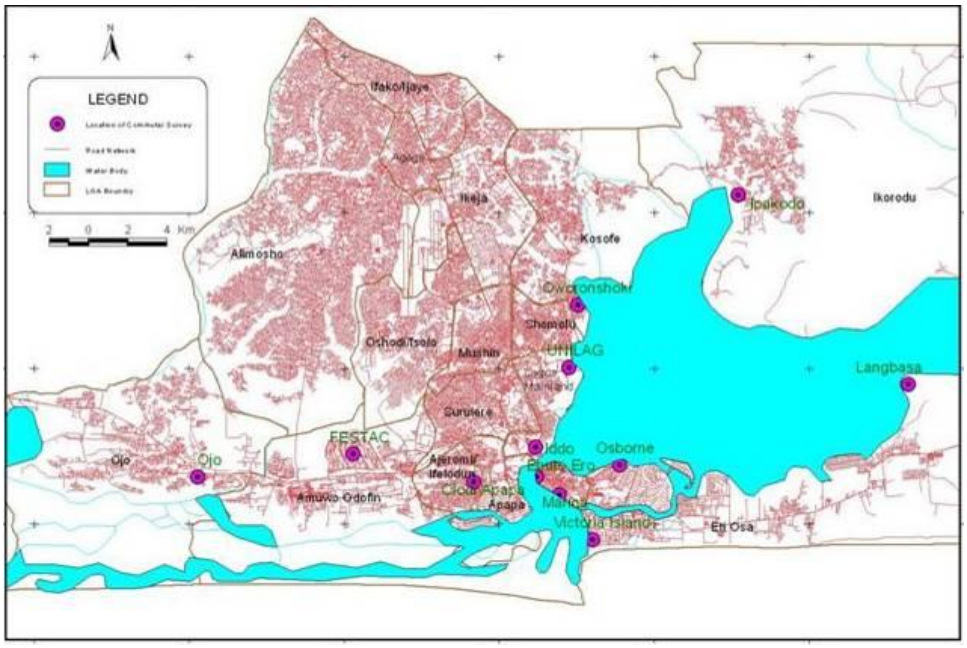


Figure 2.1 – Locations for the Commuter Surveys

For the commuter surveys the following has specifically been evaluated to meet the requirements of the Terms of Reference for this project:

- The potentials of water transport regarding its social utility as anchored on two principles: (1) to stimulate the demand behaviour of potential users with an aim to estimate it, and (2) to define the impact of the demand captured by water transport on individuals who use other modes
- The capture potential of travel demands, respondents' personal data such as, gender, age and socio-economic characteristics.
- Travelling information by potential users, willingness to use water transport and willingness to pay appropriate user charges.
- Identification of potential water route / network and give an insight into the cost of travelling on water and the perception of the potential users.

Some of the main findings of the commuter survey regarding the socio – economic aspects of potential users[2] are the following:

- Gender: Some 2/3 of the potential ferry users is male
- Age: About 2/3 of the potential users are in the age class between 21 and 40
- Education: Some 50% of the potential users have tertiary or professional education whilst some 33% have secondary education. High education levels were observed specifically at Festac, Mile 2, Marina, Victoria Island, and Ojo. For such people good service levels should be provided on board
- Occupation / Profession: The potential users typically include (1) business man as well as (2) traders. Further, (3) labour people are potential users for ferry services
- Income: High income levels have been observed in Festac, Marina, Osborne and Victoria Island, whilst medium income levels have been seen at Mile 2 and University of Lagos.
- Present mode of transport: By far the potential users at present take the bus.

In terms of ferry operations the potential users expressed the following requirements:

- Ferry operations should be provided between 0600 and 2000 hrs
- Ferry services should be provided specifically on weekdays
- There is a higher demands for ferry services during the morning and afternoon peaks

With respect to the origins and destinations the following two main observations can be made:

- The Central Business District – CBD (comprising Lagos Island, Ikoyi, and Victoria Island) attract people from all over the different areas in Lagos. Hence, this CBD area is by far the most important destination for the ferry services. This is confirmed to a large extend by the heavy traffic jams occurring every (week) day to/fro this area.

- At all other points of the survey, people had either nearby origins / destinations (hence less need for ferry services), or an O/D further away.

[2] A potential user is someone who, although may not have used water transport so far, has however indicated his willingness to use if it is available

2.3 Passenger Surveys

A passenger survey has been conducted to clarify the nature, characteristics and diversity of local transport demands in terms of volume, frequency and socio- economic characteristics of present ferry users by capturing travel time, journey purpose, destination, gender, age, safety, waiting time, cost, personal income, etc. Additionally, the information gathered has been used to determine the necessity for infrastructure development, rehabilitation and transport service provision.

The location of the passenger surveys (251 interviews) has been indicated in Figure 2.2.

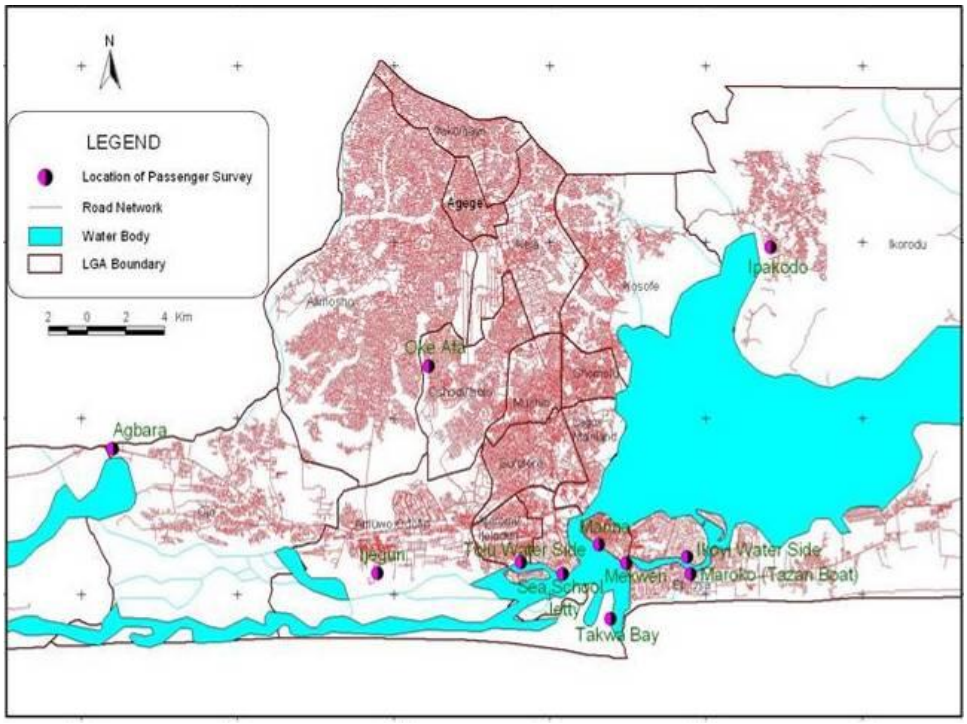


Figure 2.2 – Location of the Passenger Surveys

Some of the key findings (refer to Appendix 2A for further details) for the present water transport users are listed below.

- Over 85% of the passengers interviewed are male
- 80% of the users are in the age class 21 to 40 yrs
- Same as for the commuters, the present passengers are business people, traders, and labourers
- 85% of the respondents have no own transportation means
- The travel frequency of all people interviewed is over 50% daily
- Passengers indicated to be prepared to pay slightly more than public transport
- The reason for the selection of ferry transport is the (fast) speed of the services and shortcutting on travel time versus public transport.

2.4 Operator Survey

To have a first hand knowledge of the level of ferry service currently provided on the waters in Lagos the operator survey included the following:

- Socio-economic characteristics of operators
- Boat types, passenger capacity, engine capacity and make
- Working hours
- Maintenance
- Fares, cost of purchase, daily income and ownership and route plied

The locations of the operator surveys (120 interviews) are indicated in Figure 2.3.

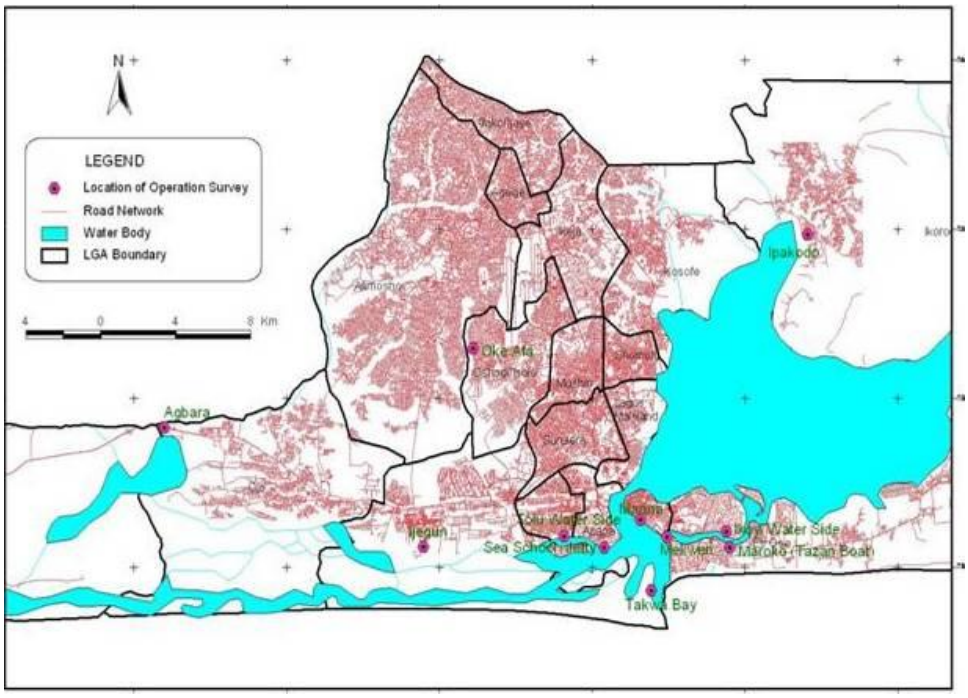


Figure 2.3 – Locations of the Operator Surveys

The key findings for the operator surveys are the following:

- Most of the operators are unmarried and between 21 and 35 years
- Operators operate between 0600 and 2000 hr (daylight only)
- They particularly make small and frequent hauls between the (small) islands
- Carrying capacity of the boats is between 5 and 20 passengers
- Daily income is between 3,000 and 7,000 Naira
- Most of the operators spent less then 3,000 Naira per day on fuel

2.5 Passenger and Boat Ferry Count

A passenger and boat traffic count has been conducted at nine jetties within and outside metropolitan Lagos to assess the current usage. These counts have been made at the following jetties:

- Marina jetty
- Oyingbo jetty
- Maroko – Tarzan jetty
- Ikoyi waterside jetty
- Apapa – Sea school jetty
- Victoria Island – Mekwen
- Ijegun jetty
- Agbara jetty
- Oke Afa jetty (small canoes)

The number of boats and passengers counted when arriving ("in") or departing ("out") as well as the average number of passenger per boat are indicated in Table 2.1.

Station	Boats		PAX		PAX / Boat	
	In	Out	In	Out	In	Out
Marina	103	91	2,179	2,072	21.2	22.8
Oyingbo	37	17	67	34	1.8	2.0
Maroko	63	60	451	412	7.2	6.9
Ikoyi	60	63	404	454	6.7	7.2
Apapa	16	7	191	87	11.9	12.4
Mekwen	154	139	540	470	3.5	3.4
Ijegun	149	164	1,035	907	6.9	5.5
Agbara	56	63	302	371	5.4	5.9
Oke Afa	109	108	716	780	6.6	7.2

Table 2.1 – Number of Boats and Passengers Counted

Some further details of the counts related to the busiest station at the Marina jetty have been shown in Table 2.2 and in Figure 2.4 to Figure 2.6 below. From these table and figures is can be seen that for the present small boat operations at Marina there is a rather equal spread over the day for boats as well as passengers. Further, the average number of passengers arriving is between 20 and 30, whilst the average number of passengers departing is between 30 and 40 with a peak up to 60 in the afternoon.

Period	# of Ferries		# of PAX		PAX / Ferry	
[hrs]	Departing	Arriving	Arriving	Departing	Arriving	Departing
6-7	-4	6	20	-11	3.3	- 2.8
7-8	-4	7	29	-12	4.1	- 3.0
8-9	-11	8	99	-117	12.4	- 10.6
9-10	-9	8	220	-122	27.5	- 13.6
10-11	-16	14	276	-132	19.7	- 8.3
11-12	-5	10	276	-159	27.6	- 31.8
12-13	-6	10	238	-268	23.8	- 44.7
13-14	-8	9	214	-306	23.8	- 38.3
14-15	-6	7	225	-179	32.1	- 29.8
15-16	-5	11	216	-314	19.6	- 62.8
16-17	-8	8	220	-134	27.5	- 16.8
17-18	-9	5	146	-318	29.2	- 35.3

Table 2.2 – Boat and PAX Count at Marina

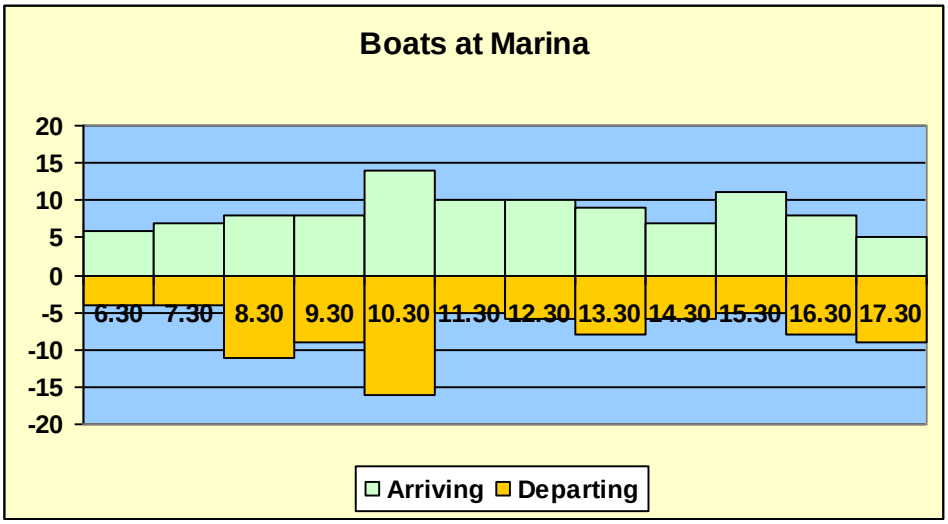


Figure 2.4 – Boat Count at Marina Jetty

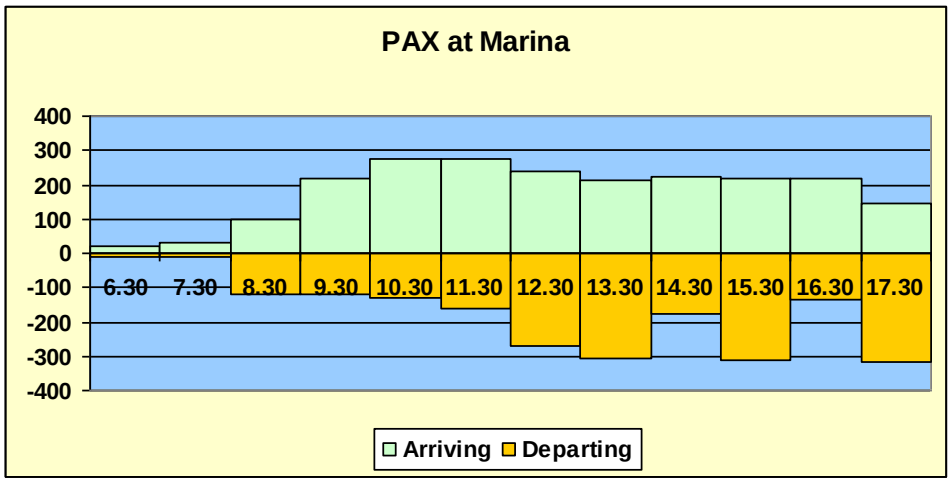


Figure 2.5 – Passenger Count at Marina Jetty

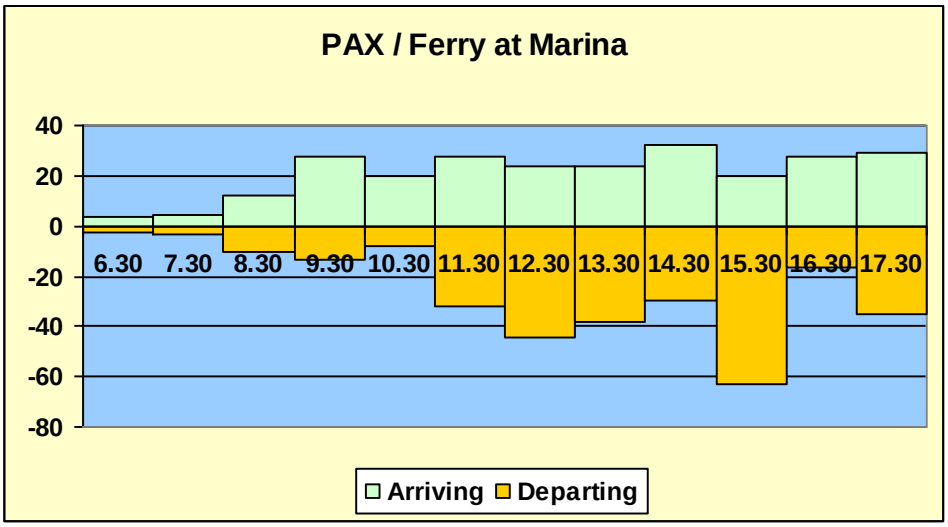


Figure 2.6 – Average Number of Passenger per Boat at Marina Jetty

2.6 Present Ferry Boat Lines

An analysis has been made as to the present boat lines as part of the boat counting survey. The results thereof are shown in Table 2.3. The total number of connections is 47 with 5 irregularly chartered lined (marked by *).

	Ijegun	Maroko	Ikorodu	Mekwen	Oyingbo	Ojo	Sea School	Takwa Bay	Marina	Ijora	Tolu Waterside	Agbara	Oke Afa	**Totals**
Ijegun				1		1	1	1	1					**5**
Maroko			1	1	*1		1	1	1					**6**
Ikorodu		1							1					**2**
Mekwen	1	1	*1		*1		*1	1	1					**7**
Oyingbo						1		1	1					**3**
Ojo	1			1			1	1	1					**5**
Sea School		1		1		1		1			*1			**5**
Takwa Bay	1	1		1	1	1	1		1					**7**
Marina	1	1	1	1	1	1		1						**7**
Ijora														
Tolu Waterside							1							**1**
Agbara														
Oke Afa														
Totals	**4**	**5**	**3**	**6**	**4**	**5**	**6**	**7**	**7**		**1**			**48**

Table 2.3 – Summary of Present Boat Lines operating in Lagos

2.7 Focal Group Discussion

Focal Group Discussions have been held in 8 locations and were meant to complement the information acquired from the surveys and questionnaires. The discussants included boat operators, community leaders, Local Government workers and the some representative of the commuting public.

A summary of the key findings of the FDG is listed below.

- There should be fixed and regular ferry routes
- Ferry services and operations should be well announced and make known to the public
- Security and safety should be strongly underlined in the adverts
- Ferry terminals should be well accessible by road and should be lit in hours of darkness
- Ferry boats and fuel are experienced as very expensive and government credit facilities should be considered

2.8 Summary of Surveys

Based on the surveys conducted for this project the main findings with respect to ferry transport can be summarised as follows:

- Ferry services at present are rather limited using small to medium sized boats and motorized canoes
- People interviewed expressed a strong interest in ferry transport as an alternative to (public) transport by road indicating a high potential for ferry services
- 85% of the respondents have no own transportation means
- Once reliable and safe ferries services are implemented, a strong growth can be expected thereby relieving congested roads
- Ferry services – once provided – should be reliable and be provided on fixed schedules and routes.
- The most important destination for passengers is the Central Business District in Lagos comprising Lagos Island, Ikoyi, and Victoria Island.
- Passengers for ferry services will typically be (1) business people, (2) traders, and (3) labour.
- Ferry services are specifically required during weekdays from 0600 till 2000 hrs with frequent services in the morning and afternoon peaks
- Over 40% of the people interviewed expressed a keen interest in water transport thereby demonstrating the high market potential for ferry services

3 PRELIM DEVELOPMENT OF FERRY SERVICES ALTERNATIVES AND PASSENGER FORECASTS (TASK 3)

This section comprises a preliminary development of ferry services alternatives with an initial selection of main ferry lines followed by a forecast for passengers on the identified and promising ferry routes.

3.1 Alternative Ferry Routes and Terminals

A preliminary development of ferry services alternatives with ferry lines and terminals has been prepared based on the following key input information:

- Results of the market surveys (refer Section 2 above)
- Results of various site inspections made to existing and potential terminals (refer Section 4 and Section 5 below)
- Results of the hydro-graphic surveys (refer Section 6 below)
- Project information as included in the Inception Report of 19 April 2007
- Results of the 1st Stakeholders' Meeting (refer Proceedings of 11 May 2007)

It is a well known fact that the traffic congestion in the Lagos metropolitan area is particularly concentrated on the roads leading to and coming from the CBD. Long and intense traffic queues can be observed daily on these arteries, specifically during the peak hours. The market surveys made during this project clearly indicated the potential for water transport to/fro this CBD as this would provide commuters with a fast and efficient mode of transport.

The alternative ferry lines have been drafted taking the following main considerations into account:

- All main lines are concentrated on transporting passengers to/fro the CBD.
- Preferred location for the central hub (certainly in the initial project phases) is the Lagos State owned terminal Marina[3].
- Main lines should have a minimum number of stops to ensure speedy ferry operations with short sailing times.
- Ferry operations in Lagos Metropolitan should be based on the following Key Performance Indicators (KPI):
  - Availability of services
  - Easy and quick accessibility to terminals
  - Proper and adequate information to passengers
  - Sailing schedules of ferry services

[3] It should be noted here that later on also Osborne has been chosen by the LSG as a main terminal.

- Due customer care for passengers
- Adequate comfort
- Security and safety of services provided
- Due attention to environmental impact

- Ferry terminals should be well accessible by road and should provide facilities for (1) road-bound public transport services, and (2) Park-and-Ride schemes.

An initial concept for ferry routes and terminals has been presented and discussed on the 1st Stakeholders' Meeting for this project in May 2007. Based on the responses received and based on a further detailed assessment of the market surveys thereafter, the main ferry routes and terminals have been drafted as indicated in Figure 3.1.

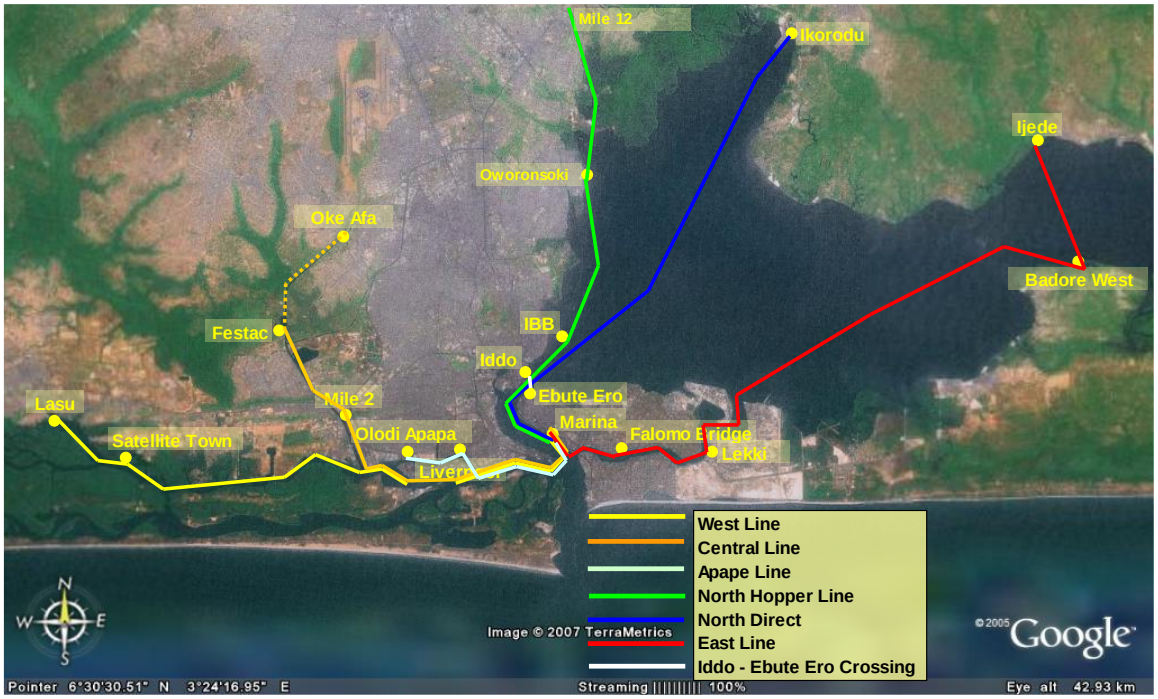


Figure 3.1 – Main Ferry Lines with Marine as Central Hub[4]

This figure shows the following main lines:

- West Line: Lasu (Ojo) → Satellite Town (Ijegun) → Marina
- Central Line: Oke Afa → Festac → Mile 2 → Marina
- Apapa Line: Olodi Apapa → Liverpool → Marina
- North Hopper Line: Mile 12 → Oworonsoki → IBB → Marina
- North Direct Line: Ikorodu → Marina
- East Line: Ijede → Badore West → Lekki → Falomo Bridge → Marina

[4] It should be noted here that following the presentation of the results of this study to LAMATA and LSG, it has been decided by LAMATA that Osborne should be an end station for the North Direct and East Line. In addition, the route for the East Line changed to Ijede → Badore West → Osborne.

In addition to the already existing short ferry lines such as the Marina – Apapa ferry crossing and for instance the Tarzan crossing (in the Five Cowry Creek), the following promising short crossing has been identified:

- Iddo ←→ Ebute Ero (Elegbatta)

Further, it has been recognized that the informal boat operators provide several short line services with small boat (motorized canoes) to several locations in the lagoon area. However, with the new ferry lines coming into operation, good feeder services by these informal operators need to be continued / extended.

The initial ferry terminals have been selected based on considerations such as:

- Capture potential for commuters: proximity to households and employment
- Availability and quality of existing terminal facilities
- Expansion capacity to accommodate future growth
- Space for park-and-ride facilities for interchange with other (public) transport modes such as taxis, mopeds, (mini) buses, and “feeder” boat services.
- Easy and direct access by road
- Connectivity to road (and future rail) transport
- Available water depths for berthing ferries to reduce dredging (capital / maintenance)

For example, a ferry terminal at the previous work island for the Ibrahim Babangida Bridge (IBB) has been selected as this location would offer good and direct links to the roads, has ample space for park-and-ride schemes, and is easily accessible from the water side with only limited need for dredging.

On the other hand, a terminal site at the University of Lagos has been discarded in view of very shallow waters, less accessibility by road, and the unlikeness of the University accepting public on their domains. Further detailed considerations on the finally selected ferry terminals have been included in Section 4 below.

3.2 Ferry PAX Forecasts

A passenger (PAX) forecast has been made for the ferry routes described above and has been based on the results of the commuter surveys for origin – destination and based on earlier traffic counts for the Lagos metropolitan area. These PAX forecasts have been concentrated on the traffic to/fro the CBD causing the most traffic congestion in the Lagos Metropolitan.

The detailed results of the passenger forecast have been included in Appendix 3A, whilst this section summarises the general methodology applied and the main findings. In order to provide the PAX forecast the following information was required:

- Traffic volumes towards CBD
- Origin-destination per zone
- Population forecast per zone
- Traffic growth rates per zone

- Commuter forecast per zone
- Assignment of zones to ferry lines
- Assignment to individual ferry stations
- Long term capture potential
- Adaptation rate to ferry transport
- PAX distribution over day

3.2.1 Step 1 – Assess Traffic Volumes to/from CBD

In 2002 the LUTP conducted traffic counts throughout the whole Lagos metropolitan area. From this data base the three northern arteries (or “crossing lines”) leading into CBD have been selected, i.e. the 3rd Mainland Bridge, Carter Bridge, and Eko Bridge (unfortunately no counts were made at that time for the southern access routes leading to CBD). From these 2002 counts it has been observed that some 1.4 million people entered the CBD daily by the three northern bridges.

The estimated total of commuter traffic to/fro the CBD via these three northern access bridges for 2007 has thereafter been estimated at some 1.7 million people per day taking into account the growth in population between 2002 and 2007.

The estimated number of commuters originating from Lagos Island and Lekki Peninsula together has then been estimated from the origin-destination data of the 2007 survey undertaken in the CBD for this LAMATA Ferry Project (refer below). From this survey it could be concluded that about 2/3rd of the CBD commuters originates from locations that requiring access via one of the 3 northern bridges. The remaining 1/3rd, or about 0.8 million people per day, originate from the southern part of Lagos, i.e. Lekki area and beyond.

In 2007 the combined number of commuters towards the CBD was therefore estimated at about 2.5 million per day.

3.2.2 Step 2 – Define Origin and Destination per Lagos Zone

To determine the origin of CBD commuters a survey has been undertaken at four locations within the CBD (at Osborne, Ebute Ero, Marina, and Victoria Island). Within this area a sample of 838 people was interviewed. The origins of these people have been classified into 13 zones (refer Figure 3.2).

Figure 3.2 – Zones in Lagos Metropolis

The % origins for the people interviewed in this sample have been displayed in Figure 3.3. It can be observed that about 2/3 of this sample have an origin in the northern and western zones, whilst the remainder 1/3 is coming from the south-eastern zone 12.

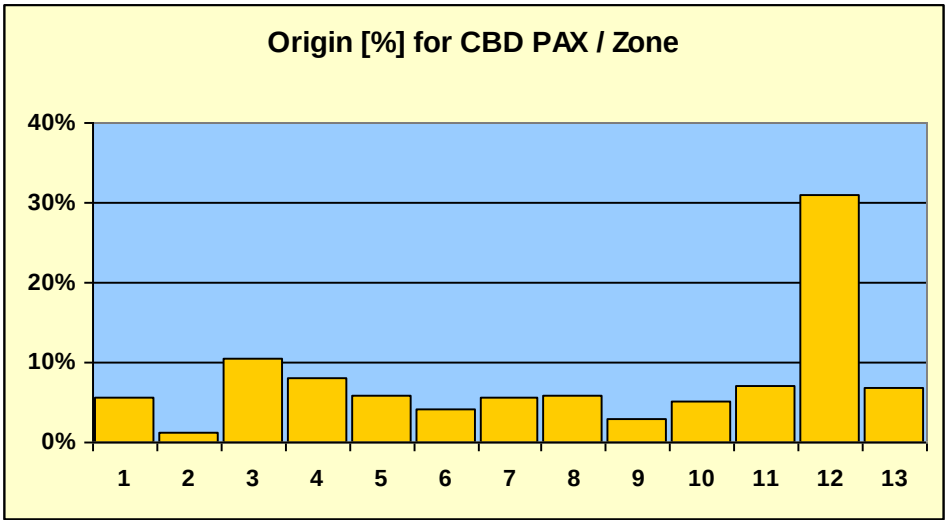


Figure 3.3 – Origin of CBD People Interviewed

It must nevertheless be noted that Zone 12 includes the people living on Lagos Island itself. Based on a further verification it has been understood that the majority of this umber is related to this Lagos Island group and that for these people there would be a demand for ferry transport from – for instance – Falomo Bridge to Marina.

The overall passenger forecast per zone with a CBD destination has then been calculated by taking the 2007 commuter flow of some 2.5 million and multiplying this flow by the zone percentage stated in Figure 3.3. The results have been included in Figure 3.4.

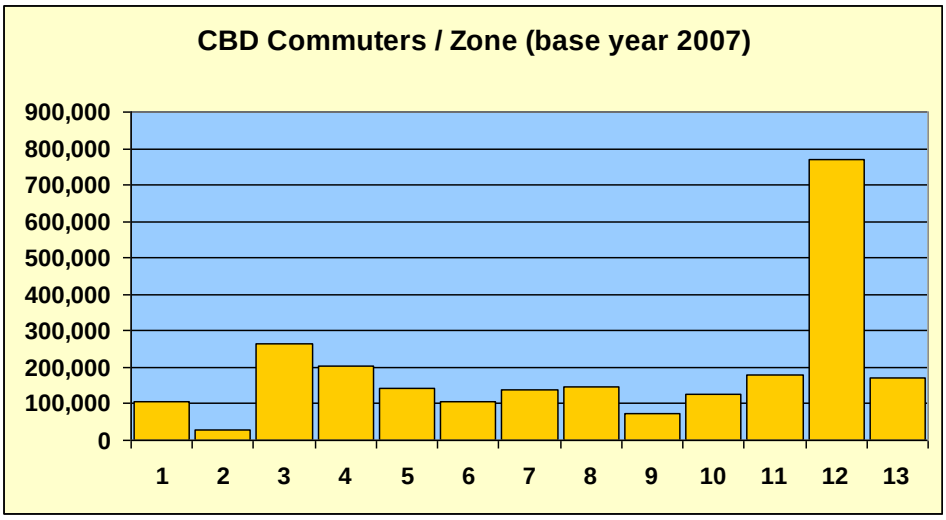


Figure 3.4 – CBD Commuters per Zone of Origin for Base Year 2007

3.2.3 Step 3 – Determine Population Forecast per Lagos Zone

The predictions of the growth of the traffic originating from the different zones have been based on the population growth of the individual zones. For each individual zone a prediction of the population has been prepared on the basis of the available census data of 1991 and 2006 (refer Appendix 3A for details). The assumed growth of Lagos Metropolitan population is indicated in Figure 3.5.

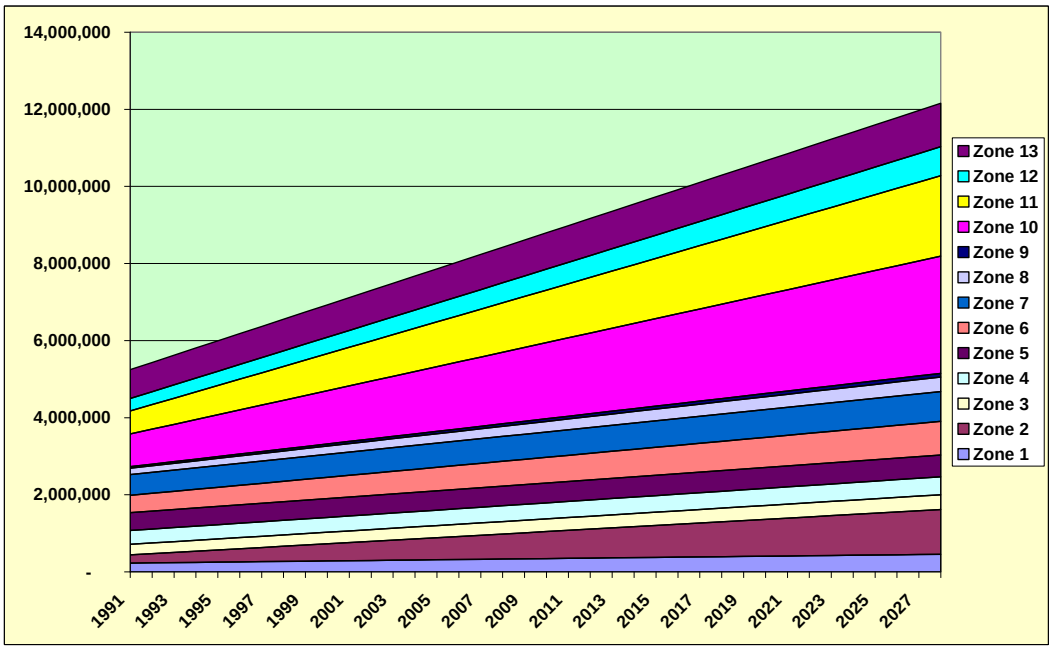


Figure 3.5 – Population Growth of Lagos per Zone

To be conservative as well as not to overestimate future (ferry) traffic volumes the population in the different zones has been forecasted on the basis of a straight line between the 1991 and 2006 census data. This has been considered more appropriate instead of using an exponential function which is often applied for population forecasts.

Further, it is likely is that the people will shift towards the outskirts of Lagos city where new housing areas are being developed pretty fast. According to the forecast the growth rates at the outskirts are therefore higher than in the older almost fully developed areas.

3.2.4 Step 4 – Determine Commuter Traffic Growth Rates per Zone

The population growth rates per zone have been calculated from the population forecast and have been used to estimate the growth rates of the commuter traffic volumes originating from the individual zones.

The commuter traffic growth rates per zone have been based on the correlation between the growth rate of the population and the growth rate of the commuter traffic volumes. The population growth rate has been calculated as the weighted average of the commuter population originating from the different zones. The average traffic growth rate has been based on the findings of the LUTP regarding the 3 northern bridges towards Lagos Island.

During the period between 1991 and 2001 the average growth rate of the traffic was 3.4% (according to 2002 LUTP). The average growth rate of the commuter population over this period was 2.4%. From the above it has been concluded that the growth rate of traffic towards CBD grows faster than the growth rate of the commuter population. The growth rate of traffic can be calculated by multiplying the population growth rate by 1.45. Details of the commuter traffic growth rates are provided in Appendix 3A.

3.2.5 Step 5 – Commuter Forecast per Lagos Zone and per Ferry Line

The commuter forecast per ferry line has been based on the commuter forecast per zone and the assignment rules to allocate commuters towards the different ferry lines and ferry terminal stations.

Commuter Forecast per Zone

The overall commuter forecast per zone has been calculated by taking the estimated commuter volumes per zone for the year 2007 and multiply them with the annual traffic growth rates per zone. The expected commuter volumes for the next 20 years are indicated in Figure 3.6.

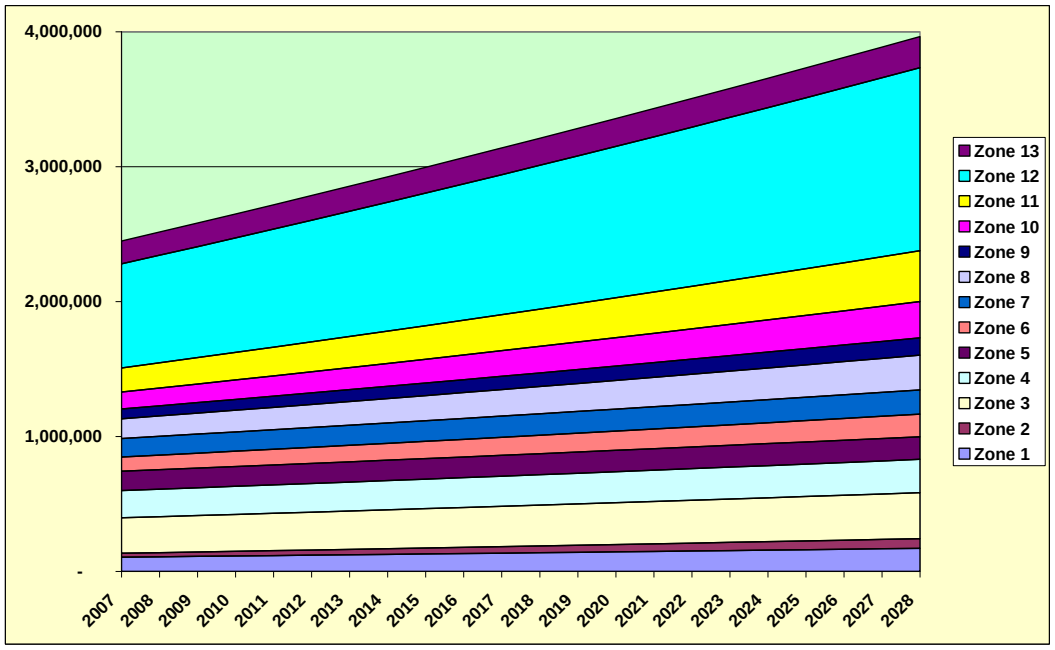


Figure 3.6 – Commuter Growth Rates per Zone

Assignments of Zones towards Ferry Lines and Terminals

The potential ferry commuter flows have been assigned to the different ferry lines as described above. The assignment of the lines has been based on the geographic location of the zones and the planned locations of the ferry terminals. The assignment of potential commuters towards the potential ferry station has been based on the zoning and expert judgements on the relative importance of the ferry stations for each line. The used allocation factors are described in detail in Appendix 3A.

3.2.6 Step 6 – Define Capture Potential and Adaptation Rate

The capture potential for the ferry lines for commuter traffic has been estimated on (1) the basis of the expected capture potential for a fully developed ferry service system in which the Lagosian population has fully adapted to the use of ferry transport and (2) an assumption on the adaptation (or grow-in) rate.

Long Term Capture Potential

The long term capture potential for ferry services has been estimated for each zone taking into consideration on the following factors:

- Shown interest levels for ferry services as result from the commuter surveys as completed for this LAMATA Ferry Project (refer above)
- Expert opinion on % of interested people finally adapting to ferry transportation
- Expected new traffic flows induced by the newly available transportation system.

The commuter surveys indicated that on average about 40% of the commuters would be interested in ferry transport. The following percentage of the people that indicated to be interested in water transport has finally been expected to shift to this mode of transport:

- 50% for zones located near short water crossings
- 30% for zones located close to a ferry terminal, but at a certain distance to the final destination,
- 20% for zones located at some distance to a ferry terminal and with no direct access to the waterside.

Additional traffic is expected to be attracted in the Lagos zones 1, 2 and 11. These zones are connected to the West Line (Lasu, Satellite Town) and the North Direct Line (Ikorodu).

The expected long-term capture potential for the ferry commuters originating from the different Lagos zones is indicated in Figure 3.7. This figure provides the percentage of the total commuter flow to the CBD that is expected to adapt to the use of ferry transport in the longer term.

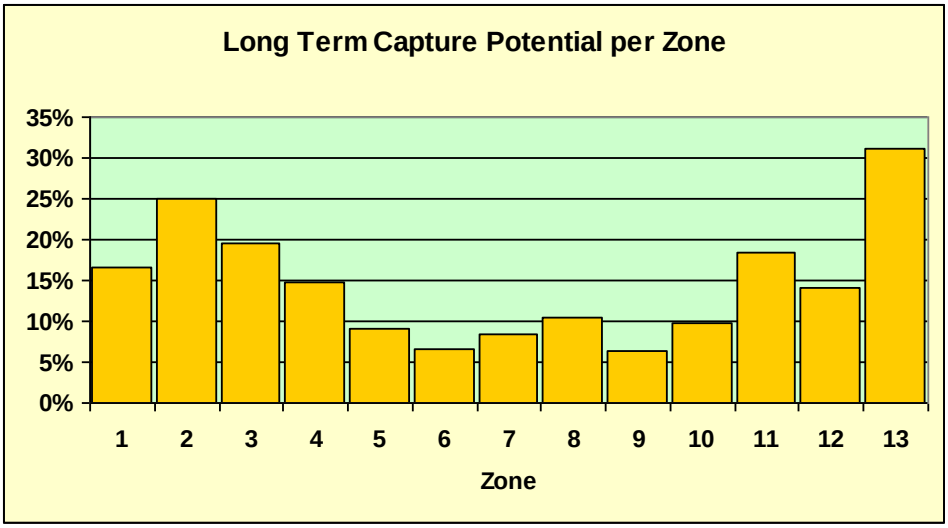


Figure 3.7 – Capture Potential [%] for Ferry Services per Lagos Zone

It is envisioned that on the long run ferry transport will have an average capture share of about 15% with respect to the commuter flows from/to CBD (based on weighted average of the capture shares for the individual zones).

However, it should be noted that the capture potential is related to the price of the ticket to be paid for ferry transport. The provided capture potentials are expected to reflect a ticket price such that for 2/3rd of the population, the cost of the ferry is lower than the price of the alternative bus transport plus the value of the time savings.

The fraction of 2/3rd of the population correlates with a minimum Value of Time (VOT) of about 27 Naira per hour [prices 2007] for time savings, which compares with the average VOT for an average worker). The issue of value of time (VOT) has been discussed in more detail Appendix 3A.

Adaptation Rate

Most people in Lagos are reported to be a bit afraid of water and water transport and therefore it will take some time before the majority of the potential users will indeed adapt to the use of ferries. In the analyses it has been assumed that every year an equal percentage of the population not yet adapted will shift to this mode of transport. The adaptation rate has been set such that after 5 years 50% of the potential ferry users would have shifted to ferry transport.

The percentage of potential users adapted to ferry transport over time is indicated in Figure 3.8.

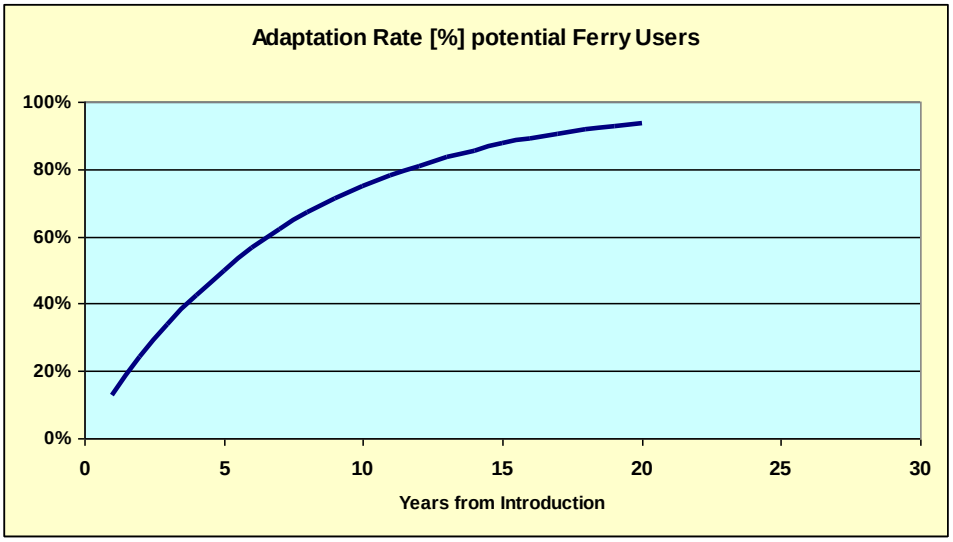


Figure 3.8 – Percentage of Potential Users adapted to Ferry Transport (Grow-in Rate)

Though the figure provides a clear view on the expected adaptation rate envisioned by the Consultants, it should be noticed that the exact rate of adaptation is hard to predict and that the uncertainty regarding this figure is considerable. The above is considered to be conservative.

3.2.7 Step 7 – Estimate Daily Passenger Forecast

Based on the assumptions described above a comprehensive passenger demand forecast has been prepared for the individual ferry lines and terminal stations. The forecast for the next 20 years has been provided in Figure 3.9. The detailed forecasts including the relative importance of the ferry terminals can be found in Appendix 3A.

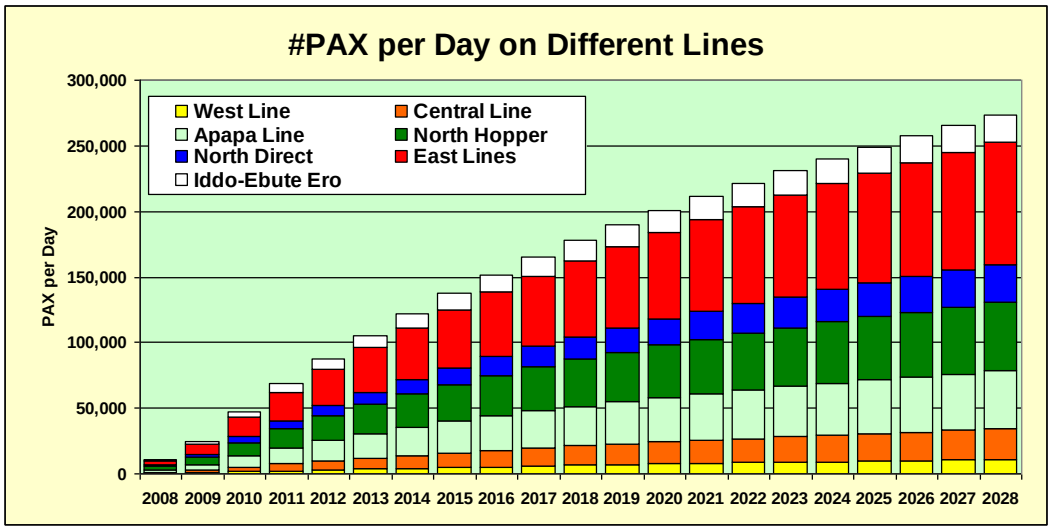


Figure 3.9 – Assumed Daily Passenger Forecast for the next 20 Years

3.2.8 Step 8 – Define Daily Peak Hour Forecast

Peak Traffic

The passenger flows are subjected to a major peak in the morning (between 7am and 10am) and in the afternoon (between 4am and 7pm). The assessed volume of the peak flows has been indicated in Figure 3.10 and has been expressed as a percentage of the daily passenger flows. This distribution of the traffic over the day has been based on Consultants own observations and on discussions with a number of stakeholders.

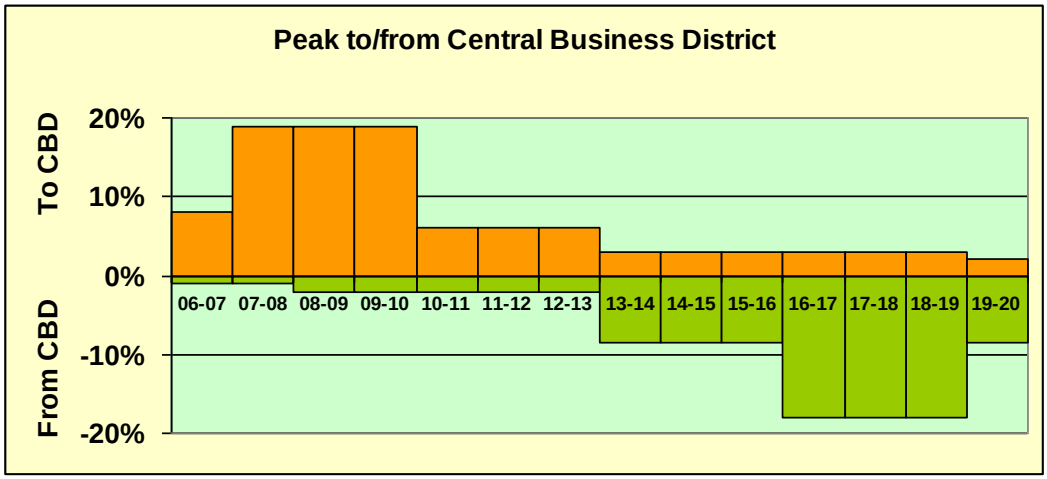


Figure 3.10 – Assumed Passenger Distribution over the Day

Peak Hour Forecasts

The peak hour demand forecast has been based on the expected percentage of the daily passenger demand during peak hours of about 18% (refer Figure 3.10 above) and the demand forecast on a daily basis (refer Figure 3.9). The results for the peak traffic for ferry PAX has been displayed in Figure 3.11 for each of the main ferry lines.

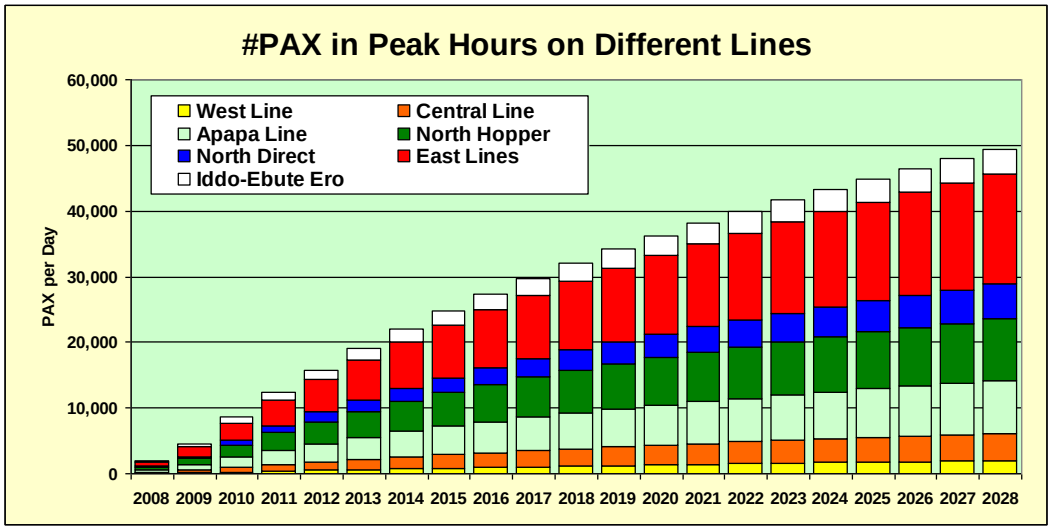


Figure 3.11 – Assumed Peak Hour Passenger Forecast for the next 20 Years

The peak hour demand is required to estimate the number of ferries and the size of the terminal facilities. However, scoping these services will require a decision to be made on the percentage of the demand that the operator is willing to supply. De desirable supply might be lower to increase the utilisation rate of the ferries and the facilities. This issue has been further addressed in Section 5 of the report.

4 INFRASTRUCTURE ANALYSES (TASK 4)

This section comprises a description as conducted for the infrastructural analyses for the existing ferry terminals in the Lagos Metropolitan area. The following issues have been addressed:

- Inventory of existing ferry and boat terminals
- Assessment of ferry terminals
- Selected terminals for main ferry lines
- Required improvements

4.1 Inventory Existing Ferry and Boat Terminals

An inventory of the existing formal jetties and boat landings has been made for this project as present in the Lagos metropolis area. These can be categorized under the following four broad headings:

- Federal agency owned jetties
- State government owned jetties
- Local government owned jetties and
- Privately owned jetties

The location, ownership and construction type for the main landings[5] have been shown in Table 4.1 below.

#	Location	Owner	Type of Construction
1.1	Oworonsoki	Federal	Concrete piled
1.2	Ijora	Federal	Concrete piled
1.3	Takwa Bay	Federal	Concrete sheet piled
1.4	Federal Secretariat	Federal	Concrete sheet piled
1.5	Festac	Federal	Concrete piled
1.6	Naval Dockyard	Federal (Navy)	Concrete quay
1.7	Oyingbo	Federal (NIWA)	Concrete piled
1.8	Maroko	Federal (NIWA)	Concrete
1.9	Marina	Federal (NIWA)	Concrete
1.10	Ikorodu	Federal (NPA)	Quay
1.11	Sea school Jetty	Federal (Sea School)	Concrete piled
1.12	NNPC jetty, V/island	Federal (NNPC)	Concrete pilled
2.1	Mile 2	State	Concrete piled
2.2	Elegbatta (Ebute Ero)	State	Concrete piled
2.3	Apapa Inside Wharf	State	Concrete
3.1	Epe LGA	Local Government	Concrete sheet piled
3.2	Baiyeku	Local Government	Concrete sheet piled
3.3	Apese	Local Government	Concrete
3.4	Ikoyi Water Side	Local Government	Concrete

[5] Source: Inception Report of 19 April 2007

#	Location	Owner	Type of Construction
3.5	Ijegun, satellite town	Local Government	Concrete piled
4.1	Mekwen Onikan	Private	Wood
4.2	Federal Palace Hotel	Private	Sheet concrete piled
4.3	Westminster	Private	Quay
4.4	Tarzan Boats	Private	Wood
4.5	Eleke Crescent	Private	Concrete
4.6	Tolu water side Ajegunle	Private	Wood
4.7	North end of TMB (IBB)	Private (Julius Berger)	Concrete piled

Table 4.1 – Location, Ownership and Type of Main Boat landings

Federal agency owned jetties are mostly constructed in reinforced concrete supported by circular piles. Except for the Apapa Jetty, which has a sheet piled jetty, all Federal Agency owned jetties are similar in design and layout, with L or T-shaped reinforced concrete heads.

Of the Lagos State owned jetties the Mile 2 terminal is currently out of use. Local government owned jetties are mostly targeted at the rural populace. A more common sight at some of these locations is therefore the motorized wooden canoes which are employed for short shuttles in the riverside communities. It is to be noted that the Ijegun, Satellite Town jetty is now under LAMATA rehabilitation using WB funding.

4.2 Assessment of Ferry Terminals

The relevant formal and informal jetties in the Lagos Metropolitan have been further assessed with respect to their future development as a main line ferry terminal. To this extent a Measure of Effectiveness table has been developed in which each terminal is reviewed against a set of effectiveness criteria as follows:

- Capture potential for passengers (PAX) – indicating the potential of a ferry terminal to capture passengers for ferry traffic. This criterion reflects the proximity of a terminal to people / business community: the further away a community is located the lower the chance is that people will make use of a ferry.

- Navigation access – describing the ease of access for ferries to the terminals. In case of deep water the access is good or even excellent, whilst in shallow and confined waters the access is poor.

- Berthing facilities – describing the conditions and presence (if any) of the quay wall / berth facilities at a terminal.

- Terminal facilities – describing whether there are any terminal buildings and facilities and if so in what conditions they are now.

- Ferry – terminal interface – describing the quality of the interface between the berths and the terminal in view of the ease of handling passengers.

- Expansion options berth / terminal – describing the options for future expansions at a site in case this would be required. This is considered an important criterion as the number of passengers to be transported by ferries is expected to significantly increase in the future.

- Space of parking area – indicating whether this is space for parking (private) cars at a terminal, an important parameter for the Park and Ride schemes for this project.

- Presence of bus terminal – indicating whether this is at present such a facility as this would be an added advantage for a ferry terminal.

- Connectivity to other modes of transport – indicating the potential linking-up of ferry transport to other modes of (public) transport such as busses and trains.

- Hinterland access road – describing whether the ferry terminal is at present directly linked to the hinterland or whether a new access road would need to be constructed.

- Relevance for main ferry lines – indicating whether an existing ferry terminal would be relevant for the main (longer distance) ferry lines.

Thereafter, a general conclusion has been drafted with respect to the use of the existing ferry terminals. Their effectiveness has been classified as follows:

- Main – Suitable as ferry terminal on one of the main ferry lines
- Feeder / Cross – Suitable for feeder lines or for as cross-river ferries
- Future / Phase 2 – Suitable for future development: Phase 2 and beyond
- Cancel – not considered suitable to be developed as ferry terminal.

The results of assessment on measures of effectiveness have been included in Table 4.2 on the following pages. The location of these terminals is indicated in Figure 4.1.

Ferry Terminal	Location	Measure of Terminal Effectiveness												Conclusion		
		PAX Capture Potential	Navigation Access	Berthing Facilities	Terminal Facilities	Ferry - Terminal Interface	Expansion Options - Berths	Expansion Options Terminal	(Space for) Parking Area	Presence Bus Terminal	Connectivity other Modes	Hinterland Access Road	Relevance for Main Ferry Lines	Main Line	Ferry Line	Other
Badagry	Far West	future	unknown	none	none	n/a	good	good	good	none	moderate	unknown	future			**Future**
Lasu	West	good	good	none	none	n/a	good	good	good	none	good	none	yes	**Main**		
Satellite Town	West	good	excellent	construct	construct	good	good	good	good	none	good	good	yes	**Main**		
Satellite Town Navy	West	good	good	excellent	none	n/a	good	good	good	none	poor	none	yes			**Cancel**
Kirikiri	Porto Novo Creek	moderate	good	good	n/a	n/a	good	good	limited	n/a	poor	poor	yes			**Cancel**
Oke Afa	Festac Creek	good	poor	n/a	options	n/a	good	good	good	n/a	good	good	future	**Main**		**Future**
Festac	Festac Creek	good	good	good	good	good	good	limited	good	n/a	good	good	yes	**Main**		
Mile 2	Festac Creek	good	good	moderate	moderate	moderate	moderate	moderate	good	n/a	good	good	yes	**Main**		
Olodi Apapa Bridge	North Tincan Island	excellent	excellent	limited	none	poor	limited	limited	none	n/a	moderate	moderate	yes	**Main**		
Liverpool	North Tincan Island	good	excellent	limited	none	n/a	limited	limited	none	none	moderate	moderate	yes	**Main**		
Sea School Jetty	South Tincan Island	limited	shallow	none	none	n/a	limited	limited	none	n/a	none	none	no		**Feeder**	
Takwa Bay	South Tincan Island	limited	shallow	none	none	n/a	limited	limited	none	n/a	none	none	no		**Feeder**	
Mekwen	South of Apapa	limited	shallow	none	none	n/a	limited	limited	none	n/a	none	none	no		**Feeder**	
Apapa Inside Wharf	Apapa Quay	Good	good	poor	poor	poor	none	none	none	n/a	none	bad	no		**Feeder**	
Marina	Lagos Island	High	excellent	moderate	moderate	moderate	excellent	limited	limited	none	good	excellent	most	**Main**		
Ebute Ero (Elegbatta)	Lagos Island	Good	good	limited	none	n/a	limited	limited	none	none	poor	limited	no		**Cross**	

Ferry Terminal	Location	Measure of Terminal Effectiveness												Conclusion		
		PAX Capture Potential	Navigation Access	Berthing Facilities	Terminal Facilities	Ferry - Terminal Interface	Expansion Options - Berths	Expansion Options Terminal	(Space for) Parking Area	Presence Bus Terminal	Connectivity other Modes	Hinterland Access Road	Relevance for Main Ferry Lines	Main Line	Ferry Line	Other
Osborne	Lagos Island	Good	shallow	good	good	good	good	good	good	none	good	good	future			**Phase 2**
Ijora	Opposite LI	moderate	deep	none	none	n/a	limited	limited	none	none	poor	poor	no			**Cancel**
Iddo	Opposite LI	Good	deep	moderate	none	n/a	limited	limited	none	none	limited	limited	no		**Cross**	
Oyingbo	Opposite LI	Poor	shallow	limited	none	n/a	limited	limited	none	none	none	poor	no			**Cancel**
IBB	West Lagoon	Good	good	good	none	n/a	excellent	excellent	excellent	none	good	moderate	yes	**Main**		
University Lagos	West Lagoon	Poor	shallow	poor	none	n/a	poor	poor	none	none	poor	poor	no			**Cancel**
Oworonsoki	West Lagoon	moderate	moderate	poor	moderate	good	limited	good	moderate	none	moderate	busy	yes	**Main**		
Mile 12	Mile 12 Creek	Good	good	n/a	n/a	n/a	good	good	moderate	none	good	good	yes	**Main**		
Ikorodu	North West Lagoon	excellent	shallow	poor	none	n/a	good	moderate	reclaim	none	good	good	yes	**Main**		
Baiyeku	North West Lagoon	limited	shallow	none	none	n/a	limited	limited	none	none	limited	poor	no			**Cancel**
Eleke Crescent	Victoria Island	Good	deep	limited	none	n/a	limited	limited	none	none	none	moderate	no		**Feeder**	
Federal Palace Hotel	Victoria Island	Good	deep	moderate	none	n/a	limited	limited	limited	none	limited	moderate	no		**Feeder**	
Naval Dockyards	Victoria Island	moderate	deep	moderate	none	n/a	limited	limited	none	none	limited	limited	no		**Feeder**	
NNPC Jetty	Five Cowry Creek	Good	deep	limited	none	n/a	limited	limited	none	none	limited	good	no		**Feeder**	
Falomo Bridge	Five Cowry Creek	excellent	deep	good	none	n/a	good	good	none	none	limited	good	yes	**Main**		
Federal Secretariat	Five Cowry Creek	Good	deep	limited	none	good	limited	limited	none	none	limited	good	no		**Cross**	

Ferry Terminal	Location	Measure of Terminal Effectiveness												Conclusion		
		PAX Capture Potential	Navigation Access	Berthing Facilities	Terminal Facilities	Ferry - Terminal Interface	Expansion Options - Berths	Expansion Options Terminal	(Space for) Parking Area	Presence Bus Terminal	Connectivity other Modes	Hinterland Access Road	Relevance for Main Ferry Lines	Main Line	Ferry Line	Other
Ikoyi Waterside	Five Cowry Creek	good	deep	limited	moderate	moderate	limited	limited	none	none	limited	good	no		**Cross**	
Tarzan Boat Jetty	Five Cowry Creek	good	deep	limited	moderate	moderate	limited	limited	limited	none	moderate	good	no		**Cross**	
Maroko	Five Cowry Creek	good	deep	limited	none	n/a	limited	limited	none	none	good	good	no		**Cross**	
Lekki	Five Cowry Creek	excellent	deep	none	none	n/a	good	good	moderate	none	good	good	yes	**Main**		
Ijede	East Lagoon	good	shallow	poor	moderate	good	good	good	good	none	none	good	yes	**Main**		
Badore East	East Lagoon	good	shallow	poor	moderate	moderate	moderate	moderate	limited	none	good	good	no			**Future**
Badore West	East Lagoon	good	shallow	good	good	good	good	good	good	none	good	good	yes	**Main**		
Epe	Far East	future	shallow	unknown	unknown	n/a	unknown	unknown	unknown	none	poor	moderate	no			**Future**

Table 4.2 – Measure of Effectiveness for existing Ferry Terminals

Figure 4.1 – Location of Ferry Terminals

4.3 Selected Terminals for Main Ferry Lines

The ferry terminals for the main ferry lines have been selected based on the socio – economic surveys and subsequent analyses related to the PAX forecasts (refer Section 3 above) and the assessment for the measure of effectiveness as included in Table 4.2. The main ferry lines and terminals have been summarised in Table 4.3.

West	Central	Apapa	North Hopper	North Direct	East
Lasu Satellite Town Marina	[Oke Afa] Festac Mile 2 Marina	Olodi Apapa Liverpool Marina	Mile 12 Oworonsoki IBB Marina	Ikorodu Marina	Ijede Badore West Lekki Falomo-Bridge Marina

Table 4.3 – Main Ferry Lines and Ferry Terminals[6]

These selected terminals have then been further inspected in more detail by the Consultants during this project. An impression of these inspections is included in Figure 4.2 to Figure 4.8 below for each of the ferry lines selected.

- West Line (refer Figure 4.2): Lasu – Satellite Town – Marina.

Lasu (Ojo) – Foreshore

Lasu (Ojo) – Speedboat Landing Site

[6] As has been described above, changes to these lines occurred after presenting the results of this study the LAMATA and LGS authorities.

Satellite Town – Under LAMATA Rehabilitation

Satellite Town – Navy Base (not selected)

Figure 4.2 – West Line Ferry Terminals

- Central Line (refer Figure 4.3): Oke Afa – Festac – Mile 2 – Marina

Oke Afa – Proposed Terminal Site located south east of the Oke Afa Bridge

Oke Afa – Alternative Site located north-east of the Oke Afa Bridge

Festac – Jetty with T-Jetty

Festac – Terminal Building

Festac – Parking Area for Park-and-Ride

Mile 2 – Jetty with Quay Wall

Mile 2 – Parking Area

Mile 2 – Terminal Building

Figure 4.3 –Central Line Ferry Terminals

- Apapa Line (refer Figure 4.4): Olodi Apapa – Liverpool – Marina

	
Olodi Apapa – Landing Site under Bridge (view from west)	Olodi Apapa – Landing Site (view from east)
	
Liverpool – Landing Site	Liverpool – Landing Site Area
	
View at Apapa Express from Liverpool Site	
Figure 4.4 – Apapa Line Ferry Terminals	

- North Hopper Line (refer Figure 4.5): Mile 12 – Oworonsoki – IBB – Marina

Mile 12 – View to North from Bridge

Mile 12 – View to South from Bridge

Oworonsoki – Jetty with T-Jetty

Oworonsoki – Terminal Building

IBB – Terminal Area with Quay Wall

IBB – Offering Space and Direct Connections to Highways

Figure 4.5 – North Hopper Line Ferry Terminals

- North Direct Line (refer Figure 4.6): Ikorodu – Marina

Ikorodu – Tarzan Jetty

Ikorodu – View to the Shore

Ikorodu – Potential Park-and-Ride Location

Ikorodu – Road leading to Jetty

Figure 4.6 – North Direct Line Ferry Terminals

- East Line (refer Figure 4.7): Ijede – Badore West – Lekki – Falomo Bridge – Marina

	
Ijede – Road leading to Jetty	Ijede – Jetty: Collapsed
	
Ijede – Terminal Building	Ijede – Jetty: Collapsed
	
Badore West – Landing Jetty	Badore West – Terminal Area and Building

Lekki – Possible Terminal Site

Lekki – View form Five Cowry Creek

Lekki – Direct Link to Admiralty Way Road

Lekki – View on Shore Area

Falomo Bridge – Site for Ferry Terminal

Falomo Bridge – Site for Terminal

Figure 4.7 – East Line Ferry Terminals

- Iddo – Ebute Ero Crossing Line (refer Figure 4.8)

Iddo – Existing Landing Area

Iddo – Busy Landing Site at Present

Figure 4.8 – Ebute – Ero Line Ferry Terminals

- Main Hub – Marina (refer Figure 4.9)

Marina – View on Ferry Landing Station

Marina – Present Terminal Area

Marina – View to South for Future Expansion

Marina – Offering Good Links to Roads

Figure 4.9 – Marina as Proposed Main Hub for the Ferry Lines

4.4 Required Terminal Improvements

The inspections for the ferry terminals have been focussing on the level of upgrading required to achieve a smooth and efficient terminal operations as well as to create good inter-modal connections between the ferry lines and onward connections by road ("molues", mini-busses, cars, motor bikes).

As such, a ferry terminal should comprise the following facilities:

- Jetty for landing of ferries and adequate space for quick embarking and disembarking of passengers
- Access corridor / bridge between jetty and terminal area
- Terminal building for issuing tickets, providing waiting room for PAX, providing small shops, etc
- Easy and smooth connections to the hinterland by (mini) busses, taxis, cars.
- Utilities for fuel for ferries, fresh water supply, sewerage tanks.

In determining the levels of costs for the (re-)construction the following classification has been applied:

- "New" means that a complete new terminal is required with the construction costs set at 100%
- "Major" means that the existing terminal facilities do require a major overhaul at an estimated level of 75% of the new building costs
- "Medium" requires an overhaul of 50% of the new building cost
- "Small" requires an overhaul of some 25% of the new building costs

Further, the terminals have been distinguished as being located in deep or shallow water as this has a direct impact on the construction (or rehabilitation) costs. The results of this assessment have been included in Table 4.4.

Line	Terminal	Ownership	Upgrade Level	%	Water Depth
West	Lasu	LSG	New	100%	Shallow
	Satellite Town	LSG	New	100%	Deep
West	Olodi - Apapa	Community	New	100%	Deep
	Liverpool	Private	Small	25%	Deep
Central	Oke Afa	LSG	New	100%	Shallow
	Festac	Federal	Small	25%	Shallow
	Mile 2	LSG / LSFS	Medium	50%	Shallow
North Hopper	Mile 12	[LSG]	New	100%	Shallow
	Oworonsoki	Federal [?]	Major	75%	Shallow
	IBB	[LSG]	Medium	50%	Shallow

Line	Terminal	Ownership	Upgrade Level	%	Water Depth
North East	Iddo	NIWA	Small	25%	Deep
	Ebute Ero	LSG	Small	25%	Deep
North Crossing	Ikorodu	LSG	New	100%	Shallow
East	Ijede	LSG	Major	75%	Shallow
	Badore West	LSG	Small	25%	Shallow
	Lekki	LSG	New	100%	Deep
	Falomo Bridge	Private	New	100%	Deep
All	Marina	LGS / Federal	New	100%	Deep

Table 4.4 – Ownership and Level of Upgrading Required for Ferry Terminals

For example, at Lasu (Ojo) there are at present no ferry terminal facilities available and therefore the construction costs have been estimated at 100% reflecting the construction of a complete new terminal. On the other hand, the terminal at Festac is considered at a reasonable condition requiring limited repair works to meet the above stated requirements.

All the collected information from the above surveys and inspections has been used as input into the further conceptual designs for the terminals as well as for the estimation of the construction costs (refer Section 5 below).

5 CONCEPTUAL DESIGNS AND COST ESTIMATES (TASK 5)

This section describes the conceptual designs and cost estimates for the ferry terminals along the selected ferry lines and addresses the following issues:

- Engineering Site Surveys
- Alternative Terminal Concepts
- Conceptual Terminal Designs
- Engineers' Cost Estimates
- Implementation Schedule

5.1 Engineering Site Surveys

In addition to the site visits by the Consultants to all the proposed ferry terminals (as reported in Section 4 above) more detailed engineering surveys and inspections have been made to a number of key ferry terminals to serve as input for the conceptual designs. The site survey measurement results have been included in Appendix 5A to this report and include the locations for the main hubs Marina and Osborne.

Further, hydro-graphic surveys have been taken at the ferry terminal sites; these have been reported in Section 6.1 below.

5.2 Alternative Terminal Concepts

5.2.1 Alternative Concept

As a first step in this study a number of alternative terminal concepts have been considered to select a preferred technical option. For this purpose three types of terminal or jetty construction have been considered as follows:

- Jetty with a deck on piles and a concrete substructure
- Jetty with a deck on piles and a steel piles substructure
- Floating pontoons

Further, a distinction has been made between shallow and deep water conditions. This results in 6 possible alternative combinations as indicated in Table 5.1.

	Jetty with a Deck on Piles		**Floating**
	Concrete Sub	**Steel Sub**	**Pontoon**
Shallow	**1**	**2**	**3**
Deep	**4**	**5**	**6**

Table 5.1 – Alternative Concepts for Ferry Terminals

A brief description of these technical alternatives is given below.

Shallow Water Terminal – Jetty Concept

The alternative design for a jetty located in shallow water has been based on the following main design considerations:

- Berth length of 50m
- Jetty width of 4m
- Length of the foundation piles at 12m
- Berthing line located at 24m from the shore
- Allowances for different embarking / disembarking levels for passengers through the provision of staircases (steps)
- Utility allowances for diesel, petrol, and water
- Provisions for ticketing and waiting facilities
- Provisions for parking places / bus stops

Shallow Water Terminals – Pontoon Concept

The shallow water pontoon concept has been based on the following considerations:

- Berth length of 30m
- Jetty width of 6m
- Length of the foundation piles at 12m
- Berthing line located at 38m from shore using two access bridges of 16m each

For a pontoon concept no additional allowances are required to accommodate the differences in water levels and hence in any differences in embarking / disembarking levels for passengers.

Deep Water Terminals – Jetty Concept

The alternative concept for a deep water jetty has been based on the following:

- Berthing length of two times 60m
- Jetty width of 6m
- Length of the foundation piles at 26m
- Berthing line located at 24m from the shore
- Allowances for different embarking / disembarking levels for passengers through the provision of staircases or steps
- Utility allowances for diesel, petrol, and water
- Provisions for ticketing and waiting facilities
- Provisions for parking places / bus stops

Deep Water Terminals – Pontoon Concept

The alternative for a deep water pontoon has based on:

- Berth length of two times 60m
- Jetty width of 6m
- Length of the foundation piles at 26m
- Berthing line located at 38m from shore using two access bridges of 16m each

5.2.2 Comparative Costs Estimates

Rough-Order of Magnitude (ROM) cost estimates have been made based on the conceptual designs as prepared for the alternative terminal concepts described above. The following cost elements have been included:

- Geotechnical soil investigations (bore holes)
- Jetty foundation piles (concrete or steel)
- Jetty deck structure
- Guiding rails
- Bollards and fenders
- Access trestle
- Coastal protection
- Excavation and land fill costs
- Pavement and parking areas
- Canopy, ticketing and waiting facilities, security building
- Facilities for water, fuel and diesel storage (for end stations)
- Lighting and power supply (utilities)

For the pontoon concepts the following costs for the terminal jetty have been included:

- Foundation piles for pontoon and pile driving
- Floating pontoons with fenders
- Access bridges

In addition to these costs allowances for general project costs and contingencies have been included in the estimates. Cost estimates have been based on Consultants' broad experiences with similar projects worldwide as well as in Nigeria.

The results of these comparative costs estimates have been included in Table 5.2 and Figure 5.1 below per alternative concept and water depth.

	Jetty with Deck on Piles		**Floating**
	Concrete Sub	**Steel Sub**	**Pontoon**
Shallow	0.7	0.9	1.2
Deep	1.6	1.6	2.0

Table 5.2 – Construction Costs (CAPEX) for Alternative Terminal Concepts [million US$]

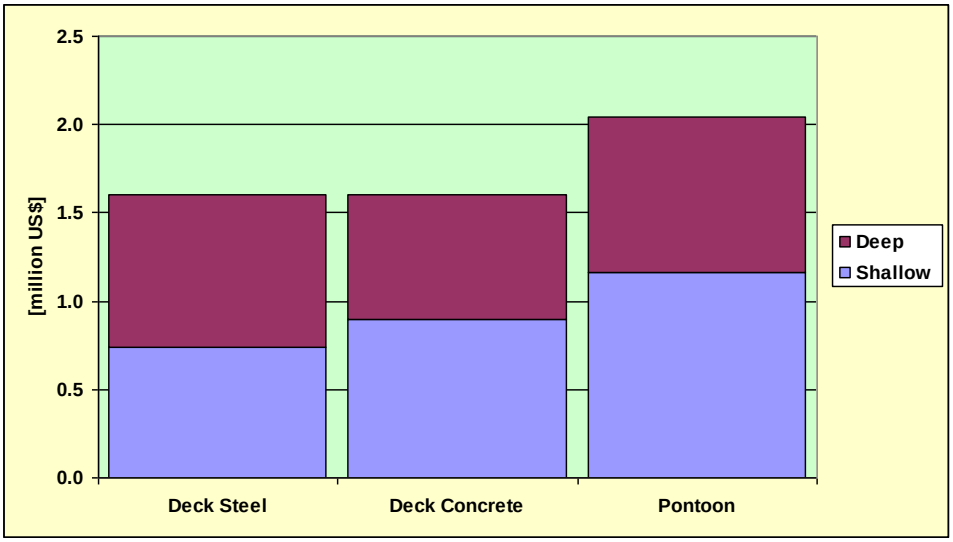


Figure 5.1 – CAPEX for Ferry Terminal Alternatives [million US$]

The total construction / rehabilitation costs for all the ferry terminals have been shown in Figure 5.2 based on the terminal characteristics as per Table 4.4 above. In case all terminals would be constructed with a steel substructure, the CAPEX would amount to some US$ 20 million. With a concrete substructure the CAPEX would be some US$22 million, whilst for a pontoon option the CAPEX would amount to some US$28 million.

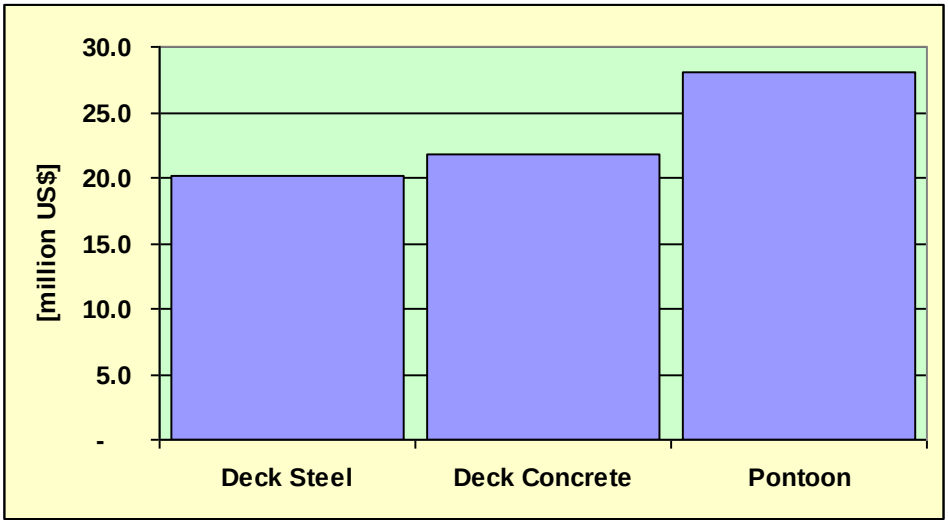


Figure 5.2 – Total Construction Costs (CAPEX) per Alternative Concept

5.3 Preferred Terminal Option

After presenting the above results to LAMATA (and other LSG authorities) a floating pontoon concept was selected as preferred option for the following main reasons:

- Level between ferries and deck of pontoon is the same
- Quick embark / disembark for ferry PAX
- Safe handling of PAX as no steps have to taken
- Concept can be used at many locations throughout the lagoon
- Floating pontoons can be easily relocated to other sites

Further it has been agreed with LAMATA that three types of terminal had to be considered: “large”, “medium” and “small” with the differentiation between the terminal types basically being affected by the number of PAX to be handled. As such, the differences can be found in:

- Size and characteristics of the terminal building,
- Number of stop-and-go stations for mini-busses,
- Number of drop-and-go positions for taxis,
- Number of parking places for busses, and
- Number of parking places for cars (“park-and-ride”).

5.4 Concept Design Ferry Terminals

For the three types of terminals (large, medium, small) typical concept layout and concept design drawings have been prepared showing the following features:

- Access road to ferry terminal
- Sop-and-go areas for mini-busses
- Drop –and-go areas for taxis and private cars
- Car park area for park-and-ride
- Terminal building with facilities including amongst others
    - Ticketing
    - PAX waiting areas
    - Offices
    - Toilets
    - Restaurant
    - Shops
- Utilities for
    - Storage tanks for petrol and diesel
    - Storage tanks for fresh water
    - Sewerage tank
- Access jetty and floating pontoon
- Side and front view for the terminal buildings

The concept layouts and concept design drawings have been included in Appendix 5B to this report. Some 3D artist impressions have been prepared for the ferry terminal as shown on the next pages.

[Add: Artist Impression Ferry Terminal with Floating Pontoon]

[Add: Artist Impression Ferry Terminal with Floating Pontoon]

[Add: Artist Impression Ferry Terminal with Floating Pontoon]

5.5 Park and Ride Facilities

For the various ferry terminals selected in this LAMATA Ferry Project an assessment has been made regarding the requirements for park-and-ride facilities. To this extent the number of required parking places has been estimated by taking the following issues into account:

- Number of PAX daily passing via the ferry terminal
- Number of PAX passing the ferry terminal in the peak (morning, afternoon)
- Origin of PAX over the different zones
- Ferry PAX profiles as derived from the market surveys
- Number of potential PAX owning cars
- Accessibility of the terminal by car
- Availability of land area at the proposed terminals locations

The required number of parking places for each of the selected ferry terminals has thus been estimated as included in Table 5.3.

Phase	Line	Ferry Terminal	# of Parking Lots
1a		Marina	40
		Osborne	50
	West	Lasu	50
		Satellite Town	100
	North Direct	Ikorodu	250
		Ijede	50
		Badore West	150
1b		Marina	100
	Central	Oke Afa	100
		Festac	150
		Mile 2	160
	Olodi Apapa	Olodi Apapa	0
		Liverpool	0
	North Hopper	Mile 12	200
		Oworonsoki	50
		IBB	200
	Five Cowry	Lekki	150
		Falomo Bridge	0
	Iddo – Ebute Ero	Iddo	0
		Ebute Ero	0

Table 5.3 – Number of Parking Lots per Ferry Terminal

These parking areas are to be fenced and provided with a ticketing office as well as proper area lighting.

5.6 Bills of Quantity and Investment Costs Ferry Lines

The LAMATA Ferry Project will be implemented under a Public Private Partnership (PPP) with LAMATA acting as the “landlord” for the project (refer Section 11). As such, LAMATA will be responsible for the construction and maintenance of the (physical) infrastructure for the ferry lines including dredging, aids to navigation, wreck removal, jetties, terminal buildings, parking areas and access roads.

Therefore, Bills of Quantity (BoQ) have been made for all the works to be constructed by LAMATA followed by estimating the corresponding investment costs (or capital expenditures – CAPEX) for the ferry terminal and lines selected as follows:

- Marine Main Hub Terminal
- Osborne Main Hub Terminal
- West Line: Lasu (Ojo) – Satellite Town – Marina
- North Direct Line: Ikorodu – Osborne
- East Line: Ijede – Badore West – Osborne
- Central Line: Oke Afa – Festac – Mile 2 – Marina
- Olodi Apapa Line: Olodi Apapa Bridge – Liverpool – Marina
- North Hopper line: Mile 12 – Oworonsoki – IBB – Marina
- Five Cowry Creek Line: Lekki – Falomo Bridge – Marina
- Iddo – Ebute Ero Crossing

The BoQ have been based on the conceptual layouts and designs (refer above), results of the various site inspections made by the Consultants (refer Section 3) and hydro-graphic surveys (refer Section 6).

The investment cost estimates have been prepared based on 2007 price levels prevailing in Nigeria. Unit rates have been derived from Consultants cost database for similar project worldwide. As needed, budget cost information has been collected from the Nigerian market.

The BoQ and CAPEX include the following items for the ferry lines:

- Mobilisation / demobilisation
- Surveys (bathymetry, bottom sampling)
- Dredging along the ferry route
- Aids to navigation
- General costs (Contractor profit, risk, general)
- Contingencies
- LAMATA tendering and construction supervision costs

For the ferry terminals the following costs items have been included:

- Land acquisition
- Surveys (bathymetry, topography, bottom sampling, bore holes)
- Dredging
- Floating pontoon (pontoon, piles)
- Access bridge to shore (bridge, piles, abutment)
- Shore protection

- Landfill at terminal
- Terminal buildings (main building, security, workshop)
- Parking areas (park-and-ride)
- Stop-and-go (for mini busses), drop-and-go (for taxis, private cars)
- Utilities (fresh water, sewerage, petrol / diesel, area lighting, generators)
- Bus terminal
- Hinterland road access
- Environmental mitigation measures
- General contractor costs
- Contingencies
- LAMATA tendering and construction supervision costs

A concise description of the above cost items ahs been included in Appendix 5C which also includes the detailed BoQ and investment cost estimates. In these BoQ and CAPEX a distinction has been made for the agreed phasing of the project (refer Section 7 below): phase 1a comprising the priority ferry lines and phase 1b comprising the remainder of the selected ferry lines.

A summary for the CAPEX for Phase 1a has been included in Table 5.4, whilst Table 5.5 shows a summary for the CAPEX for the remaining ferry lines to be implemented in Phase 1b (refer to Appendix 5C for detailed breakdowns).

Description of the Works	**Amount [million Naira]**	**Amount [million Naira]**
Main Terminal Hubs		483
Marina Phase 1a	161	
Osborne Phase 1a	323	
Ferry Routes		2,109
West	235	
North Direct	1,195	
East	679	
Totals	Naira	2,593

Table 5.4 – Summary CAPEX for Phase 1a Ferry Lines

Description of the Works	Amount [million Naira]	Amount [million Naira]
Main Terminal Hubs		417
Marina Phase 1a	417	
Osborne Phase 1a	-	
Ferry Routes		3,424
West	1,027	
North Direct	326	
East	1,407	
Totals	Naira	3,841

Table 5.5 – Summary CAPEX for Phase 1a Ferry Lines

5.7 Implementation Schedule

An implementation schedule for the construction / rehabilitation of the ferry terminals (as well as for the procurement of the ferries) has been made and is included in Figure 5.3. This time schedule shows the following key activities:

- Appointment of Consultant
- Detailed design / approvals of ferry terminal facilities
- Preparation of tender documents
- Tendering process and contract award
- Construction / upgrading of ferry terminals
- Procurement of new ferries
- Handing over of facilities

The total period of time required from the award of the consultant to the handover is some 2 years in case new ferries are employed. Assuming a starting date for the implementation on December 01, 2007 the facilities could then be handed over in December 2009.

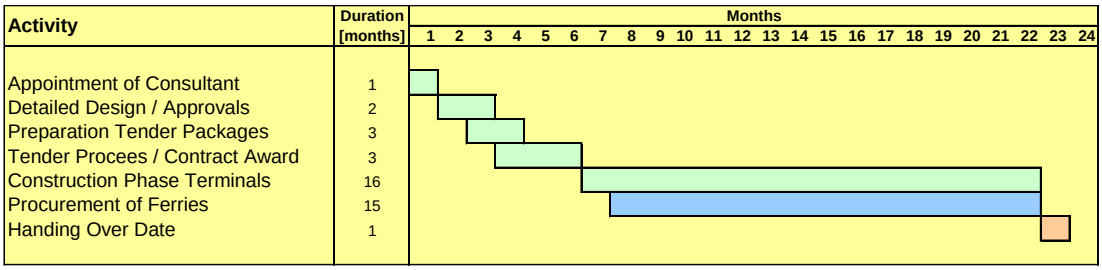


Figure 5.3 – Implementation Time Schedule Ferry Project

6 OPERATIONAL ANALYSES FERRY SERVICES (TASK 6)

This section of the report describes the operational analysis for the ferry services and comprises the following issues:

- Hydro-graphic surveys
- Operational conditions and restrictions
- Ferry concepts

6.1 Hydro-graphic Surveys

6.1.1 Introduction

Lagos is characterized by many waterways, penetrating deep into the Lagos metropolis and comprise shipping channels, creeks, canals, and the Lagoon itself. Thus water transport should give the commuter a better, faster, and safer connection with their working place. Due to current traffic congestion in Lagos, LAMATA embarked on the investigation of ferry transport as covered in this feasibility study, including a survey of the waterways, as a possible alternative means of transportation.

For this purpose, Haskoning Engineering Consultants (Nigeria) mobilized Engee Surveys Ltd to perform a hydro-graphic survey of these water routes, including sites of existing and proposed ferry stations. The full survey report is included in Appendix 6A, whilst the key results are summarised below.

6.1.2 Objectives

The survey objectives were to determine the suitability of the various water channels and ferry station sites, and the provision of appropriate charts from the surveys, as well as to aid decision-making and designing for the ferry operations.

6.1.3 Survey Programme

Period
The hydro-graphic survey was carried out during the period of March 25 – 30, 2007.

Equipment
A combined GPS and digital echo sounder interfaced to a navigation computer was used for the survey. The navigation computer was driven by the Hypack hydro-graphic survey software.

Tidal Observations

During the survey period the water level was observed at the following locations: Festac, Entrance Festac Creek, Iddo, Oworonsoki, and Badore. From these observations a Temporary Chart Datum (TCD) for each of these stations was computed, where the TCD is a height were statistically the water level should not fall below. While processing the data the depths were reduced to this TCD datum. The tidal observations are shown in Figure 6.1.

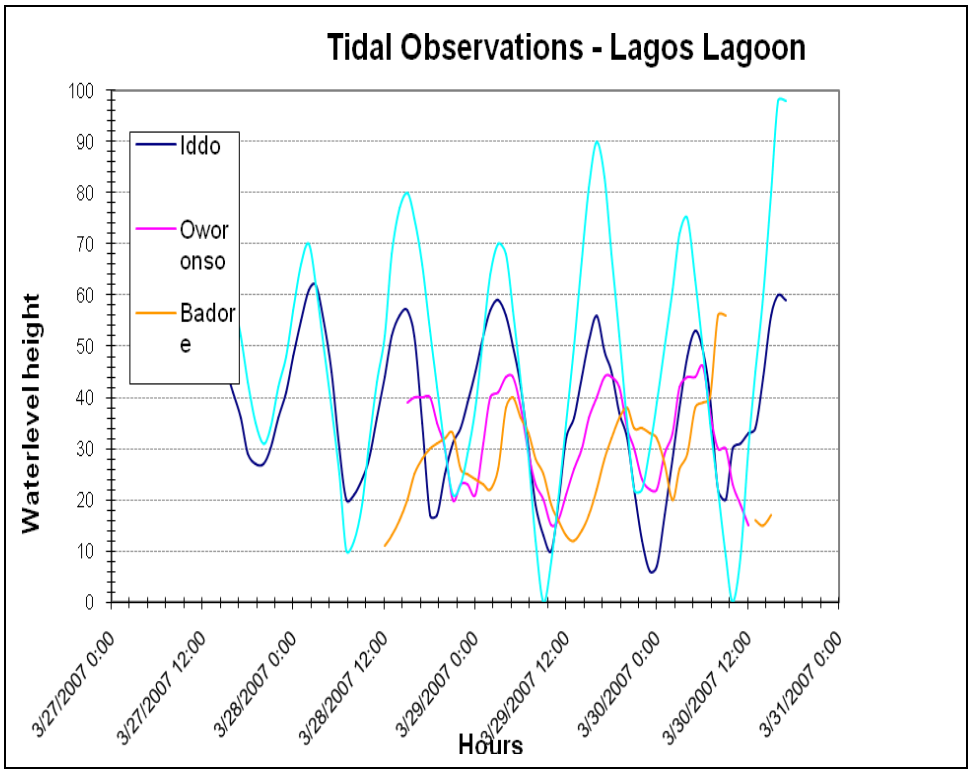


Figure 6.1 – Tidal Observations Results during Hydro-graphic Surveys

Routes

The following routes have been surveyed (refer Figure 6.2):

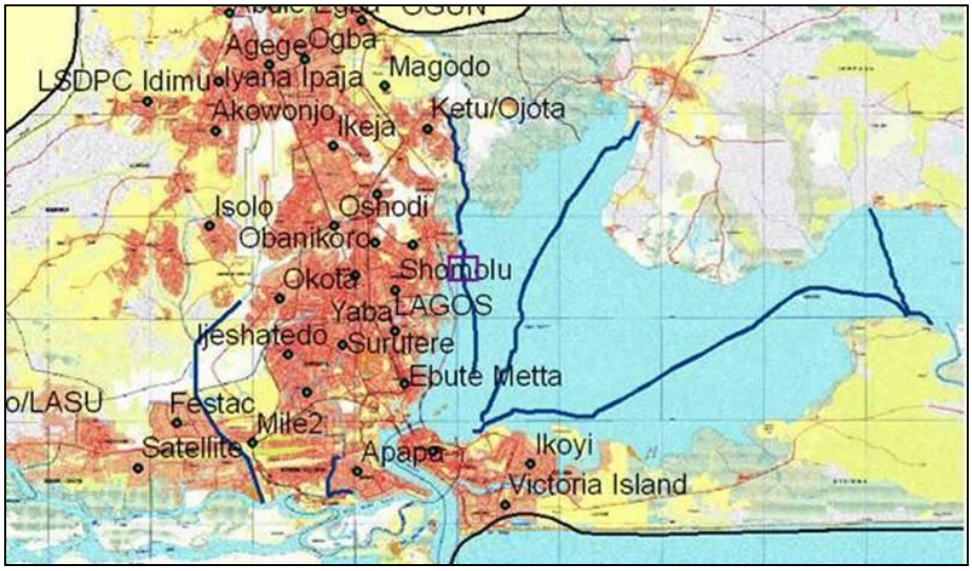


Figure 6.2 – Routes Surveyed

- Line 1A (Route North): Marina – Oworonsoki with detailed survey of Iddo, Work Island IBB – Herbert McCauley, and Oworonsoki
- Shuttle Line North: Iddo – Ebute Ero Market
- Line 1B (Route North): Oworonsoki – Ketu / Mile 12
- Line 2 (Route North): Marina – Ikorodu
- Line 3A (Route Central) : Marina – Mile 2 – Festac
- Line 3B (Route Central): Festac – Oke Afa
- Shuttle Line South: Olodi Apapa – Apapa Express / Liverpool street – Marina
- Line 4 (Route West): Marina – Alaba/Lasu – Satellite Town – Kirikiri – Olodi-Apapa,
- Line 5 (Route East): Marina – Badore-West – Ijede,
- Shuttle Route East: Lekki – Falomo Bridge – Marina.

6.1.4 Survey Observations

General

- The survey boat encountered problems in the Festac Creek by dense formation of water hyacinth, which was impossible to penetrate.

- Also debris, like plastics, on almost all the waters demanded to stop the boat and clear the propeller quite often.

- At the lagoon – mainly in the northern part, viz. the approaches to Oworonsoki, Ogudu Creek and Ikorodu – were often blocked by the fish traps and sticks set up by the fishermen.

Western Routes (Line 4 and Shuttle Route South)

- The channel of Porto Nova Creek right from the Marina up to Alaba/Lasu is deep and without any navigational hazards.

- Alaba / Lasu: A detailed survey of the proposed terminal site at Alaba showed that the direct foreshore is rather shallow. However, when a (floating) jetty would be built at some slight distance of the foreshore the depths will be acceptable.

- Satellite Town: At present LAMATA is making rehabilitation works at the jetty at Satellite town (refer Section 4 above).

- At the East of Satellite Town the Navy has its quarters and sporting grounds at some 1.5km. It is located directly north of the Porto Novo Creek and has all the required facilities, like quay wall and infrastructure. It will be questionable, however, if the Navy would permit commuters to make use of their premises.

- Kirikiri: The waterside is rather small and is used by canoes for offloading sand. There is no infrastructure to allow commuters near the waterfront by road and the site has no parking facilities. Therefore, Kirikiri is not recommended for a terminal.

- Olodi Apapa: The area is densely habited and by road difficult to pass through due to the many hold-ups. The waterside is acceptable and suitable for a future ferry terminal. The infrastructure such as roads and (limited) parking area will have to be facilitated.

- Apapa Express Bridge / Liverpool Street: Presently the boating situation under the bridge is congested and has no proper facilities for the passengers to step on or off, while there is definitely need for a ferry terminal. Bare grounds are rare in this vicinity however, close to the bridge private spacing is available, which can suitably serve as a terminal.

Central Routes (Line 3A and 3B Marina – Mile2 – Festac – Oke Afa)

- The Festac Creek is a pure tidal creek and has no valuable discharge capacity as such. This means that the waters are moved to and fro the creek and therefore any water hyacinth and or debris will remain within the creek system.

- The Festac Creek has depths varying from 5m at the entrance of the creek up to 3m off Festac and gradually decreasing to some 1.0m – 1.4m at Oke Afa. Up to the borrow pit north of Festac the creek is navigational without any serious hazards, thereafter water hyacinth and debris clustered in the hyacinth will take over to dominate the creek.

- Future ferry services, needed to liberate the eastern dense traffic, would require a thorough clean up / dredging of the northern part of the creek and preferably up to the airport.

- Oke Afa: It has been understood that a new ferry terminal is considered for construction at the southern side of the Oke Afa Bridge. This site is at present being used by a number of timber industries, which would then need to be relocated.

- It has been noticed that possibilities exist establishing a ferry terminal on the northern side of the bridge opposite the Memorial Grounds. This site seems now functioning as an agricultural area. Depending on the type of ferry craft to be used a turning basin has to be dredged at either the southern or northern location.

- Festac Terminal: The terminal and its infrastructure are present and in reasonable condition. The direct foreshore of the terminal needs some dredging to accommodate ferries with 1.5m draft.

- Mile 2: Terminal facilities are present, but a thorough clean-up is required as the parking facilities are at present used as car wreck storage. The terminal is outlived and the jetty site is used as ship repair yard.

Northern Routes

- Basically the routes are good navigable, only the approaches to Oworonsoki and Ikorodu are rather shallow, less than 1.5m and need improvement through dredging, depending on the type of craft to be used.

- Also the approaches to Oworonsoki are partly blocked by fish traps. From Oworonsoki the Ogudu Creek up to Ketu / Mile 12 was surveyed. The creek, a distributor of Ogun River, is deep and does not show any navigational hazards. South of the Mile 12 Bridge, on the east bank, facilities for a terminal are present. The approaches to Ogudu Creek are shallow and need to be dredged.

- The Ikorodu route has to follow the NPA dredged channel, marked by permanent navigational aid structures. Close to Ikorodu the route has to deviate to the main town, where a temporary wooden jetty has been constructed.

- Oworonsoki: This terminal needs a thorough clean up; the concrete deck of the jetty looks to be in a deplorable state and has to be further investigated before the service becomes into operation. The survey shows that in front of the jetty in the centre a wrecked canoe is obstructing a direct access.

- UniLag: The foreshore has been inspected and is throughout shallow and partly blocked by fish traps. The remnants of a previous jetty and concrete pillars showed that the University had a jetty in the past. No further survey was carried out for reasons of shallowness and the allowance for entering the site by commercial commuters is questionable.

- IBB Work Island: The Island would offer good infrastructural facilities and would decongest the Ebute Metta / Yaba area. The present facilities need to be connected to the road system to the IBB Express and the Herbert Macaulay Road. Part of the island has proper quay wall protection and only the direct front of the wall requires a clean up through dredging.

- Iddo: The jetty, NIWA controlled, is intensively used by boats from Ogun and Osun State as well as a general market place. A shuttle service between Iddo and the Terminal off Ebute Ero Market on Lagos Island (at Elegbatta) would serve its purpose. Depending on the type of craft to be used the foreshore of the jetty needs a clean-up through dredging. If the intention arises to make a wider use of the jetty then the wrecks on the eastern side would have to be cleared.

Eastern Routes

- For the eastern routes the general shipping route passing through the Palavar Islands has to be used, giving adequate depths and no navigational hazards. The survey, partly south of the general shipping route, showed some shallowness and has to be avoided.

- The direct approach to the Badore terminal has to be cleaned up through dredging. The westerly located State Terminal is in a good condition and offers all the required facilities. The crossing from Badore West to Ijede has to be dredged at some locations. This route is presently operated by Tarzan, applying shallow speedboats.

- Further, Tarzan has constructed wooden jetties both at Badore and Ijede to avoid the shallows in front of the jetty. The originally constructed jetty at Ijede is collapsed and needs a complete re-structuring. However, the Ijede Terminal as well as the infrastructure would fulfil its requirements.

- Lekki Phase 1: To decongest the Lekki – Epe Expressway entering into Victoria Island a ferry terminal off the roundabout off Lekki Peninsula is recommended. A suitable site for such a terminal will be off the junction Admiralty Way and Adelowo Adedeli Crescent at the Lekki Peninsula drain. This site is having all the potentials for a terminal, its infrastructure and jetty.

- The route, passing through Five Cowry Creek, is free from navigational hazards. However, good seamanship is required for passing under the Western Bridge crossing this creek as under certain tidal conditions very strong currents exist.

In general it can be stated that the orientation hydro-graphic survey described above gives adequate information of the possibilities for setting up ferry operations, thereby assisting in solving the present traffic congestion.

6.2 Operational Conditions and Restrictions

The operational conditions and restriction for larger scale ferry operations in the Lagos metropolis have been addressed below as follows:

- Water depths and dredging
- Marine conditions
- Physical restrictions
- Pollution
- Other waterborne traffic
- Safety on board

6.2.1 Water Depths and Dredging

One of the important natural restrictions for the operation of larger sized ferries in the Lagos metropolis is the available water depths along the proposed ferry routes. One option is to dredge a navigation channel at the shallow and narrow locations accommodating such ferries.

For this purpose, a channel having a depth of 1.5m and a width of 100m has been selected. The required dredging volumes have been estimated for each of the main ferry lines based on the reconnaissance hydro-graphic survey described above. The results are indicated in Figure 6.3 and show a total dredging volume of some 1 million m^3.

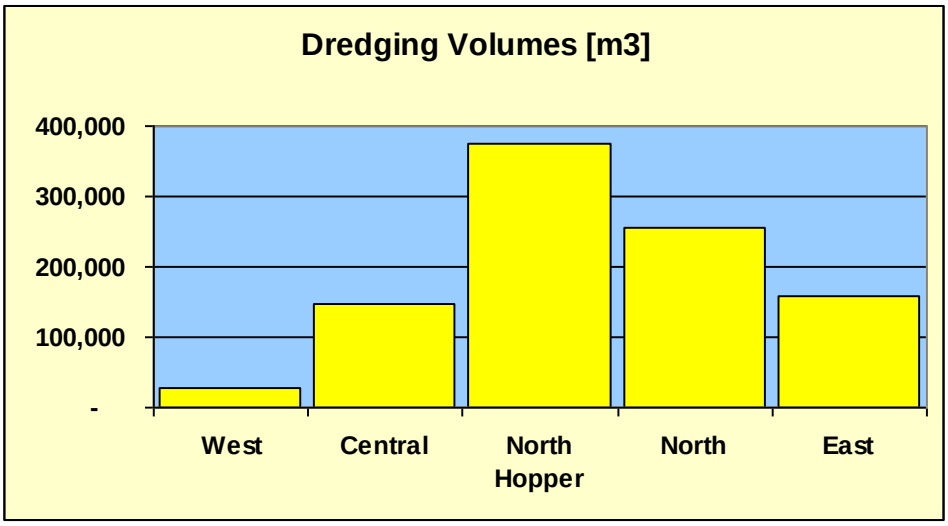


Figure 6.3 – Estimated Dredging Volumes per Main Ferry Lines

Further, an initial differentiation has been made regarding the type of material to be dredged. Three categories have been identified, namely: (1) sand, (2) mud, and (3) polluted. The respective dredging volumes have been indicated in Figure 6.4. It is expected that the sandy materials can be re-used for land fill purposes within this project or elsewhere. Muddy and polluted materials are to be dumped at designated areas, possibly at sea. Polluted materials are expected on the Central Line specifically on the section between Festac and Oke Afa.

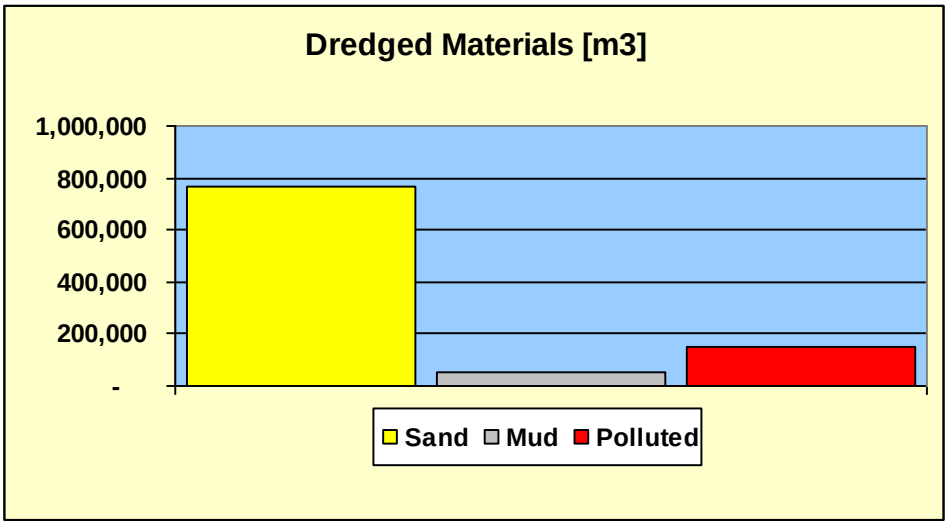


Figure 6.4 – Dredging Volumes per Type of Material on Ferry Routes

6.2.2 Marine Conditions

An inventory of the marine conditions in the project area has been made on the basis of collected information and data provided by the Oceanographic Institute in Lagos as follows:

- Tides – ranging from 1.0m in the entrance to the Lagoon to 0.5m further inside (refer also to the hydro-graphic surveys above)
- Waves – ranging from a significant wave height (H_s) from some 0.3m to 0.6m on the Lagoon; occasionally higher waves can be encountered during short period of strong winds.
- Currents – generally low with velocities less then 0.5kn (or 0.25m/s) to 1kn (or 0.5m/s). However, stronger currents can be experienced in the western entrance to the Five Cowry Creek
- Wind – generally mild with wind speeds well under 20kn (some 10m/s). Occasionally, stronger winds above 20kn can be encountered.
- Visibility – Good, but during heavy rain storms in the wet season visibility may be (somewhat) reduced.

6.2.3 Physical Restrictions

Bridges

The proposed main ferry lines are crossed by a number of bridges. The following bridge heights (refer Table 6.1) were obtained from a LSG official familiar with ferry operations and routes in Lagos.

No.	Bridge Name	Safe Passage Heights
1	3rd Mainland Bridge	10.9 m
2	Carter Bridge	8.9 m
3	Eko Bridge	8.5 m
4	Five-Cowry Bridge (Mekwen)	3.8 m
5	Falomo Bridge	4.2 m
6	Liverpool Bridge	8.0 m
7	Mile 2 Bridge	4.2 m
8	Amuwo / Festac	4.5 m
9	Coconut Bridge (Tin Can Island)	8.8 m
10	Oke Afa Bridge	4.9 m

Table 6.1 – Bridge Heights a High Tide

The bridges at Festac and at the entrance to the Five Cowry Creek are reported to be the lowest and narrowest ones (refer Figure 6.5). For the Coconut Bridge towards Tin Can Island and the Oke Afa Bridge no data was readily available and therefore additional measurements have been made for these bridges. Even with a conservative correction for tide of 1m it appears that both bridges are not the restricting factor since the Liverpool Bridge and Mile 2 Bridge are lower.

The minimum available width is reported at some 13m for all of the bridges. Width is not expected to be a constraint for the development of future ferry services.

Festac Bridge

Bridge at Entrance to Five Cowry Creek

Figure 6.5 – Lowest Bridges in Lagos Metropolis

Fish Traps

On the western side of the Lagoon the navigation of the ferries may be restricted by the presence of (unlit) fish traps (refer Figure 6.6). In case of twilight or even night navigation these traps need to be clearly marked and shown on the ferry navigation maps.

Fish Traps on the Lagoon

Figure 6.6 – Fish Traps on the Lagoon

Towers for Power Cables

Further, on the Lagoon there are a number of towers for (high voltage) power cables crossing the Lagoon (refer Figure 6.7). As these towers are generally unlit, they may pose a restriction for navigation, which can be mitigated by marking the towers with lights and radar reflectors.

Figure 6.7 – Towers for High Voltage Power Cables on the Lagoon

Water Hyacinth

Finally, navigation can be hindered by the annual recurrent growth of water hyacinth on the creeks (refer Figure 6.8), specifically on the Festac Creek and – to a lesser extent – on the creek running up to Mile 12.

Figure 6.8 – Water Hyacinth on the Festac Creek

6.2.4 Pollution

Another important issue which might affect safe and efficient navigation on the Lagos metropolis waters is the environmental pollution in the form of plastic bags (refer Figure 6.9). This issue has been extensively addressed in the section on social and environmental issues (refer Section 9). Due care for this issue is required in the design and operation for the new ferries.

Figure 6.9 – Presence of Plastic Bags hindering Navigation

6.2.5 Other Waterborne Traffic

Other waterborne traffic on the metropolis waters comprises:

- Seagoing vessels in the Lagos Harbour area (Apapa, Tincan Island),
- Wood log units being transported from the east of the Lagoon to the timber sawing mills in Lagos,
- Dredgers moored in the Lagoon for land reclamation purposes (Lekki Phase II),
- Small vessels / canoes being using for sand mining, and
- Small canoes used for the transportation of people. Some pictures of this traffic are shown in Figure 6.10.

Small Craft sailing on the Creeks

Canoes used for Sand Mining

Dredging Activities for Land reclamation on the Lagoon

Julius Berger operation on Creek outside Ijede

Figure 6.10 – Other Waterborne Transport Examples

6.2.6 Safety of Ferry Operations

Ferry Safety

Based on the results of the socio – economic surveys carried out for this project (refer Section 2 above) it is clear that the Lagosian population has a fear for water. Therefore the safety of the ferries as well as the perception of safety on board of the ferries has to be ensured and guaranteed.

With respect of the safety of the ferries it is important that they are duly classified and then surveyed at least one a year by a reputable classification society or registered inspector. An official permit (issued by for instance NIWA and regularly updated) stating that the safety is guaranteed shall be mandatory for the operator in order to provide ferry services.

With respect to the classification societies Consultants strongly advise to accept only the renowned classification societies such as Lloyds Register (LR), American Bureau of Shipping (ABS), Det Norske Veritas (DNV), or Germanischer Lloyd (GL). Sub-standard classification societies are not preferred since an accident with a ferry might be devastating for further developing and implementing ferry transport in Lagos.

To reduce the risk of capsizing of ferries due to overloading of passengers, it is strongly recommended to use only catamarans or single deck mono-hulls. Further, it is recommended / required that all passengers are being seated inside the ferry to increase the safety as well as to provide adequate comfort levels. Finally, adequate number of life vests should be provided on board the ferries (refer Figure 6.11).

All Passengers have a Life Vest on Tarzan Boats

For the Ikorodu Ferry all Passengers are seated inside the Ferry

Figure 6.11 – Life Vests for the Safety of Passengers

Terminal Safety

Quays and gangways at the landing sites for the ferries should be fitted with barriers. Further, all berths should be provided with good readily accessible life saving equipment. In addition, the availability of a safety guard is advised at all berths.

6.3 Ferry Concepts

The various types of ferries considered for this project are described in this section and comprise the following issues:

- Hull speed and fuel consumption
- High speed and vessel weight
- Ferry examples
- Propulsion systems
- Comparison of ferry alternatives
- Identified ferry options
- Selected ferries

6.3.1 Hull Speed and Fuel Consumption

Hull Speed

An important relationship for any ferry operation is the relation between ferry speed and its fuel consumption. For a standard displacement vessel that uses hydrostatic buoyancy to compensate the total weight of a vessel, the fuel consumption (and thus the required engine power) increases considerable with the increase of sailing speed as has typically been indicated in Figure 6.12.

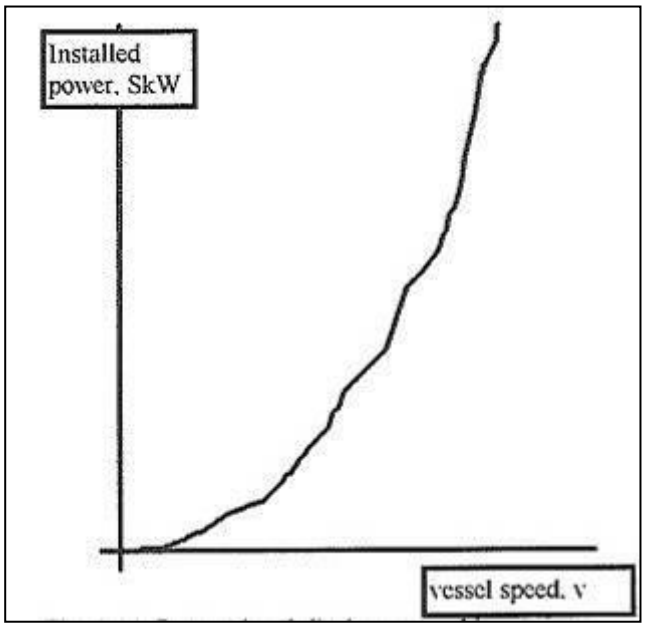


Figure 6.12 – Installed Power versus Speed for a Conventional Displacement Vessel

A conventional displacement ship can not sail much faster than the speed of the vessel generated wave with a length equal to the length of the vessel, also referred to as its “hull speed”. In this situation it would mean that a ship is not able to sail up to its own wave generated at the bow of the vessel: the ship gets a trim angle and sinks into the crest of its own wave. Therefore, the vessel draft increases and as a result, with this increasing draft the ship resistance increases even faster.

Deep Water

For conventional displacement vessels the so called “hull speed” can be calculated for unrestricted water depths using the deep water formula for wave speeds.

Wave Speed = $\sqrt{\frac{g \cdot L}{2 \cdot \pi}}$	in [m/s]

The hull speed is calculated by setting the length of the wave (“L”) equal to the length of the vessel on its waterline (so called waterline length or “L_{wl}”, which is generally about 95% of the overall length of the vessel). The resulting hull speed is then:

Hull Speed = $4.5 \cdot \sqrt{L_{wl}}$	[km/h]

And this corresponds to a speed of:

- 4 km/h for a ship of 10 meter length,
- 20 km/h for a ship with a length of 20 meters, and
- 28 km/h for a ship with a length of 40 meters.

For displacement vessels it is normally economic to sail at some 80% of the hull speed. If higher speeds are required a standard displacement vessel is no longer suitable.

Shallow Water

On shallow water the length of the waves is physically restricted by the water depth and therefore not the ship length but the water depth defines the maximum speed at which the resistance and power demand increases considerable. Besides this, also squat effects are stronger at shallow draft. The wave speed at shallow water indicates the location of the hub in the power demand and can be calculated as:

Wave Speed @ Shallow Water = $\sqrt{g \cdot h}$	[m/s]

Wave Speed @ Shallow Water = $11.3 \cdot \sqrt{h}$	[km/h]

This results in a shallow water speed of

- 14 km/h at a water depth of 1.5m
- 18 km/h at a water depth of 2.5m

For displacement vessels it is nevertheless possible to go faster than this restricted shallow water wave speed, but at cost of strongly increased power demand and hence fuel consumption. Therefore, if higher ferry speeds are required a standard displacement vessel is not suitable at shallow water depths.

→ Standard displacement vessels are only suitable for low speed operations!

Combined Effects

To estimate the maximum and economic speeds of a displacement vessel a formula can be used that takes into account both effects of water depth and the length of the vessel (at waterline). The hull speed at restricted draft can be calculated as:

$$\text{Hull Speed @ Restricted Water} = \frac{3600}{1000} \cdot \sqrt{\frac{g \cdot L_{wl}}{2\pi} \cdot \tanh\left(\frac{2\pi \cdot h}{L_{wl}}\right)} \quad \text{[km/h]}$$

It has been concluded from the hydro-graphic survey that the following water depths are relevant for this study:

- A water depth of 1.5m relate at shallow areas that need to be dredged
- A water depth of 2.5m is indicative for the northern and eastern ferry lines
- A water depth of 5.0m is indicative for the western and central lines

The maximum speed of a displacement vessel at shallow water has been calculated for different ship lengths and relevant water depths of (refer Figure 6.13).

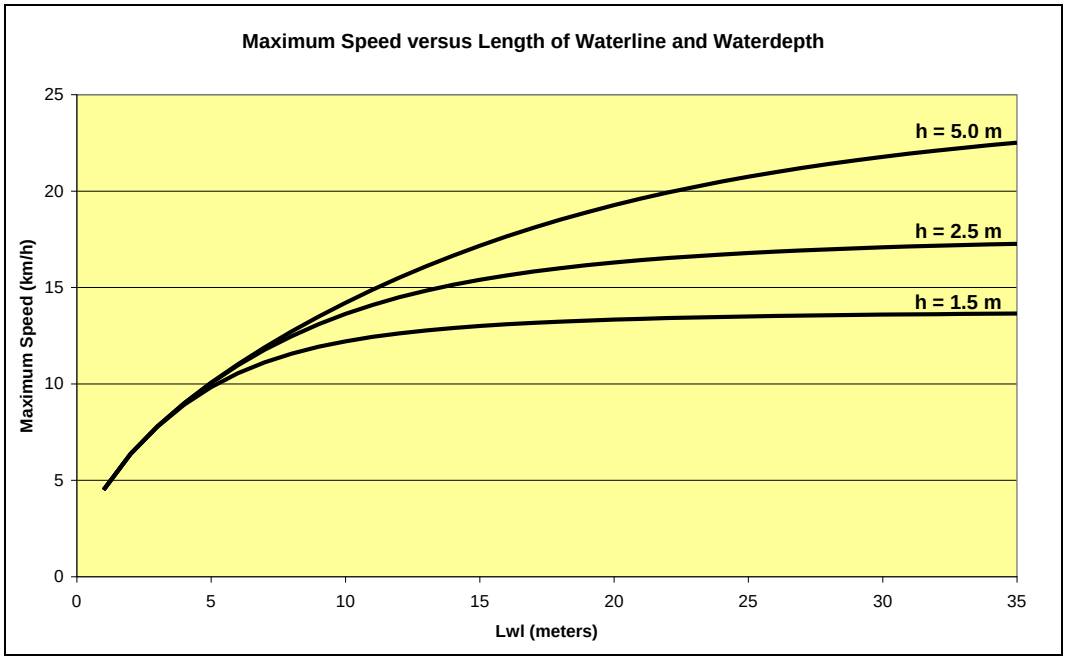


Figure 6.13 – Maximum Speed of Displacement Vessels at Restricted Water Depth

Economic Speed

The economic speed for displacement vessels in the indicated size range is generally about 80% of the maximum speed at restricted water depth. This figure has been used for displacement vessels throughout the study. For semi-planing and planing vessels a higher speed has been used in the calculations.

6.3.2 High Speeds and Vessel Weight

From the above it becomes clear that conventional displacement vessels are only suitable for the speed range between 10km/h and 20km/h and preferably at deep water. If faster services are to be offered more advance ferries would be required. The following options have been considered for this purpose:

- Planing Mono Hulls
- Catamarans
- Hydrofoils
- Hovercrafts

High speed craft can either be supported by hydrostatic, hydrodynamic or air lift (refer Figure 6.14). The type of lift has a strong impact on the performance of the vessel. Except for slender catamarans, hydrostatic lift is not suitable for high speed vessels and additional hydrostatic or air lift will then be required.

For all the lifting options the weight of the vessel is the main restricting factor. Catamarans reduce waves by making slender bodies, thereby minimizing the wave generating surface on the waterline. Since slender bodies provide small displacement their carrying capacity (and weight) is also limited.

Other vessel types like planing mono hulls and hydrofoils use hydrodynamic lift to reduce the underwater volume (displacement) of the ship. To some extend this is also the case for planing catamarans. On the other end of the spectrum air lift can be used to carry the vessel as is the case with hovercrafts.

High speed ferry services will require advanced marine vehicles which are very sensitive to weight (especially in areas were also the draft is limited due to available water depths). This implies that fast ferry services are well suitable for the transport of passengers (and a limited number of motorcycles), but that fast transport of cars will be extremely difficult or costly, especially in smaller vessels and at restricted water depths.

→ Fast ferries vessels are very sensitive to the weight of the vessel and not very suitable for the transport of cars or heavy cargo loads!

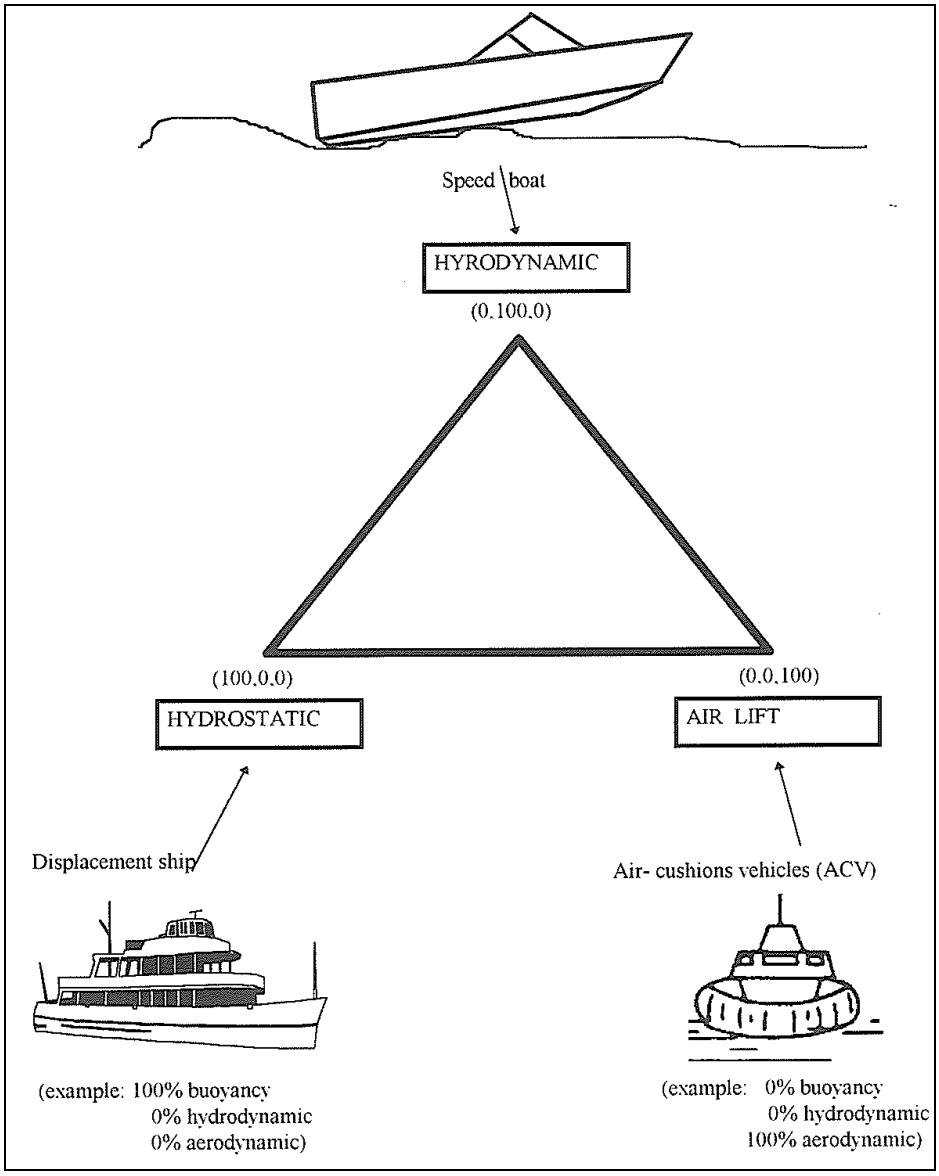


Figure 6.14 – Lifting Support of High Speed Vessels

6.3.3 Ferry Examples

1. Displacement Mono Hulls

Displacement mono hulls are suitable on short routes (e.g. crossing a river or creek) where the sailing time is limited. They have the advantage of being able to carry the weight of many passengers, motorcycles and even cars. Often they have a ramp at the front of the ship, but side loading is also an option for passengers and motorcycles. A number of different mono hulls are described below ranging from small canoes to large car and truck ferries.

- Nigerian Ferries

Canoes and small plastic motorboats (refer Figure 6.15) are currently used to offer small scale river crossing services at many locations in Lagos metropolis. It is advisable to offer space for these small operators such that they can offer additional services in addition to the main ferry network.

Figure 6.15 – Motorised Canoes and Small Boats operating in Lagos at Marina (left) and Olodi Apapa Bridge (right)

On a slightly larger scale, but still in an open boat, Tarzan offers ferry services at Maroko crossing the Five Cowry Creek (refer Figure 6.16). Passengers can cross the creek for 50 Naira. For safety reasons lifejackets are provided for all passengers and crew members. The ship is capable of carrying some 20 passengers per trip and sails 5 to 20 times an hour depending on the volume of the passenger flow.

Figure 6.16 – Tarzan Ferry crossing the Five Cowry Creek

Figure 6.17 shows a small bicycle and passenger ferry crossing a river in the Netherlands. The ship has a small ramp at the front and uses only limited shore space. Such a ferry might be an option for the transport of a limited number of motorcycles in Lagos as well.

Figure 6.17 – Small Bicycle and Passenger Ferry crossing a Dutch River

Generally, more professional ferry services do not use outboard engines since the small propellers of an outboard engine are not very fuel effective and the power output is often too limited to provide sufficient trust. Nevertheless, at low sailing speeds outboard engines can be used for vessels up to some 20m. Tarzan has developed and built a small car ferry suitable for the transport of about 6 cars (refer Figure 6.18) and offers car transport services across the Five Cowry Creek. This vessel uses two outboard engines.

Figure 6.18 – Tarzan Carry Ferry at Five Cowry Creek

- Niger Dock Ferries

In the past over 20 passenger vessels have been built at Niger Dock in Lagos. The latest delivery was back in 1994. Two examples of vessels built in the past have been provided by “Green Seas International (Nigeria) Ltd.”. They consist of a 50 PAX and a 110 PAX ferry (refer Figure 6.19).

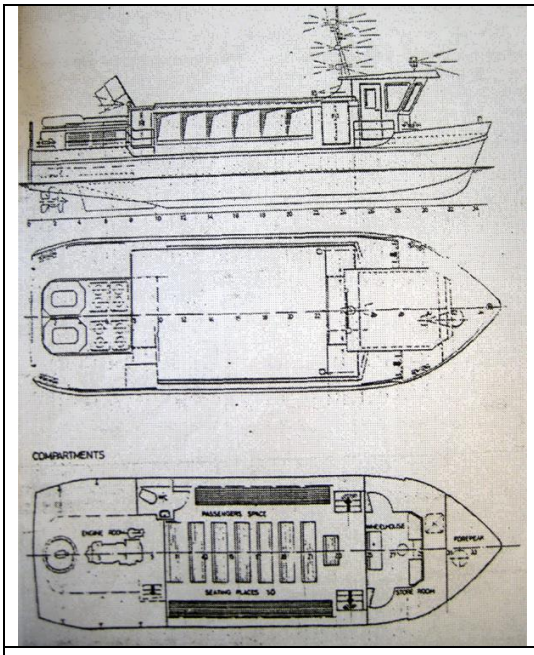
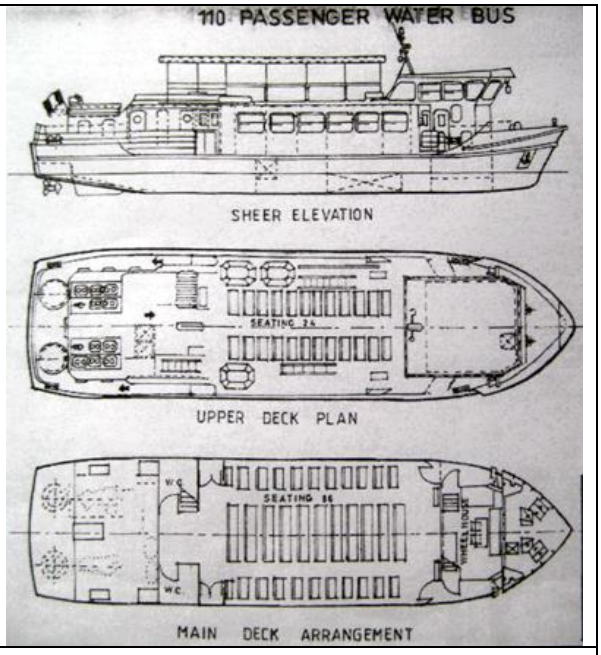
	
Length: 16 m Breadth: 5.0 m Draft: 1.0 m Speed: 15 km/h Power: 121 kW	Length: 25 m Breadth: 6.5 m Draft: 1.0 m Speed: 33 km/h (note this is a planing vessel) Power: 447 kW (high because of high speed)

Figure 6.19 – Examples of Vessels build in the past at Niger Dock

Based on the knowledge of the previous Niger Dock designs Green Seas have provided an indicative price for these vessels (at 2007 prices) and for a larger 400 PAX ferry as follows:

- Passenger Ferry (110 PAX) US$ 1.1 million
- Passenger Ferry (50 PAX) US$ 0.5 million
- Passenger Ferry (400 PAX) US$ 1.4 million

- Thailand Ferries

Simple mono-hulls made of GRP (Glass-fibre Reinforced Plastics) are for instance used in Thailand (refer Figure 6.20).

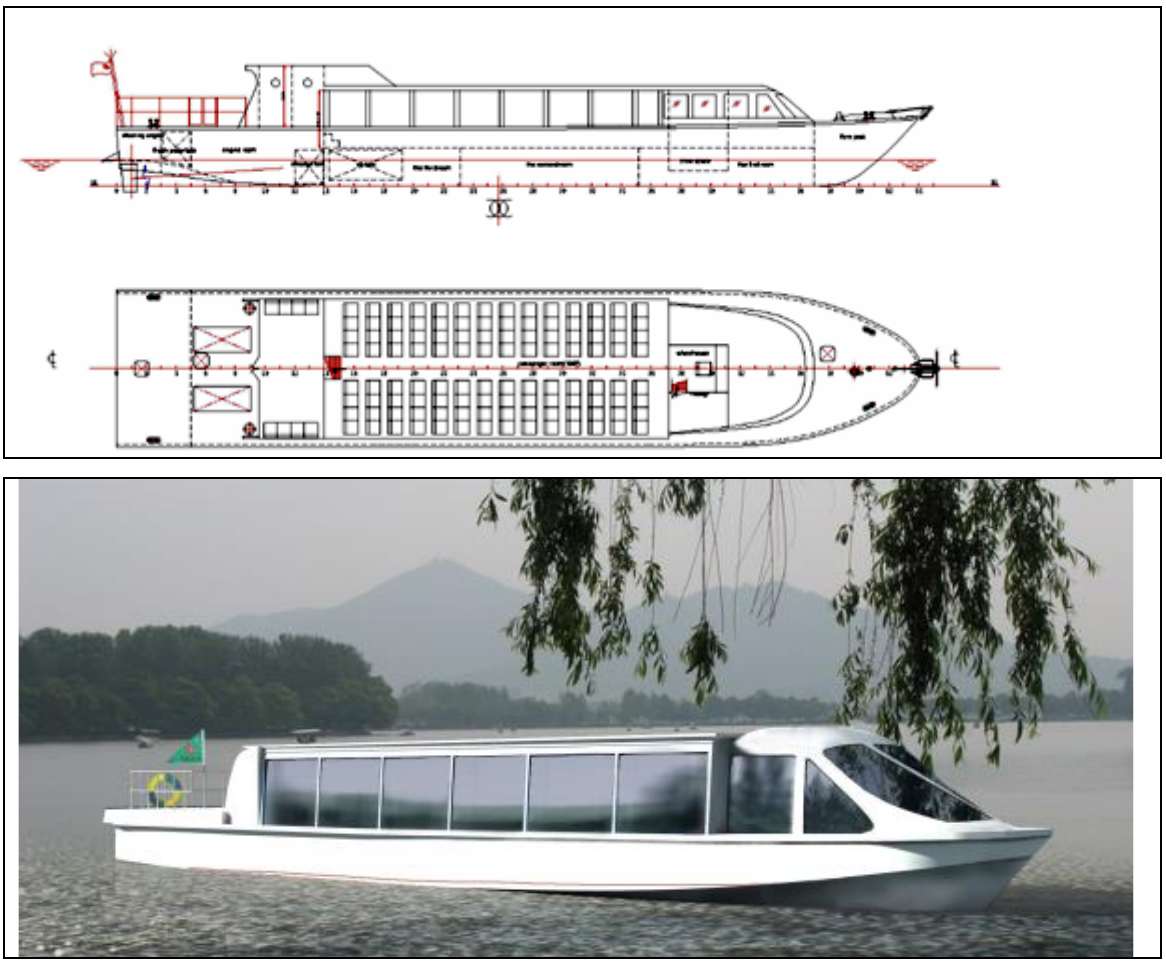


Figure 6.20 – 120 PAX Ferries as used in Thailand

The vessel has the following characteristics:

- Length overall: 27.00 m
- Length waterline: 25.55 m
- Beam: 5.30 m
- Draft: 0.90 m
- Capacity: 120 PAX
- Engine: 2 x 225 HP
- Speed 28 km/h
- Cost Indication: US$ 400,000

The benefit of these vessels is that they are long and small and therefore have a high displacement hull speed. When designed properly and well powered they can even become planing or semi-planing.

- Italian Ferries

Similar mono-hulls of higher quality are used for instance in Venice, Italy by the Alilaguna Lines from the airport to the city (refer Figure 6.21).

Figure 6.21 – 90 PAX Vessel used by Alilaguna Lines in Venice (Italy)

These ferries have the following main characteristics:

- Length 20 m
- Width 3 m
- Draft 0.80 m
- Capacity 90 PAX
- Economic Speed 15 – 20 km/h
- Fuel Consumption 50 l/h
- Propulsion 2 x 175 HP and 2 propellers

Recently some larger vessels have been acquired with the following characteristics:

- Length 24 m
- Width 4 m
- Propulsion 1 x 225 HP and single propeller
- Cost Indication US$ 1.0 million

- Dutch Ferries

Examples of some larger vessels can be found in the Netherlands. Figure 6.22 shows a ferry used in Amsterdam in the Netherlands where a municipal public transport company offers water transportation (free of charge) for passenger and bicycles. The vessel shown is suitable for transport of passengers, bicycles and motorcycles. This public transport company of Amsterdam has three such vessels in operation, each with a length of 21.3m, a beam of 5.75m, an air draft of 3.50m and a draft of 1.10m. The available deck space is 114m^2 and the vessel offers space for 120 PAX and some motorcycles and bicycles.

Figure 6.22 – Amsterdam Ferry for some 120 PAX and some Motorcycles

On the main ferry routes from the Central Railway Station in Amsterdam to the North the same public transportation company also offers free passenger services with larger vessels build quite recently (refer Figure 6.23). These vessels have a length of 28.60m, a beam of 9m, an air draft of 9.20m, and a draft of 2.1m. The available deck space is 247m^2 and the vessel offers space for 300PAX and some motorcycles.

The vessel uses the front side for embarking and disembarking. The total turn around time to exchange all passengers (dedicated lanes) is no more than 3 minutes, and this is proven to be sufficient.

Figure 6.23 – New Amsterdam Ferry for some 300 PAX and some Motorcycles

Displacement vessels are also very common for transporting cars and trucks from one side of a river or channel to the other. A displacement car ferry normally has two ramps, one ramp at the stern and one at the bow. The cars only drive forward onto and off the ship. The ship is generally built symmetrically over the length and as a result the bow and aft is identical. In stead of turning the ship around it simply changes its sailing direction. This increases turnaround times significantly. An example of a medium sized car ferry is shown in Figure 6.24 and is capable of transporting some 15 cars.

Figure 6.24 – Car Ferry capable of transporting some 15 Cars

Sort like car ferries are also build in Nigeria. During our visit to Imabin International (Nigeria) Ltd we understood that they are building a car and passenger ferry Akwaibom State. The vessel is currently under construction in Port Harcourt. Main characteristics of the vessel are:

- Length: 31.16 m
- Breadth: 10.00 m
- Draft: 1.60 m
- Capacity: 10 Cars and 60 PAX
- Cost Indication: US$ 936,000

A picture of the general plan of the vessel is included in Figure 6.25.

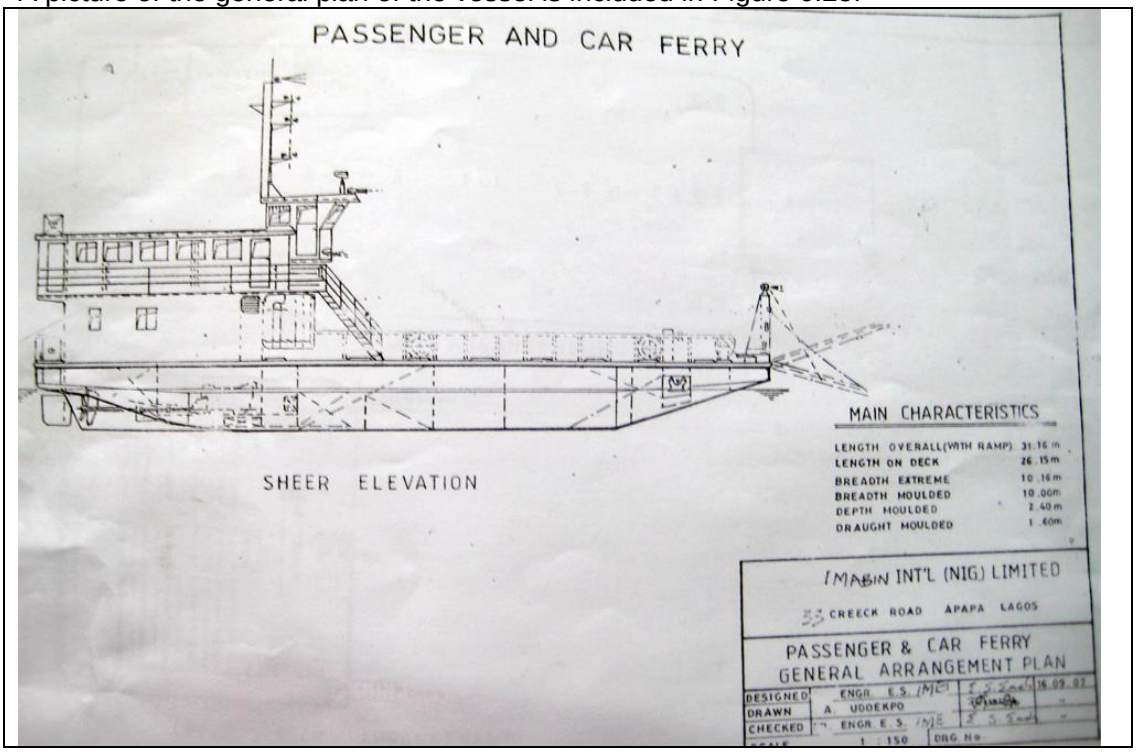


Figure 6.25 – Picture of General Plan of Vessel Under Construction

The ferry in Figure 6.26 is larger and can carry up to 40 cars (or 850 PAX instead). This larger ferry has a length of 49.30m, a beam of 13.50m, an air draft of 2.76m and a deck area of 523 m^2. Two such ferries are operated by the public transport company of Amsterdam.

Figure 6.26 – Car Ferry capable of transporting 40 Cars or some 850 PAX

Yet another example of conventional ferries is the Daman Shipyards ferry “Johé” (or Damen Ferry 4010) recently build for the Gambia Ports Authority (refer to Figure 6.27) and capable of carrying 4 large trucks. Alternatively, there is space for some 18 cars or some 400 passengers with motorcycles. In this case the draft of the ferry can be reduced. It has been understood from Damen Shipyards that a certain type of vessel can be delivered for a price of about US$ 7 million

Figure 6.27 – Damen Shipyard Ferry “Johé”

2. Low Speed Catamarans

Low speed displacement catamarans are relatively cheap compared to high speed catamarans, but the quality of the service (speed) is also not comparable. Texas Connection Ferries offers such water transport with a displacement catamaran having a capacity of some 100 passengers (refer Figure 6.28)

Figure 6.28 – Low Speed Catamaran sailing towards Marina

Catamarans are a good solution for passenger transport since passengers are light and not much vessel displdisplacement is required to carry them. A simple catamaran as operated by Texas Connexions Ltd uses a simple frame structure for the ships hull and superstructure.

Low speed catamarans are generally fitted with outboard engines since the vessel structure does not allow for a much heavier propulsion system. Therefore, the maximum reasonable size for low speed catamarans is limited to about 100 persons.

There are quite some companies producing glass-fibre (or Para Aramid) crew boats in Nigeria. The Consultants visited “Capricorn Marine Technologies Plc” which is a producer of these kind of vessels located in Lagos. It has been understood that this company has recently built two “Trimcity 40LS” tri-marans for AZI Marine Nigeria Ltd in Akwa Ibom State. The design of this vessel is included in Figure 6.29 and Figure 6.30.

Figure 6.29 – Para Aramid Ferry Side View

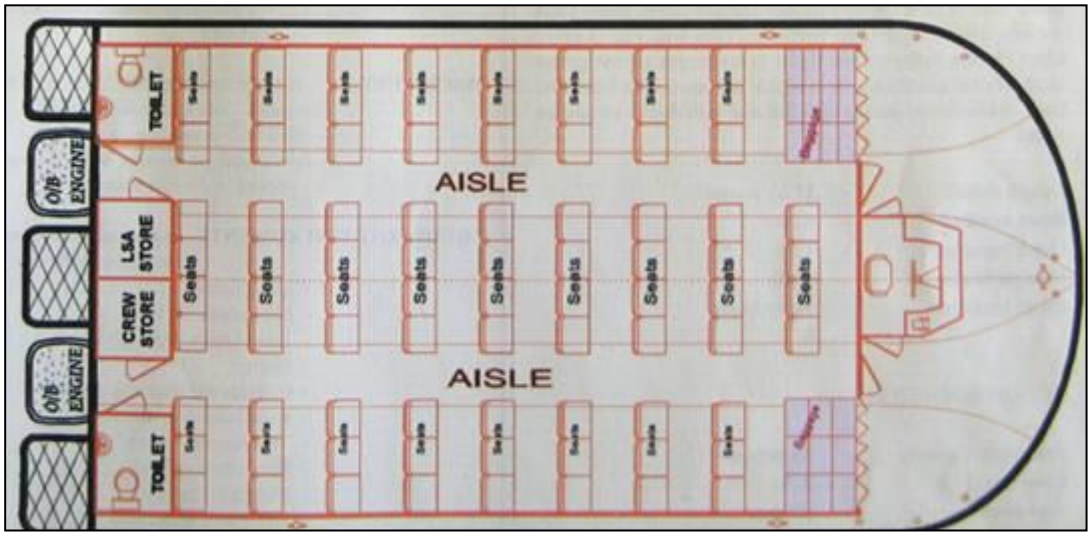


Figure 6.30 – Para Aramid Ferry Layout

The delivered vessels had the following main characteristics:

- Hull: Para-Aramid reinforced glass fibre plastics
- Length: 11.95 meters
- Breadth Moulded: 6.30 meters
- Design Draft: 0.95 meters
- Capacity: 84 seats
- Cost Indication: US$ 120,000

The vessels were fitted with 2 x 115 HP Petrol Outboard Engines. It has been noted by the yard that these vessels have a full load speed of 10kn (18km/h) but giving the length of the vessel and the wave climate in the Lagos Port Area this speed is expected to be too high. An average speed of 15km/h is considered more likely. A price indication of the vessels has been obtained at some US$ 115,000 (based on outboard engines).

Low speed catamarans are generally fitted with petrol outboard engines which are high consuming (about 260g/kwh compared 210g/kwh for efficient inboard diesel engines). To cut fuel consumption and increase safety on board a combined diesel engine with a Z-drive could be used. On the short run outboard engines are more economic since the investment costs are lower. However, on the long run an inboard diesel with a Z-drive is expected to be more efficient since fuel consumption is decreased considerably and diesel engines are more durable and better suitable for heavy duty use.

Catamaran ferries are still operated by the Lagos State Ferry Services Cooperation (refer Figure 6.31). They offer ferry services between Ebute-Ero (Elegbatta) and Ikorodu for 200 Naira and between Ebute-Ero and Olodi Apapa for 40 Naira. Nevertheless, the sailing frequencies are very low. It has been understood that they sail only when the ship is full and this implies that the ship sails from Ikorodu to Ebute-Ero in the morning peak and returns to Ikorodu in the evening peak. In principle the vessel should be operated on a constant schedule of at least one sailing per hour in order to attract later traffic over the day.

Since these vessels are available and competition between a state operator and the private sector is not acceptable (no level playing field) it can be considered to be refurbished and concession the vessels to a private operator. This would allow for a swift implementation of the first lines.

Figure 6.31 – Two Lagos State Ferry Services Cooperation Ferries moored at Mile 2

3. Fast Planning Mono Hulls

High speed planning mono hulls are considered to be suitable for smaller vessels with a carrying capacity up to some 50 PAX. A design of a 36 PAX fast mono hull was recently made by Ace Marine Ltd (refer Figure 6.32) and published in Significant Small Ships of 2004 (Royal Institute of Naval Architects, 2005).

According to the design office the prototype has been proven so successful in operation that they are currently considered for local operations on the Forth and Tay Rivers (UK), as well as for operations in Iran, Panama, and Venezuela.

Figure 6.32 – Spirit Class 36 [source: www.acemarine.co.uk]

Ace Marine has designed a range of ferries with a carrying capacity ranging from 8, 36 to 50 PAX. The Spirit 8 has a maximum draft of 0.45m, whilst the Spirit 36 has a maximum draft of draft of 0.65m, and the Spirit 50 a maximum draft of 0.80m. Figure 6.33 and Figure 6.34 provide the general plans of these three vessel sizes in the Spirit class as well as the details published in Significant Small Ships of 2004.

Table 6.2 presents some details for the Spirit 36.

Dimension / Parameter	Spirit 36
Length Over All [m]	14.8
Beam Over All [m]	3.95
Design Draft [m]	0.65
Design Deadweight [tonnes]	4.3
PAX Capacity [-]	36
Speed [kn] – Maximum	30
Speed [kn] – Design	18

Table 6.2 – Main Characteristics Fast Mono Hulls

According to the design office the Spirit 36 was originally designed to operate in fair weather conditions, but has nowadays proven more than capable of operation in moderate conditions. The Spirit 50 for example should be able to operate in 1m head seas at the design speed of 25kn. To reduce the ferry draft and reduce the vulnerability of the propeller system these vessels are fitted with water-jet propulsion systems.

In Lagos Lagoon, where water depth is restricted to some 1.5m the Spirit 50 is about the upper limit. Larger planing mono hulls are not advisable due to the fact that at displacement speeds (up to the hull speed), all vessels exhibit a degree of squat and trim, which increases the navigational draft of the vessel.

Plastic bags and other sorts of pollution in the water have been reported to be a serious problem for water-jet operations. It seems that it is hardly possible to sail with small water-jets on the Lagos waterways. Larger water-jets seem to have fewer problems than the smaller ones and have more ways of protecting them.

A number of options available that could be applied to reduce / prevent this issue of plastic bags becoming an operational problem have been further discussed below in the section on propulsion. The Spirit 36 and 50 are of such a size that the problems with water-jets are expected to remain and therefore the use of stern drives has been recommended.

Cost estimates have been provided from Ace Marine for vessels built abroad. The estimated building costs and building times are:

- Spirit 36 – GBP 320,000 (US$ 0.7 million ex delivery cost) in 6 months
- Spirit 50 – GBP 480,000 (US$ 1.0 million ex delivery cost) in 8 months

According to the design office the Spirit 36 was originally designed to operate in fair weather conditions, but has nowadays proven more than capable of operation in moderate conditions. The Spirit 50 for example should be able to operate in 1m head seas at the design speed of 25kn.

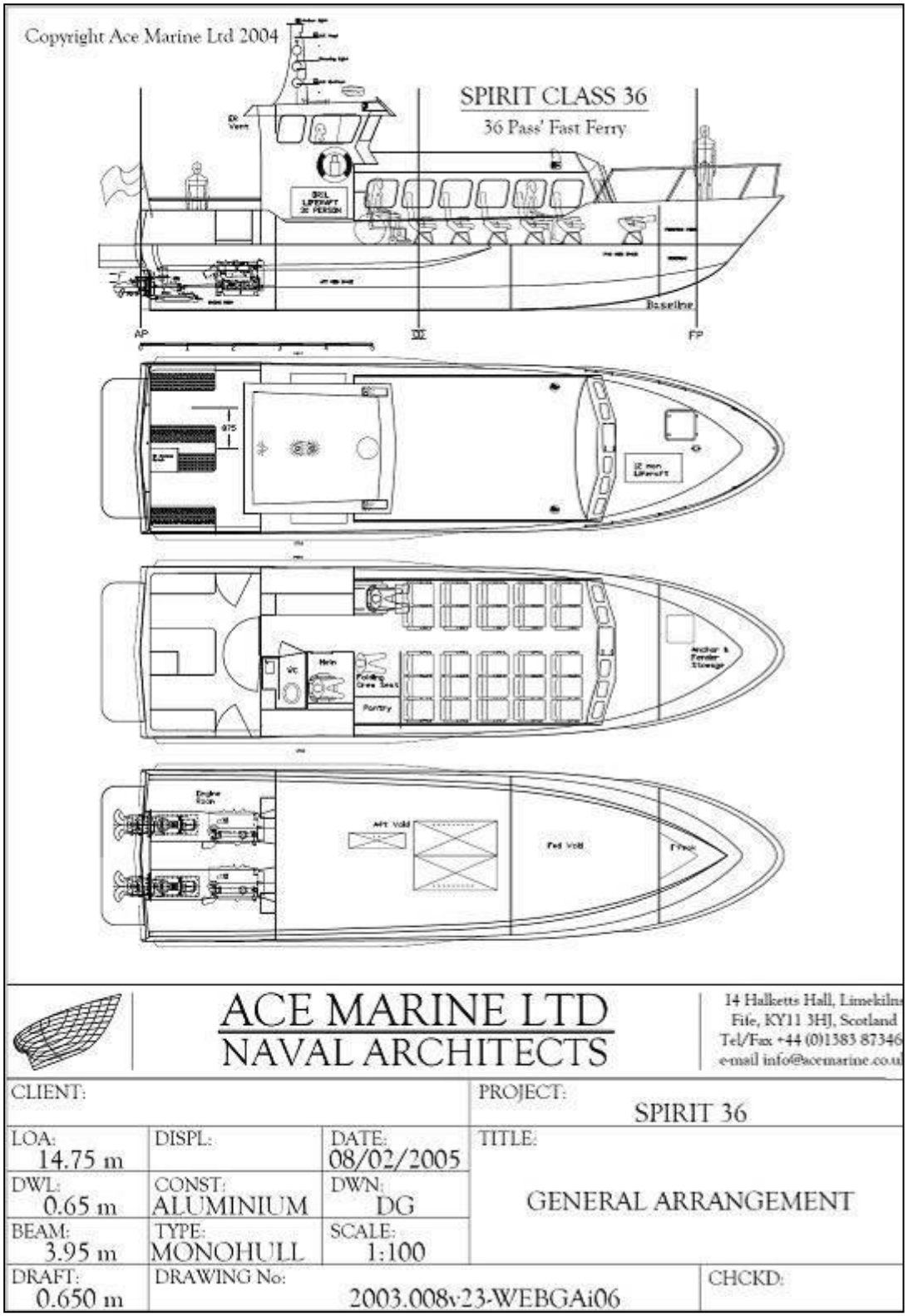


Figure 6.33 – Ace Marine Ltd – SPIRIT 36

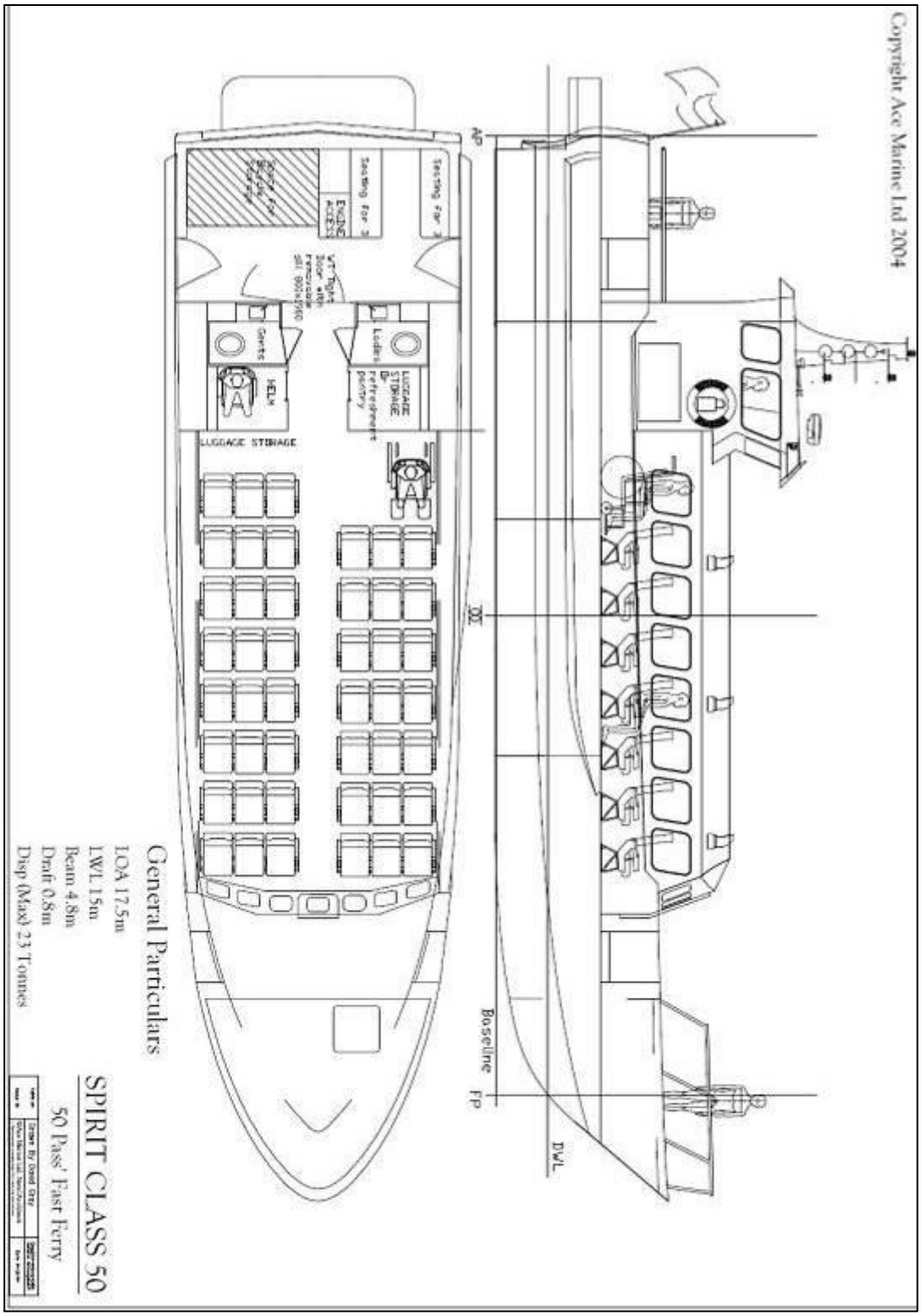


Figure 6.34 – Ace Marine Ltd – SPIRIT 50

4. High Speed Catamarans

When high speed vessels reach their displacement hull speed, they encounter a hub in the resistance curve of the vessel. When this hub is taken they need less power to increase the speed until a certain point from where the resistance increases sharply again. The effect is indicated in Figure 6.35 for both a high speed mono hull and a fast catamaran. The exact shape of this resistance curve differs per specific design for the vessel.

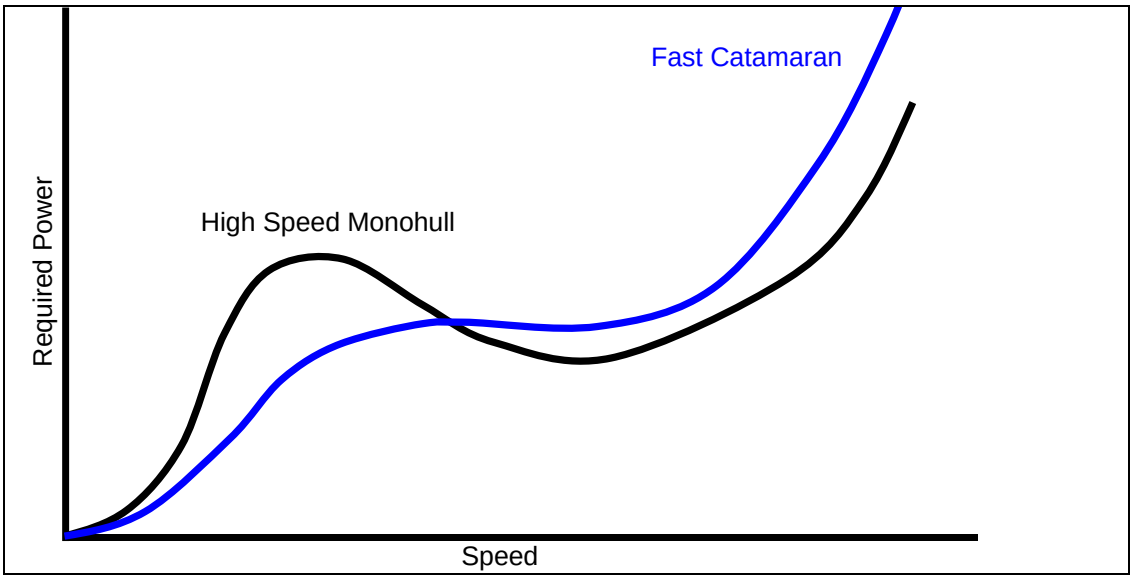


Figure 6.35 – Resistance Curves for High Speed Vessels

Since catamarans have a slender hull shape the magnitude of the hub is smaller than for a mono hull of comparable size. Especially at reduced water depths the catamaran is therefore a preferred ferry option compared with a fast mono hull because squat and trim effects are considerably smaller. One of the main reasons for building high speed catamarans is the reduction of wave hinder (wash) to small fishing boats and canoes: wash of maximum 0.25m.

The maximum feasible size of a catamaran (at restricted water depths) in terms of passengers is therefore larger than for a planing mono hull. This is not surprising since the weight of the catamaran and its passengers can be distributed over two smaller hulls in stead of one big one. Passengers are light but require quite some deck space and therefore a catamaran is also preferred with respect to comfort levels as they offer more seating area per person and wider aisles. Large catamarans are also considered to be safer than multi deck mono hulls since mono hulls have a higher risk for capsizing.

At shallow water depths of up to some 1.5m catamarans are expected to be feasible in the range of 50 up to 150 PAX. Damen Shipyards has prepared some conceptual designs for a 50, 100 and 200 PAX catamaran (refer Figure 6.36 to Figure 6.38).

Figure 6.36 – Damen Fast Ferry 1907

Figure 6.37 – Damen Fast Ferry 2408

Figure 6.38 – Damen Fast Ferry 3209 SD

Catamarans with a capacity of 200 PAX seem an absolute limit capable of operating at 1.5m water depth. It is recommended that before implementing such vessels further detailed studies on the hydrodynamics in shallow water are made to verify that a vessel of this size can operate under these conditions.

Catamarans could be built in Port Harcourt where currently a series of four fast catamarans are built for the oil and gas industry under licence and supervision of Damen Shipyards. With respect to ferry services to Festac and on the Five Cowry Creek due attention has to be paid to the height of the existing bridges when considering high speed catamarans. The best option for building these catamarans in Lagos would be at the Naval Dockyard.

The following price indications have been obtained [Source: Damen Shipyards]:

- 50 PAX, about US$ 4.0 million
- 100 PAX, about US$ 5.2 million
- 200 PAX, about US$ 7.2 million

Vessels built for the offshore industry under supervision of Damen Shipyards in Port Harcourt have been understood to be more expensive than when they are build in Singapore and then shipped to Nigeria. Advanced catamarans are much more expensive than conventional mono-hulls, also when they are built in Nigeria to serve the offshore industry.

Due to the fact that four 50 PAX ferries are currently built in Nigeria at comparable prices we expect the price indications to be correct for the high quality PAX segment. To some extend cost reductions can be made by reducing the quality standards of the vessel, but this is only possible to a very limited extend since high performance craft require good equipment which is expensive. The above cost information has been used in the further financial analyses for this project.

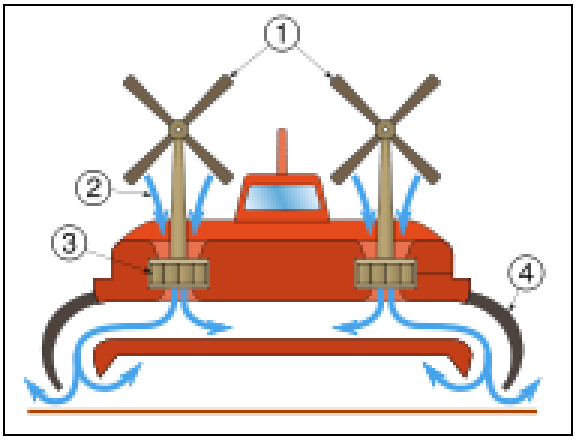
5. Hovercraft

Hovercrafts are generally more costly than other displacement or high speed vessels, but can offer good performance under difficult conditions and do not require any dredging works. They also make use of air propellers and therefore have no problems with plastic bags or water plants.

Hovercrafts require more or less sheltered conditions where the sea state is not likely to exceed 0.5m to 1.0m. The wave conditions on the Lagos lagoon and the various channels seem therefore favourable for hovercrafts.

Hovercrafts have one or more separate engines (some craft have only one engine with a drive split through a gearbox). One engine drives a fan (the impeller) which is responsible for lifting the vehicle by forcing air under the craft. The air therefore must exit throughout the "skirt" lifting the craft above the area on which the craft resides.

One or more additional engines are used to provide thrust in order to propel the craft in the desired direction. Some hovercrafts utilise ducting to allow one engine to perform both tasks by directing some of the air to the skirt, the rest of the air passing out of the back to push the craft forward (refer Figure 6.39).



1. Propellers
2. Air
3. Fan
4. Flexible skirt

Figure 6.39 – Hovercraft Concept

Hovercrafts have been built up to some 400 PAX, but are mostly used in the range of some 100 PAX. To provide further information on the possibilities of hovercrafts the following designs are discussed:

- A small 12 seat passenger hovercraft
- A medium size 98 seat passenger hovercraft
- The large hovercrafts that used to sail from Dover to Calais

For ferry operations in Lagos medium size hovercrafts are expected to be best suitable.

- Small Size Hovercrafts

This small 12 seat passenger hovercraft was build in the Netherlands and delivered to Indonesia in 1994. The craft is fitted out for 12 passengers but configurations seating up to 16 persons are available.

- Medium Size Hovercrafts

Medium sized passenger hovercrafts are for example used in the UK to maintain a connection between Portsmouth and the Isle of Wight. On this connection hovercrafts are already operational for over 40 years (refer Figure 6.40 – hovercraft as operated by Hovertravel).

Figure 6.40 – AP1-88 Hovercraft as in Operation in UK

The benefit of the hovercraft is that a simple beach area is sufficient for landing operations and no (expensive) berths and dredging works are required. Another benefit is that the air propeller has no problems with the shallow draft and debris causing downtime. An important downside of the air propeller is the much higher noise levels of the hovercraft.

The hovercraft passenger cabin contains seating for 100 PAX and is entered by port and starboard doors at the rear of the cabin. Hand baggage racks are provided at the rear of the cabin and panniers on the aft side decks carry heavier luggage. A radar installation is provided for collision avoidance. The AP1-88 hovercraft type is cleared to operate at speeds up to 45 knots with passengers.

- Large Hovercrafts

Large hovercrafts have been operated from 1969 to 2000 by Hoverspeed across the English Channel. Fierce competition and the abolishment of duty-free sales in 1999 lead to the decision to replace these hovercrafts by slower catamarans. Pictures of the Mark 1 and enlarged Mark 3 are shown in Figure 6.41, whilst Table 6.3 shows some technical details.

Figure 6.41 – Hoverspeed Mark-1 (left) and Mark-3 (right)

Dimension / Parameter	Mark 1	Mark 3
Length Over All [m]	39.7	56.4
Beam Over All [m]	23.8	23.2
Height Over All [m]	11.5	11.4
Skirt Depth [m]	2.44	2.7
Gross Weight [tonne]	165	320
Car Capacity [-]	30	60
PAX Capacity [-]	250	418
Speed [kn] – Calm Waves		60
Speed [kn] – Moderate Waves		50

Table 6.3 – Main Characteristics Large Hovercrafts

Lagos office “Hoverwork” provided cost and fuel estimates for a 160PAX hovercraft. It has been understood that the BTH 130 has a delivery time of 18 months at a price of about US$ 10 million. Fuel consumption is also very high with some 500 l/h at cruise speed and 750 l/h at maximum speed. Based on cost considerations the use of hovercrafts for passenger transport in Lagos is not expected to become feasible option (even on the long term).

6. Airboats

Airboats use air propellers like hovercrafts and have typically been designed to sail on swampy areas such as in the area of New Orleans, USA. They can operate at almost no draft, but can not operate in waves (refer Figure 6.42).

Figure 6.42 – Example of Airboats for 2 (left) to 20 (right) PAX

If dredging would not be an option at the Oke Afa channel, due to difficult social issues described in the socio-economic section of this report, airboats might be able offering a solution during the dry season. Nevertheless, it rains often in Lagos and therefore airboats are not considered a very sound and viable solution.

7. Hydrofoils

Hydrofoils are vessels that use dynamic lift generated by underwater wings to carry the weight of the vessel and cargo. During the ride the hydrofoil has three distinctive stages as follows (refer Figure 6.43):

- Hull-borne stage: the vessel sails as a normal vessel but the drag forces are larger due to the resistance of the underwater wings.
- Takeoff stage: lift is generated to lift the vessel out of the water. The takeoff stage will normally take about 2 to 3 minutes.
- Foil-borne: the vessel is lifted out of the water and is carried by its wings only. For this stage a minimum speed of some 40 km/h is required.

Figure 6.43 – Different Stages for a Hydrofoil Vessel [source: Source: Kawasaki Jetfoils]

Basically, there are two types of hydrofoils: surface piercing and fully submerged.

- Surface Piercing Hydrofoils

Surface piercing or conventional hydrofoils are stable systems. If the vessel attains a certain roll or pitch angle a greater part of the hydrofoil will immerse. This will result that a larger upward force will be generated by which the vessel motion will be quickly suppressed. To reduce vessel accelerations, this type of hydrofoil is often fitted with automatically operated flaps at the trailing edges of the hydrofoils.

The Russians have a good track record in building this type of hydrofoils since the 1950-ies. Their hydrofoils have been based on the principle that close to the water surface the hydrofoil looses its lift because of ventilation. Therefore, the hydrofoil is not lifted out of the water and stays relatively stable just underneath the water surface.

These hydrofoils have been designed to operate at reasonable shallow water depths, but still have a minimum draft of over 2m when hull-borne. Due to the design principles only small variations of heave and pitch motions is allowed. This type of hydrofoil is therefore only suitable for operation in reasonable calm water (rivers and lakes). At present, modern versions of these hydrofoils are still being built and used for passenger transport services.

The Morye Voskhod hydrofoil type (70 PAX) were exported to some 18 other countries, including Canada, Vietnam, China, the Netherlands, Austria, Hungary, Bulgaria, Thailand, Turkey. Recently some Voskhod-type boats (type Eurofoil) have been built for the Dutch public transport operator Connexxion (refer Figure 6.44) for operations between Amsterdam and the North Sea coast.

Figure 6.44 – Connexxion Hydrofoil in the Netherlands

Some typical characteristics of these hydrofoils have been included in Table 6.4.

Dimension / Parameter	Voskhod	Olympia
Length Over All [m]	27.7	42.6
Beam Over All [m]	6.8	14.0
Navigational Draft – hull-borne [m]		4.6
Navigational Draft – foil-borne [m]	2.1	2.0
Displacement Loaded [tonne]	32	135
PAX Capacity [-]	79	250
Engine Power [kW]	788	2 x 2,000
Service Speed [km / hr]	60	37

Table 6.4 – Main Characteristics of Voskhod and Olympia Hydrofoils

The Morve Olympia hydrofoil (refer Figure 6.45 and Table 6.4) is larger than the Voskhod hydrofoil with a carrying capacity of 250 PAX and higher performance. The two first Olympia Hydrofoils have been constructed at the Morye yard in Ukraine in 1993 and 1994 and were used for service on the Helsinki – Tallinn route with Tallink Express.

Figure 6.45 – Morve Olympia Hydrofoils

According to Morye, the hydrofoil is designed for operation on the routes in open seas up to 50nm from a port of refuge (or up to 100nm in a land locked seas and large lakes) with a permissible distance between two ports of refuge up to 200nm. The company further reports that a foil-borne speed of 37kn could be maintained in conditions up to sea state 2 and that the Olympia would be capable of maintaining normal service up to wave heights of some 2.5m.

- Fully Submerged Hydrofoils

Fully submerged hydrofoils require advanced systems to stabilize and steer the vessel. In the past often the front section was still of the surface piercing type while the aft was fully submerged. An air emission system was used to reduce the magnitude of the lift force at the aft of the vessel.

Finally, in 1975 the airplane manufacturer Boeing developed the first properly operating fully submerged hydrofoil known as the Boeing Jetfoil (refer Figure 6.46). At the moment there are 39 Boeing Jetfoils running in the world of which 24 were build by Boeing. The remaining jetfoils are built by Kawasaki Heavy Industries (KHI), which acquired the manufacturing licence of the Jetfoil from the Boeing Company.

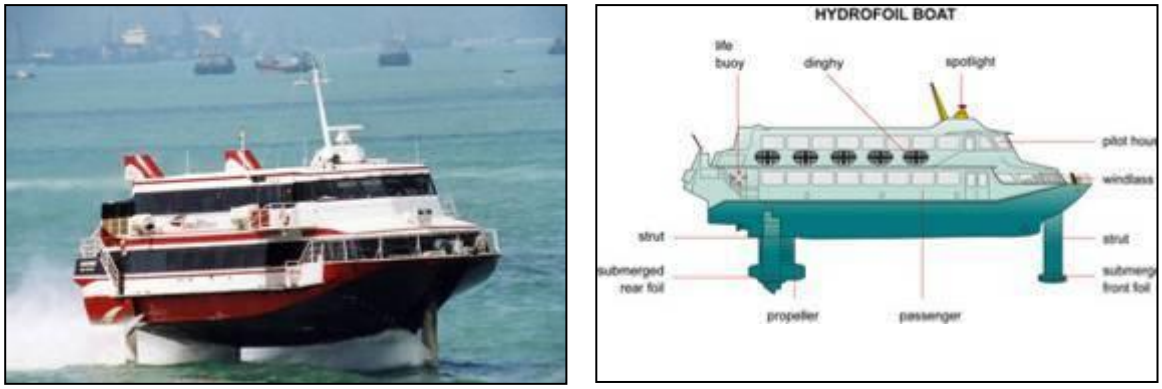


Figure 6.46 – Fully Submerged Hydrofoil Boeing Jetfoil

Since the foils of a conventional hydrofoil are piercing the water surface, they will always be affected by wave fluctuation. This automatically enhances roll and pitch movements of the vessel that can not be fully compensated by a precise attitude control. The design concept of the Boeing Jetfoil therefore was that a ship must fully “fly” in order to avoid any wave impact and therefore the foils must be fully submerged. The Boeing Jetfoil uses advanced airplane technology to control the ships attitude. The current manufacturer KHI claims that the Automatic Control System (ACS) is capable of providing a steady foil-borne ride without rolling and pitching in waves.

The Jetfoil goes ahead by the thrust force generated by water jet propulsion powered by gas turbine engines, and flies over the water surface by the dynamic lift generated by the fully submerged forward and aft foils fixed to the hull with struts. The draft of the Jetfoil in hull-borne condition is adjustable since the struts are retractable.

In strut down condition the draft is 4.9 meters (fully loaded). This can be reduced to 2.2 meters when the struts are retracted. The foil-borne draft varies between 1.4 and 2 meters (refer Table 6.5).

Dimension / Parameter	**Jetfoil**
Length Over All [m]	27.4
Beam Over All [m]	9.0
Navigational Draft – hull-borne [m]	2.2 – 4.9
Navigational Draft – foil-borne [m]	1.4 – 2.0
Displacement Loaded [tonne]	117
PAX Capacity [-]	270
Engine Power [kW]	
Service Speed [kn]	43

Table 6.5 – Main Characteristics of Boeing Jetfoil

6.3.4 Propulsion Systems

Typically suitable propulsion systems for ferries operating in Lagos are:

- Outboard Engines
- Fixed propellers
- Z-drive inboard engines
- Water-jet propulsion

Outboard Engines

Outboard engines are the common engines used for smaller vessels nowadays in Lagos. The advantages of outboard engines are that they are cheap, easy replaceable and that they can be lifted out of the water easily to remove the dirt (refer Figure 6.47).

Figure 6.47 – Plastic Bags in an Outboard Propeller

The downside of the use of outboard engines is that the propellers are very small, located just below the water surface, and operated at high rotation speeds. This makes them extremely sensitive to pollution in the water. In other words, they attract a lot of dirt in the propellers, but it is also relatively easy to clear the propellers.

Another downside of outboard engines is that they generally use petrol, which is more dangerous than diesel and therefore reduces the safety on board. It must nevertheless be noted that there are some diesel outboards available in the smaller power ranges up to some 25hp. These are nevertheless too small to power larger sized passenger ferries.

Finally, the fuel and propeller efficiency is lower than for inboard engines with a fixed propeller. The fuel consumption of an outboard is generally about 260g/kWh while the consumption of a diesel engine is about 210g/kWh. This implies a fuel saving of some 25% for diesel engines.

Equally important, the propeller efficiency increases considerable with its diameter. The small outboard propellers are therefore considerable less fuel efficient than fixed propellers. Hence, outboards are using considerably more fuel than comparable inboard diesel engines with fixed propellers.

Outboard engines are expected to be the preferred option for informal operators using small(er) boats offering services in addition to the main ferry network.

Fixed Propellers

Fixed propellers are generally the preferred propulsion system in terms of efficiency. An inboard diesel is more fuel efficient than an outboard and the propeller efficiency increases considerably due to the larger possible size of the propeller. Since the size of the propeller is larger, and the rotating speed lower, the dirt in the water is less likely to get stuck in the propeller though ropes and plastic bags can still get stuck around the shaft of the propeller.

This disadvantage can be reduced by the use of a rope cutter. An example of such a system supplied by PROP PROTECTOR is indicated in Figure 6.48. This is a simple shaft driven rope and weed cutter which is easy to install and maintain. It is a circular, razor sharp knife fixed to the propeller shaft. It revolves with the shaft and instantly cuts any rope or weed picked up by the propeller.

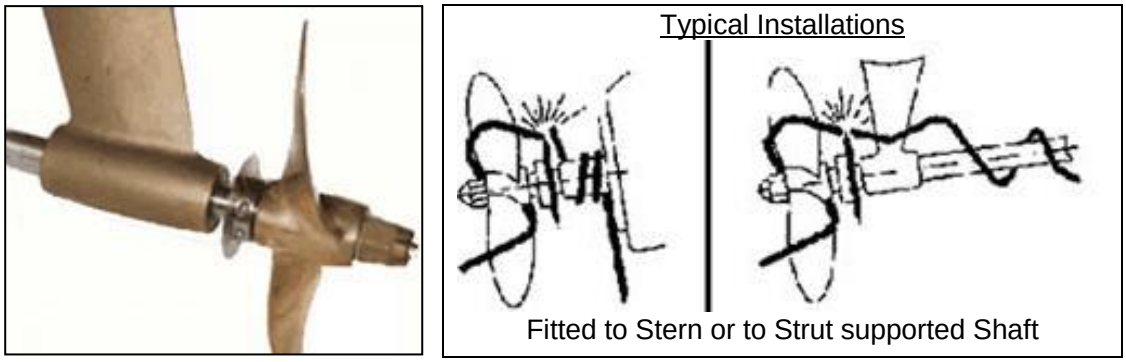


Figure 6.48 – Rope Cutting Raiser before the Propeller
[Source: www.prop-protector.com]

If for some reason still something gets stuck in the propeller divers will be required to clear the propellers. The occurrence for larger propellers is however expected to be low, especially at deeper water. As an example, the 50 PAX ferry used for transporting labour workers to Niger Dock at Snake Island is fitted with such fixed propellers.

Large fixed propellers (in combination with a rope and weed cutter) are expected to be the best solution for displacement vessels operating in the deeper waterways towards the West and Central Areas.

Z-Drives

Inboard engines with Z-drives can be used when more power is required than can be delivered with outboard engines. These units are larger and more durable and consume less fuel than outboard engines. They combine the benefits of higher fuel efficiency of inboard engines and the flexibility of outboard engines to lift the propeller above the water and clear them.

An example of such an outboard engine is provided in Figure 6.49 and is produced by Hydromaster selling Z-drive units from 50 HP to 350 HP.

Figure 6.49 – Z Drive System in Operation on Lake Victoria

The manufacturer indicated a speed range of 8kn to 12kn (15km/hr to 22km/hr). Since the propeller can be lifted the system is suitable to operate in more difficult areas. However, for high speed services this kind of Z-drives is not expected to be suitable.

It is not unlikely that larger fixed propellers counter problems with debris in the more shallow areas of the lagoon. Therefore, for the North and East ferry routes Z-drives might be preferred.

Water-jet Propulsion

In principle a water-jet propulsion system comprises an intake screen, a water pump and a ducted outflow. Water is sucked from the bottom side of the vessel, accelerated and blown out at the back at an increased speed. The acceleration force of the water pulls the vessel forward. Figure 6.50 presents a Hamilton HJ 322 Water-jet system.

Figure 6.50 – Hamilton HJ 322 Water-jet [source: Hamilton Product Manual]

Water-jet propulsion is generally used for shallow water since the system is less vulnerable than propellers. At lower speeds conventional propellers are more efficient than water-jet propulsion, though recent developments on the field of water-jets have improved the performance considerable. Water-jets are now considered to be a sensible option for speeds over 25km/hr.

Water-jet propulsion allows for the transfer of larger engine power to the water than is the case for Z-drives or outboard engines. For this reason water-jets are the only serious option for high speed vessels of considerable size. High speed mono-hulls and catamarans are therefore suggested to be fitted with water-jets. An example of a water-jet vessel operating on Lagos waters in shown in Figure 6.51.

Figure 6.51 – A Water-jet Propelled Vessel in Lagos Waters

One of the main concerns with regard to water-jet propulsion is the waste floating around. Hamilton claims that water-jets can be designed to be largely self cleaning at speed. This allows them to successfully operate in shallow and debris laden waters. The position and form of the integral screen fitted to the water-jets is shown in Figure 6.52. In addition, back-flushing can be carried out to wash out or dislodge any debris caught in the water-jet.

Figure 6.52 – Intake Screens to minimize Inflow of Debris for Water-jets

Water jets are normally the preferred option for high speed operations on shallow water. Efforts can be made to reduce the problems with debris, however, the waterways in Lagos are quite polluted and therefore problems with this propulsion system are expected to continue.

6.3.5 Comparing Various Ferry Alternatives

The strengths and weaknesses of the different ferry types as discussed above have been assessed in view of their possible application on the waters in Lagos. The results of this assessment are presented in Table 6.6 and further described below.

Selection Criteria	Normal Mono Hull (Steel)	Semi Mono Hull (GRP)	Fast Mono Hull (Aluminium)	Simple Catamaran	Advanced Catamaran	Conventional Hydrofoil	Hovercraft	Airboat
Speed Calm Water	-	+/-	+	+/-	+	++	++	+
Speed in Waves	-	+/-	+/-	-	+	+/-	-	NP
Terminal TAT	+	+	+	+	++	+	+/-	+
Shallow Draft	+	+/-	+/-	+/-	+/-	NP	++	++
Cars	++	NP	+	--	+/-	--	-	NP
Investment Cost	+	++	+/-	++	-	--	--	+/-
Fuel Consumption	++	+	+/-	+	+	-	--	-
Navigation Safety	++	+	+/-	+	+	-	--	+/-
Maintenance	++	+	+	+	+/-	-	--	+/-
Noise Level	++	+	+/-	+	++	+/-	--	-
Wash	+	+/-	-	+	+/-	++	++	++

Table 6.6 – Assessment for Ferry Types for Lagos

Normal mono-hulls are effective for heavy duty and slow speed services. They excel in cross river services that are generally short and can be offered at low speeds. An additional benefit of these vessels is that they can carry heavy loads and are suitable to carry passengers, motorcycles, cars and even trucks.

Semi planing mono-hulls are effective in situations where speed is important, but high speed craft are too advanced and expensive. They can operate at speeds above the hull speed without installing very advanced equipment. Important are the long and slender design and the use of light materials such as glass fibre.

Fast mono-hulls have the benefit that they are relatively cheap compared with other fast craft. The size of the vessel is nevertheless restricted to some 50 PAX in the Lagos Lagoon area.

Simple catamarans can be build very cost effective and offer an opportunity for medium size entrepreneurs to enter the transport market. They can provide good additional short haul services in addition to the longer distance main ferry services. Simple catamarans offer a high passenger capacity due to the available deck space. The size of the vessels is nevertheless restricted due to the use of outboard engines.

Advanced catamarans are in many respects the preferred option, specifically for the main ferry lines. They offer sufficient deck space to take a large number of passengers (some 150 PAX) on board and provide wide aisles. Due to their width and double propulsion system the ships are also very manoeuvrable. The vessels are nevertheless quite sophisticated and expensive.

Conventional hydrofoils can offer good services at calm water. The draft in the lagoon is not sufficient for hydrofoil operations, whilst the bridges between near Festac and at the western end of the Five Cowry Creek are both not high enough to allow for hydrofoil operations. Also the wave conditions in the Lagos Harbour Area can be such that the ride may become quite rough.

Navigational safety is also an issue since hydrofoils require a large anticipation length and can not easily react to unpredictable movements of small craft. Finally, conventional hydrofoils use fixed propellers that can easily be affected by plastic bags floating around. Therefore conventional hydrofoils are not advisable.

Fully submerged hydrofoils require a draft of some 5m and are therefore not possible in the Lagos Area. They are also generally designed for longer distances (e.g. Lagos – Port Harcourt).

Hovercrafts do not require any draft and can land on beach areas. They might therefore be used for places where no sufficient draft is available. The very important downside is that they use quite some fuel and are very noisy and very expensive. For Marina, for example, hovercrafts can not used in view of lack of space.

Air boats use air propellers like hovercrafts but have a flat bottom. Due to the flat bottom and high speeds they are not suitable to operate in waves. The maximum capacity of these vessels is some 20PAX. They might be suitable to operate in the Festac Creek between Oka Afa and Festac. This would avoid the need for dredging and problems with the high degree of pollution (water hyacinth and plastic bags) that makes water jet and propeller propulsion almost impossible. The downside of airboats is that they provide no shelter to rain. Since it rains quite often in Lagos Airboats are not the preferred option.

6.3.6 Identified Ferry Options

The preferred ferry options for operating on Lagos waters have been identified taking into account the local conditions, presence of floating plastic bags, and possible propulsion systems (refer Table 6.6).

Vessel Type	Propulsion Type	Speed [km/hr]	Passenger Capacity 10 20 50 100 200
Mono-hull	Outboard	10 - 25	
	Propellor	10 - 25	
	Waterjet	25 - 40	
Catamaran	Outboard	10 - 25	
	Propellor	10 - 25	
	Waterjet	25 - 40	
Hydrofoil	Propeller	40 - 60	
Airboat	Air Propeller	40 - 60	
Hoovercraft	Air Propeller	60 - 80	
			Shallow (1.5m) Deep

Figure 6.53 – Identified Ferry Options for Lagos Operations

Mono-hulls can most efficiently be powered by an inboard diesel and a fixed propeller fitted with a weed and rope cutter. The propeller diameter should be large allowing lower rotating speeds and to have fewer problems with debris.

At shallow draft the problems with debris is expected to be higher and therefore a Z-drive (or outboard) may be preferred. For fast planing mono-hulls water jets are normally preferred since they do not require additional draft for a propeller and the system becomes less vulnerable. Nevertheless water jets are not considered to be able to operate effectively in the rather polluted waterways of Lagos.

Catamarans would offer a better performance and provide more deck space for the passengers. Smaller catamarans sailing at low speeds can be fitted with outboard engines. Larger more advanced and fast catamarans have to be fitted with fixed propellers or water-jet propulsion; possibly also high performance light weight Z-drives can be used. At shallow draft water-jet propulsion will be mandatory for the larger high speed catamarans since propellers would be too vulnerable and require too much water depth.

Hydrofoils require at least some 2.5m water depth and are therefore not suitable for the Lagos Lagoon area. Also when “airborne” they are quite high on the water and can not pass underneath all the bridges in Lagos. Further, manoeuvrability is poor. Therefore type has not been considered any further.

Airboats do not require any dredging but are only feasible at relatively calm water sites. However, due to the air propeller they can not easily provide an enclosed seating area for passengers. Also the capacity of such vessels is very limited (up to some 20 passengers) and the noise hinder may be severe. These are therefore not further taken into consideration anymore.

Hovercrafts are very expensive, have high fuel consumption, and require a lot of maintenance. The operation requires no draft and no dredging works are required. A problem is that these crafts require a dedicated terminal on the land side (or at least a beach area to land). Hovercraft have therefore not been considered any further.

6.3.7 Selected Ferries

Ferry Types

The following vessels have been selected and have been used in the subsequent logistics and financial analysis.

- Steel Displacement Mono-hull: 50 PAX
- Steel Displacement Mono-hull: 100 PAX
- Steel Displacement Mono-hull: 200 PAX
- Semi-Planing GRP Mono-hull: 100 PAX
- Fast Aluminium Mono-hull: 50 PAX
- Fast Aluminium Catamaran: 50 PAX
- Fast Aluminium Catamaran: 100 PAX
- Fast Aluminium Catamaran: 200 PAX
- Semi-Planing GRP Tri-maran: 84 PAX
- Semi-Planing GRP Mono-hull: 120 PAX

Ferry Specifications

The basic ferry data, operational information, and cost information for these selected vessels has been summarized in Table 6.7 and Table 6.8.

Ferry	1	2	3	4	5
Type of Ship	Q DM 50 PAX	Q DM 100 PAX	Q DM 200 PAX	Q SPM 100 PAX	Q FM 50 PAX
Basic Ship Data	Q DM 50 PAX	Q DM 100 PAX	Q DM 200 PAX	Q SPM 100 PAX	Q FM 50 PAX
Length	16.0	25.0	35.0	24.0	17.5
Width	5.0	6.5	8.5	4.0	4.8
Draft	1.0	1.0	1.0	1.0	0.8
Capacity	50	100	200	100	50
Operational Information	Q DM 50 PAX	Q DM 100 PAX	Q DM 200 PAX	Q SPM 100 PAX	Q FM 50 PAX
Displacement Vessel	Yes	Yes	Yes	No	No
EC Speed [km/h] @ 5m WD	13.8	16.3	17.8	18	30
Operational Cost Information	Q DM 50 PAX	Q DM 100 PAX	Q DM 200 PAX	Q SPM 100 PAX	Q FM 50 PAX
Insurance Cost per year (% of New)	1.5%	1.5%	1.5%	1.5%	1.5%
Maintenance per year (% of New)	5%	5%	5%	5%	5%
Overhead Cost (% of Labour)	20%	20%	20%	20%	20%
Labour Cost	Q DM 50 PAX	Q DM 100 PAX	Q DM 200 PAX	Q SPM 100 PAX	Q FM 50 PAX
- Captain			US$ 11729	US$ 11729	US$ 11729
- Deputy Captain	US$ 9474	US$ 9474	US$ 9474		
- Main Engineer		US$ 9474	US$ 9474	US$ 9474	US$ 9474
- Sailor	US$ 5414	US$ 5414	US$ 5414	US$ 5414	US$ 5414
Total Labour on Board	US$ 14887	US$ 24361	US$ 36090	US$ 26617	US$ 26617
Factor for full year operation	1.2	1.2	1.2	1.2	1.2
Total Labour Cost	US$ 17865	US$ 29233	US$ 43308	US$ 31940	US$ 31940
Fuel Consumption	Q DM 50 PAX	Q DM 100 PAX	Q DM 200 PAX	Q SPM 100 PAX	Q FM 50 PAX
Unit Distance [km]	1	1	1	1	1
Main Engine Consumption [l/h]	30	50	80	80	120
Main Engine Consumption [l/km]	2.2	3.1	4.5	4.4	4.0
Additional Fuel Auxiliaries (%)	5%	5%	5%	5%	5%
Total Consumption	32	53	84	84	126
Fuel Cost (US$/l)	US$ 0.85	US$ 0.85	US$ 0.85	US$ 0.85	US$ 0.85
Unit Cost per km	US$ 1.93	US$ 2.72	US$ 3.99	US$ 3.95	US$ 3.55
Lub Oil Cost (% of fuel)	4%	4%	4%	4%	4%
Unit Cost per km	US$ 2.01	US$ 2.83	US$ 4.15	US$ 4.11	US$ 3.70
Capital Cost	Q DM 50 PAX	Q DM 100 PAX	Q DM 200 PAX	Q SPM 100 PAX	Q FM 50 PAX
Cost of Ship (million US$)	US$ 0.6	US$ 1.1	US$ 1.6	US$ 1.0	US$ 1.0
Fixed Operational Cost	Q DM 50 PAX	Q DM 100 PAX	Q DM 200 PAX	Q SPM 100 PAX	Q FM 50 PAX
Insurance Cost	US$ 9,000	US$ 16,500	US$ 24,000	US$ 15,000	US$ 15,000
Maintenance Cost	US$ 30,000	US$ 55,000	US$ 80,000	US$ 50,000	US$ 50,000
Labour Cost	US$ 17,865	US$ 29,233	US$ 43,308	US$ 31,940	US$ 31,940
Overhead Cost	US$ 3,573	US$ 5,847	US$ 8,662	US$ 6,388	US$ 6,388
Total Fixed Operational Cost	US$ 60,438	US$ 106,580	US$ 155,970	US$ 103,328	US$ 103,328
Variable Fuel Cost	Q DM 50 PAX	Q DM 100 PAX	Q DM 200 PAX	Q SPM 100 PAX	Q FM 50 PAX
km	1	1	1	1	1
Fuel Cost	US$ 2.01	US$ 2.83	US$ 4.15	US$ 4.11	US$ 3.70

Table 6.7 – Main Data of Vessels Used in the Financial Evaluations (part 1)

Ferry	6	7	8	9	10
Type of Ship	Q FC 50 PAX	Q FC 100 PAX	Q FC 200 PAX	LB SPT 84 PAX	LB SPM 120 PAX
Basic Ship Data	Q FC 50 PAX	Q FC 100 PAX	Q FC 200 PAX	LB SPT 84 PAX	LB SPM 120 PAX
Length	20.0	24.0	31.5	12.0	27.0
Width	7.2	8.2	9.0	6.3	5.3
Draft	0.9	0.9	1.0	1.0	0.9
Capacity	50	100	200	84	120
Operational Information	Q FC 50 PAX	Q FC 100 PAX	Q FC 200 PAX	LB SPT 84 PAX	LB SPM 120 PAX
Displacement Vessel	No	No	No	No	No
EC Speed [km/h] @ 5m WD	30	30	30	15	25
Operational Cost Information	Q FC 50 PAX	Q FC 100 PAX	Q FC 200 PAX	LB SPT 84 PAX	LB SPM 120 PAX
Insurance Cost per year (% of New)	1.5%	1.5%	1.5%	1.5%	1.5%
Maintenance per year (% of New)	5%	5%	5%	20%	20%
Overhead Cost (% of Labour)	20%	20%	20%	20%	20%
Labour Cost	Q FC 50 PAX	Q FC 100 PAX	Q FC 200 PAX	LB SPT 84 PAX	LB SPM 120 PAX
- Captain	US$ 11729	US$ 11729	US$ 11729		US$ 11729
- Deputy Captain				US$ 9474	
- Main Engineer	US$ 9474	US$ 9474	US$ 9474		US$ 9474
- Sailor	US$ 5414	US$ 5414	US$ 5414	US$ 5414	US$ 5414
Total Labour on Board	US$ 26617	US$ 26617	US$ 26617	US$ 14887	US$ 26617
Factor for full year operation	1.2	1.2	1.2	1.2	1.2
Total Labour Cost	US$ 31940	US$ 31940	US$ 31940	US$ 17865	US$ 31940
Fuel Consumption	Q FC 50 PAX	Q FC 100 PAX	Q FC 200 PAX	LB SPT 84 PAX	LB SPM 120 PAX
Unit Distance [km]	1	1	1	1	1
Main Engine Consumption [l/h]	130	170	140	80	100
Main Engine Consumption [l/km]	4.3	5.7	4.7	5.3	4.0
Additional Fuel Auxiliaries (%)	5%	5%	5%	5%	5%
Total Consumption	137	179	147	84	105
Fuel Cost (US$/l)	US$ 0.85	US$ 0.85	US$ 0.85	US$ 0.85	US$ 0.85
Unit Cost per km	US$ 3.85	US$ 5.03	US$ 4.15	US$ 4.74	US$ 3.55
Lub Oil Cost (% of fuel)	4%	4%	4%	4%	4%
Unit Cost per km	US$ 4.00	US$ 5.24	US$ 4.31	US$ 4.93	US$ 3.70
Capital Cost	Q FC 50 PAX	Q FC 100 PAX	Q FC 200 PAX	LB SPT 84 PAX	LB SPM 120 PAX
Cost of Ship (million US$)	US$ 4.0	US$ 5.2	US$ 7.2	US$ 0.12	US$ 0.40
Fixed Operational Cost	Q FC 50 PAX	Q FC 100 PAX	Q FC 200 PAX	LB SPT 84 PAX	LB SPM 120 PAX
Insurance Cost	US$ 60,000	US$ 78,000	US$ 108,000	US$ 1,725	US$ 6,000
Maintenance Cost	US$ 200,000	US$ 260,000	US$ 360,000	US$ 23,000	US$ 80,000
Labour Cost	US$ 31,940	US$ 31,940	US$ 31,940	US$ 17,865	US$ 31,940
Overhead Cost	US$ 6,388	US$ 6,388	US$ 6,388	US$ 3,573	US$ 6,388
Total Fixed Operational Cost	US$ 298,328	US$ 376,328	US$ 506,328	US$ 46,163	US$ 124,328
Variable Fuel Cost	Q FC 50 PAX	Q FC 100 PAX	Q FC 200 PAX	LB SPT 84 PAX	LB SPM 120 PAX
km	1	1	1	1	1
Fuel Cost	US$ 4.00	US$ 5.24	US$ 4.31	US$ 4.93	US$ 3.70

Table 6.8 – Main Data of Vessels Used in the Financial Evaluations (Part 2)

For displacement ferries the ferries speed has set 80% of the hull speed at a restricted water depth of 5m. If the water depth is below 5m a further reduced speed has been used in the calculations.

Operational Ferry Cost Information

The following parameters have been applied:

- Insurance cost has been taken as 1.5% of the CAPEX.
- Maintenance values range between 5% and 20%
- Overhead costs are assumed at 20% of the overall labour cost of the vessels.

Typical labour costs for the proposed ferry operations have been collected from Nigerian market. The average monthly salary rates used in the financial analysis have been included in Table 6.9.

Function	Low (Naira)	High (Naira)	Average (Naira)
Captain	110,000	150,000	130,000
Deputy Captain	90,000	120,000	105,000
Main Engineer	90,000	120,000	105,000
Sailor	50,000	70,000	60,000

Table 6.9 – Average Salaries for Sailors Assumed in the Calculations

For fuel consumption the following has been applied:

- Fuel consumption has been estimated for the provided economic speeds.
- Consumption rates have been based on information provided from shipyards, design offices, actual vessels and consultant's estimates.
- For displacement vessels the fuel consumption is expected to remain the same when speed is reduced at shallow water since engines are expected to maintain running at 85% of the Maximum Continuous Rating (MCR).
- The fuel consumption of the 100 PAX catamarans has been understood to be higher than a 200 PAX ferry due to the fact that at the speed of 30km/h the 100 PAX vessels are still trying to overcome the hub while the hub has already been taken for the larger vessels.

The capital costs for the ferries have been prepared on the basis of quotes and actual price information from the market. For the financial analysis a depreciation rate of 5 percent of the book value has been assumed.

7 FERRY SERVICES MODELLING (TASK 7)

7.1 Aims of Ferry Services Modelling

The modelling of the LAMATA ferry services aims at (1) arriving a ferry service plan and profiles for each ferry line, (2) developing ferry patronage projections, and (3) determining the required ferry service structure, pattern and frequency, peak daily and hourly flows, etc

The above aims are directly related to the financial performance parameters such as required investments (CAPEX), operational and maintenance costs (OPEX), capture of number of passengers, fare revenues, rate of return, etc. Therefore, the assessment of the logistics requirements for the ferry lines and ferry profiling has been fully incorporated in the financial analysis for this project and therefore reference is made to Section 8 of the report.

One of the issues describes below is the selection of priority ferry lines.

7.2 Selection of Priority Lines

In close consultation with LAMATA, the Governor of Lagos State and other LSG authorities and officials, a number of priority lines have been selected based amongst others upon the following considerations:

- All ferry lines described above are required to relieve road traffic in Lagos, but not all lines can be implemented at once in view of budget and implementation restrictions. Therefore, a phased implementation is required
- Ferry lines which contribute in relieving the most heavy congested areas should be installed first
- Ease of implementation: Ferry lines which can be implemented rather easily in view of terminal road access, availability of terminal area / buildings, navigation access should be implemented first
- Ferry lines which have low competition from other modes of transport such as the new Bus Rapid Transit or future mono-rail should be implemented first.

This resulted in the selection of the priority ferry terminals and ferry lines as indicated in Figure 7.1 as follows:

- Marine Main Hub (phase 1a)
- Osborne (phase 1a)
- West Line: Lasu (Ojo) → Satellite Town → Marina
- North Direct Line: Ikorodu → Osborne
- East Line: Ijede → Badore West → Osborne

Figure 7.1 – Priority Ferry Lines and Terminals for the LAMATA Ferry Project

7.3 Phase 1b Ferry Lines

The following remaining ferry lines will be included in the subsequent development phase of the project (refer Figure 7.2):

- Marina Main Hub (phase 1b)
- Central Line: Oke Afa – Festac – Mile 2 – Marina
- Olodi Apapa Line: Olodi Apapa Bridge – Liverpool – Marina
- North Hopper line: Mile 12 – Oworonsoki – IBB – Marina
- Five Cowry Creek Line: Lekki – Falomo Bridge – Marina
- Iddo – Ebute Ero Crossing

Figure 7.2 – Phase 1b Ferry Lines and Terminals

8 FINANCIAL ANALYSIS (TASK 8)

This section discusses the ferry services modelling together with the financial model and follows the structure of the model as presented in Figure 8.1. First, the approach to the financial analysis is explained. Second, key input and assumptions have been summarised followed by the description of the modelling approach for the ferry services. Finally, the financial indicators obtained from the overall ferry model are presented and interpreted.

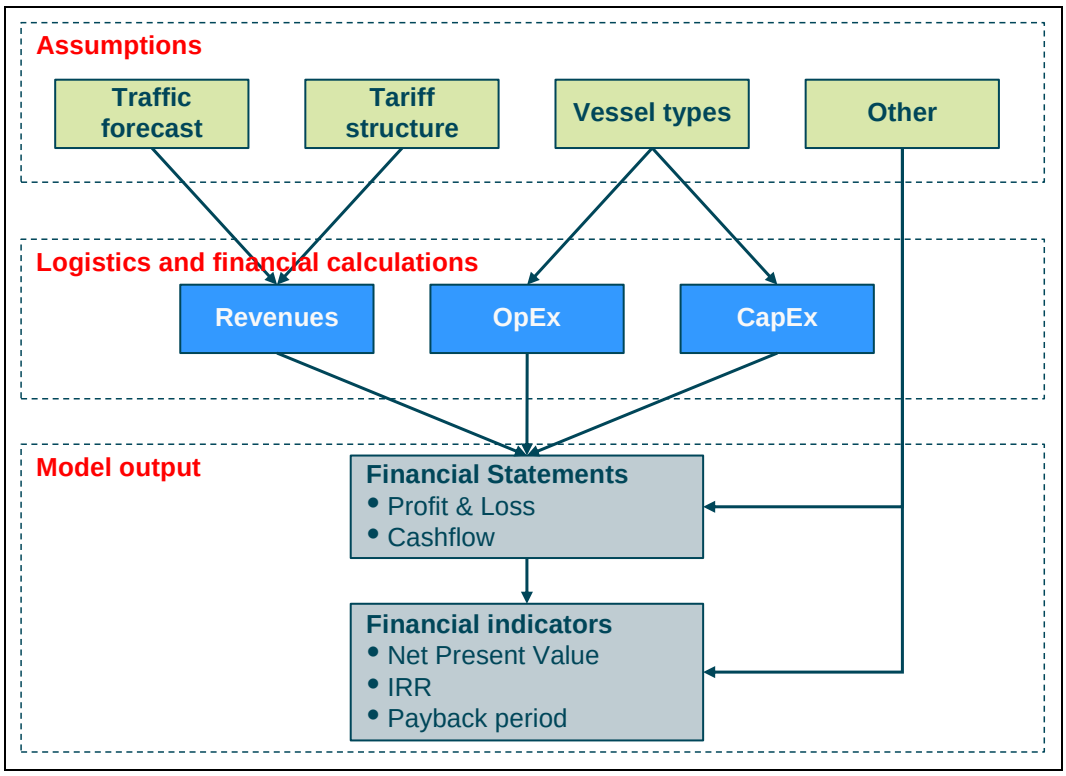


Figure 8.1 – Approach to Ferry Services Modelling and Financial Modelling

The explanations in this section are illustrated taking the East Line as an example. The modelling approach thus presented is equal for all the other ferry lines analysed.

8.1 Approach to Financial Analysis

The financial analysis has been carried out with the use of a financial model covering a project period of 5 years (2009 – 2013) as specifically called for in the Terms of Reference. The model uses a cash flow approach, i.e. value is created through cash flows rather than accounting profit. Even though the focus of the financial analysis is on calculating the Net Present Value (NPV) of the net cash flows, a complete financial model has been developed, including also a Profit and Loss Account.

The financial results for this project are pre-finance values, meaning that financing costs have not been taken into account.

Although the financial model includes a broad range of information, this financial analysis is focused on a limited set of main financial performance indicators, namely NPV, Internal Rate of Return (IRR) and Pay-Back Period (PBP), which are defined below.

Net Present Value (NPV)
The NPV is calculated by summing up the discounted projected cash flows over the project period. The cash flows are assumed to be “end of year” (or end of period) cash flows. The project can be marked as financially feasible if the NPV is higher than zero. This is a one of the key threshold levels the private sector uses to assess the attractiveness of investment projects.

An important element of the NPV calculation is the discount factor. The present value of a payoff in the future is less than the payoff today. Thus, the present value of the delayed payoff can be found by multiplying the payoff by a discount factor. The discount factor is equal to the rate of return offered by equivalent investments alternatives. This rate of return is often referred to as the discount rate, or as the Weighted Average Cost of Capital (WACC) – refer below.

Weighted Average Cost of Capital (WACC)
The capital funding of an investment is made up of two main components, i.e. debt and equity. Lenders and equity holders each expect a certain return on the funds they have provided. The cost of capital is the expected return to equity owners (or shareholders) and to debt holders, so the WACC indicates the return that both the lenders and stakeholders (equity owners) can expect.

The WACC, in other words, represents the investors' opportunity cost of capital when taking on the risk of putting money into an investment and is therefore a tool to decide whether or not to invest. The WACC is based on four financial elements:

- Gearing: distribution equity and debt
- Cost of equity
- Cost of debt
- Tax

Internal Rate of Return (project IRR)

This financial parameter or measure gives the return of the operational cash flows of the underlying project. This means that cash inflows and cash outflows are netted over a determined period (refer Figure 8.2).

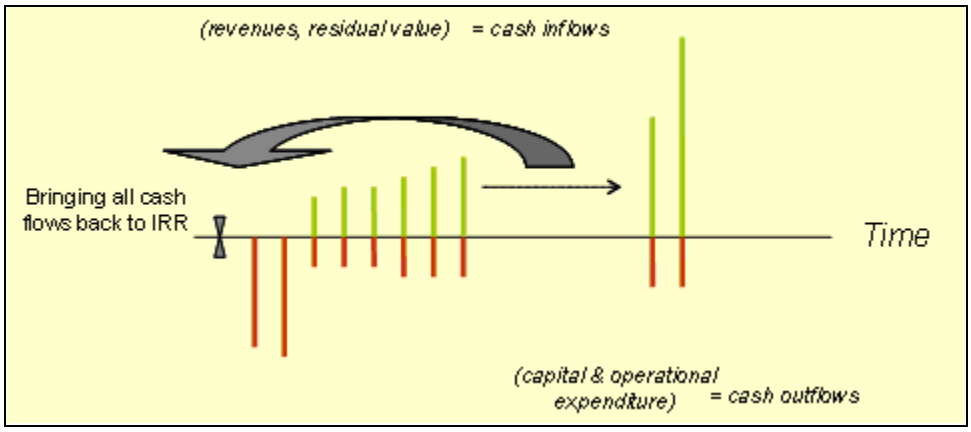


Figure 8.2 – Example of IRR Calculation

Private sector investments require an IRR of more than the discount factor. If the calculated IRR is below this level, the investment would not be attractive to a private sector operator. If the IRR is equal to the discount factor, the NPV should be zero.

Payback Period (PBP)

The payback period is defined as the length of time required to recover an initial investment through cash flows generated by the investment. The payback period shows the level of profitability of an investment in relation to time. The shorter this time period is the better the investment opportunity is for the private sector.

8.2 Key Input and Assumptions

The key input and assumptions for the financial model are discussed below as follows:

- Revenues
- CAPEX and OPEX
- Other financial assumptions

8.2.1 Revenues

Ferry Revenues

The main project revenues are driven by the traffic forecast and ferry tariffs. The traffic forecast for all ferry lines has been discussed in Section 3. Figure 8.3 below presents the traffic forecast for the East Line.

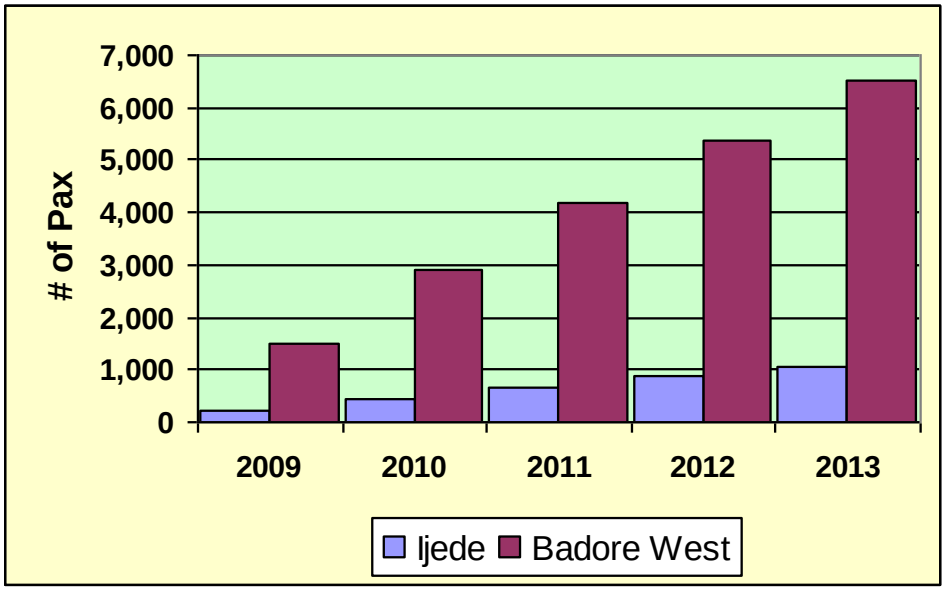


Figure 8.3 – PAX Forecast for East Line

The established ferry tariff is determined by two components:

- Price of competing with public transport by minibus
- Value of the time gained by travelling by ferry

The ferry is assumed to compete with the minibus for travellers from the suburbs of Lagos to the CBD. Therefore, the minibus tariffs have been regarded as the benchmark for the ferry tariff.

Further, ferry services provide travellers a mode of transport which is faster (and more reliable) than minibus services as the ferry does not experience delays from congestion on the road network. Travellers are assumed to be willing to pay an additional fee to the minibus for these time savings. The value of time saved by travelling by ferry instead of the minibus is determined on the basis of the income of the population.

The resulting ferry tariff for the East Line has been provided in Figure 8.4.

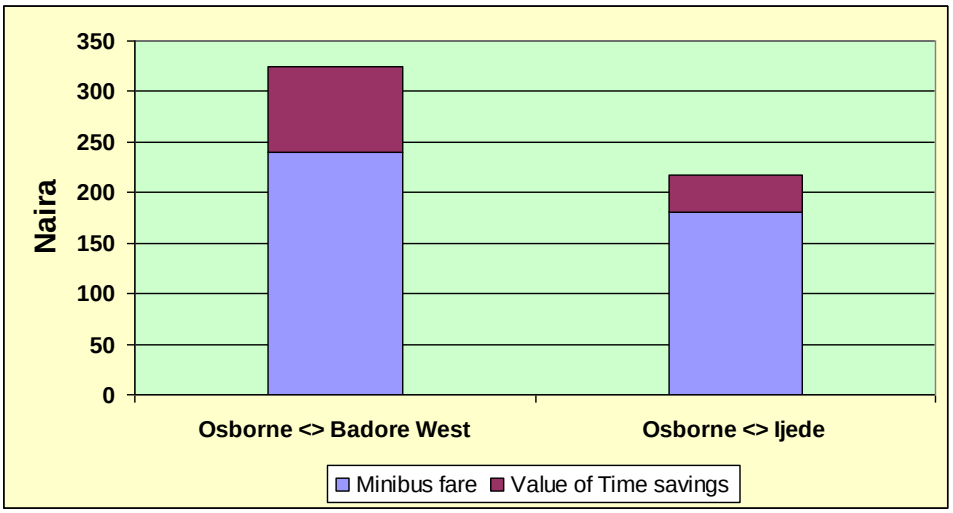


Figure 8.4 – PAX Tariff for the East Line

The above ferry tariff for the trip between Osborne and Badore West has been determined as follows:

- Minibus travel time 240 minutes (4hrs)
- Ferry travel time 55 minutes
- Time gain by travelling by ferry 185 minutes (3hrs 5min)
- Value of Time (VoT) 27 Naira per hour
- Value of time savings gained by ferry 84 Naira
- Tariff minibus 240 Naira
- Ferry PAX tariff 240 + 84 = 324 Naira

The revenues from ticket sales are determined by the product of the number of passengers transported by the ferry services and the ticket tariff.

Additional Revenues

In addition to the revenues from ticket sales other revenues can be generated in the project, for example by providing the following activities:

- Offering other trips during off-peak hours, evenings, weekends (e.g. school trips)
- Sales of snacks and beverages on board of vessels (e.g. from vending machines)

These additional revenues for the LAMATA Ferry Project have been assumed as 10% of the revenues from ticket sales and have been based on our international expertise with similar ferry operations.

8.2.2 CAPEX and OPEX

The main costs involved for the ferry operators (under a Public Private Partnership set-up) with the LAMATA Ferry Project are investments in ferries (capital expenditures – CAPEX) and operational and maintenance expenditures (OPEX) associated with running the ferry services. The CAPEX and OPEX expenditures regarding operating the vessels differ per vessel type.

The vessel types assumed to be fit for purpose for the project have been selected in Section 6; their corresponding CAPEX and OPEX are summarised in Table 8.1.

#	Vessel Type	CAPEX (million US$)	Fuel Cost (US$ / km)	Fixed OPEX (US$ / year)
1	Q DM 50 PAX	0.6	2.0	60,438
2	Q DM 100 PAX	1.1	2.8	106,580
3	Q DM 200 PAX	1.6	4.2	155,970
4	Q SPM 100 PAX	1.0	4.1	103,328
5	Q FM 50 PAX	1.0	3.7	103,328
6	Q FC 50 PAX	4.0	4.0	298,328
7	Q FC 100 PAX	5.2	5.2	376,328
8	Q FC 200 PAX	7.2	4.3	506,328
9	LB SPT 84 PAX	0.1	4.9	34,663
10	LB SPM 120 PAX	0.5	2.8	96,403
11	LB SPM 120 PAX	0.5	3.7	96,403

Table 8.1 – CAPEX and OPEX for LAMATA Ferries

The fixed OPEX includes the following components:

- Insurance Cost
- Maintenance Cost
- Labour Cost
- Overhead Cost

The analysis presented in this section have principally been based on vessel type LB SPM 120 PAX (# 11) for all lines, as this type yields the best results in the model.

In addition to costs associated with running the ferries, operational costs to run the terminal buildings are also incorporated in the model. It has thereby been agreed with LAMATA that they are responsible for investing in the terminals, whilst the ferry operator shall be responsible for manning the terminal and assure a smooth and safe embarkation and disembarkation of PAX and ticket sales. For the latter, two staff members per working shift per terminal have been assumed to be sufficient to operate the terminals. Further, it has been assumed that each operational day consists of two shifts (morning and afternoon shift).

8.2.3 Concession Fees

The ferry operator is assumed to be required paying a concession fees to LAMATA. The present financial model assumes a concession fee of 1.5% of the operator's total annual revenues. This "concession model" is similar to the one applied by LAMATA for the BRT operations in Lagos.

8.2.4 Other Financial Assumptions

Below, some other key financial assumptions are listed:

- Duration of the concession: 5 years (2009 till 2013)
- Exchange rate 130 Naira per US$
- Fuel price 0.85 US$ per litre
- Corporate tax: 30%
- Interest on debt: 8%
- Required return on equity: 18%
- Financing source (gearing) 70% debt; 30% equity
- WACC (as explained above): 11%
- Depreciation of vessels: 5% per year
- Number of operational days per year: 300 days
- Operational day: 6:00 till 20:00

The analysis has been carried out in real terms, implying that inflation has not been used on either revenues or costs of the model, due to volatile and high inflation rates in Nigeria.

8.3 Approach to Modelling Ferry Services

The ferry services as modelled for the LAMATA Ferry Project targets at facilitating the PAX demand as efficiently as possible, specifically in peak hours. Due to the large difference in the level of PAX demand transport between peak and off-peak hours, two different ferry service schedules are determined for these periods of the day.

Figure 8.5 below shows the assumed distribution of passengers during the day as a percentage of the total demand. Please note the large difference during the peak and off-peak hours but also the large stream of commuting travellers to the CBD in the morning peak and from the CBD in the afternoon peak. As a result, ferries will run full with passengers on the way to the CBD and return nearly empty (and vice versa during afternoon peak).

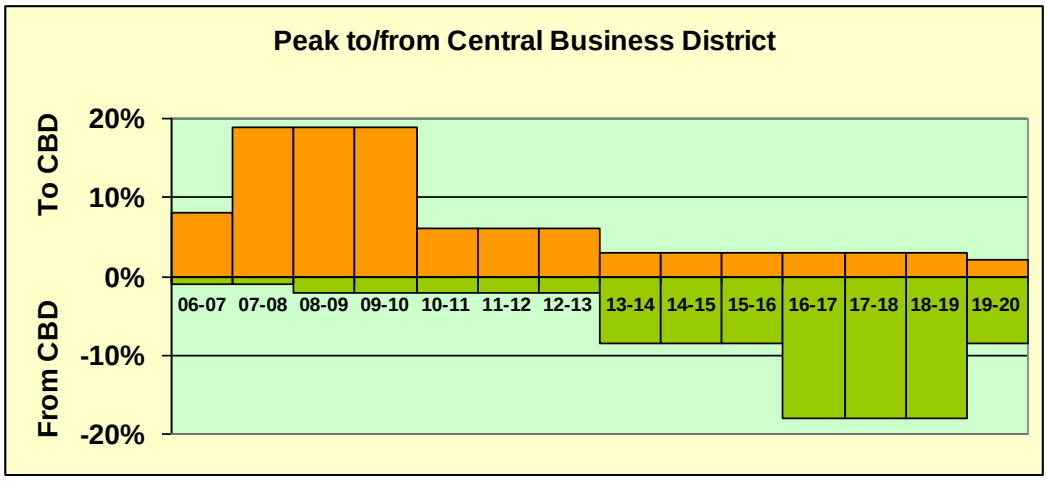


Figure 8.5 – Passenger Distribution to/from the CBD during the Day

The service schedule for the East Line in the year 2009 has been presented in detail below. As stated above, the service schedules for the other lines have been determined following the same approach.

The East Line consists of the following three terminals:

- Ijede
- Badore West
- Osborne

8.3.1 Peak Hours

First, the required number of ferries has been determined facilitating the demand from Ijede with destination Osborne in the peak. The following steps show the number of vessels required for this line in 2009.

- Maximum demand in peak — 42 PAX per hour
- Sailing time per roundtrip — 150 minutes (=2h30min)
- Capacity per ferry — 120 PAX
- Capacity per ferry per hour (one-way) — 120 / (2h30min) = 48 PAX
- Number of Ferries required — 42 / 48 ≈ 1 vessel

The service schedule during peak hours between Ijede and Osborne, including stops in Badore West, is shown in Figure 8.6. Please note that the time is expressed in hours of the day and decimals of an hour (e.g. 9.51 = 9h31).

Trip nr	Ijede D	Badore West A	Badore West D	Osborne A	Osborne D	Badore West A	Badore West D	Ijede A
1	7.00	7.24	7.31	8.19	8.25	9.13	9.20	9.44
2	9.51	9.75	9.81	10.69	10.76	11.64	11.71	11.95

Figure 8.6 – Example Ferry Service Schedule Ijede – Osborne in 2009 (Peak)

The ferry running between Ijede and Osborne does stop at Badore West. However, the spare capacity at this vessel is not sufficient to facilitate the high demand between Badore West and Osborne. Therefore, additional ferries need to be deployed between these two stations Badore West and Osborne. The number of additional vessels is determined as follows:

- Maximum demand in peak — 270 PAX per hour
- Sailing time per roundtrip — 114 minutes (=1h54min)
- Capacity per ferry — 120 passengers
- Capacity per ferry per hour (one-way) — 120 / (1h54min) = 63 PAX
- Capacity available on ferry running between Ijede and Osborne — 48 – 42 = 6 PAX per hour
- Number of ferries required — (270 – 6) / 63 ≈ 4 vessels

The (direct) service schedule during peak hours between Badore West and Osborne is shown in Figure 8.7.

Trip nr	Badore West D	Osborne A	Osborne D	Badore West A
1	7.00	7.88	7.95	8.83
2	7.47	8.35	8.42	9.30
3	7.95	8.83	8.89	9.77
4	8.42	9.30	9.37	10.25
5	8.89	9.77	9.84	10.72
6	9.37	10.25	10.31	11.19
7	9.84	10.72	10.79	11.67

Figure 8.7 – Example Additional Ferry Service Schedule Badore West – Osborne in 2009 (Peak)

8.3.2 Off-peak Hours

The ferry service schedule during off-peak hours between Ijede and Osborne (via Badore West) is shown in Figure 8.8.

- Maximum demand in off-peak — 21 PAX per hour
- Sailing time per roundtrip — 150 minutes (=2h30min)
- Capacity per ferry — 120 PAX
- Capacity per ferry per hour (one-way) — 120 / (2h30min) = 48 PAX
- Number of ferries required — 21 / 48 ≈ 1 vessel

Trip nr	Ijede D	Badore West A	Badore West D	Osborne A	Osborne D	Badore West A	Badore West D	Ijede A
1	10.00	10.24	10.31	11.19	11.25	12.13	12.20	12.44
2	12.51	12.75	12.81	13.69	13.76	14.64	14.71	14.95
3	15.01	15.25	15.32	16.20	16.27	17.15	17.21	17.45

Figure 8.8 – Example Ferry Service Schedule Ijede – Osborne in 2009 (Off-peak)

The direct service schedule during off-peak hours between Badore West and Osborne is shown in Figure 8.9.

- Maximum demand in off-peak — 135 PAX per hour
- Sailing time per roundtrip — 114 minutes (=1h54min)
- Capacity per ferry — 120 passengers
- Capacity per ferry per hour (one-way) — 120 / (1h54min) = 63 PAX
- Capacity available on ferry running between Ijede and Osborne — 48 – 21 = 27 PAX per hour
- Number of ferries required — (135 – 27) / 63 ≈ 2 vessels

Trip nr	Badore West D	Osborne A	Osborne D	Badore West A
1	10.00	10.88	10.95	11.83
2	10.95	11.83	11.89	12.77
3	11.89	12.77	12.84	13.72
4	12.84	13.72	13.79	14.67
5	13.79	14.67	14.73	15.61
6	14.73	15.61	15.68	16.56
7	15.68	16.56	16.63	17.51

Figure 8.9 – Example Additional Ferry Service Schedule Badore West – Osborne in 2009 (Off-peak)

8.4 Financial Results

8.4.1 Main Results

Table 8.2 below summarises the main financial results of the model for all ferry lines as considered in the LAMATA Ferry Project.

Line	# of Ferries	NPV (million Naira)	fIRR [%]	Pay-Back Period [years]
Priority Lines				
West	11	-434	n/a	n/a
East	23	267	21%	5
North Direct	19	136	17%	5
Phase 2 Lines				
Central	20	-311	n/a	n/a
Apapa	32	-635	n/a	n/a
North Hopper	42	-897	n/a	n/a
Five Cowry Creek	23	124	15%	5
Crossing	3	440	115%	2

Table 8.2 – Main Financial Results for LAMATA Ferry Lines

The model results indicate that four of the eight selected ferry lines appear feasible, as their fIRR is higher than the WACC of 11% (and as a result the NPV is higher than zero). Sample Cash Flow Statement and Profit and Loss Accounts for East Line are presented in Appendix 8A.

8.4.2 Sensitivity Analysis

Business Case highly dependent on Residual Value of Ferries

The PBP for the East, North Direct and Five Cowry Creek lines is 5 years, which is equal to the pre-set concession period. This can be explained by the fact that the residual book value of the ferries is included in financial analysis. The remaining value of the ferries can be used by the operator by selling these after the concession period or deploy them in a next concession.

However, there is a considerable risk associated with the dependency of the financial results of the project on the residual value of the ferries. It is likely that an operator / investor is not willing to take that risk of not being able to sell the ferries, which still are “as-new”, or deploy them in another concession.

This risk can – for example – be mitigated by an extension of the concession period, which would reduce or even mitigate the dependency on the residual value of the ferries for the business case. Another solution could be that LAMATA (as concessionaire) would provide a guarantee to the operator that they will purchase the ferries after the concession period.

The cash flows of the East Line, which demonstrates the large contribution of the residual value on the result has been included in Figure 8.10 and Figure 8.11.

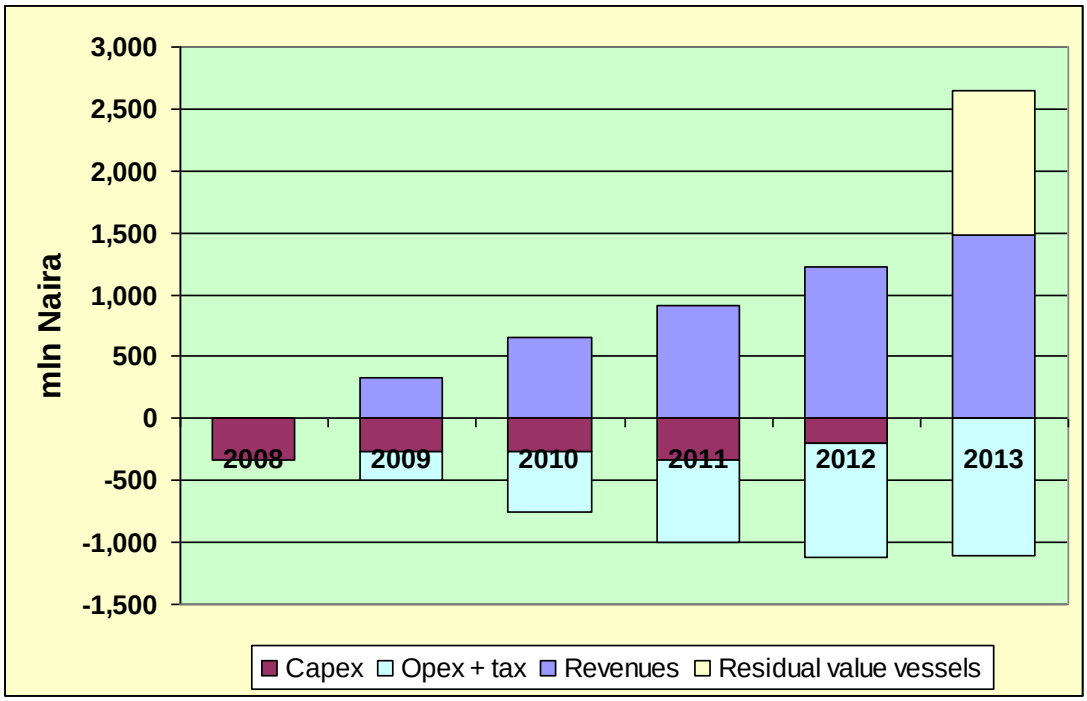


Figure 8.10 – Project Cash Flows for the East Line

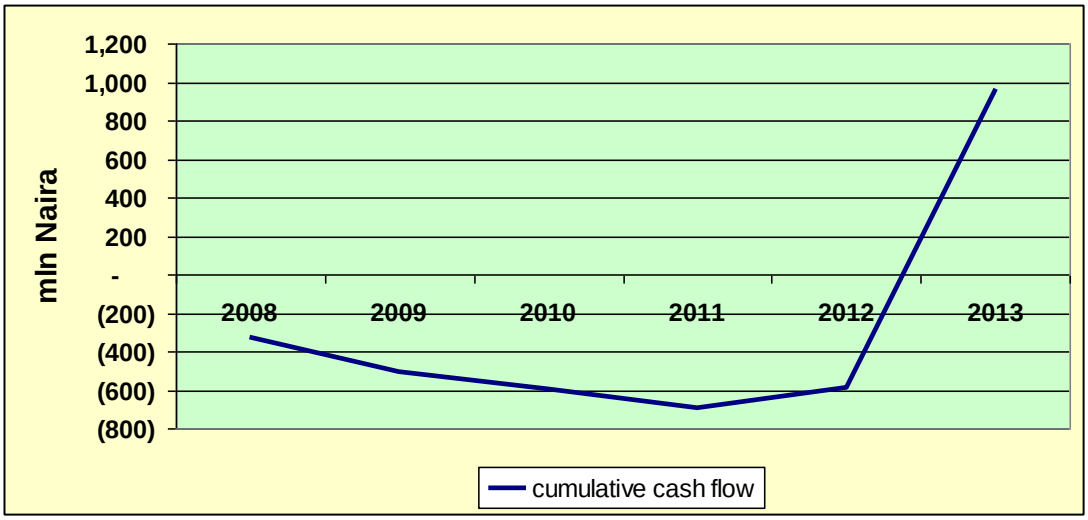


Figure 8.11 – Cumulative Project Cash Flow for the East Line

The sensitivity on the financial results for the East Line to (1) extending the concession period with steps of 5 year or (2) including the residual value in the analyses is shown in Table 8.3 below. It can be observed that extending the concession period has only a marginal effect on the financial results, whereas the impact of the residual value is paramount.

Concession Period (years)	Residual value Ferries included	NPV (million Naira)	fIRR [%]
5	Yes	267	21%
5	No	-425	n/a
10	Yes	724	22%
10	No	120	14%
15	Yes	1,174	23%
15	No	757	21%

Table 8.3 – Sensitivity for East Line to Residual Value and Concession Period
Source: Consultant Team

Feasible Lines have relative high Tariffs compared to non-feasible Lines
Remarkable is the large difference in ferry tariff on the different lines when the tariff is expressed relative to the distance travelled by ferry. The tariff on the North Direct line for example is 194 Naira for a 15km trip (or 13 Naira / km). The tariffs on the West line are 210 Naira for a 31km trip from Lasu to Marina (or 7 Naira / km) and 191 Naira for a 23km trip from Satellite Town to Marina (or 8 Naira / km).

The relatively low tariffs on the West line do not even cover the operational costs, which makes it impossible to recover from the investments in vessels.

Figure 8.12 shows the required ferry tariff increase in order to reach a minimum required fIRR of 11% on the non feasible lines. It can be observed that an increase of up to 30% would yield the target fIRR of 11%.

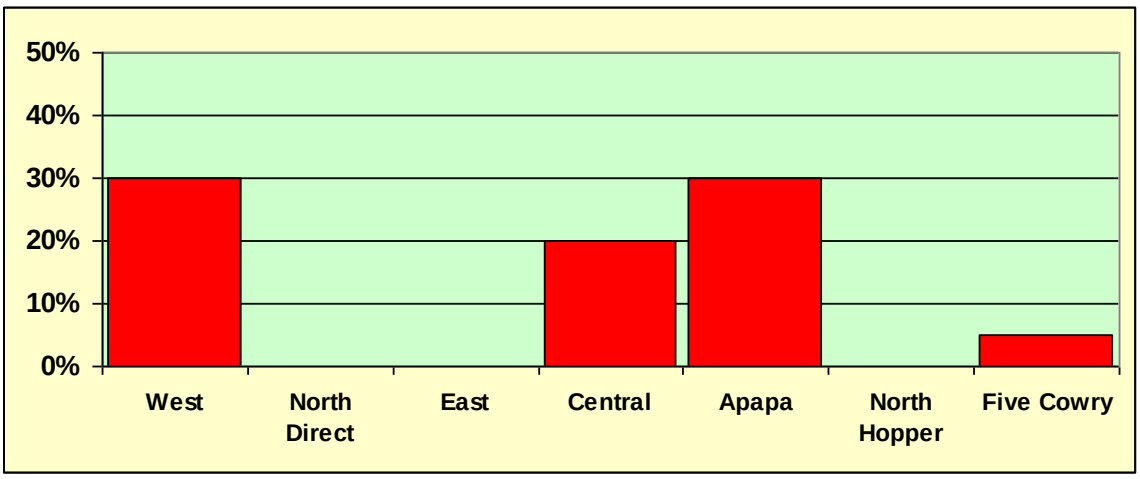


Figure 8.12 – Required Ferry Tariff Increase to reach Target fIRR of 11%

Results more Sensitive to Fuel price than other OPEX

About 75% of the total annual OPEX are fuel costs. Therefore the financial results are more sensitive to changes in fuel price than the fixed OPEX for the ferries and terminals. The sensitivity of the East Line financial results to fluctuation in fuel costs are reflected in Table 8.4.

Change in Fuel Price	NPV (million Naira)	fIRR [%]
-25%	523	30%
-10%	369	24%
0	267	21%
+10%	164	17%
+25%	10	11%

Table 8.4 – Fuel Sensitivity for East Line

9 SOCIAL AND ENVIRONMENTAL ISSUES (TASK 9)

This section addresses the social and environmental issues related for the ferry project and describes the following key issues:

- Water Transportation in Lagos
- World Bank / IFC policies
- National institutional and regulatory considerations
- Environmental baseline conditions
- Social Impact Review
- Assessment of the lagos lagoon ferry project
- Health Safety and Environmental Management

9.1 Glossary

Name	Description
Benthos	Those animals and plants on or near to the seabed.
Biodiversity	The richness and variety of wildlife and habitats on earth.
Built environment	Developed areas, including residential, commercial and industrial property.
Conservation	Active management of the earth's natural resources and environment to ensure quality is maintained and that they are wisely used, whilst acknowledging the dynamic character of biological and physical systems.
Contamination	The presence of a sufficient quantity of a substance in land, water or air making it capable of causing significant harm.
Dust	Airborne solid matter up to about 2 mm in size.
Ecology	Study of the relationships between organisms and the relationship between them and their physical environment.
Environmental Action Plan	A report which ensures commitment to the adoption of mitigation and management measures, as recommended within the ES.
Environmental Impact Assessment (EIA)	A procedure employed to assess the likely significant impacts of a proposed development upon the environment.
Environmental Statement (ES)	The report or final set of documents which contain the findings and recommendations of the EIA procedure.
Fauna	The animal life of a region or a particular environment.
Flora	The plants of a region or a particular environment (e.g. salt-marsh flora).
Geomorphology	The study of the physical features of the Earth's surface and their formation (i.e. processes of erosion and deposition).
Groundwater	The water in the ground.
Habitat	The particular environment in which an organism or a group of organisms live.
Intertidal	The zone between high and low tide marks that varies in extent along the coast.
Invertebrates	Animals that lack a back-bone, including insects, worms, crustaceans and molluscs.

Name	Description
Maintenance (plant and vehicles)	The general task of ensuring that construction plant and vehicles are kept 'road worthy' and capable of undertaking their allotted tasks.
Maintenance (works)	The construction and re-construction activities required in order to keep a built structure or commenced scheme operational.
Mudflat	An area of fine silt (mud) usually exposed at low tide but covered at high tide. Typically occurs in sheltered estuaries and can occur behind shingle bars or sand spits.
Natural environment	The composition of wildlife and habitats.
Noise	Sounds that are undesired or cause nuisance to local residents and businesses. Noise is measured in decibels (dB)
Offshore	That area of sea beyond the land which has depths in excess of 20m.
Organism	Any single living plant or animal.
Pollution	Introducing substances or energy (e.g. noise) to land, water or air that are likely to cause significant harm to humans, wildlife and/or buildings. Pollutants include silty water, heavy metals, sewage, oils, chemicals, litter, clays and mud.
Recycling	Collecting and separating materials from waste and processing them to produce marketable products.
Reuse	Putting objects back into use, without processing, so that they do not remain in the waste stream.
Risk	The chance of an adverse event actually occurring.
Sediments	The layers of particles that cover the bottom of the seabed and other water-bodies, such as rivers and streams.
Silt	Waterborne particles with a very small grain size.
Species	A group of organisms that interbreed.
Subtidal	The region of the sea and the seabed that occurs beneath the tidal zone.
Tide	The periodic rise and fall in the level of water in the oceans and sea, resulting from the gravitational attraction of the sun and the moon.
Turbidity	The interference of the passage of sunlight through the water column caused by the presence of fine suspended matter (e.g. silt, sand).
Waste	Any substance or object that the holder discards, intends to discard or is required to discard.
Wildlife	Wild animals and birds.

9.2 Water Transportation in Lagos

Lagos Metropolitan Area (LMA) is currently witnessing a rapid population growth with facilities and infrastructures being stretched to the limit. Thus, the security, sanitation and transportation infrastructure, among others, is also deteriorating. In order to arrest this deterioration and put in place measures that will improve the living conditions of the people, Lagos Metropolitan Area Transport Authority (LAMATA) with the assistance of the World Bank is embarking on initiatives to improve transportation systems in the LMA.

One of the measures proposed by LAMATA and the World Bank is the revitalization of the water transportation sector. The water transportation is underutilized in the LMA despite the availability of navigable water bodies and the obvious potential they present. Hence, the Lagos State Government is considering the re-introduction and development of ferry services in the LMA.

The re-introduction and development of the ferry services in the LMA falls in line with Nigeria's National Transport Policy as well as the current development of inter-modal transport systems throughout the ECOWAS.

9.2.1 National Transport Policy

The revitalization of the water transportation sector in Lagos falls in line with Nigeria's National Transport Policy, the Lagos Plan of Action for the Economic Development of Africa (1980 – 2000) and the goals outlined in the Report of the Presidential Committee on the Re-Development of Lagos Mega-City Region (April 2006).

Nigeria's Transport Policy has the following broad objectives:

- To improve the safety, security, reliability, quality and speed of movement of people and goods;
- To promote qualitative transport infrastructure and operations through greater effectiveness and efficiency in meeting customer needs;
- To promote a culture of maintenance and upgrading of existing infrastructure;
- To structure the infrastructure to ensure environmental sustainability and internationally accepted standards;
- To promote the use of public transport over car travels.
- To promote trade competitiveness through an efficient and affordable integrated transport network;
- To facilitate trade and transport transaction through transparent and streamlined administrative procedures based on modern management and information technologies;

- To increase the involvement of the private sector in the financing and operation of transport related services;

- To build strong financial base (both public and private) for the creation, maintenance and upgrading of transport infrastructure; and,

The focus of the National Transport Policy includes:

- Maintaining and expanding existing transport infrastructure;
- Fostering a sound management base for the transport system;
- Keeping the transport industry competitive;
- Protecting the environment from the negative externality effects of transport;
- Supporting the safety of operators and users of transport system;
- Improving human capacity development of the transport sector; and,
- Encouraging more innovative, more effective and more effective means of transport whenever it seems possible.

9.2.2 The Need for Water Transport in Lagos

Water transportation is an integral component of the development of Lagos' inter-modal transport system and plans of the Presidential Committee on the re-development of the Lagos Mega-City Region (April 2006). The physical environment of Lagos is well-suited to accommodate water transport as about 17% of Lagos is composed of lagoons and waterways. The main water bodies in Lagos State are the Lagos Lagoon, Ologe Lagoon, Porto-Novo Creek, Badagry Creeks and the Atlantic Ocean.

Water transport is one of the most advantageous transport modes, having the least impact on the environment, the lowest cost for city transport, enormous capacity reserves and the least energy consumption. The environmental, health, safety and security (EHSS) advantages of adopting water transportation facilities in Lagos are numerous. Moreover, the population of the LMA continues to rise. People of all walks of life migrate to Lagos.

The LMA (excluding Badagry, Epe and Ikorodu) accounted for 93% of the 1991 population census figure. At a growth rate of 5%, the population figure for the LMA was about 10,465,119 people in the year 2005. It is estimated that the population will have risen to 17,046,575 people in 2015 and about 27,767,075 people in the year 2025. If these estimations are correct, the need for safe, environmentally-friendly and efficient water transport is highly needed.

There are a number of positive aspects of water transport which are worth taking into account. These are as follows:

Ferry transportation causes little congestion. The steady increase in car traffic in Lagos has far outstripped any increase in infrastructure capacity, resulting in delays, safety problems, and congestion. Other impacts of traffic congestion are accidents, increased energy (fuel) consumption, environmental damage, increased commuting times, and greater social tension. Water transport, in contrast, does not have congestion problems, and seldom causes them for others. The fact is that far from being congested, the Lagos water transport system is highly underutilized.

Water transportation is extremely safe. Transporting safety is an important measure of environmental responsibility, and water transport has the fewest number of accidents, fatalities, and injuries as compared to bus, car or rail. Water transportation has definite advantages over competitive modes: it generally involves less urban exposure than bus, car or rail transportation; it operates on a system that has few crossing junctures; and does not cross directly through population centres, all factors that reduce both the number and impact of water transportation incidents.

Water transportation produces little air / noise pollution. Some of the most pervasive and intrusive sources of noise and air pollution are transportation systems involving cars, motorcycles, busses, trucks and rail. Noise levels, with road traffic being the chief offender, have been rising. Air pollution comes from a wide variety of man-made and natural sources, with fossil fuel combustion being the largest contributor. Air pollution caused by transportation includes pollutants directly emitted by engines as well as secondary pollutants formed by chemical reactions. Road traffic is, by far, the greatest source of air emissions.

Water transport, conversely, causes far less air pollution than cars or busses, and less or comparable amounts, than rail. Cumulatively, it has a relatively minor effect on air quality, consumes much less energy (and as a result, produces less air pollution) per ton-mile of passengers carried than either bus or rail. For the most part, waterway operations are conducted away from the most densely populated areas in cities, thereby reducing the exposure and overall health impact of its exhaust emissions. Moreover, with the sound of their engines muffled below the water line, any noise levels produced by ferries are hardly audible beyond the immediate area.

Water transportation has minimal land-use social impact. Cars and busses travel streets and highways whilst trains rumble through cities. Ferries, on the other hand, quietly make their way along isolated waterways. Increased traffic congestion and/or unwelcome traffic patterns leading to reduced social interactions and reduced access to other neighbourhoods, are often the result of increased land surface traffic.

Since most of the right-of-way for water transport is provided by nature, navigation is less likely than other transport forms to compete with non-transportation uses for land area, an important consideration in urban locations. Extensive land area can be taken up by new highways and railroad corridors, but apart from a few connections and waterside terminals, waterways pre-empt very little land.

The impact of cars and bus operations occurring in close proximity to high-density population areas, and rail lines passing through urban areas, can become a disturbing element to an otherwise reasonably calm environment in settled areas. By contrast, water transport has little impact on densely populated areas: shallow-draft vessels operate in mid-river, well away from shore, and because of the large number of people moved at one time, tow passages are infrequent.

A ferry water transportation system is energy efficient. The measure of energy efficiency in transportation is the amount of energy used for the service provided, and can be expressed as the number of BTUs required to move one ton of cargo one mile (a ton-mile). Hence, the ferry water transportation system will allow Lagos' general public to circumvent the hours otherwise spent stuck in the city's daily car congestion. Ferry systems are financially more efficient at the individual level in that it will allow the general public to save money otherwise spent on fuel consumption whilst standing still in a traffic jam. Moreover, the number of miles one ton can be carried per gallon of fuel by ferry compared with other means of transportation is:

- By ferry 514 miles
- By rail will travel 202 miles
- By bus will travel 59 miles

In studies comparing water, rail and bus, shallow-draft water transportation has been proven to be the most energy efficient method of transportation. An analysis of waterway and rail fuel efficiency shows the average BTUs expended per ton-mile totals 433 for water transport and 696 for rail transport. It is much more efficient to move through water than over land.

Size is the key to water transport's efficiency. The capacity (1,500 tons) of a ferry, which can carry five times its own weight, is impressive, and the industry as a whole has enormous capacity. The cargo capacity of a ferry is 15 times greater than one rail car and 60 times greater than one semi trailer. To move the same amount of people transported by a standard tow of 15 ferries as seen on big international rivers would require a train 2¾ miles long or a line of busses stretching more than 35 miles.

For example, one 10,000 horsepower towboat can push 40 ferries that have the carrying capacity of 600 railcars or more than 2,200 busses (refer Table 9.1).

Transportation Capacities		
River Ferry	**Rail**	**Road Bus**
1,500 tons 52,500 bushels 453,600 gallons	100 tons 3,500 bushels 30,240 gallons	25 tons 875 bushels 7,560 gallons

Table 9.1 – Transportation Capacities and Characteristics

Water transportation is a low-energy form of transportation, and shifts of traffic to high-energy forms would be inconsistent with the Millennium Development Goal (MDG) Number 7 towards environmental sustainability. The environmental advantages of water transport should be weighed when considering any activity that would result in a shift from the waterways to a land form of transport.

Bus, car and rail tank car spills occur more often than ferry spills. Due to their large capacity, ferries require far fewer units than either bus or rail to move an equivalent number of passengers, and so the cumulative amount of spillage is by far less per journey travelled. Also, design features of ferries such as navigational aids help reduce accident frequency.

Globally, the companies that make up the ferry industry have a reputation for a strong environmental stewardship and are dedicated to improving the compatibility of their operations with the environment in an effort to reduce environmental incidents to an absolute minimum. Pollution control, protection and enhancement of the environment and maintenance of the ecological balance have long been major concerns of the water transportation industry. They are aware of the importance of maintaining a healthy balance between economics and environment.

There is a growing commitment throughout Lagos, Nigeria and the ECOWAS to restore and preserve the natural environment, and this goal has become a priority in transport and business planning and reporting. However, it has geographical constraints and operates at relatively low speed.

In the past ferry transport has been used in Lagos to provide terminal-to-terminal movement. In light of this, today Lagos seeks a more integrated logistics approach to the inclusion of water transportation to facilitate an inter-modal transport system in Lagos which has efficient connections to roads, airports and a bus network system to provide both national and international travellers access to environmentally friendly and sustainable transport that captures the best aspect of each mode of transport while providing door-to-door services.

In light of the last-mentioned, the EHSS benefits of a ferry system in Lagos are addressed in order to:

- Explore the potential for environmentally-friendly and commercially sustainable transport development by bringing together government agencies and the private sector to jointly plan the development of Lagos' ferry system; and,

- Create an environment attractive to private sector investment and the formulation of Public Private Partnership to support the development of a ferry system in the Lagos Metropolitan Area (LMA).

9.2.3 The Lagos Metropolitan Area

Physically, the Lagos Metropolitan Area (LMA) is a low-lying terrain that makes up an integral part of the sedimentary basin of the coastal Lagos environment. Fine sands of quaternary deposits constitute the main sediments. The relief is lower than 20m above sea level and gently undulating.

Lagos is part of the Barrier Lagoon system which stretches from Côte d'Ivoire to the Niger Delta in Nigeria. The Barrier Lagoon Complex in Lagos consists of a narrow, low-lying, sandy beach and is backed by the Lagos, Lekki and Ologe lagoons. These lagoons are inter-linked by many creeks. About 12 million Lagosians inhabit this area. The on-going population growth is putting pressure on the increasing need for infrastructure development by both Government and the private sector.

The ecology of LMA shows a sharp contrast between rain forests and derived savannah. With the exception of a few areas, the original evergreen and freshwater forest vegetation has been encroached upon as a result of extensive farming and construction activities. Some of these now stand as shrubs, secondary forests and derived savannah. The main physical development and construction activities include housing, markets and other infrastructures (see Section 4.1.9 on Land-Use).

Continuous depletion of the natural ecology that exposes the surface, sand-filling of the surrounding wetlands, marshes and swamps for physical development, are common. In view of the inadequate planning and uncontrolled development in the area, the geo-morphological characteristics have contributed significantly to continuous flooding of the region via the neighbouring sluggish streams, drains and canals.

There are numerous water bodies in Lagos State as it is a coastal region. The relief and drainage patterns in Lagos State are a reflection of the coastal location of the region. The coastal lowlands which dominate the landscape form part of a wider stretch of the coastal zone of South Western Nigeria. The main characteristic features of the coastal lowlands include:

- The presence of a regular and almost straight sandy barrier beach behind the modern shoreline;
- Fringing lagoons and a network of creeks running parallel to the shoreline; and,
- Rivers and streams emptying water from upland parts of the State into the lagoons.

The main water bodies in Lagos State are:

- Lagos Lagoon;
- Lekki Lagoon;
- Epe Lagoon;
- Ologe Lagoon;
- Alaguntan Lagoon;
- Badagry Creek;
- Porto Novo Creek;
- Five Cowry Creek;
- Ogun River;
- Oshun River; and,
- Majidun River.

The water bodies listed above are fed by numerous “creek lets” and seasonal streams which straddle the southern landscape of the State. It is important to observe that all upland rivers running through Lagos State empty their waters into the lagoons.

Lagos Lagoon

The lagoon of Lagos is one of the several lagoon systems in the West African sub-region and the most extensive one too. It is part of the barrier lagoon coasts of Nigeria. The water is generally shallow and covers an area of about 208 km² (Ekundayo and Akpata, 1978). Lagos lagoon is fed mainly by the rivers of Ogun, Shasha, Oshun, Agboyi and Majidun as well as the Ogudu creeks and waters of the Lekki and Epe lagoons. The lagoon empties its water into the Atlantic Ocean through Lagos Harbour. The southern margin of Lagos Lagoon is bounded by Five Cowry Creek, the eastern margin by the Palaver Islands and its northern border by Ikorodu.

Lagos Lagoon is 40-64 km long and has two arms; one connects the Lekki Lagoon, while the other arm leads northward into the hinterland (Allen, 1965) and to the Ologe Lagoon via an intricate network of creeks. The Lagos Lagoon is shallow with depths of 1.5 – 3.0 m (Ibe, 1988), and is made up of a muddy and sandy bottom. Its bottom relief is negligible.

Navigation in the Lagos Metropolitan Area

The water bodies are generally navigable. Lagos lagoon provides water access to the Lagos Island from the North while the Deep Water Harbour links up from the South. The water depth in Lagos ranges from 0.5 – 2.5 m making it sufficiently navigable by motorised boats and canoes. In fact, the private water transport company called Texas Connection Ferries Limited (TCFL) which has a jetty at Osborne Road, Ikoyi, operates scheduled and unscheduled services for corporate groups. The Marina-Maroko, Marina-Ikorodu and Ikorodu-Oworonsoki routes were shut down mainly due to poor navigable waters in need of dredging.

The Porto-Novo Creek provides access through a network of natural and artificial channels and canals northward to Ajegunle, a densely populated suburb with very limited and highly congested road infrastructure. Furthermore, this water body has the potential of providing water transport to Isolo and the International Airport. The water depth varies from about 0.5 – 2.5 m. The navigability is poor as a result of massive indiscriminate disposal of solid waste and liquid effluent into the water.

The Deep Water Harbour currently provides water transport to Satellite, Badagry and neighbouring communities. These routes are generally navigable.

The Lekki lagoon currently serves the nearby rural communities where canoes are the main means of water transport in the area. Water depth ranges from 0.5 – 1.5 m.

The Ologe lagoon is flanked by industries (Agbara Industrial Estate) and heavily populated communities, such as Ojo, Okokomaik, Iba and Agbara Housing Estate. The water depth varies from 0.5 – 2 m. Rain water from surrounding land and waste water effluents from nearby industries, is channelled into the Ologe lagoon through a network of gutters, gullies and streams in the area.

The Badagry Creek divides between Badagry and Ipokia area near the border between Nigeria and the Republic of Benin. The creek is flanked by a hill to the South of which Badagry is located. The water depth is about 0.5 – 2 m. The water body on the Ipokoira side is about 500 m wide. Dredging activities will make this creek navigable and provide access to motorised and outboard engine boats as well as ocean-going vessels.

The aforementioned water bodies are safe and good routes for commuter transportation following dredging. The Lagos State Government, for example, embarked on the dredging of the following waterways:

- Ikorodu – Oworonsoki route 100m wide;
- Badore – Ijede route 100m wide.

Furthermore, the dredging of Lagos lagoon in the vicinity of the third mainland bridge is still on-going.

Waste management throughout the navigable routes, however, will be essential because indiscriminate waste disposal into the water bodies, particularly those running upland such as Ajegunie, Isolo, and International Airport, continues unabated.

9.2.4 LAMATA and Royal Haskoning

In consonance with the Lagos State Policy on environment and in order to strike a balance between the environment and water transportation development in the State as well as in compliance with the Regulations and Guidelines of the Federal Ministry of Environment and LASEPA, the Lagos Metropolitan Area Transport Authority (LAMATA) invited and commissioned Royal Haskoning to conduct feasibility studies for the development of ferry services within the context of the Lagos Urban Transport Project (LUTP). The development of Ferry Services in the Lagos Metropolitan Area (LMA) requires an Initial Environmental and Social Examination to establish the need for an Environmental Impact Assessment (EIA) and a Social Impact Assessment.

9.3 World Bank / IFC policies

The Lagos Lagoon Ferry Project shall adhere to the environmental and social requirements set forth by the World Bank / International Financial Corporation (IFC). The World Bank through the International Development Agency (IDA) has been influential in the drafting of environmental standards through:

- Environmental and Social Safeguard Policies;
- World Bank / IFC Operational Manual (OM) and Operational Policy (OP);
- Pollution Prevention and Abatement Handbook (PPAH); and,
- The Environmental Assessment Sourcebook.

A brief description of a select number of environmental and social requirements set forth by the World Bank / IFC, which apply to this project, are listed below:

- The "Policy Potential Relevance to the Project How Addressed by the Project EIA Document Reference IFC OP4.01 Environmental Assessment" (October 1998) details the requirement for environmental assessment (EA) of projects proposed. The associated guidelines specify the stages of the EIA process, discuss their objectives and list requirements for each stage, including: screening, scoping and development of terms of reference, preparing environmental assessment report, EA review and project appraisal, and project implementation.

- The World Bank / IFC OP4.04 Natural Habitats embodies the "no net loss" principle, Paragraphs 4 and 5 state: "The IFC will not invest in projects that significantly convert or degrade critical natural habitats or in projects that otherwise affect habitats supporting threatened or endangered species. They will also not invest in projects that significantly convert or degrade other natural habitats unless careful and comprehensive review and analysis indicate that:

    - No feasible alternative exists for the project or its siting;
    - The project's overall benefits substantially outweigh its environmental costs;
    - Project plans include mitigation measures acceptable to IFC; and,
    - Project sponsors have the ability to implement necessary conservation and mitigation measures or the project includes plans that are acceptable for developing this capacity.

- The Project recognises the importance of protecting biological diversity, and in particular ensuring that protected natural habitats are avoided where at all possible. Where an overall project assessment indicates that this is unfeasible, and the overall benefits substantially outweigh the environmental costs, direct mitigation measures have been developed and will be implemented to minimise the impact. Where a residual impact remains, the project will implement compensation plans and environmental investment projects to offset this impact and ensure that there is no net loss to biological diversity.

- The “Policy Potential Relevance to the Project how Addressed by the Project EIA Document Reference Policy on Disclosure of Information” requires consultation with project stakeholders including the potentially affected population, NGOs and other interested parties about the project’s environmental and social aspects, and to take their views into account.

- The World Bank / IFC Operational Directive OD 4.30, Involuntary Resettlement (June 1990) describes the WB’s policy and procedures on involuntary resettlement and also sets out the conditions that sponsors are expected to meet in projects involving displacement of communities.

- The World Bank / IFC Operational Policy Note OP11.03 Management of Cultural Property (September 1986) addresses sites having archaeological, paleontological, historical, religious and unique natural values. It encompasses both remains by previous human inhabitants and unique natural environmental values such as canyons and waterfalls. The WB’s general policy regarding cultural property is to assist in their preservation.

- The World Bank / IFC Operational Directive OD4.20: Indigenous People (September 1991) describes World Bank policies and processing procedures for projects that affect indigenous people. It sets out basic definitions, policy objectives, guidelines for the design and implementation of project provision of components for indigenous peoples and processing and documentation requirements. The directive provides policy guidance to ensure that::

    - Ensure that indigenous people benefit from development projects;
    - Avoid or mitigate potentially adverse effects on indigenous people by Bank assisted activities.

- The “IFC Child and Forced Labour Policy Statement” (March 1998) highlights how the IFC will not support projects that use Forced or Harmful Child Labour. Projects should comply with the national laws of host countries, including those that protect core labour standards and related treaties ratified by the host countries.

- The “IFC Doing Better Business through Effective Public Consultation: A Good Practice Manual” (1999) recommends procedures and good practice for public consultation and information disclosure. The Manual offers advice on managing the expectations of local communities, tailoring consultation to a private sector context, and encouraging consultation between companies and their local stakeholders throughout a project's lifecycle.

- The “IFC Investing in People: Sustaining Communities through Improved Business Practice” (2000) is a publication geared towards IFC private sector and acts as a resource guide in establishing effective community development programs. The Guide also includes 3 in-depth case studies that demonstrate different ways of doing community development innovatively and effectively.

- The “IFC Handbook for Preparing a Resettlement Action Plan” (April 2002) provides guidance on preparing resettlement action plans for private sector projects. It is a good practice guide to designing and implementing resettlement action plans for IFC clients and private sector companies.

Based on the collective resettlement experience of IFC staff in applying the WB Group's policy on involuntary resettlement to IFC investments, the Handbook takes the reader step-by-step through the resettlement planning process and includes practical tools such as implementation checklists, sample surveys and monitoring frameworks.

- The “IFC Good Practice Note on Addressing Child Labour in the Workplace and supply Chain2 (June 2002) is the first in a Good Practice Note series, this publication offers a unique private sector perspective on the topic of harmful child labour. It seeks to share corporate learning and experiences by providing companies with a range of basic, good practice approaches that other businesses have successfully applied in managing risks associated with child labour in their own workplaces and those of their vendors and suppliers.

- The “IFC Good Practice Note on HIV/AIDS in the Workplace” (December 2002) is an introduction to the issue of HIV/AIDS in a business context. The note looks at the impact of the epidemic on the private sector, assesses the costs to companies, and provides a menu of programme options from awareness raising and policy development to prevention, care and treatment programs for businesses interested in implementing HIV/AIDS initiatives to support their employees and the communities in which they work and live.

- The “IFC Good Practice Note Addressing the Social Dimensions of Private Sector Projects” (2003) is a practitioner’s guide to undertaking social impact assessment at the project level for IFC financed projects. This Good Practice Note has been written by IFC social development specialists based on years of private sector experience across industry sectors and regions.

  It covers issues from scoping and baseline data collection to impact analysis, mitigation and monitoring of social impacts. Social assessment is presented as both an integral part of the IFC environmental assessment process and as a tool for identifying value-adding opportunities that go beyond traditional mitigation measures to promote sustainable development on a broader scale.

9.3.1 IFC Environmental Guidelines

The IFC Environmental Guidelines are technical reference documents containing the expectations of the International Financial Corporation (IFC) with respect to the performance standards required for the management of the industrial pollutions caused by projects. More than 70 guidelines are now available and are grouped around the two following sources:

- The guidelines for each industrial sector published in the document entitled Pollution Prevention and Abatement Handbook (PPAH, 1998) of the World Bank;
- The guidelines of the International Financial Corporation (IFC) concerning environment, health and safety published in 1993, on subjects not covered by Pollution Prevention and Abatement Handbook (PPAH).

The PPAH includes (i) general specifications that can be used in new projects for which no specific directive is available and (ii) specifications for each industrial sector covering about forty sectors of activity and concerning pollution control and prevention, releases of certain polluting agents, and treatment technologies for emissions and releases. The World Bank guidelines applicable to the Lagos Lagoon Ferry Project are the following:

- General Environmental Guidelines (1998);
- General Health and Safety Guidelines (1998);
- Hazardous Materials Management Guidelines (2001);
- Life and Fire Safety Guidelines (2002);
- Occupational Health and Safety Guidelines (2003);
- Port and Harbour Facilities (1998).

Note that the update of these guidelines is on-going.

9.3.2 General IFC Guidelines

The general environmental specifications of the PPAH yield guide values for atmospheric releases, ambient air quality, liquid waste, and ambient noise. All the guide values must be observed during at least 95 % of the working time.

Atmospheric Emissions

The sources of atmospheric releases are considered significant when their thermal rate is higher than 10 millions British Thermal Units per hour (Btu/h) or 2.9 MW. The pollutant concentrations must not exceed the guide values provided in Table 9.2.

Pollutant	Guide Value
Particulate matter	100 mg/m^3 for the units <170 MBTU/h (50 MW) 50 mg/m^3 for the units ≥ 170 MBTU/h
Nitrogen oxides in the form of NO_2 Supplied by liquid fuel products	460 mg/m^3
Sulphur dioxide (SO_2)	2 000 mg/m^3
Dioxin (equivalent of 2.3.7.8.-TCDD)	1 mg/m^3

Table 9.2 – Air Emission Limits for General Application
[Source: PPAH. Note: The concentrations refer to dry matter at 0 °C and 1 atm]

Ambient Air Quality

Long-term exposure to sulphur dioxide, nitrogen oxides, ozone, and dust PM10 (or air–borne particles) must not exceed the guide values provided in Table 9.3.

Pollutant	Guide Value
Particulate matter (PM)	
Annual arithmetic average	50 µg/m^3
Arithmetic average per maximum 24 h	70 µg/m^3
Sulphur dioxide (SO_2)	
Annual arithmetic average	50 µg/m^3
Arithmetic average per maximum 24 h	125 µg/m^3
Nitrogen oxides (NO_x)	
Arithmetic average per maximum 24 h	150 µg/m^3

Table 9.3 – Ambient air conditions at property boundary, for general application [Source: PPAH]

Liquid Wastewater

Liquid waste releases (sanitary waste water, industrial water, contaminated rainwater) must correspond to the guide values presented in Table 9.4Table 4.

Pollutant or parameter	Limit
pH	6-9
BOD_5	50 mg/l
COD	250 mg/l
Hydrocarbons	10 mg/l
Suspended solids	50 mg/l
Heavy metals, total	10 mg/l
Arsenic	0.1 mg/l
Cadmium	0.1 mg/l
Chromium (hexavalent)	0.1 mg/l
Chromium (total)	0.5 mg/l
Iron	3.5 mg/l
Lead	0.1 mg/l
Mercury	0.01 mg/l
Nickel	0.5 mg/l
Selenium	0.1 mg/l
Silver	0.5 mg/l
Zinc	2 mg/l
Cyanide, free	0.1 mg/l
Cyanide, total	1 mg/l
Ammonia	10 mg/l
Fluorine compounds	20 mg/l
Residual chlorine, total	0.2 mg/l
Phenols	0.5 mg/l
Phosphorus	2 mg/l

Pollutant or parameter	Limit
Sulphur compounds	1 mg/l
Coliforms	The most probable amount < 400 / 100 ml
Temperature increase	3°C
Other toxic components (dioxin, furan, HAP (hydrogen ammonium percolate) etc.)	0.05 mg/l

Table 9.4 – Limits for process wastewater, domestic sewage, and contaminated rainwater discharged to surface waters, for general application [Source: PPAH]

Waste and Hazardous Substances Management

According to the general environmental guideline principles of the PPAH 1998, waste disposal shall comply with the following practice:

- Encourage waste recycling and re-utilization;
- If impossible, eliminate waste in compliance with the environmental protection and local regulations.

Moreover, the following measures should be observed:

- Any storage of hazardous substances (inflammable, corrosive, toxic, etc) must be clearly indicated;
- The management of hazardous waste must comply with the local legislation. The storage sites of flammable substances, wastes and other liquid products must be provided with retaining facilities in order to prevent the contamination of soil, underground and surface water in case of leakage.

Ambient Noise

The ambient noise levels measured within the site area must not exceed the highest value of the two following guide levels:

- The levels presented in Table 5;
- A maximum increase of 3 dB(A), as compared to the residual level.

Receptive Environment	Maximum allowable log equivalent (hourly measurements) in dB(A)	
	Day (07.00-22.00)	Night (22.00-07.00)
Residential area, sites of official institutions, educational sites	55	45
Industrial areas, commercial areas	70	70

Table 9.5 – Guidance values applicable to the Ambient Noise Level [Source: PPAH]

9.3.3 International Environmental and Social Conventions

International legal and institutional considerations include those rules and regulations established by inter-Governmental organizations (IGOs), like the United Nations. These international institutions address environmental and social legislation internationally. In light of this, international legislative measures can influence privatization transactions and commercialization activities which impact upon the natural and social environment in Nigeria. The following conventions, best practises and requirements apply:

International Conventions and Best Practices	
Revised Equator Principles 2006	IAIA Principles of Environmental Impact Assessment Best Practices
Ramsar Convention	Environmental policies and guidelines of other US Government and multilateral ODA
UNCCD	OECD Common Approaches
CBD	IUCN Guidelines for Protected Area Management
Stockholm Convention on POPs	World Bank Operational Policies on Natural Habitats (OP 4.04)
Kyoto Protocol to the UNFCCC	World Bank Operational Policies Involuntary Resettlement (OP 4.12)
MoU concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa	World Bank Operational Policies Indigenous People (OP 4.10)
UNESCO World Heritage Convention	World Bank Operational Policies Environmental Assessment (OP 4.01)
UNCLOS	World Bank Operational Policies Cultural Property (WB No. 11.03)
Contonou Agreement	Revised IFC / WB environmental and social standards
Fourth ACP-EEC Lomé Convention	UN FAO Code of Conduct for Responsible Fisheries
Revised IMO/MEPC/MARPOL 73/78 (Annex 1/11 – V) and amendments	WMO LDC Programme
London Convention 72 and amendments	Basel Convention
Revised World Bank Standards and Policies (2006)	Revised International Finance Corporation (IFC) standards and Policies (2006)

International Maritime Requirements	
IMO Convention 48	CSC Convention 72
IMO amendments 93	INMARSAT Convention 76
SOLAS Convention 74	Facilitation Convention 65
Load Lines Convention 66	SUA Convention and Protocol 88
Tonnage Convention 69	OPRC Convention 90
COLREG Convention 72	SAR Convention
CLC Protocol 92	FUND Protocol
MARPOL 73/78 (Annex I/II)	MARPOL 73/78 (Annex III)
MARPOL 73/78 (Annex IV)	MARPOL 73/78 (Annex V)

A brief description of a selected number of international agreements and conventions, to which Nigeria is party, and their status at the national level, is provided:

- The Convention Concerning the Protection of the World Cultural and Natural Heritage (Heritage Convention 1972) addresses the protection of world cultural and natural heritage. It is concerned primarily with immovable property classified by: monuments, groups of buildings (ensembles), and sites. The Convention established the World Heritage List of cultural and natural heritage sites of "outstanding universal value".

- The Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (London Convention 1972) seeks to restrict the deliberate dumping of waste into the sea from ships or aircraft. The disposal of waste from ships transporting Project equipment will be carried out in accordance with a waste management plan.

- The United Nations Convention on the Law of the Sea (UNCLOS), Montego Bay, 1982, established a new and comprehensive legal regime dealing with all matters related to the law of the sea, including platforms and other man-made structures at sea. The UNCLOS also suggests measures to prevent, reduce, and control pollution of discharge of oil, oily wastes and other noxious substances into the marine environment by co-operation on an international and regional scale.

- The Vienna Convention on Substances that Deplete the Ozone Layer 1985 is an international agreement designed to protect the stratospheric ozone layer.

- The Montreal Protocol on Substances that Deplete the Ozone Layer 1987 (and its London, Copenhagen and Montreal Amendments) is an international agreement designed to protect the stratospheric ozone layer. The treaty was originally signed in 1987 and substantially amended in 1990 and 1992. The Montreal Protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere, including chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform, are to be phased out by 2000 (2005 for methyl chloroform).

- The Kyoto Protocol to United Nations Framework Convention on Climate Change (UNFCCC, 1992), negotiated by more than 160 nations in December 1997 has as objective the reduction in net emissions of specified greenhouse gases, primarily carbon dioxide (CO2). Each of the participating developed countries is responsible for determining how to meet their respective reduction goal during a five-year period (2008 – 2012).

- The Convention on Biological Diversity (CBD, 1992) establishes a system of protected areas to conserve biodiversity, sustain the use of its components, and fairly and equitably share the resulting benefits.

- Parties to the United Nations Convention to Combat Desertification (UNCCD, 1994) agree to “promote, finance and/or facilitate the financing of the transfer, acquisition, adaptation and development of environmentally sound, economically viable and socially acceptable technologies relevant to combating desertification”. The Convention aims to work as a global mechanism to “promote actions leading to the mobilisation and channelling of substantial financial resources” to combat desertification.

9.4 National Institutional and Regulatory Considerations

Nigeria is committed to a national policy that ensures sustainable development based on proper management of the environment so as to meet the needs of the present and future generations. In enunciating this national policy on the environment, cognizance has been taken of the various institutional settings and professional groupings, as well as the complex historical, social, cultural and legal considerations which have been, and continue to be involved, in the identification and implementation of measures designed to solve national environmental problems.

The purpose of a legal framework as an integral part of a National Environmental Policy is to consolidate, strengthen, provide and extend legislation for environmental protection and improvement in all ramifications whilst also providing for effective implementation and enforcement procedures.

9.4.1 Federal Ministry of Environment (FMENV)

The Federal Government of Nigeria allocated the responsibility of environmental management to the Federal Ministry of Environment (FMENV), formerly Federal Environmental Protection Agency (FEPA). The overall mandate is to protect, restore and preserve the ecosystems of the Nigerian environment. In fulfilment of this mandate, FMENV has since published guidelines for environmental protection for industries operating in Nigeria. Twenty-one guidelines for pollution abatement in all categories of industries were laid down. Part of the guidelines is a mandatory requirement for environmental auditing of all existing industries and an Environmental Impact Assessment (EIA) for new industries and major development projects.

In exercise of the powers conferred to the FMENV by Section 37 of the FEPA Act Cap. 131 (same as Decree 58 of 1988), the FMENV has to date made the following Regulations:

- S.I.8 of 1991 National Effluent Limitations Official Gazette Fed. Rep. Nigeria. No, 42 vol. 78 20th August, 1991;
- S.I.9 of 1991 Pollution Abatement in Industries Generating Wastes Official Gazette Feb. Rep. Nig. No. 42 Vol. 78, 20th August, 1991; and,
- S.I.15 of 1991 Management of Hazardous and Solid Wastes Official Gazette Fed. Rep. Nig. No. 102 Vol. 78, 31st December, 1991.

It is important to observe that the FMENV Regulations and Standards for Environmental Pollution Abatement stipulates in paragraph 15(2) of the new regulation S.1.9. by FEPA states clearly that “no oil, in any form, shall be discharged into public drain, rivers, lakes, sea, atmosphere or underground injection without a permit issued by the FMENV”. Paragraph 17 of the same legal instrument states “an industry or a facility which is likely to release gaseous, particulate liquid or solid untreated discharges shall install into its system appropriate abatement equipment in such manner as may be determined by the FMENV”.

The Environmental Impact Assessment (EIA) Decree No. 86, which was promulgated in 1992, further gives specific powers to the FEPA to facilitate environmental assessment on certain public and private projects. The decree stipulates that the public or private sector of the economy shall not undertake or embark or authorize projects or activities without prior consideration, at an early stage, of their environmental effects.

The Decree also states that where the extent, nature or location of a proposed project or activity is likely to significantly affect the environment, its EIA shall be undertaken in accordance with its provisions.

The Policy and Legal Instruments developed to date by FMENV and FEPA to halt environmental degradation in Nigeria include:

- The Federal Environmental Protection Agency (FEPA) Decree 58 of 1988;
- The National Guidelines and Standards for Environmental Pollution Control in Nigeria 1990;
- National Effluent Limitation Regulations S.I.8-1991;
- Harmful Wastes (Criminal Provisions) Decree 42 of 1988;
- The National Policy on the Environment, 1989;
- Pollution Abatement in Industries and Facilities Generating Wastes Regulation S.I.9, 1991;
- Hazardous and Solid Wastes Management Regulations S.115, 1991;
- Federal Environmental Protection Agency (Amendment) Decree 59, 1992;
- Environmental Impact Assessment Decree 86 of 1992; and,
- Guidelines for Environmental Impact Assessment.

The FMENV is also the Focal Point and Designated National Authority (DNA) for the implementation of the following international Laws:

- Vienna Convention for the Protection of the Ozone layer, 1985;
- Montreal Protocol on Substances that Deplete the Ozone Layer 1987 (Ratified 1991);
- Basel Convention on the Trans-boundary Movement of Hazardous Waters and their Disposal 1989 (Ratified 1991);
- The UNEP/FAO Prior Informed Consent (PIC) Procedure of the London Guidelines and the International Code of Conduct on International Trade in Potentially Toxic Chemicals 1991;
- United Nations Framework Convention on Climate Change (UNFCCC) 1992;
- United Nations Convention on Biological Diversity (CBD) 1992; and,
- United Nations Convention to Combat Desertification (UNCCD) 1994.

9.4.2 Lagos State Environmental Protection Agency (LASEPA)

Lagos State Environmental Protection Agency (LASEPA) was established through the Lagos State Edict of 1996 for the protection and development of the environment, the conservation of biodiversity, the sustainable development of the State, the sustainable consumption of natural resources, and the application of Best Available Technology Not Exceeding Excessive Cost (BATNEEC) as well as environmental technology. The Agency has a Task Force which enforces the legislation.

Legal Framework

Environmental legislation has the objective to integrate national and State regulations and bye-laws on environmental management and streamline decision-making on pollution control, hazardous waste management and disposal, conservation of water resources and protection of biodiversity.

The environmental protection measures put in place by the State include:

- Lagos State Waste Management Authority Law Cap 106, Laws of Lagos State 1994.
- Environmental Sanitation Law Cap 44, Laws of Lagos State, 1994.
- Environmental Sanitation Enforcement Agency Law Cap 45, Laws of Lagos State, 1994.
- Environmental Pollution Control Law Cap 46, Laws of Lagos State 1994.
- Lagos State Environmental Protection Agency Edict, 1996.

The enabling Edict of the LASEPA vests this Agency with the overall responsibility for the protection of the environment within Lagos State. The functions of the Agency are set out in paragraph 7 of the Edict while the powers to carry out the functions are spelt out in S.8 of the Edict. Some of the functions of the Agency include:

- Powers to prepare policies;
- Establishment of criteria, guidelines, specifications and standards for various forms of pollution;
- Spelling out specific removal procedures, penalties and compensation necessary to minimize pollution and spillage; and,
- The enforcement powers of the Agency include powers to, without warrant, inspect, search, take samples, perform test, seize items and arrest any individual believed to have committed an environmental offence.

9.4.3 The Lagos State Waste Management Authority (LAWMA) Law

The Lagos State Waste Management Authority (LAWMA) Law establishes a Waste Management Board with the functions spelt out in S.3 of the Law. These functions are powers of removing, collecting and disposing of domestic, commercial and industrial waste. Under the enabling law, it is an offence for anyone whether individual or body corporate to dump waste on unauthorized site.

9.4.4 The Environmental Sanitation Law

The Environmental Sanitation Law was promulgated to bequeath a clean and safe environment to the State to compliment the efforts of the Waste Management Board.

S.1. of the Environmental Sanitation Law prohibits any owner or occupier of a tenement to construct or put any structure on the footpath or on the required set back from the road and that the owner or occupier shall maintain and keep free from drain, gutter or channel all filth, rubbish, refuse or waste of all description.

S.2. requires every person generating liquid waste in his tenement to provide a suitable holding tank for waste disposal and provide a suitable waste treatment plant for treating the liquid waste.

S.3. prohibits the throwing or discharging of refuse or sewage effluents or liquid waste into the streets or drains or open spaces, gutter or tenement.

S.7. requires every owner or occupier to provide approved waste receptacle within the tenement for the deposition of refuse and that the receptacle be maintained.

S.8. of the law empowers the State Ministry of Environment and Physical Planning to perform among others the under-listed functions:

- Monitor and survey water, including underground water, air, land and soil environment so as to determine pollution levels or collect baseline data from them;
- Monitor and survey solid, gaseous and liquid wastes generated in the state.
- Monitor and control the discharges and disposal of solid, liquid and gaseous industrial wastes.
- Carry out toxicological tests on insecticides, herbicides and other agricultural chemicals which are new in the market with a view to checking possible adverse effect on the environment.
- Formulate environmental protection policies, guidelines and standards acceptable in the State.

S.9. prohibits the deposition of hazardous, toxic or poisonous waste in a waste receptacle.

It is equally an offence under the law for any vehicle used in conveying or transporting waste or refuse within the state not to be covered such as to prevent the content thereof from littering the street.

Environmental Sanitation Enforcement Agency Law was promulgated for the establishment of Environmental Sanitation Enforcement Agency for the enforcement of the provisions of Environmental Sanitation Law, Pollution Control Law and any other law relating to the environment.

To compliment other environmental laws already enacted, Lagos State promulgated the Environmental Pollution Control Law for the protection of the Environment.

S.14. prohibits the discharge of oil, grease used in the cause of manufacturing operation or business into any public drain, water course, water gorge or road verge.

S.15. prohibits air pollution through discharges of injurious gases such as sulphur dioxide, oxides of nitrogen, hydrogen sulphide, carbon monoxide, ammonia, chlorine, smoke and metallic dusts.

S.16. prohibits the manufacturing or storage of chemicals such as lubricants, petroleum products, radio-active materials in residential and commercial areas of the State without written permission.

S.18. prohibits the dumping and burying of toxic or hazardous substance or harmful waste in any land or water within the State.

S.21 The Lagos State Environmental Protection Edict states that no person shall operate the business of manufacturing of any description or the storage of chemicals, lubricants, petroleum products, cement other than that used in building, radioactive materials or gases or carry on the containerization of any oil or lubricant or petroleum produce in residential or commercial areas within the State except a written permission is obtained from the Agency.

S.22 states that no person shall:

- Carry on or run any manufacturing operation or business in any premises within the State except such waste generated in the process of such manufacturing operation or business is treated or purified to the satisfactory standards approved by the Agency before discharged into the environment;
- Discharge or cause to be discharged, raw untreated human waste into any public drain, water-course, gorge, storm-water or unto any land within the State;
- Discharge or cause to be discharged any form of oil, grease, spent oil including, trade waste, brought about in the course of any manufacturing operation or business into any public drain, water-course, water gorge and road verge;
- Discharge into the air any inadequately filtered and purified gaseous waste;
- Burn, dump or bury or cause to be burnt, dumped or buried refuse of any type, bush, weeds grass tyres, cables or waste of any description without a written permission from the Agency; and,
- Use Gamalin 20 or any herbicide, pesticides, insecticide explosives or any other chemicals to kill aquatic animals or for any other purposes in rivers, lakes and streams.

9.4.5 The Environmental Clearance Process

Under national environmental law, the developer is required to prepare an Initial Environmental Examination (IEE), also known as a project brief, which describes the nature of the project, the projected area of water, land and air that may be affected, the activities that shall be undertaken during and after the development of the project, design of the project, the materials that the project will use and to submit then copies of the brief to the Executive Director.

If found complete, a copy of the project brief is transmitted to the Chief Executive Officer (CEO) of LASEPA for comments within seven days of receiving the project brief. The Agency comments and these comments are transmitted by the CEO within a period of fourteen days from receiving the project brief.

Approval of the Project

Where the project brief reveals no significant impacts on the environment then the developer is not required to carry out an EIA and / or SIA study.

After reviewing the project brief and where it discloses no significant impact on the environment or where it reveals sufficient mitigation measures to cope with the anticipated impacts, the project may be approved and a certificate of approval issued.

Figure 9.1 illustrates the project approval / environmental clearance.

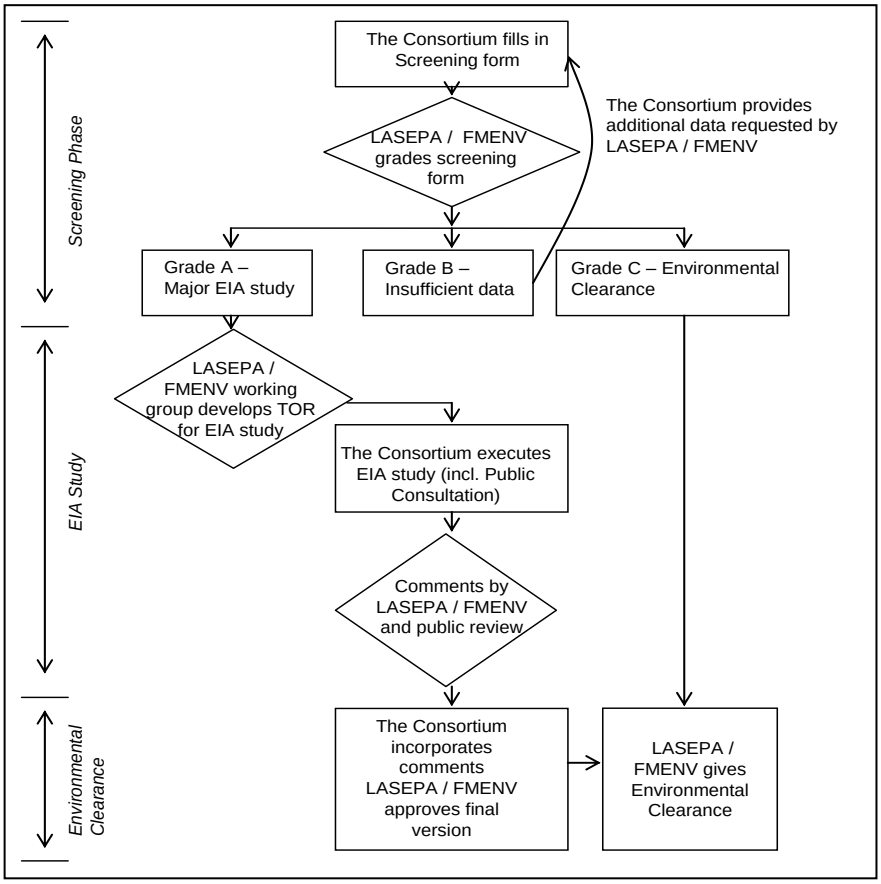


Figure 9.1 – Environmental Clearance / Approval Process

The Environmental Impact Assessment

An EIA may be defined as an appraisal of an activity or project to determine the extent and gravity of its likely environmental effects, the measures necessary to eliminate or mitigate those effects and the appropriateness or otherwise of executing the activity or project in view of the likely effects on the environment. An EIA can thus be regarded as a decision-making tool, which is primarily concerned with environmental soundness of projects and programs. An EIA assesses various alternatives by which desired objectives may be realized and seeks to identify the one, which represents the best combination of economic and environmental costs and benefits. Secondly, it attempts to weigh environmental effects on a common basis with economic cost and benefits. Thus, an EIA will determine:

1. If the project is to be executed without mitigation;
2. If the project is to be executed with mitigation of the environmental effects and, in such a case, what mitigation measures are required;
3. If the project execution is to be denied on grounds of the likely negative environmental effects.

The main aim of an EIA is to ensure that potential problems are foreseen and addressed promptly at an early stage during project planning and design. To achieve this aim, the findings of the assessments are communicated to various groups, such as the proponents, investors, regulators, planners and administrators.

The EIA Guidelines are contained in the EIA Decree No. 86 of 1992, published in the Official Gazette of the Federal Government of Nigeria, No. 73 Vol. 79, pages A979 to A1012. According to the Decree no activity shall be undertaken by any Government, whether Federal, State or Local, or by any corporate group or a private person, without first conducting an EIA on the proposed project.

Activities or projects are categorized into following five groups to determine which ones shall have an EIA:

1. Activities which may result in significant and diverse environmental impacts such as large-scale aquaculture, maritime-culture, irrigation and drainage projects, dams, reservoirs and other large-basin-development projects, chemicals and allied sector, refineries and power plants, major land clearances, excavations, reclamations, development and resettlement projects, new transportation networks, oil, gas or water pipelines shall require a mandatory EIA.
2. Activities, which may result in specific environmental impacts such as small-scale agricultural and industrial projects, mini hydroelectric power and other renewable energy projects, shall require limited and focused EIA.
3. Activities with no significant environmental impact such as education, public health, family planning and other social service projects, do not require an EIA, when they do not involve construction.
4. Activities for environmental restoration and improvement do not require an EIA.
5. Activities under emergency situations, such as national disasters, major industrial accident or a war, which require immediate response, shall not require an EIA.

Based on the above, the proposed Ferry Services Development Project falls under the first category (the Mandatory list), and therefore requires a full EIA. The owners of the project, in this case, Lagos State Government, shall be the proponents (sponsors) of the EIA study.

EIA Procedural Guidelines

The EIA Procedural Guidelines are spelt out in EIA Act of 1992. The procedure indicates the steps to take in the EIA process from project conception to abandonment in order to ensure that the project is executed with adequate consideration for the environment. Figure 2 shows the EIA Management procedure as stipulated by the Federal Ministry of Environment.

In order to perform an EIA, consultation activities need to be performed in order to:

- Obtain copies of, or determine the methods for obtaining any further relevant information that might be available to assist with the EIA.
- Determine the nature and characteristics of the proposed project facilities, their processes and scale.
- Identify issues that the regulatory bodies consider to be of greatest concern.
- Discuss the level and nature of information that the regulatory authorities require to be included in the EIA.
- Identify, define and review the relevant regulatory and legislative framework with which the development would be required to comply.
- The level of consultation, goals to be achieved and factors considered for all stages of this impact assessment process are tabulated below in Table 9.6.

Stage in EIA	Consultation Goals	Strategic Considerations
Project Screening and Scoping	• EIA registration with LASEPA and FMENV • Disclosure of relevant project information • Determine LASEPA and FMENV concerns and include them in the EIA Scope	• Commitment to early and adequate consultation with the relevant authorities • Accountability for implementation monitoring and evaluation • Potential conflicts between needs of the Project and those of the public
Environmental Analysis and Production of Draft Reports	• Disclose information on study methods and findings • Agree on proposed mitigation measures with stakeholders and regulators • Allow stakeholders to determine whether their concerns are adequately addressed (EIA draft report review process)	• Methods appropriate for reaching different stakeholders groups • LASEPA / FMENV Standards, World Bank / IFC Standards, and other national, regional and international requirements
Production of Final Report	• Finalize mitigation and disclose to stakeholders	• Mechanism in place to ensure ongoing consultation and compliance with agreement / MOU
Implement the EMP including Monitoring	• Inform the public about scheduling of potentially disruptive event • Disclose results of environmental monitoring • Effective complaints procedure of programme	• Roles of LASEPA / FMENV in monitoring (scheduling, parameters methods and evaluation) • Company resources • Reporting
Final Evaluation	• Assess effectiveness of consultation process • Consult stakeholders for their assessment	• Any lessons learned that might be transferred to other projects

Table 9.6 – Consultation at Various Stages of EIA

9.4.6 The EIA Process and Planning

A general indicative description of the EIA process is given in the Table 9.7 below. The duration of each phase depends on many factors. Timing will be greatly reduced if the water transport project has a strong and frequent presence at the Federal Ministry of Environment (FMENV) and LASEPA, in order to make this project a priority for the experts within the FMENV and the Agency.

Phases	Phase Description	Duration (estimation)
Phase 1 ⇩	Formally announce the Project at the Federal Ministry of Transport, the Federal Ministry of Environment and LASEPA.	1 day
Phase 2 ⇩	Agree with the relevant Federal Ministry on Scope of Work for the EIA	1-2 months
Phase 3 ⇩	Carry out the EIA (might be seasonal surveys needed that could influence timing). Frequent contact with the relevant Ministry and LASEPA is advisable.	3 - 6 months
Phase 4 ⇩	Official submission of EIA.	1 day
Phase 5 ⇩	The relevant Federal Ministry will select and install an evaluation committee and evaluate the EIA.	1-3 month
Phase 6 ⇩	Feedback from the evaluation. Possibly need to make some adjustments go-ahead is given (then the Ministry supports the project and the EIA).	Depends on feedback
Phase 7 ⇩	Public participation process.	3 months
Phase 8 ⇩	Answer questions raised during public participation.	1 month
Phase 9 ⇩	Finalisation after Public participation.	1 month
Phase 10	Environmental clearance.	

Table 9.7 – EIA Process and estimated Timing

The main EIA process is made up of three phases namely:

Phase I - Preliminary Activities / Screening Process

The regulatory measures governing the EIA process in Nigeria law usually requires that all projects which are listed in Annex 2 of the EIA Guidelines undergo a preliminary assessment to determine whether a full EIA is required. Not all development projects will necessarily cause adverse effects to the environment. Hence, not all proposed projects that require an EIA have to undergo the entire EIA process or the same level of assessment.

The objective of the screening phase is to determine if a proposed project:

1. Has or does not have significant impact. If it is found to have no potential of causing adverse effects to the environment, it shall be excluded from further EIA and an appropriate decision shall be made to either approve or implement the project.

2. Has adverse environmental impacts for which mitigation measures can readily be identified either directly or through an environmental impact review. If found that adequate mitigation measures have been incorporated for the identified impact, the environmental aspects of the project may then be approved.

3. Has significant impact whose mitigation measures can not readily be identified hence requiring a detailed EIS.

The developer gives a description of the project he intends to undertake and its impacts in the preliminary report. The report is submitted to FMENV and LASEPA.

Phase II - Environmental Impact Study (EIS)
This stage, if required, addresses the identification of possible impacts.

Scoping
This exercise should as much as possible involve consultation with the potentially affected communities as well as Non-Governmental Organisations, the private sector and other interested parties. Meetings should be arranged to obtain their comments on what to include in the study and what alternatives to be considered.

The team under the guidance of the coordinator identifies all the possible environmental impacts of the proposed project. The team in conjunction with the authority determines the scope of the study based on the magnitude of the project, extent of the impact, significant impacts which include specific local economic, social and ecological setting.

Baseline Study
This involves undertaking a detailed description of the existing environment including the social and economic activities of the local population resident in the area to be affected.

Impact Evaluation
The types of environmental impacts are illustrated in Table 9.8. The various impacts that the project may have on the environment are evaluated by the team and ranked according to two criteria:

- Quantitative or measurable change, where the impact can be measured and
- Qualitative change where the impact cannot be measured but depends on the environmental acceptability of the project.

Direct (or primary) – impacts that result from a direct interaction between an activity/aspect and the receiving environment (e.g. between an effluent discharge and receiving water quality).

Secondary – impacts that follow on from the primary interactions between the project and its environment as a result of subsequent interactions within the environment (e.g. loss of part of a habitat affects the viability of a species population over a wider area).

Indirect – impacts that result from other developments or activities that are encouraged to happen as a consequence of the original development (e.g. a new development stimulates a requirement for improved road access).

Cumulative – impacts that act together with other impacts to affect the same environmental resource or receptor.

Permanent: impacts that occur once on development of the project and cause a permanent change in the affected receptor or resource (e.g. the felling of old growth forest as a result of occupation of a site, the diversion of a watercourse).

Short-term: impacts that are predicted to last only for a limited period (e.g. during construction, seismic studies, drilling or decommissioning) but will cease on completion of the activity, or as a result of mitigation/reinstatement measures and natural recovery.

Long-term: impacts that will continue over an extended period, (e.g. noise from operation of a development, impacts from operational discharges or emissions). These will include impacts that may be *intermittent or repeated* rather than continuous if they occur over an extended time period (e.g. repeated seasonal disturbance of species as a result of well operations, impacts resulting from annual maintenance activities).

Non-Normal Impacts: impacts that result from non-normal events within the project (e.g. breakdowns, failures and emergencies) or in the external environment affecting the project (e.g. floods, seismic activity, landslip). In these cases the assessment should take account of the probability of the event.
Local: impacts that affect locally important environmental resources or are restricted to a single habitat/biotope, a single (local) administrative area, a single community.

Regional: impacts that affect regionally important environmental resources or are felt at a regional scale as determined by administrative boundaries, habitat type.

National: impacts that affect nationally important environmental resources or affect an area that is nationally important / protected.

International: impacts that affect internationally important environmental resources such as areas protected by International Conventions.

Table 9.8 – Types of Environmental Impacts

Quantitative changes provide a numerical representation of a measure and include the following:

- Water quality and hydrology: whether the proposed project will contaminate a public water supply, alter the course or flow of flood water, or deplete ground water supply;
- Population and housing: whether the proposed project will displace large numbers of people, induce substantial growth or concentration of people
- Geology; i.e. whether the proposed project will expose structures and human to major hazards such as earth quakes, landslides or result in changes in deposition of soils;
- Biological resources: whether it will eliminate plant and animal communities, cause fish or wildlife population to drop below self-sustaining levels;
- Air quality: whether the intended project will result in substantial air emissions or decrease in ambient air quality.

Qualitative changes on the other hand refer to measures that are more descriptive and represent the presence of something reported and not necessarily measurable. These changes would subsequently lead to the degradation of the visual quality and sense of beauty of the natural environment. This considers such issues as, whether:

- The proposed project will significantly alter the existing natural view sheds including changes in natural terrain;
- It will greatly reduce sunlight or introduce shadows in areas used extensively by the communities;
- It will comply with local guidelines or goals related to visual quality;
- It will significantly increase light and glare on the project vicinity.

Identification of Mitigation Measures
The EIA process seeks to compare various alternative options that may be available for any project and hence determine which one represents the most desirable balance between environmental and economic costs and benefits. Analysis and discussion of a range of alternatives to the proposed project should include an evaluation of the merits of each alternative with respect to:

- Technology and engineering design;
- Associated environmental costs of each alternative; interference and harmony with the surrounding features;
- Conformity to the existing laws;
- Constraints and benefits of each alternative; or,
- Nature of the alternative/ locations of project.

During such analyses, environmental losses and gains associated with the various alternatives are compared together with economic costs and benefits to provide a balanced and full picture of each alternative.

The team then identifies measures for the elimination (where possible), reduction of the potential impact, repairing damage or compensation for the various alternatives identified in the study and enhancing positive environmental benefits. The cost of the mitigation measures is also included in the evaluation.

This IEE can be used in order to make a gap-analysis on the information the FMENV and LASEPA need and the information already presented in this IEE. The missing information can then be included for the final EIA.

Phase III – Decision-making

On the basis of whether the proposed project is exempt or appropriate mitigation measures have been incorporated for the identified impacts, a decision shall be made to either approve or disapprove the environmental aspects of the proposed project. If approved, the necessary action shall be undertaken by the developer. After reaching a decision on the proposed action, and if it is approved, the developer will be permitted to implement the project in accordance with the mitigation terms or conditions attached to the approval. In the decision given by the developer, he shall give one alternative and cite reasons for rejecting others. The alternatives rejected and their reasons for being rejected should also be included in the report.

When approving an EIA, LASEPA can give a directive to the developer before, during and after realization of the project with a view to remedying any adverse effects of the project and ascertaining what impact the project may have in the event of decommissioning.

Post Assessment Environmental Audits

Monitoring of projects after EIA has been conducted is essential as this will ensure that the mitigation measures and any other conditionalities set out by the developer in the EIA are complied with and also verifies the performance of existing plans in the face of new laws and standards. The developer is required to ensure that all practicable measures to minimise any predictions as laid out in the project brief or EIS are complied with.

Environmental Audit means the systemic, documented periodic and objective evaluation of how well an environmental organisation, management and equipment are performing in conserving the environment and its resources. Environmental Audits are therefore a monitoring mechanism, the responsibility of carrying out an environmental audit lies with LASEPA and Nigeria's FMENV. After completion of the project or before the commencement of its activities, the developer is required to undertake an initial environmental audit of the project. It is required of the developer to prepare an environmental audit report after each audit and to have it submitted to the Executive Director.

Audit of the Agency

An inspector shall be designated to carry out an audit of any land, project or facility for which a project brief or EIS has been made to determine how far the predictions made in the project brief or EIS are complied with.

Mitigation Measures

A mitigation measure is that which a developer may carry out to reduce or minimize the impact to the environment that the proposed project may cause or may have caused. The purpose of this is to look for alternative and better ways of implementing the proposed project or associated activities so that the negative impacts are substantially eliminated or minimised while the benefits are enhanced.

A mitigation or management plan should include the following items:

- Identification and summary of all anticipated adverse' environmental impacts;
- Description of each mitigation measures, including the type of impact to which it relates and the conditions under which it is required, together with designs, equipment descriptions and operating procedures;
- Description of the elements of the monitoring programme;
- Monitoring and reporting procedures that are designed to ensure early detection of conditions that necessitates corrective actions and provide information on the progress and results of mitigation and institutional strengthening measures.

Improvement Notices
Where a developer fails to put in place mitigation measures as set out in the EIS, an improvement notice can be issued to the developer by an environmental inspector and / or criminal or civil proceedings can be started against the developer.

9.5 Environmental Baseline Conditions

In order to assess potential environmental impacts caused by a ferry system in Lagos, it is necessary to describe the environmental baseline conditions. Specific legal aspects associated with environmental law can influence the timing of setting into place a ferry system, the associated dredging works and mitigation measures required to minimise / eliminate undesirable environmental impacts, and the selection of alternatives if necessary which will minimize or eliminate any exposure to risks and liabilities.

9.5.1 Water Quality

The water bodies in the LMA are significantly polluted as a result of the high population density of the State, the lack of waste management facilities and lack of infrastructure. Solid wastes, nylon rice bags, plastic bags and other types of waste are a common sight throughout LMA's water bodies. It has been reported that about 100,000 tonnes of biodegradable organic matter are indiscriminately disposed of into the Lagos Lagoon on a daily basis. Bioaccumulation of heavy metals in aquatic organisms has been reported. Vessel wrecks indiscriminately litter the water bodies surrounding Lagos port as well as other areas.

Photograph 1 Nylon Rice Bag and Plastic Bags in Water

Photograph 2 Rubbish along the River Shoreline

9.5.2 Climate and Meteorology

The project area is a coastal low-lying and flat terrain stretching from Badagry in the West to Iwopin in the East, and lying on the Nigerian coastline area off the Gulf of Guinea of the Atlantic Ocean. Its climate and meteorology are therefore determined by its close vicinity to the Atlantic Ocean and latitudinal location.

A dry North-Easterly Tropical Continental wind from across the West African Continent and a wet South-Westerly Tropical Maritime wind from the Atlantic Ocean constitute the dominant air masses influencing the project area. Their meeting point which is referred to as the Inter-Tropical Convergence Zone (ITCZ), Inter-Tropical Discontinuity (ITD) or Inter-Tropical Front (ITF) oscillates towards the North and South of the Equator, following the position of the sun in relation to planet Earth. These north-south oscillations influence the seasons year round.

Hence, the climate in the Gulf of Guinea and Central Eastern Atlantic is strongly influenced by ITCZ weather patterns. Maritime tropical air masses, characterized by warm, humid south-westerly winds and the continental air mass, characterized by hot, dry north-easterly winds, converge in the ITCZ. The alternating wet season and dry season phenomenon is determined by the north-south oscillation of air masses in the ITCZ.

Winds from the south-west and from the south-southwest blow year round with monthly averages between 2m/s and 4m/s. While there are two main seasons during the course of the year, the annual weather patterns are somewhat more complicated due to a short break in the wet season in August.

The typical weather is as follows:

- Long summer rainy period stretches from April to July and starts with storms and strong, humid south-westerly winds. There is an upwelling event along the shoreline in July;
- Short dry period occurs in August as rainfall amounts suddenly decline about 75 percent;
- Short rainy period is associated with decreasing winds and a weak upwelling during October and November. Ocean surface temperatures increase during September, reaching 28 ºC
- Long dry season stretches from December to March and is characterized by persistent Harmattan winds, which derive from anticyclone systems in the north.
- The mean annual rainfall in the region ranges from 500mm to 2,000mm. During the wet season, rainfall events can be as much as 140mm per day. Along the coast, the mean annual rainfall ranges between 920mm and 1,491mm.
- As one would expect at near sea level in the equatorial zone, temperatures are high and only vary approximately 8ºC throughout the year. Maximum temperatures are 32ºC during the dry season (February, March), and a minimum of 22ºC often occurs in August.

Since the areas are located in a multiple set of ecological zones, relative humidity varies accordingly. Higher values are recorded in the mornings and evenings. In general, temperatures are high all the year round owing to the latitudinal location of the region within the tropics, though some mild variations are traceable and influenced by sea breezes from the Atlantic and South East Wind. An average of just between 3.9 hours and 7.0 hours of bright sunlight were recorded on daily basis within the project area.

9.5.3 Rainfall

The most singular element for defining climatic seasons in the tropics is rainfall. Rain falls every month of the year in direct proportion to the relative effects of the South-Westerly Tropical Maritime wind and the North-Easterly Tropical Continental wind as well as the location of the ITD and other monsoon-related air masses. The total annual rainfall is about 1468 mm. The minimum rainfall is about 13 mm during the dry season in the month of January. The highest rainfall occurs during the month of June.

The number of rainy days ranges between 98 and 135. The regime is characterised by two maximum values. A primary maximum occurs during the month of June and a minor peak is in the month of September, shortly after the “August break”. Storms, thunder, lightening, squalls and disturbance lines characterize the seasonal changes. The average number of day of rain lies between 45 and 70 days per annum. The highest is about 5-9 days per month, which usually occurs between March and May and towards the end of the rainy season around the month of October.

9.5.4 Relative Humidity

The relative humidity is usually in excess of 80% throughout the wet season. This is due to the geographical location of Lagos State and its direct influence of maritime air mass (see Table 10). Humidity is high during both the daytime and night time throughout the seasons. While it is in excess of 90% during night time hours, it is between 60% and 75% during the day time hours. Similarly, the drier months of the year have a lower value of relative humidity.

9.5.5 Sunshine Hours

Table 10 shows the characteristic sunshine hours typical of LMA. The mean monthly values vary between 51.2 and 165.7 in July and December, respectively, giving a total of 1462 hours per annum. It assumes that an average low of 121 hours per month and less than 4 hours per day are experienced, a factor of prevailing season depending on the atmospheric attenuation caused by cloud cover and rainfall.

The sun could shine for as much as 10 hours for some days of the dry season and as low as one hour during the rainy season. A low value is common in July due of heavy cloud coverage and a high level of rainfall around that period of the year. The proximity of the area to the Equator accounts for a relatively uniform split of 12 hours of daylight and 12 hours of darkness which is constant all year 'round. Only when the sun is over head at the two extreme tropics of Cancer and Capricorn does a ±30 minute variation occur. Visibility can also be impaired during the Harmattan season.

Month	Sunshine hours	RH at 16:00 hours	RH at 10:00 hours
January	161.7	60.0	86.5
February	158.7	60.0	85.0
March	139.0	68.5	82.0
April	141.1	71.0	83.5
May	146.3	74.5	81.5
June	99.9	79.5	83.5
July	51.2	82.0	84.5
August	81.0	79.5	85.5
September	67.8	83.0	86.5
October	112.8	78.0	84.0
November	137.2	72.0	83.5
December	165.7	66.5	87.0
Mean	121.9	72.9	84.4
Max	165.7	83.0	87.0
Min	51.2	60.0	81.5

Table 9.9 – Relative Humidity (RH) and Sunshine Hours Typical of LMA

9.5.6 Temperature

The air temperature in and around Lagos State is high throughout the year. The temperature peaks during the period ranging from February to March. On a daily basis, the maximum and minimum temperature values of about 33ºC and 25ºC are recorded at the peak of the dry and rainy seasons in February and August, respectively. The flat topography and the effects of land and sea breezes do keep the diurnal range below 6ºC. Around December, the incoming North East trade winds, known as the Harmattan winds, significantly reduce the temperature in and around Lagos State, thereby breaking the dry season into two.

9.5.7 Wind Direction and Speed

Wind directions follow two main seasonal patterns in the LMA. These are mainly South Westerly or Westerly during the monsoon season, and account for about 60% of the quantum of winds in the area. They are more southerly in the morning hours. In the afternoon, south easterly and south westerly winds prevail for more than 65% of the time.

The dry months have northerly, north easterly or north westerly prevailing winds. Often the winds show traces of southerly, south easterly or westerly direction during the morning hours of the dry season. This indicates a fairly strong influence of the adjoining maritime (i.e. lagoon and ocean) environment. The micro-impact results from contrasting land-sea differential heating characteristics and the consequent land and sea breezes.

The wind speed is generally low and usually less than 2 m/s under calm conditions for most of the year. Relatively higher wind speeds occur mainly in the afternoon inducing convective activities and creating diffusion characteristics. Atmospheric disturbances such as line squalls and disturbance lines induce the variability that results in speeds higher than 5 m/s. Such increases characterise the beginning of the rainy season (from March to April) and end of heavy rains (from September to October). During these periods, most of the atmosphere pollution that may be ejected into the atmosphere from industries is likely to be carried far away from the immediate environment.

9.5.8 Air Quality

Air quality parameters identified in existing literature typifying the wet season were generally lower than the levels detected during the dry season sampling regime. For instance, the mean concentration of suspended particulate matter (SPM) detected ranged from 7.33ug/m^3 to 26.8ug/m^3 during the dry season and from 4.0ug/m^3 to 17.86ug/m^3 during the wet season.

Literature review on gases such as NO2, SO2, highlighted that these gases were detected in varying concentrations but within the acceptable ambient air quality standards. It should however be expected that with the proposed project and the attendant issues such as increased water traffic, higher rates of industrialization, etc., the ambient air quality will change accordingly.

9.5.9 Geology, Hydrology and Hydrodynamics

The geology of the study area indicated that the basin is a down-warped basin filled with sediments of the Cretaceous age. Sedimentation and stratigraphy are characterized by transgressive and regressive phases which date back to the pre-Albian period, with the deposition of the Asu River Group sediments. These sediments rest on the Pre-Cambrian Basement Complex and are overlain by subsequent Cretaceous, Tertiary and Quaternary sediments.

9.5.10 Soils

Past EIA studies have indicated that the Lagos lagoon sediments and soils are generally sandy, low in organic matter (OM) and slightly acidic (refer Table 9.10).

Ferry Line	Name of Ferry Line	pH (H_2O)	OM	Acidity
1	West Line	7.11	17.01	0.61
2	Central Line	6.12	4.16	0.42
3	Apapa Line	6.96	8.32	0.42
4	North Hopper Line	7.79	8.70	0.41
5	North Direct	7.43	9.45	0.21
6	East Line	7.10	8.35	0.44
7	Iddo-Ebute Ero Crossing	7.45	8.45	0.42
Range		6.12 – 8.08	4.16 – 17.01	0.21 – 0.63

Table 9.10 – Physical Parameters of the Sediments and Soils of the Ferry Routes

The heavy metal content of the sediments and soils has not been established but shall be established prior to any dredging and reclamation activities by the Contractor. This is necessary in order to establish the safe limits of heavy metals present in the soils of the area to be dredged and reclaimed.

It will also be necessary in order to establish how and where the dredged spoil can be dumped. Suitable dumping sites for any polluted dredged material will have to be identified in collaboration with the Lagos Waste Management Authority (LAWMA). For example, the LAWMA will complete the construction of a 2,000 metric-tonne integrated solid waste facility in Epe in conjunction with Chevron Nigeria Plc within the next 12 months (Punch, 31st December 2007). Two new landfill sites in the Epe and Ikorodu divisions of the State will also be opened by LAWMA. These landfill sites are part of LAWMA's medium-term strategy to ensure a cleaner environment in the State of Lagos[7].

Past EIA studies have indicated a low presence of heavy metals. This means that heavy metals like lead and cadmium are within safe limits. It has been suggested that the low heavy metal presence is connected to the sandy nature of the soils and the absence of clay material and organic matter that can serve as adsorbing surfaces for these metals. However, it is not possible to exclude the possibility of heavy metals being present in the dredged spoil. Hence, samples will have to be taken to test for heavy metals.

[7] The LAWMA's "New solid waste management strategy (2007-2011)" will lead to the closure of the Abule-Egba dump. To ensure better management of solid wastes, the agency will also complete the ongoing rehabilitation of the existing three dumps and procure pollution-prevention equipment for them. The LAWMA will also intensify negotiations with the Lagos Mega City Project Authority on the construction of landfill sites at Ibafo and Igbesa in Ogun State in addition to procuring three new bulldozers for the dumps as part of its short-term strategy.

Past studies have indicated that the soil in the entire study area is generally fertile. In some cases, soil was acidic as the pH was as low as 3.3. In the other places, the pH ranged between 4 and 6 indicating faintly acidic conditions. Cations and organic carbon were identified in varying low concentrations throughout the study area. Chlorine (Cl) and sulphate (SO4) were significantly low with nitrite and phosphorus concentrations ranging from low in most cases to high in few cases. Iron (Fe) is among the dominant ions in wetland chemistry and ranged between 16 and 116ppm. All other heavy metals (Pb, Cd, Cr, Ni, Cu and Zn) have average concentrations in all the sampling locations.

Past studies have indicated the presence of micro-organisms in the soil, like heterotrophic bacteria, hydrocarbon-utilizing bacteria, coli forms, fungi and yeast. The abundance and occurrence or these micro-organisms differ with seasons as such the concentration levels were equally different. However, a common trend in the study area was the high presence of heterotrophic bacteria and hydrocarbon utilisers. This suggests that there is substantial microbial activity and enough quantity of organic matter that can sustain microbial proliferation. Also, the presence of coli form bacteria is a good indication of human pollution in the study area.

9.5.11 Land Use Features, Land Use and Environmental Sensitivity

The land use features of the project area can be characterised as:

- Aquatic grassland;
- Cultivated areas;
- Mangrove swamps;
- Mosaic farmlands and oil palm forest;
- Mosaic farm lands and swamp;
- Mosaic oil palm and secondary forests;
- Riparian forest swamps;
- Water bodies;
- Settlements;
- Savannah woodlands; and,
- Shrubs and woodlands.

9.5.12 Flora and Fauna

The fauna in the LMA comprises invertebrates, such as members of the class *Insecta* (Phylum *Arthropoda*). Large numbers of rodents appear to be based on their high adaptability and fecundity. Birds (Phylum *Aves*) were equally well represented throughout the area. Generally, aquatic birds such as king fishers, cormorants, seabirds, and ibises were observed along the ferry route.

The main land-use resources within the project area include built-up areas, farmlands, vegetal covers, water bodies and sandbars (within flood plains). Identified built up features along the defined region are mainly residential areas.

Flora

The vegetation of the project area was mixed, containing trees, shrubs and grasses. Vegetation composition of the study area includes deltaic-seasonal swamp and riparian forest. Vegetation density, diversity and dominance indicated that woody shrubs and trees of the riparian and moist lowland forest exhibited the largest girth measurements while the smallest came from the wooded savannah.

Biomass was largest in the forest-savannah / woodland savannah vegetation zones concomitant with the highest species diversity. The smallest mean biomass results came from the deltaic-season swamp / riparian forests and the wooded savannah grass land zones. The common pathological problems observed were chlorotic and necrotic leaf spots particularly in the forest zones. These diseases were associated commonly with Pseudomonas, Fusarium, Rizophaera, Pestalotia and Aspergellus species.

Flora observed include:

- *Nymphacaea*
- *Cyperacae* (*Sporobolus Spp., Hydrocharism, Ceratophyllum)*
- *Graminae*
- Algae (filamentous)
- Palm trees (*Elaeis guineensis*)
- *Cocos nucifera*
- *Avocado*
- Papaya
- *Annona muricata*

The coastal forests comprise flora such as *Manilkara lacera* (Sapotaceae), *Chrysobalanus icaco (*Chrysobalanaceae*), Fegimanra africana* (Anacardiaceae)*, Barteria nigritana (*Passifloracaea*), Ongokea gore (*Olacaceae*),* Myrtaceae and *Casearia barteri* (Flacourtiaceae), as well as species of Rubiaceae and Apocynaceae. Also found are species of Graminae, Mimosa spp (semi-aquatic) and Phragmites.

The estuarine zone is characterized by R*hizophora racemosa*, *Avicennia africana* and *Languicularia spp*.

Phytoplankton characterise the coastal waters. At least seven (7) Families of phytoplankton dominated by diatoms were identified, notably:

1. Baccillariophyta
2. Pyrrophyta
3. Chysophyta
4. Xantophyta
5. Cyanophyta
6. Chlorophyta
7. Eugleunophyta

Literature studies have suggested that amongst the diatom species which can be found in the coastal areas neighbouring the LMA were: *Biddulphia oboliensis, Dtylumbrightwelli, Pleurosigma elongatum, Asterionella japonica, Striatella unipunctata, Nitzschia tenuirostris, Nitzschia pongens var atlantica, Thalassionema nitzschiodes, Rhizosolennia stolterfothi, Rh, Setigera, Guinardia flaccida, Leptocylindrus danicus, Chaetoceros compressus, Chaetoceroslorenzianus, Chaeteceros sp, Thalassioosira sp, Nitzschia sp, Plagiogramma vanheurckii, Oscillatoria thiebautii, Nostroc sp, Exuviaella compressa, Schroderella delicatula, Stephanopyxis palmeriana, Eucapia zoodiacu.*

At least three classes of algae have been identified during the literature survey, notably:

1. Brown algae
2. Green algae
3. Red algae

Fauna

Among the invertebrates, members of the class *Insecta* (Phylum *Arthropoda*) were by far the most numerous invertebrates in the area belonging to the Family *Calicidae* and *Muscidae*, like *Anophela gambiae*, *Anophela funesta, Musca domestica*, *Musca sp.* and *Culex fatigens*.

Protozoans (at least 9 species), gastropoda species, polychetes, bivalves and cephalopods have also been observed during past EIAs. *Spongaria species,* such as *Oscarella sp, Tetilla lobularis, Geodia senegalensis, Tethya aurantum, Esperiospsis sp, Mycale sp, Tedania anhelans, Haliclona perforata, Haliclona cinerae, Haliclona parasimulas, Verongia sp, Apeysilla sp.* have also been observed.

Echinoderms can be found along the coast neighbouring the LMA, including species like *Amphiopu congensis, Amphiopu nudipora, Holothuria sp.* Annelid species such as *Phyllodoce oculata, Lepidonotus hup feri, Lepidasthnia microdepis, Harmathoe riticula, Bhawaniagoodei, Glycera rouxu, Glycera convoluta, Sphaaerosyllis hystrix, Exogone gemmifera, Syllis sp, Nereis falsa, Perinerciscultrifera, Spiroibis pagenstecheri.*

The main molluscs of the Class Gastropoda and Lamillibranches observed include *Alis beddomei, Turbonilla senegalensis, Eulima spp, Cylichmagrymaldi, Acteon senegalensis, Vitrinela bushi, Philbertia haullevillei, Kleinalla pucturata*.

Molluscs found along the coast of the LMA include *Nevita senegalensis, Melaraphe cingulifera, Litorina anguifera, Crassostrea tulipia, Stranmnitra forbesi*. Crustacea and crabs found in the mangroves include species like *Uca tangeri*, *Sesarma elegans*, *Sarmatium curvatum* and *Candosoma armatum*.

Three shrimp species were also found, notably P*arapenaeopis atlantica, Penaeus notialis* and P*aleomon hastatus*. The cephalopos were represented by *Sepia officinalis* and O*ctopus vugaris*.

Members of the class *Reptilia* (reptiles) can also be found to occur in the area, but were less prominent, probably meaning that their population is lower than mammals and / or birds. The more prominent members of this class include lizards (*Agama agama*) and snakes, such as the Tree Viper (*Dendcaspis viridis*). The amphibians observed include *Bufo bufo, Bufo calamita, Rana viridis and Rana esculenta***.**

Furthermore, large numbers of rodents appear to be based on their high adaptability and fecundity.

Birds (*Aves*) were equally well represented throughout the area. Generally, aquatic birds such as king fishers, ibises and hammer kops were found along the route (see Section 9.6.13 on Ornithology).

Mammals include *Sousa teutzi, Trichechus senegalensis, Python sebae, Varanus niloticus, Crocodilus niloticus, Sylvicapra sp., Tragelaphus scriptus, Phacochoerus aethiopicus, Potamochoerus porsus, Thryonomys sp, Cercopithecus aethiops, Atilax paludinosus, Hystrix (sp), Lutra maculicollis.*

9.5.13 Ornithology

Lagos Lagoon and neighbouring marine areas constitute habitats for migratory bird species. The area is characterised by numerous bird species such as the Pelican *Pelicans erythrorhynchos,* the Ralliadae , the Phalacrocoracidae (cormorants), the Anatidae (*Ana platyrhynchus, Carinamascata, Anser cinericus, Cyznus sp*.) and other species like the king fisher.

Birds	**Habitat Use**
Seabirds.	Various species of seabirds were observed gliding above the offshore waters for feeding. These birds tend to stay well offshore.
Cormorant.	The cormorants utilise the waters for feeding.
Waders.	The mud flats are an important feeding ground for waders during migration and in winter.
Gulls and terns.	Gulls and terns are dependent on the area and adjacent seas for roosting and feeding.
Passerines.	Though several species of small perching birds have been observed at the port site, the area cannot be said to be of particular importance for these species.

Table 9.11 – Various Bird Species observed in the LMA and surrounding areas

At least 71 bird species characterize the coastal area. Some of these species are listed in the tables below.

Family	Species
ARDEIDAE	*Gorsachius leuconotus* *Bubulcus ibis* *Butorides striatus* *Ardea cinerea* *Ardea melanocephala* *Egretta ardesiaca* *Egretta gularis* *Egretta garzetta* *Egretta intermedia* *Egretta alba*
ACCIPITRIDAE	*Milvus migrans* *Gypohierax angolensis* *Nocrosyrtes monachus* *Kaupifalco monogrammicus* *Haliaeetus vocifer*
SCOLOPACIDA	*Calidris canutus* *Calidris minuta* *Calidris ferruginea* *Calidris alpina* *Limosa limosa* *Numenius phaeopus* *Numenius arquata* *Tringa totanus* *Tringa nebularia* *Tringa achropus* *Actitis hypoleucos*
CHARADRIIDAE	*Vanellus senegalus* *Vanellus spinosus* *Charadrius hiaticula*
LARIDAE	*Larus cirrocephalus*
STERNIDAE	*Sterna caspia* *Sterna sandvicensis* *Sterna albifrons*
CICONIIDAE	*Ciconia ciconia* *Ciconia nigra* *Ciconia épiscopus*
COLUMBIDAE	*Turtur timpanistria* *Turtur afer* *Columba guinea* *Streptopelia semitorquata* *Streptopelia senegalensis*
PSITTACIDAE	*Psittacus erithacus* *Poicephalus senegalus* *Agapornis pullarius* *Psittacus krameri*
MUSOPHAGIDAE	*Corythaeola cristata* *Tauraco persa* *Crinifer piscator*

Family	Species
ALCEDINIDAE	*Halcyon malimbica* *Ceyx pictus* *Alcedo quadribrachys* *Alcedo cristata* *Ceryle rudis*
MOROPIDAE	*Merops apiaster* *Merops albicollis* *Merops persicus*
CORACIIDAE	*Coracias abyssinicus*
UPUPIDAE	*Upupa epops*
BUCEROTIDAE	*Tockus fasciatus* *Tockus nasutus*
NECTARINIIDAE	*Chalcomitra senegalensis* *Cinnyris venustus*
CORVIDAE	*Corvus albus*
PLOCEIDAE	*Ploceus nigricallis* *Ploceus cucullatus*
STRIGIDAE	*Otus senegalensis*
PHALACRO CORACIDAE	*Phalacrocorax africanus*
PHASIANIDAE	*Francolinus bicalcaratus*
NUMIDAE	*Numida meleagris*
GRUIDAE	*Balearica pavonina*
SULIDAE	*Sula leucogaster*

Table 9.12 – List of Bird Species observed in the LMA and surrounding areas

Members of the class *Reptilia* were observed, the more prominent members of this class include lizards (*Agama agama*) and snakes, such as *Dendcaspis viridis*.

Photograph 3 Lizard (Agama agama)

Photograph 4 Mudskipper (Periophthalamus bararus)

9.5.14 Aquatic and Hydro-Biology

Fishing is the primary occupation of the inhabitants of the port site. Major fishing activities occur along the coast. It was identified that fishing activities are very high during the dry season relative to the wet season.

Different fish species were identified along the coastal area comprising the port site. Relative to benthos, plankton species were productive both in composition and abundance. Plankton population was observed to be high during the dry season.

9.5.15 Fisheries

Artisanal (i.e. small scale) fisheries activities take place in the Lagos Lagoon as well as in waters neighbouring Lagos Lagoon, such as the Atlantic Ocean. The artisanal fishermen mainly fish the shallower areas using long-lines or seine nets from stiffs. The nearshore saline areas are considered productive fisheries largely as a result of the nutrient up welling.

At least 89 fish species can be observed to live in the coastal waters and waters neighbouring the Lagos Lagoon, as listed in Table 9.13.

Genus	Species	Family	English name
Albula	*Vulpes*	*Albulidae*	Bonefish
Alectis	*Alexandrinus*	*Carangidae*	African threadfish
Brachydeuterus	*Auritus*	*Haemulidae*	Bigeye grunt
Caranx	*Hippos*	*Caragidae*	Crevalle jack
Caranx	*Chrysos*	*Carangidae*	Blue runner
Carcharhinus	*Altimus*	*Carcharinidae*	Bignose shark
Chromis	*Chromis*	*Pomacentridae*	Damsel fish
Cynoglossus	*senegalensis*	*Cynoglossidae*	Tongue sole
Cynoglossus	*Canariensis*	*Cynoglossidae*	
Dactylopterus	*Volitans*	*Dactyloptoridae*	
Dasyatis	*Margarita*	*Dasyatidae*	Daisy stingray
Dasyatis	*Margaritela*	*Dasyatidae*	
Decapterus	*Punctatus*	*Carangidae*	Round scad
Decapterus	*Rhoncus*	*Carangidae*	
Dentex	*Canariensis*	*Sparidae*	Canary dentex
Dentex	*macrophthalmus*	*Sparidae*	
Drepane	*Africana*	*Drepanidae*	African sicklefish
Fistiluria	*Petimba*	*Fistularidae*	
Galeoides	*decadactylus*	*Polynemidae*	Lesser African threadfish
Hemicaranx	*Bicolour*	*Carangidae*	
Ilisha	*Africana*	*Pristigasteridae*	West African ilisha
Lagocephalus	*Laevigatus*	*Tetraodontidae*	Smooth puffer
Liza	*Dumereli*	*Mugilidae*	Groaved mullet
Liza	*Falsipinnis*	*Mugilidae*	Large-scaled mullet
Lobotes	*surinamensis*	*Lobotidae*	Atlantic tripletail
Lophoides	*Kempi*	*Lophiidae*	Longspine African
Lutjanus	*Agennes*	*Lutjanidaequarius*	African red snapper
Lutjanus	*Goreensis*	*Lutjanidae*	Gorean snapper
Mobula	*Rochebrunei*	*Myliobatidae*	Lesser Guinean mobula
Monodactylus	*Sebae*	*Monodactylidae*	African moony
Mugil	*Cephalus*	*Mugilidae*	Flathead mullet
Mugil	*Curema*	*Mugilidae*	White mullet
Negaprion	*Brevirostris*	*Carcharinidae*	
Pagelius	*bellottii bellottii*	*Sparidae*	Red pandora
Pagrus	*caeruleostictus*	*Sparidae*	Bluespotted seabream
Pentanemus	*Quinquarius*	*Polynemidae*	Royal threadfin

Genus	Species	Family	English name
Periophthalamus	*Bararus*	*Gobiidae*	Mudskipper
Plectorenchus	*Macrolepis*	*Haemulidae*	Biglip grunt
Polidactylus	*Quadrifilis*	*Polynemidae*	Giant African threadfin
Pomadasys	*Incisus*	*Haemulidae*	Bastard grunt
Pomdasys	*Jubelini*	*Haemulidae*	Sompat grunt
Psetidoes	*Belcheri*	*Psettodidae*	
Pseudotolithus	*Elongates*	*Sciaenidae*	Bobo croaker
Pseudotolithus	*Moorii*	*Sciaenidae*	Cameroun croaker
Pseudotolithus	*senegalensis*	*Sciaenidae*	Cassava croaker
Pseudotolithus	*Senegallus*	*Sciaenidae*	Law croaker
Pseudotolithus	*Typus*	*Sciaenidae*	Longneck croaker
Pseudupeneus	*Prayensis*	*Mulidae*	West African goatfish
Pteromylaeus	*Bovines*	*Myliobatidae*	West Ray
Pteroscion	*Peli*	*Sciaenidae*	Boe drum
Rachycendron	*Elongates*	*Rachycentridae*	
Rhinobatos	*Cemiculus*	*Rhinobatidae*	Blackchain guitarfish
Rhnoptera	*Bonasus*	*Myliobatidae*	Cownose ray
Rhinoptera	*Marginata*	*Myliobatidae*	
Sarda	*Sarda*	*Scombridae*	Atlantic bonite
Sardinella	*Aurita*	*Clupidae*	Round sardinella
Sardinella	*Maderensis*	*Clupidae*	Madeiran sardinella
Scomber	*Japonicus*	*Scombridae*	Chub mackerel
Scomberomorus	*Tritor*	*Scombridae*	West African Spanis mackerel
Serranus	*Africanus*	*Serranidae*	
Sphyraena	*Barracuda*	*Sphyraenidae*	Barracuda
Sphyraena	*Guachancho*	*Sphyraenidae*	Guachanche barracuda
Sphyrna	*Lewini*	*Sphyrnidae*	Scallored hammerhead
Sphyrna	*Mokarran*	*Sphyrnidae*	Great hammerhead
Squalus	*Blainville*	*Squalidae*	Longnose spurdog
Squalus	*Megalops*	*Squalidae*	Shortnose spardog
Syacium	*Micrurum*	*Paralichthydae*	
Torpedo	*Torpedo*	*Torpenidae*	Common torpedo
Trichunus	*Lepturus*	*Trichiuridae*	Largehead hairtail

Table 9.13 – Fish Species observed in Lagos Lagoon and bordering marine habitats

The flora comprises in the area surrounding and bordering Lagos Lagoon and peripheral waterways include *Cocos nucifera, Manguifera indica, Carica papaya, Cola nitida, Musa spp., Ceiba pentandra, Allophyllus africanus, Hymenocardia acida, Pterocarpus erinaceus, Anacardium occidentale, Cassia sieberiana*.

Photograph 3 Sparse Tree Population along Shoreline

9.6 Social Baseline Conditions

9.6.1 Introduction

In order to assess potential social impacts of a ferry system in Lagos, it is necessary to describe the social baseline conditions. The identification of the social baseline conditions is necessary in order to evaluate and assess the timing of setting into place a ferry system, the associated dredging works and mitigation measures required to minimise / eliminate undesirable social impacts, or the introduction of alternatives to the proposed ferry system if necessary.

9.6.2 Human Environment

The proposed ferry route is all within the Lagos Metropolitan Area (LMA). The Yoruba make up the overwhelming majority of the population in the project area.

The population of Lagos and direct surrounding areas is dense. With its land area, Lagos is one of the most densely populated cities in the ECOWAS. The distinction between urban and rural is based predominantly on the general occupation of the majority of the population. As compared to most rural residents in Nigeria, many of the residents in the surveyed communities enjoy relatively high income and access to infrastructure and are relatively cosmopolitan.

A demographic analysis of the population shows that 36.8% of the population are within the working age group (i.e. between 31 and 45 years old). The level of education of the population is still very low. The net school enrolment for primary schools is still less than 60% whilst the net school enrolment for secondary schools is only 16%. Unemployment is faced by more than 74% of the active population.

The LMA is more densely populated and experiencing more rapid population growth than other areas in Nigeria. Most Lagosians are self-employed (43 percent) whereas others are employed by the public sector (24 percent) and private sectors (22 percent). Traditional, rural fishing or non-fishing villages of mostly native peoples exist near Lagos Lagoon and new Bar Beach and Badagry Beach. Residents in most of the surveyed communities have access to basic infrastructure, including education and health care facilities. However, access to water within the immediate vicinity to the ferry route and ferry terminals is a problem for some communities (the quality of water is poor and often polluted), and most residents surveyed use open pit latrines and / or the canals for sanitation.

Important cultural resources exist in the vicinity of the ferry terminal sites, including churches. The planning of the pipeline terminals and the related facilities included consideration of environmental and socio-economic issues and care was taken to avoid community and population centres and cultural areas. The proposed plan avoids these resources and the need for major resettlement of people.

9.6.3 Land Use and Built-Up Areas

Land use in Lagos State includes built up areas, agricultural lands and vegetal coverage. Primarily, the built-up areas include settlements, associated buildings for commercial use, hotels, industries, religious centres, communication centres, etc. Industrial land use ranges from many large scale industrial complexes to some small scale industries in corners of villages comprising Lagos State. The industrial estates in Lagos State are listed in Table 9.14.

Estate	LGA	Year of Development	Area Extent in ha
Mushin	Mushin	1957	30
Apapa	Apapa	1951	100
Ijora	Apapa	1958	160
Badiya	Apapa	1958	15
Matori	Mushin	1958	120
Ikeja	Ikeja	1959	180
Agidingbi	Ikeja	1962	97
Ilupeju	Mushin	1966	110
Oshodi	Oshodi-Isolo	1968	120
Iganmu	Surulere	1968	80
Ogba	Ikeja	1969	414
Yaba / Oyadiran	Lagos Mainland	1970	20
Ilasamja	Mushin	1971	60
Oregun-Ojota	Ikeja	1971	500
Isolo	Isolo-Oshodi	1972	45
Gbagada	Somolu	1974	50
Ikorodu	Ikorodu	1976	1582
Akowonjo	Alimosho	1976	50
Kirikiri	Apapa	1981	30
Surulere	Surulere	1981	20
Abesan-Ipaja	Alimosho	1981	100

Table 9.14 – Industrial Estates in Lagos State [Source: Soneye, 2004]

Photograph 4 Local Housing and Boat in Oworonsoki

Photograph 5 Young Girl in Oworonsoki surrounded by Waste

Photograph 6 – Local People crossing Lagos Lagoon

Photograph 7 – Artisanal Fishermen's Boats in Oworonsoki in Lagos State

9.7 Environmental Assessment

9.7.1 Impact Assessment and Rating

The potential impacts of the construction and operational phases of the FERRY PROJECT development are described, assessed and quantified (where possible) according to characteristics such as whether they are:

- Beneficial or adverse;
- Short, medium or long-term;
- Direct or indirect;
- Reversible or irreversible; and
- Local, regional, national, international or strategic.

The following definitions of 'significance' are highlighted in Table 9.15 below.

Impact Significance	Impact Characteristic
Major beneficial	The impact is large scale, giving rise to a significant gain to the environment.
Moderate beneficial	The impact will provide a positive gain to the environment.
Minor beneficial	The impact is small and will have a slight benefit to the environment.
Negligible	The impact is slight and of little issue.
Minor adverse	The impact is small and of little concern; it is undesirable but acceptable.
Moderate adverse	The impact gives rise to some concern but is likely to be tolerable in the short-term (e.g. during construction) or will require a value judgement as to its acceptability.
Major adverse	The impact is large scale, giving rise to great concern; it should be considered unacceptable and requires mitigating, compensating or a significant change to the development if no alternative is available.

Table 9.15 – Definitions of Impact Significance

9.7.2 Consideration of Alternatives

Please note that the engineering and environmental investigations, in-line with accepted good practice and legislative requirements, have considered a number of alternative development options, processes and techniques (i.e. at the design, construction and operational phases).

9.7.3 Main Environmental Impacts

The potential environmental impacts are divided into positive and negative impacts caused during dredging and/or operational phase. An important aspect is the chosen route for the ferry system in Lagos Lagoon, which will limit the potential negative environmental impacts:

- Characteristics of dredging and reclamation works, and distribution of the various materials which will be dredged, will determine the plume volume;
- Approved location for the disposal of the dredged spoil;
- Management of negative impacts to sensitive areas.

In this section, the aforementioned environmental baseline is used to determine which parameters are likely to be significantly affected by various components of the development.

9.7.4 Dredging and Reclamation

In this paragraph, a review is undertaken to identify key environmental factors likely to have an impact on the overall planning and layout of the ferry system.

It is anticipated that two types of dredger will be used to undertake the dredging and reclamation works. Where it is technically and economically feasible to pump the dredged material directly ashore from the dredger through a pipeline, then it is likely that the dredging contractor will prefer to use a cutter suction dredger. When dredging, the back end of the dredger is anchored using a working spud. The dredger rotates in an arc around the spud. The dredging process involves cutting the sediment and pumping it, as a slurry, directly ashore or to a barge.

For dredging areas further than approximately 2.5km from the reclamation area, the dredging contractor is expected to prefer the use of a trailing suction dredger. Trailer suction dredgers move across the dredging areas under their own propulsion system, towing a drag head along the seabed. The sediment is pumped, as a slurry from the drag head into the dredger's hopper. Once in the hopper most of the sediment settles out of suspension and the supernatant water is discharged into the sea via an overflow arrangement.

Dredging will cause some degree of turbidity irrespective of the type of sediment, dredging technique and hydrodynamic conditions. The visual effect of a turbidity plume often looks much worse than its actual effect on the aquatic environment. Large turbidity plumes occur even when small quantities of suspended sediment are released. The main cause of sediment suspension by a cutter suction dredger is disturbance by the cutter head, although high concentrations of suspended sediment are usually restricted to a small area of the seabed around the cutter head. Sediment suspension increases with increased cutter rotation and swing speeds.

The greatest source of suspended sediment from a trailer suction dredger is the overflow of supernatant water from the hopper. Some trailer suction dredgers “recycle” some of the supernatant water (and the suspended solids it contains) back down to the drag head. Sediment also becomes re-suspended around the drag head during operation.

A highly visible turbidity plume can be expected to surround the dredger, extending furthest in the direction of the predominant current. Relatively long settlement times and greater horizontal dispersion can occur during the dredging of fine silt particles. There is some potential for dispersal over a wider area because the fine silt may remain suspended in the water column for longer periods of time. Hydrodynamic conditions will determine the maximum area of turbidity dispersion and settlement time.

At this stage, it is difficult to anticipate the exact significance of the turbidity that might occur beyond one kilometre of the dredger/hopper discharge, even when the overflow is discharged from a trailer suction dredger’s hopper. In general, it is likely that most suspended sediment will settle within 100m of the dredger/hopper, particularly during dredging by cutter suction techniques, unless tidal currents are quite strong.

A number of mitigation measures can be put into place to reduce unnecessary turbidity, and monitoring can be used to check that siltation effects, if any, are environmentally acceptable. If the above assessment is correct, any suspended solids reduction measures should not be difficult for the appointed dredging contractor to achieve. If the mitigation and monitoring requirements are followed, the impact should be reduced to minor adverse to negligible.

The main potential negative impacts that can arise during the dredging and reclamation phase are given. These are:

- The dredging, disposal (possible deep water locations offshore and reuse sites onshore or reuse) of dredged spoil, and associated fluvial works. Although the footprint of the works may be relatively small, the influence of dredging plumes, depending on tidal and current flow rates, could be beyond one kilometre. However, mitigation and monitoring measures can be put in place to manage the size of the dredging plume.

- Dredging induced turbidity can occur. Dredgers release sediment into the water column during excavation and during dewatering. The proposed dredging will introduce significant quantities of sediment into surface waters, thereby creating turbid water conditions. It is important to recognise that the sediment, dredger and hydrodynamic regime affect sediment release synergistically. Because the situation can be complex with many influencing factors dependent on one another, it can be difficult to accurately predict the release of suspended solids into the water column. Nevertheless, some predictions can be made. Each factor is discussed, in turn, in the following bullet points.

- The small-scale effect of dredging should not exceed the natural variability of the riverine ecosystem. When the dredging activities are carried out in areas with high hydrodynamics activities as a result of currents and / or regular vessels transit, the diversity of sedentary species inhabiting the dredged sediment is low. If the accumulation of organic matter in sediments increases, the diversity can increase. Hence, as a result of the small-scale dredging activities, both the abundance and biomass of phytoplankton and zoobenthos can increase.

  Mitigation measures will be put in place, such as waste management, to limit the impact on the natural environment by limiting the possibility of any eutrophication. A proliferation of phytoplankton is often connected to human activities, such as dredging and waste water inflows. Invertebrate species can be quite sensitive to the organic pollution. However, these population dynamics have a temporary nature and will readjust to their natural equilibrium once the dredging activities have been completed.

- The nature of the dredged sediment can influence rates of re-suspension, particularly in terms of the rate of settlement to the riverbed. Coarse sediment (i.e. gravel and coarse sand) and fine cohesive sediment (i.e. compacted clays) will quickly fall through the water column and resettle on the riverbed. Non-cohesive fine sediment (i.e. silts) tends to form plumes of suspended material and can be dispersed depending on the hydrodynamic conditions. Dredging can temporarily change the sediment structure, mobilising and fluidising particles. Other sediment characteristics that can affect sediment suspension include particle density, organic matter content and the presence of gas as fine particles adhere to escaping bubbles. However, in time, the sediment will resume its original equilibrium.

- Impact of the plume resulting from the dredging activities, can temporarily reach surrounding habitats along the lagoon shoreline. It must be taken into consideration during the dredging works especially if indirect impacts (e.g. sedimentation of feeding area for fish and birds) may occur. Steps will be taken to ensure a careful design and specification of dredging to control the effects of increased turbidity levels on lagoon habitats.

- The sediment's particle size distribution reflects the physical composition of the lagoon stratigraphy. The sediment to be dredged for the ferry system three main stratigraphic layers. These layer distributions are as follows:

- The potential for exposure of contaminated sediment and the mobilisation of contaminants during dredging. A sediment quality survey will need to be done. A sediment quality of the dredging areas will establish the concentrations of TBT and cadmium, if any present. Sewage effluents and other discharges, primarily for reasons of distance from the site to be dredged, will have to be identified. Both cadmium and TBT can cause toxic effects of aquatic organisms at very low concentrations.

It is therefore possible that the disturbance of the sediments could significantly alter water quality such that sensitive aquatic species are adversely affected. Exposure (especially over the medium to long term) to high concentrations of bioavailable TBT and cadmium could have a major adverse impact on the health of certain (i.e. TBT and/or cadmium sensitive) species. Many species are not so susceptible to the effects of TBT and/or cadmium, and many mobile species will move away from water areas if turbidity (including adsorbed contaminants) becomes intolerable.

- Mobile contaminants: dredging activity can cause contaminants (e.g. heavy metals) associated with sediments to become available to biota (animals and plants), resulting in toxic effects. Biota may or may not be seriously affected, but contamination will be concentrated by progression up the food chain and could seriously affect the larger marine predators. The degree to which this occurs depends on the type and amount of contaminants, the sediment type, oxygenation of the sediment and method of dredging.

- No impacts as a direct result of dredging are expected on any neighbouring local community.

- Potential disruption to the aquifers from dredging and reclamation. Drawings and borehole information will need to be submitted to LASEPA in order to obtain approval.

- Flora: the plume arising from the dredging activities can impact on the mangroves, which act as nursery areas for fish and bird species. Steps will be taken to limit mangrove exposure to sedimentation. An assessment is required of the direct habitat loss from dredging and reclamation as a result of the plume. This will be done in relation to the socio-economic value of any mangrove areas, in terms of fisheries, proposed protected habitats, and habitat for bird species which receive protection under international law and from BirdLife International.

- Fauna: during dredging, the noise and human activity can lead to disturbance of the fauna present. It is necessary to ensure that any birds protected under international law and BirdLife International, and which may be impacted by the dredging activities, are identified and located. Steps will be taken to minimise / eliminate the possibility of any disturbance to these species.

- Socio-economic impacts of displacing local small scale fishermen utilising the mangroves for fisheries: the presence of dredgers may interfere with small scale fisheries activities, particularly if dredging is within a specified fishing area. Disruption could be caused by interference with small scale fishing vessels or interference/damage to fish traps and/or nets. It is important to ensure that the dredging activity does not adversely affect any artisanal fisheries, in particular. The dredging will, however, be carried out either within the permitted dredging area and therefore not within any fisheries areas.

- Fisheries resources: the majority of the fishery resource comprises mobile species, which can avoid adverse impacts resulting from dredging activity such as increased turbidity.

- Potential impacts of dredging on aquifers: it will be necessary to ascertain whether the dredging activities will have implications on the aquifers and any freshwater springs in the area.

- Water quality impacts from industrial and port discharges and accidental spillages or pollution incidents.

- Construction disturbance and noise: during dredging, the use of heavy machinery can cause noise pollution which is a nuisance to human being and wildlife. The prevailing wind direction is also such that any noise will be taken away from residences. Noise impacts are predicted to be negligible

- Waste: during dredging phase, waste will be produced in the way of packaging of raw materials, machinery breaking down and waste produced by the workers.

- Air pollution: there will be no significant direct impacts on air quality arising from the dredging operations. The dredged material will be wet when handled and hence has no potential to be a source of dust. The only direct emissions will be from the engines of the dredgers. Some additional dust might pollute the air during the removal and transport of waste and dredged spoil.

- Provided that they are in good working order the potential effect of dredgers on air quality in the study area is considered to be negligible.

- Raw materials: any raw materials being used from within Nigeria / Lagos could lead to deterioration of the natural environment. The used of raw materials will be minimal.

- Navigation: the physical presence of a dredger may pose a risk to any commercial vessels passing the area for dredging.

- Risk of collision: the physical presence of a dredger may pose a risk of collision to other users of the waters resulting in a spillage of dredged material or other substances into the water. As far as can be ascertained, there have been no reported collision incidents involving dredgers and other traffic on Lagos Lagoon. Given the fact that dredging operations do not appear to pose a significant collision risk at present it is considered that any additional risks resulting from increased dredging activity will be minimal. Good international standards of best practice should be adhered to.

- Traffic: there are no anticipated environmental impacts on the road network as a result of dredging activities. The impacts of support vehicles involved in transporting equipment and personnel required for the dredge is likely to be negligible, given the inadequacy of the existing road network.

- Landscape: no landscape impacts during the dredging operations are anticipated.

- Employment: Some local employment may be created. The impact is minor beneficial.

- Hydrodynamics and sedimentation: no impacts on hydrodynamics and sedimentation are anticipated.

9.7.5 Operational Phase

All the points mentioned above for the dredging and reclamation phase will be relevant during maintenance work.

Table 9.16 lists the main environmental and social impacts and mitigation measures.

9.8 Social Assessment

This chapter illustrate the potential social impacts, negative and positive, for the people of Lagos, if this project goes ahead. The legal regulatory framework is illustrated, a general description is given of the social structure within the country, then the main social impact are given and the impact during construction and operational phase are described in separate tables. The company has a strong urge to ensure that the people of Lagos will greatly benefit from this project.

9.8.1 Social World Bank / IFC Guidelines

The guidelines for social justification, as presented in the World Bank / IFC directives apply to the project. In this respect, the World Bank / IFC guidelines specify that the project will have to conform (within a period to be agreed on) to established international standards for social impact. Appraisal of this aspect is based on the International Labour Organisation (ILO) and World Bank frameworks. The project should contribute to the creation of sustainable employment in the developing country. This contribution can be either direct or indirect, for example, through infrastructure improvements.

With reference to The Equator Principles as well as the main requirements of the World Bank OP/BP 4.10, the World Bank policy OD 4.20 and revised World Bank policy OP/BP 4.10, note should be made of the following:

- The Indigenous People (IP) should not suffer adverse effects and should receive positive (culturally appropriate) benefits;
- IP are given and will be given informed participation, consultation, use of indigenous knowledge and social specialists;
- IP will benefit from development investments; and,
- The issues raised by the IP are addressed through environmental and social impact assessment processes, with appropriate mitigation measures.

We have taken into account recent changes in OP/BP 4.10, including:

- The OP/BP 4.10 clarifies the overall process: screening, social assessment, consultation, preparation of plan and disclosure.
- The OP/BP 4.10 clarifies the need for a social assessment, non-coverage of economic migrants to urban areas and the role of the Bank in screening for the presence of IP in the project area;
- The level of detail depends on the complexity of the project and scale of potential impacts;
- A planning framework can be prepared rather than an up-front plan for projects that involve annual investment programmes and multiple subprojects;
- The Bank will provide project financing only where free, prior and informed consultation results in broad community support, and will not agree to physical relocation of IP if they have not provided their broad support;
- The commercial development of affected IP cultural resources and knowledge is conditioned upon their prior agreement to such development.

In light of the potential requirement for a resettlement action plan (RAP), making reference to the World Bank Operational Policy 4.12, the IFC “Handbook for Preparing a Resettlement Action Plan”, and where resettlement will be deemed a necessary course of action, a resettlement action plan (RAP) will be have to be prepared detailing measures to be taken by both the public and private entities involved in this project to assist project-affected peoples to “… improve former living standards, income earning capacity and production levels…or at least restore them …”.

The World Bank policy on involuntary resettlement refers not only to physical re-location of people but also to loss of income or means of livelihood due to project-related land-take. Key points of the World Bank OP 4.12 on involuntary resettlement taken into consideration are:

- Avoid or minimise involuntary re-settlement, exploring all viable project alternatives;
- Development of resettlement action plans and provision of appropriate compensation;
- Re-settlement should be carried out as a sustainable development programme, and displaced people should have an opportunity to share in project benefits;
- Meaningful consultation with affected communities;
- Integration into host communities; and,
- Absence of legal title to land should not be a bar to compensation.

The Yoruba make up the overwhelming majority of the population in the project area. Although the majority of households in the communities neighbouring the proposed ferry terminals are native to their respective community, there are no "indigenous" peoples (IP) as defined by World Bank policy, in the areas destined to become ferry terminals.

The construction of new ferry terminals and the upgrading of existing ferry terminals, activities which comprise this ferry project, would affect relatively few people in any one locality and would in general only affect an isolated portion of a larger village or community. The to-be-built terminals and associated infrastructure and real estate facilities will contact a limited number of land plots.

Although one of the land plots considered is currently occupied by a plank association (notably, Oke Afa), the legal owner of this land is LAMATA. Hence, legally LAMATA's projects are given precedence. However, in order to minimise social impacts and ensuing protests, an alternative to this land is proposed; i.e. an abandoned landfill site which is up for redevelopment, as highlighted in the "Report of the Presidential Committee on Redevelopment of Lagos Mega-City Region" (April, 2006). The alternative site is directly opposite the former landfill site where small plank producer firms are located as well as the Planker's Association who represents these small-sized firms.

If the former landfill site is chosen, the site will have to be cleaned and the waste will have to be transported to an alternative landfill site, which will have to be identified in collaboration with LAWMA. If, however, the preferred site is identified as that belonging to the small plank producer firms, an appropriate compensation plan and relocation appraisal plan will have to be designed in collaboration with the Planker's Association.

It should be noted that those sites which have been identified as sites for new ferry terminals and which are currently occupied by residents, comprise dwellings which have been built illegally without permission of LAMATA. Some of these dwellings are fully complete whilst others are only partially complete or a mere foundation. Fully complete structures generally are cement block or concrete or wood with metal roofs (aluminium or galvanized iron).

National Social Targets

Nigeria's national socio-economic and environmental targets include:

- Millennium Development Goals (MDGs);
- Medium Term Sector Strategy (MTSS) / National Economic Empowerment and Development Strategy (NEEDS)
- State Economic Empowerment and Development Strategy (SEEDS)
- Agenda 21;
- WTO Pre-shipment Inspection (PSI) requirements;

Nigeria's MDG Targets

The MDGs are a set of development targets agreed by the international community and institutions, like the International Monetary Fund (IMF). The aim of the MDGs is to halve poverty and improve the welfare of the poor by 2015. The IMF contributes to this effort through its advice, technical assistance and lending to countries, as well as its role in mobilizing donor support.

Together with the World Bank, the IMF assesses progress toward the MDGs through an annual Global Monitoring Report (GMR). In turn, the conclusions presented in the annual GMR will influence the development of proposals and goals for economic policies in Nigeria.

The first seven MDGs focus on:

1. Eradicating extreme poverty and hunger;
2. Achieving universal primary education;
3. Promoting gender equality and empowering women;
4. Reducing child mortality;
5. Improving maternal health;
6. Combating HIV/AIDS, malaria and other diseases; and,
7. Ensuring environmental sustainability.

The eighth goal calls for the creation of a global partnership for development, with targets for aid, trade, and debt relief. A significant step toward meeting the MDGs was taken in Monterrey, Mexico, in March 2002, when the international community adopted a two pillar strategy whereby sustained pursuit of sound policies and good governance by the low-income countries is to be matched by larger and more effective international support. The requirements for a global partnership towards development include:

- The promotion of strategic FDI;
- The promotion of partnerships with the private sector;
- Streamlining national regulatory requirements and procedures that affect the flow of transportation goods and services;
- Promoting international transport in a multi-model manner; and,
- Developing, implementing, monitoring and regulating standards.

To date, the steps taken by the Federal Government of Nigeria with support provided by United Nations Development Programme (UNDP), progress has been made to satisfy Nigeria's MDG targets. From available reports, Nigeria has high potential to attain three of the MDGs, namely:

- Achieving universal primary education;
- Ensuring environmental stability; and
- Developing a global partnership for development.

Nigeria's MDGs are also linked with on-going initiatives and processes under the New Partnership for African Development (NEPAD) and the National Economic Empowerment and Development Strategy (NEEDS). Other policy initiatives include:

- Improved monitoring of pollution;
- Strengthening of the environmental guidelines and standards in Nigeria;
- Implementation of global climatic initiatives;
- Encouragement of private sector participation in waste management; and,
- The introduction of measures to discourage pollution (e.g. tax relief, emission fees, grants).

The MDG targets include strengthening of monitoring, control and surveillance (MCS) by agencies such as the Federal Environmental Protection Agency (FEPA) and the National Oil Spill Detection and Response Agency (NOSDRA).

MTS / NEEDS
Nigeria's Medium Term Sector Strategy (MTSS) and National Economic Empowerment and Development Strategy (NEEDS) address the relationship between economic sustainability and environment. The goals of NEEDS include:

- The creation of wealth;
- The creation of employment opportunities;
- Poverty reduction; and,
- Value re-orientation.

In order to meet these NEEDS, Nigeria is:

- Enhancing the effectiveness and efficiency of Government and improving governance;
- Fostering economic growth, in particular in the non-oil private sector; and,
- Addressing the Social Charter, notably, Nigeria's Human Development Agenda.

Against the fact that NEEDS expires by 2007, the Federal Government of Nigeria is preparing a Medium Term Sector Strategy (MTSS) for an incoming administration to last from 2007 to 2009. The MTSS targets are likely to include a similar policy thrust which constitutes NEEDS, notably the:

- Establishment of a self-sustaining environmental regulatory agency;
- Strengthening the role of an agency to control desertification and erosion;
- Utilisation of space-based systems for environmental management; and,
- Evolution of public-private sector partnerships on environmental matters.

The Nigerian economy places an emphasis on sustainable development to ensure that economic growth and environmental management go hand-in-hand through:

- Increased environmental supervision;
- The enforcement of environmental regulations by the Federal Government of Nigeria;
- The encouragement of self-regulation amongst companies operating in Nigeria;
- The empowerment of households and community-based organisations to secure environmental management within their communities and schools.

Agenda 21

The Federal Government of Nigeria has set in place local and national plans to manage water, solid and liquid waste. This is stated in the African Union Initiative on the Promotion and Development of Agenda 21 in Africa, also known as the EGA Initiative, which in short sets out to:

- Implement legislation throughout the African Union to control pollution;
- Enhance environmental performance and a green image of public and private investors throughout Africa; and,
- Facilitate the transfer of cleaner, greener and environmentally-friendly proven energy technologies.

For example, Nigeria will require logistics to satisfy the Agenda 21 requirements as well as infrastructure to manage facilities (e.g. waste and water management facilities). The reporting and monitoring on waste management targets, for example, will be done by non-governmental organisations (NGOs). The NGOs will report to national and international focal points. The national focal points will report to the regional centres, which in turn will report to the Secretariat of the African Union. If Nigeria is found not to have satisfied those commitments laid down in Agenda 21, Nigeria will be sanctioned by the African Union.

9.9 Main Social Impacts

9.9.1 Introduction

The establishment and enhancement of a ferry system in the LMA can be of great importance to the social welfare of the people in Lagos and those areas directly surrounding Lagos Lagoon. It can, for example have an affect on the following aspects:

- Reduce travelling time to work and family, thereby raising the quality of life;
- Reduce travelling time to schools and hospitals;
- Increase safety and security in travel to and from work, schools and hospitals;
- Reduce travelling time to food markets; and,
- Enhance merchandise at the ferry terminals where shopping malls and small merchandise markets will be established.

There is a need to enhance the existence of alternatives to road travel as congestion in Lagos is high and the number of road accidents in Lagos is also very high. Throughout the ECOWAS, the risk of road accidents is a serious problem due to the lack of speed control, lack of education and lack of awareness of the risks on the roads.

9.9.2 Construction Phase

In Table 9.16 the main environmental and social impacts are given with their control measures in order to reduce the affects. During construction it is important to ensure safety to the public by using proper markings and indicators. Construction causes visual amenities due to the trucks being used but this is of such a short time and so small that it is negligible. Another impact is the temporary nuisance to inhabitants during the construction period. Especially people living close to the edge of the Lagos Lagoon, or shop owners at the side of the road will have some loss of commercial activities.

The company will take this into account and during each assessment, before construction is started; the company will state what the situation is regarding this impact and how it will compensate. Any interruption to social activities is considered neglect able due to the short time of construction and the mobility still expected to be available. The company will appoint an HSE manager who will be responsible for all the health, safety and environment aspects associated with the activities of the company. This company will make sure the appointed employee is well trained and aware of rules and regulations regarding this within Nigeria, throughout the ECOWAS and internationally.

9.10 Environmental and Social Impacts and Mitigation Measures

The environmental and social impact and the recommended mitigation measures as listed below in Table 9.16.

Type of impact	**Comments and Key Control Measures**
Potential Negative Impacts	
Dredging	It is recommended that the potential dredging contractors are made to demonstrate their approach(es) to minimising dredging induced turbidity as part of their tender. It is not felt appropriate to restrict the dredging contractor with a suspended solids discharge limit at the dredger, but to encourage the contractor to incorporate turbidity prevention measures into his tender and require him to carry out an appropriate programme of monitoring. The effectiveness of the appointed contractor's turbidity prevention measures will be monitored. Should the monitoring demonstrate that suspended solids concentrations are increased to the extent that sensitive habitats are likely to be affected by dredging induced turbidity, then it will be necessary for the contractor to remedy the situation by, for example:

Type of impact	Comments and Key Control Measures
	Changing this dredging technique (e.g. reduce cutter head rotation speeds, improve settlement in the trailer dredger's hopper); and, Dredging an area further away from the sensitive area(s) affected (e.g. plan the dredging programme such that when the local wind and wave patterns are most likely to transport suspended sediment in the direction of the sensitive areas, dredging actually takes place as far away as possible). Contract documents for the dredging should specify monitoring requirements and control limits in appropriate locations for the areas where dredging is required in the contract.
Water Quality	A baseline survey of water quality (based on concentrations of suspended solids) will be required before the dredging begins. The baseline survey should cover water quality variation that might be caused by natural factors. Background levels of suspended solids should be established for areas which are likely to be affected by the dredging proposed in the contract. The baseline survey will need to establish the level of suspended solids in the water column. It is recommended that measurements for suspended solids concentrations and turbidity are taken. It is suggested that the amount of suspended solids being transported by currents is measured by techniques which give an essentially continuous profile, such as an acoustic Doppler current profiler (ADCP). During the dredging (and reclamation works), the survey work should record and monitor the changes (if any) in suspended solids in the relevant areas. The monitoring must be consistent with the baseline survey in order to facilitate direct comparison of the data. If during the dredging and reclamation the monitoring demonstrates that suspended solids in the areas of interest exceed baseline conditions by a significant amount (to be detailed in the contract documents), then measures should be taken to reduce the level of suspended solids being released during dredging. The monitoring should make allowance for natural variation and be supported by evidence from the control site. The monitoring should be continued after the dredging and reclamation in order to record any permanent changes. In addition, the health of the mangroves, fishery areas and control site should be recorded using photographic records. Photographs should be taken before and immediately after dredging. Should the mangroves be covered in excess silt or fine sand following dredging then methods should be employed to remove this sediment. All monitoring and mitigation should be co-ordinated and agreed, in advance, with LASEPA and the appointed contractor.

Type of impact	Comments and Key Control Measures
Habitat Removal	Although habitats within the proposed dredging area will not be removed, there could be some loss of species. The long-term loss can be mitigated against by ensuring that, where possible, the same habitat remains following dredging. This will reduce the scale of this potential impact to one of minor adverse significance. Again, this is to be stated in the contractual arrangement.
Sediment Quality	Perform a sediment quality survey. If some cadmium and TBT are identified, these are strongly attached to particulate matter. It is therefore considered appropriate to control the spread of contamination by controlling dredging induced turbidity. The recommendations for restricting dredging induced turbidity should be translated into contractual requirements such that the appointed dredging contractor will be aware of his responsibility to control sediment re-suspension. Monitoring should be specified in locations which will identify whether re-suspended sediment is transported to sensitive aquatic habitats (mangroves and fishery areas).
Small Scale Fisheries	Dredging activities should be co-ordinated with LASEPA to ensure minimal disruption. Notices to fishermen should be issued prior to dredging activity to avoid any conflicts.
Disposal Dredge Spoil	It is proposed that the material arising from the dredging will be disposed of in reclamation areas or out at sea. The reclamation has a beneficial effect in that the aquatic environment will not have to receive large volumes of dredged material. Disposal at sea will require a detailed consultation with the Nigerian authorities, including LASEPA. Consideration should be given to the guidance established by the London Convention on the prevention of Marine Pollution by Dumping of Wastes and Other. The London Convention includes useful guidance for assessing the environmental acceptability of disposing of dredged material at sea.
Noise Production	The machinery being used will carry the standard certification for noise production, this can be audited at any time by the Government of Nigeria (e.g. when they receive any complaints)
Waste Generation	Within the HSE plan the Company will demonstrate how the waste will be managed. This will be done in agreement with the government. Important aspects are the bags containing raw material. This can cause a death hazard to animals eating these bags. It also causes general environmental pollution. Government can audit the Company at any time to monitor if the agreements are being met.

Type of impact	Comments and Key Control Measures
Air Pollution	The machinery being used will carry the standard certification for air pollution (exhaust emission standards), this can be audited at any time by the Government of Nigeria (e.g. when they receive any complaints)
Raw Material Use	Consideration of the environmental performance of suppliers of raw material will be taken into account. The policy will be to use as much of the material available on the local market as possible. Reuse and recyclable material will be given priority. There is no need to excavate soil from the construction site to a land dumping location and there is no need to use sand from sand quarries for construction process.
Navigation	The dredger is likely to operate for 24 hours per day for seven days a week therefore for reasons of safety, extra radio warnings should be broadcast to vessels in the area by the VTMS Centre. The dredging vessels should display the relevant IALA marks. Given these measures, the impacts will be negligible.
Risk of Collision	International standards of best practice should be adhered to. During all dredging activities, “Notices to Mariners” are issued to commercial boat operators on a weekly basis. The aim of the notices is to warn all vessels in the area of the presence of dredgers and their positions at specific times. They also include instructions on passing the dredger, details of speed restrictions, and other controls deemed necessary by the NAMASA. This system is well-established and is thus likely to be well known and understood by all regular users of the waterways. Should additional information be required by vessels in the area, this can be obtained by contacting the port VTMS centre. The likelihood of a collision incident between a dredger and another vessel is further reduced by the fact that dredgers have lights (and are highly visible), they travel very slowly, and that they are required to listen to certain radio channels for information. Providing all the above are adhered to, no further mitigation measures will be necessary during the dredging operation, and the impact is minor adverse.

Type of impact	Comments and Key Control Measures
Potential positive impacts (no mitigation just some comments)	
Noise production	Due to the speed of the dredging activities, the noise pollution will be kept to a very short time window. This is a lot less then with the conventional technique being used.
Air pollution	Due to the speed of the dredging activities, the atmospheric pollution will be kept to a very short time window and will therefore be less intensive. This is a lot less then with the conventional technique

Table 9.16 – Key Impacts and their Mitigation Measures during Construction Phase

9.11 Operational Phase

Table 9.17 gives the impacts that could potentially occur during the operational phase. All the activities during maintenance of the roads will be the same as during construction phase and will therefore not be addresses.

An important aspect for the long run of a ferry system in Lagos Lagoon and the social welfare of the people in Lagos, is the willingness of the company to invest in public education programmes on the subject of travel safety and to provide swimming lessons. It is important to develop a syllabus for schools and adults in order to educate all users travel safety and the standard procedures to follow in order to reduce any risks to the public. Moreover, it is important that children are given swimming lessons at school to minimise risks of drowning.

Type of impact	Key control measures
Potential Negative Impacts	
Dredging	During maintenance the same condition will be given as for construction.
Noise Pollution	During maintenance the same condition will be given as for construction.
Waste Generation	During maintenance the same condition will be given as for construction.
Air Pollution	Dust pollution is minimal compared to present situation. This technique completely fixes all soil and sediments. This will lead to no further dust pollution during the use of the road.
Raw Material Use	During maintenance the same condition will be given as for construction.

Potential positive impacts (no mitigation just some comments)	
Noise Pollution	Due to the speed of this construction
Waste Generation	Very little waste is expected except during maintenance, this will be covered in the HSE plan.
Soil Erosion	Negligible
Air Pollution	Very little expected except during maintenance with heavy machinery, exhausts. Same measures should be taken as during the construction phase.
Raw Material Use	Only possibly small amounts needed during construction. Same principle as for construction phase will be maintained.
Fuel Consumption	Less fuel consumption because of less transport movements in comparison to other road construction methods.

Table 9.17 – Key Impacts and their Mitigation Measures during Operational Phase

Adopting International Standards of Best Practice

Following the desire to issue bankable reports and attract investors, it will be necessary to adopt international standards of best practice. In order to avoid, minimise and address potential environmental impacts arising from the construction works and during operations, the following measures of best practice will be adopted:

- Prepare contracts which meet the requirements of all licenses, consents and agreements applicable.

- Fully brief contractors on Health, Safety and Health (HSE) international standards of best practice to be adopted (and adhered to) prior to the commencement of dredging and disposal works. Contractor method statements for operations should be agreed by the relevant authorities (e.g. LASEPA) before the works are allowed to proceed. Consideration in this method statement should be given to:
    - Hydrodynamic conditions at the excavation and disposal location;
    - Features for which the site was designated, if appropriate areas which are particularly sensitive to the effects of dredging at specific times of year; and,
    - Particular areas of the dredging and disposal operations where contractor error can cause adverse effects on marine features.

- Endeavour to regularly monitor the operations of the contractor during dredging and disposal activities.

- Ensure that dredging is undertaken in a manner that limits, as far as practically possible, the disturbance and dispersion of sediments from the dredger and barges, during dredging operations and transport.

- Consider timing of operation to avoid or minimise environmental effects. Liaise with LASEPA where relevant, on the identification of the most appropriate times to undertake dredging to avoid or minimise disturbance to habitats. Common sense must be applied and full consideration given to seasonal operational constraints.

- Ensure that the most suitable dredging equipment (BATNEEC) is used in order to minimise the suspension of any fine sediments and contaminants at the dredge site, where considered appropriate.

- Consider investigating practical means of reducing the amounts of material dredged, where possible.

- Use the best practicable environmental option for the disposal of dredged material, promoting its beneficial use or disposal within the sedimentary system wherever practical.

- Investigate the possibility of using dredged material for inter-tidal recharge schemes to combat erosion of inter-tidal habitats. Seeking advice from the licensing authorities who will take a long-term view of such proposals and localised short-term damage will be accepted where there are long-term benefits, in terms of sustainable management of broader areas of inter-tidal habitats.

- Consider establishing post dredge monitoring programmes to verify the effect of dredging and disposal on freshwater, brackish water and marine ecology and sediment regimes.

- Endeavour to keep organised, up-to–date records of dredging operations, incorporating data from regular hydro-graphic surveys, which may have the following benefits:
    - The need to dredge, or otherwise, can be clearly demonstrated;
    - The possible identification of areas within ports and harbours where dredging can be reduced, or not undertaken at all; and,
    - The collation of this information eases the path to the renewal of dredging licences.

- Consider carefully the proposal of dredging which are not presently regulated under the LASEPA licensing process, such as water injection dredging and agitation dredging, and where practical, undertake the above recommendations to minimise the potential impacts. Furthermore, the developers should consider consulting the country conservation agencies when these types of dredging are proposed within the port area to ensure that nature conservation considerations are taken into account.

- Monitor and document operations to ensure legal compliance with international, regional and national environmental and social requirements for due diligence purposes.

9.11.1 Social Mitigation Measures

Table 9.18 below give the social mitigation measures which will be followed by LAMATA to ensure that the impacts are kept as low as reasonable possible (ALARP). The table also includes the potential positive impacts, especially compared by the conventional road construction techniques.

Type of impact	**Key Control Measures**
Potential Negative Impacts	
Safety of the Public	Use proper markings and indicators during the whole construction period, including at night. This is essential to ensure the publics safety.
Visual Amenities	Negligible
Nuisance and Interruption of Commercial and Social Activities	The company will make an inventory of each ferry route. before any construction will start, and indicate how, if need be, citizens will be compensated for any loss of commercial activities during this period. Construction is too short to consider any compensation for interruption of social activities.
Occupational Health and Safety	The company will appoint an HSE manager who will be responsible for all the health, safety and environment aspects associated with the activities of the company.
Safety of the Public	Adequate protection and signalling of work sites, in particular during the night, with clear marking of the safety border on the works perimeter. (Timely) informing the local communities of the construction programme through for example, local radio stations. Establishment of traffic plans at locations of (partial) blockage of existing ferry systems and roads, and the implementation of appropriate traffic control at such locations, possibly with the help of the local police. Prohibition of access to work sites by unauthorized persons.
Visual Amenities	Restriction of the size of construction sites and camps. Conservation of vegetation around construction sites in order to serve as visual shields. Good housekeeping. Restoration of construction sites upon completion of works

Table 9.18 – Key Impacts and their Mitigation Measures during Construction Phase

Type of impact	Key Control Measures
Potential Negative Impacts	
Safety of the Public	LAMATA will take steps to ensure that the public is informed about travel safety during construction and once the ferry system is operational.
Nuisance and interruption of Commercial and Social Activities	There is no nuisance or interruption to the commercial activities. In many ways there will benefit from the new ferry routes.
Occupational Health and Safety	The main risk is increased traffic accidents due to the increase activity and increase in the speed of the ferry boats will be noted and mitigation measures will be put in place by LAMATA.
Potential Positive Impacts (no mitigation)	
Commercial Activity	Will increase due to faster travelling time to markets.
Safety of the Public	LAMATA will ensure proper communication of Health and Safety measures to the general public and users of the ferry system during construction and operation.
Social Improvements	The people of Lagos can travel faster to hospitals, schools, markets, family and work. Social workers can reach the people in the rural areas much easier especially during the rainy season. This is of great importance for the orphans and aids/HIV sufferers.

Table 9.19 – Key Impacts and their Mitigation Measures during Operational Phase

9.12 Assessment of Lagos Lagoon Ferry Project

This section presents the findings of the assessment of the Lagos Lagoon Ferry Project in line with the Terms of Reference (TOR) provided by the World Bank. The identification, prediction and evaluation of potential environmental and social impacts considering changes in the baseline due to the implementation of the Lagos Lagoon Ferry Project services are presented in the following three (3) scenarios:

1. Future condition without the project;
2. Future condition without environmental and social mitigation measures;
3. Future condition with environmental and social mitigation measures.

This chapter starts with an overview of the methodology used to assess the above-mentioned scenarios. Then a summary of the findings is presented. The subsequent two sections explore the cumulative impacts (incorporating the direct and indirect pathways and the potential adverse and beneficial impacts), followed by the proposed mitigation measures respectively.

9.12.1 Methodology

The methodology used to determine the potential impacts of the water transportation project is the source-pathway-receptor model of determining the initial and likely physical effects of the indicative activities. From these indications the likely scale of increase or decrease to physical parameters could be determined, and subsequent indirect effects also identified. Using these, the change to the indicators and their linked objectives was then examined in relation to the nature of the change, and assessment undertaken to denote whether the impact would be direct, indirect, secondary, short, medium, long-term, permanent or temporary, reversible or irreversible, adverse or beneficial. Determination of the significance of each potential effect took into account the following criteria:

- Magnitude (i.e. size);
- Importance which is measured in terms of sensitivity of the receiving environment;
- Direct or indirect;
- Generic character of the impact (i.e. positive or negative)
- Reversibility;
- Duration and frequency;
- Area of influence; and,
- Probability of occurrence.

The magnitude of the source of an impact was determined based on the objectives laid down in Nigeria's Millennium Development Goals (MDGs) and MTSS (formerly NEEDS). In addition, this was based alongside aspects such as the existing GDP and the monetary value and approximate contribution to the various physical forces on the environment (e.g. emissions volumes, traffic volumes, water use volumes, etc) of the industrial / commercial / domestic and other economic sectors. This then provided an indication of the magnitude of the effect of the water transportation project in Lagos.

Due to the hydrography of Lagos Lagoon, certain sites will be subject to site-specific activities, such as dredging, which will require an EIA and through this should avoid potentially significant adverse impacts on the environment, or significantly minimise or mitigate for any potential adverse impacts. It is recommended that consideration for any site-specific activities take account of its siting and potential environmental constraints at the earliest possible stage.

Following this assessment of the impacts of the proposed developments and indicative activities comprising the water transportation project, a cumulative impact assessment is undertaken. This incorporated the combining of all related impacts identified in the assessment of measures, and also the indirect effects and ascertaining whether any synergistic effects (an effect greater than the sum of its parts) occur. Likely differences in timescale of these impacts were also considered.

9.12.2 Site-specific Effects

Where an indicative activity, like dredging, will lead to a development (e.g. increase navigability, thereby ensuring transportation and ensuing increase in commercial trade) this will result in beneficial impacts (including indirect, secondary and cumulative) that will be specific to development of the Lagos Lagoon Ferry Project.

Any negative environmental impacts are expected to be avoided or offset during the planning process and the related EIA requirements for a specific development. In addition, best practice and World Bank / IFC Guidelines related to aspects, such as gaseous emissions and waste management, are also being addressed.

Site-specific development will comply with the aims and other regulatory requirements set forth by the LASEPA and FMENV. All impacts identified will therefore be addressed in that process, and selection of site location will identify the most suitable location to avoid, wherever possible, adverse impacts.

9.12.3 Assessment of Cumulative Impacts

A number of cumulative effects relevant to this study have been identified. In particular, there is the potential for air pollutants and low water quality to give rise to cumulative effects on flora and fauna receptors.

Key areas where cumulative effects are possible:

- Water quality: the potential adverse cumulative effects on discharges, water quality, quantity and usage could arise where increased economic activity for some activities in Lagos Lagoon could result in increased pressure on these resources, as well as discharges to water bodies. The mitigation/avoidance measures identified in Boxes 2, 3, and 5 in Section 10.6 would offset and potentially reduce the existing impacts. Overall, it is anticipated that a cumulative beneficial impact would occur in the long term with regard to water quality and resources.

- Air quality: there is a high probability for adverse cumulative impacts to arise from locally small-scale emissions to air for some activities comprising the water transportation project, where these would result in increased transport levels. The mitigation/avoidance measures identified in Boxes 3, 4, and 5 as well as traffic management and sustainable transport. The influence toward greater efficiency would offset or reduce these impacts. Overall, it is anticipated that a cumulative beneficial impact would occur in the long term with regard to air quality.

- Climate change: there is a potential for small-scale contributions to carbon dioxide (CO2) emissions from increased economic activity due to increased transport that may arise. The mitigation/avoidance measures identified in Boxes 3, 4, and 5 as well as traffic management and sustainable transport. The influence toward greater efficiency would offset or reduce any gaseous impacts. Overall, it is anticipated that a cumulative beneficial impact would occur in the long term with regard to climate change impacts and adaptation to climate change.

- Biodiversity: the incorporation of the mitigation measures are anticipated to have an overall reducing effect on the conservation of natural resources, use of clean technology, overall reduction in emissions and energy usage, and other activities that would prevent and could ameliorate the direct effects on water quality and air quality, which in turn is beneficial towards the enhancement of aquatic biodiversity specific to Lagos Lagoon. Overall, this is expected to result in a cumulative beneficial effect on habitats and species (including sensitive and designated habitats and species).

9.12.4 Proposed Mitigation Measures

The following sub-sections describe the impacts predicted against the key objective headings for each of the priorities for the development of the Lagos Lagoon Ferry Project, and outline measures to avoid or minimise potential adverse environmental and social impacts.

Generic impacts that could arise from the development of the transportation project in Lagos that could be influenced by direction of the indicative activities include:

- Habitats and species: the impact would depend on the focus of the activities, and would also be indirectly dependent on the impacts on resources and waste identified below.

Box 1 Mitigation / Avoidance
By raising the following as a focus for supported activities, it is envisaged that the water transportation project would provide potential benefits to landscape and waterscape management and ensuing nature conservation depending on the nature of the supported activities: The creation and development of enhanced biodiversity sites as part of a development or principle or an activity; The promotion of biodiversity and sustainable land use management for developed sites.

- Water and water quality: unsustainable use of water resources and emissions to water could result in degradation to the various water aspects (coastal waters).

Box 2 Mitigation / Avoidance
Supported activities should ensure that issues relating to the water environment are considered, in particular in relation to water resources (consumption) and water quality (emissions). The mitigation and avoidance measures identified in Box 3 would apply to this area.

- Resources and waste: increased economic activity as a result of improved transportation to and from work and school could lead to an increased use of primary materials, fuels and energy, and lead to increased volume of waste created. Therefore, activities should ensure that awareness is made of issues relating to waste creation and utilisation of the waste cycle. In addition, energy conservation measures should also be important points of focus.

- The probability exists that the increased economic activity influenced by the Lagos Lagoon Ferry Project and ensuing activities in Lagos could lead to a reduction in vehicle use and therefore a reduction in road traffic and overall congestion in Lagos. In turn, this will lead to a direct reduction in the amount of emissions to air and noise produced, as well as a reduction in the amount of energy (fuel) consumed. Any further reductions in waste production, resource and energy consumption can be obtained through the application of the mitigation measures provided in Box 3.

Box 3 Mitigation / Avoidance
The water transportation project will focus on supporting activities to offset the potential growth in resource use and waste production, and encourage sustainable consumption and energy conservation practices, which could reduce the overall level of these across the Nigerian economy as a whole, as Lagos is a prime consumer of material goods, depending on the nature of the supported activities: • Promoting further sustainable transport measures combined with the application of ICT to improve efficiency of materials and reduce resource / energy use specifically for transport; • Improvements in clean technology and the application of BATNEEC; • The encouragement of appropriate location of businesses to public transport links through improved urban planning and the development of environmentally friendly transport plans in Lagos; • Raising awareness and implementation of measures for efficient use of resources (materials and energy); and, • The promotion of Environmental Management Systems (EMS).

- Air emissions – impacts on this are linked to the effect of increased transport and associated activities causing increased material and energy use. One clear focus is the promotion of resource efficiency, and promotion of environmental technologies that minimise emissions to air. Further, the points raised in Box 3 would aid in what would be anticipated as an overall reduction in emissions.

- Climate change – the influences on climate change are covered in the resource and waste, and air emissions impacts described in the bullet points above. Furthermore, the mitigation/avoidance measures identified in the Boxes 1, 3, 4, and 5 in particular would result in a similar limited increase or reduction in greenhouse gases, and facilitate adaptation to climate change.

Box 4 Mitigation / Avoidance
Within the Port Development Plan's objectives focus on stimulating growth in clean economic growth that would automatically aim toward reductions in carbon emissions (and the related factors that cause this).

- Lagoon shoreline, waterscape and landscape: predominantly impacts would arise as a result of site-specific development nearby the jetties comprising this water transportation project. Generic mitigation/avoidance measures are incorporated in the Lagos Lagoon Ferry Project as shown in Box 5.

Box 5 Mitigation / Avoidance
Supported activities that result in construction or refurbishment of buildings used as offices by the jetty and boat operators, should implement and promote the following: • Enforcement of EMS and HSES throughout enterprises comprising the Lagos Lagoon Ferry Project; • High standards of environmental performance for all constructions and buildings comprising the Lagos Lagoon Ferry Project; and • Utilisation of ICT provision to increase longevity of buildings (reduction in space/efficiency of product movements).

- Quality of life: the improvement in transport facilities (e.g. less time spent stuck in traffic jams, less noise and light pollution caused by vehicles) offered to the citizens of Lagos will increase the quality of life and provide Lagos' citizens more time to invest in recreational activities and education. This, in turn, will allow the citizens to develop a greater environmental awareness which can lead to a reduction in fly-tipping.

- Improvements in the planning of transport in Lagos and the direct built environment of the Lagoon shoreline, will improve the overall aesthetic and landscape value of Lagos.

- Health and wellbeing: improved travel time will positively contribute towards improved production and boost the economy of Lagos State and Nigeria as a whole. The water transportation project could well aid the population of Lagos by improving access to health infrastructure. This will have an overall beneficial impact.

- Material assets: overall benefits are anticipated on material assets such as transport infrastructure and energy infrastructure. However, potential indirect adverse impacts could arise as a result of increases in waste produced, amount sent to landfill, and increased use of energy. Overall, however, these aspects are not anticipated to increase above present levels and may reduce due to the points discussed above for resources and waste, and climate change, based on the mitigation/avoidance measures identified in Boxes 1, 3, 4 and 5.

- Cultural heritage: the focus of this objective on sustainable transport and improvements in the built environment and air emissions could reduce potential damage to historic structures in Lagos.

- Quality of life: the many benefits of the aspects described above, particularly in relation to the Lagos Lagoon shoreline, its aquatic habitats, as well as improved waste management and reductions in fly-tipping and also reduced air pollutants are expected to improve the quality of life for the population living in Lagos.

- Health and wellbeing: the reduction in air emissions and subsequent improvements in air quality as a result of reduced vehicular traffic and improved metropolitan water transport, and the improvements to the environment and recreational access are anticipated to result in a benefit to health of the population.

- Material assets: overall benefits for Lagos are anticipated from the water transportation project as part of an inter-modal transport infrastructure, as this objective targets improvements in sustainable transport in Nigeria, and improvements in the waste management infrastructure. Recreational access as well as the Lagos Lagoon shoreline as a whole will be enhanced as a result of the water transportation project, and therefore have a beneficial impact on the population of Lagos.

9.12.5 Summary of Mitigation Measures

Mitigation measures are likely to be needed, taking into account the potential for uncertainty, negative effects and/or for cumulative effects. The potential direct, indirect and cumulative impacts from site-specific aspects that may arise from supported activities of the Lagos Lagoon Ferry Project should be avoided by adherence to any Lagos Municipal development plans.

The objective of the water transportation project is to support sustainable activities. The utilisation of the mitigation measures identified in Boxes 1 to 5 will result in the avoidance of impacts and could result in major benefits in relation to the natural and social environment. Overall, the activities should maintain a focus on:

- The operators and facilitators operating the water transportation project in Lagos Lagoon and the general public which makes use of this transport facility should be educated through training and information provision, on waste management, resource use, health and safety, alternative forms of transport, time management and the benefits of car sharing schemes. Increased awareness and training will allow both the operators / facilitators and general public to actively participate in conservation measures to protect and enhance the surface water quality of Lagos Lagoon; and,

- Inter-modal transportation schemes which set out to reduce risk and promote value-added services (VAS), by their very nature, encourage greater levels of economic development and activity. Such schemes include the adoption of EMS (e.g. ISO 14001), HAZOP / PHA and the enforcement of Nigeria's National Oil Spill Contingency Plan and Oil Spill Response Plan. These systems should be welcomed because they can result in greater care for and awareness of the Lagoon environment and of the need for sustainable development. The encouragement of economic activity as economic development can have significant, particularly cumulative, effects on the natural environment. The inclusion of social and environmental criteria in the activity selection process is recommended.

9.12.6 Measures to Reduce Risk to the Environment

The following measures are recommended to ensure that if a specific activity carried out in an unsuitable manner, then compensatory or improvement works can be carried out to alleviate any impact.

- Adopt an HSES plan, as provided;

- Provide clear opportunity for funding activities to target waste management;

- Provide clear opportunity for funding activities to manage water quality, air quality, reduce noise levels and target biodiversity (habitats and species) enhancement through landscape and recreational management;

- Adopt a Traffic Management Plan around the Ferry Terminal sites;

- Adopt an Oil Spill Response Plan and adhere to Nigeria's National Oil Spill Contingency Plan;
- Adopt an Environmental Response, Compensation and Liability Plan;
- Encourage the location of appropriate activities so as to be accessible by public transport; and,
- Provision of funding to enable poorly-managed landscapes or unforeseen environmental impacts to be re-dressed and the environmental assets rehabilitated in and surrounding Lagos Lagoon.

9.12.7 Objectives and Indicators for Environmental Sustainability

In order to assess the three scenarios, indicators are established in light of the project's objectives and sub-objectives. These indicators are used to establish whether the project is environmentally sustainable and therefore meets MDG 7 targets.

Table 9.23 here below, provides a list of the objectives and sub-objectives and indicators used to establish environmental sustainability.

Objective	Sub-Objective	Indicators
Environment		
Avoid damage or deterioration to marine, coastal and terrestrial habitats and valued species, and enhance where possible	Protect internationally, regionally, nationally and locally designated Ramsar and nature conservation sites.	• % of sites in favourable condition. • Number of freshwater, marine, coastal and terrestrial Conservation Review sites.
	Protect Biodiversity, habitats and species, and increase area of habitat.	• Trends in key Biodiversity habitats and species.
	Protect and enhance the vulnerable and commercially exploited fish species and other fisheries.	• Input of hazardous substances into the marine environment.
Protect and enhance freshwater / brackish water and (possibly) sea water quality, and the water environment	Protect and enhance the quality of groundwater (coastal aquifers) and coastal waters.	• Freshwater quality – biological and chemical. • Bathing water quality. • Coastal water quality.
	Avoid or minimise diffuse pollution.	• Area of Lagos designated as nitrate vulnerable zone.
	Comply with good "status" Water Quality legislation of Nigeria and as established in the World Bank / IFC Guidelines.	• Compliance status with Nigeria's and international Water Quality legislation.
	Avoid physical disturbance to the water and waters edge environment.	• Compliance status with Nigeria's and international Water Quality legislation.

Objective	Sub-Objective	Indicators
	Ensure that flood risk is not exacerbated and that adaptations to increased flood risk are not hindered.	• Developments to shoreline defence. • Number of Strategic Shoreline Defence Assessment undertaken by LASEPA.
Minimise consumption of resources (waste, materials, water, soils, minerals and aggregates)	Minimise the amount of waste generated, and follow the waste hierarchy.	• Quantity of waste per annum at Terminal sites. • Quantity of industrial and commercial waste per annum. • Proportion of municipal waste recycled or composted. • Proportion of industrial waste recycled.
	Development of markets for secondary materials, and waste management facilities and infrastructure.	• Number of waste management facilities. • Number of non-hazardous waste management facilities. • Number of hazardous waste management and hazardous materials management facilities.
	Encourage the efficient use and management of water.	• Leakage levels. • Per capita consumption of water.
	Protect and manage soil.	• Number of “greening” activities at Terminal sites. • Number of landscaping activities at Terminal sites.
	Protect primary resources by increasing the use of alternative materials, secondary materials, and recycled materials.	• Proportion of construction and demolition waste that is reused and recycled. • Proportion of abandoned vessels for decommissioning and recycling.
Minimise and/or reduce pollutant emissions to air	Reduce air pollution at the Ferry Terminal sites and urban areas constituting the Ferry system in Lagos.	• Trends in number of days when air pollution is moderate or higher at the Ferry Terminal sites and neighbouring urban agglomerations at the Ferry Terminal sites. • Level of emissions of sulphur dioxide, ammonia, nitrogen oxides, fine particulates, and volatile organic compounds from the National Atmospheric emissions inventory.
	Encourage technology and industry targeted at reducing emissions through new processes or alternative methods.	• Emissions from Ferry system and Terminal sites. • Number of businesses with Environmental Management Systems (EMS).
	Minimise the use of processes that produce toxic air pollutants, and incorporate extensive safety and capture processes for those that occur.	• Emissions of toxic pollutants, and concentrations in the air (compared with standards).

Objective	Sub-Objective	Indicators
Reduce contribution to climate change	Minimise and reduce greenhouse gas emissions by increasing energy efficiency and reducing excess	• Annual emissions of greenhouse gases by commercial activities at the Terminal sites and of the Ferry system in Lagos. • Renewable energy consumed at Terminal sites.
Protect and enhance the coastline and the associated shorelines / seascapes / landscapes of Lagos	Protect designated coastline, seascapes and landscape areas	• Area of Outstanding Natural Beauty (AONB). • Area of Heritage. • Area of outstanding historic landscapes. • Area of special historic landscapes.
	Protect and enhance access to the coastline (footpaths)	• Total length of rights of way.
	Avoid significant alteration to urban landscape character	• Area of open space.
Protect and preserve the historical and cultural heritage	Protection of heritage assets	• Number of Listed Buildings, Conservation Areas. • Number/area of World Heritage Sites.
	Encourage the use of heritage assets to preserve, protect and inform.	• None identified.
Society and Community		
Improve the quality of life of all the stakeholders at the Terminal sites and in Lagos as well as Nigeria as a whole	Minimise environmental nuisance such as spill-over effects of uncollected waste, fly-tipping, littering, noise pollution, and light pollution.	• Trend in waste, spill-over effects, level of fly-tipping. • Level of litter in the sea, Ports and fishing Harbours.
	Protect existing natural green space.	• Area of open space.
	Protect and enhance access to coasts where this does not affect sensitive habitats.	• Impact of waste, include abandoned vessels.
Reduce activities affecting health and safety, and increase health infrastructure	Reduce emissions to air from industry and traffic.	• Air quality. • Annual emissions of greenhouse gases by sector.
	Improve traffic logistics	• Introduce traffic management plan. • Total number of traffic lights in the Terminals and along the Ferry routes. • Introduce roundabouts to facilitate right of way during heavy traffic. • Streamline traffic during peak times (loading / unloading of cargo) at the Terminal sites.
	Encourage the use of cycling and walking as a means of transport.	• % of people who's main mode of travel to work and school is cycling and walking.

Table 9.20 – Objectives and Indicators of Environmental Sustainability

Table 9.24 refers to Table 9.23 in order to establish a score needed to assess, in broad terms, whether the project's impacts are either beneficial or adverse, with the scale of 'minor' or 'major' used to denote whether the impact is not significant or is significant based on particular criteria. This allows one to establish whether the project meets MDG 7 requirements. The scores and description of these scores are presented in Table 9.21.

Score	Description
Major Beneficial ✓✓	An option/theme/measure very likely to lead to a significant opportunity / improvement, or a series of long-term improvements, leading to large-scale and permanent benefits to the ESIA objective being appraised. A major positive effect is also likely to have cumulative and indirect beneficial impact and / or improve conditions outside the specific scheme area, i.e. it may have positive trans-boundary effects.
Minor Beneficial ✓	An option/theme/measure likely to lead to moderate improvement in both short and long-term, leading to large scale temporary, or medium scale permanent benefits to the objective being assessed. Even where beneficial effects are felt to be temporary, they should not be easily reversible (to detriment of objective) in the long-term.
Neutral **O**	An option/theme/measure which is unlikely to have any beneficial or negative impact / effect on the objective being assessed in either the short, or long-term. Neutral scoring should only be used where it is very likely that the effect will be neither positive, nor negative. A neutral score is not the same as 'uncertain', where an appraiser is not sure if an effect is likely to be positive or negative, or 'mixed', where the appraiser feels that the effects are likely to be both positive and negative (see below for more detail).
Minor Adverse ✖	An option/theme/measure likely to lead to moderate damage / loss in both short and long-term, leading to large-scale temporary, or medium scale permanent negative impact on the objective. An option/theme/measure which may also have limited cumulative and indirect detrimental impact and / or limited degradation of conditions outside the specific policy or project area. It is also likely that it will be possible to mitigate or reverse a minor negative effect through policy or project intervention.
Major Adverse ✖✖	An option/theme/measure likely to lead to a significant or severe damage / loss, or series of long-term negative effects, leading to large-scale and permanent negative impacts on the ESIA objective being assessed. An option/theme/measure which may also have significant cumulative and indirect detrimental impact and / or degrade conditions outside the specific scheme area – i.e. will have negative trans-boundary effects. An option/theme/measure which is likely to threaten environmental thresholds / capacities in areas already under threat. The detrimental effects of scheme/measure will be hard to reverse and are unlikely to be easily mitigated through policy or project intervention. Any damage or detrimental effect in or to environmentally sensitive areas, issues or landscapes which are recognised and / or protected regionally, nationally or internationally should be scored as a major adverse impact.

Score	Description
Mixed **✓✓/✖ or ✓/✖✖**	The effect is likely to be a combination of beneficial and detrimental effects, particularly where effects are considered on sub-issues, areas or criterion. For example an option/theme/measure may enhance the viability of certain protected species or habitats (such as native woodlands), but through this damage existing (non-native) habitats which may themselves be important. Such mixed and effects will be hard to predict, but could be significant in the long-term, or when taken with other effects (cumulative).
Indeterminable **?**	The effect of an option/theme/measure is not known, or is too unpredictable to assign a conclusive score. The appraiser is not sure of the effect. This may be the case where a scheme/measure covers a range of issues, or where the manner in which a scheme/measure is implemented will have a material impact on the effects it will have.

Table 9.21 – Significance Criteria Used in the Assessment of Impacts

Table 9.24 needs to be referred to in order to understand the results illustrated in table 9.26.

Ferry Project's Environmental Sustainability Objectives	Lagos' Environmental Sustainability Objectives (i.e. MDG 7)					
	Reduce greenhouse gases / adapt to effects of climate change	Promote sustainable transport	Efficient use of natural resources	Promote biodiversity and sustainable land management	Improve local built environment, access to green space and biodiversity	Minimise environmental hazards, thereby safeguarding health
Protect and avoid damage or deterioration to habitats and species, and enhance or improve degraded habitats	✓	✓	✓	✓✓	✓✓	✓✓
Protect and enhance water quality, and the water environment	✓	✓	✓✓	✓✓	✓	✓✓
Minimise consumption of resources (waste, materials, water, soils, minerals and aggregates)	o	✓✓	✓✓	✓✓	o	✓
Minimise and/or reduce pollutant emissions to air	✓✓	✓✓	✓✓	✓	o	✓
Reduce contribution to climate change and encourage adaptation	✓✓	✓✓	✓✓	✓	✓	✓

Ferry Project's Environmental Sustainability Objectives	Lagos' Environmental Sustainability Objectives (i.e. MDG 7)					
	Reduce greenhouse gases / adapt to effects of climate change	Promote sustainable transport	Efficient use of natural resources	Promote biodiversity and sustainable land management	Improve local built environment, access to green space and biodiversity	Minimise environmental hazards, thereby safeguarding health
Protect and enhance the river shoreline and the associated landscapes neighbouring ferry terminals	O	✓	✓✓	✓✓	✓✓	✓
Protect and enhance the cultural heritage.	O	O	✓	✓	✓✓	O
Improve the quality of life of all Lagosians	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Protect and enhance skilled employment	✓✓	✓✓	✓✓	✓	✓	✓✓
Protect and enhance the material assets of Lagos	✓	✓✓	✓✓	✓	✓	O

Table 9.22 – Testing the Compatibility of the Ferry Project's Objectives and Lagos's Environmental Sustainability Objectives

Key to symbols

Direct link / beneficial synergy	✓✓
Indirect link / slight beneficial synergy	✓
No significant interaction	O
Conflicting / harmful	x

9.12.8 Future Condition without the Project (i.e. “Do Nothing Scenario”)

An important driver for future economic growth in Lagos is ensuring that Lagos is an attractive place to work, live, do business and invest in. Currently, Lagos’ bottleneck is the difficulty with which people can mobilise themselves throughout the city, to and from work, which entails being stuck in traffic jams for up to several – sometimes up to four hours – for distances which in Europe or the USA would take no more than half-an-hour.

Due to the current traffic jams, people resort to using motor taxis. Using motor taxis in Lagos is dangerous because the incidences of traffic accidents (that is, collisions with trucks and / or cars) is very high and people suffer can incur terrible injuries or die.

The roads in Lagos are terribly chaotic and there is little law and order present to ensure that the traffic flows smoothly and that the drivers adhere to the road signs and road regulations. Basically, it cannot get much worse. It is literally impossible to timely reach certain parts of Lagos as the traffic jams have blocked all roads into certain areas of the city. When it rains, it is impossible to get out of the car to walk because the roads are flooded with water and sewage which has overflowed into the roads via the torrential rain.

The “Do Nothing Scenario” would mean that an opportunity to improve the quality of life of the Lagosians is missed, that business opportunities will not be encouraged, that future investment into real estate in Lagos will be impaired, that road traffic accidents will continue to increase and continue to affect the life of many families in Lagos negatively.

Moreover, due to the traffic jams, the emissions of greenhouse gases (GHG) will continue to increase exponentially thereby not allowing Lagos as a city and Nigeria as a country, to satisfy the GHG reduction targets as agreed upon with the United Nations Framework Convention on Climate Change (UNFCCC). If targets set forth in the UNFCCC are not satisfied, Nigeria can be sanctioned. The Kyoto Protocol will enter into full force on the 16th of February 2008. The Bali Action Plan agreed upon in January 2008 will determine how the Compliance Committee of the UNFCCC will set out its course of action to ensure compliance through enforcement of the UNFCCC guidelines which are set out in the Decisions of the Conference of Parties serving as the meeting of Parties to the Kyoto Protocol.

With regards to a future condition of Lagos without the Ferry project, the immediate impacts on the environment would be a worsening of environment, both environmental and social. In specific regard to environmental issues, the ‘do nothing’ scenario would provide for a general deterioration of core values of MDG 7, notably environmental sustainability.

9.12.9 Future Condition without Environmental and Social Mitigation Measures

In light of Lagos' environmental and social rules and regulations as well as those requirements set forth in the International Conventions and Agreements to which Nigeria is signatory, the adoption of the ferry project without environmental and social mitigation measures would result in liability entitlements and ensuing increase in transaction costs, making the project financially and economically unsustainable as it would be able to access international capital as it will not satisfy the Equator Principles. Failure to mitigate environmental and social mitigation measures would mean that the assets created by this project cannot be traded on international capital markets, thereby limiting any return on investment (ROI).

The dredging plume resulting from the dredging activities could potentially upset the artisanal fishermen and upset the general public. If mitigation measures are not put in place, the local artisanal fisheries could be affected by the increased concentrations n sedimentation resulting from the dredging. The sedimentation could impact on fish stock recruitment rates and therefore the artisanal fisheries in Lagos Lagoon. If the recruitment would be negatively affected and proper steps were not put in place to ensure transparency and timely disclosure of information through stakeholder engagement, strikes and demonstrations could result in LAMATA's exposure to reputational risk.

Failure to institute environmental and social mitigation measures would mean that international standards of best practice are not satisfied. The project would therefore be in breach of World Bank / IFC requirements as well as those requirements to which Nigeria is signatory (e.g. the UNFCCC / Kyoto Protocol). Subsequently, access to international capital would be hampered through failure to satisfy corporate governance requirements as well as the Equator Principles to which banks are signatory.

Project implementation without the implementation of environmental and social mitigation measures, could expose the project to liabilities.

9.12.10 Future Condition with Environmental and Social Mitigation Measures

The economic activities ensuing improved transport within Lagos will positively contribute towards the MDGs and MTSS / NEEDS and, in turn, will stimulate further developments within Lagos, including the development of additional inter-modal transport systems and improved environmental, health, safety and security (EHSS) management.

The Lagos Ferry Project offers a good opportunity to reduce the current overall negative impacts resulting from a need for enhanced environmental and economic sustainability within Lagos and throughout Nigeria. Moreover, the water transportation project will contribute positively towards the enhancement of economic sustainable development, the management of waste (both hazardous and non-hazardous) and the protection of water quality, soil quality, resource management, biodiversity and cultural heritage, and in so doing, decrease and manage the total amount of greenhouse gases emitted into the environment.

Due to the high level nature of the Lagos Ferry Project and the lack of quantifiable or location- or activity-specific detail, many of the possible synergistic effects are on the whole covered by the cumulative assessment, as they are usually dependent on contributions by a number of sites.

Criteria for determining the likely significance of effects on the environment and society	**Summary of Significant Environmental and Social Effects**
The degree to which the Ferry Project sets a framework for projects and other activities, either with regard to the location, nature, size and operating conditions or by allocating resources.	The Ferry Project is raising the skill levels of individuals both directly and indirectly, laying down developments that will take place within Lagos in order to ensure leadership qualities within Lagos, throughout Nigeria and the ECOWAS and internationally in terms of Health, Safety, Environment and Security (HSES).
The degree to which the Ferry Project influences other plans and programmes (such as real estate development and business investment) including those in a hierarchy.	The Programme positively contributes towards the success of national strategies, such as MTSS / NEEDS, MDGs, etc.
The relevance of Ferry Project for the integration of environmental considerations in particular with a view to promoting environmental sustainability and sustainable development.	The Ferry Project addresses and positively contributes towards the environmental sustainability (MDG 7) and the World Bank / IFC's Guidelines on sustainable development. Consequently, a positive effect would be anticipated in the raising of environmental awareness and individual and possibly commercial activities aimed at reducing adverse effects.
Environmental problems relevant to the Ferry Project.	The Ferry Project will contribute towards a considerable reduction of environmental problems in Lagos in terms of reduction in emissions through decreased road travel and an increase in safety in terms of reduced road accidents.
The relevance of the Ferry Project in satisfying the Environmental, Health, Social and Security (EHSS) targets of Nigeria and contributing positively towards increased quality of life through an improved natural environment.	The Ferry Project sets out to improve Lagos' traffic by ensuring that Lagos takes steps to abide by World Bank / IFC Guidelines and international environmental and social standards. This will include the implementation to manage waste, water quality, etc.
The probability, duration, frequency and reversibility of the effects.	There is a potential for an indirect adverse effect on use of materials for development purposes, and possibly additional transport associated with development. Whether these effects are likely to increase levels of consumption, waste and travel is difficult to determine. However, the significance of the potential effect is considered to be low, and could be substantially offset by the environmental improvement throughout Lagos.

Criteria for determining the likely significance of effects on the environment and society	Summary of Significant Environmental and Social Effects
The cumulative nature of the effects.	It is not considered that significant effects would occur, and that in relation to other activity (material consumption, waste, transport volume) that occurs at a much greater level, any cumulative effect would be negligible.
The trans-boundary nature of the effects (i.e. environmental effects on neighbouring countries).	It is unlikely that significant trans-boundary effects would occur other than beneficial environmental and sustainable development.

Table 9.23 – Significance of Environmental and Social Effects

The purpose of testing the Ferry Project's environmental objectives against Lagos' sustainability objectives (i.e. MDG 7) is carried out in order to ensure that the project is developed and designed to provide Lagos with a sustainable framework that falls in line with Nigeria's MDGs and MTSS / NEEDs objectives, which will provide long-term environmental sustainability and sustainable development, employment creation and other environmental and social benefits. The compatibility testing was set out in order to identify potential synergies and inconsistencies between the project's environmental objectives and Lagos' environmental sustainability targets.

The environmental sustainability and sustainable development objectives of the ferry project are:

- Promote environmental sustainability and sustainable development in Lagos;
- Promote waste management;
- Minimise environmental hazards, thereby safeguarding health;
- Promote sustainable transport;
- Reduce greenhouse gases/adapt to effects of climate change;
- Efficient use of natural resources;
- Promote biodiversity and sustainable land management; and,
- Improve local built environment, access to green space and biodiversity.

9.13 Health, Safety, Environmental and Social (HSES) Management

To ensure sustainability in its greater form it is important to pay attention to the Health, Safety and Environmental aspects of the company's activities. The company will therefore develop an HSE management plan and employ an HSE manager. This HSE management is described in more detail below.

9.13.1 HSES Management Plan

As part of the environmental management of projects, environmental performance monitoring needs to be undertaken to ensure that mitigation measures are implemented and have the intended result. Additional remedial measures may be undertaken if mitigation measures are inadequate or the impacts have been underestimated within the EIA report, the work of which will be contracted out by LAMATA, in particular where the project would be in breach with permits, national standards and guidelines (from LASEPA).

HSES Management Plan

In order to ensure that the Company is fully aware of HSES aspects of the company's activities, a HSES Management Plan (HSES-MP) for the specific works shall be developed. This HSES-MP will serve two main purposes:

- For the company (internal purposes) to ensure that all measures are in place and as an operational manual for his staff.
- For documentation and to demonstrate their HSES management if anyone should demand to see it (government or public), external purposes;

On the basis of this EMP, the Contractor's HSES-MP should provide:

- An overview of the HSES aspects and impacts related to construction works.
- Relevant Nigerian legislation and Nigerian standards to which the Contractor will comply, including the way in which he will monitor such compliance, specifying:
    - Standards against which the monitoring will be set (set out in EIA),
    - Which parameters and limits will be monitored,
    - Frequency at which monitoring will be undertaken.
- A clear definition of specific mitigation measures that are intended to be implemented in order to minimize the impacts and the internal organisational management.

It is advisable for LAMATA to demonstrate their HSES-MP to LASEPA for approval.

HSES Manager

The company will appoint an HSES manager in order to keep up to date and control the implementation of the HSES-MP by LAMATA. It is expected that an international expert will give on the job training to a Nigerian appointed expert. This will enhance knowledge transfer and good practise. The tasks for this function would include the following:

Transportation: The management of motor vehicles used for the transport of materials and personnel should be monitored and include the following:

- Motor vehicles' condition and maintenance
- Ferry safety signals
- Loading and off-loading procedures
- Ferry license and permit to drive, and
- Kit for first aid and fire extinguisher

Execution of civil Works: The monitoring criteria should include the following:

- Noise levels
- Water pollution, including sediment flux into watercourses
- Plant and equipment maintenance
- Management of construction site aesthetics
- Dust levels
- Destruction of flora and fauna

Wastes management: Solid and liquid wastes which will be generated will have to be disposed off accordingly (adequate disposal).

Raw material use: reduce where possible the amount of raw material and carefully select suppliers on their company ethics.

Soil protection: In areas and at sites with increased risk of erosion as a result of construction works, the Contractor's practices to be monitored include:

- Implementation of erosion-protection measures
- Implementation of environmental engineering measures and ecological restoration after completion of works
- Prevention of soil contamination

Protection of public safety: The Contractor's practices with regard to protecting public safety should be monitored with regard to:

- Bordering and signalling of works
- (Timely) provision of information to the public
- Traffic management
- Restriction of access to work sites

Disturbance and interruption of commercial and social activities:

- (Timely) provision of information to the public
- Traffic management
- Avoidance of relocation
- Provision of access to sites to allow continuation of socio-economic activities
- Prevention of land take where possible
- Prevention of destruction / disruption of other utilities and infrastructure
- Prevention of destruction / interference with cultural property
- Development of educational programme on travel safety
- Development of educational swimming programme for schools

9.13.2 Setting-up and managing the Site

Liaison, Participation and Consents

Liaison with the relevant environment agency, planning authorities, conservation agency, site neighbours and the public is essential when setting up and managing a site. The wide range of users and activities at marine sites can mean that construction projects in these locations are particularly vulnerable to complaints.

Establishing good relations with the environment agency, planning authorities and conservation agencies should include:

- Identifying the extent of the liaison already undertaken at the design phase;
- Identifying from the specification, other contract documents, and consultation with the engineer/architect any special environmental requirements that may be required;
- Identifying any existing contacts;
- Making plans to establish working relationships with each appropriate organisation;
- Identifying and assigning responsibility to appropriate site staff to undertake the necessary liaison during the construction phase.

Early contact should be made with the planning liaison officer in the relevant environment agency area. If possible, arrange a site visit with all interested parties as soon as possible. In this way, contacts can be made, issues identified and works can be suitably planned. Also, training and induction courses should be timed to occur around the same period, so that information on habitats and other sensitive features can be passed on directly to your staff.

Checklist – Consents and Controls (examples only)

- Noise – has LASEPA been asked to identify noise requirements / limits in advance of the construction phase? What are those limits?
- Discharges – are consents in place for any water discharges that may be required to controlled waters or a public sewer?
- Land drainage – have consents been obtained if required?
- Groundwater – has the relevant environment agency been consulted with regard to any dewatering operations that are to be undertaken and the likely effects on groundwater reserves?
- Waste – are procedures in place to comply with the duty of care, and have waste management licenses been obtained (if required)?
- Traffic – have access routes and any statutory limitations on noise and dust contained within the planning conditions for the works been identified?
- Dredging – have licenses been obtained for disposing of material to land or at sea?
- Coastal construction – has a licence been obtained for works below mean high water?
- Environmental Management Plan – has one been produced in response to the company EMS, if in place, and will it require implementation at the site?
- EAP – has one been produced as the result of an EIA, have the actions been implemented?

Establishing good relations with site neighbours (including local residents, businesses, fisherman, etc.) could include:

- Public meetings to explain the construction of the project and its potential impacts;
- Regular meetings with local representatives groups;
- An exhibition in a suitable local venue;
- Setting up liaison with local schools; and
- On large long term projects, a newsletter, web site, up-to-date notice boards or regular bulletins on progress, providing details of the proposed timing of disruptive activities.

Good Public Relations

Good public relations are vital in the drive to complete a project with the minimum disturbance to neighbours. Experience has shown that members of the public tend to complain less if they know what is happening on site. Public liaison is, therefore, particularly important if operations that are likely to cause disturbance are going to be carried out for any length of time. Try to explain the efforts that are being made to limit the impacts of operations through phasing and other control measures. Use hot-lines, newsletters, notice boards and viewing stations to encourage an understanding of the development, the costs and efforts involved, and to minimise confusion and discontent.

Establishing good public relations is easier if the site personnel understand the project and its impact from the public's perspective. Training should be appropriate to the size, nature, and type of activities carried out and should emphasise the key environmental aspects and impacts of the operation, and methods for their mitigation. In particular, the need to be sensitive to local communities and aware of sensitive environmental assets must be stressed.

Considerate Contractors Scheme

A useful tool in demonstrating the site's environmental intentions are to work within a good practice framework; a considerate contractor scheme. These often involve adherence to a code of good practice, visits by external auditors, establishing good relations with neighbours and incentive awards for tidy sites. Considerate contractor schemes provide an ideal framework within which to manage environmental issues but do not replace an environmental management system. They are often administered by the local authority, although the Construction Industry Board has set up a nationwide scheme (see web site at http://www.ccscheme.org.uk).

Checklist – Considerate Construction

- Show consideration to site neighbours and the public at large;
- Send letters to neighbours at the start of site work, apologise for inconvenience and provide a contact name and number (on a notice board);
- Inform neighbours if any unusual activities occur (i.e. early deliveries, noisy work);
- Be mindful of people with sight, hearing or mobility difficulties;
- Monitor parking, especially on neighbouring roads and car parks;
- Consider ensuring that deliveries do not coincide with the rush hour;
- Where possible make viewing facilities available;

- Be responsible and respectful, lewd or derogatory language should not be tolerated and radios/music muted; and
- Keep an incident and complaint book.

Site Management, Control and Security

The vast majority of environmental accidents or causes of complaints stem from one or more of the following reasons:

- Ignorance;
- Negligence;
- Carelessness; and/or
- Vandalism

A priority of the contractor is to ensure that site personnel understand that environmental issues must be taken seriously and that poor environmental practice will not be tolerated. Use the following checklist:

Checklist – Site Awareness

- Has an environmental management plan been formulated and have ideas been developed for its implementation?
- Have environmental responsibilities been defined?
- Is everyone on site aware of their responsibilities and liabilities, including sub-contractors?
- Are all environmental standards and obligations clearly defined?
- Have the standards been brought to the attention of all concerned?
- Are all established mitigation measures understood and in place?
- If training is necessary, has a training programme been established?
- Are environmental awareness posters/bulletins displayed?
- Are warning signs displayed prominently on the site?
- If in place, is the company environmental policy displayed? And
- If one exists, is the company environmental policy available?

Good Housekeeping

Good housekeeping is an important part of good environmental practice as it helps everyone to maintain a more efficient and safer site. The site should be tidy, secure and have clear access routes that are well signposted. Particular consideration should be given to the possible effects of weather events in the coastal zone on site management and control.

Checklist – Housekeeping

- Segregate waste as it is produced and remove waste from the site frequently (or re-use/recycle as appropriate);
- Damp down, cover or shelter stored loose material (e.g. sand) to prevent it from being blown away by the wind;
- Ensure skips are emptied before they become overfilled;
- Keep the site tidy and clean (storing and locking away appropriate equipment and materials at the end of each day);
- Ensure that material and plant storage areas are properly managed;

- Keep hoardings tidy – repair them and repaint them when necessary, remove any fly posting;
- Frequently brush clean the wheel washing facilities; and
- Do not leave plant unattended in public areas or in the vicinity of the tidal zone.

General site appearance is important. When planning the site layout, all offices and equipment should be sited to minimise visual intrusion. In coastal areas, consideration must be given to minimising impact, both on neighbours and on recreational users.

Site Security
Site security is an important component of good environmental management. Vandals often cause damage that harms the environment, by:

- Opening taps on tanks containing fuel;
- Tipping out other liquids from drums and containers;
- Smashing/stealing raw materials;
- Playing on construction site;
- Spraying graffiti or fly-posting on site hoardings; and
- Destroying works in progress.

The incidence of vandalism will be higher when working in coastal sites that are close to urban or popular visitor areas. However, remote sites by their very nature can be at as much if not a higher risk. Help reduce vandalism by securing the site, and moving valuable items and those prone to theft from public view. Store these items in locked containers or a storage area. Although emergency equipment can be particularly vulnerable, it should not be locked away when the site is active as daily checks are required to check its usability.

Suggested Security Measures:

- Where possible, secure the site boundary using perimeter fencing and high quality locks on gates. Various types of fencing are available and each has its own advantages and drawbacks. For example, solid barriers (e.g. hoardings) are more difficult to scale than chain-link fences and prevent casual surveillance by prospective thieves. However, they also provide cover for thieves and vandals once they are on site;
- Lockable fuel dispenser to prevent vandalism;
- Contractors can be liable for environmental damage caused by vandals if they have not made reasonable attempts to guard against it. A contractor's liability increases if vandals have already struck at a site;
- Avoid stacking materials against the site boundary/fence, as this can provide an opportunity for vandals and thieves to scale it;
- Within the site, ensure that materials that are potentially hazardous to the environment are well secured. It is important to lock fuel outlets when not in use;
- Secure plant to prevent vandalism;
- Immobilise plant and equipment overnight;
- Install deterrents such as lights, warning notices, 24-hour security guards (where appropriate) and alarm systems;
- Control the movement of people on and off the site: use site passes or swipe cards;

- Position the site manager's office to give a good view of the site;
- If the site is large or at high risk from trespassers, consider installing CCTV cameras; and,
- Inform local police about the site and seek their advice on security.

Pollutants
It is essential that equipment, fuel and materials are secured to prevent them entering water courses; environmental damage and prosecution could result and the recovery of materials can be costly. This is covered further in Chapters 3.1, 3.5, 4.16 and 4.17.

Working Hours, Noise and Lighting
Site working hours can create considerable concern and annoyance among neighbours, in particular due to noise and light pollution.

Noise
Coastal sites can be more susceptible to risks associated with noise restrictions due to the inherent nature of the works (e.g. rock unloading, the use of large moving plant and piling works), the fact that water is acoustically 'hard' (i.e. sound waves move over water rather than penetrate) and also due to the often close proximity of tourists (especially in the summer).

Conflict can arise due to the need to maximise the utilisation of marine plant and the need to optimise the tidal windows available. This is often against accepted working hour standards and can lead to a high level of complaint. The potential effects of noise in coastal locations can also be exaggerated by the propagation of noise over water to potential receptors and by the limited applicability of some noise control measures at the coast, such as bunds.

On some projects, the working hours for noisy operations are defined by the local authority and stipulated within the contract document – perhaps through Section 60 or 61 notices. There may be opportunities for extending working hours in consultation with the local authority or the client. Although extensions to working hours may be crucial to the programme (particularly on projects that require tidal working), their effect on neighbours should be carefully considered – try to stick to sociable working hours as far as practicable. When extended working is necessary, it is important to inform neighbours in advance of the reasons for the work and its duration.

Time activities within the allowable day carefully. For example, in the same way that it is advisable to schedule deliveries outside the rush hour, other intrusive activities can be scheduled at less sensitive times. To understand the constraints, which will vary from site to site, it is important to establish the patterns of neighbours and the public.

Timing of Activities

- Plan works well in advance, identify the issues, discuss and solve them before going on site;
- Avoid noisy activities during school hours (if applicable);
- Local restaurants appreciate less disturbance over lunch time;

- Establish whether local business or the tourist industry require quieter periods during the day;
- Determine whether weekend or night-time working is especially sensitive (consider tourist activities as well as residents);
- Establish whether there are particularly sensitive receptors near the site; and
- Understand the seasonal requirements of wildlife (including breeding birds), tourism and recreation.

Lighting

Lighting is essential for many coastal activities, not only as a deterrent to vandals but also to maximise working hours, for the use of machinery, and to provide suitable working conditions. However, light can be a source of annoyance to local residents, so it is essential to keep site lighting at the minimum brightness necessary for adequate security and safety. Locate and direct the lighting so that it does not intrude on any properties nearby and remember that high levels of lighting waste energy and money. Consider the use of infra-red lighting for security.

Managing Materials

Improving the delivery and management of materials and components reduces materials wastage and increases site efficiency. The environmental benefits of reducing wastage include minimising resource use and the amount of waste sent for disposal. Where site personnel follow established procedures for managing materials and components there will be fewer incidents of spillage and contamination arising from incorrect storage or handling, and less damage to materials and components. This means less wastage of raw materials and, hence, saving money.

Storage

A combination of central storage and workplace storage is typically used on site; the balance between them depends on the site and the works in progress. It is important to manage storage areas well because they set an example for the site.

Checklist – Storage of Materials

- Ensure that the materials suppliers instructions on storage and delivery are being followed;
- Store materials that are valuable or attractive to thieves in a secure area;
- Take care not to store fragile equipment in site offices that may be subject to tidal flooding (including maximum spring tides);
- Do not store material or position offices on or near to cliffs or slopes that may be unstable;
- Consider storing materials in a central storage area away from sensitive receptors such as watercourses;
- Store materials away from waste storage containers and from vehicle movements that could cause accidental damage;
- Secure lightweight materials to protect them from wind damage or loss;
- Take special care over the storage of materials that are potentially polluting;
- Ensure that when storing materials the effects of extreme weather in the coastal zone is considered and appropriate action taken; and
- Make sure that all appropriate emergency response equipment is located near to the stored material and that staff know how to use it.

Handling

There are many methods for moving materials around the site. Options include cranes, trucks, fork lifts and even manual handling. Ensure that the suppliers' instructions on handling their materials are followed to minimise damage to materials and injury to site personnel. Particular care should be taken when moving potentially polluting materials around the site.

Ordering and Receiving Materials

- Order the right quantity and quality;
- If materials arrive at the time when they are needed, this reduces the length of time materials have to be stored on site and, therefore, reduces the potential for damage, pollution and theft to occur;
- Consider whether large volumes of potentially polluting materials need to be stored on the site. Can the material be delivered to site in quantities that can be used on the day of delivery?
- Can potentially polluting materials be eliminated from the construction process altogether or could relevant processes be undertaken elsewhere (i.e. at a more suitable site);
- When ordering, find out in what form the materials will be delivered in, so that appropriate unloading plant can be arranged;
- After placing an order, check the arrangements for handling and storing the materials as soon as they arrive on site;
- Always make sure that deliveries are received by a member of site personnel who is able to supervise the delivery, carry out a quality inspection and ensure that the materials are unloaded to the appropriate place; and
- Make sure that all delivery drivers and site staff are aware of these conditions.

Waste Minimisation

Construction waste originates from three main sources: earthworks and excavation; demolition; and general construction. The creation of waste on your site creates a number of problems, namely:

- The costs incurred in removing the waste;
- The costs incurred for the safe disposal of the waste (i.e. landfill tax);
- The increasing need for waste disposal sites in Lagos; and
- The misuse of potentially valuable or marketable products.

To lessen the effects of these issues on industry, the practice of waste minimisation has been widely adopted. Waste minimisation helps businesses to save money through reductions in wastage and also helps to improve market image through increased awareness of sustainable development issues.

Key Elements of Waste Minimisation:

- Reuse of materials or use of recycled materials;
- Appropriate materials and dimensions, prefabrication;
- Efficient ordering of materials;
- Materials handling and storage;
- Efficient waste management – segregation; and
- Efficient waste management – auditing.

Traffic and Access Routes

It is important to manage site traffic, because it can cause delays to local traffic and create a safety hazard both on and off site. People living and working near the site are often annoyed by emissions, noise and the visual intrusion of queuing vehicles. An organised site with well managed traffic activities can provide a positive perspective to local residents.

Access Routes

The use of public roads for site access may be restricted (i.e. within the planning consent). Such restrictions may include weight and width controls, parking controls, steps to minimise pedestrian conflict and low-headroom access routes. Even if these aspects are covered within the contract, consult the local police and the local authority fully to address potential traffic issues and agree on a workable site access that does not compromise public safety. Plans may be required to identify each access point, the agreed route to the nearest main road, and the routes to be used by lorries to access the road network. Wherever possible, arrange the access so that lorries enter and exit the site in a forwards direction.

When undertaking certain coastal projects, delivery of materials may be possible by sea and should be investigated because of the clear advantages of minimising traffic disruption. However, there is a risk that the sea conditions will disrupt deliveries.

Send a site map to your suppliers, showing them where you wish them to access the site and how to get there.

Managing Site Traffic

Plan the timing of deliveries to avoid vehicles waiting. Where several deliveries are likely to take place over a short period, designate queuing areas. In summer, avoid queuing outside buildings as windows will most likely be open, and try to avoid vehicles reducing the amenity and recreation value of surroundings areas. In urban areas, it may be best to allocate a waiting area some distance from site and call in deliveries when access to the site is clear.

Site personnel car traffic often annoys the public. Arrange designated parking areas, ensure that staff do not park in unsuitable areas and that restrictions are complied with. Consider implementing a park-and-ride or car-share scheme. Try not to monopolise public car parking areas, especially those used during the summer by high numbers of visitors to the area.

Sometimes construction sites are blamed for disturbance caused by vehicles that are not associated with the site. To avoid this, it may be helpful if site vehicles display some visible identifying marks. While this may not be appropriate for individual deliveries it can be done for the main contractor's vehicles and for regular delivery vehicles.

Checklist – Managing Site Traffic

- When ordering deliveries, ensure that all drivers are aware of traffic restrictions at and around the site;
- Arrange deliveries to site so that vehicles can go straight in without having to queue outside the site boundary;
- Store materials as close to where they are needed as possible;
- Instruct drivers to switch off engines when vehicles are waiting;
- Consider the use of in-cab communication systems to maintain control over lorry movements;
- Load and unload vehicles off the highway, wherever possible;
- Plan parking for site personnel's vehicles; and
- Consider getting regular site vehicle's to display identification.

Emergency Actions and Remediation

The nature of coastal and marine sites requires that emergency action plans are put in place to deal with potential pollution incidents before setting up the site. It is essential that consideration is given to controlling and containing solid and liquids pollutants along with detailed action plans for dealing with emergencies. In some situations, for example oils and lubricants, especially on or in close proximity to water, the purchase of a range of specialist equipment to tackle spills may be required. Section 3.5.5 covers this area in detail.

If land or water become contaminated through the spillage of oils, lubricants or other substances, remediation will be required. This will take place after the initial clean up and will require advice from the relevant environmental agency and/or specialist consultants.

Key Guidance

Pollution incident response planning, Pollution Prevention, LASEPA.

Pollution Avoidance

It is essential that pollution avoidance strategies are used when working in coastal locations.

Checklist – Pollution Avoidance

- Wastewater control - ensure that all waste water produced on site is disposed of appropriately and cannot enter controlled waters;
- Waste management - ensure that appropriate containers are available for the collection and disposal of all wastes;
- Air pollution control - ensure that equipment is serviced and managed to minimise air pollution;
- Noise control - ensure that plans are in place to mitigate noise levels from any major noise sources to keep them within acceptable limits;
- Light control - ensure that lighting is correctly set up and focussed to avoid causing pollution through 'light spill'; and
- Spillage control - ensure that all liquids are appropriately stored to prevent spillage.

Managing Monitoring and Mitigation Equipment

In order to meet the requirements of existing consents, it may be necessary to have a range of monitoring and mitigation equipment on site. This could include noise meters and flow meters for monitoring volumes of discharges. Mitigation equipment could include oil spill kits, screens to trap dust, and screens/bunds to reduce noise.

To remain effective, all equipment will need to be managed. Monitoring equipment will require regular servicing, and possibly calibration (and certificate), by a competent authority. To avoid complaints and ensure compliance with consents, mitigation equipment should also be regularly checked. Spill kits, and other emergency 'first aid' kit, should be checked on a daily basis.

On-site accident and emergency equipment, such as spill kits, should be kept in an easily accessed location. Relevant trained staff should know of its location and how to use the equipment.

Site Clearance / Abandonment

This is a phase of the works that can receive little attention, but it can cause most problems. In clearing the site it is vital that wastes are managed in accordance with relevant regulations. Normally, on completion of the works, the contractor is required to clear away and remove from the site all plant, surplus materials, rubbish and temporary works. The whole of the site and works should be left clean – until then the project is unfinished.

It is likely that the project's planning permission and waste management licence (if granted) will have conditions attached. It is usual for these conditions to address post-construction landscaping and reinstatement issues and it is a legal requirement to comply with them.

In clearing the site, options for the salvage, re-use and recycling of materials should be considered. Finally, any disposal of waste should be carried out with regard to the Duty of Care and relevant legislation and policies on waste.

10 INSTITUTIONAL ARRANGEMENTS (TASK 10)

This section addresses the institutional issues relevant for a proper development of ferry services in Lagos. For this purpose, the various agencies and institutions which have a direct or indirect impact on ferry transportation in the Lagos metropolis have been identified and reviewed in terms of the following aspects:

- Legal basis
- Functions and responsibilities
- Impact on ferry operations
- Area of conflict / overlap
- Recommendations for improvement

Agencies and institutions reviewed are:

- LAMATA – Lagos Metropolitan Area Transport Authority
- LAMDA – Lagos Mega City Development Authority
- NIWA – National Inland Waterways Authority
- LSFSC – Lagos State Ferry Services Corporation
- NIMASA – Nigerian Maritime Administration and Safety Agency
- LASTMA – Lagos State Traffic Management Authority
- LSWTDC – Lagos State Waterfront and Tourism Development Corporation
- LASEPA – Lagos State Environmental Protection Agency

10.1 LAMATA – Lagos Metropolitan Area Transport Authority

Legal Basis
LAMATA has been implemented with Law 2007 with affect from 04 April, 2007.

Functions and Responsibilities
The key functions and responsibilities of LAMATA are the following:

- Management and development of transportation and connected infrastructures in Lagos State,
- Promotion and development of transport infrastructural facilities on the inland waterways within the state; and
- Regulation of rail and other modes of transportation within Lagos State, such subject to the Constitution of the Federal Republic of Nigeria.

Impact on Ferry Operations
By the 2007 Law LAMATA now has and will continue to have a direct and indeed serious impact on ferry transportation in the whole of Lagos State. It has to carry out and effect the necessary coordination and streamlining of Inland Waterways Transport (IWT) with the vehicular (road) and rail transports within the State. LAMATA shall be capable of being the overall and effective instrument of solving all multi-modal transportation problems with the State of Lagos.

Area of Conflict / Overlap
Some of the functions of LAMATA, e.g. the provision of infrastructural facilities like jetties and terminal buildings, the allocation of inland navigable routes to ferry owners, the supervision and administration of IWT will conflict or overlap with those of NIWA and, to some extent, with LSFSC and Lagos Megacity Development Authority (LAMDA).

Recommendations for Improvement
To avoid any jurisdictional conflict and assure fast delivery of services of LAMATA to the populace, it is highly recommended that a serious approach be made to the Federal Government to allow LAMATA to take over completely the functions, responsibilities and duties of NIWA in Lagos State in all its ramifications.

It is to be noted that this approach is best handled at intergovernmental level. Fortunately by Section 28 (2) of the NIWA ACT CAP N47 LFN, the Federal Minister of Transport is empowered to give approval to NIWA on all issues or matters as may appear expedient to or necessary to inland water transportation.

10.2 LAMDA – Lagos Mega City Development Authority

Legal Basis
LAMDA was set up in year 2005 by means of a Presidential decision of President Olusegun Obasanjo in conjunct ion with the governors of Lagos and Ogun State.

Functions and Responsibilities
LAMDA is responsible for the total planning, effective transformation and redevelopment of the Lagos Megacity region including the establishment of a functional, hassle-free, multi-modal mass transport system that will feature the large scale use of the rail, road and inland waterways of the Lagos metropolis.

Impact on Ferry Operations
With a proper cooperation between LAMDA, LAMATA and LSG ferry transportation could be a huge success in Lagos State. LAMDA could persuade the Federal Government and its relevant agencies to develop and fund an efficient integrated multi-modal transport system that will feature the economic and extensive usage of the lagoons and waterways of Lagos metropolis.

Area of Conflict / Overlap
The Consultants have not noticed any serious conflict between LAMDA and the other agencies involved in water transportation in Lagos State.

Recommendations for Improvement
It is advised that LAMATA, LSG, and LAMDA cooperate fully and work together in order to achieve the objective of a modem, efficient ferry transportation in the metropolis.

10.3 NIWA – National Inland Waterways Authority

Legal Basis

NIWA was established by the National Inland Waterways Authority Act, Cap N47 Laws of the Federation of Nigeria 2004.

Functions and Responsibilities

Primary functions of NIWA are: (a) to improve and develop inland waterways for navigation, (b) provide an alternative mode of transportation for the evacuation of economic goods and persons, and (c) executive the objectives of the national transport policy as they concern inland waterways.

It also has responsibilities for the grant of licences and permits to private inland waterways operators. It also operates ferry services within the inland waterways system. It approves and controls all jetties, terminals and dockyards. It also approves designs and construction of inland river crafts, etc. Indeed, it is the umbrella of everything pertaining to inland waterway transportation.

Impact on Ferry Operations

NIWA, more than any other organisation, has a direct impact on ferry transport in Nigeria generally. It issues and control licences and permits to all operators of ferries and other crafts on annual and daily basis respectively. It designs ferry routes, surveys, removes, and receives derelicts, wrecks, water hyacinth from inland waterways. NIWA constructs and maintains inland ports and jetties. In fact, NIWA is heavily involved in IWT.

Area of Conflict / Overlap

The area of overlap between NIWA and LSFSC is that both of them are allowed to operate ferry services in uncharted and not segmented inland waterways. But the most important conflict is that NTWA Act exclusively reserved ownership of all waterways to NIWA, thereby excluding the LSFSC from lawfully operating any route of its choice. The only water route on which the LSFSC is allowed to operate by NIWA Law are the entry points to the ports in Lagos metropolis.

Recommendations for Improvement

There is an urgent need to amend its enabling law to separate the dual functions of a regulatory authority and an operator from the statutes of NIWA. By so doing NIWA will be able to effectively perform the functions of a regulator of inland waterway and ferry services.

10.4 LSFSC – Lagos State Ferry Services Corporation

Legal Basis
No known legal instrument for this body. Therefore, LSFSC operates without any enabling law, but was established in 1981 as Lagos State Ferry Services Limited

Functions and Responsibilities
LSFSC was set up to operate ferry services in Lagos inland waterways. It took off in 1981 with two ferries named M.F. Babakekere and M.F. Ita Faji. Its ferries ply the route between Mile 2 and Marina, as well as between Ebute Ero to Ikorodu. In all it has close to 8 ferries in its fleet, but it leased out 6 ferries to private operators like Corporate Messengers Ltd., Golad Nigeria Limited, etc..

Impact on Ferry Operations
Presently the LSFSC has little impact on ferry transportation as it no longer operates any ferry of its own. However, it has a concrete terminal or jetty at both its Mile 2 headquarters and also at Ebute Ero and one at the Ikorodu beach.

Area of Conflict / Overlap
Since it no longer operates any ferry of its own and no statute to back up its operation, it is most unlikely that it will have any conflict with other agencies. But when properly set up, its services would certainly overlap with those of NIWA whose duty it is to allocate routes to all ferry operators.

Recommendations for Improvement
It is advised that a law to regulate and back tip the agency as an operator and or regulatory agency in waterways transportation be enacted as soon as practicable. It is also recommended that those who leased ferries from LSFSC make copies of their lease agreement available to LAMATA.

10.5 NIMASA – Nigerian Maritime Administration and Safety Agency

Legal Basis
NIMASA was originally established as National Maritime Authority (NMA) by Decree 10 of 1957. The Decree is however obsolete now as the scope and functions of the agency are now much bigger than when it was NMA. However, a new Bill to regularise its status has since been passed by the National Assembly awaiting the assent of the President.

Functions and Responsibilities
The functions of the Agency are to the regulate, control, enforce and ensure the safety of all ships coming into out of the Nigerian waters. It also ensures that the maritime environment is not polluted. Its activities are guided by the International Maritime Organisation (IMO) of which it is a member. It also registers ships and boats flying the Nigerian flag national flag. It also deals in cabotage. However, it is not a profit oriented organisation. It derives its finances from fees charged ships plying the Nigerian waters. It also registers ships coming in and out of the Nigerian waters.

Impact on Ferry Operations
NIMASA has no direct impact on ferry operations except in the area of registration of vessels that wish to fly the national Nigerian flag. However, should a foreigner intend to go into water transportation business in Nigeria and on Nigerian territorial waters, NIMASA will have to register it.

Area of Conflict / Overlap
The only area of conflict is possibly with NIWA in the case of vessel and ship registration. Similarly, it will intervene on matters of environmental pollution during dredging campaigns so as to prevent the sea from being polluted environmentally. It also overlaps with LASEPA in the area of environmental pollution of the waterways.

Recommendations for Improvement
It is recommended that NIMASA be included in the Stakeholders' Meetings for the LAMATA ferry project so as to streamline the areas of overlap and conflict.

10.6 LASTMA – Lagos State Traffic Management Authority

Legal Basis
There is no known legal instrument as its Law is yet to be published in the set of Lagos State of Nigeria 2003 which is the most recently revised set of laws of Lagos State. But the establishment of LASTMA was backed up by a government official gazette which in itself is no longer available.

Functions and Responsibilities
Just as its name suggests LASTMA is empowered and required to regulate, direct, control and ensure smooth flow of vehicular traffic on Lagos roads. It is also expected to enforce road traffic sanctions against traffic offenders. It is also responsible for the removal of victims of motor accidents and the clearance of accidental vehicles on the roads. Its members are regimented and are adorned with uniforms.

Impact on Ferry Operations
LASTMA has no direct impact on ferry transport. However, the successful implementation of the LAMATA ferry project will ease the pressure of LASTMA.

Area of Conflict / Overlap
In case of the park-and-ride schemes at the ferry terminals it will be necessary to streamline the functions of LASTMA with LAMATA.

Recommendations for Improvement
It is recommended that the enabling law of LASTMA be published and made available to all agencies. LASTMA should further be involved in the mega-planning to reform and transform the traffic situation in Lagos State.

10.7 LSWTDC – Lagos State Waterfront and Tourism Development Corporation

Legal Basis
Lagos State Waterfront And Tourism Development Corporation Law of 11th June,2002 Chapter L83, Laws of Lagos State of Nigeria 2003.

Functions and Responsibilities
It has several functions relating to tourism but the only one relevant to ferry transportation is the one that empowers LSWTDC to regulate, licence, register and classify, inter alia boats and ferry services.

Impact on Ferry Operations
The direct impart of this corporation on ferry services is the promotion of tourism to encourage the use of ferry boats as a means of recreation aid and transportation for tourists and their cargoes. By providing a conducive environment for tourism ferry operators will also benefit from the boom in the growth of tourism. And this will certainly go a long way to increase capacity building and finances of the ferry owners

Area of Conflict / Overlap
The most noticeable area of conflict is the power vested on this body to licence, register and regulate ferries as well as regulate and establish standards for the development of all waterfronts in the state. This sharply conflicts with the duties of NIWA, LSFSC and even NIMASA.

Recommendations for Improvement
It is recommended that the duty of licensing, registering, and regulating of all motor ferries and water transporters should be removed from its era as it is fully superfluous at present.

10.8 LASEPA – Lagos State Environmental Protection Agency

Legal Basis
LASEPA was established by the Lagos State Environmental Protection Agency Law No. 9 of 6th November 1997.

Functions and Responsibilities
The functions of this body relevant to this ferry project are (a) the monitoring and control of all forms of environmental degradation from agricultural, industrial and government operation, (b) to survey and monitor surface, underground, and potable water, air, land and soil environments in the State as well as to determine pollution levels in them.

Impact on Ferry Operations
The most direct impact of LASEPA is in the area of dredging of inland waterways to make these safe and suitable for navigation. In the process of dredging it is obvious that there will be a certain degree of pollution. Where such a pollution becomes too dangerous or unsafe for the environment, LASEPA will definitely step-in to exercise some level of control. But if the dredging company refuses or even fails to heed to comply with LASEPA's instructions or advices, the authority will sanction the company. This could take the form of fines, partial or even total suspension of the dredging works.

Area of Conflict / Overlap
Not much area of conflict or overlap was noticed between the functions of LASEPA and the incoming mega-agency that will be saddled with ferry transportation in Lagos metropolis. Rather, what is now required is understanding and co-operation between them.

Recommendations for Improvement
It is recommended that a representative of LASEPA be brought on board into the Board of Directors or the Management Team of the proposed new improved LAMATA which will be saddled with regulatory duties of terry operators. By so doing, conflict of duties and responsibilities will be eliminated.

10.9 Summary of Key Recommendations

The assessment of the existing institutional and legal framework of all agencies and institutions having an impact on the ferry operations in Lagos metropolis clearly indicated that (1) LAMATA should be empowered with a stringer legal authority, and (2) that the roles and responsibilities of these agencies and institutions should be clearly demarked and established in new laws.

11 PRIVATE SECTOR PARTICIPATION (TASK 11)

This section provides an assessment of the Public Private Partnership (PPP) regarding the LAMATA Ferry Project and addresses the following issues:

- LAMATA PPP objectives
- Key PPP elements
- Responsibilities for PPP
- Selection methods for private operators
- LAMATA organigram

11.1 Introduction

LAMATA is responsible for the concessioning of the ferry operations in Lagos and has selected three priority ferry lines which are nominated to transport passengers from and to the Central Business District – CBD in Phase 1a of the project. These priority ferry lines were selected due to the important role the lines can play in the solution to the structural road traffic congestions. The ferry lines will be put to market by LAMATA and This section provides a guideline on how to structure the contract between the public and private parties and addresses all major PPP items

Firstly the key issues involved with PPP design, scope, allocation of investments responsibilities, risks and activities are addressed followed by a decision is for implementation. It has been understood that these decisions will be included in the concession contract.

Secondly, an overview is provided of the key characteristics of two selected methods of procuring a private party for the ferry operations: (1) via direct award or (2) via tendering of the concession. Based on these characteristics the preferred method of tendering is recommended.

Defining a concession agreement starts with translating the strategy of LAMATA and the project specifications (investments, operational costs, revenues) into a financial analysis, in order to investigate the attractiveness of the project to private operators. This requires an iterative process to find an optimal balance between meeting objectives of LAMATA and the private operator. The financial analyses have been reported in Section 8.

11.2 LAMATA PPP Objectives

The concession of the ferry operations will increase the involvement of the private sector in Lagos public transport sector. Based on an interview with LAMATA officials for this project the concession should meet the following key objectives:

- Decrease road congestion
- Create an efficient and high quality ferry services, which is likely to be achieved by introducing experienced local or international private sector capabilities
- Ferry services should provide safe transport
- Ferry services should be environmental friendly
- Ferry services should be affordable for Lagos citizens
- The privatisation of ferry operations should be bankable as the private operator should make sufficient return on its investments and should be able to attract commercial loans
- Concession should be valuable to LAMATA
- Tender implementation should be transparent and implemented swiftly

One of the important comments made by LAMATA was that LAMATA will not subsidize in any form the ferry operator based on the project scope for the ferry operator. This objective has a significant impact on the structuring of the concessioning contract and simply means that the private ferry operator should be able to run a sustainable financial autonomous business.

As concluded in the financial analyses it is possible that ferry operations indeed can be feasible when certain conditions are met (refer Section 8). The concession for the ferry operations has been structured accordingly.

11.3 Key PPP Elements

Private sector participation can be structured according various contract types, such as Lease, BOT, Operating contract, etc. Key elements that should be addressed in a concession contract are:

- Investment allocation
- Scope contract
- Commercial structure
- Tariffs
- Other income operator
- Volume guarantee
- Termination of contract
- Routing
- KPI

11.3.1 Investments

The allocation of the required investments in (primarily) equipment and infrastructure for the ferry operations in Lagos has been indicated Table 11.1below:

Investment item	Allocation
Dredging (capital, maintenance)	LAMATA
Ferries	Private Operator
Terminal	LAMATA
Jetty	LAMATA

Table 11.1 – Allocation of Investment Responsibilities

The required ferries will be selected and financed by the private operator, also the maintenance of the ferries is the responsibility of the private operator. LAMATA is responsible for the provision of infrastructure related investments.

11.3.2 Scope of Responsibilities

Activities

The following activities (refer Table 11.2) are allocated to one of the two signing parties:

Activity	Allocation
Design and Build Ferries	Private Operator
Finance Ferries	Private Operator
Ferry Operation / Maintenance	Private Operator
Design and Build Terminal	LAMATA
Finance Terminal	LAMATA
Terminal Operation	Private Operator[8]
Terminal Maintenance	LAMATA

Table 11.2 – Allocation of Activities

All Ferry related activities are allocated to the private ferry operator. In addition, the private operator is also responsible for the operations on the terminal buildings. LAMATA is responsible for all the other terminal activities. By joining the responsibilities for the ferry services and the terminal operating activities to one private party, the risk of interface problems decreases.

Number of Ferry Lines per Concession

The activities of the ferry operations may cover 1 or more ferry lines (routes).

- One line per operator
  If one operator per line is selected, multiple private operators have to be selected. Selecting multiple operators does not create a true market competition because most passengers will travel only on one route and thus passengers can not change to a different operator.

[8] All private operators in the table are the same entity.

On the other hand if the operator does not perform according certain performance criteria, the concession contract can be terminated and another ferry operator can take over the activity. This makes LAMATA less independent to one operator if it would concession all lines to one operator.

- Number of lines – More than one line per operator
  The main advantage of awarding 2 or 3 lines to one operator is that the concession will gain in scope and the operator can spread its volume risk (risk of reducing the volatility of revenues) and might have a better return on its investments.

  Financial advantage from economies of scale can be gained in case the number of lines per operator is increased. Examples are that the overhead costs can be spread over more revenue, which makes the operator more efficient (economies of scale). This makes the tender more valuable and therefore could attract more interested investors. The disadvantage is that a monopoly is created.

We suggest operating with one private operator per line to maintain flexibility and be less independent of one or a few operators. .

Concession Period

In this specific case the operators will purchase and finance the vessels, which will involve significant costs for the operator. Therefore we suggest designing a concession with a sufficient time horizon. International market practice shows concession periods between 5 and 10 years. Ferry projects such as in Rotterdam and London have a concession period of more than 7 years. Especially new projects can have a slow start-up period due to operational and demand (low level “early adapters”) issues. A long term contract creates more dedication from the private operator and provides him more time to recover its investments.

If the concession period is relatively short, LAMATA could purchase the assets (ferries) from the ferry operator at the end of the concession period and sell them to the new operator (only applicable in the case the operator buys the vessels instead of leasing). The financial effects for LAMATA will be limited due to the short ownership period and the ferry operator has a more limited investment scope. If the concession period is relative short (less than 7 years) and if the vessels are not purchased by LAMATA, the financial analysis for this project may not be financial feasible (refer Section 8).

11.3.3 Commercial Structuring

Payment structures can be organized from the private operator to LAMATA and visa versa. A typical payment from LAMATA to the operator is the availability fee, i.e. fee for making the transport mode available to the public. The availability fee is commonly used in many infrastructure projects (especially road projects). This fee is paid by the authority to the operator when the transport mode is made available to the public, often expressed in the number of hours per ferry line.

However, LAMATA had indicated not to pay the operator any fee and therefore this option is not available for this project. Therefore, the private operator should be allowed to obtain sufficient revenue generating activities to cover its investments and costs.

11.3.4 Tariffs

Tariffs to be charged by the operator are a delicate point of discussion in any privatisation or commercialization process as the interests of private and public sector are not always aligned: The public sector wants to minimize tariffs to make its transport more competitive compared to the road sector. Therefore LAMATA might want to include a maximum tariff level.

On the other hand the private operator wants to maximize the tariffs to improve its profit margin. Of course there is a commercial limit to raising tariffs in view of competition. However, in practice commercial tariffs tend to be higher than those determined by public interests for ferries with a similar cost base. Tariff reductions are normally only achieved when there is more than one operator in the sector.

The concession contract contains the right to LAMATA to set a maximum tariff rate at the beginning of the concession.

11.3.5 Other Ferry Operator Income

To achieve sufficient return, the ferries have to be operated with high utilization rate. Regarding the Lagos ferry case, the ferries are transporting many passengers in morning and evening peaks but less in the off-peak hours. LAMATA may well allow the operator to generate additional income such as:

- Non regular scheduled services such as for example business trips, school trips, etc. During the off-peak less vessels per hour are used compared to the peak hours and therefore the operator could use these vessels for other trips
- Beverages and / or food;
- Advertising on vessels
- Renting commercial space on terminals

With these additional activities the quality of the overall ferry service is improved and the operator can generate additional income.

11.3.6 Volume Guarantee

An important element is the projected PAX forecast. Private operators tend to indicate optimistic / overstated PAX forecasts in their bids to obtain the concession. When operators are requested to provide some sort of volume guarantee, PAX projections become more realistic. LAMATA could incorporate a volume guarantee from the operator in the concession contract.

If actual PAX volumes are below the guarantee, the private operator then has to pay a certain penalty (also a bonus / males system could be incorporated). This motivates the private operator to achieve higher volume growth. Volume guarantees are common practice in Europe even though private companies strive to maximize their profits.

We suggest using volume guarantees to obtain competitive bids as well as to create an additional incentive to ensure that the ferry operator is acting according the contract. LAMATA will pay a variable fee (or bonus) in case realised PAX numbers exceed the PAX target. This variable fee will be paid on a yearly basis. In the other side, a penalty shall be levied by LAMATA to the ferry operator when the PAX number realised is below the PAX target. The variable fee is related to the difference between the PAX target and the realised PAX numbers.

11.3.7 Ferry Terminals

The activities and responsibilities on the ferry terminals concern activities such as:

- Terminal scope: Large terminal with several facilities or a small jetty approach
- Manning for ticketing, crowd management, customer service, security, information desk, etc
- Commercial space: Shops can be incorporated in the terminals

It is noted that all operational activities on the terminals are allocated to the private ferry operator.

11.3.8 Routing

The quality of the ferry service is partly determined by the number of vessels calling a certain ferry terminal per hour. If the concession would call for many calls per hour, the operator shall have to invest in many vessels. Consequently, the overall utilisation rates per vessel will go down which have a negative impact on the financial return of the project. Therefore the number of required calls forms a vital part of the concession. The financial analysis have addressed the issue of optimal number of calls per ferry route.

11.3.9 KPI's

Concession contracts often have Key Performance Indicators (KPI) to measure the performance of an operator. KPI for the LAMATA Ferry Project could cover the following items:

- Service reliability: Service reliability is decisive in retaining and, in the longer term, in increasing the number of PAX using water transport

.

- Service punctuality: Punctuality in the public transport terminology is the characteristic of being able to reach the required terminal before or at a previously designated time.

- Service availability: Service availability is defined as the number of ferries available at any time for operation.

- Safety: Number of accidents per year.

Specific KPI are to be stated in the concession contract in addition to the default structure and penalties.

11.4 PPP Responsibilities

Table 11.3 provides a summary overview of the allocation of responsibilities between LAMATA and the ferry operator.

Description	Allocation	
	LAMATA	Ferry Operator
Investments		
• Capital Dredging	√	
• Maintenance Dredging	√	
• Design, Build and Finance Terminals	√	
• Design, Build and Finance Vessels		√
Operations and Maintenance		
Ferry Services:		
Ferry Operation		√
Ferry Maintenance		√
Ferry Scheduling		√
Terminal:		
Terminal Operation		√
Terminal Maintenance	√	
Commercial Arrangement		
• Payment for Concession		√
• Payment per passenger transported (royalty)		√
• Volume Guarantee		√

Description	Allocation	
	LAMATA	Ferry Operator
Legal		
• Granting the Operator the right to operate ferry	√	
• Delivery of Permits and Authorisations	√	√
• Ferry plus Terminal Operations Liability and Indemnity Insurance		√
Commercial Management		
• Tariff Settings	Ceiling	√
• Customers Acquisition and Throughput Development		√
• Marketing, PR and Advertisement Policy and Framework	√	√
Operational / Human Resources Management		
• Operational Expenditure Ferry / Terminal		√
• Marine Services (Safety)	√	
• Granting Access to Waterway	√	
• Customer Service		√
• Customer Survey		√
Maintenance		
• Terminal	√	
• Dredging	√	
• Vessels		√
Performance Responsibilities		
• Throughput Targets Compliance	Monitoring	√
• Ferry Productivity Targets		√
• Line Availability		√
• HSE Performance		√
General Item	Concession contract	
Signing Authority	LAMATA	
Term	Between 4 and 10 years	
Scope	1 line per Operator	
Fee operator to authority	NA	
Tariffs	Maximum Ceiling	
Other Income	Allowed	
Volume Guarantee	Yes, passenger based	
KPI's	Yes, Service Reliability, Punctuality, Availability, Safety	

Table 11.3 – Detailed Allocation of Responsibilities

11.5 Selection Methods for Private Operators

11.5.1 Direct Contract Award versus Tendering

The concession contract for the ferry operations in Lagos can be awarded either directly to a private operator or via tendering. The differences have been summarised below in Table 11.4:

Issue	Direct Award	Tendering
Market Competition	No market competition is created because the concession is negotiated with only one possible investor.	Market competition is included as request for concession bid is submitted to multiple possible investors. In addition, competition can be included in the tender selection process.
Time Line	Time line can be short because of a direct investor approach. However, contract negotiations can be timely due to possible stale mate situation.	Tender requires several steps which can take some time, but market competition can be used to speed up negotiations.
Cost	Due to short timeline the contract award costs are usually low.	Contract negotiations costs can be high due to long time line.
Value	Deal value and therefore the concession payments to the LAMATA can be low due to lack of competition.	Deal value can be high if transparent and competitive tender procedure is conducted.
Quality	Quality of ferry service negotiated during a direct contract award can be low due to lack of comparison with other candidates / competitors.	Quality of ferry service negotiated during tender process can be high as competition in included and in view of input from consultation rounds during tendering process.

Table 11.4 – Direct Contract Award versus Tendering

Our experience with several tendering procedures indicates that tendering can be timely and somewhat more expensive than direct awards. However, the main advantage of a tendering procedure is that generally more value (i.e. higher concession payments) and better services are provided within the concession contract due to the competition element applied. Hence, use of the tendering method is therefore preferred.

11.5.2 Tendering Procedure

The following main steps in a tendering process can be distinguished in the selection of a preferred private ferry operator (table uses example number of candidates):

Step	Description	# of Candidates
1	Prequalification of potential ferry operators / investors ("Long list")	6
2	Qualification of Bidders	4
3	Tender Procedure with issue of the Bid Package ("one stage or two stages")	4
4	Evaluation of the Bids and Selection of the Best Offer	4
5	Contract Negotiation (or Best And Final Offer – BAFO approach)	2 or 1
6	Contract Award	1

For large projects it is common practice to pre-qualify a (limited) number of potential investors before issuing the tender documents in order to restrict the number of candidates to those who are seriously interested and capable of carrying out the project successfully.

In case of the Lagos ferry operations this can be a relative straight forward exercise. A long list of potential operators should be prepared and an expert could prepare a shortlist of 4 to 6

11.5.3 Concession Bid Package

The bid package generally comprises the following documents

- Invitation to tender
- Instruction to tenderers
- Terms of Reference
- Sample contract with contract conditions
- Tender evaluation process

Invitation to Tender
This is the formal letter from the tendering authority (LAMATA) addressed to the short-listed bidders with an invitation to submit a tender and description of the tender dossier (tender procedures and tender documents).

Instruction to Tenderers
The instructions to tender describe the project background, tender procedures, required bid contents and selection criteria to the bidders in order to submit a valid and valuable proposal. Non compliance with the instructions can lead to rejection of the proposal.

Terms of Reference (ToR)
The Terms of Reference describe in detail the required which need to be provided by the bidders for the project. Bidders may be invited to propose alternative bids / services to improve the envisaged services.

Sample Contract with Contract Conditions
It is very useful to include the draft Contract Conditions for the concession agreement with the selected concessionaire to provide bidders a clear understanding of the contractual arrangements envisaged.

Tender Evaluation Process
The evaluation of the bids is a critical process which should be carried out in an impartial, unprejudiced, transparent and unbiased manner. The tender process should strictly follow the tender procedures and selection criteria as defined in the tender documents.

In particular the proposed scoring system in the evaluation should be carefully implemented and formally recorded in order to reduce the risk of disagreements and disputes. Usually an (internal) tender evaluation report is prepared describing the evaluation process. During this step the number of candidates can be reduced to one or two.

11.5.4 Contract Negotiation and Award

The last step in the tendering process consists of the negotiations with the selected bidder (or bidders) and the subsequent contract award once the negotiations have been conducted successfully. This step can be structured according several ways:

- Negotiations with one candidate
- Negotiations simultaneously with two candidates
- Negotiations simultaneous with one candidate and with the other candidate “waiting” if the first candidate does not sign contract within reasonable time period

As a result of the negotiations the contract will be awarded to the most suitable party with the offer that provides highest value to the project.

11.6 LAMATA Organigram

An adequate organisational structure for LAMATA is required to achieve effective and efficient ferry operations in Lagos under the PPP structure as describe above. An assessment for the LAMATA organigram has been made and has been indicated in Figure 11.1.

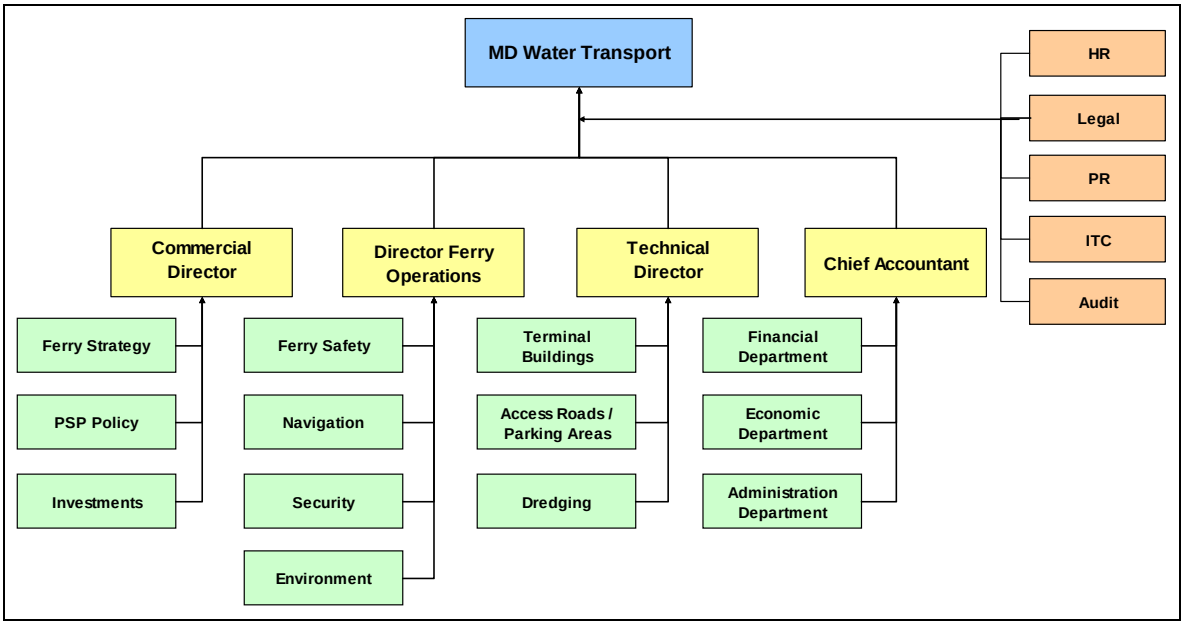


Figure 11.1 – LAMATA Organigram for Water Transport

In this organigram the Water Transport Division of LAMATA comprises the following departments and services:

- Commercial Director responsible for
  - Ferry development strategy
  - Private sector participation
  - Investments by LAMATA

- Director Ferry Operations responsible for
  - Ferry safety
  - Navigation safety (aids to navigation)
  - Security of ferry operations
  - Environmental

- Technical Director responsible for
  - Terminal buildings
  - Access roads and parking areas (Park-and-Ride)
  - Dredging (channels, at terminals)

- Chief Accountant responsible for
    - Financial
    - Economic
    - Administration

In addition, the following staff functions are required for LAMATA:

- Human Resources (HR)
- Legal / contracts
- Public Relations (PR) / Marketing
- ITC
- Audit

The MD Water Transport should have ample experience in managing (public) transport operation systems. He / she has preferable international expertise to develop and maintain proper ferry operations in Lagos. All directors and chief should have a senior development level preferably at university or similar level. The number of staff required for the various department and services is dependent on the number of ferry lines being contracted to the private sector. Management staff should have proven track records in the respective fields.

12 LAGOS STATE FERRY SERVICES – LSFS (TASK 12)

Section 10 above comprises an assessment of the institutional issues relevant for a proper development of ferry services in Lagos by reviewing various agencies and institutions directly or indirectly related to ferry operations. An additional assessment has been made to the present and future role of LSFS once ferry operations have been privatised. The results are reported below.

As reported in Section 10 above, there is, at present, no legislation on this para-statal company as it is being run as an arm of the Ministry of Transportation of Lagos State. Though it is headed by a General Manager, it has no existing Law applicable to it.

This is not surprising because the State Government has no legislative power to pass a law on water transportation. This is a Federal Government matter under the Constitution of Nigeria 1999. If the State of Lagos would pass such a law this law will be inconsistent to the National Inland Waterways Act (a federal legislation); and to that extent such law will be a nullity.

With regard to the regulations and or guidelines applicable to the para-statal LSFS, it is unfortunate that we could not lay hand on a copy; even their General Manager was not in a position to assist the Consultants in this respect.

The final opinion on LSFS is that the Lagos State Government should continue to run it as it is now until the Federal Government delegate authorities on water transportation in Lagos State to it. In this respect, the Consultants have sent the following letter to the Honourable Minister of State for Transportation in Abuja with clear recommendations and request to make the required changes in favour of LAMATA.

[quote]

30th October, 2007

Prince John Okechukwu Emeka,
Honourable Minister of State (2),
Federal Ministry of Transportation,
Bukar Dipcharima House,
Central Area,
P.M.B. 336,
Abuja, FCT.

Dear Sir,

RE: DEVELOPMENT OF FERRY TRANSPORTATION SERVICES IN THE LAGOS METROPOLITAN AREA: AN URGENT NEED FOR FEDERAL GOVERNMENT'S COLLABORATION AND CO-OPERATION

With reference to the meeting held in your office this morning between your goodself and our principal partner Prince A. A. Adeoba in respect of the subject captioned overleaf, we respectfully submit herewith our humble proposal/request in response to your advice. But before we go further, permit us to give a brief introduction of the project that culminated into our visit to your honourable self this morning.

1.01 ***LAGOS URBAN TRANSPORT PROJECT (LUTP)***

At the request of the Lagos State Government, the World Bank signed a loan agreement with the State Government to improve the urban transport sector. In order to facilitate proper execution of the project, the LAGOS METROPOLITAN AREA TRANSPORT AUTHORITY (LAMATA hereafter) was set up by the State Government in 2002 as an Agency saddled with the responsibility to execute the project.

The Agency was set up by the Lagos Metropolitan Area Transport Authority Law No. 1 of 2002 and it came into effect on 13th January, 2002. The Law has since been amended by giving more responsibilities to the Agency with respect to the three aspects of the multi-modal means of transportation, i.e. road, rail and waterways.

The LUTP objective is to sustainably improve and modernize the capacity and modality to manage the transport sector in the Lagos Metropolitan Area and enhance the efficiency of the public transport network, such that it contributes its quota to national growth and development as well as poverty reduction. One of the reasons for the project is the traffic demand and supply situation between the mainland and Lagos Island / Victoria Island/Ikoyi. Close to two million persons per day cross the three bridges connecting the Mainland with Islands. Congestion during rush hours leads to undesirable loss of time which has been calculated to amount to 50 billion Naira per year.

The LUTP targets at the three main transportation modes which are as follows:

(a) Improvement of the public busses transport systems in Lagos, which are mainly privately owned.

(b) The train system has been hardly utilized in recent decades. LAMATA is promoting the introduction of a light rail system, with a branch line connecting with the Apapa ports.

(c) Lastly, but possibly the most promising is the utilization of the existing waterways to revitalize the water transport sector LUTP targets that public/private partnerships should be built and encouraged for a successful introduction within the next few years.

This proposal letter is specifically in respect of water transport component of the project.

*1.02 **ADVANTAGES OF FUNCTIONAL, SAFE, AFFORDABLE AND EFFICIENT WATER OR FERRY TRANSPORTATION SERVICES***

There is no gainsaying the tremendous advantages and huge potentials of a functional, sate, affordable and well managed ferry transportation service to a city like Lagos which is developing rapidly and 22% of whose surface area is occupied by water. We like to record here some of those advantages which are:

(i) It contributes to improving modal diversity within an integrated urban transport system by promoting the enhanced provision and maximal use of the inland waterways.

(ii) *It will focus on a workable development and implementation of a detailed strategic plan for improving the use of the inland waterways of Metropolitan Lagos for transport services, including the establishment of an appropriate regulatory framework.*

(iii) *Privatization of the Lagos State Ferry Services Corporation and / or disposal of existing State owned ferries.*

(iv) *Encouragement of private sector participation (PSP) in the provision of water transport services.*

(v) *Rehabilitation expansion and judicious use of and addition to existing terminal facilities such as the jetties, terminal building and infrastructure.*

(vi) *Reduction of the perennial and frustrating vehicular traffic situation in Lagos Metropolis.*

2.0 ***FEDERAL AGENCIES INVOLVED WITH WATER TRANSPORTATION SERVICES IN LAGOS STATE***

There are presently a couple of Federal Agencies playing one role or the other in the provision of water transport services in Lagos State. These are:

(i) *National Inland Waterways Authority (NIWA). This is the most comprehensive federal agency as it is empowered by law to carry out almost 80% of regulatory functions.*

(ii) *Lagos Mega City Development Authority which is responsible for inter alia, the development of integrated transportation services in both Lagos and Ogun States under the aegis of the Federal Government of Nigeria.*

(iii) *Nigerian Maritime and Safety Authority (NIMASA) which is saddled with responsibilities for ensuring, regulating and prescribing security and safety standards for ships and vessels plying Nigerian territorial water.*

(iv) *Federal Ministry of Solid Minerals. This Ministry is statutorily empowered to issue license and perform other oversight functions connected with the dredging of water ways for all navigable purposes in Nigeria.*

(v) *Nigerian Ports Authority (NPA).*

2.01 ***NATIONAL INLAND WATERWAYS AUTHORITY***

Of all these five Federal Agencies, the one that performs the most relevant and necessary functions in the water transport sub-sector is NIWA. This is so because its enable law (National Inland Waterways Authority Act, Cap N47 Laws of Nigeria 2003) NIWA doubles as both an operator and a regulator in the inland water transportation sub-sector.

Similarly, by section (10) of this Act the rivers and their tributaries, distributaries, creeks, lakes, lagoons and intra-coastal water ways in Nigeria are already declared as Federal navigable waterways Section 11 of the same law specifically prescribed that all navigable waterways, inland waters, river ports and internal waters of Nigeria shall be under the exclusive management direction and control of NIWA.

By the combined provisions of Section 13 (2) and Section 9 of the NIWA Act all States of the Federation are specifically banned and prohibited from all waterways activities including dredging, operation of ferry transportation, development of jetties, granting of licenses to private inland waterways operators, designing of ferry routes and approving designs and construction of inland river crafts or vessels, et cetera.

The simple and direct implication of all these restraining statutory provisions is that the Lagos State Government and LAMATA are now seriously handicapped from implementing all the laudable programmes and plans they have now put in place for the resuscitation, modernization and repositioning of ferry/water transportation as an integral part of the World Bank's assisted Lagos Urban Transport Project (LUTP). To be specific, the State Government has, within the last nine months, spent (and is still spending) billions of Naira on this water transport sub-sector.

Several experts (both local and foreign) have been engaged in the programme. And a feasibility studies dated 12th March, 2007 has been compiled incorporating the reports, expert opinion and advice as well as the modus operandi for the implementation of a 21st century inland water transport system in the Lagos Metropolis. Enclosed herewith is a copy of this Feasibility Studies.

3.0 ***PLANS OF LAMATA FOR THE EXECUTION OF THIS PROJECT***

Your Honourable Sir, LAMATA has indeed gone very far towards the practical implementation of the programme to make ferry transportation a transport model of first choice for all Nigerians and foreigners in Lagos State. No effort and no expense had been spared in this regard. The Agency has, amongst its plans, the following goals and objectives, viz:

(i) *The dredging of at least 1500 nautical kilometres of navigable waterways in the Lagos metropolis. To this end, a Consultant has already been commissioned to carry out a study on the exercise.*

(ii) *The Agency has put in place all the necessary machinery for the building of at least fifty (50) new jetties completed with modern terminal buildings in selected riverine areas of the metropolis.*

(iii) *Public private sector's participation and interest has been seriously awakened and is being consistently sustained. To this end, several stake holders meetings had been held between the Agency and private sector ferry operators in both the formal and informal sectors.*

(iv) *Acquisition of new and very modern ferry boats with air-conditioners and passengers with capacity minimum of 100 passengers by private ferry operators is receiving serious attention.*

(v) *Numerous hydrological and hydro-graphic surveys have been carried out and more are in the pipeline.*

(vi) *The Agency would have wished that it could allocate waterways' channels to ferry operators and regulate their operations but for its limitation under the NIWA Act (supra).*

However, the Agency has several other plans and infrastructures to put in place as part of its programme for an efficient and modern ferry transport service. But its hands are being tied by the statutory limitations imposed by the Federal law.

4.0 ***PROPOSAL FOR A NEW LEGAL FRAMEWORK TO ASSIST LAMATA WITHIN SECTION 28(2) OF NIWA ACT***

Section 28 (2), of the NIWA ACT provides thus:
"Subject to this Act, the Authority may, with the approval of the Minister, also make regulations generally for the regulation of users of navigable waterways and such other regulations as appear to him to be expedient for giving full effect to the provisions of this Act."

Since the objective of the Act corresponds exactly with the functions of LAMATA and is also capable of being enhanced further by the activities and achievements of LAMATA (as previously enumerated), it is our humble submission that this sub-section is capable of solving all the legal challenges put on the ways of the Agency in its implementation of this laudable programme. We therefore, respectfully propose that you take up this matter with the honourable Minister of Transportation so that he can execute an instrument under his hand granting approval for:

(a) Ousting, removing and withdrawing all authorities and control over the operation and regulation of inland water transportation in Lagos State from the purview of NIWA; and

(b) Vest same on LAMATA for and on behalf of the Federal Government of Nigeria.

If this is done for Lagos State, it will go a long way to decongest the perennial and permanent traffic situation in the Lagos Metropolis, which is extremely suffocating and frustrating.

Finally, Sir, we are very gladdened and happy to recall your statement (in the course of our meeting with you this morning) that this present Federal administration will give its full support to any State Government in its effort to make life easier and better for all Nigerians. We therefore respectfully appeal to you to effect this delegation of functions from NIWA to LAMATA.

But if this is not done the direct effect of it is that all the billions of Naira already expended by the World Bank and Lagos State Government as well as all the efforts of all the experts involved in this project since February, 2007 till date will simply go down the drain. Reason is because Lagos State is constitutionally incapable of legislating on water transportation.

While we thank you profoundly in anticipation of our esteemed cooperation, we also look forward to reading from you Sir in the shortest possible time.

Yours faithfully,

GBOYEGA ADEOBA & CO.
Legal Consultant to LAMATA
And Challenge International Associates Ltd

[…]
[unquote]

APPENDIX 2A – REPORT ON SOCIO – ECONOMIC SURVEYS

This Appendix comprises a copy of the socio – economic surveys conducted for this project by Geo-Trans Associates from Lagos, Nigeria.

APPENDIX 5A – SITE MEASUREMENTS MARINA TERMINAL

The site measurements as taken for the existing ferry terminals at Marina and Osborne are included in the Appendix.

APPENDIX 5B – CONCEPTUAL DESIGNS FERRY TERMINALS

This Appendix comprises the layout drawings of the conceptual design as prepared for this project as follows:

- Large Terminal
- Medium Terminal
- Small Terminal

APPENDIX 5C – BOQ AND CAPEX PER FERRY LINE

This Appendix comprises the results for the determination of the Bills of Quantity (BoQ) and Capital Expenditures (CAPEX) – or investment costs – for the LAMATA Ferry Project as follows.

5C.1 – Introduction

Ferry Lines

Two subsequent development phases have been identified for the ferry lines: in the start-up (Phase 1a – refer Figure 5C.1) the following terminals and priority lines will be implemented:

- Marine Main Hub (phase 1a)
- Osborne (phase 1a)
- West Line: Lasu – Satellite Town – Marina
- North Direct Line: Ikorodu – Osborne
- East Line: Ijede – Badore West – Osborne

Figure 5C.1 – Phase 1a Priority Ferry Lines and Terminals

In the subsequent development Phase 1b (refer Figure 5C.2) the following terminals and lines will be implemented:

- Marina Main Hub (phase 1b)
- Central Line: Oke Afa – Festac – Mile 2 – Marina
- Olodi Apapa Line: Olodi Apapa Bridge – Liverpool – Marina
- North Hopper line: Mile 12 – Oworonsoki – IBB – Marina
- Five Cowry Creek Line: Lekki – Falomo Bridge – Marina
- Iddo – Ebute Ero Crossing

Figure 5C.2 – Phase 1b Ferry Lines and Terminals

Bills of Quantities (BoQ)

The BoQ for the ferry lines have been based on typical conceptual designs as prepared for the ferry terminals and as illustrated in the drawings enclosed in Appendix 5A to this report. Further, the results of the various site inspections and assessments made by the Consultants for this Project (refer Section 3) as well as the results of the hydro-graphic surveys (refer Section 6) have been used in estimating the BoQ.

Capital Cost Estimates

The cost estimates (or CAPEX) have been presented based on 2007 price levels prevailing in Nigeria. Unit rates have been derived from Consultants cost database for similar project worldwide. If needed, budget cost information has been collected from the Nigerian market.

Exchange Rates
The following exchange rates have been used in the CAPEX:

- 1 Naira = 0.0058 Euro [or 1 Euro = 171 Naira]
- 1 Naira = 0.0078 US$ [or 1 US$ = 127 Naira]

Results
The results for the BoQ and CAPEX have been presented for each of the above ferry lines and comprise the following sheets

- Overall Summary Sheet
- Ferry Route Sheet
- Terminal Sheets

In addition, the following overall summary sheets have been included:

- Phase 1a
- Phase 1b
- Phase 1a + 1b

5C.2 – Ferry Routes

In the ferry route sheets the following costs items have been included:

1. Mobilisation / Demobilisation Contractor

The mob / demob costs for each of the ferry lines has been estimated at Naira 5 million.

2. Surveys

2.1 – Bathymetric Surveys

Detailed bathymetric surveys at the shallow sections (as selected from the reconnaissance survey completed for this project – refer Section 6 and Appendix 6A) on the ferry routes are required to define actual water depths. These detailed survey results are needed to refine the actual required dredging quantities.

Cross sectional surveys (at every 100m distance) have been adopted with a survey length of 250m each. The unit rate for these surveys has been determined at Naira 600 / m^1 all inclusive (i.e. boat and equipment hire, staff, data processing and reporting).

2.2 – Bottom Sampling

Bottom sampling along the ferry route is required at the shallow sections in the fairway to identify whether and to which extend materials to be dredged are polluted. An overall average unit rate of Naira 1 million per ferry line has been adopted for budgeting purposes.

3. Dredging along the Route

The dredging volumes along the ferry routes (as well as at the ferry terminals – refer below) have been derived from the reconnaissance surveys as carried out for this Project. For the determination of the CAPEX the following unit rates apply:

Type	Naira / m^3	US$ / m^3	Euro / m^3
Sand	1,000	7.9	5.8
Muddy	1,300	10.2	7.6
Polluted	2,000	15.7	11.7

These dredging rates have been based on present market rates for sand mining / dredging in Nigeria. Muddy materials are assumed to be dumped at sea, whilst polluted materials are assumed requiring dedicated and environmentally protected dumping sites (hence the increased rates).

4. Aids to Navigation

Aids to navigation are required to mark shallow areas along the ferry route. In case of open water areas (such as at the Lagos Lagoon) buoys are required, whilst at more narrow sections (such as in the creeks) land based beacons can be used. The number of buoys and beacons along the route has been based on the reconnaissance surveys conducted for this project. The costs for a buoy have been estimated at Naira 1 million; a beacon has been estimated at Naira 500,000.

5. General Costs

General project costs are so-called direct project costs and cover the items such as (1) profit, (2) risk, and (3) general costs. The latter covers the Contractor's provisions at the project site for project staffing such as for the project team leader and staff as well as provisions for the supervising engineer or Clients' representative, etc.

These costs will be part of a Contractor’s bid to a possible tender. Since the level of difficulty for the ferry terminal works for the LAMATA Ferry Project is considered to be “moderate” we have estimated these general costs at a level of 35% of the total CAPEX.

6. Contingencies

Contingencies are also direct project costs and cover provisional sums and variation orders. These contingencies (set at 15%) will not be part of the initial Contractors' bid but may be spent during the project when provisional items need to be purchased and / or variation orders need to be granted. Such contingencies are generally included in the engineers' cost estimates to set required project budgets.

7. LAMATA Tendering and Construction Supervision Costs

Finally, an allowance has been included for the costs incurred for LAMATA for (1) tendering and (2) construction management and supervision. These costs have been estimated at 7% of the total project costs.

5C.3 – Ferry Terminals

Ferry terminals have been classified as “large”, ”medium”, or “small” as follows:

Line	Large	Medium	Small
Phase 1a			
Marina Main Hub		Medium	
Osborne Main Hub	Large		
West Line			Lasu
			Satellite Town
North Direct Line	Ikorodu		
East Line			Ijede
		Badore West	
Phase 1b			
Marina Main Hub	Marina		
Central Line			Oke Afa
		Festac	
		Mile 2	
Olodi Apapa Line		Olodi Apapa	
		Liverpool	
North Hopper Line		Mile 12	
			Oworonsoki
		IBB	
Five Cowry creek Line		Lekki	
		Falomo Bridge	
Iddo – Ebute Ero			Iddo
			Elagbata

In the Ferry Terminal sheets the following cost items have been included:

1. Land Acquisition Costs

A number of the proposed terminal sites are not yet owned by Lagos State (or LAMATA) and may therefore have to be procured from “others”. For this purpose the required land areas for the terminals have been listed under this heading. However, the rate for land acquisition has – at present – been set in these estimates at Naira 0 /m^2 [to be confirmed by LAMATA].

2. Surveys

2.1 – Bathymetric Surveys

The costs for the bathymetric surveys comprise a detailed bathymetric survey at the specific terminal to define the available water depths in front of the proposed facilities. It has been assumed that a 300m survey line would be needed (perpendicular from the shore line) at an average spacing of 25m. The width of the survey area varies per terminal location. For these surveys a rate of Naira 600 / m^1 has been applied (refer above).

2.2 – Topography
A detailed topographic survey is required for each terminal site to define the present contour levels. The results of these surveys are to be used to define levelling and land fill needs, if any. The costs for these surveys have been assessed at Naira 500,000 / piece.

2.3 – Bottom Sampling
Bottom sampling is required to identify whether and to which extend materials to be dredged in front of the ferry terminals are polluted. An overall average unit rate of Naira 1 million per ferry terminal line has been adopted for budgeting purposes.

2.4 – Bore Holes
Finally, bore holes have to be taken at each terminal site to define the specific soil characteristics at the proposed floating terminal facilities (floating pontoon, access bridge) as well as on land (terminal facilities). The unit price for these surveys has been assessed at Naira 3,500,000 per berth location.

3. Dredging
Same as for the ferry routes, the dredging volumes for the terminals have been derived from the reconnaissance surveys as completed for this project (refer Section 6). The same unit rates as for the ferry routes have been applied to determine the costs for dredging (refer above).

4. Floating Pontoon
4.1 – Pontoon
The floating pontoon provides the berthing place for the ferries and facilitates quite embarking / disembarking for the passengers. The floating pontoon has a length of 30m and a beam of 6m (approx. weight is 250 kg/m^2). Unit rate for the steel pontoon has been assessed at Naira 25,000,000 including fendering, mooring bollards, railing, roof, etc.

4.2 – Piles Pontoon
The floating pontoons are moored with 4 steel piles. In shallow water these piles have a length of 12m and in deep water the length is 28m. The costs for these mooring piles have been estimated at Naira 105,000 / m^1.

4.3 – Pile Driving
The costs for driving the mooring piles into the soil have been assessed at about Naira 7,000 / m^1.

5. Access Bridge
5.1 – Bridge
The floating pontoons are connected to the shore by an access bridge having a length of 16m and width of 4m (weight is 100 kg/m^2). The costs for these access bridges amount to 2.7 million Naira based on a steel price of about Naira 430 / kg (or 2.5 Euro / kg).

5.2 – Interim Support Access Bridge
In case more than one access bridges would be required for a pontoon, an interim support of reinforced concrete is required measuring 5.0m x 1.0m x 0.5m. The unit costs for these interim support blocks have been estimated at Naira 135,000 each based on a unit rate of 54,000 Naira / m^2 (including reinforcement).

5.3 – Foundation Piles Interim Support
The interim support is carried by 4 steel piles and a length of 12m (shallow water) or 28m (deep water). The costs for these supporting piles are Naira 33,000 / m^1.

5.4 – Pile Driving
The costs for driving the supporting piles into the soil have been assessed at about Naira 3,500 / m^1.

5.5 – Abutment Access Bridge
The dimensions for the reinforced concrete abutment located at the shore line are 5.0m x 1.5m x 1.0m. The costs for this block are about Naira 400,000 based on a unit rate of 54,000 Naira / m^2 (including reinforcement).

5.6 – Foundation Piles Abutment
The abutment is supported by 4 steel piles having a length of 12m (shallow water) or 28 m (deep water). The costs for these supporting piles are Naira 18,000 / m^1.

5.7 – Pile Driving
The costs for driving the supporting piles into the soil have been assessed at about Naira 3,500 / m^1.

6. Shore Protection
At the location of the pontoons the shore line needs to be protected. For new terminal locations the length of the shore protection has been selected at 45m with a height of 3m. The costs for this protection have been assessed at Naira 2,000 Naira / m^2.

7. Landfill at Terminal
In case landfill at a terminal is required to increase the base level a unit rate of Naira 1,000 / m^3 has been applied. The quantities for the landfill have been derived on Consultants visual inspections and assessments at each terminal site.

8. Terminal Buildings

At each terminal the following building are required:

- Main building
- Security building
- Workshop

8.1 – Main Building

The main building comprises the ticketing office, waiting rooms / areas, shops, offices, etc. The dimensions of these buildings have been selected as follows for a large, medium and small sized terminal:

Type	Large	Medium	Small
Length [m]	60	50	40
Width [m]	10	10	10
Height [m]	4	4	4

Some further characteristics for these buildings are as follows:

Type	Large	Medium	Small
# of Ticketing Stations	11	8	4
# of Seats	260	150	85
# of Offices	4	3	2
# of Shops	2	1	1
# of Shopping Booths	2	1	0
# of Toilets	12	10	5

8.2 – Security Building

The dimensions for the security building are 3.0m x 3.0m x 3.0m.

8.3 – Workshop

The dimensions for the security building are 4.0m x 3.0m x 3.0m.

The unit costs for all these buildings have been assessed at Naira 18,250 / m^3.

9. Parking Areas

9.1 – Area

The size of the parking areas has been determined as follows:

- Number of parking lots: variable per terminal
- Size of parking lot 4.8m x 2.4m
- Allowance for internal roads: 20% extra

The costs for the parking areas have been assessed at Naira 7,500 / m^2.

9.2 – Fencing
Parking areas to be ring fenced with a fence height of 2.5m at Naira 2,000 / m^1.

9.3 – Ticketing Office
The dimensions for the ticketing office are 3.0m x 2.0m x 3.0m. The construction costs amount to Naira 17,000 / m^2.

9.4 – Area Lighting
The complete parking area at each terminal has to be lit. The costs have been assessed at Naira 2,500 / m^2.

10. Stop-and-Go and Drop-and-Go areas
10-1 – Stop-and-Go
Stop-and-go areas are required for the mini-busses calling at the ferry terminals. The dimensions for these areas are based on (1) the number of mini-bus stations (refer table below), (2) the length of the area (number of stations x 4.5m), and (3) the width of the area (assessed at 2 x 6.0m for access road and stations).

Type	Large	Medium	Small
Number [-]	12	8	4

Unit rate for construction amounts to Naira 7,500 / m^2.

10.2 – Drop-and-Go
Drop-and-go areas are needed for taxis and (private) cars dropping of picking up passengers from the ferry terminals. The length of this area as the same as for the stop-and-go areas, whilst the width is 6.0m.

11. Utilities
11.1 – Fresh Water Tank
A fresh water tank is required for each terminal. The size has been estimated at 10 m^3 located at a level of 7m high. The investment costs are Naira 1 million per piece.

11.2 – Sewerage Treatment
The sewerage treatment unit is needed at every terminal; costs have been estimated at Naira 1 million.

11.3 – Water Lines
The length of the water lines to / from the fresh water tank / sewerage treatment unit is dependent of the specifics of the terminals and has been estimated for each terminal separately. The unit costs have been estimated at Naira 150 / m^1.

11.4 – Petrol Tank
A petrol tank is required at every end station and at the Marina Main Hub to re-fuel the ferries: size 30 m^3. The costs amount to Naira 400,000.

11.5 – Diesel Tank
A diesel tank is required at every end station and at the Marina Main Hub to re-fuel the ferries: size 30 m^3. The costs amount to Naira 400,000.

11.6 – Fuel Lines
The length of the fuel lines to / from the petrol and diesel tanks is dependent of the specifics of the terminals and has been estimated for each terminal separately. The unit costs have been estimated at Naira 200 / m^1.

11.7 – Fuel Pump
In case petrol and diesel tanks are present a fuel pump is needed costing Naira 100,000 a piece.

11.8 – Area Lighting
The complete area at each terminal has to be lit. The costs have been assessed at Naira 2,500 / m^2.

11.9 – Generator Set
A generator is required at every terminal to provide redundancy power in case of a power cut. A medium sized generator of 25 kVA has been selected costing some Naira 5 million.

12. Bus Terminus
12.1 – Bus Terminal Area`
A bus terminus for large busses is required at the main hub at Marina, Osborne and at the larger terminals such as at Ikorodu. The dimensions are dependent on the number of large bus positions (dependent on terminal location), a unit length of 4.0m per bus station, and unit width of 20m per bus station (including an allowance for the access roads). The costs for the bus terminus have been selected at Naira 7,500 / m^2.

12.2 – Area Lighting
The complete area for the bus termini has to be lit. The costs have been assessed at Naira 2,500 / m^2.

13. Hinterland Road Access
In some terminal case a new access road to the hinterland is required. The width for such a road has been selected at 6m, whilst the length has been determined on each specific terminal location. The costs for new access roads have been assessed at Naira 21,000 / m^2.

14. Environmental Mitigation Measures

Two possible mitigation costs for this project have been identified as follows:

- Relocation costs for people
- Compensation costs for terminal areas

14.1 – Relocation Costs for People

In some cases people living at or nearby a location for new ferry terminal sites may have to be relocated. The relocation costs have been based on international guidelines for similar projects and amount to Naira 12,700 / people. The number of people to be relocated has been derived from the environmental and social assessment as completed for this project (refer Section 9) and is terminal location dependent.

14.2 – Compensation Costs for Terminal Areas

Further, in some case the development of a new terminal may require specific compensation costs as the environment has been affected. Same as above these costs have been based on international guidelines for similar projects and amount to Naira 1,270 / m^2. The size for these compensation areas has been has been derived from the environmental and social assessment as completed for this project (refer Section 9) and is terminal location dependent.

15. General Costs

The general project costs for the contractor have been estimated at 35% of the total CAPEX of the above items (refer above).

16. Contingencies

An allowance of 15% of the total CAPEX has been included for project contingencies (refer above).

17. LAMATA Tendering and Construction Supervision Costs

Finally, an allowance has been included for the costs incurred for LAMATA for (1) tendering and (2) construction management and supervision. These costs have been estimated at 7% of the total project costs.

APPENDIX 6A – HYDROGRAPHIC SURVEY REPORT

This Appendix comprises a copy of the hydro-graphic survey report as completed for this project as follows:

- Hydro-graphic Survey Report – May 2007

The detailed results of the surveys are included in a separate volume (A3 format) entitled “LAMATA Bathymetric Survey of Ferry Services Routes – Dates of Survey: 25th March – 30th March 2007 / Chart Ref No LAMATA Sht 1 of 80.mxd”

APPENDIX 8A – RESULTS FINANCIAL ANALYSES

This Appendix comprises the results of the financial analysis for the East Line as follows:

- Cash Flow Statement
- Profit and Loss Account

- Cash Flow Statement

Cash flow statement								
		year	2008	2009	2010	2011	2012	2013
Revenues from ticket sales	Naira per year	4,364,896,618	**-**	**315,696,416**	**620,612,628**	**896,378,083**	**1,133,900,683**	**1,398,308,808**
Additional revenues (10%)	Naira per year	436,489,662	**-**	**31,569,642**	**62,061,263**	**89,637,808**	**113,390,068**	**139,830,881**
Labour Cost on terminals	Naira per year		-	(2,427,192)	(2,427,192)	(2,427,192)	(2,427,192)	(2,427,192)
Insurance Cost	Naira per year		-	(4,923,750)	(9,847,500)	(14,771,250)	(17,725,500)	(22,649,250)
Maintenance Cost	Naira per year		-	(32,825,000)	(65,650,000)	(98,475,000)	(118,170,000)	(150,995,000)
Labour Cost on vessels	Naira per year		-	(20,760,902)	(41,521,805)	(62,282,707)	(74,739,248)	(95,500,150)
Overhead Cost	Naira per year		-	(4,152,180)	(8,304,361)	(12,456,541)	(14,947,850)	(19,100,030)
Fuel Cost	Naira per year	(2,347,612,033)	-	(179,076,350)	(332,390,794)	(485,705,238)	(598,562,604)	(751,877,047)
Lease fee for fleet of vessels	Naira per year		-	-	-	-	-	-
Total opex		(3,249,546,018)	**-**	**(244,165,375)**	**(460,141,652)**	**(676,117,928)**	**(826,572,393)**	**(1,042,548,670)**
Concession fees	Naira per year		**-**	**(5,208,991)**	**(10,240,108)**	**(14,790,238)**	**(18,709,361)**	**(23,072,095)**
Operational cash flow	Naira per year		**-**	**97,891,692**	**212,292,131**	**295,107,725**	**402,008,997**	**472,518,924**
Taxes	Naira per year		-	(16,565,757)	(47,783,927)	(69,760,521)	(101,154,502)	(119,774,180)
Pre investment pre finance post tax cash flow	Naira per year		**-**	**81,325,934**	**164,508,204**	**225,347,205**	**300,854,495**	**352,744,744**
Investments	Naira per year	(1,509,950,000)	(328,250,000)	(328,250,000)	(328,250,000)	(196,950,000)	(328,250,000)	-
Residual value	Naira per year		-	-	-	-	-	1,292,373,488
Pre finance post tax cash flow	Naira per year		**(328,250,000)**	**(246,924,066)**	**(163,741,796)**	**28,397,205**	**(27,395,505)**	**1,645,118,232**
Pre finance pre tax cash flow	Naira per year		**(328,250,000)**	**(230,358,308)**	**(115,957,869)**	**98,157,725**	**73,758,997**	**1,764,892,412**
Cumulative cash flow	Naira		**(328,250,000)**	**(575,174,066)**	**(738,915,862)**	**(710,518,657)**	**(737,914,162)**	**907,204,069**

- Profit and Loss Account

Profit & Loss								
		year	2008	2009	2010	2011	2012	2013
Revenues from ticket sales	Naira per year		-	315,696,416	620,612,628	896,378,083	1,133,900,683	1,398,308,808
Additional revenues (10%)	Naira per year		-	31,569,642	62,061,263	89,637,808	113,390,068	139,830,881
Total opex	Naira per year		-	(244,165,375)	(460,141,652)	(676,117,928)	(826,572,393)	(1,042,548,670)
Concession fees	Naira per year		-	(5,208,991)	(10,240,108)	(14,790,238)	(18,709,361)	(23,072,095)
EBITDA	Naira per year		**-**	**97,891,692**	**212,292,131**	**295,107,725**	**402,008,997**	**472,518,924**
Depreciation	Naira per year		-	(16,412,500)	(32,004,375)	(46,816,656)	(54,323,323)	(68,019,657)
EBIT	Naira per year		**-**	**81,479,192**	**180,287,756**	**248,291,069**	**347,685,673**	**404,499,266**
Interest	Naira per year		-	(26,260,000)	(21,008,000)	(15,756,000)	(10,504,000)	(5,252,000)
EBT	Naira per year		**-**	**55,219,192**	**159,279,756**	**232,535,069**	**337,181,673**	**399,247,266**
Taxes	Naira per year		-	(16,565,757)	(47,783,927)	(69,760,521)	(101,154,502)	(119,774,180)
Net earnings	Naira per year		**-**	**38,653,434**	**111,495,829**	**162,774,548**	**236,027,171**	**279,473,086**