

Draft Final Report

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Prepared by:

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Liberia Multimodal Transport Master Plan

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Terms, Abbreviations and Acronyms

AfDB	African Development Bank
AfT	Agenda for Transformation
AOC	Air Operator's Certificate
APMT	AP Moller Terminals
ATC/ANS	Air Traffic Control/Air Navigation Service
ATM	Air Traffic Movement
BADEA	Arab Bank for Economic Development in Africa
BCA	Renefit-rost assessment
BDT	Bus Danid Transit
	Contral Business District
CBL	
CdL	
CNS	Comunication Navigation & Surveillance
	Communication, Navigation & Sulvenance
	Department for international Development (or the OK)
	Disportion Trade Integration Study Undate
	Diagnostic frade integration study opdate
DVUR	Doppier Vir Onni-Directional Kange
	Deadweight tofnage
ECOWAS	Economic Community of West Annua
ESKP	
EDM	European onion
FPIVI	Freeport of Monrovia
FRAIVIP	Feeder Roads Alternative & Maintenance Program
	reasibility study
FSDIM	Four-step demand model
	FOOT/Feet
GAIRS	Generally Accepted International Rules and Standards (INIO)
GDP	Gross Domestic Product
GIS	Geographic information System
GIZ	German society for international Cooperation
GOL	Government of Liberia
na	Hectare
	ngnway Development and Management System
HOC	the nousehold mome and expenditure survey
	neau-qualiers
	International Davidom of granization (of the World Pank)
	Industrial Davidopment Policy
	Infrastructure Implement Folicy
	International Monetary Fund
	International Maritime Organization
	Initial water ways
ka	Kilogram
km	Kilometre
	Liberia Airport Authority
	Liberia Civil Aviation Authority
	Liberia Domestic Airport Authority
	Libera Domestica Angori Additionty
	Liberia Institute of Statistics & Geo-Information Services
IMA	Liberia Maritime Authority
IMMTMP	Liberia Multi-Modal Transport Master Plan
INTA	Liberia National Trade Policy
LRA	Liberia Revenue Authority
IRT	Light Bail Transit
LRTF	Liberian Reconstruction Trust Fund
MCA	Multi-criterion analysis
MCC	Millennium Challenge Corporation
MCC	Monrovia City Corporation
MDA	Mineral Development Agreement
MFDP	Ministry of Finance & Development Planning
MLW	Spriggs Payne Airport

MMTMP	Multi-Modal Transport Master Plan (this document)
MOA	Ministry of Agriculture
MOCI	Ministry of Commerce & Industry
MOT	Ministry of Transport
MPW	Ministry of Public Works
Mt	Million tons
Mtpa	Million tons per annum
NBC	National Bureau of Concessions
NES	National Export Strategy
NMT	Non-motorised transport
NGO	Non-Government Organization
NPA	National Port Authority of Liberia
NTA	National Transit Authority
NTMP	National Transport Master Plan (2010/12)
NTPS	National Transport Policy & Strategy (2009)
OD	Origin-Destination
OFID	OPEC Fund for International Development
OPRC	Output and Performance-based Road Contract
рах	Passenger/s
PDU	President's Delivery Unit
PIDA	Programme for Infrastructure Development in Africa
PPCC	Public Procurement and Concessions Commission
PPP	Public-Private Partnership
PRS	Poverty Reduction Strategy
RA	Roads Agency
RED	Roads Economic Decision Model
RF	Road Fund
RFP	Request for Proposals
RIA or ROB	Roberts International Airport
SARPs	Standards and Recommended Practices (ICAO)
SIDA	Swedish International Development Cooperation Agency
SIP	Strategic Investment Plan
SOE	State-Owned Enterprise
SSS	Short-Sea Shipping
t	Ton (1,000kg)
tkm	Ton-kilometer
TAH7	Trans-Africa Highway No. 7
TEU	Twenty Foot Equivalent (container)
TOR	Terms of Reference
tpa	Tons per annum
TPA	Third-party access
TSG	Technical Support Group (of the IIU)
UNDP	United Nations Development Program
UNMIL	United Nations Mission in Liberia
USAID	United States Agency for International Development
USD	United States Dollars
VOC	Vehicle Operating Cost
VOT	Value of Time
WMO	World Meteorological Organization

1. Executive Summary

[Update: To be drafted in Final Report]

2. Introduction & Methodology Used in Preparing the Plan

2.1 Purpose

The objective of this report is to "articulate a transport strategy to provide for sustainable economic growth of the country, and prepare an economically sound multimodal transport plan and financially viable Strategic Investment Program and, expressed in a timely phased manner that embraces all modes and improves regional integration."¹ The Terms of Reference (TOR) points out that the plan should not just collect strategies for each transport mode, and for rural and urban service, developed separately and independent of each other, but seek to create synergy and optimization through integrated planning of the different modes and geographic tiers.

The plan has a ten-year timeframe, i.e. 2017 to 2027. However, in some areas it is appropriate to look beyond that horizon to ensure that no large-scale or paradigmatic events lie ahead which should already be prepared for.

2.2 Qualifications

The plan is primarily a national transport infrastructure plan with accompanying strategic investment plan. The main focus is therefore on the physical investments required from a national perspective. Although the plan touches on and in places makes findings on these, it does not aim to develop the following matters in detail:

- Transportation services. The plan takes a position on the types of services and vehicles involved in transport of goods and people to ensure that these can be appropriately handled by the transport infrastructure.
- Non-national, urban transport infrastructure and services. The plan is national in nature. It addresses the cases of national transport infrastructure transecting or interacting by the urban network, but it does not attempt to solve sub-national urban issues.
- Transport policy and legal framework. Because of its national infrastructure focus, although the plan comments on the institutional arrangements in the sector, it does not purport to be a comprehensive, wall-to-wall transport policy.
- Maintenance. The ultimate output is a "strategic investment" program, i.e. interventions that change the shape and operation of the transport system by adding new links and nodes, increasing capacity on the existing system and reinstating condition. This definition includes heavy maintenance interventions that aim to restore assets to their design standards and capacity – which are included in this plan.

2.3 Approach

The approach followed in developing the plan is also the sequence of reporting in this document.

The plan is founded in understanding the country and its development objectives and strategies (chapter 3). Liberia has emerged from turbulent events but in some respects not quite recovered its economic momentum. It remains particularly dependent on imports of consumer commodities, the balance of payments for which must be made up from the export of a few natural commodities. Both the population and the economy are highly concentrated around the capital, implying that routes in and to it have also been the magnet for transport investment in recent years.

Chapter 4 considers how well the sector role players can respond to the national development requirements. It records that, on the face of it, the transport sector appears to be by-and-large organized according to generally-accepted international norms in terms of policy makers, safety regulators and infrastructure agencies. However, it is also found that there remain some serious challenges related to policy-making capacity, conflicts of interest, governance shortcomings and non-compliance with

¹ Terms of Reference for Liberia Multimodal Transport Master Plan, Strategic Investment Program and Associated Action Plan, August 2016

international commitments. It is not the purpose of this master plan to re-design the sector institutionally, only to review it. However, given that many decisions on sector reform are being made on a day-by-day basis presently, the longer horizon of this document does provide an opportunity to sketch a future vision for the sector and therefore give direction to sector reform decisions today.

The report next turns to the quite practical matter of how much, which and from where to where goods and people must be moved (chapter 5). As noted above, much of this is to/from and even within Monrovia. But the development agenda also requires other areas to be opened up by transport (pertinently the north-west and south-east). However, except for the export of some natural commodities, the transport volumes to these areas will likely remain quite modest.

Chapter 6 presents the motivation for and results of how the different intervention programs are formulated. It is at this point that the specific requirements of the TOR to look beyond mode-based, and geographic confined solutions are addressed. The transport system is deconstructed to its essential functionalities: to connect the country with the world, to link it with its neighbors, to have a strong national transport backbone onto which more specific and localized solutions can be attached. Each functional layer program is in general dominated by one transport mode (because the various modes' efficiency differs for distance traveled, commodity type and volume moved), but especially the roads mode appears in many of the layers.

The programs are unpacked and motivated, each major one in a separate chapter, from the highest level international connectivity program (chapter 7) through to the local access program (chapter 10). This report does not list and detail each individual project making up the programs. Rather, this is done in the accompanying Strategic Investment Plan (SIP) which is a spreadsheet that allows projects to be inserted/deleted, modified (e.g. dependencies on other projects, timing, cost, etc.), and prioritized.

Chapter 11 deals with the prioritization "rules". It makes the distinction between "priority" (how important the project is), "readiness" (whether the project is sufficiently prepared to be executed, notwithstanding its priority), and "constraints" (factors which may delay a project, notwithstanding its priority or readiness – of which the most important is the available budget for the transport sector). Also, to redress the situation of economic activity and traffic naturally concentrating in some areas, this plan does not only consider "economic" justification of investments, but promotes contiguity in the transport system, the linking up of administratively important and strategic locations, and the weighting of underserved areas to achieve more regional equity.

The results of the prioritization and constraining process are presented in chapter **Error! Reference source not found.**

The last chapter (13) provides some brief pointers on responsibilities for executing the investments and oversight required by the Ministry/ies to implement the Strategic Investment Plan. The required oversight capacity must especially be established at the MOT. It is also proposed that multi-agency task teams be set up to coordinate some of the more complicated multi-modal programs proposed in this document.

3. Macro-Economic and Policy Context

This chapter briefly describes the backdrop to the Transport Master Plan, i.e. the people and the economy that the transport system must serve and which must be improved and managed to support the country's development.

3.1 Overview of Country & Economy

3.1.1 Population

The last comprehensive, country-wide, district-level population census was conducted in 2008.² In 2013, there was a Demographic and Health Survey which includes data on employment and occupation.³ In 2014 (i.e. just before the Ebola outbreak), the Household Income and Expenditure Survey (HIES) was carried out.⁴

The HIES simply extrapolated the 2008 population at an annual growth rate of 2%, leaving the 2008 population shares per county intact. By this estimate, the national population was just above 4 million people (4,001,855), comprising an estimated 938,383 households with a mean household size of 4.26. Some 40% of the population was urbanized, i.e. living in a locality with a population of 2,000 or more. The relative distribution of the population is shown in Figure 3-1. Approximately a third of Liberians live in Montserrado county, after which the largest region by population are the North Central (around Nimba) and South Central (around Bassa) regions.



Figure 3-1: Population Density (persons/km²)

Source: LISGIS

² LISGIS: "2008 Population and Housing Census - Final Results", May 2009

 $^{^3}$ LISGIS & Others: "Demographic and Health Survey, 2013", August 2014

⁴ LISDIS: "Household Income and Expenditure Survey 2014 - Statistical Abstract", March 2016

Some pertinent population metrics are:

- > The population is very young, with about half being less than 18 years old
- > The national literacy rate is estimated to be 67%, i.e. just over two thirds of Liberians are able to read and write (but 80% of males vs. 55% of females)
- > Even though unemployment is low at around 3%, informal employment (employment in the informal sector altogether or in a formal business yet under informal circumstances) is around 68%, and vulnerable employment (considering the risk an employee faces of running into financial trouble despite being employed) is about 74%
- > Around 45% of Liberian wage employees receive a monthly salary between 6,000 and 15,000 Liberian Dollars (i.e. about USD 60-150 per month)
- > The poverty figure (i.e. the point at which individuals cannot meet their food and non-food minimum needs) is 54% (70 for rural and 43% for urban areas). This implies that more than 2.1 million Liberians are living in poverty
- Nationally, 65% of total spending is on food, including the equivalent market value of home production, and 35% on non-food, including estimated rent for those that own their homes and the estimated use value of household assets
- > Just over 20% of food consumption is from home-production. Of all food items, rice comprises the largest single share (23%)
- > Of non-food spending, 12% went towards education, and 3% each towards health and housing

In terms of living conditions:

- > The majority of dwellings' walls in Liberia are made of mud and sticks (41%), followed by concrete and cement blocks (25%) and mud bricks (22%). Most roofs are of sheets of zinc, iron or tin
- > Electricity is supplied to 7.5% of urban but no rural households. Approximately 14% of urban households obtain electricity from generators, but only some 3% in rural areas
- > For drinking water, Indoor pumps or pipes are a rare and nearly exclusively urban phenomenon, supplying 6% of urban households and hardly any in rural areas. Rivers, lakes, or creeks are the single largest source of drinking water in rural areas.

3.1.2 Economic Activity

3.1.2.1 Gross Domestic Product

The size of the national economy measured in terms of GDP was about USD 900 million in 2015. Figure 3-2 shows that GDP growth after the civil war was strong, but dropped sharply in 2014 due to the Ebola epidemic and fall in international commodity prices. Whereas post-war growth had averaged about 7%/annum, in 2014 it slowed to less than 1%. And the Central Bank has reported that real GDP actually contracted by 0.5% in 2016.⁵

The International Monetary Fund (IMF) predicts growth rates to increase back to the 6% range in the medium term, averaging about 5% over the next five years.⁶ Such growth is anticipated to come from the recovery in commodity markets and increased export diversification. However, major constraints remain the domestic skills base, lack of electricity supply and poor infrastructure.⁷ This (5% average annual growth) is then also the figure applied to the baseline demand forecast for the duration of the MMTMP timeframe.

⁵ CBL Financial & Economic Bulletin, Volume 17 No. 4 October - December, 2016, p.4

⁶ IMF, World Economic Outlook Database, October 2016

⁷ IMF Country Report No. 16/239, July 2016



Figure 3-2: GDP Development (current GDP, real GDP growth)

Sources: GDP Actual from World Bank World Development Indicators; GDP Projection from IMF World Economic Outlook Database (October 2016)

3.1.2.2 GDP per Capita

One way of demonstrating the relative size of the economy is to standardize GDP as a value per head of the population. This measure does not take into account how income is actually distributed, so really is no more than a short-hand way of comparing economies. Figure 3-3 shows how this metric compared in recent years between Liberia and countries in its region. Economic activity in Liberia is at a similar level to Guinea and Sierra Leone, but quite substantially lower than Côte d'Ivoire and Ghana. Before the war (pre-1988), the Liberian GDP per capita was in excess of 50% higher than that of Ghana. This provides a rough indication of the latent economic potential of the country.



Figure 3-3: Comparative GDP per Capita

Source: IMF World Economic Outlook Database

3.1.2.3 Structure of the Economy

Figure 3-4 shows the sectoral contributions to local economic value addition (GVA) for the five major sectors of the economy in the recent past. The economy is dominated by services (47%), the main contributors which are Trade & Hotels (32% of services) and Government Services (15%). Agriculture and Forestry make up a third of the economy, but employ nearly half of the formal labor force and engage more than two thirds of rural households. The main agricultural outputs are rubber, commercial crops (cocoa and coffee) and food commodities (cassava, rice, palm oil). The forestry sector is made up largely of charcoal and wood products (92%), with a further contribution by logs and timber (8%). The Mining and Petroleum sector contributes a tenth to GVA. It is primarily driven by contribution from iron ore, gold, diamonds and oil exploration. Manufacturing represents less than a tenth of GVA. It is dominated by the cement and beverages industries. Other local manufactures include paint, candles, Clorox, rubbing alcohol and mattresses.



Figure 3-4: Sectoral Contribution (value)

Source: MFDP Annual Economic Review, 2015

3.1.2.4 Trade

Liberia's imports and exports were roughly in balance until 2005. Since then, imports (including essential food commodities such as rice, as well as machinery and fuel) have sharply increased from about US \$ 250 million in 2005 to almost US \$ 1.5 billion in 2008, while exports have been stagnating. As a result, Liberia's trade deficit has widened, reaching about US \$ 1.25 billion in 2008.⁸

Major Exports

Liberia's trade is highly concentrated on a limited range of products. Unprocessed or semi-processed commodities have traditionally comprised Liberia's primary exports. These include rubber, wood (timber), iron ore, and diamonds. Exports in the rubber sector have been rising since 2001 and they currently account for more than three-quarters of Liberian exports. The wood sector has traditionally also been a very significant share of exports, although its share has been declining in recent years. Liberia has also increased exports of cocoa beans in recent years.⁹ Increased concessions-based activity in the mining and oil sectors, coupled with higher demand and prices in international markets may support export performance going forward.

⁸ MoCI: "National Export Strategy 2014-2018"

⁹ MoCI: "National Export Strategy 2014-2018"

Major Imports

Liberia relies on imports for fuel, processed goods and consumer products. Major imported goods include petroleum products, machinery and transport equipment (including cars), foodstuffs (including rice, frozen products and meat), miscellaneous manufactures, chemicals and related products, and cement (bagged cement and clinker).

3.1.2.5 Comment on Informal Cross-Border Trade

The demand (and traffic) projection relies heavily on official record-keeping of production, consumption, import and export activity. Although there are data gaps and inconsistencies, that profile can be reassembled fairly adequately.

However, there is an active cross-border trade between Liberia and Sierra Leone, Guinea and Cote d'Ivoire which happens largely "under the radar" of formal statistics. This includes products such as rice (from Lofa to Sierra Leone), palm oil (from Sierra Leone and Liberia to Guinea), gari (processed cassava) (from Sierra Leone to Liberia and Guinea), and possibly even coffee and cocoa (exported from Cote d'Ivoire via Liberia). These movements would be both via formal border posts but also informal (uncontrolled) border crossings. Some anecdotal numbers of product flow are available, but are volatile in that they depend on local supply conditions and seasons.¹⁰ At the level of detail that the MMTMP demand is developed, some guestimates of these volumes will have to suffice.

3.1.2.6 Production & Trade Volumes

To estimate the requirements on the transport system the level of economic activity needs to be converted into volumes of goods moving around. The relative contributions of the different sectors in monetary terms contribute to understanding the dynamics of the economy, but since unit rates are so vastly different (e.g. compare a ton of iron ore with a ton of consumer goods), the values of goods are not particularly useful as an indicator of the actual physical units produced and traded and which must be accommodated in the transport system.

Presently, there is no mechanism in place that tracks the movement of goods (or even traffic) over the national transport system. There are periodic, *ad hoc* surveys conducted in very short timeframes (typically a day or two and sometimes a week at a time). Care must therefore be taken to scale such intermittent and small surveys to a reference production/trade profile over a longer period of time.

Four data sources were identified that each present data for various commodities produced and transported. These are wide-reaching enough to make possible some "triangulation" (cross-correlation) and therefore ensure that data is used for which there is some consensus (i.e. ensuring that outlier data is not used). Table 3-1 shows the main attributes of the four sources. The sources sometimes report both or either of "production" (i.e. locally produced) and/or "trade" (imports and exports), and sometimes report volume ("t") and/or amount ("\$").

Source	Document	Freeseware	Lost	Production		Trade	
Source	Document Frequency		LdSL	t?	\$?	t?	\$?
Central Bank of Liberia (CBL)	Financial & Economic Bulletin	Quarterly	Q4 2016	Major goods	-	Major exports	Major exports & imports, and total
Ministry of Commerce & Industry (MoCl)	Annual Trade Bulletin	Annual	2015	Major goods	-	Major exports & imports	Major exports & imports
National Ports Authority (NPA)	Annual Report	Annual	2015	-	-	Exports & Imports	-
Liberia Extractive Industries Transparency Initiative (LEITI)	Annual Report	Annual	2015	Selected companies	Selected companies	Selected companies	Selected companies

Table 3-1: Sources of Production & Trade Statistics

 $^{^{10}}$ WFP: "Cross-border trade and food security – Liberia & Sierra Leone", May 2010

Note: Data was not available from the Liberia Revenue Authority (LRA)

For some sectors and commodities, these sources provide quite similar values and volumes, but for some, the discrepancies are quite considerable.

The main data sources were complemented by sector and commodity-specific strategies, such as the various export strategies developed by MOCI, and the agricultural commodity data obtain from the MOA and FAO. The data from LEITI could often be cross-correlated with records of the National Bureau of Concessions.

3.1.3 Economic & Development Policies

The future demand for transport infrastructure and services will change as the shape and size of the economy evolve. It is therefore useful to recognize what objectives Government has set and which initiatives it has put in place to stimulate and direction economic growth and development. There are broadly three categories of policy: those formulated after the civil war policies that set out the broad direction of national development, policies aimed at reshaping the structure of the economy, and more recent policies focusing on reforming and growing specific sectors and products. Those policies that are most likely to have a direct impact on future demand and traffic are briefly reviewed below.

3.1.3.1 National Development Framework

Poverty Reduction Strategy (PRS) (2008)¹¹

The first policy instrument of the post-transitional government elected in 2005 was the First 150-day Action Plan. That was succeeded by the Interim Poverty Reduction Strategy (IPRS) which covered the period 2006 to mid-2008. The IPRS was later transformed into the Poverty Reduction Strategy (PRS) which laid out the Government's blueprint for the development and growth of the country for the period 2008-2011.

The objective of the PRS was to improve the social and economic conditions of the population of Liberia. Its strategies were built around four complementary pillars, i.e. consolidating peace and security, revitalizing the economy, strengthening governance and the rule of law, and rehabilitating infrastructure and delivering basic services.

The economic revitalization pillar focused on the establishment of a strong economy, with robust employment growth, widespread economic opportunities and a vibrant private sector as a partner to the Government's development efforts. The PRS emphasized the role of industrialization in development, acknowledging that the emergence of a dynamic manufacturing sector has typically marked a country's transition from low to intermediate income levels.

The PRS underscored that:

- > The Government had to act to reduce production costs so as to encourage diversification of the economy over the medium-to-long term towards the competitive production of labor-intensive downstream products, manufactured goods, and services
- > Liberia's comparative advantage lay in agro-based industries, in particular, agro-processing, horticulture, furniture and other down-stream wood products, and downstream rubber products
- Sustained growth had to be built on producing goods for export. The resulting competition with other countries' manufacturers would ensure efficiency and provide access to new technologies that would result in productivity growth
- > The potential of exporting to the West African region, Europe, the United States and other large markets in a range of products had to be better utilized.

¹¹ Republic of Liberia: "Poverty Reduction Strategy Paper, July 2008"

Vision 2030 (2012)12

Vision 2030 acknowledges that many gains were made under the PRS, however, there was still a need to integrate development policies in a holistic development framework in the form of a national visioning exercise with accompanying national development strategy.

Vision 2030 identified four possible pathways for the country, depending largely on the nature of the State and the nature of the economy:

- > The "Thank God Oh" scenario foresees a country in 2030 with some economic and infrastructural changes but those changes are not significant enough to bring about necessary structural changes to transform the society. There is no catastrophe, but also no real development.
- > The "It's not for fun a Tall Order" scenario foresees large-scale structural changes in the economy, lead by a reformed and capable "developmental" state. The country is not yet fully transformed, but has taken bold steps in that direction.
- > The "Ain't that bad" scenario assumes a country in 2030 in quest of a "fairer deal" where there is significant improvement in governance without any significant economic transformation and the economy remaining dominated by resources.
- > Under the "Everything chakla oh" scenario the State remains authoritarian and unreformed, and the economy highly reliant on natural resources. The state remains weak and cannot provide the political, economic and social goods. This scenario gives rise to the potentially-catastrophic situation of another civil war.

The desired scenario is clearly that of the developmental State (scenario 2). And this gives rise to a vision of:

- > A United People with core aspirations of political stability based in equity, a society that embraces its triple heritage and guarantees space for all positive cultures to thrive, a society that is democratic, tolerant, respectful of the rule of law and human rights, and a society of gender equity, empowerment and opportunities for all
- > A Progressive Nation which is self-reliant and innovative, a competitive private sector-led economy with strong indigenous presence, people-focused investment policies, a nation that embraces science and technology as avenue to modernization, agriculture for food self-sufficiency and security, and a population that is healthy, well and relevantly-educated with improved quality of life.

Agenda for Transformation (AfT)¹³ (2013)

The Agenda for Transformation (AfT) was the Government of Liberia's five-year development strategy. It followed the three-year (2008-2011) Poverty Reduction Strategy (PRS), which transitioned the country from post-conflict emergency reconstruction to economic recovery, and it was a first step toward achieving the goals of Vision 2030, i.e. middle-income status by 2030.

The AfT had four main goals:

- > Creating an atmosphere of peaceful co-existence based on reconciliation and conflict resolution, and provide security, access to justice, and rule of law to all.
- > Transforming the economy so that it meets the demands of Liberians through development of the domestic private sector—using resources leveraged from foreign direct investment in mining and plantations; providing employment for a youthful population; investing in infrastructure for economic growth; addressing fiscal and monetary issues for macroeconomic stability; and improving agriculture and forestry to expand the economy for rural participation and food security.
- Improving quality of life by investing in more accessible and higher quality education; affordable and accessible quality healthcare; social protection for vulnerable citizens; and expanded access to healthy and environmentally-friendly water and sanitation services.

¹² Republic of Liberia: "Liberia National Vision 2030", November 2012

¹³ Republic of Liberia: "Agenda for Transformation – Steps Towards Liberia Rising 2030", 2013

In partnership with citizens, create transparent, accountable and responsive public institutions that contribute to economic and social development as well as inclusive and participatory governance systems.

In terms of spending, the emphasis of the AfT was to address the huge infrastructure gaps. Government, however, recognized that investing in infrastructure alone will not result in the achievement of inclusive growth. The GoL therefore intended to improve upon the regulatory environment for the business sector in order to improve upon domestic private sector participation in the economy.

Economic Stabilization and Recovery Plan (2015)¹⁴

The primary aim of the ESRP was to set out the actions required to respond to the Ebola epidemic, i.e. to stabilize the economy and place Liberia on a path to inclusive growth. The ESRP was therefore is intended to highlight investments that have the greatest potential of bringing about economic stabilization and recovery in the shortest time possible, creating jobs, and improving lives. This would be done in three areas:

- > Programs to respond to and mitigate the effects of the Ebola crisis (the main focus of the ESRP)
- Completing previously-agreed and ongoing programs within the pre-Ebola development agenda, with priorities in the infrastructure/energy, agriculture/private sector development, health, education and social development (children and youth) sectors
- > Financing the remaining infrastructure projects which are critical to Liberia's inclusive growth, including the Gbarnga-Medicorma and Ganta-Fishtown road corridors.

Three strategic intervention areas were identified to focus the efforts of Government and development partners:

- Recovering output and growth, with the aim of revitalizing growth to pre-crisis levels whilst ensuring that it is more inclusive and creates decent jobs, through stimulating private sector growth in value chains sectors that are labor-intensive and have most potential for export (e.g. rubber, oil palm, cocoa, fish, and cassava)
- Strengthening resilience and reducing vulnerability, via health, education, social and security investments
- Strengthening public finances and ensuring service delivery, including the de-concentration of public service delivery across Liberia's 15 counties.

3.1.3.2 Policies on Economic Reform

Industrial Development Policy (2011)¹⁵

The Industrial Development Policy (IDP) is the Government's framework for accelerating the development of a thriving and competitive industrial sector in Liberia. Growth of Liberia's economy has historically been driven by extractive industries with minimal linkage to the wider economy, resulting in "growth without development". Although these resources were extracted and exported without local processing or value-addition, Liberia has exceptional capacity for growth (particularly in the agro-based industries) as current production levels are far below Liberia's proven capacity in the past.

For Liberia's future, and its goal of becoming a middle-income country by 2030, the Government recognizes that Liberia needs to diversify the economy and improve the industrial sector so as to maximize utilization of the country's productive capacities and her comparative advantages. The aim of this policy is therefore to provide a focused, clear set of priority actions for Government in relation to this goal.

The Government recognizes that the private sector faces many challenges in Liberia. Therefore, it sees its primary role as creating a strong enabling environment for investment and private sector growth,

 $^{^{14}}$ Republic of Liberia: "The Economic Stabilization and Recovery Plan, April 2015"

¹⁵ Ministry of Commerce and Industry: "Industry for Liberia's Future" (Industrial Policy), November 2011

while focusing on services and issues that the private sector or individuals cannot provide or overcome themselves, and are barriers to industrial growth. It has therefore identified three key policy levers that will help Liberia achieve its goal of industrial transformation, i.e. legal and regulatory reforms, infrastructure development, and investment in human capital. These will be supported by measures in the form of specific sector support, providing fiscal incentives to industries, creating physical areas like SEZs that agglomerate industries to crowd-in investment and maximize potential synergies between the activities of those industries, and protecting domestic industries.

Diagnostic Trade Integration Study Update (DTIS-U), 2013¹⁶

The initial DTIS was carried out in 2008, designed together and intentionally similar to the PRS with the aim of reinforcing the message contained in the PRS, deepen the analysis, and offer some practical next steps. The DTIS put particular emphasis on agricultural exports, focusing on increasing growth through Liberia's traditional sources of income, specifically rubber, palm oil, cocoa and forestry.

The purpose of the DTIS-U was to take stock of progress in implementing the 2008 DTIS, to review the country's trade competitiveness with particular reference to participation of the domestic private sector in global supply chains, and to update the action matrix taking into account the Agenda for Transformation.

The four key messages from the DTIS-U were that -

- > Despite robust economic recovery, Liberia remains vulnerable to global commodity price shocks largely due to an undiversified economy
- > Liberia has hitherto adopted the "concessions approach" to development, where exports are driven mainly by few large foreign firms (concessionaires)
- > Accession to the World Trade Organization (WTO) will enhance Liberia's ability to integrate effectively into the global economy as the country adopts a more transparent and predictable trade policy regime
- > To optimize the benefits of increased trade integration GoL needs to put in much effort at improving the country's weak trade competitiveness.

The key conclusion is that the prioritization of infrastructure spending under the AfT will not achieve the desired impact on inclusive growth if it is not complemented with a strong outward-oriented strategy based on an effective trade development program, increased trade integration, and improved trade competitiveness.

National Export Strategy (2014)¹⁷

The National Export Strategy (NES) complemented the AfT with the objective of leveraging trade to achieve inclusive growth. The Strategy pointed out that to an extent, Liberia's economic growth had been largely non-inclusive, fuelled by increased enclave-based activity in the commodity and extractive sectors, such as iron ore. Labor-intensive sectors such as agriculture, which accounted for the largest sectoral share of the country's GDP, had often been neglected. Foreign direct investment had centered on the extractive sector and was driven by concessionary activity. Investment flows facilitate much needed technology transfer, a critical requirement for the whole economy. The influx of best practices and new technology is especially important considering the extensive destruction of infrastructure and capital equipment stocks during the civil conflict.

Liberia's current comparative advantage lay in its abundant natural resources. In recognition of this, the Government prioritized the development of domestic resource-based sectors that utilize the available raw materials; materials which typically undergo minimal transformation before sale and/or export from Liberia. The Strategy therefore laid the foundation for investment to flow into sectors that generate sustainable employment and growth for the economy as a whole.

The five priority sectors identified for export diversification were cocoa, fish and crustaceans, oil palm, rubber, and cassava. These were selected for their potential to sharply raise in-country value, distribute

¹⁶ Republic of Liberia: "Diagnostic Trade Integration Study Update - Leveraging Trade for Economic Diversification and Inclusive Growth", December 2013

¹⁷ International Trade Centre: "National Export Strategy, 2014-2018", 2014

value more equitably, and to improve competitiveness in international markets. These were all laborintensive sectors that offered significant potential to attract domestic and foreign investment. Trends for these sectors indicate stable or increasing demand in world markets. Other areas that GoL intended to support were the tourism and furniture industries.

Liberia National Trade Policy (2014)¹⁸

The LNTP pulls together recent policies and strategies (including the NES and DTIS-U) to create a primary umbrella policy for the Government with regards to trade. The policy further outlines Liberia's strategy with regards to important trade policy issues which are currently not adequately covered in existing Government policy.

The LNTP's overall objective is to promote international trade and a competitive domestic private sector by supporting the agricultural, industrial and services sectors to trade at the local and international levels, thereby contributing to employment generation, improvement of the livelihood of the Liberian people, and reduction in poverty.

The country suffers from multiple domestic constraints for firms to invest, produce, and export. Key policy areas are therefore to:

- Promote international export competitiveness through a variety of actions ranging from infrastructure to export incentives
- Promote domestic trade and strengthening of the productive capacity in general, as a precondition for more businesses to become export ready
- > Increase the efficiency of the import and export administration
- > Promote regional trade and integration, primarily in the context of the MRU and ECOWAS
- Promote global market access for Liberian goods and services, through WTO membership and efficient use of preferential trade agreements and preference schemes
- Increase the effectiveness of Liberian institutions responsible for formulating and implementing trade policies
- > Enhance the legal framework and good governance for trade.

3.1.3.3 Sector Strategies

Whereas the NES had targeted a portfolio of industries, subsequent policies were aimed at analyzing and supporting specific sectors more directly. These specific strategies support maximizing the use of local productive capacities and inputs. The various strategies are listed here only, since they are considered more in-depth in the discussion of the various commodities making up transport demand later-on in this report.

Sector strategies have been developed for the following commodities and services (listed chronologically):

- > Food and Agriculture Policy and Strategy (2008), Ministry of Agriculture
- > Liberia National Cassava Sector Strategy (2010), Ministry of Agriculture & Ministry of Commerce and Industry
- > Mineral Policy of Liberia (2010), Ministry of Lands, Mines and Energy
- > National Rice Development Strategy of Liberia (2012), Ministry of Agriculture
- > Fish and Crustaceans Export Strategy, 2014-2018 (2013), Ministry of Commerce and Industry
- > Oil Palm Export Strategy, 2014-2018 (2014), Ministry of Commerce and Industry
- > Cocoa Export Strategy, 2014-2018 (2014), Ministry of Commerce and Industry
- Liberian National Export Strategy on Tourism, 2016-2020 (2015), Ministry of Information, Cultural Affairs and Tourism.

¹⁸ Ministry of Commerce and Industry, "Liberia National Trade Policy, 2014-2019 - Promoting Inclusive Growth through Trade Competitiveness", 2014

4. Transport Sector Legal & Institutional Overview

The main objective of the Transport Master Plan is to identify, justify and phase transport infrastructure requirements. Infrastructure interventions do not happen in a vacuum, and are amongst others affected by the structure and governance of the transport sector and sub-sectors. Case in point is this master plan which is a practical planning document for the roads sector (where MPW is also the executing agency) but more of a policy document for agencies that carry out their own planning (NPA and LAA). This is one example of why it is important to understand the current division of roles, which then provides an opportunity to comment on possible improvements to the organization of the sector. A tidy institutional map with clear responsibilities and transparent governance should simplify and even encourage the effective delivery of infrastructure.

There are various initiatives underway to internally reorganize the ministries involved with transport (both MOT and MPW) which have a short to medium term focus, have to account for current realities, and are therefore more *organizational* and *capacity* building in nature. But this master plan looks further ahead (ten years), is somewhat absolved from current constraints and can therefore put forward concepts with truly *institutional* (sector restructuring) consequences. These concepts are sometimes presented as firm recommendations (rail, maritime and aviation sectors), and sometimes just to provide the context of likely future institutional developments (roads sector).

4.1 Drivers of Public Sector Institutional Evolution

It is expected that Government will always provide the overall direction for the transport sector. Historically, the public sector proper also fulfilled several other roles lower down the "transport value chain", although the norm has become to increasingly delegate selected responsibilities to bespoke agencies of Government or even the private sector. There are a handful of considerations that propel this process of devolution, specialization and right-sizing of national government –

- Steering vs. Rowing. Because of the inherent bureaucracy and inefficiency of the public service, Governments internationally increasingly delegate specialist functions to specialist bodies, while retaining the policy-making and rule-making (policy) role itself. Governments are retaining the ability to strategically "steer" matters, but are delegating and outsourcing the industry of "rowing". (The term "rowing" refers to the day-to-day operational aspects of managing infrastructure and services.)
- Conflict of Interest. The same body should not be charged with trading off inherently conflicting obligations. These arise between service provision vs. regulation (can the CAA license its own air traffic controllers?), and safety regulation vs. commercial regulation (can MOT issue an operating license to a rail service provider with a dubious safety record?). In a small economy with limited skills some compromises may have to be made, but if housed in the same organization, such conflicts need to be clearly identified and managed transparently.
- International Compliance. Especially the aviation and maritime sectors entail long-distance, cross-border and even inter-continental transport, and for which elaborate and industry-specific international systems of safety regulation and exchange of commercial rights have been established. Non-compliance with these rules may lead to the restriction of Liberia's rights to participate in these activities, e.g. "all air carriers certified by the authorities with responsibility for regulatory oversight of Liberia" are currently banned from operating within the European Union.
- Regional Integration and Harmonization. There are strong trade, transport efficiency and even political collaboration arguments to provide some public services on an integrated, regional footing. Although such regional integration issues mostly play out in the form of technical standards (axle loads, customs documentation, etc.), there are also opportunities for national governments to collaborate with other governments or to entrust some services to regional bodies, e.g. the RIA FIR arrangement already in place between Liberia, Sierra Leone and Guinea.
- Decentralization. Functions should be delegated to the level where the needs of the public are best understood and served. The National Policy on Decentralization and Local Governance (NPDLG, 2011) called for decentralization and transfer of political, fiscal and administrative

powers to local governments. Some functions which historically resided at the national level are therefore drifting down to other levels of government.

- Corporatization/Commercialization. Even where functions are retained in government, there is a drive to provide these as efficiently and effectively as the private sector would have. To escape the formalities of the public sector and tap into the fleet-footedness of the private sector often requires the function to be housed in an arm's-length agency of Government, if not by the private sector itself. Contrasted with the public sector, agencies provide a much more attractive work environment to attract and retain the level of expertise required to properly manage complex assets and networks. And such entity will then be subject to a quite rigorous and transparent performance management regime.
- User Charging. As the transport sector matures, beneficiaries are increasingly called on to fund the services provided to them. When cost responsibilities become more clear-cut, crosssubsidization within the sector and subsidization to the sector reduces. Government eventually only retains a defined and discrete role to fulfil public service obligations (PSOs) for the vulnerable, or for underdeveloped areas, or to stimulate a strategic initiative of which the risks are still uncertain.
- User Participation. The adage "no taxation without representation" applies. Government can hardly expect users to contribute more without a commensurate improvement in service and without giving users a bigger say in how services are delivered. User input will come in the form of increased user consultation, more user representation on the boards of government agencies and increased transparency in the dealings of Government, agencies and SOEs.
- Market structure considerations. Economies of scale and network benefits may justify agglomerating functions (vertically integrated railway and rail operations, or an airport network), but these are often trumped by the benefits of competition in an unbundled environment. In transport, infrastructures are mostly provided on a network basis, while services (rail operations, air services, etc.) are usually unbundled and deregulated.
- Integration. The above principles will manifest as a larger number of narrower-mandate, autonomous, rule-based entities. Without a common purpose as articulated in clear policy the sector may fragment. Strategic leadership is required to integrate the various role players' efforts.

Having the above drivers play out uncontrolled is evidently not without risk. Many of the preconditions for such transition are not in place now: the public sector has limited knowhow on how to strategically guide a sector of unbundled entities; there is a small pool of experience and skills to draw from as custodians for or specialist functions of such liberated entities; there are capacity and resource constraints at local government level; and there is limited indigenous private sector skills, management experience, and capital which inhibits upscaling private sector participation. Also, the market (transport operators and users) may just not be able to afford the services provided to them.

These distractions are quite real in Liberia today. For example, one of the arguments not to proceed with an autonomous roads agency is the indifferent to poor governance, financial and performance track record of independent agencies and state-owned enterprises. But these conditions are not permanent, and the national development project (e.g. as articulated in the Agenda for Change) is premised on the overall service delivery environment improving – otherwise the country will just continue "muddling through". Over time, users' expectations will rise as will their ability to pay, and the reform drivers listed above will start playing out more insistently. The challenge is not to avoid reform, but reform at a sensible pace.

4.2 Reform Template

The general drivers and principles can be translated into institutional form as shown in Table 4-1. The left-hand column presents the hierarchy of functions in the sector, from policy making at the top through to the delivery of transport services at the bottom.

The list closely resembles the situation in Liberia today, except possibly for the "tariff & service" aspect of "economic regulation". This refers to the restrictions placed on an infrastructure provider or transport service provider – whether a public or private provider, but typically a monopoly – so that it does not increase its tariffs above or reduce its service levels below justifiable levels.

Function			Definition	Responsible	Public Level	Form	Regional?	User Charge?	
Policy	Policy		Strategic direction, sector rules & regulations, sector governance	n, sector rules & regulations, ce		Public Service	Harmonized policy	No (general Government function)	
	Fconomic	Market Entry	The right to participate in the market for infrastructure and/or services, e.g. a flight frequency, a taxi permit, a rail concession		National or	Public Service or	National competency	Yes, for infrastructure Yes, for	
Regulatio n		Tariff & Service	Capping of tariffs and protecting service levels of monopoly infrastructure and service providers	Public	decentralized	Agency	only	commercial services	
	Safety		Setting and enforcing safety standards on equipment, facilities, personnel & operations			Corporatized	Harmonized standards.	Yes, but approved by Govt	
Accident In	vestigation		Confirming the reason for a failure, which may have as its cause a policy, safety regulation and/or economic regulation shortcoming		National	Agency	single regional regulator	No (general Government function)	
Sorvico	Infrastructure		Provision of network (e.g. road, rail) and/or nodal infrastructure (e.g. port, airport, terminal)	Public or PPP (Private?)	National or decentralized	SOE or Concession	National competency only?	Yes, for	
Delivery	/ Transport Services		Provision of transport service, e.g. bus service, shipping service, etc. Typically private, even if subsidized as PSO. May be provided as a public service in order to develop the service industry	Private	N/A	Company	Regional service (e.g. maritime, air)?	Subsidized for public goods	

Table 4-1: Template for the Assessment of the Transport Modes

In principle, each row in the table is sufficiently conflicting in interest from the other rows that it deserves to be placed under a separate authority. But, for the public functions, that would require a substantial resource pool and a significant financial overhead. So, in practice, the demarcations between entities are often made as indicated by the thick horizontal lines in the table.

As will be demonstrated in the following sections, in Liberia, the institutional arrangements for each transport mode already largely resemble the archetypical lay-out of Table 4-1. There are a handful of issues related to the *safety regulators*, including conflicting mandates, capacity shortcomings and (therefore) whether combining forces in region-wide regulators should be considered. For *infrastructure*, the national ports have already concessioned off some facilities, and the question now arises at airports and possibly even roads. *Transport services* are effectively fully privatized, except for a public bus service which could possibly be more efficient and even cheaper if provided by unbundled subsidized, private PSO operator/s.

Given the infrastructure focus of the master plan, most attention in this chapter is given to that aspect of the template in Table 4-1. There are other investigations looking into the arrangements for transport services, and only cursory comments are therefore made here in that regard. Since many of the policy and regulatory aspects pertain equally to infrastructure and services those are addressed here too.

Most institutional loose ends pertain to the roads sector. Policy makers are currently grappling with how decentralization should be dealt with (e.g. to counties and cities), where the ownership and planning of roads should reside (in the public sector or roads authorities, the nature and form of a road safety regulator, the ideal form of separating out the management of national roads from Government proper, and the implementation of road user charging.

4.3 Ministries

Applying the template in Table 4-1 from the top implies looking into the policy-making, strategic management level of the transport sector first, i.e. the ministries of Transport (MOT) and of Public Works (MPW). In Liberia today, there are two ministries dealing with transport matters (MOT and MPW), and proper consideration should be given to rationalizing this situation.

As in other countries in the region, the MPW is somewhat of a historic legacy reflecting a time when the skills and capacities for all infrastructure development was located within the Government, and therefore was directed under a central ministry of works. Roads were thought of as an "engineering" and not a "transport" issue.

MPW previously ring-fenced the IIU to implement most of Liberia's donor and locally funded infrastructure projects, with the intention that it would evolve into a semi-autonomous roads authority. Although there have been some recent detractions around the exact form of the RA, whatever the outcome in the short-term, the drivers described in section 4.1 will eventually cause it to settle down as something akin to the infrastructure agencies already reporting to MOT (NPA and LAA). MPW is therefore naturally trimming back to a construction standards and enforcement body in general (not just of roads or of transport infrastructure), and its only transport vestige is in the process of being cut loose.

The Government Reform Commission is investigating ministerial reform and is likely to come to its own conclusion on whether all transport-related functions should be in one place, taking into account broader considerations of public sector service delivery. However, from a purely transport perspective, to have one transport infrastructure agency report into one ministry and the others into another abrogates holistic, coordinated, integrated sector management. Roads are the backbone of the national transport system and should ideally not be planned and delivered in isolation of the complementary transport modes. There should be ultimate one-stop responsibility for transport, and this should be the role of MOT. In as far as MOT is not sufficiently resourced with the required skills to oversee a roads infrastructure agency, this should be addressed by strengthening MOT, not by fragmenting the sector.

However, implementing one-stop transport policy and oversight in the MOT will be very challenging. Notwithstanding the functions legally assigned to it, the MOT today is little more than a vehicle registration, insurance and licensing office (e.g. refer to the Ministry's Administrative Regulation of 2011). Consideration should be given to merging MPW and MOT together with capacity building measures to aid the performance of the new roles.

4.4 Roads

Roads are the dominant transport infrastructure providing almost all of the national and regional transport capacity. It is also the transport mode where the discussion on institutional solutions is the most vibrant today.

4.4.1 Roads Policy

In terms of where roads policy should be housed, the argument was made above for the consolidation of roads functions under the same ministry already responsible for the other modes of transport. As regards the content of that policy, key areas would be how to organize the roads system (e.g. roads classification), roads design standards, the levels of service required, the position of roads relative to the other modes to respond to economic and social needs (e.g. policy on road-rail inter-modal competition, inter-modal interfaces), mandating and supervising the public agencies and other actors in the sector, and to award rights to road transport service providers (form of competition, PSOs, etc.).

Two policy aspects and responsibilities should be clarified given that roads responsibilities are in a transitional period between public and agency provision of roads (refer the discussion under the next section) –

- > The long-term *planning* of roads will remain with the roads parent ministry for now, although it would probably be outsourced to the roads agency for actual preparation and implementation.
- Government itself hatches concepts for private participation in transport infrastructure (e.g. dry port) and regularly receives unsolicited offers to do so (e.g. Kesseley Str. Bridge). The planner of the network will be in the best position to judge the technical, economic and financial implications and merits of such initiatives which would therefore continue to be Government (MOT/MPW) for now.

4.4.2 Roads Regulatory Aspects

4.4.2.1 Road Safety

Road safety oversight is shared by the MOT itself (licensing of vehicles and drivers) and the NLP (traffic and licensing enforcement, and road accident investigation). Liberia has not yet outsourced licensing to accredited third-parties. A National Road Safety Committee (NRSC) has been called into life, but is still developing its approach to road safety promotion.

4.4.2.2 Roads Economic Regulation

For road transport, in as far as there is a requirement to award commercial rights for road transporters, this function would continue to reside with MOT. Cases where exclusive rights may be justified would be to limit competition to improve the viability of social services, which may also then attract a government subsidy. There may also be agreements with neighboring countries to regulate the rights to provide cross-border transport.

For roads infrastructure, there is no equivalent of market access regulation (except, possibly for PPPs as mentioned previously) since the road networks are exclusively delegated to specific levels of government proper, and eventually to their agencies. The role of tariff and service level regulator will for now be performed by MOT, but will migrate to the Road Fund (see below).

4.4.3 Roads Service Delivery

All of the non-roads sectors already have SOE-based infrastructure provision with transport services provided by the private sector. The SOEs do their own planning, asset creation/maintenance, and are user-funded, although sometimes GOL underwrites investments (e.g. the RIA terminal expansion project). This type of reform is imminent in the roads sector, i.e. moving roads move roads off Government's budget, commercializing them and managing them like a business on a fee-for-service basis.

4.4.3.1 Roads Agency to Provide Roads Infrastructure

The creation of a roads agency has been on the table for some time, and it was always the intention that the IIU would be converted into such body. The roads agency would then assume the functions of the IIU (currently a project implementation unit for major projects, e.g. LRTF projects) as well as other roads projects which are the domain of MPW today. The entity would not just do project preparation and execution like the IIU presently, but be a roads agency proper, i.e. the custodian of national roads, responsible for the long-term planning and management of the network.

It is important to highlight that the motivation for creating a modern roads agency is not just the benefits derived from the legal and governance shell around it, but the internal dynamics set in motion. An agency that is truly the owner of the roads network is focused on asset value creation and preservation, made possible by data-rich information systems, with predictive capability (of level of service, capacity utilization and road condition, and the ability to appreciate the interactive effects of interventions across the roads network. That agency makes long-term decisions on lifecycle asset performance, and contracts appropriately (e.g. build and maintain separated vs. OPRC) placing a high premium on competitive and transparent procurement.

Notwithstanding the other, inherent benefits of the agency, the governance environment in Liberia today has caused Government to draw back from creating a fully autonomous entity. Although it will still superficially be an agency, the entity will not be the roads asset custodian itself, but rather be a technical office at the disposal of national and other levels of government ("client bodies" who will retain the basic ownership role themselves). This approach will of course require not just strategic, policy-type skills in the parent ministry, but a more hands-on, operational-level understanding of the road assets as well – to know when and how to brief the roads agency (or even another service provider) on how to advise the parent asset owner. The parent itself will have to take more responsibility for long-term roads planning, while the agency will operate in a similar domain as the IIU today (an implementation office, not a lifetime asset manager). Given the scale of the economy, an affordable new road agency should not be much bigger than the existing IIU.

4.4.3.2 Comment on Axle Load Regulation

Although the axle loading regulations were updated fairly recently (reference), there is no formal axle load enforcement system in place. The appropriate positioning of this responsibility would be with the road asset owner who wants to manage and preserve the asset life. For the time-being, this would therefore be MPW/MOT, but it would later migrate to the fully-fledged roads agency when it transpires.

4.4.3.3 Road Fund to Ensure Value for Money to Road Users

Most national treasuries are not in favor of carving out specific parts of the budget and funding these from dedicated (earmarked) sources. However, where the benefits of such services are large, the beneficiaries clearly discernable and budgets tight, governments have increasingly been shifting the burden of funding to users. In the case of roads, this is done by means of a roads fund that sets and collects road user charges and channels revenue back to roads infrastructure and roads-related functions (e.g. road safety promotion) on a value-for-money basis.

Whereas roads agencies naturally want to spend to improve and sustain the road network, road funds are the countervailing power ensuring that spending is done wisely. If spending is in any case going to be done by Government, a road fund is largely superfluous (except for being a collection agent); if spending is going to be entrusted to an autonomous and empowered roads agency, a skeptical road fund is indispensable; combining an autonomous roads agency and fund is fatal. The flywheel of this arrangement is the positive buyer-seller tension between the RA and the RF. To support this arrangement, but also allow for the resolution of conflict, there would be two separate parent ministries.

Road funds have migrated from being purely collection agents of earmarked funds (first generation) to being a second-generation roads fund with the following attributes –

- oversight by a public-private board representing organizations with a strong vested interest in well-managed roads (including government departments)
- day-to-day management by a small secretariat along commercial lines, i.e. equally autonomous as the RA

- revenues from charges related to road use ideally a two-part tariff consisting of vehicle license fees (often also a heavy vehicle surcharge) and a fuel levy
- transfer of existing roads allocations in the national budget to the road fund, in the form of an equivalent fuel levy
- > funds allocated to road agencies based on sound planning and with clear results targets
- funds disbursed in a way which strengthens financial discipline, including full and proper accounting for the use of the funds
- transparency: regular technical and financial audits of works with the results tabled before parliament and published in the press
- > road fund supported by sound legislation and published financial rules and regulations.¹⁹

These qualities were at the heart of the original intention to complement the establishment of a roads agency in Liberia with the creation of a road fund administration, as recorded in the draft National Road Fund Act of 2016. But recently Government has reconsidered whether a separate fund outside of the MFDP is actually required, whether to allow any additional road user charging over-and-above what is already nominally used for roads, and whether that revenue will be formally converted into a road user charge fuel levy.

The existing roads expenditure from Government's own budget is significantly less than required to maintain the existing roads network, and has also been subject to cuts (ongoing roads expenditure was budgeted at USD 27 million in FY15/16 but revised down to USD 6.6 million, compared with a basic maintenance requirement of around USD 40 million.) All development expenditure comes from donors (refer section 11.2.3).

Notwithstanding any current sensitivities around the role, form and positioning of the road fund, the need to grow and maintain the roads system coupled with increasing pressure on public finances will in all likelihood lead to the maturation of road funding in the form of a road fund proper in the future. In the meantime, and given the fairly modest amounts available for roads maintenance at the moment, creating a small, dedicated unit in the Ministry of Finance to oversee roads funding is probably a sensible compromise.

4.4.3.4 Comment on Decentralization in the Roads Sector

Under the decentralization agenda, county administrations will in future become the primary decision maker for planning and prioritization of road development within its jurisdiction. The same could happen for the larger cities who would assume responsibility for non-national urban streets. The practical effect would be that secondary roads be devolved to counties and urban streets that are not of a national, primary nature, would devolve to city administrations. Feeder roads would firstly devolve to counties and later-on to districts.

It should be noted that the initiative to devolve roles and functions is not driven by transport efficiency considerations per se, but reflect a broader policy of participatory governance which has to be accommodated in the transport sector as well. From a purely roads perspective, three considerations inform the nature and tempo of decentralization of roads –

- Contiguous network. The more interdependent the links in the network, the more a decision on one affects the performance of another (e.g. by traffic diversion). The primary network should be operated as one, and – given the interaction between the two layers and the low national coverage of the primary system – the decentralization of secondary roads should not be hurried.
- Design standard. The higher the physical standards, the more it makes sense to centralize management given that there are limited skills and capacity to go around. Presently, the secondary roads are semi-engineered and unpaved. Even so, it is unlikely that all counties today would be able to take on such asset management responsibility. However, there is equally limited capacity to oversee secondary roads at the central level, and a well-managed

¹⁹ Adapted from Second Generation Road Funds: The Way Ahead; World Highways, Vol. 9, No. 7, October 2000

primary network would make a major difference and provide more than enough work for a central roads agency.

Local knowledge. The more a road's performance requires local insight and understanding, the more decentralized it could/should be managed. This quite definitely applies to the feeder roads (and the new set of motorcycle tracks proposed later-on in this master plan. But in the case of the secondary roads, these should be physically robust to not require regular, small-scale tweaking and could therefore continue to be managed/maintained centrally.

Considering all three aspects together, it is reasonable to expect a central responsible entity to oversee the primary and secondary roads, and to devolve feeder roads to capable counties and motorcycle tracks to capable districts. Based on experiences elsewhere, it will be several years before the counties have the resources and capacity to plan, manage and finance road construction in their jurisdiction. Although these local governments may establish their own roads agencies, for the time being, it is foreseen that they will rely on the national roads authority for these services. However, when the counties have established some roads management capacity, the provision in the Local Government Act to assign responsibility of secondary roads to Counties should be executed.

As regards urban streets, based on the first consideration above, main arterials which serve both a national and local function should probably remain with the central entity. But in this case, there should also be a move towards protecting the national function of these arterials more aggressively - especially by limiting access to intermittent, defined and controlled intersections. For the remaining urban streets, these should be managed by capable local authorities, or otherwise at the county level. A national roads agency cannot usefully and effectively look after all these assets.

4.4.3.5 Conclusion on Road Sector Reform

As noted in the introduction to this chapter on institutional matters, this report does not aim to provide firm recommendations on institutional reform. Rather, it describes the likely trajectory of institutional evolution based on some underlying drivers and as seen played out elsewhere in the world. There are some contested issues regarding the organization of the roads sector today, however, these will settle down and the road sector will migrate to a more comparable situation with Liberia's peers (as has already happened in the other transport modes).

4.5 Aviation Institutions

Civil aviation is conducted in terms of an elaborate system of standards and recommended practices (SARPs) established under the Chicago Convention on International Civil Aviation of 1944, and is overseen by the International Civil Aviation Organization (ICAO). Liberia is a signatory of the Chicago Convention, which has been supplemented by a number of other conventions (many of which Liberia has not assented to). As discussed below, in some crucial respects the country is non-compliant with this international civil aviation regime.

The organization of the aviation sector already to some extent follows the standard template set out earlier, but there are some specific shortcomings relating to conflicts of interest and capacity.

4.5.1 Aviation Policy and Economic Regulation

Oversight of civil aviation was originally overseen directly by the Ministry of Transport, and later this function was placed under the Bureau of Civil Aviation of the Ministry. The Civil Aviation Act of 2005 dissolved the Bureau and transferred its functions to the Liberia Civil Aviation Authority.

The Executive Law now provides for a Division of Civil Aviation within the MOT. However, since the transfer of the Ministry's Bureau of Civil Aviation to the CAA, there is no formal unit dealing with aviation matters in the MOT itself. The Civil Aviation Act in fact quite pertinently assigns duties to the CAA that could have been expected to reside with the MOT, including some aspects of aviation policy and economic regulation.

As regards economic regulation, and specifically market entry regulation, the CAA is mandated to issue commercial air service licenses and permits to foreign air operators. Such licenses/permits are subject to the applicant achieving the required safety certification first. The model in Liberia of the CAA checking safety compliance as well as issuing the commercial right to operate is quite common across the continent and not completely dissimilar to, say, the UK where the CAA awards the commercial rights in

the case of scarcity of capacity. In the USA, the Secretary of Transportation issues the commercial right, and in South Africa an independent Air Services Licensing Council. There is no compelling reason to change the current arrangement of issuing commercial rights in Liberia. Nonetheless, it should be recalled that government proper negotiates and signs bilateral or multi-lateral Air Services Agreements with other countries or regions, and MOT itself should maintain some capacity for this purpose.

The other aspect of economic regulation – tariffs and prices – is a more pressing area of reform. The CAA has quite broad-ranging powers regarding capacity restrictions, protection of incumbents, acting against anti-competitive behavior, protection of consumers, etc. Paradoxically, it economically regulates its own ATC/ANS operations.

Both the LAA and CAA are monopoly providers of services – operational (airports and ANS) and safety (regulation) services – and both charge fees for their services. It has become common practice for governments to oversee the economic performance public agencies and SOEs which are monopolies in their respective fields. This would take the form capping the tariffs they may charge and setting minimum service standard performance levels. There are variety of more and less formalized, and proactive vs. reactive models for this.

The important inference is that MOT has to take a keener interest in overseeing its agencies in the aviation sector and take steps to ensure satisfactory services are rendered. Consideration should also be given to initiating a more formalized performance management framework for the aviation agencies, i.e. an agreement on programs to be undertaken, key performance areas and reporting-back to the MOT. The MFDP's State-Owned Enterprise Financial Reporting & Coordination Unit (SFRCU) already monitors SOEs' and agencies' financial performance to ensure that they are commercially and economically viable. There should be a similar interest in the parent ministries on how the entities perform against their operational mandate.

4.5.2 Aviation Safety Regulation

4.5.2.1 Liberia Civil Aviation Authority (CAA)

Civil aviation authorities are responsible for the oversight and regulation of civil aviation, typically including aviation safety, security, airspace policy, economic regulation, efficiency, sustainability, consumer protection and respect for the environment.

The Liberia Civil Aviation Authority was established in terms of the Civil Aviation Act. The CAA is responsible for regulating aviation safety and security, including certification of aircraft, airmen, aircraft maintenance organizations, air operators, airports, air traffic management and other participants in the aviation sector. However, the CAA performs these tasks only to a limited extent or not at all. For example, it is not licensing pilots and has not issued an AOC (air operator certificate), only temporary Air Service Permits to operators holding AOCs from other countries. Although the CAA maintains an aerodrome registry, of which 13 are "serviceable" and 21 "unserviceable, the situation at only 6 airfields has been verified since 2014, and there are no formal aerodrome licenses issued.

The unsatisfactory situation of the CAA is illustrated by the most recent safety audit carried out by ICAO in terms of its Universal Safety Oversight Audit Program (USOAP). USOAP aims to address concerns about the adequacy of aviation safety oversight around the world. The findings of the 2016 Liberia audit are summarized in Figure 4-1, and compared with the global average in terms of the Effective Implementation (EI) of each Audit Area. One Significant Safety Concern (SSC) was raised, resulting in Liberia being placed on the operational European Air Safety List, which means that no Liberian registered aircraft are allowed to fly in European airspace.



Figure 4-1: Liberia Effective Implementation of Audit Areas

Note: The Effective Implementation (EI) of each Audit Area is rated from 0% to 100%, with 0% being "Not Implemented" and 100% being "Fully Implemented".

4.5.2.2 Pooling of Regional Aviation Safety Resources

Liberia is a member of the Banjul Accord Group Aviation Safety Oversight Organization (BAGASOO), one of a number of Regional Safety Oversight Organizations (RSOOs) established under AFCAC (African Civil Aviation Commission, a specialized agency of the African Union). Their purpose is to institutionalize and strengthen the ICAO COSCAP (Cooperative Development of Operational Safety and Continuing Airworthiness Program) through the pooling of resources.

This concept – pooling of resources – needs to be explored further. The shortcomings in the Liberia CAA are also evident in the CAAs of neighboring countries who have similarly small and underdeveloped civil aviation systems, but who have to participate in the regulation-heavy international civil aviation market. Regulatory harmonization and sharing skills would reduce the burden on national bodies acting individually. Pulling together in this manner is already done in aviation, with Liberia and the other two Manu River states (Sierra Leone and Guinea) jointly managing the Roberts FIR (Flight Information Region, i.e. upper airspace control). The RFIR already maintains the Liberia AIP (Aeronautical Information Publication – the definitive document containing all essential aeronautical information, and one of the cornerstones of aviation in any country). The same states also participate in sub-regional aviation and maritime rescue coordination centers.

Furthermore, the European Union, through the European Aviation Safety Agency (EASA), implemented the "Support to the Improvement of Aviation Safety in Africa" (SIASA) program in 2012. The beneficiaries are aviation authorities of Sub-Saharan Africa, including the RSOOs and national CAAs of the region. The Liberia CAA too would qualify for support under SIASA. This could take the form of –

- Completing the on-going process of reviewing and upgrading of the aviation legal and regulatory framework, focusing on priority regulations (air operator certification, provision of air navigation services, and aerodrome and ground aids)
- Enhancement of aviation safety through training and orientation of inspectorate staff to European regulations and requirements
- Instilling the Continuous Monitoring Approach (CMA) for Liberia to continuously provide evidence of its implementation of ICAO SARPs, in order to update the country's EI status.

Carrying out a SIASA support project at the regional (Manu River Union) level would lay the foundation for longer-term sub-regional cooperation and even consolidation of civil aviation safety regulation. A

Terms of Reference has been developed for supporting the CAA with technical assistance and capacity building.

4.5.3 Accident Investigation

One of the functions of the CAA is to carry out accident investigation. Since 2000, there have been four occurrences of accidents or incidents in Liberia airspace, two with fatalities. So, air accident investigation is not a regular requirement.

Countries deal with air accident investigation as a branch of the ministry responsible for transport (e.g. AIIB of the UK), as part of an agency investigating all transport accidents (e.g. NTSB of the USA), or under the CAA (e.g. AIID of the South African CAA). The first two approaches avoid the conflict of interest dilemma, but the third is more financially sustainable for a small country with infrequent investigation requirements.

For Liberia, if civil aviation safety regulation continues to be executed at the country level, consideration should be given to reallocating accident investigation to the parent ministry (MOT). There, it could form part of a broader, non-modal "major accident investigation" office which also looks into major road and maritime catastrophes. If aviation safety regulation is elevated to the sub-regional level, the same could happen with the responsibility for accident investigation, although the legal jurisdictions will have to be clarified (accident investigation is the responsibility of the government of the area where a plane goes down).

4.5.4 Air Traffic Control

Air traffic control services are of three types: tower control (TWR) in the control zone (CTR) directly around an airport; approach control (APP) in the terminal control/maneuvering area (TMA) for incoming and outgoing flights to/from the CTR; and area control (ACC) above that for en-route movements in the control area (CTA) or upper control area (UTA). As noted above, for Liberia, the area control function is delegated to the RFIR area control center (ACC). The LCAA itself is responsible for air traffic control (ATC) services in –

- Roberts terminal control area (TMA terminal movement area), in a radius of 100 NM around Roberts Airport from FL30 (flight level 30, i.e. 3,000 feet) to FL100
- Roberts control zone (CTR controlled traffic region), in a radius of 15 NM around a Roberts Airport and extending from ground level up to FL30
- > Helicopter routes and a VFR (visual flight rules) corridor for light aircraft.

The LCAA also provides air navigation and communication aids.

The standard models for air navigation service provider (ANSP) are to be part of the CAA or Directorate of Civil Aviation of the ministry of transport if a CAA has not yet been established (e.g. DANS in the Kenya CAA), part of a CAA that provides safety regulation and also manages airports and ANS (e.g. Uganda CAA), part of an airports authority (e.g. DHMI of Turkey), a stand-alone authority (e.g. NAMA of Nigeria), or a private service provider (e.g. at small aerodromes in the UK).

The situation in Liberia of the safety regulator also being the ANSP is not uncommon, but it clearly creates a player-referee conflict of interest. Other considerations are that –

- > The CAA is not coping with its core mandate of safety regulation
- The type of control (upper airspace) that is most closely associated with national sovereignty a major reason for keeping ANS within or close to Government – has already been entrusted elsewhere (to a sub-regional body, to be precise)
- Approach and tower control are closely associated with airport operations. As the domestic aerodrome network grows, ATC services will eventually be required across the country (especially if scheduled services take off).

There are therefore a number of reasons to consider relieving the CAA of its ATC operations role, although it will continue to be the ATC and ANS regulator. Also, the LAA is a functioning and growing agency, largely corporatized already, dependent on reliable ATC/ANS, and therefore a secure location to house the ANSP function.

4.5.5 Airports

The LAA was established by the Liberia Airports Authority Act of 2009, to manage and operate all government airports in Liberia. The intention of the Act is clearly that the LAA should be financially self-sufficient, and for that purpose it may charge users and develop commercial revenues (rents and concessions). But it is very much still a public agency carrying out all airport services itself, with very limited non-aeronautical activity (such as snack shops, a money changer, cell phone agents).

The actual number of airports across the country is a matter of some discussion (refer section 8.1). Apart from RIA and Spriggs Payne, the number owned by the LAA is in the order of 20 to 30, in various stages of repair/disrepair, and with a few exceptions not operational. There are some private airstrips, typically owned by mining companies or a palm oil concessionaire. And there is a large number of helipads across the country used by UNMIL.

As discussed in sections 7.1 and 8.1, RIA is the main point of access by air to the country, and Spriggs Payne is anticipated to grow into a more prominent domestic air services hub. The financial position of Spriggs will be integrally tied to the tempo and success of re-establishing the domestic air services system. For some time, it will be most prudent to operate this network out of the LAA proper.

But the situation of RIA is different. This airport already carries enough traffic to be financially selfsustaining. This would include the capacity to service the financing cost of the current facilities expansion (terminal building) and rehabilitation (runway). Government therefore has the option of considering doing with RIA what it previously did at the Freeport of Monrovia, i.e. ring-fencing and concessioning or leasing out a commercially attractive section of the business, placing it under professional, international management, probably earning a fee which can be re-applied elsewhere in the airports system. The decision to outsource RIA in this manner must self-evidently be preceded by a financial feasibility and risk identification/mitigation assessment.

4.6 Maritime Institutions

International maritime affairs are carried out in terms of the International Maritime Organization (IMO) Convention, of which Liberia became a member in 1958. Technically, it encourages and facilitates the general adoption of standards related to maritime safety, efficiency of navigation and prevention and control of marine pollution from ships. Commercially, it promotes the removal of discriminatory action and unnecessary restrictions by governments affecting international shipping. The IMO establishes Generally Accepted International Rules and Standards (GAIRs), and IMO Member States are expected to adopt these in in their own laws and regulations. Liberia has ratified all of the major maritime conventions.

4.6.1 Maritime Policy and Economic Regulation

Originally, the MOT represented the Government's interest in maritime matters. In 1989, the powers and functions related to maritime affairs were transferred to an autonomous Bureau of Maritime Affairs (BMA). And in 2010, the BMA was transformed into the Liberia Maritime Authority (LMA).

The Maritime Authority Act (2010) repealed the provision in the Executive Law that provided for a Division of Maritime Affairs/Shipping in the MOT, so that, as is the case with aviation, there is no specific unit at the MOT dedicated to maritime affairs. In fact, the LMA Act stripped any role in maritime affairs from the MOT, including removing all policy-making duties, the Government's role of representing the country at international level, its duty to collect and maintain data, and other maritime-related functions.

As for aviation, the MOT can hardly play a policy-making and oversight role of a key leg of the transport system without a maritime unit of some kind. Its role would be similar to the aviation unit, i.e. to ensure that the country stays current with international developments and compliant with its international obligations; to ensure that maritime transport is properly integrated in the overall transport system; and to oversee the role players in the maritime sector (the maritime regulators and ports authority) under a more formalized performance management framework and by ensuring a fair tariffs/ service level offering.

Although dealing with two different transport modes, their objectives and principles are similar. As an interim measure, and to first establish a basic capacity, it may be considered to run these two domains

together in the same unit. But the volume of local oversight and international compliance really require properly established units in their own right.

4.6.2 Maritime Safety & Labor Regulation

The legal framework for the regulation of shipping is based on maritime zones of jurisdiction -

- "Flag State" refers to the regulation of vessels on the high seas. All ships are required to sail under the flag of an individual state whose domestic laws apply to those aboard its ships and who must also ensure that its ships conform to international rules and standards concerning matters such as safety at sea, pollution control and communication regulations.
- The "Coastal State" is required to allow "innocent passage" through its territorial sea. Coastal states may adopt domestic laws and regulations applicable to foreign ships transiting through the territorial sea in relation to such things as safety of navigation, preservation of the marine environment and marine pollution control.
- The "The Port State" has the authority to impose conditions for the entry of foreign ships into its ports, and has broad inspection and enforcement powers. A flag state may also request the port state's assistance in relation to enforcement of pollution offenses on the high seas.

4.6.2.1 Liberia Maritime Authority (LMA)

Maritime authorities are generally responsible for regulation and safety oversight of the country's shipping fleet and its ports, and the management of the country's international maritime obligations.

In Liberia, the LMA carries out the Coastal State and Port State regulatory roles, entailing the inspection of large foreign vessels, as well as commercial fishing vessels operating in territorial waters. It also carries out domestic flag state regulation (registration of canoes, pleasure watercraft, speed boats and other forms of marine crafts, including small commercial vessels), and regulates the use of inland waterways.

4.6.2.2 Liberian International Ship & Corporate Registry (LISCR)

Flag State control is exercised over all ships register in a country. The registration of a ship is almost like its passport, allowing it to travel internationally. Per international agreements, every merchant ship must be registered to a particular country. Liberia has what is referred to as an open ship's register (or "flag of convenience" or FOC) that allows a merchant ship to be registered in a country other than that of its owners. The vessel is operated under the regulations of the Flag State (i.e. Liberia in this case), including certification of the ship's equipment and crew and enforcing safety, pollution and labor practice requirements.

Although the LMA Commissioner has superintendence of ships registered under the laws of the Republic of Liberia, this function has been outsourced since the inception of the Liberian ship's registry in 1948. Since 1989 (when the BMA was established by the Taylor government), the contract has been held by the Liberian International Ship and Corporate Registry (LISCR). LISCR is a privately owned, limited liability company registered in the USA. It provides both the ship registry services as well as the Liberian corporate registry.

The role of LISCR as a revenue-generating opportunity for GOL has been extensively discussed elsewhere, including Parliament. LISCR transfers two thirds of its net revenues to the GOL consolidated account, and this amount is recorded by LMA. Government in turn makes a subvention to the LMA to cover its operational cost shortfall.

Whatever the financial gain for the country from the LISCR arrangement, the flag state arrangement appears to comply with international obligations. FOCs are subject to a range of criticisms related to a lack of regulatory control. The International Transport Workers' Federation (ITF) identifies 32 registries as FOCs registries, of which 14 are targeted for special enforcement. Importantly, the Liberian ship's registry is not one of these.

4.6.2.3 A Regional Maritime Safety Agency?

The relative small scale of national aviation industries in the region warrant the question of pooling of highly technical and scarce resources to achieve a viable safety regulator. In the case of maritime

safety regulation, the market served is much bigger and a national regulator therefore more sustainable. There are also few examples of such type of cooperation. The European Maritime Safety Agency (EMSA) performs such a role regionally, but this has not done away with national agencies, e.g. the UK's Maritime and Coastguard Agency and Germany's BSH (Federal Maritime and Hydrographic Agency).

4.6.3 Ports

The National Port Authority (NPA) was established by an Act of the National Legislature in 1956 and amended in 1970 to be a state-owned corporation. It operates four ports: the Freeport of Monrovia and the outports of Buchanan, Greenville and Harper.

As regards the NPA's functions, the main port operational models are shown in Table 4-2. In terms of this type, the NPA applies a mixed tool/landlord port model. It has concessioned discrete parts of the Freeport of Monrovia (to APM Terminals, Firestone, China Union and Western Cluster), and provides space for two GOL-owned entities (LPRC and LEC) and a private company (Total). At Buchanan Port, it has concessioned the iron ore facilities to ArcelorMittal, and it entered into an equipment handling agreement at the commercial port (UMARCO).



 Table 4-2: Port Operating Models

Source: Summarized from PPIAF Port Reform Toolkit (https://ppiaf.org/documents/toolkits/Portoolkit/Toolkit/module3/port_functions.html)

For the non-concessioned, monopoly parts of NPA there is no service level or tariff regulatory regime in place. Neither is there a functional performance regime for the NPA in general (although it also falls under the financial oversight of the MFDP's SFRC Unit).

4.7 Rail

Rail, like roads but unlike the aviation and maritime sectors, is largely a domestic transport matter. There is a regional integration initiative (discussed in section 7.4) which would require harmonization of design standards and operational approach, but these are decided on by the countries involved (and not imposed under an international regulatory regime).

4.7.1 Rail Policy

The MOT has a unit for Land & Rail Transport, but in as far as there is a national rail policy, it is effectively made by the Ministries and entities involved with mining concessions. Rail rights and obligations are awarded in the course of signing a Mineral Development Agreement (MDA). The MDAs do not subject the rail operations to the safety regulation of the MOT specifically or GOL; there are only obligations from a general health and safety perspective. Since the rail lines pass through long stretches of non-mining lands, there is much potential for conflict – especially around built-up areas and at level crossings. As a minimum, the MOT should keep an eye on the rail operations from such a public interest perspective.

The one area where the MDAs do in fact allude to a role for their railways in the public transport system, is to require the mining concessionaires to provide third-party access (TPA) to the rail system if there is indeed spare capacity, and a fair compensation. As discussed in section 8.3, there will quite probably
be spare capacity on the Nimba (ArcelorMittal) line which can be usefully made available to a third party. This is therefore an area that the MOT should be organized to oversee.

4.8 Transport Sector Cross-Cutting Institutional Issues

There are at least three further subjects that do not just pertain to one transport mode, but which are essential for the safe operation of the whole transport sector.

4.8.1 Accident Investigation

The CAA and LMA both have the responsibility to investigate accidents and incidents. As noted before, to address conflicts of interest, it could be considered to ring-fence the investigation of major accidents in a body similar to the USA NTSB (National Transport Safety Board). However, in both domains, the requirement for such investigations is sufficiently rare to retain this function within the parent safety regulators.

4.8.2 Search & Rescue

The Roberts RCC (Rescue Coordination Centre) is located at Roberts Airport. The information received by the Roberts RCC is disseminated to the rescue sub-centers (RSC) of Conakry, Freetown and Robertsfield (Aeronautical) and also to the (MRCC) Maritime Rescue Coordination Center Headquarters in Monrovia, which relays this to MRCC Rescue Sub-Centers in Freetown and Conakry. Again, this is an adequate arrangement for events which are quite rare.

4.8.3 Meteorology

Up-to-date meteorological information is especially important in the aviation sector. MOT is charged (in the Executive Law) with maintaining meteorological services, and this duty is delegated to the CAA (in the LAA Act). The only two weather stations recorded by the World Meteorological Organization (WMO) are at Roberts and Spriggs Payne airports.

An approach taken by other countries is to establish a dedicated agency (e.g. the Nigeria Meteorological Agency), but this would hardly be viable in Liberia. In terms of capacity and demand for the service, the appropriate body to handle meteorology would be the LAA. This approach would have the national system of weather stations grow at the same tempo and be located at the same places as the expanding domestic airports network.

4.9 Summary Institutional Proposals & Recommendations

Table 4-3 presents the main conclusions of the institutional review, against the backdrop of the institutional reform template presented at the beginning of this chapter.

Function		Roads Funding	Roads Provision	Aviation	Maritime	Rail	Other	
Es		Establish formula-		Consolidate transport policy functions in single, merged ministry (MOT)				
			based principles for		Establish sectoral units	s with policy and	Capacitate existing	Prepare update of
			RUC determination		oversight capability		Rail unit	Nat. Transport Policy
			and allocation		Establish capacity to er	ngage with		
Deliev					international organizat	tions and other		
POILCY					Review international			
					aviation			
					commitments			
				Establish performance infrastructure authorit	management regime for ies	safety agencies and		
		Markat			MOT to assume duty			
		Fntry			to award commercial			
	En				air service rights			
Pogulatio	Economic		Establish Road Fund		Set up economic regul	ation regimes for		
		Tariff &	unit in MOF, to be		safety agencies and mo	onopoly infrastructure		
		Service	Fund later		authorities in MOT			
n					Lindate legislative	Continue with		
				Capacitate NRSC	framework in line	corporatization of		
					with SARPs	LMA		
	Safety				Engage regional			
					counterparts and			
					explore cooperation			
Accident In	unitigation			Potain in LND	Build CAA capacity	foty rogulators		
Accident in						lety regulators		Turnefer
				Establish roads	from CAA to LAA			meteorological
				agency				duties to LAA
					Consider	Continue process of		
Service				RA to be responsible	concessioning of RIA	concessioning		
Delivery	Infrastructu	re		for overload control		terminals		
				Delegate lower-				
				order roads to some				
				counties and some				
		4		cities				

Table 4-3: Summary of Institutional Proposals and Recommendations

5. National Transport Demand Analysis & Forecasting

5.1 Approach to Demand Estimation & Projection

5.1.1 Estimating Transport Demand

Estimating transport demand entails two broad stages. The first is to determine the nature, size and growth in the "activity" system. This relates to the characteristics of travelers and land use which give rise to a need to move around. The second stage is to interface the activity system with the "transport" system which enables and impedes the movements to and from actually taking place.

In the classic four-step demand model (FSDM), the first step (trip generation) corresponds with the first stage above, i.e. determining the propensity to travel. This is based on considerations of trip production (at origin) and trip attraction (at destination).

The next three steps of the FSDM all contribute to the transport system. Trips are distributed (step 2) by matching production and attraction nodes according to the relative impedance (distance, travel time, etc.) between them; transport modes are allocated (step 3); and mode-specific routes selected (step 4). Our experience is that the three steps in the transport system are not sequential but rather play out simultaneously. Whether production and attraction modes can be matched at all, or matched efficiently, concurrently depends on the routes and modes that are (or are not) available. The impedance-route-mode considerations are inter-related and cannot be separated neatly.

5.1.2 Traffic Zone Organization

The activity system (trip production and attraction) and transport system have to exchange data accurately. They therefore have to work at the same spatial resolution, i.e. based on the same organization of geography.

This chapter deals with a "national" system, i.e. covering the whole country at a resolution that should make at a high level but which would not drill down into local area. The 2010 NTMP used counties as organizing principle. That would correspond with the definition of primary roads which link county capitals. However, secondary roads link up district headquarters, and feeder roads go even deeper. All three road classes (primary, secondary and feeders) are "national" roads.

The approach taken here is therefore to carry out the demand analysis at district level. There are 15 counties but 135 districts, implying that this approach gives a much sharper resolution to the analysis. Although district HQs are not necessarily centrally located within a district, they do provide an indication of the population and economic point of gravity of the district. Therefore, districts are the traffic zones and district HQs the traffic centroids in the analysis.

Refining the analysis to the inter-district level would require the input data to be available at that same level of detail. This is so in some cases (e.g. population, and major concessions) but not in others (especially non-agricultural land-use). Working at the district level therefore requires some data fields that are only available at the county level (or even country level) to be distributed (often, averaged) to the district level.

This district-based zoning arrangement is amplified in some respects:

- County head-quarters (HQs) as trip zone centroids would also provide a geographic coverage of the country, but not as sharply as district HQs. Fewer than half of the district HQs are at the same time also county HQs, so that many county HQs would not be recognized in the demand analysis if done purely at the district level. In the demand analysis, the approach is therefore to retain county capitals.
- > Some transport nodes are added for places that are not also district HQs. These are sea ports, airports, and border posts.
- Provision is also made for places of major economic activity, such as a mine or a plantation. (However, in practice, it was found that the geographic specificity of data does not go deeper than the district level implying that the district HQ also in effect represents that center.)

Considering district and county capitals, transport nodes and a provision for some additional traffic generation nodes, results a $\pm 170 \times 170$ origin-destination (OD) matrix. The place name vector is presented in Appendix A, and mapped in



Figure 5-1: Districts, Counties, Sea Ports, Major Airports and Border Posts

Source: Cardno Project Team

Apart from "national" demand at the district and county level, there will be purely local traffic as well. These movements correspond with "feeder" roads. To estimate these movements would require a zoning system that penetrates deeper than the district level. Also, it is quite unlikely that any feeder road will utilized close to its capacity. The analysis of feeder roads is therefore approached purely from an access perspective, i.e. linking rural communities effectively, and not based on a purely benefit-cost assessment (BCA) approach (transport benefit vs. transport cost).

5.1.3 Demand Composition

The demand for transport is two-fold: passengers and goods.

5.1.3.1 Passengers Transported

Passenger traffic reflects the spatial distribution of settlements, their size and people's incomes. There is obviously a close correlation between these factors and the nature and location of the real economy, i.e. people movements follow goods movement and vice versa (although this relationship diminishes in the case of bulk commodities).

5.1.3.2 Categories of Goods Transported

Goods traffic is quite country-specific, reflecting the stage of economic development (primary/extractive at one end vs. tertiary/service at the other). The description of the economy in section 3.1.2 and the plans to grow and diversify it discussed in section 3.1.3 point out that Liberian economy is essentially extractive, with limited value addition taking place. Exports are therefore of a commodity nature, imports are mainly manufactures and processed goods, and internal trade is mostly of basic agricultural products.

Each major product has a distinct demand and supply rationale. It is therefore useful to delaminate the "product mix" transported, to investigate every product separately, and then to reassemble the individual projections into a total forecast. Also, the major products transported can be classified into a handful of distinct categories to reflect similar dynamics of how these categories are likely to develop in future:

- Self-Produced Basic Needs are traditional agricultural crops and products produced and consumed at the household level, with small surpluses being transported to larger urban centers. The key ones are cassava, sugar cane, banana and plantains, and charcoal and firewood. These products will continue to fulfil basic needs, but will over time diminish in importance as the economy modernizes and grows
- Substitutable Imports are goods currently imported because of weaknesses in the national economy, but which have the potential to be produced locally and therefore replace the import stream. These include rice, protein (meat) and some consumer goods
- Non-Substitutable Imports are those that the country either does not (yet) have proven resources of (fuel oils and petroleum products), or which require a large-scale and sophisticated manufacturing capacity which is not currently planned for (consumer goods, cement, vehicles and fertilizer)
- Non-Concession Exports are sectors that Government has identified for support but which are earmarked for development by smaller-scale, local entrepreneurs. The main products are cocoa and coffee
- Concession Exports are those that require large capital investments and operating skills that would usually be obtained from international investors. These are iron ore, other mining (gold and diamonds), rubber, palm oil and forestry.

Most of the products considered in the demand forecast generate substantial shares of the total volume of demand, but this is not always so. Some products are included because they are fairly high value and/or because there are national strategies in place to promote these products, there would be an expectation to see them in the demand forecast. An example is cocoa, which has a small volume, high-ish value but is a target sector for development and export.

5.1.4 Trip Production Areas

The above categories of goods can be grouped into three main sectors, i.e. agriculture, mining and industry. The mining production areas are determined by the geological map of the country, as discussed further in section 5.2.5.1. Industry is located almost exclusively in the Greater Monrovia area. However, it is expected that it will grow and spread further into other areas over time.

Goods Categories	Agriculture	Mining	Industrial
Self-Produced Basic Needs	Х		
Substitutable Imports	Х		Х
Non-Substitutable Imports	Х		Х
Non-Concession Exports	Х		
Concession Exports	X	X	

 Table 5-1: Classification of Goods Categories by Sector

In the case of agriculture, the production footprint is more complex. Agriculture concessions (palm oil, logging, etc.) are mostly quite discretely located, similar to mining concessions. The one exception is rubber, which is not only produced under concession but also more informally. Non-concession exports (coffee, cocoa, etc.) are spread more widely, but still occur in somewhat specific locations. However, other crops that are consumed locally are distributed across the country and can be found in many districts.

The geographic distribution of each good is discussed in more detail in the relevant section below.

5.1.5 Trip Attraction Areas

As for trip production areas, the attraction areas can also be simplified into three categories. Goods will either be consumed locally or outside Liberia. For exported goods, the trip attraction zone will almost always be the major sea ports as gateway (exports by road and especially air will continue to be

negligible). Most goods consumed in Liberia will flow according to the distribution of the population. The attraction of some products may also depend on economic activity centers, but the data available does not really make it possible to distinguish between the attraction generated by population vs. economic activity, especially when population has already followed economic activity. The population distribution and other characteristics were previously discussed in section 3.1.1.

Goods Categories	Population	Industry	Export
Self-Produced Basic Needs	Х		
Substitutable Imports	X		
Non-Substitutable Imports	Х	(X)	
Non-Concession Exports			Х
Concession Exports			Х

Table 5-2: Classification of Goods Categories by Demand Driver

5.1.6 Demand Scenarios

Most of the attention in this document is on establishing a baseline of demand and transport activity, and to then motivate a defensible, conservative (i.e. realistic) growth path. There is a strong bias towards the past recent events and trends. New developments are brought into account if there is a fairly high degree of likelihood that they will occur. The realistic scenario therefore presents quite smooth growths.

It is possible to take a more aggressive (optimistic) position on some sectors, which then shows the effect of new developments that have less certainty of transpiring. But these often involve policy initiatives that are difficult to quantify and schedule in the forecast (e.g. the cassava industrialization strategy). Also, these are developments that hinge on unpredictable events (e.g. the recovery of international commodity prices). Therefore, the optimistic scenario implies faster growth with some step-changes in demand as well.

A separate pessimistic" scenario is not developed. Such a scenario will just be the "realistic" scenario played out over a longer period of time. Therefore, the approach taken with the demand forecast is to assume that generally activity will stay the same as the recent past or grow moderately (realistic), and in some cases, possibly boom (optimistic).

5.2 Cargo Projections

5.2.1 Self-Produced Basic Needs

The basic needs products are all of an agricultural nature, or at least natural by-products in the case of charcoal/fuelwood. Although the various agricultural products' contribution to total transport demand is discussed under different sub-headings (basic needs, non-concession exports and concession exports) below, it is useful to obtain a perspective of the relative shares of the major agricultural crops by showing them all together. The relative contributions of the crops also provide some justification for a more indepth analysis of e.g. cassava and rice and less attention on e.g. coffee and coccoa (notwithstanding that both are target export sectors). Figure 5-2 therefore shows the development of the various agricultural outputs from before the war to quite recently (2014). This dataset was obtained from the FAO – in the absence of this type of data being available from a national agency.

In terms of tonnage, in 2014, cassava made up nearly a third (30%) of output. Sugar cane (15%), paddy (unprocessed) rice (13%), palm oil fruit (12%) and banana and plantain (10%) were the other significant contributors. Even though high in value, the export-targeted crops of rubber (4%), cocoa (0.4%) and coffee (0.04%) made a tiny contribution in terms of physical volume.



Figure 5-2: FAO Agriculture Production Volumes (tpa)

Source: FAO Production Statistics

Note: The products are all shown in their raw (pre-processed) form. For example, palm fruit (shown) is reduced to crude palm oil, and sugar cane (shown) is processed into juice and other products

5.2.1.1 Cassava (BN1)

Cassava production is one of the primary sources of income and livelihood for rural farmers. Many farmers produce large quantities of cassava and manually process it into value-added products including farina (cassava flour), fufu and starch.²⁰

Cassava is the second most consumed staple food crop in Liberia, but the first staple-protein food (consumption of roots and leaves). Its primary use is as food crop, and in this capacity, the FAPS of 2009²¹ envisaged self-sufficiency in cassava by 2015. Furthermore, the Cassava Sector Strategy of 2010²² foresaw that this crop would in the near future make the transition from staple-protein food to a high value product and raw material for the processing industry. The Strategy notes that the promotion of the cassava sector can lead to a significant boost in the following areas: agro-food industry (cassava flour, chips, etc.), non-food industry (glue, starch, etc.), poultry and livestock industries (chicken feed, pig feed, etc.) and even bio-fuel (ethanol).

Figure 5-3 shows the key performance metrics of the cassava sector. From 2008 to 2010 (the last three years for which a detailed survey was done) the number of farms, area harvested and yield per hectare showed little variation. Production volume of fresh cassava has been stable around 500-530,000 tons/annum, or around 140kg/capita. It is grown throughout the country. The major cassava-producing counties in 2010 were Nimba (19%), Bong (11%), Grand Bassa (10%) and Lofu (9%).

 $^{^{20}}$ MOA: "Production Estimates of Major Crops and Animals", 2010

²¹ MOA: "Food & Agriculture Policy & Strategy", 2009 (date not specifically stated)

²² MOA & MoCI: "Liberia National Cassava Sector Strategy", 2010



Given the fairly constant rates of production in the recent past, the projection of cassava self-sufficiency, and the expectation that the population will shift consumption to more "modern" and convenient sources of food, it is foreseen that production for current types of use will remain at similar levels as today. The projection of cassava production therefore depends largely on the realization of the strategy to diversify the use of cassava. The Cassava Strategy did not set any quantitative targets and the production statistics do not yet show a noticeable increase. The approach is therefore to provide for a nominal step-up in production in the optimistic demand scenario.

As regards trip attraction, it is assumed that cassava consumption per capita is similar across the country. Attraction levels are therefore set according to the relative population sizes. The step increase in the optimistic production scenario is expected to gravitate to larger centres, relative to their size. Given the dominance of the Greater Monrovia area in the national economy, this implies that most of the step change would be located there.

There may well be a second-order effect in the form of processed cassava (in whatever form) moving around the country and even exported. This effect is probably too small to include explicitly in the demand forecast.

5.2.1.2 Sugar Cane (BN2)

Sugar cane was originally introduced as an export crop in the mid-19th century. In the 1950s and 1960s some large, commercial sugar enterprises were established. These were later converted into public Agricultural Development Projects (ADPs), but proved to unsustainable.²³

Today, sugar cane is cultivated mainly on the banks of the large rivers (St Paul, Cavalla, etc.). Cane juice is usually concentrated into cane syrup, some of which is worked up to rum. Sugar is also made by evaporating the juice further.

Refined sugar is all imported.²⁴ In 2008, this amounted to 29,500t (or, about 8.5kg/capita).²⁵ Sugar is not targeted as a growth sector in the National Export Strategy. Just for interest, if the national cane crop were converted into refined sugar only, a volume of about 33,000tpa of sugar could be produced.²⁶

²³ MOA: "Food & Agriculture Policy & Strategy", 2009 (date not specifically stated)

²⁴ MoCI: "2014 Annual Trade Bulletin"

²⁵ LISGIS: "Transport Sector Statistics Bulletin, 2009", Dec. 2009

²⁶ At a ratio of 8t of cane per 1t of sugar (<u>http://link.springer.com/article/10.1007/BF02942725</u>)

Sugar cane production levelled off at the commencement of the war, at about 220,000tpa. Current production is around 270,000tpa, and has been around that volume for a couple of years. This implies that the production of cane per capita has been declining, at a rate of about 1-2% per year.



Figure 5-4: Sugar Cane Production & Consumption

The sugar cane production areas are obtained from the 2010 Crop Estimate.²⁷ Households involved in cane production are most prominent in Nimba, and also Bong and Montserrado counties. In the absence of any statistics on the distribution of cane consumption, it has to be assumed that per capita consumption is similar across the country.

5.2.1.3 Banana & Plantain ("Musaceae") (BN3)

Starchy crops (potatoes, eddoes, yams, bananas/plantains) are used mainly as secondary food commodities and sources for income. Like rice, these are grown in upland farming areas.²⁸

Banana/plantain is included as a distinct commodity in this demand forecast because of the relatively large volume of output. In 2014, this crop made up about 10% of the volume of total agricultural output.²⁹ Production volumes were only slighted dented in the war period, and quickly recovered to the long-term trend. As shown in Figure 5-5, since the early 2000s output has been quite consistent, at a level of about 50kg/capita.

 $^{^{27}}$ MOA: "Production Estimates of Major Crops and Animals", 2010

²⁸ MOA: "Food & Agriculture Policy & Strategy", 2009 (date not specifically stated)

 $^{^{29}}$ FAO crop statistics





Source: FAO

The banana/plantain production forecast assumes that recent production per capita will be maintained. The 2010 Crop Survey does not include an estimate of households involved in this sector, but since production areas would be similar to rice, that crop's distribution is assumed by proxy. For trip attraction, like cassava, it is assumed that consumption per capita is the same throughout the country.

5.2.1.4 Charcoal & Firewood (BN4)

Almost all of Liberia's household thermal (cooking) energy requirements are met using mostly charcoal (urban) or mostly firewood (rural households). For cooking, people rely mostly on charcoal in the County Capitals and large towns and on wood in the more rural areas. ³⁰ It was estimated in 2005 that about 36,500t of charcoal was being produced annually³¹, or some 11kg/capita.

Some of the demand for biomass would be reduced by improved cooking technology, by increasing electrification and by increased incomes (which would cause people to make use of more modern energy carriers). Liberia has a grid electrification rate of less than 3% of the total population connected to grid power, and less than 0.5% of the rural population being connected.³² The rural electrification target is 35% by 2030. Whatever the tempo of implementation, a large-scale switch-out from charcoal and woodfuel as primary sources of thermal energy is unlikely to occur during the MMTMP demand projection horizon.

More pertinently for the demand forecast, though, is that the total volume is too small to locate in terms of places of production and attraction. Also, especially for woodfuel, production would be located quite close to demand and the movement will not really show up on the national transport network. Charcoal and woodfuel trip generation is therefore not projected distinctly. (However, these commodities' effect is included in the "other" category of goods transported.)

5.2.2 Substitutable Imports

From a trip production perspective, the substitutable import products would all grow strongly as imports from abroad are replaced by local production. Since this category of product is also closely tied to the

 $^{^{30}}$ Rural and Renewable Energy Agency: "Rural Energy Strategy and Master Plan for Liberia Until 2030", 2016

³¹ National Charcoal Union of Liberia (NACUL), quoted in Africa Energy Unit (AFTEG) : "Options for the Development of Liberia's Energy Sector", 2011

³² Rural and Renewable Energy Agency: "Rural Energy Strategy and Master Plan for Liberia Until 2030", 2016

development of the local economy and growth in per capita income, trip attraction volumes (at the point of consumption) will also increase.

5.2.2.1 <u>Rice (SI1)</u>

Rice is the staple food in Liberia, with cassava as major substitute. Rice is predominantly grown in upland environments by smallholder farmers. The major rice-producing counties are Nimba, Lofa and Bong, each accounting for around 20% of national production. About nine varieties are grown, but more than 90% of rice-growing households report using the "traditional" variety.³³ The trend in gross (see below) local rice production is shown in Figure 5-6. Liberia has recently maintained production at 300-330,000tpa, which is at a historic high. The average yield was 1,179kg/ha³⁴ which is apparently low by international standards.³⁵





The MoA calculates a rice "balance sheet", which shows the relationship between rice production, processing, consumption and imports. It assumes a typical consumption rate of 120kg^{36} of milled rice per capita per year. Considering losses in the field (10%), seed rice retention (5.2%) and milling losses (35%)³⁷, the "gross" production required is about 216kg of local crop per capita per year. Figure 5-7 shows how the shortage of local production translated into rice imports in the past. Imports have made up about 60% of total consumption in the last couple of years.

³³ MOA: "Production Estimates of Major Crops and Animals", 2010

³⁴ MOA: "Production Estimates of Major Crops and Animals", 2010

³⁵ MOA: "Liberia National Rice Development Strategy", 2012

³⁶ The LNRDS refers to 133kg/capita

³⁷ MOA: "Production Estimates of Major Crops and Animals", 2010



Sources: Calculated from FAO and MOA data, compared with NPA rice import data

The National Rice Development Strategy (LNRDS) aims to achieve rice self-sufficiency by doubling the local rice production by the year 2018. The LNRDS proposes to achieve this by increasing the rice productivity in both upland and lowland ecosystems, and by expanding the land area under rice cultivation in the lowlands. Productivity per acre of swamp (lowland) rice exceeds that of traditional upland rice.³⁸ Table 5-3 shows how the LNRDS aims to achieve the goal of increased production and national self-sufficiency.

		На	Yield (kg/ha)	Gross Production (Mt)	Milled Equivalent
Unland	2010	147,220	1,216	179,000	≈116,000
Opiano	LNRDS 2018	190,000	2,000	380,000	≈247,000
Lowland	2010	104,010	1,126	117,000	≈76,000
	LNRDS 2018	110,000	≈4,500	≈500,000	≈325,000
Total	2010	251,230	1,179	296,000	≈192,000
	LNRDS 2018	300,000	≈2,930	≈880,000	≈572,000

Table 5-3: Rice Production Strategy

Sources: 2010 data from MOA: "Production Estimates of Major Crops and Animals", 2010. 2018 assumptions from LNRDS

By the LNRDS estimate, rice imports in 2015 should have been around 140,000t. However, actual imports were just above 280,000t, had been around that level for a couple of years, and was about at the same level as imports were in 2009 (the base year of the LNRDS). This suggests that the rice promotion and import substitution strategy has not yet taken off as planned. A realistic demand path would be a marginal increase in hectares under cultivation and improvement in yields, say, achieving the LNRDS goals over two decades. This would have the effect of maintaining imports roughly at the current levels. An optimistic projection would be for the LNRDS objective of self-sufficiency to be achieved in just a decade or so.

5.2.2.2 Livestock & Fisheries (SI2)

The 2010 State of Food Security report³⁹ notes that about 40% of the Liberia population consume limited or insufficient nutritious foods, with a diet dominated by cereals with minimal or no protein-rich

³⁸ FAPS, p.21

 $^{^{39}}$ MOA: "The State of Food and Nutrition Security in Liberia, 2010", October 2010

foods like fish, pulses and meats. Meat and milk consumption is low.⁴⁰ Over 80% of the population directly depends on fish for animal protein supply⁴¹, and fish contributes 65% of the animal protein intake.⁴²

One of the sectors targeted for export promotion is fish and crustaceans.⁴³ The industrial fisheries sector was relatively well-equipped and grew strongly but lost much of its capacity during the war. Figure 5-8 shows the size and composition of the catch as reported to the FAO. By the mid-2000s it was in the range of 10-11,000tpa, with some 90% in the form of marine (mostly industrial) fishing. The reported numbers show that the contribution of inland (all artisanal) fishing has grown. Recent total (marine and freshwater) production volumes are about half of pre-war levels, at roughly 10,000tpa.



Figure 5-8: Liberian Fish Production

The Fish and Crustaceans Export Strategy⁴⁵ proposed a program to develop the fisheries sector. However, it did not make any projections of likely or possible future production. Nevertheless, the official fish production statistics equates to less than 3kg of fish per capita per annum, which seems to significantly underestimate the actual fish consumption. It can only be concluded that the local, artisanal fisheries sector is more active than recorded. This sector cannot maintain a cold chain, which implies that fish is consumed close to where it is caught. There is likely to be a small – and indeterminable – impact on transport demand.

The same conclusion applies to other meat products. The Food & Agricultural Policy notes that notwithstanding the country's large natural endowment of pasture land and coastline, the meat production sector remains underdeveloped. An impression of the relative distribution of livestock activity across the country may be obtained from Figure 5-9, which shows the households involved with rearing different animals in 2010. Nimba, and to a lesser extent Bong, dominate this sector.

Source: Fishery Committee for the West-Central Gulf of Guinea⁴⁴

 $^{^{40}}$ WFP: "Cross-border trade and food security – Liberia & Sierra Leone", May 2010

⁴¹ MOA: "Food & Agriculture Policy & Strategy", 2011

⁴² International Trade Centre: "National Export Strategy, 2014-2018", 2014

⁴³ International Trade Centre: "National Export Strategy, 2014-2018", 2014

⁴⁴ http://www.fcwc-fish.org/fisheries/statistics/liberia

⁴⁵ International Trade Centre: "Liberia Fish and Crustaceans Export Strategy, 2014-2018", 2014





Source: MOA Crop Survey, 2010

An estimated 26,000 heads of live cattle (3,000t) and 15-16,000 head of live sheep and goats (312t) were imported from neighboring countries in 2005/2006. But that excludes the frozen meat imported mostly by supermarkets in Monrovia. Frozen product imports were running at 30-40,000tpa between 2013 and 2015.⁴⁶ If indeed consumed mainly in the Monrovia area, the frozen product consumption per capita has been between 20-30kg/capita/annum for a number of years.

The Food & Agricultural Policy includes various measures to support and promote the livestock sector. However, it does not make an estimate of the sector potential. The view taken here is that the local livestock sector will gradually grow and modernize, but without a strong push (e.g. in the form of livestock farming concessions), the current pattern of animal rearing and trading will remain in place. That implies that Monrovia will continue consuming imported meat and the rest of the country will rely on localized meat production.

5.2.2.3 Self-Produced Consumer Goods (SI3)

As previously shown in Figure 3-4, the manufacturing sector makes up only about 5% of GDP. Although this is similar to pre-war levels expressed as a share of the economy, in terms of actual activity the sector has shrunk substantially. Figure 5-10 shows the value added in manufacturing over time, but note that this is in terms of current (i.e. including inflation) USD. (The U.S. dollar experienced an average inflation rate of 2.70% per year between 1988 and 2014, i.e. USD 1 in 1988 was worth USD 2.00 in 2014.) In absolute terms, the manufacturing sector therefore is about half the size today compared with what it was in 1988.

⁴⁶ NPA Port Statistics



Figure 5-10: Manufacturing (USD mill, current)

Source: World Bank Development Indicators

The main areas of local manufacturing are beverages and cement. Other manufacturing includes household products, paints, varnishes, mattresses, industrial oxygen, bakeries, woodworking, metal working, plastic, rubber products and clothing, again for the purpose of supplying the domestic market.⁴⁷ The Central Bank keeps a record of major manufacturing outputs. The non-mining and non-agricultural products the CBL deems significant enough to track are shown in Table 5-4. The list shows the dominance of cement and beverages. To place the total annual volume of the recorded products into perspective, and assuming that the unit of transport is a full container (at 15t/container), then cement generates a transport demand of 44 containers per day, and non-cement products 6 containers per day for the whole country.

Manufacture	Original Unit	Annual Volume (original units)	Factor per tonne	Annual Tonnes	% (excl. cement)
Cement	Mt	240,929	1	240,929	-
Spirits	Litre	346,415	1,000	346	1%
Beer	Litre	7,255,221	1,010	7,183	23%
Stout	Litre	6,851,576	1,010	6,784	22%
Malta	Litre	648,086	1,010	642	2%
Soft Drinks	Litre	8,577,412	1,000	8,577	27%
Oil Paint	Gal	106,779	0.00090	96	0%
Water Paint	Gal	101,506	0.00090	91	0%
Varnish	Gal	11,343	0.00090	10	0%
Manoline Hair Grease	Kg	14,146	1,000	14	0%
Soap	Kg	380,196	1,000	380	1%
Candle	Kg	177,535	1,000	178	1%
Chlorox	Litre	1,218,081	0.00105	1,279	4%
Rubbing Alcohol	Litre	277,951	0.00079	219	1%
Thinner	Gal	12,078	0.00087	10	0%
Mattresses	Pcs	99,575	0.040	3,983	13%
Mineral Water	Litre	1,461,347	1,000	1,461	5%
Total inl. Cement				272,184	
Total excl. Cement				31,255	

Table 5-4: Annual Manufacturing Volumes (2016)

Source: Central Bank of Liberia Quarterly Bulletins

⁴⁷ MCI: "Industry for Liberia's Future", February 2011

The projection of cement output is addressed in more detail in section 5.2.3.3. As regards other local manufactures, the above list is obviously not exhaustive of all local production. From the origin-destination surveys it can be seen that "consumer goods" make up about a fifth or more of what is being transported. However, that would include both imports and local manufactures. Given the relative volume of containerized imports (730,000t in 2015), most of that traffic would probably be made up of imports.

In the absence of any better evidence, a nominal provision of 50,000tpa is made for local manufactures in 2017, growing at the same rate as the economy i.e. 5%/annum).

5.2.3 Non-Substitutable Imports

The Liberian economy is heavily import driven, with more than 90% of what is consumed brought from overseas. About 5% of such imports are sourced from intra-regional trade.⁴⁸ The products considered under this category are unlikely to be substituted by local production in the timeframe of the Transport Master Plan.

5.2.3.1 Consumer Goods (Containers) (NS10)

The NPA statistics show that one of the major categories of import is containerized goods. These statistics do not provide a further break-down of the contents of the containers, but it is possible to obtain an impression of this from other data sources. For example, Table 5-5 shows the composition of total imports in 2016 (by value). Many of the products are accounted for specifically elsewhere in this report, and would therefore not be "containerized" goods. The main product groups likely to be imported in containerized form are therefore manufactures (electronics, household goods, clothing/textiles, etc.) and chemical-related (e.g. pharmaceuticals, cosmetics, etc.).

Product	USD mill.	%	Comment	
Petroleum	298	25%	Discussed congrately in section 5.2.2.2	
Other Fuel & Oil	30	3%	Discussed separately in section 5.2.5.2	
Machinery & Equipment	272	23%	Includes mining equipment. Likely to be dominated	
	212	2370	by motor vehicles, see 5.2.3.4	
Other Food	192	16%	Some of this will be frozen meats, see 5.2.2.2	
Rice	100	8%	Discussed separately in section 5.2.2.1	
Manufactured Goods	168	14%		
Chemicals & Related	95	8%	Likely to be containerized	
Beverages & Tobacco	22	2%		
Other Commodities	26	2%	Including cement, see 5.2.3.3	
Total	1,204	100%		

Table 5-5: Imports by Value (2016, USD mill.)

Source: CBL Quarterly Financial & Economic Bulletins

Note: The table appears to exclude the "importation" of vessels registered in the Liberian ships register, which value is sometimes shown in national trade statistics

Note: The values reported are substantially lower than recorded by means of mirror data (i.e. trade partners' data) and reported by TradeMap of the ITC (International Trade Centre)

Figure 5-11 shows the volume of incoming containers at the four sea ports. (There could be some container traffic across land borders, but this is expected to be inconsequential.) Import volumes at the three outer ports are typically between 2-3% of the throughput at the Free Port of Monrovia.

There has been a sustained growth in containerized imports, roughly in line with the expansion of GDP. The demand for imported goods would be expected to continue rising with local income levels, i.e. by the same growth rate as GDP. A small share of these imports will come through the outer ports, but based on past trends which have been quite volatile, the most sensible approach is to just award each

⁴⁸ Ministry of Commerce & Industry: "Strategic Plan 2013-16", p.11

of these ports a nominal share based on a rolling average (FPM = 97.7%, Buchanan = 1.8%, Greenville = 0.4% and Harper = 0.2%).



Figure 5-11: Development of Container Imports at NPA Ports

Source: NPA Traffic Statistics

Note: Values for Buchanan, Greenville and Harper available for 2013-2015 only. TEUs for FPM interpolated between 1989-2008 and 2008-2013

5.2.3.2 Petroleum Products & Heavy Fuel Oil (HFO)

In decades of oil exploration activity by international oil companies, no onshore commercial hydrocarbon reserves have been discovered in Liberia. However, offshore exploration may hold some potential. The National Oil Company of Liberia (NOCAL) oversees the "upstream" activities (exploration and development) of the oil sector. In 2015, there were six petroleum companies with exploration rights.⁴⁹ However, even if a commercially viable find were made soon, it would take in excess of a decade (and possibly even several decades) to commercialize.⁵⁰ The upstream petroleum sector will therefore not impact on the export or import substitution (of petroleum products) profile for purposes of the NMMTMP.

As regards "downstream" activities, the country's only refinery was scrapped before the commencement of the civil conflict. Therefore, all refined petroleum products and lubricants are today imported. The Liberia Petroleum Refining Corporation (LPRC) has the exclusive right over importation, sales and distribution of petroleum products within the Republic of Liberia, which rights it may license to others. It has recently been reported that a feasibility study is being undertaken into developing a 100,000-b/d refinery in Buchanan, but this prospect has been in the offing for some time.⁵¹

⁴⁹ MFDP: "Annual Economic Review, 2015"

⁵⁰ World Bank: "From Commodity Discovery to Production: Vulnerabilities and Policies in LICs"; Global Economic Prospects, January 2016

⁵¹ <u>http://www.ogj.com/articles/2016/06/liberian-firm-lets-contract-for-refinery-feasibility-study.html</u>

Table 5-6 shows the main petroleum products imported and their principal uses. Most of the petroleum usage in the country is for the transportation sector, with some used for power generation and also for household purposes.

Known in Liberia as	Abbre- viation	Also known as	Used for
Liquid Petroleum Gas	LPG	Propane	Cooking, heating
Premium Motor Spirit	PMS	Gasoline, petrol	Transport
Jet Fuel	Jet-A1	Aviation fuel	Aviation
Kerosene	Kero	Paraffin	Cooking, lighting
Diesel	AGO	Automotive gas & oil, Distillate Fuel Oil	Transport, power generation, agriculture, construction
Heavy Fuel Oil	HFO	Residual fuel oil	Power generation, shipping

Table 5-6	: Petroleum	Products	&	Uses
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Figure 5-12 presents the recent volumes of petroleum imports by major product. At least four entities report on volumes, however, their estimates are sometimes strikingly different. LPRC and NPA report annual statistics, and in two overlapping years (2013 and 2014) they report similar values. Records of the US Energy Information Administration (EIA) go back to 1980, but this data set is only updated every couple of years. The Central Bank of Liberia (CBL) reports petroleum consumption figures quarterly, however, these values fluctuate quite considerably from year to year, and are either substantially above or below the other sources. As shown below, there seem to be above enough corresponding data points in 2013 and 2014 to conclude on the likely volumes of petroleum imported, i.e. slightly higher than reported by NPA and slightly lower than recorded by LPRC. These guesstimates are shown in red: about 310,000t in 2013 and 330,000t in 2014. (Note that LPRC was anticipating imports of 380,000t in 2015, but NPA only recorded 254,000t.)

(It needs to be pointed out that petroleum products are important enough both in terms of volume and value to <u>investigate the precise amounts and to reconcile</u> between the various sources. However, such an inquiry falls outside the scope of the MMTMP assignment.)



Figure 5-12: Reported and Guesstimated Petroleum Volumes

The mix of applications makes forecasting petroleum needs quite complex. The transport applications are expected to increase in line with the general growth in the economy as well as increased consumption per capita usually associated with higher incomes per capita. Structural changes in the transport market, especially the preference for gasoline vs. diesel engines, could rebalance demand

between petroleum products. And growth in the energy applications should be capped by the extension of the electricity grid and introduction of non-fuel rural energy systems.

Gasoline (PMS) (NS21)

From the above estimates, recent levels of gasoline consumption have been quite stable. This probably corresponds to a stagnant economy, as it is generally recognized that transport (and therefore gasoline) consumption is tightly coupled to the economy. There is insufficient tie series data in Liberia to establish the relationship between changes in gasoline demand and GDP, but it is probably reasonable to assume that gasoline consumption will follow at least the GDP trend.

LEC Petroleum Requirement

A major consumer of petroleum products is the Liberia Electricity Corporation (LEC). It generates power at the LEC Bushrod Island facility, but apparently only during the four dry months of the year when water levels drop and the Mt Coffee hydro station is idle.

Existing thermal capacity is 38MW (LEC) plus 10MW (IPP), and LEC has indicated that it plans to add another 20MW in the next year or so. To match the Mt Coffee capacity (88MW), a further 20MW of thermal capacity would be required. Based on the December 2016 and January 2017 fuel order, formal (LEC) thermal generation consumes about 8,000t of diesel and 6,000t of HFO in the four dry months (i.e. to operate 38MW). An additional 20MW HFO/LFO genset would require roughly 3,500t of diesel and 4,500t of HFO in a dry season.

LEC only generates and supplies power in the Monrovia area, and supplies power to some other towns by means of cross-border imports from Cote d'Ivoire. There is therefore an indeterminate amount of informal (private) power generation across the country, making use of diesel. The Rural Energy Master Plan⁵² has set the goals of increasing the household electrification rate outside of Monrovia of 10% in 2020, 20% in 2025 and 35% in 2030. The 2010 base was about 4%. The amount of household self-generation could be of a similar rate.⁵³

Although the diesel consumed in own generation cannot readily be isolated from diesel used in transport, non-transport energy consumption is also linked closely to economic growth (i.e. like energy consumption for transport). Therefore, for purposes of this demand forecast, own-generation diesel use is rolled up and treated together with diesel in general.

Diesel (AGO) (NS22)

Diesel would mostly be used for transport purposes. That includes road as well as rail transport. A moderately efficient iron ore rail operation could consume around 0,003l/tkm (net) of diesel.⁵⁴ This implies that the two iron ore concessions would together have been consuming about 3,500tpa in the recent past, which may increase to 7,000tpa at the projected levels of operation (refer section 0). There would also be other diesel applications at the mines. Rail is therefore responsible for a fairly minor share of the non-LEC diesel volume of about 160,000tpa, even if the iron ore concessions increase production substantially.

For non-LEC diesel consumption, the same growth assumption is applied as for gasoline, i.e. a growth rate commensurate with the projected GDP growth.

Other Petroleum Products (NS23)

Although the EIA shows HFO imports in 2013, the LPRC reports that HFO has only been imported since 2014. Subtracting the allocation to LEC, there is a further 10,000tpa consumed in the non-electricity economy. Industries that would use HFO include shipping (bunker fuel) and possibly mining (power generation). The amount of HFO is small, and it is probably not transported in the main national

⁵² Rural & Renewable Energy Agency: "Rural Energy Strategy and Master Plan for Liberia Until 2030", April 2016

⁵³ Master Plan Technical Report, p.31

⁵⁴ Calculated from Rail CRC: "Rail Research Industry Report", December 2006

transport network (just to and from the ports, and along the concessioned railways), implying that a nominal provision for HFO in the demand forecast is appropriate.

The data sources record Jet Fuel, but it is suspected that this category of fuels includes kerosene. Kerosene is used as a household lighting source. Only the EIA shows records of historic kerosene consumption separately from Jet Fuel, indicating that kerosene consumption was double that of Jet Fuel in the mid-2000s, at around 10,000tpa. Given that household kerosene consumption should have competes with other household energy sources and could therefore have remained flat, and considering the recovery in air traffic after the war, for purposes of the demand forecast the split between kerosene and Jet Fuel is assumed at half-half (i.e. about 10,000tpa each).

Various local suppliers provide LPG and some even have LPG filling plants, however, LPG imports are not isolated in any of the sources of petroleum products import statistics. The only available estimate of LPG consumption is by the EIA, i.e. about 100 bbl/d (or about 5,000t/annum). LPG is almost only available in Monrovia. The Rural Energy Strategy has as a goal that cooking gas should be available in all county capitals and gas stations at affordable prices with at least one reception and storage facility in Liberia.⁵⁵ A fairly aggressive growth rate could therefore be expected (possibly double GDP growth?), as well as a roll-out towards the rest of the country.

5.2.3.3 Clinker & Cement (NS31 & NS32)

Liberia Cement Corporation (Cemenco) operates the only cement plant in the country, on Bushrod Island, Monrovia. It is a grinding plant (mill), i.e. a facility that grinds the hard, nodular clinker from the cement kiln into cement, with an annual capacity that was expanded to 500,000tpa in 2013.⁵⁶ Dangote has reported that it plans to build an import or grinding facility in Liberia, with a capacity of 750,000tpa.⁵⁷ The timing of this prospective investment is not known, having been periodically publicized since 2012.⁵⁸

The cement balance (capacity, production, import and consumption) for recent years is as shown in Figure 5-13. Although the CEMENCO plant capacity exceeds local demand, about a third of the cement required was imported. This is of course over-and-above the importation of clinker as feedstock for local production, all of which is imported. The total annual final cement consumption therefore was in the order of 400,000t. That equates to cement consumption of about 100-110kg per person.

⁵⁵ Rural and Renewable Energy Agency: "Rural Energy Strategy and Master Plan for Liberia Until 2030", 2016

⁵⁶ http://www.heidelbergcement.com/en/node/1368

⁵⁷ <u>http://www.dangotecement.com/operations/liberia/</u>

⁵⁸ <u>http://allafrica.com/stories/201203200566.html</u>, <u>http://venturesafrica.com/dangote-invests-20-million-in-liberias-cement-sector/</u>, <u>http://venturesafrica.com/dangote-invests-20-million-in-liberias-cement-sector/</u>



Figure 5-13: Cement Consumption & Sources

Sources: Central Bank of Liberia, National Port Authority, CEMENCO

Figure 5-14 shows the relationship between economic activity (expressed as GDP/capita) and cement consumption per capita for selected countries in 2012. There clearly are a number of outlier countries that do not conform to the norm (China, Saudi Arabia, Qatar, etc.), typically ones with large national infrastructure investment programs. Looking past these, the lowest income, developing countries usually have consumption levels of around 100kg/capita; emerging economies like the BRICS countries consume in the 300-600kg/capita range; with more mature economies settling back at around 350kg/capita. These are rough numbers, but they do provide an indication of the likely consumption expansion path for a country like Liberia. It is suggested that the consumption rate could increase to around 125kg/capita in the next decade or so (i.e. a quarter more than the present level).



Figure 5-14: GDP/Capita vs. Cement Consumption/Capita (2012)

Source: Davidson, E: "Defining the trend: Cement consumption versus Gross Domestic Product", Global Cement Magazine, June 2014 Note: Trend fit by Cardno (conceptual only) It is possible that specific projects could boost the consumption level. These would include infrastructure projects in general, but mining projects in particular. In the optimistic scenario, it is assumed that the consumption level could increase by another quarter still (i.e. to 150kg/capita).

There does not appear to be an explicit strategy for the domestic cement industry, e.g. not in the Liberia National Trade Policy or Industrial Policy. At present, the CEMENCO plant operates at around 60% of capacity. If this were increased to 80% CEMENCO would nearly satisfy domestic demand. At the same utilization rate, the Dangote investment would be required after about ten years from now. Any domestic production shortfalls will be made up by cement imports. And all local cement production will use imported clinker as feedstock.

5.2.3.4 Vehicles (NS40)

All Liberian vehicles must be re-registered annually, implying that the annual number of registrations should provide a good indication of the official (registered) vehicle population. In 2016, this number was in the order of 25,000 vehicles,^{59 60} as further disaggregated in Figure 5-15. There were about 21,000 passenger cars, 2,500 commercial vehicles and fewer than 1,000 buses. The official number of motorcycles was some 1,800, but this is clearly an understatement of actual numbers. The recorded vehicle population size fluctuated over the five years shown, whereas the expectation would have been for a steadily growing number. As shown later-on, about 6,000 vehicles are imported per year, which, given that vehicles are operated for a long life in Liberia, is a further indication that the official statistics understate the actual vehicle numbers.



Figure 5-15: Annual Vehicle Registrations

Source: MOT Div. Research, Statistics & Information Management

Based on the official statistics, the Liberian vehicle pool compares with other countries as shown in

⁵⁹ MOT: Data Tracking on Quantity and Revenue of Motor Vehicles & Motorcycles Registered" (Division of Research, Statistics & Information Management, April 2017)

⁶⁰ The World Heatlh Organization (WHO) reports that there are 1,085,075 vehicles registered in Liberia ("Global status report on road safety 2015", Statistical Annex

Figure 5-16. For both passenger cars and commercial vehicles, there appears to be a positive relationship between income (GDP/Capita), with the ratio attenuating at higher levels of income. As Liberia pursues goals of economic growth, it may be expected that it will "climb" the vehicle population curve.

Figure 5-16: Vehicles per Capita – Africa (units/1,000 population)

Commercial Vehicles per 1,000

Passenger Cars per 1,000 Population



Source: International Organization of Motor Vehicle Manufacturers⁶¹ (with actual Liberia numbers) Note: Trend fit by Cardno Project Team (conceptual only)

Like many African countries, the passenger vehicle market is dominated by the import of second-hand cars.⁶² Liberian regulations generally allow the importation of used vehicles up to 12 years of age.

Vehicle imports manly take place at the four the ports, as shown in Figure 5-17 for 2013-2015. (There is some informal vehicle importation at land border posts, mostly Ganta and Loguatuo.) Although Greenville had one specific busy year, Monrovia is the dominant entry point. Also, although there is generally a small number of vehicles that are re-exported, but in 2015 this made up a large part of the vehicle trade. At Monrovia, vehicles are handled roll-on roll-off (RoRo) (FPM only) or containerized, but only containerized at the other ports. Assuming a 2t average weight⁶³, net imports were around 11,800, 6,100 and 5,900 units respectively in of the three years.



Figure 5-17: NPA Vehicle Imports/Exports (tpa)

Source: NPA port statistics

⁶¹ http://www.oica.net/category/vehicles-in-use/

⁶² There is a small, informal local vehicle assembly trade where Bajaj RE60 (Qute) "box" cars and auto rickshaws are assembled from knock-down kits.

⁶³ The weight of a car ranges from about 1.3t for a compact car to 2.0t for a large car. A small truck ranges from 5-7t.

In terms of forecasting the number of vehicles imported the actual growth of the vehicle population cannot be determined from the change in registered vehicles over time (as shown previously, the total of vehicles measured in that manner remains fairly flat). The number of actual imports also do not display a clear trend. It is therefore appropriate to reserve a nominal amount of vehicle import activity, which is assumed at 10,000 units per annum (i.e. 20,000tpa), allocated three quarters to Monrovia and one quarter to Greenville ports.

5.2.3.5 Fertilizer (NS50)

As the agricultural sector matures, it is expected that farming will increasingly make use of modern fertilizers. The International Fertilizer Development Centre (IFDC) recently made an estimate of the fertilizer requirement⁶⁴, and that has been adapted in this report to reflect the crop production projections previously discussed in chapter 5.2.1 (cassava, sugar cane and banana/plantains) and section 5.2.2.1 (rice).

Table 5-7 shows the calculation of the fertilizer demand. Firstly, crop volume growth from 2012 to 2017 is based on the volumes projected in the National Agriculture Investment Plan (NAIP). For interest, the IFCD/NAIP volumes are compared with those in the Cardno forecast. For the individual crops included in the Cardno forecast, the base year (2012) totals are alike. The Cardno rice forecast (based on the rice balance discussed in section 5.2.2.1) is significantly more aggressive, while the volumes of the more traditional crops are projected to grow slightly slower than the NAIP projection. The selected main crops as per the Cardno forecast make up 91% of the crops considered in the IFCD/NAIP volumes. IFCD estimates that a further one third of crops are not considered in their total crop estimate.

Secondly, an assessment is made of the crop nutrient removal rates and the fertilizer required to reinstate the nutrient level – as reflected in the "fertilizer ratio" in Table 5-7. Thirdly, a conceptual allocation is made for the fertilizer requirements of the crops not specifically assessed.

Groe	20	2012 2017		17	Fertilizer	Fertilizer 2017	
Стор	IFCD	Cardno	NAIP	Cardno	Ratio	IFCD	Cardno
Cassava	512	529	685	540	0.003	1.9	1.5
Rice (paddy)	271	* 303	363	* 899	0.021	7.5	18.5
Banana & Plantain	168	174	226	208	0.027	6.2	5.7
Sugar Cane	264	273	353	265	0.003	1.1	0.8
Sub-Total	1,215	1,279	1,627	1,912		16.6	26.5
Other Crops Assessed	110		148		0.016	2.4	3.81
Sub-Total	1,325		1,775			19.0	30.3
Crops Not Assessed	424		568			6.0	9.6
Total	1,749		2,343			25.0	39.9

Table 5-7: Fertilizer Consumption Requirements

Sources: IFCD and Cardno own projections

Notes: * This is the gross (paddy) rice volume

Applying the same approach to the Cardno crop projections, fertilizer consumption should reach about 40,000t by 2017. The requirement would be 53,000t by 2032.

The IFCD estimated that about 3,000t of fertilizer was consumed in 2012. Since there is no domestic fertilizer manufacturing industry, this had to be imported (although it does not show up in the port statistics). The IFCD projection therefore foresees a growth in demand from practically no fertilizer use currently, to an adequate level to maintain soil fertility levels by 2017. So, this approach provides for both a sizeable increase in crop volumes AND an adequate ratio of fertilizer use. A more realistic approach would be to assume that there will be some phase in of fertilizer use.

Based on the usage ratios shown in Table 5-7, it is in principle possible to calculate a crop-specific demand for fertilizer. However, the crop projections themselves are at best indicative, the fertilizer consumption phase-in rate is uncertain, and the main crops have fertilizer factors at the low end of the scale. It is therefore appropriate to acknowledge these uncertainties and rather provide for an indicative

⁶⁴ IFDC: "Liberia Fertilizer Assessment", October 2014

level of fertilizer use in the demand forecast. The approach followed is to smoothly grow the current level to two thirds of the potential 2032 level indicated previously.

5.2.3.6 Other Imports (NS60)

The NPA port statistics show up some imports that are too small to warrant investigating in-depth in this demand forecast. The most prominent of these are:

- Wheat. Liberia does not grow any type of wheat and relies exclusively on imports to meet demand. Imports are both in the form of wheat grain (there is a milling company in Monrovia - Premier) and wheat flour. The typical imports are between 20-30,000tpa. The NPA and other sources show that the volume was significantly higher around 2014 possibly because of food aid related to the Ebola outbreak. Wheat flour products are readily available in urban areas and there is some demand in main markets in rural areas, where small quantities of these products are increasingly available. Wheat consumption levels should follow the trend in GDP/capita growth (i.e. about 3%/annum).
- Maize. Maize imports do not specifically appear in the NPS statistics, but are reported elsewhere.⁶⁵ The imported volumes are apparently similar to wheat, i.e. around 20,000tpa. Domestic maize production takes place in the same areas as cassava is cultivated. Production is of a similar volume as imports, and has been stable for a number of years.^{66 67}
- Intermittent Products. Quarrying/mining products such as Limestone, Bentonite and Barie (Crush aggregate), agro products such as wood chips and sawn timber, and scrap metal, appear from time to time in the NPA statistics. However, the volumes are small and the activity so intermittent that these are most appropriately dealt with by adding a little fat to the overall forecast.
- <u>"Other"</u>. The NPA shows both "other imports" and "other exports". Other imports peaked at 0.3mtpa in 2014, but are typically less than 100,000tpa. Other exports are usually below 10,000tpa.

5.2.4 Non-Concession Exports

The Liberian National Export Strategy⁶⁸ targets five product sectors (cassava, rubber, cocoa, fish and crustaceans, and oil palm) for export promotion. Cassava had already been addressed in a bespoke strategy in 2010. The next focus areas would be tourism and furniture.

Since cassava will be predominantly a basic needs product for the time-being, it was discussed in section 5.2.1 above, and by the same token rubber and palm oil are discussed under the "concession exports" in section 5.2.5 below.

As a general comment on the target export sectors, it should be noted that these are all of a primary (extractive and harvesting) nature. Although the aim is to add value to the raw commodities obtained, these are still largely unprocessed, compete against international suppliers and are therefore exposed to somewhat volatile commodity demand and price cycles. Any medium to long-term forecast of demand and production must therefore be treated with caution.

5.2.4.1 Cocoa (NC10)

Cocoa and coffee are produced mainly by smallholders and exclusively for export. In 2010, about 36,000 households were involved in cocoa production.⁶⁹ Liberian production was depressed until about 2010 when pre-war output was again achieved. In 2011 and 2012, about 12,000tpa was produced, falling back to between 7-8,000t thereafter.

⁶⁵ E.g. in FAO/WFP: "Crop and Food Security Assessment – Liberia", December 2014

⁶⁶ <u>http://www.factfish.com/statistic-country/liberia/maize,%20green,%20production%20guantity</u> (reporting FAOSTAT data)

⁶⁷ IFDC: "Liberia Fertilizer Assessment", October 2014

⁶⁸ International Trade Centre: "National Export Strategy, 2014-2018", 2014

⁶⁹ MOA: "Production Estimates of Major Crops and Animals", 2010



Figure 5-18: Cocoa Production

Source: FAO Agriculture Production Statistics

The global cocoa market comprised 3.9mt in 2016. The major suppliers are Côte d'Ivoire (39%) and Ghana (21%).⁷⁰ Global growth was 7% per annum between 2008 and 2012.

The Cocoa Export Strategy⁷¹ notes that Liberia faces an uphill battle as it seeks to position itself with these strong regional competitors, with Côte d'Ivoire having a global reputation for supply capacity and consistency and Ghana a known for supplying high-quality cocoa. Also, prices are fairly unstable, reacting especially to supply-side events.

The Cocoa Export Strategy develops a comprehensive implementation plan, but does not venture a projection of likely output. In any case, even a quite dramatic increase in cocoa production would still contribute only a fraction to total transport demand, obviating the need to take a view on this sector specifically. Rather, a nominal provision of 15,000tpa throughout the forecast period is made.

5.2.4.2 <u>Coffee (NC20)</u>

Coffee is not a targeted export commodity. It is listed here only for completeness' sake given that it used to be a major crop in the past.

By both value and weight, coffee production in Liberia is even smaller than cocoa. The number of households involved is about two thirds of those in cocoa (i.e. 24,000).⁷²

Coffee volumes are quite small, having peaked at 13,000t in 1980, but since 2010 not reaching 1,000tpa. At the resolution of the national demand forecast, these volumes are too small to justify considering coffee as a stand-alone contributor to traffic. Here too a nominal provision (5,000tpa) is added to the forecast.

⁷⁰ World Bank: "Commodity Markets Outlook, January 2017"

 $^{^{71}}$ International Trade Centre: "Cocoa Export Strategy 2014-2018", 2014

⁷² MOA: "Production Estimates of Major Crops and Animals", 2010

5.2.5 Concession Exports

The National Bureau of Concessions (NBC) keeps a register of active concessions. However, a more comprehensive source is LEITI (Liberian Extractive Industries Transparency Initiative) which keeps a record of all concessions whether active or not.

5.2.5.1 Mining

Liberia's principal mineral resources are iron ore, alluvial gold and diamonds. There are also traces of platinum, uranium and niobium, and base metals such as nickel, cobalt, tin, lead and manganese. Industrial rocks and minerals such as sulphur, phosphates, clays (kyanite), granite, silica sand, heavy mineral sands (rutile & ilmenite) and diabase/dolorite are also known to exist in both small and large quantities. Government is committed to attracting and enabling private sector investments for the development of mineral deposits, particularly iron ore mines, and to promote new investments in exploration and development of gold, diamonds, base metals and other mineral deposits.⁷³ Figure 5-19 shows the location of mining concessions to demonstrate the geographic distribution of mining activity in the country.



Figure 5-19: Mining Concessions

Source: National Bureau of Concessions

Iron Ore Concessions (CE11)

West Africa has numerous deposits and major resources of iron ore. It accounts for about 15% of African production with most mines located in Sierra Leone, Guinea, Cote d'Ivoire and Liberia. The Simandou deposit in Guinea is considered to be the sixth-largest iron ore deposit in the world.^{74 75} In Liberia, there are eight major deposits, as shown in Figure 5-20.

⁷³ Ministry of Lands, Mines and Energy: "Mineral Policy of Liberia", March 2010, Section 3 (Mineral Endowment)

⁷⁴ MOLM&E: "The potential for iron ore in Liberia", 2015

⁷⁵ Although options to export Simandou ore via Liberia have been explored in the past, the Guinean government's policy at present is that when developed, exports will be transported via its own territory only



Figure 5-20: Iron Ore Deposits

Source: Ministry of Lands, Mines & Energy: "The Potential for Iron Ore in Liberia", 2016

Historically, Liberia was a major global producer of iron ore. But production levels declined from about 1980 until 1992 when the Yekepa operation was suspended due to the war. Today, there are two active iron ore concessions. The Yekepa mine (Tokadeh, Gangra and Yuelliton deposits) has been concessioned to ArcelorMittal since 2005, and production commenced in 2011. The Bong mine was concessioned to China Union in 2011 and has been operational since about 2014.

Company	County	District	Status	
ArcelorMittal	Nimba	Yarmein	Operational	
China Union	Bong	Sanoyeah	Operational	
Putu Iron Ore Mining	Grand Gedeh	Putu	Exploration	
Western Cluster Ltd	Bomi	Senjeh	Exploration	
Western Cluster Etu	Grand Cape Mnt	Golakonneh, Porkpa		
	Nimba	Sanniquellie Mahn, Yarwein Mehnsonnoh		
Cavalla Resources	Bong	Bong Panta		
	Grand Bassa	District # 1]	
Anglo American	Bong, Nimba	Suakoko, Twan River	Exploration	
Kumba Exploration				
	Grand Bassa,			
Jonah Capital	Nimba, Grand		Exploration	
	Gedeh, Bong			

Table #	5-8: Iro	n Ore Co	oncessions &	Exploration	Licences
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Source: LEITI 2014, National Bureau of Concessions

There are three further exploration concessions: Western Cluster/Vedanta Resources (Bomi and Grand Cape Mount counties), Putu Iron Ore Mining (Grand Gedeh) and Cavalla Resources⁷⁶ (Grand Bassa, Nimba and Bong). Resource studies have been done on these deposits, but there do not appear plans to start up production soon. These opportunities may flicker to light if the international iron ore price recovers.

 $^{^{76}}$ BHP Billiton's entire iron ore interests in Liberia were acquired by Cavalla Resources in 2015.

Figure 5-21 shows the international market conditions for iron ore as reflected in the ore price. On the back of rapidly increasing demand in China, iron ore prices reached a peak of more than \$180/ton in early 2008 but subsequently collapsed during the global financial crisis. They recovered almost to their pre-crisis levels by mid-2011, but then entered a five-year bear market. Lately, as Chinese growth slows to a more sustainable level, prices have improved somewhat and are predicted to return closer to the long-term average. However, there are many uncertainties, not least the position the major iron ore miners (Vale and BHP Billiton) take regarding matching global supply closer with demand.



Figure 5-21: Iron Ore Price (USD/t Fe 62%)

Figure 5-22 shows the historic production, how this declined, and the extent to which activity has recently resumed. There is some variance in the statistics, but the market size can be determined fairly accurately, i.e. production of about 5mtpa in 2015, of which Bong only contributes 1mtpa. Both concessions (but especially Bong) are therefore producing quite substantially below their capacities. The ArcelorMittal Mineral Development Agreement (MDA) provides for the production of 17.25mtpa of crude ore, with an annual output of about 9.75mtpa of 65% Fe concentrate (Phase III).⁷⁷ The proposed production schedule would exhaust all the currently reported reserves in the above deposits within 25 years. For Bong, the China Union MDA requires the concessionaire to develop transportation capacity to handle 12mtpa of concentrate.⁷⁸ However, in a personal communication, China Union indicated that the planned capacity is 10mtpa.

⁷⁷ ArcelorMittal MDA, Appendix C

⁷⁸ China Union MDA, article 6.6





It is neigh impossible to forecast what the likely iron ore output will be in future. Whatever the international demand for Liberian iron ore, the volumes from the two operations are capped to a maximum by their production and transport capacity. A rational projection seems to be that each concession typically operates at two thirds of its contracted capacity. (This approach also allows testing the two rail lines' attractiveness for non-iron ore cargoes,)

Although the Western Cluster was originally served by the now-defunct Mano railway line, there is no rail transport infrastructure in place to serve any of these locations. There may be a possibility of the Cavalla areas linking up with the Nimba railway, but as a junior miner it may also consider exporting by road. As regards port export facilities, there is space set aside for Western Cluster at FPM, Cavalla may be able to access spare capacity at Buchanan Port and Putu Mining Company opted for an alternative port location/site about 20km west of the Port of Greenville – Grand Butaw Point – which still has to be developed.

Gold & Diamonds (CE12)

LEITI⁸⁰ reported that in 2015 a total of 55 mining companies paid some form of revenue to Government (i.e. to LRA, NPA, EPA and LCAA). These include the iron ore miners already discussed above. LEITI applies a co-called materiality threshold (MT) when analyzing the financial transactions of concessionaires, and only those non-iron ore, non-mining service companies above the MT are shown in Table 5-9 below.

Company	County	Mineral
Bea Mountain Mining Corp.	Grand Cape Mount	Gold
MNG Gold Liberia Inc.	Bong	Gold
Steinbock Minerals	Margibi	Barite
Hummingbird Resources (Liberia) Inc.	Sinoe, Rivergee, Maryland, Grand Kru	Gold
Earth Source Mineral International	Gbarpolu	Diamond

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Source: LEITI 2014, National Bureau of Concessions

Sources: World Bank, Central Bank of Liberia, LEITI annual reports, Steel Statistical Yearbook 2016⁷⁹, NPA

⁷⁹ https://knoema.com/SSY2014/steel-statistical-yearbook-2016?tsId=1028840

 $^{^{80}}$ LEITI EITI Report for the Year ended 30 June 2015, Final (July 2016)

Recently, publicly traded companies such as Hummingbird Resources, Aureus, and Bukon Jedeh have invested heavily in exploration activities. Aureus Mining, through its subsidiary Bea Mountain Corporation, continues to develop Liberia's first commercial gold mine, New Liberty gold project, in western Liberia.⁸¹

The non-bulk commodity mines are of minor interest to the demand forecast – because the processed output that must be moved long-distance is counted in kilograms rather than thousands of tonnes. Much of these mines' initial impact on traffic will be because of plant construction, the placing of power generation, water infrastructure and mining fleet equipment, preparing the mining footprint, and village relocation costs. Over the mine life, there will be some traffic impacts caused by mine victualling (importation of diesel, chemicals, staff, etc.), but these will not really be distinguishable from the background traffic.

For the traffic forecast, a nominal provision of 5,000tpa (i.e. about one container per day) of inputs is made for the Bea Mountain/New Liberty project.

5.2.5.2 <u>Agriculture</u>

Although small acreages of tree crops are maintained for generating household cash income, the crops of rubber especially, but also oil palm, are mostly produced commercially by plantation estates, i.e. agricultural concessions. Little or no value (processing) is added for either of these primary commodities.⁸²

Rubber & Latex (CE21)

One of the five priority sectors of the NES is rubber, in the form of latex and dry rubber. This commodity has in recent years been the second highest value export earner for Liberia (after iron ore).

There are six active rubber concessions, as shown in Table 5-10. Firestone (now Bridgestone) operates one of the world's largest natural rubber operations. The dominant area of production is Margibi, most of which is by Firestone/Bridgestone.

Concession	Product	County	Main District	Acreage	Production (t)	
				Granted	2013	2014
Firestone	Rubber	Margihi	Eirostopo	119.000	28,121	NC
	Latex	Ingland	Filestone	110,990	7,913	NC
Liberian Agri. Co.	Rubber	G/Bassa	District # 3	600,000	15,290	16,885
Cavalla	Rubber	Maryland	Pleebo/Sodoken	74,100	NC	7,147
Salala Rubber Co.	Rubber	Margibi	Kakata	100,000	3,066	NC
LIBCO (Cocopa)	Rubber	Nimba	Gbor	100,000	NC	NC
Sime Darby (ex Guthrie)	Rubber & Oil Palm	Gd Cape Mount	Garwula	768,631	NC	NC

Table 5-10: Active Rubber Concessions

Source: National Bureau of Concessions, LEITI reports for 2013 and 2014

Note: NC = not communicated

It is officially stated that the rubber concessions only account for 45% of rubber production.⁸³ And the 2010 MOA Crop Survey determined that there are nearly 50,000 rubber producing households in the country. However, comparing the reported production by the concessionaires in 2013 (61,000t) with the total crop (75,000t) would indicate that the smallholder share is actually not more than about one fifth. (It is possible that the use of outgrowers may skew the calculation of the respective shares.)

^{81 &}lt;u>https://www.export.gov/article?id=Liberia-Mining</u>

⁸² MOA: "Food & Agriculture Policy & Strategy", 2011

⁸³ MOA: "Invest Agriculture", date not stated, appears to be 2015



Figure 5-23: Liberia Rubber Production (tpa)

Sources: FAO, CBL

Rubber is an international commodity, produced mostly in South-East Asia (especially Thailand and Indonesia). In 2014, Liberia contributed less than 1% to global production. The country is therefore very much a price taker. Figure 5-24 shows the development of the price of natural rubber, as well as the World Bank's price projection.⁸⁴ Real prices moved in a range of about 1-2USD/kg up to the mid-2000s, and spiked around 2011. Liberian production followed the price trend, with the return of the price to more historic levels resulting in a halving of output. The recent price recovery is attributed to increased supply in China and supply control measures in key natural rubber producing countries.



Figure 5-24: Rubber Price Movement

Sources: World Bank Commodity Markets Outlook; Thomson Reuters quoted by Financial Times⁸⁵

If the projected price is an indicator of what the level of supply could be in Liberia, then production and export volumes should return to mid-2000s levels, i.e. in the order of 100,000t. Of this, 20,000t would be produced by smallholders.

⁸⁴ World Bank: "Commodity Markets Outlook, January 2017"

⁸⁵ <u>https://www.ft.com/content/9b2b54a2-dbbb-11e5-a72f-1e7744c66818</u>

Palm Oil (CE22)

Like rubber, palm oil is one of the target sectors of the National Export Strategy⁸⁶ and this sector therefore also has its own development strategy. ⁸⁷

Palm oil is one of the most efficient vegetable oil crops to grow, yielding significantly more oil per planted area than soybean, sunflower or rapeseed.⁸⁸ Palm oil is used in processed foods, personal care and cleaning products. In Liberia, it is primarily used for cooking, although also consumed in some industries (soap, hair grease, candles). There has more recently been a push to expand oil palm plantations for biofuel production, also in Liberia. The production process entails harvesting palm fresh fruit bunches (FFB), and milling the fruit to extract crude palm oil (CPO) from the flesh and crude palm kernel oil (CPKO) from the kernels. The main oil extracted in Liberia is CPO.⁸⁹

Large oil palm plantations were established in the 1970s and operated as government-owned or cooperative ventures. However, those trees are past their productive lives and most of these plantations have fallen into disuse. Now there are five concessions, all awarded from 2008 to 2011. These include two major international oil palm producers in Sime Darby (Malaysia) and Golden Veroleum (Indonesia). The concessions produce for their own account, and also make use of outgrower schemes (i.e. small, private suppliers delivering to the concessions).

Concession	Product	County	Dominant District	Acreage Granted
Sime Darby	Oil Palm & Rubber	G C Mnt	Garwula	768,631
Golden Veroleum	Oil Palm	Sinoe	Butaw	543,400
Maryland Oil Palm Plantation	Oil Palm	Maryland	Pleebo/Sodoken	21,736
LIBINCO (Equatorial Palm Oil)	Oil Palm	G/Bassa	District # 4	34,000
LFP (Liberia Forest Product Inc.)	Oil Palm	Sinoe	Sanquin Dist# 1	19,795

Table 5-11: Palm Oil Concessions

Source: National Bureau of Concessions, LEITI reports for 2013 and 2014

Liberia produced between 135-170,000tpa of crude palm oil before the war. ⁹⁰ It is not known what share of this was exported, but it would have been substantial considering the likely local consumption. For example, by 2006, the country produced only 30,000t and was importing 7,000t⁹¹, i.e. a total domestic demand of a quarter of pre-war production. It is expected that most of the CPO consumption would have been by households, but some would also have gone to factories (soap, hair grease, candles, etc.). Interestingly, the FAO refers to a per capita consumption of 10-11kg of edible oils per capita in West Africa⁹²; and the 2006 data quoted above results in consumption of about 11kg/capita/annum. So, that datum appears to be quite robust.⁹³

Recent production and consumption numbers are hard to come by. The FAO provides an estimate of FFB production up to 2014. None of the concessions shown in Table 5-11 declared CPO production numbers to LEITI for either 2013 or 2014. This is probably because those plantations were still being developed and trees need to mature (three years after planting⁹⁴). Imports were between 10-11,000tpa

⁸⁶ International Trade Centre: "National Export Strategy, 2014-2018", 2014

⁸⁷ International Trade Center: "Oil Palm Sector Export Strategy 2014-2018", 2014

⁸⁸ http://blog.conservation.org/2016/10/what-you-need-to-know-about-palm-oil-in-5-charts/

⁸⁹ International Trade Center: "Oil Palm Sector Export Strategy 2014-2018", 2014

⁹⁰ MOA: "Food & Agriculture Policy & Strategy", 2011

⁹¹ MOA: "Food & Agriculture Policy & Strategy", 2011

⁹² Ofosu-Budu, K., and D. Sarpong (2013): "Oil palm industry growth in Africa: A value chain and smallholders study for Ghana", in: Rebuilding West Africa's Food Potential, A. Elbehri (ed.), FAO/IFAD

⁹³ The consumption per capita could be up to 14kg/capita/annum if calculated from 327kcal/capita/day – see WFP: "Cross-border trade and food security – Liberia & Sierra Leone", May 2010

⁹⁴ www.simedarby.com/upload/Palm_Oil_Facts_and_Figures.pdf

from 2013 to 2015.⁹⁵ It has been estimated that from "half" ⁹⁶ to the "majority"⁹⁷ of Liberia's palm oil is produced by smallholder farmers. The most recent reported crop survey⁹⁸ in 2010 determined that 29,000 households were involved in palm oil production.

The recent production volumes can be reconstructed as shown in Table 5-12, and used as the basis to project possible future production and export volumes. Historic data would indicate that there are about 8,100ha of non-concession (smallholder) oil palm under production, yielding much FFB but from which lower-end CPO yields are obtained. Going forward, it is expected that the smallholder crop area should increase given the optimistic international outlook for palm oil (see below). There are about 500,000ha of palm oil concessions granted.⁹⁹ Sime Darby advertises that CPO yields can be from 4-8t/ha.¹⁰⁰ Juggling around these inputs shows that a very conservative CPO export level would be about 1mtpa, but it could be up to 3mtpa. To triangulate this number, it should be noted that the Oil Palm Export Strategy projects that by 2030, oil palm will cover approximately 10% of total land area (600-700,000ha) and produce approximately three million tons of CPO annually. It notes that this is a conservative estimate.¹⁰¹

litowa	Colo	Historic		Expected	Scenarios	
item	Calc.	2006	2014	Range	Low	High
FAO FFB estimate	A	216,000	218,809			
FFB/ha (t)	В	**28.8	*28.8	18-30 ¹⁰²		
Ha Non-Concession	C=A/B	**7,500	**7,598		*8,000	*16,000
Ha Concession	D				*250,000	*500,000
CPO/ha (t)	E	*4	*4	4-8 ¹⁰³	*4	*6
CPO Production (tpa)	F=(C+D)*E	30,000	**30,390		**1,032,000	**3,096,000
CPO Imports (tpa)	G	7,000	11,000		-	-
CPO Domestic Demand	H=F+G	37,000	41,390		**50,000	**50,000
CPO/capita (kg/ann.)	I=H/Pop.	**11	**11	11-14 ¹⁰⁴	*11	*11
CPO Export	J=F-H				**982,000	**3,046,000

Table 5-12: Estimate of Palm Oil Production

Note: * = Assumption; ** = Calculated

The above calculations are purely an indication of the supply-side potential. From a demand perspective, Liberia is a small player and price taker in an active and growing palm oil market. The total global production of CPO is about 65.5mtpa, dominated by Indonesia and Malaysia responsible for 85% of the total. Nigeria produces 1mtpa and Ghana 0.5mtpa. Palm oil production has been growing steadily, at about 8%/annum from the mid1990s. Prices are projected to remain stable.

⁹⁵ NPA Statistics. The Oil Palm Sector Export Strategy refers to imports of USD 30 million in 2012.

⁹⁶ <u>http://www.usaid.gov/press/frontlines/fl_mar10/p12_liberia100318.html</u>

⁹⁷ International Trade Center: "Oil Palm Sector Export Strategy 2014-2018", 2014

⁹⁸ MOA: "Production Estimates of Major Crops & Animals, 2010"

⁹⁹ LEITI, 2014 (?)

¹⁰⁰ www.simedarby.com/upload/Palm Oil Facts and Figures.pdf

 $^{^{101}}$ International Trade Center: "Oil Palm Sector Export Strategy 2014-2018", 2014

¹⁰² <u>http://www.wilmar-international.com/our-business/tropical-oils/plantations/harvesting-oil-palm-yield/</u>

¹⁰³ www.simedarby.com/upload/Palm Oil Facts and Figures.pdf

¹⁰⁴ Ofosu-Budu, K., and D. Sarpong (2013): "Oil palm industry growth in Africa: A value chain and smallholders study for Ghana", in: Rebuilding West Africa's Food Potential, A. Elbehri (ed.), FAO/IFAD
Figure 5-25: Palm Oil Production & Prices



Sources: European Palm Oil Alliance¹⁰⁵, World Bank Commodity Markets Outlook

To project palm oil activity, it is assumed that domestic use will continue at around 11kg/capita/annum. As regards production, a provision is made for increasing the cultivated area by 2,000ha every 5 years, i.e. from 8,000ha in 2017 to 14,000ha by 2032. For the palm oil concessions, the area under plantation could increase by 100,000ha every 5 years, starting with 50,000ha in 2017 (in 2014 as about 21,000ha was already planted). These assumptions would lead to a total production of about 1mtpa by 2027.

5.2.5.3 Forestry (CE30)

Liberia has around 4.2 million ha of forested land (about 43% of the land area), most of which is primary or otherwise naturally regenerated forest, and around 8,000ha of planted forest. Liberian forests represent over half of the remaining rainforests in West Africa.¹⁰⁶

Forest is cleared by smallholders for traditional subsistence farming or for fuel wood and charcoal, but also on a more industrial scale – which is the focus of the analysis here as it impacts on the national transport system. Timber is harvested under concessions ("Forest Management Contracts", or FMCs) requiring replanting and "Trade Sales Contracts" (TSCs) where land is transferred for non-forest purposes (i.e. farming).¹⁰⁷ All the FMC and most of the TSC output is exported. The FMCs are shown in Figure 5-26.

¹⁰⁵ http://www.palmoilandfood.eu/en/palm-oil-production

¹⁰⁶ FAO Global Forest Resources Assessment 2015, quoted by European Timber Trade Federation (<u>http://www.timbertradeportal.com/countries/liberia/</u>)

¹⁰⁷ There are also PUPs (private use permits), FUPs (forest use permits) and CFMAs (community forest management permits)



Figure 5-26: Forestry Concessions

Source: National Bureau of Concessions

Table 5-13 shows that there are presently seven FMCs concessions and ten TSCs.¹⁰⁸ The so-called sustainability study of 2007 identified a potential approximately 3.3 million ha of concessionable forest. By 2009, the government had granted about 1 million ha to FMCs and 50,000ha to TSCs. The FDA indicated that, to ensure sustainability, the policy is to not expand the current FMC and TSC allocation for the time-being.

Contract	Company	County	District	Issued Ha	
	Alpha Logging	Lofa	Salayea	110 240	
	Alpha Logging	Gbarpolu	Belleh, Gounwolaila	119,240	
FMC B	EJ & J Investment	Rivercess	Central Rivercess, Fen River	57,262	
FMC C	Lib. Tree & Trading	Rivercess	Fen River	59,374	
	Funa Liberia Langing	Grand Gedeh	Konobo, Tchien	252 670	
FIVIC F	Euro-Liberia Logging	River Gee	Chedepo, Potupo, Nanee, Sarbo	253,670	
FNACL	Cable Lessing	Sinoe	Pynes Town, Seekon	121 466	
FIVICI	Gebio Logging	Grand Gedeh	Cavala, Tchien, Putu	131,466	
	Int'l Consultant Capital	Rivercess	Fen River		
FMC K		Nimba	Gbi & Doru	266,910	
		Grand Gedeh	Gboe-Ploe	7	
		Grand Kru	Barclayville, Buah, Kpi, Dweh, Gee, Wlogba		
FMC P	Atlantic Resources	River Gee	Nanee, Nyenawliken	119,344	
		Maryland	Gwelekpoken, Whojah		
TSC -	Tarpeh Timber	Grand Bassa	District # 2	5,000	
TSC a7	Bargor&Bargor	Gbarpolu	Bokomu	5,000	
TSC a9	B & V Company	Grand Cape Mnt	Porkpa, Golakonneh	5,000	
TCOOL	D. Q. V. Compony	Gbarpolu	Bokomu	F 000	
120.90	ва v company	Bong	Fuamah	5,000	
TSC a3	Akewa Group	Grand Bassa	District # 1, District # 2	5,000	

 $^{^{108}}$ LEITI contracts database, verbally confirmed by Forest Development Authority (FDA)

Contract	Company	County	District	Issued Ha
TSC a11	Bassa Timber & Log.	Grand Cape Mnt	Porkpa, Golakonneh	5,000
TSC a15	Sun Yeun (1)	Grand Cape Mnt	Porkpa	5,000
TSC a16	Sun Yeun (2)	Grand Cape Mnt	Tewor	5,000
TSC -	Ecowood	Lofa	Zorzor	5,000
TSC a8	Thunder Bird Int'l*	Grand Cape Mnt	Porkba, Gola Konneh	(5,000)

Source: LEITI Concessions List, 2014; FDA communication

Note: Never commenced production

The maximum legal production is $3,000m^3$ /block/annum.¹⁰⁹ However, the optimal production per block is about $3,000m^3$ ¹¹⁰, and the typical expected number of blocks operated are about 400/annum. A reference output rate is therefore in the region of 720,000 m³/annum. The unit of accounting applied to logging is cubic meter, however, to standardize the units of the goods part of the demand forecast, it has to be converted to metric tonne. This introduces some additional uncertainty, as the conversion factor depends on the tree species, moisture content, and other factors. The conversion factor applied here is 1 m³ = 586kg.¹¹¹ That provides an indicative tonnage of log export of about 420,000tpa.

To put that projection into perspective, the contribution of forestry to GDP, which was only 5-6% before the 1990s, soared to over 20% in the early 2000s. It declined with the UN ban on timber exports during the war (2003)¹¹², but the ban was lifted in 2006 and commercial logging restarted in 2010.¹¹³ Logging volumes were again negatively affected during the Ebola crisis. The NPA recorded log exports of 146,000t in 2015.





Source: NPA Port Statistics

Note: Logging output is measured in TDF (tree data form – the stumpage cut) and LDF (log data form – the selected trunks that are exported)

¹⁰⁹ 1 block = 1km² = 100 ha

 $^{^{110}\,\}mathrm{Personal}$ communication by SGS

¹¹¹ Simple average for densities (kg/m³) of Azobé (Lophira alata): 870, Niangon (Heritiera utilis): 625, Bossé (Guarea cedrata): 480, Iroko (Milicia excelsa): 660: , Ayous (Triplochiton scleroxylon): 320 and Dabema (Piptadeniastrum africanum): 560

 $^{^{112}}$ MOA: "Food & Agriculture Policy & Strategy", 2009

¹¹³ LEITI Report for the Year Ended 30 June 2014 (issued June 2016)

Timber is exported via the Freeport of Monrovia, Port of Buchanan and the Port of Greenville. The preferred consignment type is to move the logs as-is. However, at FPM there is no log storage facility requiring logs transiting there to be containerized.

The above discussion deals only with logs, i.e. unprocessed forest product. Sawn timber has been an important export product, contributing as much as logs (in terms of value) to exports in 2015.¹¹⁴ There is no specific strategy in place to ensure that post-logging value is added in the timber sector. E.g. this sector is not really addressed in the National Export Strategy, except that it is noted that timber exports (including logs) are expected to exhibit gradual and increased export levels and support the country's move towards diversifying its export portfolio. From a transport demand perspective, it is noted that the NPA does not record sawn timber anymore as a separate product (possibly because it is now exported by container).

5.2.6 Summary Cargo Volumes

As noted in section 5.1.6, the focus of the demand forecast is on a "realistic" position strongly influenced by the recent past and resulting in a fairly smooth growth in demand and traffic. On the upside, there are some sectors and products which are especially influenced by the international commodity cycle, or by the success of Government to stimulate specific targeted sectors.

5.2.6.1 Forecast Drivers

The discussion on projected cargo volumes in chapters 5.2.1 to 5.2.5 can be summarized as shown in Table 5-14 below.

Code	Category & Product	Production	Attraction	Optimistic Step for
BN	Self-Produced Ba	sic Needs		
BN10	Cassava	Stable total production	Stable shares of consumption per District	Diversification: +5% every 5 years
BN20	Sugar Cane	Stable shares of production per District	Declining consumption per capita: -1%/annum	-
BN30	Banana & Plantain	Stable production distribution	Stable consumption per capita (50kg)	-
BN40	Charcoal & Firewood	N/F	N/F	N/F
SI	Substitutable Imp	ports		
SI10	Rice	Increased production area & yield to achieve targets in 20 years	Stable consumption per capita (120kg)	Increased production area & yield to achieve targets in 10 years
SI20	Livestock & Fisheries	Local production consu forecast	N/F	
		Imports to meet demand	Stable consumption per capita (25kg) in counties around Monrovia (Monrovia, Margibi & G/Bassa)	-
SI30	Self-Produced Consumer Goods	50,000tpa increasing at GDP growth rate (5%/annum)	Equal national consumption per capita	-
NSI	Non-Substitutabl	e Imports		
NS10	Consumer Goods (Containers)	Imports to meet demand	Growth at GDP growth rate (5%/annum)	-
NS2	Petroleum & HFO			
NS21	Gasoline	Imports to meet demand	Growth at GDP growth rate (5%/annum)	-

Table 5-14: Demand Drivers Summary

¹¹⁴ MoCI. 2015 Annual Trade Bulletin

Code	Category & Product	Production	Attraction	Optimistic Step for
NS22	Diesel	Imports to meet demand	Growth at GDP growth rate (5%/annum), plus historic and additional LEC demand	_
NS23	HFO	Imports to meet demand	Historic and additional LEC demand, plus historic non- LEC demand	-
NS24	Jet Fuel & Kerosene	Imports to meet demand	Jet Fuel growth at GDP (5%/ann); Kerosene remains stable	-
NS25	LPG	Imports to meet demand	Growth at twice GDP growth (10%/ann)	
NS30	Clinker & Cement	Local production stop-gapped by imports	Increasing consumption per capita (125kg)	Increased consumption per capita (150kg)
NS40	Vehicles	Imports to meet demand	Stable number of units per annum	
NS50	Fertilizer	Imports to meet demand	Expand towards 2032 estimated requirement	
NS60	Other	Imports to meet demand; nominal provision for exports	Nominal growth allowed per product type	??
NC	Non-Concession	Exports		
NC10	Сосоа	Nominal provision made	(all exported)	-
NC20	Coffee	Nominal provision made	(all exported)	-
CE	Concession Expo	rts		
CE10	Mining			
CE11	Iron Ore Concessions	Ramp up to 2/3 of capacity	(all exported)	-
CE12	Gold & Diamonds	No provision made	(all exported)	-
CE20	Agriculture			
CE21	Rubber & Latex	Return to historic level	(all exported)	-
CE22	Palm Oil	Ramp up of production (to low end of official projection)	Stable consumption per capita	Ramp-up to double realistic scenario
CE30	Forestry	Ramp up to optimal production level	-	-

5.2.7 Projected Cargo Volumes

The projected volumes are presented graphically in Figure 5-28, and the numbers are tabulated in Appendix B. By 2017, there should be a total estimated volume of cargo of about 4.8Mtpa moving around the country, excluding iron ore. The main categories of cargo are cement (both clinker and bagged) which contribute 21% to non-iron ore volumes, imported consumer goods of 17%, and foodstuffs like cassava (11%) and imported and locally-produced rice (10%).



Figure 5-28: Cargo Projections (tpa, excluding iron ore)

This volume is projected to grow to some 8.3Mtpa by 2032. As shown in Figure 5-29, the main growth industry is expected to be palm oil, projected to grow at an annual rate of around 13%, and resulting in this commodity's share of the total volume rising to around 17%. The category of self-produced basic needs should track the general population growth rate (around 1%/ann.), substitutable imports should grow slightly faster to reflect rising personal incomes (around 2%/ann.), while non-substitutable imports should grow at about the tempo of growth of the national economy (around 4%/ann.).

Figure 5-29: Compound Annual Growth Rates per Cargo Category (2017-2032)



To appreciate the projected cargo volumes in terms of the requirements placed on the transport system, it is useful to observe the volumes at specific points in the transport network. Since a large part of the volumes (excluding iron ore) are imported (63%) or exported (16%), an appropriate point to do so is at the country's ports. Since the 2010 NTP also included projections for the ports, this approach makes it possible to compare the 2010 with the 2017 projections. The detailed comparison is shown in Appendix B, while a summary for the Freeport of Monrovia is presented in Table 5-15.

			Imports					Exports		
Commodity	Actual	NTP	Cardno	NTP	Cardno	Actual	NTP	Cardno	NTP	Cardno
	2015	2015	2017	2025	2027	2015	2015	2017	2025	2027
Cassava	-	-	-	-	-	-	-	-	-	-
S/Cane	-		-	-	-	-		-	-	-
Ban/Plantain	-		-	-	-	-	-	-	-	-
Wood & Charc.	-		-	-	-	-		-	-	-
Rice	282	100 -	310	-	310	-		-	-	-
Frozen Import	27	33	46	58	56	-	-	-	-	-
Cons. Goods - Self	-		-	-	-	-	-	-	-	-
Cons. Goods - Import	729	919	790	2,268	1,287	-	-	-	-	-
Gasoline	253	384	137	562	222	-		-	-	-
Diesel	-		181	-	283	-		-		-
Other Petroleum	-	20	45	50	60	-		-		-
Cement bagged	144		· -	-	133	-		-		-
Clinker	277	467	572	875	625	-	-	-	-	-
Vehicles	45	17	15	36	15	31		-	-	-
Fertilizer	-	40	24	72	31	-		-		-
Other	27	64	204	122	214	-		15	-	15
Iron Ore	-		-	-	-	683	3,000	2,000	17,000	8,000
Gold & Diam. supplies	-		5	-	5	-			-	-
Rubber & Latex	-		-	-	-	-	40	100	40	100
Palm Oil	10		-	-	-	-	20	186	200	992
Forestry	-	-	-	-	-	-	100	48	56	48
Balancing	117	14	-	19	-	126	40	-	76	-
Total	1,910	2,058	2,329	4,062	3,241	840	3,200	2,349	17,372	9,155

Table 5-15: Cargo Projections compared at FPM

From the above table, it can be seen that regarding imports -

- > S10: It is foreseen that Liberia will keep on importing rice
- > NS10: Container imports should not grow as fast as projected in 2010
- > NS21 & NS22: Diesel and gasoline imports are projected at a similar level (note that the 2010 projection did not split out petrol/PMS and diesel/AGO)
- > NS31 & NS32: Cement/clinker imports are projected a bit lower now.

As regards exports -

- > CE11: Iron Ore exports are projected lower, given the hindsight of the recent mining commodity slump
- > CE22: Palm Oil exports are projected much higher, based on the recent and ongoing investments in that sector.

For the port of Buchanan, the 2010 projections were for a greater share of petroleum products to shift to that port, and that fertilizer would in future be imported there. Also, there were good prospects of a wood chip enterprise to be established at Buchanan, but this has not happened. As regards iron ore, like for FPM, the projection for Buchanan was more optimistic in 2010 than now.

5.2.8 Optimistic Scenario

Table 5-14 indicates that for some commodities, there could be an optimistic (i.e. higher growth) scenario. This could apply in the cases of cassava (more production diversification), rice (higher degree of import substitution), and clinker/cement (higher domestic consumption). Such additional growth will not place significant additional strain on the national transport system. The one commodity that may have this effect is palm oil, specifically at the port/s of export. This could have an implication for port capacities at Freetown and Greenville.

5.3 Passenger Volumes

The previous sections set out how cargo volumes were developed from a bottom-up, first principles basis based on land use (distribution of production) and demand. The cargo volumes are effectively derived from the activity system only (refer section 5.1.1), i.e. something that is produced must be

evacuated and something that is consumed must be brought in – since everywhere can be reached in principle.

People movement, on the other hand, is the result of both the activity and the transport systems. Especially over longer distances, people are not compelled to move (like cargo is). These dynamics are usually expressed in terms of a gravity relationship, i.e. the bigger the population of two places and the shorter the distance (or other form of impedance) between the places, the more movement there will be between those places.

The form and size of the gravity between the places is country and context-specific, for example in a low-income country (like Liberia) the gravity "pull" would be lower than in a high-income one. The implication is that the movement of people has to be estimated based on sampling and understanding actual movements, and then extrapolating and projecting that. This process of determining likely people movements is summarized in Figure 5-30 and discussed in more detail in this chapter.





5.3.1 Sampling of People Movements

With reference to the first step in Figure 5-30, origin-destination surveys and traffic counts could be carried out at five locations as shown in Table 5-16. The number of stations was what was allowed within the resource constraints of this assignment. The locations were selected to capture a large share of the present-day national traffic on what may be termed the "mature" part of the road network (i.e. paved, primary roads between economically significant centers).

No	Station	County
1	Parker Paint	Montserrado
2	Brewerville	Montserrado
3	RIA Airport Road	Margibi
4	Lofa Road	Bong
5	Immigration Gate	Nimba

Table	5-16:	OD	&	Count	Stations
I UDIC	v iv.	00	~	oount	otations

The counts and surveys were carried out continuously over two days (48 hours) in February 2017. A sample of the counted traffic was surveyed for trip characteristics related to origin-destination, travel

time, passengers carried and type of cargo. The OD survey findings were assumed to be representative of the counted traffic population.

5.3.2 Preliminary Matrix

As expected (and as show in step 2 of Figure 5-30), not all routes were represented in the results. In other words, there were trips in the national transport system not passing through and therefore not recorded at the count/OD stations. In the preliminary matrix below, the red cells indicate the OD pairs not recorded in the surveys. The shades of yellow and green show the pairs that were recorded, with the colors representing the relative share of people. The dominance of Montserrado as the most populated county is also very obvious.





The above table includes the effect of very local traffic, i.e. between districts in the same county as well as intra-district traffic (i.e. within the same district). These are purely local effects that should ideally be excluded from a "national" traffic perspective.

It should further be noted that the table is presented at the county level, but the surveys were actually conducted on a district pair basis. A more detailed table is therefore also available.

5.3.3 Estimation of Gravity

The basic gravity equation involves mass and distance. Mass is represented by the OD pairs' respective populations. The population may be adjusted for income levels and other characteristics, but this was not investigated here.

Distance is the physical distance (km) or time (hours) or some other measure of relative impedance to move between two places. As noted before, it is in principle possible to reach everywhere by road, however, the time taken is highly dependent on the state of the road links involved. Since the roads network is generally of a low (unpaved) standard, it may therefore be expected that time (trip duration) would be a more relevant measure of impedance. But as can be seen from Figure 5-32, there is a fairly strong correlation between time and distance – for the trips registered in the survey. It is expected that the trips outside of the survey footprint would be more time-dependent. In other words, movements away from the core, surveyed network would likely be slower than the roughly 45km/h achieved on the core network.



Figure 5-32: Relation between Time (minutes) and Distance (km)

The usual form of the gravity formula is to express the denominator (impedance) squared. This approach gives a fairly satisfactory result, but can be slightly improved if included in non-squared form. Such improvement is indicated by the increase in the correlation coefficient (R^2). However, from the distribution of the data and the size of the R^2 (which can be a maximum of 1.0) it is apparent that the projected people movements based on these equations will be useful, but not completely reliable.

Figure 5-33: Alternative Gravity Results (time squared and non-squared)



The figures above both demonstrate a dense cluster of OD-pairs at the low-gravity/low-passenger junction, with a much more nebulous outer region. These two regions can be separated to some extent by considering movements to and from Montserrado districts separately from movements between non-Montserrado districts. Clearly, the more "mass" (population) and impedance (time) are involved, the more reliably movements can be predicted.





It may be considered to apply two separate gravity formulas to complete the OD matrix. However, close to the 0-junction of the graph (below 30 million "gravity units", i.e. where most of the low-pax data lie) the two results are in any case quite similar which would make a two-formula approach unnecessarily complicated.

5.3.4 Estimated Attraction

Step 4 in Figure 5-30 entails replacing the preliminary matrix with the estimated results. The effect of applying the single (i.e. not distinguishing Montserrado and other movements) gravity formula is shown graphically below.



Figure 5-35: Estimation of People Movements

Expressed in terms of a matrix (Step 5), the results are as shown in Figure 5-36. This table is now fully populated, including the origin-destination pairs that were not recorded in the sample data obtained from the OD survey. As noted earlier, the calculation of these volumes excludes the effect of very localized traffic, which is the reason for the total movements being lower in this figure than in Figure 5-30.

Figure 5-36: Estimated Passengers

From To	BOMI	BONG	GBARPOLU	GRAND BASSA	GRAND CAPE MOUNT	GRAND GEDEH	GRAND KRU	LOFA	MARGIBI	MARYLAND	MONTSERRADO	NIMBA	RIVER GEE	RIVERCESS	SINOE	TOTAL
BOMI	257	316	157	217	160	191	416	177	137	166	606	425	233	191	397	4,276
BONG	316	1,724	438	681	393	595	1,253	598	468	510	1,010	1,492	707	582	1,199	12,656
GBARPOLU	157	438	335	294	196	281	623	253	159	246	329	610	347	280	591	5,486
GRAND BASSA	217	681	294	1,045	268	394	837	367	404	340	867	892	471	415	809	8,762
GRAND CAPE MOUNT	160	393	196	268	400	239	521	222	161	209	514	533	292	239	497	5,131
GRAND GEDEH	191	595	281	394	239	595	836	344	205	341	329	867	476	379	799	7,331
GRAND KRU	416	1,253	623	837	521	836	1,955	731	421	745	554	1,778	1,042	831	1,768	15,346
LOFA	177	598	253	367	222	344	731	1,068	209	298	429	802	412	335	698	7,344
MARGIBI	137	468	159	404	161	205	421	209	663	176	999	503	239	210	411	5,597
MARYLAND	166	510	246	340	209	341	745	298	176	549	278	728	423	329	698	6,438
MONTSERRADO	606	1,010	329	867	514	329	554	429	999	278	3,292	1,000	334	345	587	11,760
NIMBA	425	1,492	610	892	533	867	1,778	802	503	728	1,000	3,176	1,006	823	1,699	17,312
RIVER GEE	233	707	347	471	292	476	1,042	412	239	423	334	1,006	698	464	987	8,707
RIVERCESS	191	582	280	415	239	379	831	335	210	329	345	823	464	485	792	7,160
SINOE	397	1,199	591	809	497	799	1,768	698	411	698	587	1,699	987	792	1,841	14,751
TOTAL	4,276	12,656	5,486	8,762	5,131	7,331	15,346	7,344	5,597	6,438	11,760	17,312	8,707	7,160	14,751	146,452

5.4 Converting Trips into Traffic

As discussed in section 5.1.1, there are two broad stages in estimating transport demand, i.e. defining the activity system (the requirement to move around) and interfacing the activity system with the transport system to connect trips produced and attracted. It is this second stage that attention is now turned to.

In the case of passengers, the gravity estimation method results in movements that are already linked by origin-destination pair. What is not yet known is the routing that will be followed or the vehicle that will be used. For cargo, the production vector is known as well as the attraction vector, and it is known that their sums should be equal (all production and demand must be cleared). But for cargo, apart from the routing and vehicle, the OD pairs are also not yet known. When these are solved for cargo, then the passenger and cargo process of selecting routes and vehicles becomes the same.

5.4.1 Determining Origin-Destination Pairs for Cargo

The methodology for projecting cargo traffic is summarized in Figure 5-37. Steps 4.1 and 4.2 were previously developed in detail, resulting in production and attraction vectors. These vectors link via a least-impedance routing. As discussed under the chapter on the passenger forecast, impedance is usually considered in the form of distance but the preference here is to rather use travel time.



Figure 5-37: Cargo Estimation Method

The road network (Step 1) allows any number of routes between a selected OD pair (Step 2). The leastimpeding routes per OD pair were selected from all of the available route options based on the current travel speeds on the road network links (Step 3). Figure 5-38 shows the selection of routes that link all OD pairs most efficiently.





Source: Cardno Project Team

There are no real capacity shortcomings on the roads network from a national transport perspective (national traffic levels are quite low). The production and attraction vectors can therefore be linked by minimizing (optimizing) the total transport cost (ton-hours) across the network without causing additional (congestion) cost or diversion effects. This is done by means of linear programming. The result is a cargo matrix in the same form as the passenger matrix shown in Figure 5-36.

The map of <u>road routes</u> is quite dynamic. The national network has recently been reclassified. There are also a number of actual and planned interventions to upgrade (pave) primary roads, and improve secondary and feeder roads. However, even if at a low service level (speed/transit time), all locations in the country can in principle be reached from anywhere by road today. In future, as the roads program is rolled out, the impedance will only decrease. This should not have a large effect on goods traffic but may stimulate additional passenger traffic as it becomes easier to get from point to point in the country.

The <u>rail routes</u> are very discrete and link up only a limited number of locations. The two main considerations in terms of traffic carried is whether rail has the surplus capacity to accommodate nonmining goods, whether there is sufficient demand at hinterland locations to justify a rail service, and (in the case of Buchanan Port) whether the volumes achieved will justify a (scheduled) liner service.

5.5 Converting Demand into Vehicles

With the exception of bulk mining commodities which move by rail, effectively all internal cargo and passenger movement is by road. The larger-volume goods with product-specific handling requirements are moved by large, dedicated vehicles (e.g. fuel tankers and log carriers, but also container trucks). However, most goods parcels are transported by passenger cars which double up as goods carriers, especially for the categories of basic needs goods and some substitutable imports. As the economy modernizes there is an expectation that the range of vehicle types will expand and that the fleet mix will migrate towards the heavier vehicle categories.

The typical loading per vehicle is shown in Table 5-17. The vehicle population mix was calculated from the OD survey results. The capacity of the different vehicles is based on observations and judgement.

5.5.1 Summing Vehicles per Link

The final step to achieve the projected traffic is to convert the route-based vehicles to link-level traffic. In other words, because one link may serve multiple routes, the vehicles generated by each route must be summed to obtain the traffic activity on that link. Again, this is a query executed using GIS.

Table 5-17: Vehicle per Pax/Commodity

	De. / (logal			Ve	ehicle Type	e %			Vehicle Typical Load (pax or t)						
	Pax/G	000	Car	PU/MB	Bus	Truck	Trail1	Trail2	Wagon	Car	PU/MB	Bus	Truck	Trail1	Trail2	Wagon
Passengers				84%	16%						6	18				
Self-Produce	d Basic N	leeds	15%	20%	0%	55%	10%	0%		0.2	0.3	0.5	3.0	10.0	15.0	
Substitutable	e Imports		10%	5%	5%	55%	25%	0%		0.2	0.3	0.5	3.0	10.0	15.0	
Non-	NS10	Containerized	10%	5%	5%	55%	25%	0%		0.2	0.3	0.5	10.0	15.0	20.0	
Substitu-	NS21	Gasoline	0%	0%	0%	65%	25%	10%		0.0	0.0	0.0	5.0	10.0	13.0	
table	NS22	Diesel	0%	0%	0%	65%	25%	10%		0.0	0.0	0.0	5.0	10.0	13.0	
Imports	NS23	Other Petroleum				100%				0.0	0.0	0.0	5.0	10.0	13.0	
	NS31	Cement & Clinker	0%	0%	0%	67%	33%	0%		0.2	0.3	0.5	10.0	15.0	20.0	
	NS40	Vehicles	0%	0%	0%	0%	0%	0%		0.0	0.0	0.0	5.0	10.0	13.0	
	NS50	Fertilizer	0%	0%	0%	67%	33%	0%		0.2	0.3	0.5	10.0	15.0	20.0	
	NS60	Other				100%				0.2	0.3	0.5	10.0	15.0	20.0	
Concession	CE11	Iron Ore							100%	0.0	0.0	0.0	0.0	0.0	0.0	80.0
Exports	CE12	Gold & Diamonds	0%	0%	0%	35%	50%	15%		0.2	0.3	0.5	3.0	10.0	15.0	
	CE21	Rubber & Latex	35%	25%	5%	30%	5%	0%		0.2	0.3	0.5	3.0	10.0	15.0	
	CE22	Palm Oil	0%	5%	0%	60%	25%	10%		0.2	0.3	0.5	5.0	10.0	15.0	
	CE30	Forestry	0%	0%	0%	33%	33%	33%		0.2	0.3	0.5	3.0	10.0	15.0	

6. Shaping the MMTMP Programs

The major challenge of formulating a national, multi-modal transport infrastructure master plan is to not just collect initiatives from the mode agencies (roads, airports, ports, etc.) and present these in one place. Initiatives in one mode (e.g. renovation of the RIA airport) require support from others (e.g. the improving the service level of the airport road), and sometimes also compete (e.g. paving the Buchanan-Ganta roads vs. encouraging third-party access on the Nimba railway). The master plan is also the occasion where the estimation of demand and the distribution of traffic between modes can be synchronized.

The aim of this chapter is therefore to step back and consider the underlying purpose and structure of the transport system, and then to identify packages of interventions that support the various functions of the national transport system. These packages are referred to as "programs" and their individual interventions as "projects".

6.1 Translating Development Agenda into Transport Infrastructure

The transport system broadly has three roles, not always clearly distinguishable because the same component in the system (e.g. a road link) can fulfil more than one function.

- National integrity. To effectively govern and administer the country, an essential fabric is required providing enough connectivity to move around the country. The denseness of this network is determined by the political organization of the country, the location of strategic centers and other such considerations that require a place to be connected into the national fabric.
- Economic role and justification. Some nodes and links are required to ensure that the transport system does not just provide access to places, but to improve the standard of transport service and reduce transport and logistics costs to the economy.
- Social or equity considerations. Some interventions are required not because they are fundamental to running the country or because they serve important economic sectors or large places. Rather, they are the "right" thing to do because they provide access to markets and social services, and access to the backbone transport system, i.e. they ensure fairness. These types of programs are more difficult to justify based on their own economics.

The economic interventions are the ones that naturally attract financiers' attention, because their inherent rationale can be assessed and supporting them therefore readily justified. Without downplaying their importance, some care must, however, be taken to ensure that the "economic" justification of investments is not overplayed in a developing, post-war country like Liberia and therefore not to undervalue aspects of strategic, administrative and social (equity) integrity.

6.2 Planning Principles

The three roles referred to above are accommodated in transport planning by introducing the concepts of mobility vs. access functions, the distinct transport requirements at the international, regional, national and local levels, and how the concept of inter-modality links these concepts.

Transport Linkages

The transport system can be seen as serving distinct "layers" of need. The system can link places at an international, regional, national and/or local/urban scale. The same part of the system can potentially provide more than one of these services.



Figure 6-1: Transport Linkages

Transport Functions

The term "connectivity" is used to indicate that there is indeed a linkage between two places. All relevant places should be connected in some way, but not all places are "created equal". The quality of the linkage will therefore differ.

This implies that linkages must perform along a continuum of mobility at the one end and access at the other. "Mobility" refers to high speed and high level of service (i.e. frequent, no interruption, no congestion), often with a commercial purpose. Mobility is crucial for high-value¹¹⁵ cargo and for passengers who attach a high value to their time. "Access" has less to do with the "quality" of transport but rather ensuring that there is some form of transport available, providing entry into the transport system even if at lower speeds and service levels, at lower volumes and with more interruptions, often for transport users with local or social objectives.

Importantly for the SP's purposes, the higher layers (international) in the transport system typically have "mobility" as objective whereas the lower layers (local) have "access" as their primary goal. This logic can be seen, for example, in the Liberian roads classification system that distinguishes between primary roads (high mobility links between important places), secondary roads (linking less important places) and feeder roads that provide the remainder of places access to the higher-order roads.

Modal Choice

Figure 6-2 illustrates that different modes of transport have a "sweet spot" in terms of distance, value and volume. Mobility considerations apply at the higher value/longer distance corner and access considerations at the lower volume/shorter distance juncture. The important take-outs from this figure is that roads-based transport is very versatile, with other modes occupying more niche positions. If the master plan is going to err, it should do it in terms of over-investing in roads.

¹¹⁵ Equate "value" to "unit price" or "unit utility"





Inter-Modality

Taking Figure 6-1 and separating the transport system by layer, results in Figure 6-3. IT shows how different parts of the system fulfil different roles (e.g. international vs. regional), and sometimes more than one role (e.g. national and regional). But the important point of this figure is to illustrate that between the "horizontal" layers there are "vertical" tubes of articulation. These collect at one level and evacuate at another, e.g. local taxis bringing passengers to a bus terminal from where the passengers travel by bus to another center altogether. The typical configuration would be for proximate layers to be connected, e.g. national to regional or local to national.





6.3 SIP Programs

The effect of applying the above principles is that the SIP aligns with the demands on the transport system. I.e. what is the nature of the goods (or passengers) to be moved, is it a long or short trip, what is their requirement of the quality of transport, etc. There is therefore not a separate "roads plan", a "ports plan", etc.; rather, the aim is to achieve the appropriate solution for the need. Justifying projects from a needs or outcome perspective (e.g. "international mobility"), the solutions proposed are more inter-modal, integrated and door-to-door.

Following this logic, and to address the country's transport infrastructure needs, the structure of the SIP is as shown in Table 6-1.

Cotocom	Due que re		Need Add	lressed		Inter-modal
Category	Program	Function	Distance	Value	Volume	link
International 9	By Air	Mobility	Far	High	Small	Road
	By Sea	Mobility	Far	Low	Large	Road & Rail
Connectivity	By Road	Mobility	Far	Mid	Mid	Port
Connectivity	By Rail	N/A	Far	Mid	Small	Port
	Domestic Aviation	Mobility	Far	High	Small	Road
National	Aviation CNS	Mobility	Far	High	Small	N/A
Connectivity &	Nimba Corridor	Mobility	Midrange	Mid	Mid	Port, Rail, Rd
Mobility	Other Commodity Corridors	Mobility	Midrange	Mid	Mid/Small	Port & Road
	National Roads & Terminals	Mob/Acc	Midrange	Mid	Mid/Small	Port (& Rail)
Monrovia	Improvement of Arterials	Mobility	Near	High	High	Nat. Road
Urban Mobility	Future Mass Transit	Mobility	Near	High	High	Nat. Road
	Feeder Roads	Access	Near	Low	Low	Nat. Road
LUCALACLESS	Motorcycle Trails & Crossings	Access	Near	Low	Low	Nat. Road

Table 6-1: Proposed SIP Programs

6.4 Analysis Approach for SIP Programs

The SIP was developed within its resource limitations (i.e. budget and time), requiring an appropriately accurate but affordable analysis technique to be applied. Importantly, the national planning framework is very much under development still, and data on actual and projected economic activity (i.e. transport demand) is disordered. The various transport infrastructure modes also have quite disparate information endowments (infrastructure catalog, condition assessment, traffic data, etc.). Some agencies already have master plans, but these are often not recent. Under these circumstances, setting up a comprehensive, multi-modal transport model to identify and assess projects was not practical (and it was also not required in the TOR).

The analysis techniques applied were therefore generally of a more pragmatic nature, i.e. one of following four ways –

- Modeling of the projected performance and requirements. This is the most detailed technique that could be used, but its intensity and resource requirements limited its application to one program only (national roads)
- > <u>Validation</u> of the timing of investments that were originally included in a master plan, but for which the timing needed to be verified against actual demand growth
- Scoping of investments based on professional judgement, applying rules of thumb for local circumstances
- Coverage estimation, i.e. providing for certain modular types of investment to achieve a target rate of access for users. This approach was used to calibrate the local access programs (feeder roads and motorcycle trails).

Table 6-2 shows the analysis approach for each program.

Table 6-2: Analysis Approach per Program

Report Section	Program	Modeling	Coverage Estimation	Scoping	Validate against Demand
7.1	International Conn. by Air				Х
7.2	International Conn. by Sea			(X)	Х
7.3	Regional Connectivity by Road	Х			
7.4	Regional Connectivity by Rail			N/A	
8.1	Domestic Airport Network		Х	Х	
8.2	Aviation CNS			Х	

Report Section	Program	Modeling	Coverage Estimation	Scoping	Validate against Demand
8.3	Nimba Corridor			Х	
8.4	Other Commodity Corridors			Х	
8.5	National Roads & Terminals	X (road)		X (terminal)	
9.1	Improve Urban Arterial N/W			Х	
9.2	Future Urban Mass Transit				
10.1	Feeder Roads		Х		
10.2	M/Cycle Trails & River Crossings		Х		

6.5 National Roads

As noted above, the one area where there is a substantial body of evidence and which therefore allows a more quantified, modeling-type assessment, is national roads. In an unconstrained situation (i.e. if there were no financial limit to what could be applied to roads), the roads program would be largely shaped by purely economic optimization considerations. However, the financial envelope is indeed very tight (refer the discussion in section 11.2 later-on), which means that there is an imperative to be pragmatic and "make-do" with what is available.

6.5.1 Roads Intervention Strategy

Therefore, although some aspects of the national roads program can indeed be economically optimized, this needs to happen in the context of a system-wide, coherent strategy that ensures that available resources are applied not just to where the economics of an individual road dictate. In other words, an over-arching and guiding roads intervention "strategy" is required.

Following the planning logic set out in section 6.2, roads' functions lie on a spectrum of mobility (highspeed, high-service level roads) to basic access (roads connecting people to basic services and allowing admission to the economy) – as shown on the left-hand axis of Figure 6-4. At the top and towards the bottom there are roads that are required notwithstanding their economic justification, i.e. to serve national contiguity and strategic purposes (top) and roads that provide basic access (bottom). All the different standards of roads have an associated endowment of bridges. In terms of the standard of road provided and therefore the type of intervention required in the road intervention strategy, from the top the roads would be sealed ("black-top"), unsealed (constructed roads at least partly graveled), or rudimentary (with basic geometry and drainage standards). Over the top of Figure 6-4 the three classes of national road are shown, and – for completeness – also the motorcycle tracks and bridges.



Figure 6-4: Approach to National Roads Intervention Strategy

On the right-hand side of Figure 6-4 are the three justifications for roads investments. At the top, some additional road links are required to ensure a minimum integrity, i.e. an ability to reach places of a certain importance (as identified in the roads classification system). Then there are interventions that have good transport economic merit. However, as alluded to above, not all meritorious projects may actually financially affordable. That therefore leaves a swathe of roads where the interventions are just enough to keep the roads passable, but without improving them as such.

The national roads intervention strategy proposed here is to -

- > Obtain the maximum beneficial roads investments from the available funding envelope. This implies interventions nearly exclusively on the primary network
- > Delay expanding the network, even though there are contiguity, strategic and other network "fabric" considerations arguing for that
- > Come up with pragmatic, reactive and low-cost solutions to keep roads and bridges open and passable elsewhere.

Figure 6-4 further shows how the strategy is divided into programs – each indicated by a blue block. The blocks are cross-referenced to the sections in this report where they are described in more detail.

6.5.2 "Integrity" Roads: Responding to the National Roads Classification System

The national roads classification system was recently updated. It has retained the three-tier roads system, but each class is now defined as shown in Table 6-3. One of the benefits of this classification system, is that it provides a systematic basis on which to identify roads that are of an "integrity" nature and therefore required to be constructed as a minimum.

Class	Description	Label for Road Number
Primary Roads	Links between county capitals Links between county capitals, other primary roads and major international connections including border ports, international airports and sea ports	Р
Secondary Roads	links between district capitals to the primary roads Links between district capitals Links between major towns and cities Links to major tourist centers	S
Feeder Roads	Roads linking villages Roads not classified as Secondary or Primary but link to Secondary or Primary	F
Private Roads	Roads owned by and individual or entity No commercial traffic allowed Restricted travel, controlled by the entity / individual	N/A

 Table 6-3: Revised National Roads Classification

Source: Proceedings of the Organization Design Working Group Workshop 16-18 November 2016

Applying the above system implies that the "essential fabric" (refer section 6.1) will be in place when every primary link and every secondary link anticipated in the roads classification is actually constructed. (The classification does not require it to be built to a defined standard, but it may be expected that all primary roads and all secondary roads will have a generally common, minimum design standard.) The result is that for the foreseeable future, there will be a requirement for road link fill-in activity to complete the essential fabric. The economic justification of some projects may prioritize them above others, but it should nevertheless be the aim to also roll out the ones that are more "integrity" and less "economic".

<u>Importantly</u>, and as indicated in the overview of the roads intervention strategy, although the fill-in projects are discussed here, the budget envelope for the 10 years of this MMTMP <u>does not allow</u> any network development (expansion) and these projects are flagged for future attention only.

6.5.2.1 <u>Completing the "Base" Primary Network</u>

There are already some primary road initiatives ongoing for which the direct economic justifications are not overwhelming, but which are generally understood to be important for national integrity purposes. These include the (regional) link to Loguatuo and the (national) trunk from Ganta via Zwedru to the South-East. Although not as advanced, attention is also being given to improving the Coastal Corridor (Buchanan via Greenville to the South-East). The major apparent break in the primary roads system would then be a road arterial up the western border of the country, i.e. Gbarpolu to Lofa (and this is also now the subject of investigation by a group of funders).

Other links that could be targeted to increase the trunk density are Tubmanburg-Ganta (which will also straighten out the regional road corridor), improving roads along the Nimba Corridor (Buchanan-Gbarnga/Ganta) and improving the link to Greenville (from Fish Town).

Of the above-mentioned extensions to the primary system, the only link that does not also have sufficient economic justification and is therefore not (yet) included in the master plan is Gbarpolu to Lofa. However, the investigation referred to may make find it sufficiently attractive to be earmarked for funding by a specific donor (in addition to the rest of the investment plan).



Figure 6-5: Missing Links in Primary Roads System

6.5.2.2 Completing the "Base" Secondary Network

At the secondary level, there are a number of "missing links" apparent when matching the classification system with the actual secondary network. The main areas with gaps are shown in Figure 6-6.



Figure 6-6: "Missing Links" in the Secondary Roads System

The major missing links in the secondary system are shown in Table 6-4.

County	From	То	km
Nimba	Karrs-Little Liberia Juction	Telbawein	30.5
Sinoe	Kwitatuzon Junction-Tuzon Town Road	Seamannah	23.9
Sinoe	Garbo Wragbah(Grand Gedeh/Sinoe Boundary)-Garbo Wragbah-Sanquin Road	Voogbadee	18.4
Sinoe	Touh-Paris Road	Paris	17.5
Grand Kru	Big Suehn-Behwan City Road	Gbanken	16.1
Sinoe	Warkpo-Doewen(Secondary road Junction) Road	Gmagmakpo	12.6
Rivercess	Neezorwien-Cestos City Road	Kpaqueh Gor	12.3
Grand Kru	Geetugbaken Community-Kunea Road	Planplanken	9.5
Grand Gedeh	Pelokon Number One(Sinoe/Grand Gedeh Boundary)- Panniewein Road	Bloquiah	7.8
Grand Kru	Doewen-Allawala City Road	Cheneken	6.7
Rivercess	Neezorwien-Cestos City Road	Garyea Zohn	5.7
River Geee	Kanweaken-Nyouken Road	Kanweaken	5.3
Gbarpolu	Timba(Grand Cape Mount/Gbarpolu Boundary)-Kungbor Road	Zuie	5.3
Rivercess	Neezorwien-Cestos City Road	Boewein Toba	5.0
Rivercess	Neezorwien-Cestos City Road	Neegba	3.4
Sinoe	Greenville City(Down the Mogroove)-Kwitatuzon Junction Road	Central Wedjah	33.0

6.5.3 "Economic" Roads: Modeling Approach

The Highway Development and Management tool (HDM-4) was used develop a 10-year works program for Primary and Secondary roads under budget constraint. The model compares life cycle costs predicted under the existing regimen of road pavement management (also referred to as the without project case) against the life cycle costs predicted for the periodic maintenance, road improvement or development alternative (that is, with project case). This provides the basis for estimating benefits that would be derived by including each candidate project within the budget timeframe.

When budget constraints are imposed (refer section 11.2), the model performs optimization by selecting the combination of user-defined road work options on sections that maximize the Net Present Value (NPV)/costs ratio for selected sections in the road network subject to the sum of the investment costs being less than budget available. The set of investment (road works) options that were optimized are given in Table 6-5.

Road Surface Type	Works Class	Treatment Type and Unit Cost	Intervention Criteria
Paved	Development	Capacity Improvement (Widening)	Peak Volume/Capacity Ratio > 0.7
	Periodic Maintenance	Pavement Rehabilitation/reconstruction	Roughness (IRI) ≥ 10
		Overlay (50mm)/light rehabilitation	Roughness (IRI) ≥ 4.5
Unpaved	Development	Upgrade to Paved Standard	Two way AADT ≥ 300
	Periodic Maintenance	Re-gravel with selected material and mechanical compaction, final gravel thickness 150mm	Gravel depth <u><</u> 50mm AND Interval <u>></u> 6 years

Table 6-5: Works Interventions for Paved and Unpaved Roads

7. International & Regional Connectivity

7.1 International Connectivity by Air

Roberts International Airport (IATA code ROB, ICAO code GLRB) is located at Harbel and was originally developed during the Second World War for the military objectives of the USA. Although it was subsequently incorporated in Pan Am Airline's African network, and has since served as the main commercial entry point by air to Liberia, it was not specifically sited for this purpose. However, the ongoing investments at the airport confirm Government's intention to continue developing the current site, and a discussion of the merits of relocating the airport closer to Monrovia is therefore not useful. Also, the ongoing improvement in the road link to ROB further obviates such consideration.

The airport is presently served by six airlines that tie Liberia into an immediate regional network of Accra-Freetown-Monrovia, and from there to Nairobi (Kenya Airways), Brussels (Brussels Airline), Casablanca (Air Maroc) and Amsterdam (KLM). The majority of traffic is carried on commercial airlines, while the balance is made up by special and unscheduled flights, most of it related to the United Nations mission in Liberia.

In 2016, RIA handled 186,000 embarking and disembarking passengers, about 3,100t of cargo (including mail) and nearly 1,800 aircraft movements (i.e. about 500 passengers and five movements per day). The traffic level in 2016 is substantially lower than 2012 (passengers were lower by 20% and flights by 14%), pointing to the effect of the EVD epidemic in 2014 and 2015.

Year	Passengers			Car	go (t)	Ma	Flickto	
	Embark	Disembark	Transit	Load	Offload	Load	Offload	Flights
2012	114,437	116,581	29,031	210	3,233	22	42	2,039
2013	115,813	112,545	24,861	226	2,128	30	32	1,908
2014	89,470	77,377	29,528	153	17,107	19	19	1,897
2015	81,755	77,159	13,758	135	3,752	12	14	1,592
2016	95,700	90,132	44,116	147	2,903	26	22	1,757

Table 7-1: ROB Annual Traffic

Source: LAA, "Roberts International Airport - Yearly Statistics of Passenger, Cargo & Mail, and Flight Movements"

On the airside, the airport is currently configured to handle category 4E aircraft (wide bodied aircraft excluding A380), providing a Cat II approach service (350m RVR (runway visual range) and 100 ft decision height). Although all airside facilities (runway, taxiways and apron) are not in good condition, there is more than adequate space for further development when required. The stand-in terminal buildings and associated passenger handling filters are under stress with resultant inadequate levels of service. On the landside, the parking area and access road fall short in various respects.

An airports master plan addressing these inadequacies was prepared in 2006 (by NACO/SSI). It anticipated demand of 210,000 passengers by 2020, i.e. a trajectory in line with what has been experienced so far. ATMs were projected at 2,800 at that time, which is slightly more optimistic than the actual trend. The NACO master plan provided for a new terminal and some other improvements, including power and water supply. It provided for rehabilitating the airside pavements. A subsequent study (InterVistas, 2014) confirmed the case for a runway rehabilitation.¹¹⁶ The ROB master plan also anticipated a gradual upgrading of airfield ground lighting, which is included in the current runway extension contract.

One aspect that was under-emphasized in the master plan is the situation of the airport access road. Although towards ROB (where airport traffic makes up a larger share of total traffic) the situation is tolerable, closer to the city the road has insufficient capacity.

 $^{^{116}}$ Its pessimistic scenario foresaw passengers at 300,000 and ATMs at about 4,500 in 2020 already.

The main contract to give effect to the requirements of the master plan is the one awarded to China Harbor Engineering Company (financed by China Exim Bank) and which is currently under construction. The contract provides for a new passenger terminal building, together with utilities (power generator station and sub-station, water pump station, fire pump station, and package sewage treatment plant), car park and related access road, and fencing with CCTV cameras. The contract confirms that the reference aircraft is up to Category E, and provides for two each of key processing filters (baggage reclaim belts, aircraft bridges), which would indicate that the terminal capacity could be well in excess of $450,000 \text{ pax/annum}^{117} - i.e.$ about double the 2016 passenger total.

A contract to rehabilitate the runway was awarded to Sino-Hydro and commenced in September 2016 (financed by the Saudi Fund, the Arab Bank for Economic Development in Africa, and the Liberian Government). It entails excavation and re-asphalting sections of the runway in addition to a rehabilitation of the AGL (Aeronautical Ground Lighting) system and other work to bring the runway to international standards.

Apart from the terminal and runway extension projects, an ILS (instrument landing system) upgrade is scheduled to be completed by mid-2017, including a new localizer, DVOR (Doppler VHF Omnidirectional Range) and G/P (Glide Path). The UNDP/WMO are also upgrading the meteorological equipment at ROB.

The main outstanding shortcoming from the 2006 master plan appears to be the status of rescue and fire protection facilities and equipment. The master plan found that ROB did not comply with the ICAO Annex 14 minimum safety requirements, which is a serious safety breach and exposes ROB to huge liabilities in case of an accident. ROB currently provides an ICAO firefighting category 8 fire-fighting response, whereas the master plan recommends category 9 (roughly corresponding with aircraft category E). It is recommended that the current (2017) status of firefighting and rescue vehicles, equipment, extinguishing agent, communication systems, personnel, etc. be reviewed and a rejoining strategy be developed.

The terminal and runway capacity being provided for allows for a substantial increase in throughput over the situation today. The conclusion is that RIA will unlikely run out of capacity in the MMTMP/SIP timeframe, and probably not for some time thereafter.

Then, outside the remit of the LAA, the CAA needs to carry out a more wide-ranging inspection of the airport facilities, equipment, operations and staff to certify the airport in terms of Liberia's obligations in terms of ICAO. It is not apparent that the necessary regulatory instruments and protocols are in place for such an inspection. Developing these would form part of the CAA support package referred to in section 4.5.2.1.

7.2 International Connectivity by Sea

The Freeport of Monrovia is located on Bushrod Island, north of Monrovia, near the confluence of the Mesurado and St. Paul Rivers. It was originally developed shortly after World War II by the USA, and transferred to Liberia in the 1967.

Table 7-2 shows the liner services offering scheduled port calls at Monrovia. Maersk Line consolidates cargo between Conakry, Freetown and Monrovia for a connection to Southern Spain; CMA CGM provides a similar service to Morocco and Spain as well as to India; PIL to Singapore and China via Lome and Conakry; and MSC to Northern Europe via San Pedro. Non-liner (chartered) vessels also call at the port, including iron ore carriers and petroleum tankers. From 2011 through 2015, there were roughly one vessel call per day (346 calls in 2015).

Destination/Origin	Liner	Typical Vessel
West Africa-West Mediterranean	Maersk line (Relay Service 7)	Container, General Cargo
India-West Africa/ Middle East	CMA CGM (Midas 1)	Container, General Cargo, Reefer

Table 7-2: FPM Liner Shipping Routes

¹¹⁷ A conservative estimate of 5 arriving and 5 departing flights per day, with 120 disembarking and embarking passengers per flight. At 5,000m², the terminal would provide an adequate level of service (LOS C) if there were two arriving and two departing flights at the same time.

Destination/Origin	Liner	Typical Vessel
West Africa-Europe	CMA CGM (EURAF 5)	Container, General Cargo, Reefer, Bulk
West Africa-Far East	PIL (WA2 & SW2/SWS)	Container
West Africa-North Europe, Med	MSC (Coastal Feeder Service)	Container, General Cargo

In 2015, FPM handled 2.8 Mt and 47,000 TEUs of imports, and 0.9 Mt (including 0.7 Mt of iron ore) and 46,000 TEUs (including empties) of exports. Table 7-3 shows the key commodities imported and exported historically, as well as over the last three years for which cargo data is available. The table is presented in the same format as the demand forecast (refer section 5.2.6), but excludes the category of Self-Produced Basic Needs (Cassava, Sugar Cane, etc.) which products are not handled through the port. Imports make up more than two thirds of the cargoes handled, but more than 90% if iron ore exports are not considered. The volumes of both imports and exports were stable between 2014 and 2015.

FPM is one of the deepest ports in the region, handling vessels up to about 60,000 DWT (dead weight tons) and carrying up to 2,500 TEUs (Handymax vessels). The port was last dredged in 2012 to a depth of 12.5m in the entrance channel and 12m in front of the Marginal Wharf. It was recently equipped with Aids to Navigation, enabling resumption of vessel accommodation at night. The Port is at Security Level 1 (Normal) in compliance with the International Ship & Port Security Code.

The major port facilities and operations are summarized in Table 7-4. Berthing facilities consist of a general cargo quay (Marginal Wharf), three iron ore finger piers, and an oil jetty. FPM is a landlord port (infrastructure is provided by the port authority but superstructure and equipment and port operating services by private or non-authority operators). The main agreement is the 25-year PPP concession with APM Terminals which commenced in 2010, and under which APMT reconstructed the Marginal Wharf. APMT has equipment to handle vessels carrying general cargo, break-bulk cargo, and containerized cargo. APMT further provides marine services, including pilotage, towage (tugboats) and mooring and unmooring of vessels.

						Imports	;			Exports						
Category	Code	Product			Actuals			NTMP '10	ММТМР '17			Actuals			NTMP '10	MMTMP '17
			1989	2008	2013	2014	2015	2025	2027	1989	2008	2013	2014	2015	2025	2027
Substi-	SI10	Rice	142	299	295	238	282	-	310	-		16	-	-	-	-
tutable Imports	SI20	Frozen	21	23	44	33	27	58	56	-		-	-	-	-	-
	NS10	Containerized	272	524	611	621	729	2,268	1,287	-	-	-	-	-	-	-
	NS21	Gasoline	378	210	291	316	253	562	222	-	-	-	-	-	-	-
	NS22	Diesel	-	-	-	-	-	-	283	-	-	-	-	-	-	-
Non-Substi-	NS23	Other Petr.	-	-	-	-	-	50	60	-	-	-	-	-	-	-
tutable	NS31	Cement	7	112	175	94	144	-	133	-	-	-	-	-	-	-
Imports	NS32	Clinker	68	94	122	288	277	875	625	-	-	-	-	-	-	-
	NS40	Vehicles	7	9	10	11	45	36	15	-	-	-	0	31	-	-
	NS50	Fertilizer	-	-	-	-	-	72	31	-	-	-	-	-	-	-
	NS60	Other	-	3	18	62	27	122	214	-	-	-	-	-	-	15
	CE11	Iron Ore	-	-	-	-	-	-	-	7,087	-	-	751	683	17,000	8,000
Concession	CE21	Rubber	-	-	-	-	-	-	-	89	20	-	-	-	40	100
Exports	CE22	Palm Oil	-	-	10	11	10	-	-	-	-	-	-	-	200	992
	CE30	Forestry	-	-	-	-	-	-	-	178	24	-	-	-	56	48
Balance	BA	Balance	88	49	179	312	117	19	5	46	-	152	150	126	76	-
Total			983	1,323	1,756	1,986	1,910	4,062	3,241	7,400	44	167	902	840	17,372	9,155
<u>Iotal 983 1,323 1,756 1,986 1,910 4,062 3,241 7,400 44 167 902 840 17,372 9,155</u>																

Table 7-3: FPM Annual Traffic (tpa)

The port also handles some specialized cargoes (bulk latex, petroleum products, and iron ore). The Oil Jetty is operated by the Liberian Petroleum and Refining Corporation (LPRC) to store imported petroleum products on behalf of licensed petroleum distributors; the BMC (Bong Mining Company) pier is operated by China Union in terms of its Mineral Development Agreement (MDA); and the LMC (Liberia Mining Company) and NIOC (National Iron Ore Company) iron ore piers were once operated as well by mining companies, but are now out of commission (NIOC pier) or used for other purposes (LMC pier).

Pier	Location	Length (m)	Max. Depth (m)	Berths (no)	Main Activity	Operator
BMC	North	270	12.8	1	Iron Ore, HFO	China Union/ Connex
NIOC	Central	270	9.5	1	Mining	Now defunct
LMC	Central	270	13.0	1	wiiriirig	Now defunct
Marginal Wharf	South	600	12.0	3	Container, Gen. Cargo, Dry Bulk, Liquid Bulk	APMT
Oil Jetty	South	500	9.5	1	Petroleum Products	LPRC

Table 7-4: FPM Piers & Operations

Source: National Ports Authority

A National Ports Master Plan was concluded in 2012¹¹⁸, presenting operational and facility requirements under three different growth scenarios for a 25-year period (up to 2035). That master plan included a traffic and market development analysis and forecast, however, the results thereof have not been available to the authors of this report. Apart from the historic cargo volumes, Table 7-3 also shows the projected volumes. "MMTMP '17" shows the demand forecast from chapter 5 of this report and "NTMP '10" the projected volumes from the previous, 2006 port master plan¹¹⁹ which numbers were also incorporated in the 2010 National Transport Plan. Compared with the 2006 projections, the current projection of imports points to Liberia continuing importing rice, and container and cement/clinker imports not growing as fast. Regarding exports, iron ore exports are projected lower but palm oil exports much higher.

The NPA Master Plan provides an investment pathway by identifying projects to be developed on demand according to the actual traffic development and feasibility. Although it is envisaged that the port capacity may at some stage have to be increased paradigmatically (by reclaiming land), the projects generally are extensions of already-existing infrastructures or additions of a similar nature (i.e. capacity improvements) and these can quite adequately be accommodated in the existing port footprint. The reclamation option will not be pursued in the foreseeable future, will require a significant investment and will also be preceded by a long lead time, implying that it is not a pressing consideration in this master plan.

Apart from some internal operational (internal roads) and administrative (new administration building) projects, the major investments that were planned and for which construction commenced are:

- Development of 7.5 ha container yard (including paving) and ancillary facilities (expected completion in August 2017)
- > Replacement of the Fuel Unloading Facility (ongoing, could be completed in 2018 (latest))
- Dredging of the harbor entrance channel to restore required depth and width (expected completion in 2017)
- > Construction of a fishing pier (close to completion).

The plan was furthermore to extend the existing 600m (3 berths) commercial quay southward by an additional 200m ("new quay"), but this would have been scheduled and constructed on demand, according to the actual traffic development and feasibility. It was indicatively timed for 2022. However, the container terminal performance indicators (berth occupancy of 47%, ship turnaround of 40 hours,

¹¹⁸ NIRAS: "Ports Development Study and National Port Master Plan", 2012

¹¹⁹ Royal Haskoning: "Freeport of Monrovia Master Plan", 2006

ship productivity of 10 moves per hour) demonstrate that the demand, together with the potential to increase productivity, does not yet justify this investment. Services offered could be enhanced, and terminal capacity increased by investments in new equipment (e.g. Gottwald mobile harbor cranes), and the current yard management could later-on be significantly improved by adding Rubber Tyred Gantries (RTGs) to the existing major types of equipment. Furthermore, the existing facilities offered, coupled with the possible use of the LMC pier (if required for General Cargo handling), maintaining required water depths and width of the harbor's entrance channel will be able to support (physically) and improve the port's competitive position and handle the forecast demand.

As noted above, the port entrance channel must be dredged periodically to safeguard port access. Since the end of the Liberian civil war, maintenance dredging has been carried out in 2007 and 2012, and a combined total quantity of approximately 2.2 million cubic meters of materials (sand, mud, and silt) has been dredged from the entrance channel to restore the water depth. It was already documented in 1978¹²⁰ that FPM is subject to an ever-increasing rate of northward sediment transport which is the main source of siltation in the port. After many years, the sediment transport is now no longer deposited along the exterior area of the southern breakwater because the area has completely sanded-up, and the percentage of the "theoretical rate" calculated has increased simultaneously with increasing sanding-up of this area. Presently, the sediment bypassing the breakwater head is the main source of siltation in the port. There is no apparent risk in removal of sand from this area for harbor extension or other works. On the contrary, a removal of sand from this area would counteract the continued building of sand in the harbor.

A possible complementary investment project aimed at removing or reducing the need for periodic dredging could be to modify or extend the main (southern) breakwater and/or remove and dispose of the deposited sediment from along the exterior area of the breakwater. The optimal approach should be determined through a feasibility study – with the objective being to identify a preferred solution and to prepare bidding documents for this preferred solution. A draft Terms of Reference for such a study have been developed.

7.3 Regional Connectivity by Road

7.3.1 Regional Road Network

The Economic Community of West African States (ECOWAS) is a 15-member regional group incorporating Liberia with a mandate to promoting economic integration of the member countries. The ECOWAS Regional Road Transport and Transit Facilitation Programme aims to improve regional transport connectivity. Pertinent to Liberia is the improvement of the 4,010km Trans Africa Highway 7 (TAH7, also called the Trans West African Coastal Highway) which runs from Dakar in Senegal to Lagos in Nigeria. This road corridor aims at promoting the physical integration of the ECOWAS countries by allowing free movement of people and goods within these counties.

Figure 7-1 shows the routing of TAH7. It follows a routing through Liberia from Ganta via Toe Town to Côte d'Ivoire. However, the focus on primary roads in that part of the country is presently on both the Toe Town routing (World Bank)¹²¹ as well as the route from Ganta via Saniquellie to Côte d'Ivoire via Loguatuo border post (EU/AfDB). For the purposes of this report, and given the advanced status of the two initiatives, both routes are included in the SIP as regional roads.

¹²⁰ Rhein-Ruhr Ingenieur-Gesellschaft mbh: "Preliminary Engineering and Economic Investigations for the Rehabilitation and Extension of the Freeport of Monrovia - Vol. II: Actual Situation of the Port and Site Investigations", 1978

 $^{^{121}}$ The Toe Town link is combined with the works on Tappita-Zwedru.





The road is mostly of paved standard, however, unpaved sections exist including within Liberia. The condition of the road corridor within Liberia is illustrated in Figure 7-2.





[Update figure to also show Ganta-Loguatuo status]

7.3.2 Border Posts

There are nine land border crossings staffed primarily by the Liberia Revenue Authority (LRA), as well as Customs facilities at the NPA's four ports. Furthermore, there are numerous unmanned "informal" crossing points with the three neighboring countries.



Figure 7-3: Border Posts (Land Crossings)

Official records of the number of crossings have not been available. However, as shown in Table 7-5, the LRA could provide a general impression of the maximum number of trucks that would have to be inspected at any time.

All the land borders except for Mendicorma are river crossings. Many of the bridges and ferry landings require rehabilitation or replacement. Access to the major border posts (Ganta, Loguatuo, Bo Waterside) are or will shortly be paved, and since roads leading to border posts are part of the primary road network, consideration should be given to progressively paving the access to the other posts too – when the proximate national road is earmarked to be paved.

Border With	Location	Max No Trucks	Type of Crossing	Road Type
	Loguatuo	6	River – steel bridge in adequate condition	To be paved
Côte d'Ivoire	Toe Town	6	River – steel bridge requiring rehabilitation	Unpaved
	Harper	4	River – ferry requiring proper concrete landing	Unpaved
	Buutuo	4	River – previously ferry, now requires steel bridge	Unpaved
	Ganta	6	River – steel bridge in good condition	Paved
Guinea	Yealla	6	River – steel bridge to be replaced	Unpaved
	Jorwah	4	River – requires a steel bridge	Unpaved
Sierra	Mendicorma	4	Land crossing	Unpaved
Leone	Bo Waterside	6	River – concrete bridge in good condition	Paved

Γa	able	7-5:	Trans	port l	Facilities	at	Border	Post	s
	INIC	1-0.	i i ano	ροιιι	acintico	uı	Doraci	1 031	9

Source: LRA and Cardno Project Team

Elsewhere on the continent, including West Africa, the concept of a One-Stop Border Post (OSBP) has already been implemented. An OSBP eliminates the need for travelers and goods to stop twice to undertake border crossing formalities, by two countries applying joint controls to minimize routine

activities and duplications. An OSBP would typically be located at a particularly busy border with high delay-related costs. A regional legal framework already exists,¹²² and OSBPS in West Africa are already operational at Malanville (Benin-Niger) and Cinkansé (Togo-Burkina Faso), with more OSBPs planned or under implementation on the regional Abidjan-Lagos (shown as a red line in Figure 7-4) and Dakar-Bamako (blue line) corridors. For the time-being, no OSBPs are yet foreseen on the remainder of TAH7 (Dakar to Abidjan).



Figure 7-4: West Africa OSBP Program

Source: Virtual PIDA information Centre (VPiC)

In their current configuration as traditional border posts (i.e. not OSBPs), apart from the transportrelated infrastructure requirements, many of the Liberian road border posts require additional facilities to function as an efficient and secure filter, and so as not to cause undue delays for consignors and transporters. Therefore, apart from providing crossings and upgraded roads, the investment plan also makes provision for adequate vehicle parking area, a Customs building, a covered inspection shed, a goods storage warehouse, gatehouse, fence and yard lighting – where this does not already exist or needs extension and/or rehabilitation. These requirements were determined to cater for the situation at each border post individually, in consultation with the LRA.

In the near term, from a Customs perspective, the four sea ports will become destination inspection ports. This implies an increased work load for the LRA and a concomitant need for additional inspection areas and sheds at especially the Freeport of Monrovia. However, a more detailed investigation will be required to quantify the required investments, and only a nominal provision has been made for these facilities.

For purposes of timing the above investments, it is useful to categorize the border posts in terms of their role in the national transport system. The ones that already carry the most traffic and provide the most strategic linkages are FPM, Ganta, Bo Waterside and (soon also) Loguatuo, and the required investments should be made quite promptly. The facility at Buchanan Port should also be established soon, possibly 2020. Investments at the smaller ports and border posts (Mendicorma, Toe Town and Harper) can probably be postponed to at least 2025, with the remaining border posts (Yealla, Jorwah and Buutuo) unlikely to require a commitment before 2030 or later.

7.4 Regional Connectivity by Rail

The ECOWAS Railway Master Plan (2009) aims to enhance competitiveness of the region' economy by providing affordable transport costs for agriculture and mining products and goods. It identifies 17 priority links, and provides for the rehabilitation of 3,300km existing and the construction of 6,700km of new lines.

As shown in Figure 7-5, Liberia would be spliced into the regional rail network by extending the existing Nimba line from Sanniquellie to Man in Côte d'Ivoire, a connection of some 140km of which about a

¹²² ECOWAS Supplementary Act/SA.1/07/13 Relating to the Establishment and Implementation of the Joint Border Posts Concept within Member States of the Economic Community of West African States, June 2013

third is in Liberia. It should be noted that none of the western rail system in Côte d'Ivoire exists yet. Also, the rail gauge in Côte d'Ivoire is 1,000 mm (narrow gauge) compared with 1,435 mm (standard gauge) in Liberia (a dual gauge solution raises various safety and operational concerns). There could be further inter-operability issues related to telecommunications, axle load limits and couplings.





Source: ECOWAS Railway Master Plan

One of the options previously explored to evacuate iron ore from Simandou in the south-east of Guinea was constructing another rail line approximately parallel to the existing Nimba line. That plan came under political pressure in Guinea which has decided in principle to export such ore from its own port/s. However, there is the potential of other (non-ore) traffic generated in the south-east of Guinea being allowed to transit via Liberia, i.e. implying via the Nimba rail line. At this point, there is no hard evidence for this concept, and if it does develop momentum, the lead time for a large rail project means that such initiative would fall outside the current planning horizon.

For the time-being, the MOT should therefore just remain current with regional rail developments, including the update of the ECOWAS Rail Master Plan (which was scheduled to be updated recently), but realistically will not be required to implement the Liberia component for some time.

8. National Connectivity & Mobility

8.1 National Connectivity & Mobility: Domestic Aviation

The recent EVD outbreak underlined the importance of maintaining national connectivity, and the value of being able to reach everywhere in a certain minimum time. But proper connectivity is not just required for humanitarian and strategic purposes; it is a prerequisite to encourage geographic diversification of the economy by providing access to business opportunities in remote areas. To some extent, the UNMIL operations have maintained a network of access by air. However, with UNMIL's imminent withdrawal, a sustainable national airports strategy with a civilian, commercial focus should be put in place.

8.1.1 Continued Operation of Spriggs Payne Airport?

James Spriggs Payne airport (IATA airport code "MLW", ICAO code "GLMR") is the domestic hub airport. MLW can handle category C aircraft (narrow-body, medium-range aircraft such as B737, A320, etc.), although the typical aircraft is category B. The airport is not equipped with ILS and provides daylight services only.

Practically all domestic flights either originate from or have MLW as their destination. Periodically, the airport also receives a regional flight (Air Côte d'Ivoire from Abidjan).

Six operators provide domestic air services from Spriggs Payne. None of these is formally licensed by the LCAA or has an Air Operator's Certificate (AOC) allowing it to use aircraft for commercial purposes. This means that today it is officially not possible to buy a ticket for a flight within Liberia. Aircraft in use are fixed wing (13 to 19 passengers) and helicopters (4 to 24 pax).

Company/Organization	Nature	Type of Aircraft	
UNMIL	Military and relief	MI-8, Dash 7, Beech 1900	
Samaritan Purse International	Relief	Caravan 208, Bell 206	
Aspen Medical	Aero-medical evacuation	Beech 1900	
Golden Veroleum	Agro-Industry (palm oil)	Caravan 208	
Liberty Aviation ¹²³	Contract charter services	(not available)	
Mission Aviation Fellowship (MAF)	MLW-Harper air service	Caravan 208	

Table 8-1: Operators operating from Spriggs Payne

The airport handles about 7 aircraft movements (ATMs) and 44 passengers per day. UNMIL is responsible for most of the activity.

Activity	UNMIL	Non-UNMIL	Total
Passengers	9,425	6,668	16,093
ATMs	1,229	1,390	2,619

Note: Arrival and departure pax and ATMs

The occasion of a master plan is when the current configuration of the transport network can be assessed more strategically. In the case of MLW, the question is whether a second airport in the Monrovia area is justified, or whether the two operations should be consolidated (especially if large investments are required at both). The current large-scale investments being made at ROB confirm that it is GOL's preferred location for staging long-haul flights. Given the low activity level at MLW, the issue is therefore whether MLW should be closed and operations moved to ROB. The main benefits of consolidation would be reduced overall investment, reducing duplicated operating costs, better utilization of ROB and making available the MLW site for alternative use. On the downside, the commercial land value of MLW is (only) in the order of USD 5-10 million (not considering any

¹²³ Liberty reports that it has obtained an AOC and ASL (Air Services License) from the LCAA. See http://www.libertyaviationgroup.com/about_us.html

decommissioning costs), which is not a particularly useful amount for reinvestment elsewhere in the airport system. MLW's location in Sinkor is attractive from an access perspective compared to ROB, especially for short-haul, domestic flights for which the transit time to/from ROB become prohibitive. But, given the low volume of traffic at MLW, such time savings are not significant now nor will it be in the timeframe of the master plan.

Had it not already existed, it is very unlikely that a case to develop MLW could be made today. The investment focus would rather have been to improve the road access to ROB.

The proposed approach to MLW is based on two principles. First, any new investments must be reasonably contained, and limited to essentials only The mooted major extension of the runway into the swamp to accommodate B737 aircraft is not required in terms of the airport's role in the domestic aviation system nor in terms of the type of aircraft it handles. A good test for a proposed new investment would be whether its financing cost could be recovered directly from the airport's users, i.e. those in the best position to judge the locational advantage of MLW vs. ROB. Second, a clear policy is required on which types of operation may (domestic, possibly short-haul regional flights) and may not (longer-haul flights) use MLW. Such policy is required to contain investments in MLW, to comply with increasingly stringent international environmental (noise, emission) requirements, and also to ensure the financial viability of ROB (especially is provided under a concession-type approach as discussed in section 4.5.5).

MLW will therefore continue to serve in a "city airport" role as is usually found in much larger cities with much higher domestic aviation activity. But this may only be an interim (medium-term) role to stimulate the redevelopment of the domestic aviation market. In the 2010 NTMP it was recommended that a thorough feasibility study be undertaken into the costs and benefits of upgrading vs. relocating MLW operations to ROB. That study is still required, although its focus is likely to be "when" rather than "whether" MLW operations should relocate to ROB. The trigger moments would include when a high-speed road connection to ROB is in place (reducing the locational benefit of MLW), when domestic-international air passenger transit starts occurring (which is more efficiently accommodated at one airport), when the cost of operational and environmental compliance at MLW becomes prohibitive, when the urban land value and land-use opportunity cost exceeds the benefit of using the MLW site as an airport, etc.

Subject to not over-investing at MLW as discussed previously, there are some basic, mostly safetyrelated investments that should be made for MLW to serve as domestic hub airport. The scope of the MMTMP did not allow a detailed assessment to be made, but from a cursory inspection the major issues appear to be spot improvements to the runway; improving runway lighting; reviewing the status of the voice communication systems and navigation equipment (VOR/DME); installing an automated meteorological station; ensuring the operability of the back-up power system (generator); and improving the airfield fence. To not over-invest for in a facility with limited long-term prospects, only critical aspects of these items should be addressed. A comprehensive Safety Management System (SMS) should be implemented at MLW and all LAA airports. These investments should be made subject to a proper safety audit considering the SARPs as contained in ICAO Annex 14, as well as supporting documents¹²⁴.

8.1.2 Redevelopment of Domestic Aviation Network

There are several lists of airfields around the country¹²⁵, but what is clear is that there is little left of the former airports system. Although not inspected in the course of the MMTMP, it is understood that these aerodromes generally have inadequately maintained runways, aprons, fences, terminal buildings and facilities, and that navigation facilities and firefighting equipment are generally in a poor state. None of the domestic airport or airfields has a formal approval for use from the LCAA. Therefore, and similar to the situation of air operators not having AOCs, no domestic airfield in Liberia should be handling a commercial air transport operation presently.

A selected number of these facilities should be re-opened and redeveloped to add a high-mobility tier to the national transport system. These would provide sufficiently fast access to air services over the

¹²⁴ E.g. Airport Planning Manual. (Doc 9184) and Airport Services Manual. (Doc 9137)

¹²⁵ The Liberia National Investment Commission (LNIC) lists 140 aerodromes with airstrips and heliports. The LCAA lists 13 "serviceable" (including ROB and MLW) and 21 "unserviceable" aerodromes, with 6 of the serviceable aerodromes having been inspected since 2014. The UN maintains a map showing a large number of helipads they utilize across the country.

whole country, considering the roll-out of the road network and typical road travel times. The selection of airfields should take into account the level of demand (size of towns, nature of local economic activity), but the balanced geographic distribution of the network should take higher precedence. This approach naturally implies a bias in favor of locations further away from Monrovia (need for access), but also a reduction in the current number of airfields (need for efficiency). The network will be less inclusive than the primary road network, as all county capitals will not be endowed with an airfield.

The previous Master Plan spoke about a set of core airfields that will be maintained by Government. That concept is developed further here by proposing some principles on which the selection of such a portfolio can be based:

- Proximity of Air Services. The goal should be for everyone in the country to be within about two hours of an all-weather, fixed-wing service aerodrome. Given the relatively low penetration of paved roads, this may mean a service radius of no more than 100km. In a country that is about 550x300km big, this coverage would be achieved with five or six airports (apart from the two in Monrovia).
- Location by Demand. The centroids of the airport service areas should be matched with nodes of economic activity and/or population. Figure 8-1 shows the resultant selection of airport locations. The confluence of high population density ("P") and high economic activity ("C" – using concessions as proxy) give three priority locations (Lofa, Nimba and Maryland counties). Three more locations would largely complete the coverage map (Grand Cape Mount, Grand Gedeh and Sinoe counties).



Figure 8-1: Domestic Airport Location

- Best-fit Existing Airports. In selecting airfields, account must be taken of the configuration of the existing facility, its current condition and its siting. The likely aircraft used for domestic air services would be local-range with a capacity of up to about 20 passengers and flight range of about 1,000km (MLW-Harper round trip), including aircraft such as Beechcraft-1900, Let L-410, Dornier D-228 or Cessna 208 Caravan. The required runway length would be up to 1,100m (3,500ft). The preferred airports would be located fairly close to a national road. Focusing on the airfields in the vicinity of the center points of the services areas shown in Figure 8-1, the situation of the candidate airfields is summarized in Table 8-3. The preferred airfields for inclusion in the core domestic network are:
 - Lofa (Voinjama) area: Foya/Kamala airfield, although not in as good condition as Tenebu, is better located and currently under renovation
 - Nimba area: Tapitta airfield, although located fairly far away from Ganta is in a better condition than Sanniquellie which has to be completely redeveloped
| Location | Airport | Comment | Opera-
tional? | R/W Length | Terminal | Fence | Fire
Equipment | Conclusion |
|---------------------------|---------------------|---|---------------------------------|--------------------------------------|---|--|-------------------|---|
| Lafa | Tenebu | LAA is now rehabilitating the r/w.
Used by MAF and Samaritan Purse | Yes | 5,000ft *
100ft | Yes, in
good
condition | No | Manual
service | Closest to Voinjama (county capital) |
| (Voinjama)
Area | Foya/Kamala | R/W recently rehabilitated.
Samaritan Purse flies here. Has
mini-met station | Yes | 4,200ft *
100ft | Hut
(shelter)
only | Yes (one
side of
r/w to
prevent
crossings) | Manual
service | Quite far away, but in
better condition (presently)
than Tenebu |
| Nimba Area | Sanniquellie | Airfield was practically abandoned
after the war. Property became
"undefined". LAA has recently
marked the borders again. Incursion
has happened, including some
housing erected on the runway.
Squatters will have to be removed.
Will require total redevelopment as
an airport | No (used
as helipad
only) | N/A | No | Νο | No | Location is good to serve
Nimba |
| | Ganta | Last used pre-war | No (now
helipad
only) | N/A | No | No | No | Not a candidate for consideration |
| | Tapitta | 0 | Yes | 2,750ft *
100ft | No | Yes | No | In best shape of the
aerodromes in the region,
but far away from central
Nimba |
| Maryland
(Harper) area | Alexander
Tubman | It has a short r/w (3,200ft) that is
constrained on the south by the sea
and the north by a hill with 2x
comms masts. Had a VOR which is
now decommissioned | Yes | 3200ft *
70ft
Unpaved
RWY | Yes, in
good
condition
(one
facility for
arrival and
departure
) | No | YES | In the list of the CAA for
serviceable aerodromes,
but not a candidate for
consideration |
| | Rocktown | Was constructed in the 1980s.
Earthworks completed but not
paved. Was never operated. | No | 5,000ft *
100ft
Unpaved
RWY | One
terminal
facility | No | YES | This is LAA's preferred
airport in Harper area
(because of r/w length), but
needs investment to be
serviceable and to be
approved by the CAA |
| Grand Cape | Robertsport | LAA has no information | No | 1,500ft | N/A | No | No | Not in service |
| Mount | Mano River | LAA has no information | No | 2,900ft | N/A | No | No | Not in service |

Table 8-3: Assessment of Candidate Airfields

Location	Airport	Comment	Opera- tional?	R/W Length	Terminal	Fence	Fire Equipment	Conclusion
(Robertsport) Area								
Zwedru Area	Tchien	At the northern end a local road crosses the runway. LAA is planning to cut off 1,000ft of r/w to accommodate the road	Yes	6,000ft Unpaved RWY	Yes, in good condition	No (was fenced, but now in disrepair)	No/Manu al service	LAA is positive about this airport. The airport is in the CAA's list of serviceable aerodromes
	Grand Cess	Was basically rehabilitated after the war. GVL flies here regularly	Yes	3,772ft * 100ft Unpaved RWY	Yes, in good condition, one terminal facility	No	No	Could also be a candidate
	Sasstown		Yes	3200ft*10 0ft	Yes	No	No	Not a priority for LAA, but in the list of the CAA for serviceable aerodormes. Not a candidate for consideration
	Sweaken	Samaritan Purse flies here regularly	Yes	2,380ft * 100ft	No	No	No	Restricted use. Not a candidate for consideration
Greenville	Greenville	Owned by LAA	Yes	4,400ft	Yes *needs of renovatio n	Yes	No	Have to decide whether to invest here. Since Greenville is not a priority area to service, is just 196km from ROB airport?
	Wakefield	Private airstrip owned by GVL. Located in the GVL oil palm concession. Used only by GVL	Yes	3,117ft	Yes	N/A info	N/A info	Is a second (duplicate) airstrip in the Greenville area

Source: Mostly informed by personal communications by LAA

- Maryland (Harper) area: Rocktown has better development potential than Alexander Tubman
- Grand Cape Mount (Robertsport) area: There is no serviceable airport in this area, but Mano River appears to have a longer runway
- o Grand Gedeh (Zwedru) area: Tchien is better configured than Grand Cess
- Sinoe (Greenville) area: Greenville is a public airport (compared with Wakefield which is private).
- Diversion Airport. The 2010 NTMP pointed out that ROB is in reality the only available diversion airport in the case of non-availability of MLW. But the two airports are in close proximity, implying that an extreme weather-related situation may also affect the availability of ROB, especially for VFR flights. One of the other domestic airports, within a reasonable flying time from Monrovia, should be designated as a diversion airport and equipped accordingly (e.g. with a fuel supply facility). Given its central location, and its (soon-to-be completed) good connectivity by road, this should probably be the airport serving the Nimba area (Tapitta).
- Investment Package. The facilities and condition of the selected airports need to be verified against a checklist of minimum requirements for domestic aerodromes. These do not need to be elaborate, but should include a gravel (all-weather runway), fence, waiting area (small terminal). Lighting and fuel services are probably not required. Flights will be VFR (visual flight rules), so very basic navigation equipment only will be required (localizer). Although not ideal, it may further be possible to operate these airports without permanent staff. An inventory of minimum requirements should be developed with the collaboration of the CAA and LAA, and a more detailed investment package designed per domestic airport.
- <u>Certification</u>. Those aerodromes to be used for domestic flights need to be certified by the Liberian CAA according to the promulgated safety and security recommended standards. In as far as these regulatory instruments and protocols are not in place, they need to be developed (as mentioned in section 7.1 in the discussion of ROB).
- Encouragement of Air Services. The opening up of the domestic airports network must coincide with the reestablishment of air services (including scheduled services). As for other modes of transport in Liberia, the private sector should be encouraged to provide these. A major stumbling block presently is the ability of the CAA to issue AOCs, as is further addressed in the chapter dealing with institutional matters.

The selection process applied above results in a number of "stranded" aerodromes across the country. The temptation is to somehow place these in reserve for possible future use. However, it has been argued above that fewer, better-equipped facilities will provide the required level of access by air – especially when seen as operating in tandem with the expanding terrestrial (paved road) network. Facilities that do not make this list of "public" airfields should be offered to the private sector if there is a specific need by a local industry, or to the relevant local authority that senses a benefit in maintaining an airfield in its area. The remainder should be decommissioned and the land sold or transferred.

Previously, an indicative investment package for a domestic airport was loosely described. The minimum requirements should be formalized by the LAA in consultation with the CAA. For purposes of costing the master plan, a basic investment allowance is made per airport. It is foreseen that the three priority locations will be addressed in a first phase (Foya/Kamala, Tapitta and Rocktown), and then the next three in a second phase (Robertsport, Zwedru/Tchien and Greenville).

8.2 Domestic Air Traffic Management System

For some time, domestic flights will be conducted according to VFR (visual flight rules), i.e. a set of regulations under which a pilot operates an aircraft in weather conditions generally clear enough to allow him to see where the aircraft is going, and to take off and land. The navigation equipment used is therefore carried on-board the aircraft itself (compass, airspeed indicator and altimeter). Only if the aircraft enters controlled airspace is a radio required. Often, countries mandate the use of a radio when flying into an uncontrolled airport (such as the domestic airports discussed in the previous section).

An elaborate navigation and communication system is therefore not required to support the domestic airport system. However, the ideal would be to have basic navigation equipment on the ground (VOR and DME) and a good communication system at each of these airports. Later-on, consideration can be

given to providing active tower control, and to provide complementary services like a meteorology station. The design and roll out of NAV, COMM and MET requirements should be the subject of a separate, dedicated study.

UNMIL apparently operates to more than 50 heliports and airfields throughout the country. They are already downscaling operations and will pull out completely by about 2018. That would be an appropriate time to carry out the N/C/M study, at which point it can be assessed whether any of the UNMIL specialized aviation equipment in use can be reassigned for use at the public airfields.

8.3 National Connectivity & Mobility: Nimba Corridor

Within the national transport fabric, there are some actual and potential routes that are more dominant in terms of traffic and volumes moved and therefore of higher importance to the economy. These routes are referred to as "corridors". A corridor would typically be an export and/or import conduit, and would therefore be inter-modal (a port with a road or rail outlet) and even multi-modal (both road and rail links).

There are four broad categories of terrestrial corridor in Liberia:

- Regional road links. The Monrovia-Gbarnga-Guinea and Monrovia-Robertsport-Sierra Leone regional corridors were addressed in section 7.3. From a regional perspective, the important issue is that these links should be open and unconstrained. Given the still relatively low levels of cross-border trade and traffic, the service level on these corridors will be determined by the volume of national rather than regional traffic making use of these links.
- Nimba Corridor. This entails the Buchanan-Ganta routing. It is a port-rail corridor with the possibility of also opening up a primary road link in future. The significance of this corridor arises from how it can compete with or complement the Monrovia-Ganta corridor. The relative roles of the two ports (Monrovia and Buchanan), the relative attractiveness of rail on the one and road on the other, and supporting initiatives on one or both (e.g. the planned dry port) make the Nimba corridor an important area of consideration in the future configuration of the national transport system.
- Other commodity corridors. The Greenville and Harper ports were created to evacuate commodity exports (e.g. forestry products) directly and efficiently, rather than first transporting such cargo to far-off ports like Monrovia and Buchanan. These ports with their road connections are therefore classic economic corridors.
- Non-"economic" corridors. Three further routes are sometimes referred to as corridors, i.e. the Ganta-Zwedru-Fish Town-Harper route that is currently being upgraded, the south-eastern coastal corridor from Buchanan to Harper, and the initiative to improve the connectivity to the north-west (Gbarnga-Voinjama and beyond). The main role of these routings is not to export commodities or otherwise facilitate trade, but to fulfil a more strategic function of linking up the country and facilitating domestic distribution. Trade traffic on the two transversal routes (Ganta-Harper and Buchanan-Harper) especially hinge on how port activity shifts from the Freeport of Monrovia to the outports in future.

Whereas all the corridors and links referred to above are terrestrial, for completeness' sake, the usefulness of a sea-based ("short-sea shipping") corridor should also be considered. As discussed in section 8.6, such a linkage would mainly fulfil a strategic, connectivity role like the non-economic corridors mentioned above, rather than compete with land-based corridors.

After Montserado, Nimba County has the highest population number. It is probably the second-most important economic center in the country. It is strategically located on the regional axis between the three neighboring countries. The Ganta-Gbarnga region similarly occupies the domestic crossroads to the north-west and south-east (at least for the time-being until the coastal corridor is established).

The movement of commercial traffic from, to and through Ganta/Gbarnga is currently coupled with Monrovia. This situation is likely to prevail for some time, since neither the Freeport of Monrovia nor the Monrovia-Ganta road link are under capacity or performance pressure.

But the Buchanan-Ganta ("Nimba") corridor offers some enticing prospects. The non-Monrovia cargo passing through the FPM add to the congestion in the greater Monrovia area. If there are sufficient volumes, then vessel calls directly to Buchanan become attractive. Buchanan port has ample spare capacity, but more importantly, is connected to Ganta by a rail line that is underutilized at present. So, as volumes passing through Ganta increase, there could well be a tipping point where it becomes feasible to open up the Nimba corridor as a complimentary trade route. Such a shift of activity towards

Buchanan would further be supported by the upgrading of the coastal highway from Buchanan towards Harper.

The potential shift of traffic from FPM to Buchanan port can be demonstrated based on the concept of traffic watershed. This suggests that a port will drain a certain, natural traffic catchment area. As shown in Figure 8-2, if differences in port service level and availability of connecting transport infrastructure (roads and rail) are put to one side, FPM would "drain" the north-west of the country and Buchanan most of the central and all of the south-east parts. The "traffic-shed" is shown by the indifference line from Roberts Airport to Gbarnga to Yealla.





In terms of traffic volumes, indifference between FPM and Buchanan would have an effect roughly as shown in

Figure 8-3. The figures are projections for 2027, i.e. towards the end of the planning horizon by when the implied traffic shifts may have played out. The left-hand map shows the projected heavy vehicle (trucks and horse-trailer combinations) traffic with the roads network as-is in 2017. The right-hand map shows the case where the Ganta-Buchanan road has been upgraded to paved standard, operating at the same speed as the Monrovia-Ganta road; and where vessel calls at Buchanan are sufficiently regular for traffic to be indifferent between the two ports.



Figure 8-3: Conceptual Cargo Shift to Buchanan Port by Improving Nimba Corridor

The effect of opening the "Nimba corridor" (i.e. improved road connectivity and increased port call frequency) shows up in a clear shift of traffic away from the Monrovia-Ganta to the Buchanan-Ganta route. There is also a noticeable reduction in traffic between Buchanan and Monrovia (the need for land transit has been obviated) and between Ganta and Gbarnga. The situation that would play out under this scenario is that Buchanan would become the preferred port for the south-east and would compete (with FPM) for traffic generated by the Gbarnga/Ganta area. Given similar distances to FPM and Buchanan, the extent to which Buchanan can attract traffic will be largely a function of the port service level, including number of vessel calls.

In terms of the absolute number of heavy vehicles, traffic on the two corridors could be of a similar size – between 350 to 400 heavy vehicles per day. In terms of cargo volume, it is estimated that there would be about 0.9Mtpa on the Nimba Corridor, the composition of which is shown in Table 8-4. Imports account for 80%, most of which is consumer goods and fuels.

Category	Code	Product	Mtpa	%
	SI10	Rice	0.060	7%
Substitutable	SI20	Frozen Products Imports	0.009	1%
imports	SI30	Consumer Goods (self-produced)	-	0%
	NS10	Containerized Consumer Goods	0.373	43%
	NS21	Gasoline	0.063	7%
	NS22	Diesel	0.078	9%
Non-	NS23	Other Petroleum	0.009	1%
Substitutable	NS31	Cement bagged	0.041	5%
Imports	NS32	Clinker	-	0%
	NS40	Vehicles	0.004	0%
	NS50	Fertilizer	0.012	1%
	NS60	Other	0.051	6%
	CE11	Iron Ore	Not shown	-
Companying	CE12	Gold & Diamonds-related	-	0%
Concession	CE21	Rubber & Latex	0.040	5%
Exports	CE22	Palm Oil	0.026	3%
	CE30	Forestry	0.111	13%
Total			0.876	100%

Table 8-	4. Estimated	Cargo on	Nimha	Corridor	(2027)
I able 0-		Cargo on	miniba	Contract	2021

8.3.1 Port of Buchanan

Buchanan port was originally constructed by Liberian-American-Swedish Mineral Company (LAMCO) mainly for the export of iron ore from the Yekepa area. The harbor is protected by two breakwaters extending approximately 1,890m (southern breakwater) and 590m (northern) into the sea, providing 57ha of protected water. The access channel has a depth of 12.8m (last dredged in 2010), implying that the port can handle Handysize, Handymax and Panamax vessels.

The total port land area is 1,475ha, about 20% of which makes up the commercial port, administered by the NPA. The commercial quay is located on the northern breakwater, is 335m long with two berths, and has a maximum depth of 10m. It is used mainly for the export of logs, but can also handle general cargo. Only geared vessels can be handled, except for liquid bulk petroleum products (hose) and vegetable oil (pump). There is a storage shed partly leased out to Cemenco for storage of bagged cement, but there is no designated container stacking yard at the commercial quay area.

The remainder of the port is under concession to ArcelorMittal for the export of iron ore. There is ample space (400-500m) between the perimeter of the concession area (the rail balloon) and the northern breakwater for expansion of the commercial area.

The 2012 National Ports Master Plan foresaw the need in future for a container quay centrally located on the mainland, between the two breakwaters, west of the iron ore quay. Its dimensions were scoped as a length of 530m and maximum draft of 12.6m. The projected date for this quay to be required was 2025. However, the cargo projections presented in this report indicate that the traffic by 2027 (the last of year of the planning horizon) is still unlikely to justify the quay.

On the other hand, a decision to open up the Nimba Corridor in competition with the Monrovia-Ganta corridor would change this conclusion. As shown above, there is a potential of nearly 0.9Mtpa of cargo feeding to/from the Nimba route. Additionally, another 0.3Mtpa of cargo (excluding any palm oil or forest products) could be obtained from the Coastal Corridor to the south-east (assuming Greenville Port can handle the palm oil and forest exports, but not the rest of the commercial cargo to the south-east).

In support of the Nimba Corridor strategy, NPA may also consider converting the current (and future) commercial port into a landlord arrangement, and concessioning this out to a private operator. This approach would be similar to what has already been successfully executed at the Freeport of Monrovia. Setting up this arrangement now could mean that the private party is sufficiently embedded and confident of the port's potential to act as co-investor or investor when the outlay needs to be made in the new container quay.

8.3.2 Road Interventions on Nimba Corridor

The port access road is an extension of the primary road from Monrovia (the P02/Tubman Street). The road is paved and in a good condition. However, apart from the link to Monrovia, Buchanan is not well connected by poorly constructed and maintained gravel roads to the south-east or the north.

The existing secondary(s) road from Buchanan-Ganta (S1) including a spur to Gbarnga (S12) is proposed to be upgraded to paved primary road standard.

8.3.3 Potential for Rail Service?

The 267km standard gauge (1435 mm) Nimba Railway from the port of Buchanan to Yekepa was built in 1963 as a single track standard gauge of 1,435 mm (4 ft. 81/2 in), and had eight intermediate stations with passing loops. The line was designed for iron ore haulage, and was one of the first railways to be designed specifically for use by long trains.

Notwithstanding, prior to 1990 passenger trains also used this route. The question therefore arises whether this system can again be used for non-ore purposes, and so be integrated in the national transport system for long-distance non-ore commercial and passenger movements.

This possibility was foreseen in the wording of the ArcelorMittal (iron ore concessionaire) Mineral Development Agreement (MDA) which provides for the possibility of Third-Party Access (TPA) onto the line in the case that the concessionaire does not utilize its railroad and mineral port Infrastructures to full capacity. However, the MDA refers only to TPA for the purposes of transportation and shipment of minerals. TPA for non-ore purposes would have to be negotiated legally, and also accommodated

technically because commercial services would be scheduled differently to ore trains and may not use the same equipment (e.g. communications).

Based on the lay-out of the railway line (crossing loop location, train speed, etc.) and train operating hours, it is estimated that the Nimba line has a capacity of 16 trains per day, i.e. eight per direction. The current operation is one loaded train per day. The ArcelorMittal MDA provides for the annual export of about 9.75Mtpa of concentrate, which would require five loaded trains per day, implying that three commercial slots per direction per day would be available for TPA. In the demand projection, it was suggested that given the cyclical nature of iron ore demand, typical exports would amount to two thirds of the maximum capacity (i.e. 6.5Mtpa) which would could make another two to three slots available.

A block train providing a daily service (one round-trip per day) could consist of 20 flat-bed wagons, each carrying two TEUs (20-foot containers). It is likely that for a period at least, the train will run loaded in one direction (going up-country) but largely empty on the return trip. Given the typical loading of a container, the annual capacity would then be in the order of 0.2Mtpa.

Since the track infrastructure is already in place, the investments required for the commercial services would comprise rolling stock and fixed installations (depots and terminals at the ends of the line and one intermediate terminal between Buchanan and Yekepa). The commercial train wagons will have a much lower loading per axle, implying that the additional maintenance requirements related to this service will be minimal. Under these circumstances, the operating cost would be in the order of 20c/tkm – which is high by rail standards but still below the typical truck cost of around 30c+/tkm. Adding a loaded train on the return journey would roughly halve the cost.

The overall Nimba Corridor strategy would have to first show positive results before opening up the iron ore line to TPA commercial traffic could be pursued more actively. Then, it would provide a neat, marketable investment opportunity for the private sector. It could be offered directly to the iron ore concessionaire, or a third party proper.

8.3.4 Ganta Dry Port

The MPW has been investigating the feasibility of establishing an inland dry port in the area of Ganta. It is premised on quite aggressive growth in container traffic to and via Ganta, the assumption that the dry port would facilitate containers being allowed to travel up-country, and that road transport costs can be reduced by establishing a dedicated road shuttle between Monrovia and the dry port.

The recommended site is at Kpoapa, 15km south of Ganta and the P1 road linking Monrovia to Ganta and beyond to Guinea and Côte d'Ivoire. It is located on the P5 primary road (Ganta-Tapeta), but about 3km from the S1 road to Buchanan and the Nimba railway line (which are located closely together). If the main purpose of the site is to serve the Monrovia corridor, it should ideally be placed closer to Ganta. However, to serve both that and the Nimba corridors strategy proposed here, it would be better located at a rail head, probably at the P3/S1 junction right next to the railway line.

8.3.5 Nimba Corridor Investment Package

From the above discussion, the conclusion is that opening up the Nimba Corridor entails a series of initiatives. However, these are not required simultaneously, but may be executed sequentially.

The two key pillars of this strategy would be to relax the vessel call rules for the Port (i.e. to allow the shipping liners to add a Buchanan call to their timetables), and to upgrade the ex-secondary S1 (to Ganta) and S12 (to Gbarnga) – which roads will in any case become primaries under the new roads classification system. Depending on the tempo of traffic shift onto the Nimba Corridor, it is possible that investment a third pillar will be required, i.e. the new container quay. It would be premature to schedule this facility for a specific date, but more detailed feasibility and design could already be undertaken. The fourth leg of the Corridor package would be facilitating investments in the rail line for commercial cargo purposes. A good test for the timing thereof would be when a private investor has the appetite to make this commitment. Government should test the water after the first two pillars have been executed.

8.4 National Connectivity & Mobility: Other Commodity Corridors

For the other two commodity corridors (Zwedru-Greenville and Fish Town-Harper) there are ongoing or planned road improvements, and the two ports themselves are largely under-utilized. Following a similar approach as the analysis of the relative attractiveness of the Nimba/Buchanan corridor, traffic

indifference lines and catchments can also be defined for these ports – as shown in Figure 8-4. The effect is to divide the country into four areas, each drained by a specific port.



Figure 8-4: Introducing Traffic-Sheds for Greenville and Harper Ports

The same assumptions can be tested for Greenville and Harper ports as were made for Buchanan port in the previous section, i.e. the effect of a similar service level at and connections to these ports. As shown in Figure 8-5, it is expected that traffic from the south-east that would otherwise largely have gone via Buchanan Port would now shift to especially Greenville Port, and the cargo movements along the coastal route between these two ports would reduce substantially.



Figure 8-5: Conceptual Cargo Shift to Greeneville and Harper

Catagoni	Code	e Product	Green	ville	Harper	
Category	Code	Product	Mtpa	%	Mtpa	%
Substitutable	SI10	Rice	0.010	1%	0.004	3%
Imports	SI20	Frozen Products Imports	-	0%	-	0%
	SI30	Consumer Goods (self-produced)	-	0%	-	0%
Non-	NS10	Containerized Consumer Goods	0.094	12%	0.078	52%
Substitutable	NS21	Gasoline	0.016	2%	0.016	11%
Imports	NS22	Diesel	0.020	2%	0.019	13%
	NS23 Other Petroleum		0.001	0%	0.001	1%
	NS31	Cement bagged	-	0%	-	0%
	NS32	Clinker	-	0%	-	0%
	NS40	Vehicles	0.005	1%		0%
	NS50	Fertilizer	0.003	0%	0.003	2%
	NS60	Other	0.011	1%	0.009	6%
Concession	CE11	Iron Ore	-	0%	-	0%
Exports	CE12	Gold & Diamonds-related	-	0%	-	0%
	CE21	Rubber & Latex	0.001	0%	0.010	6%
	CE22	Palm Oil	0.406	51%	-	0%
	CE30	Forestry	0.228	29%	0.010	6%
Total			0.796	100%	0.150	100%

Table 8-5: Potential Cargo handled at Greenville and Harper Ports (2027)

8.4.1 Greenville Corridor

Greenville port is situated on a peninsular across the Sinoe River from Greenville City. It has a single 400 m long west-oriented breakwater, which protects the harbor basin and the quay on the east side of the breakwater. The single quay is located on the inner side of the breakwater, with 8.1m draft. It has two berths, the main berth being 180m and the secondary (lighter/tug) berth 65m long. The port also has a 150m log ramp constructed around 400m from the quay on the coast of the harbor basin protruding some 20m into the basin. The quay is designated mainly for the handling of timber products. There are some rehabilitation works planned for the quay. The port has a log ramp which was previously used for facilitating floaters (logs) into the harbor basin for towing to an anchored vessel for loading. There is no warehouse, shed or silos in the Port, but there is sufficient unused land area for storage purposes.

The Port was dredged in 2012 to a water depth of 9.2m in the harbor basin and 8.1m in front of the quay. It currently handles 15,000 DWT log carrier vessels, and all vessels must use their own shipping gears. The Port can only be reached directly by the (unpaved) P3-18 primary road passing through the city.

The Greenville Corridor will continue to be mainly an export port, handling palm oil and logs – as shown in Table 8-5. The National Ports Master Plan of 2012 anticipated the construction of a new quay in the form of a 180m extension of the existing main quay, possibly by 2025. If consumer goods for the Greenville traffic catchment area were imported exclusively through Greenville Port, it could potentially be required to handle nearly 100,000tpa. However, the port's share of this trade has traditionally been quite small with most transported overland from Monrovia. It is more likely that it would in future come from Buchanan.

As regards logs, the port is likely to remain the main point of export for Liberia. Historic exports were at less than 50,000tpa, but this could grow about five to six-fold. The National Ports Master Plan (2012) budgeted for two mobile log-loaders. The port's log export capability and facility requirements should at least be the subject of a feasibility investigation in the near-term. It has the potential to be concessioned off as a PPP.

The main growth area for the Greenville port is likely to be palm oil exports, with this commodity reaching around 0.5Mtpa in the next decade. The National Ports Master Plan (2012) provided for the construction of a palm oil/fuel jetty of 350m at the port (but it should be noted that vegetable oils and petroleum products cannot be stored/handled interchangeably in the same facilities). The quay would need to be complemented by palm oil storage tanks with heating facilities and load-out pipelines. Such a facility would be a ring-fenced, commercial venture appropriate for development as a PPP.

The existing unpaved primary road (P14) between Greenville and Zwedru is proposed to be upgraded to paved primary road standard. The extend of upgrading works will include access to Greenville port.

8.4.2 Harper Corridor

The Port of Harper is located near the border with Côte d'Ivoire. The harbor is protected by a 150m long breakwater and a natural land north of the basin, providing some 6.3ha of protected water. The total land area is 7.5ha. The port facilities consist of a 92m marginal quay, a jetty (defunct) and three log ramps. It can accommodate 2,000 DWT vessels with maximum draft of 5.5m CD, and all vessels must use their own shipping gears. The Port has not been dredged since 1987.

Like Greenville, it is unlikely that Harper would handle a large share of imports to the south-east, with possibly the exception of petroleum products. Its main activity will remain commodity exports in the form of logs and rubber. An extension of the existing quay (by some 138m) was indicated in the National Ports Master Plan. However, it is unlikely that port volumes will justify such an extension in the next decade or so.

The port is connected to the main road network of Harper city over a laterite causeway. Upgrading of the road is not proposed due to budget. Traffic volume on the link is also predicted to remain low over the next 10 years.

8.5 National Connectivity & Mobility: National Roads & Terminals

8.5.1 Constrained National Roads Program

A constrained National Roads program was developed using HDM-4 in line with analysis process introduced in section 6.5. The output of this analysis was a schedule of investments assigned to a selection of road sections to be implemented over the next 10 years.

Table 8-6 shows the National roads program, the list of investment includes ongoing works as well as projects for which funds of have already been committed (denoted as 'Committed' projects in the table).

Table 8-6: National Roads Program

Road No.	From	То	km	Intervention	Year	Comments
P1	Redlight	Fendell Junction	10.1	Overlay(50mm)	2023	Committed
P1	Fendell Junction	Gbarnga	168.4	Overlay(50mm)	2023	Committed
P1,P3	Gbarnga	Ganta/Guinea Border	126.0	Overlay(50mm)	2022	Committed
D1	Ganta	Sanniquellie	40.2	Lingrade to Payed	2018	Committed
	Guilta	Sumqueme	40.2	opgrade to raved	2019	Committed
				Regravel	2018	Proposed
P1	Sanniquillie		15.6	Regraver	2024	Proposed
11	Sannquine	Luguatuo	45.0	Lingrade to Payed	2027	Committed
				Opgrade to Paved	2028	Committed
				Regravel	2018	Proposed
010	Pancanvilla	Careysburg	9.3	Upgrade to Paved	2021	Proposed
P12	Bensonville				2022	Proposed
					2023	Proposed
	Saw Mill	Compoundsu Junction		Dograval	2018	Proposed
				Regiaver	2024	Proposed
P13			25.4	Upgrade to Paved	2027	Proposed
					2028	Proposed
					2029	Proposed
			2	Pogravel	2018	Proposed, included under Greenville corridor programme (see 8.4.1)
				Negraver	2024	Proposed, included under Greenville corridor programme (see 8.4.1)
P14	Greenville Corridor	Greenville City	138.4		2027	Proposed, included under Greenville corridor programme (see 8.4.1)
				Upgrade to Paved	2028	Proposed, included under Greenville corridor programme (see 8.4.1)
					2029	Proposed, included under Greenville corridor programme (see 8.4.1)
P2	ELWA	Junction with Marshall Road	19.5	Lane Addition	2026	Proposed
P2	Junction with Marshall Road	Roberts International Airport Junction	27.0	Partial Widening (Climbing Lanes)	2027	Proposed
D2	Buchanana	Junction with Zwedru-	160 5	Pegravel	2018	Feasibility/Proposed
Γ ∠	Buchanana	Greenville Road	109.5	Negiavei	2024	Feasibility/Proposed

Road No.	From	То	km	Intervention	Year	Comments
					2027	Feasibility/Proposed
				Upgrade to Paved	2028	Feasibility/Proposed
					2029	Feasibility/Proposed
					2018	Committed
P3	Ganta	Tappita	110.7	Upgrade to Paved	2019	Committed
					2020	Committed
				Pegravel	2018	Feasibility/Proposed
02	Tappita	Zwodru	126.0	Negraver	2024	Feasibility/Proposed
F3	Тарріта	Zwediu	120.0	Lingrado to David	2027	Feasibility/Proposed
				Opgrade to Paved	2028	Feasibility/Proposed
P3	Tappita	Zwedru	126.0	Upgrade to Paved	2029	Feasibility/Proposed
				Pogravel	2018	Proposed
	Zwedru	Approx. 50km from Fish Town		Negraver	2024	Proposed
P3			88.3		2027	Proposed
				Upgrade to Paved	2028	Proposed
					2029	Proposed
D2	Approx. 50km from Fish	Fish Town	25.0	Ungrade to Payed	2019	Committed
FD	Town	FISH TOWN	55.0	Opgrade to Paved	2020	Committed
02	Fish Town	Karlokon	75 7	Lingrado to Pavod	2018	Committed
FD	FISH TOWN	Kallokeli	/3./	Opgrade to Paved	2019	Committed
					2018	Committed
P3	Karloken	Harper	54.5	Upgrade to Paved	2019	Committed
					2020	Committed
P4	Freeport	Brewerville	10.0	Overlay(50mm)	2025	Proposed
				Pogravol	2018	Proposed
				Regraver	2024	Proposed
P5	Brewerville	Bopolu	87.6		2027	Proposed
				Upgrade to Paved	2028	Proposed
					2029	Proposed
					2018	Committed
P7	Gbarnga	Salayea	80.5	Upgrade to Paved	2019	Committed
					2020	Committed

Road No.	From	То	km	Intervention	Year	Comments
			195.0	Pogravol	2018	Feasibility/Proposed
Р7				Regiavei	2024	Feasibility/Proposed
	Salayea	Mendekorma			2027	Feasibility/Proposed
				Upgrade to Paved	2028	Feasibility/Proposed
					2029	Feasibility/Proposed
				Regravel	2018	Proposed, included under Nimba corridor programme (see 8.4.1)
				Ū	2024	Proposed
S1, S12	Buchanana	Ganta/Gbarnga	237.7		2027	Proposed
				Upgrade to Paved	2028	Proposed
					2029	Proposed

8.5.2 Primary Roads Responsive Interventions Responses

The roads intervention strategy (refer back to section 6.5.1), given the limited resources to upgrade the primary network, is to at least retain a limited financial set-aside for purposes of responding to events on the primary network. These would be specific pavement failures, replacing failed culverts and other interventions that are not just of a routine maintenance nature.

An estimate of the required annual amount per county has been made based on the current condition of the network, as shown in Table 8-7. The amount provided for is USD10,000/km of paved roads that are of a fair or lower condition, and USD5,000/km for unpaved roads in that condition band.

		Paved		Unpaved			
County	Km	Excellent & Good	Fair, Poor & Bad	Km	Excellent & Good	Fair, Poor & Bad	
Bomi	71.8	71%	29%	46.5	0%	100%	
Bong	134.3	93%	7%	45.4	1%	99%	
Gbarpolu	-	-	-	72.4	2%	98%	
Grand Bassa	72.0	94%	6%	85.5	13%	87%	
Grand Cape Mount	66.4	98%	2%	92.1	19%	81%	
Grand Gedeh	-	-	-	203.8	5%	95%	
Grand Kru	-	-	-	165.4	1%	99%	
Lofa	-	-	-	246.8	3%	97%	
Margibi	69.8	96%	4%	0.5	52%	48%	
Maryland	-	-	-	101.4	0%	100%	
Montserrado	101.6	64%	36%	23.7	28%	72%	
Nimba	31.7	100%	0%	214.4	4%	96%	
River Cess	-	-		101.9	0%	100%	
River Gee	-	-		124.1	3%	97%	
Sinoe	-	-	-	252.2	5%	95%	
Total	547.6	86%	14%	1,776.3	5%	95%	

Table 8-7: Length of Primary Road Network (km) by County and Condition Band

8.5.3 Secondary Roads Responsive Interventions

The same approach as for primary roads above is followed for secondary roads, i.e. to make a setaside for failures that need to be addressed to keep the secondary roads open and passable. In this case, all roads are unpaved. Their condition bands are shown in Table 8-7.

Table 8-8: Length of Secondary Road Network (km) by County and Condition Band

	Unpaved						
County	Km	Excellent & Good	Fair, Poor & Bad				
Bomi	4.2	0%	100%				
Bong	369.0	6%	94%				
Gbarpolu	290.2	8%	92%				
Grand Bassa	201.3	0%	100%				
Grand Cape Mount	179.5	18%	82%				
Grand Gedeh	157.1	10%	90%				
Grand Kru	112.1	4%	96%				
Lofa	105.6	1%	99%				
Margibi	74.3	58%	42%				
Maryland	105.0	0%	100%				
Montserrado	13.3	13%	87%				
Nimba	407.6	15%	85%				
River Cess	247.9	0%	100%				

	Unpaved						
County	Km	Excellent & Good	Fair, Poor & Bad				
River Gee	-	-	-				
Sinoe	158.8	5%	95%				
Total	2,426.1	9%	91%				

Note: There are some paved secondary roads within the Firestone concession area as well as the road to Marshall (which was constructed by the Maritime Authority). Maintaining these roads are not currently responsibility of GOL.

8.5.4 National Roads Bridge Program

The bridges data used was collected as part of a network level survey, it indicates overall condition of bridges and not for individual bridge components. This data is considered to be at too high a level for use in developing a detailed works program that would clearly indicate the critical elements of each bridge that may need major maintenance or replacement on a year by year basis over the 10-year analysis period. To that end, a probabilistic approach that makes the best use of this high level data was used to develop the investment plan for Bridges. The analytical tool used was the UK Highway Maintenance Efficiency Lifecycle Planning Toolkit.

Table 8-9 shows the number of bridges on the national road network by type and condition. The deterioration profile of each bridge type was based on service lives given in the table.

	Inventory and Condition (No.)								
Bridge Type	Excellent	Good	Fair	Poor	Bad	Total	Life (Years)		
Bailey Bridge	2	20	20	2	7	51	50		
Composite Bridge	9	62	42	26	38	177	50		
Concrete Bridge	24	205	70	50	52	401	55		
Log Bridge	1	35	260	297	694	1287	15		
Steel Bridge	4	16	20	14	36	90	60		
Timber Bridge	1	36	92	45	108	282	30		
Other	2	14	12	16	116	160	50		

Table 8-9: Bridges Inventory, Condition and Service Life

The following interventions were used:

- Periodic including periodic maintenance such as steel painting and/or replacement of moving components of expansion joints. This treatment is modelled to be applied to structures in poor condition state.
- > Rehabilitation includes major works on existing bridges deemed to be very poor condition state;
- > Reconstruction Refers to complete replacement of the structure that are in very poor condition state.

The analysis carried out aimed to estimate investment required to eliminate bridges in Very Poor condition state by year 10. In addition, it was assumed that log and timber bridges in Very Poor condition will be replaced by bailey and concrete bridges respectively. The predicted condition profile for this analysis scenario is illustrated in Figure 8-6. The corresponding investment cost for bridges by intervention type (periodic, rehabilitation and reconstruction) and bridge type was accordingly calculated. Each of these categories of intervention is included as a separate project in the SIP long-list in Appendix B.



Figure 8-6: Predicted Bridges Condition

8.5.5 Road Terminals

The contiguity of the roads network requires that there is adequate opportunity for passengers and cargo to transit along and transfer between long-haul and short-haul transport services – in comfort. This takes the form of exchanges or terminals at key nodes. In Liberia, such terminals would mostly provide for road-to-road transfers, but could in principle be located to also accommodate inter-modal transfers (e.g. road-rail, road-IWW).

A typical passenger terminal would comprise of a covered passenger waiting area, a washroom, offices (for administration, transporters, and for public functions such as licensing authorities, vehicle inspectors and police), commercial facilities (shops and small kiosks), and a vehicle parking area (for buses, mini-buses, sedan-taxis and motorcycles) which may be partly covered for adverse weather.

Apart from providing passenger-related services, the terminals' location and facilities would also make them useful as truck rest stops and overnight spots. Although there is likely to be transfers of car-boot consignments of produce, charcoal and other tradeables, the terminals as envisaged here would not be for the large-scale storage and warehousing of cargoes as could possibly be found at a cargo-only dry port or inland container depot.

The network of passenger terminals should complement the national roads system, i.e. larger, more elaborate terminals positioned along the primary roads and smaller, simpler ones to serve secondary links. Following the roads classification reasoning, primary terminals would be located close to county headquarters and secondary terminals at district headquarters. Where county headquarters are large, primary change-over facilities should be located at the outskirts of the city, where long-distance, higher-order routes enter the city limits and the network changes to a more localized distribution system.

One terminal per headquarter would generally suffice. For Monrovia, however, given its fairly large footprint and population, consideration should be given to providing a primary terminal at every one of the city's main entrances. The vision of a future Bus Rapid Transit system for Monrovia is discussed in section 9.2. Using the BRT corridor as reference point, primary terminals could be located at Caldwell junction (serving the North-West entrance), Red Light (North-East) and ELWA junction (South-East/airport). At each of these points there already exist an informal transfer arrangement, which would be exchanged for a more permanent facility with more orderly operations).

Apart from serving firstly a transport and transfer function, these Monrovia terminals would be ideal platforms for larger-scale commercial development, i.e. a hybrid of shopping mall and transfer terminal. Such a hybrid should ideally be financed by a private developer. There may also be some potential for private participation at the other, larger primary terminals.

There would be at least three sizes and configurations of terminals. "A"-type terminals would serve really busy transfer points, such as in Monrovia; "B" terminals would be located on the primary network at county capitals; and "C" terminals at District HQs. The sizing of the terminals would roughly be as shown in Table 8-10. The small terminals (C) would not have covered vehicle parking, and the large terminals (A) would be purely passenger terminals not also a truck rest stop, i.e. no provision is made there for truck parking. Whereas the B and C terminals would be quite standardized, the A terminals will have to be designed more bespoke and their sizing shown here is therefore only indicative.

Facility		Unit	A Terminal	B Terminal	C Terminal
Land		ha	4	0.5	0.25
Offices, shops, washrooms		m ²	1,250	400	100
Waiting Area		m ²	1,250	400	100
Parking	Covered	m ²	1,000	250	-
	Open-non-truck	m ²	10,000	2,500	1,250
	Open-truck	m ²	-	1,000	500
Fence		m	800	300	200

Table 8-10: Approximate Sizing of Terminals

A town-by-town audit of the availability and nature of road terminals was not made. For this master plan, a conservative approach is therefore to provide for terminals even if a useful facility may already exist. Before implementation of the terminals program, a more comprehensive, pre-feasibility level assessment should be made, including the potential to use current transfer sites' footprint, the potential to utilize some of the existing buildings and facilities, a more detailed determination of the sizing requirements, facility design and costing, and a consideration of the commercial model (i.e. potential for private provision or partnering).

The number of terminals required per type is shown below. There are some cases where County HQs have small populations (smaller than many District HQs), and in those cases only a "C"-type terminal is provided. Also, where a terminal is provided for a County HQ, a terminal is not also provided for the district in which that County HQ is located. With the exception of Maryland, the districts in the South-East (Rivercess, Sinoe, River Gee and especially Grand Kru) generally have really small populations for which even a C terminal may be an over-specification.

	Terminal Type					
County	A	В	С		Comment	
County	County HQs		District HQs	comment		
Bomi			Tubmanburg	4		
Bong		Gbarnga		11		
Gbarpolu			Bopulo	6		
Grand Bassa		Buchanan		7		
Grand Cape Mount			Robertsport	4	Small County HQ population	
Grand Gedeh		Zwedru		7		
Grand Kru			Barclayville	[17]	Small County HQ population	
Lofa		Voinjama		6		
Margibi		Kakata		2		
Maryland		Harper		6		
	Red Light					
Montserrado	Caldwell			4		
	ELWA					
Nimba		Ganta		16	Not County HQ but biggest city	
River Gee			Fish Town	[9]	Small County HQ population	
Rivercess			Rivercess	[7]	Small County HQ population	
Sinoe			Greenville	[16]	Small County HQ population	
Total Number	3	9		127		

Table 8-11: Planning-Level Estimate of Road Terminal Requirements

As regards the implementation of the roads terminal program, it would follow the roll-out of the national roads program. In other words, terminals along already-paved and soon-to-be paved primary roads would be prioritized, as well as along secondary roads that are upgraded.

8.6 National Short-Sea Shipping?

Short-sea shipping (SSS) is also referred to as coastal shipping, i.e. shipping movements from port to port over quite short distances in territorial waters (near coastal voyages).

During the war and for a period thereafter, there existed such a coastal shipping arrangement, linking Monrovia with Greenville and Harper ports. The United Nations Mission in Liberia (UNMIL) made use of the M/V Caterina for logistical purposes, as well as to carry aid cargo for NGOs operating in south-eastern Liberia. The vessel is less than 2,000 deadweight tons, with a cargo capacity of about 1,000t, but not equipped for passengers. There were also limited commercial services, e.g. by Coastal Marine Transport Ltd. The total cargo transported between Monrovia and Harper was about 12,000t in 2009.

However, the CMT vessel sunk in 2013, and UNMIL closed down its operations in Greenville and Harper towards the end of 2016. Currently, the only vessel providing a coastal service is the M/V Lady Kentucky (of a similar configuration as M/V Caterina), plying a route Monrovia-Greenville-Harper-Monrovia. And there remains some informal, localized, short-distance movements of passengers and freight by sea mostly in open boats with outboard motors.

SSS was a sensible response to the lack of a reliable land transport alternative, both in terms of inadequate service level (unpaved roads susceptible to weather) and lack of security. Coastal shipping also makes possible the movement of outsized cargo, or particularly large consignments required for a specific project. Internationally, it is further promoted as a relatively more environmentally-friendly means transport.

It is generally accepted that ocean-going transport of non-time sensitive bulk cargo and containerized goods is the least-cost option over long distances. But for shorter distances and more valuable goods, the relative flexibility of especially road transport outcompetes maritime transport – because marine

transport is book-ended by time-consuming and costly handling, transfer and storage events not required for road trucks, and because trucks move faster.

Recent international evidence show that the economics of transport are exerting pressure on short-sea shipping. In the European Union, the potential of SSS has been promoted under the so-called Motorways of the Sea (MoS) program, commencing in 2001. There, the main motivations were to address congestion in especially road transport and to reduce the environmental impacts of transport. The program included improving port-rail linkages to improve end-to-end transport efficiency and induce a shift to SSS. However, the relative shares of the cargo transport modes have largely remained unchanged, due to a variety of factors that continue favoring land transport vis a vis SSS.

The recent SWIOC (South West Indian Ocean Maritime Corridor) study shows how coastal shipping along the Indian Ocean coast of Africa has declined. This is ascribed to low demand, low frequency of SSS vessel calls, low port efficiency, lack of port IT infrastructure, and other reasons. However, the important take-out is that notwithstanding relatively long distances between ports and significant issues in road transport and at border crossings in Southern and Eastern Africa, the contribution of sea-borne trade has actually decreased compared to road transport.

In the case of Liberia, the land (road) transport system is systematically being reconfigured. In the near term, the whole of Monrovia-Ganta-Harper will be paved and offer a reliable service. Although not immediately, the co-called Coastal Corridor linking Monrovia-Buchanan-Greenville-Harper will also be upgraded to a high standard. The sailing distance from Monrovia to Harper is about 450km, but the road trip via Ganta and Zwedru is about 755km. When the coastal road link is complete, the distance would be about 600km (via Greenville and Fish Town). For the other ports (Buchanan and Greenville), the road and sailing distances would be quite similar. It is therefore expected that land transport will be increasingly competitive.

Providing transport alternatives that give users a choice of price and service level (and even offering a strategic alternative) should be encouraged. As regards infrastructure at the outports, all three ports can handle break bulk, general cargo and containers. Operations are low-key and an increase in SSS would not test capacity. However, to increase port efficiency investments could be required in shore-based gear and container storage areas – but these investments would be prompted by growing long-distance port traffic and not SSS traffic.

As to the shipping services, the private sector should respond to the perceived market demand and tailor services accordingly. If required, Government's role would be limited to regulating market entry, providing a suitable window of exclusivity for a private operator to develop a SSS route.

9. Monrovia Urban Mobility

The main strategy adopted in the development of this section is to make the most of the Monrovia's existing infrastructure. Although there is no escaping the need for certain new infrastructure, including roads, the classic urban planning blunder of the 20th Century of adding more and more capacity to the network without addressing demand management or the traffic operations is not proposed to be repeated.

Rather, a modern, 21st Century approach based on the principles of operating transport intelligently has been adopted, in which road building is only proposed where operational solutions alone will be ineffective.

Such an approach minimizes cost, environmental damage, and is easier to implement.

9.1 Improvement of Arterial Network

The initial focus of the MMTMP/SIP is to improve the operation of the existing urban arterial transport network. In the medium to longer term, the attention will shift to reconfiguring the network and consider the possibility of introducing new means of transport.

The specific routes covered in this section are both the national primary roads and their overlap with the urban arterials. Hence, a number of roads in this section, though not part of the primary road network, are included since the development of the national primaries alone will be ineffective in developing an appropriate multi-modal transport plan for the City of Monrovia.

The arterial network itself is made up of the route that circulates the city, running along Tubman Boulevard, along Haile Selassie Avenue, across the Johnson Street Bridge and northwards along UN Drive to the Junction with Somalia Drive, along which the route continues until it joins up again at its eastern end with Tubman Boulevard. This is a distance of approximately 35km.

9.1.1 Traffic Flow

Traffic flow around Monrovia follows the same pattern as most other cities in the world. In the morning, traffic flows predominantly in the direction of the Downtown area (marked as *Central Monrovia A* in figure 9.1). In the late afternoon and early evening, traffic flows in the opposite direction, away from the Downtown area. As such, the traffic flows in each direction are hugely imbalanced at these times of the day.

Cardno

Figure 9-1: Monrovia Road Network



9.1.2 Capacity Issues

The issue with too many vehicles occupying the same amount of space on Monrovia's arterial road network are both obvious and well documented. At current projections of future transport use, which is linked to the rate of GDP growth, the number of journeys undertaken on the road network will increase at around 5% per year, that is, in terms of people and vehicles.

There are only two ways to deal with insufficient capacity of the transport network, namely:

- > Increase the capacity of infrastructure and vehicles,
- > Manage demand for transport usage through a combination of incentives and disincentives to avoid overuse of the available infrastructure and vehicles.

Both are considered here.

9.1.2.1 Increasing Capacity

The most obvious way of increasing capacity on a transport network is to build more infrastructure, such as a new road. This has the effect of making additional space available for people and vehicles, thereby cutting congestion.

However, the problem with building new infrastructure is that it is a costly and time-consuming exercise, and in general needs to be planned for many years in advance of the date when it is actually needed. Furthermore, unless the way in which the new infrastructure is to be operated is carefully planned, then it may not have the desired result of cutting traffic congestion to the level expected.

9.1.2.2 Managing Demand

There are two main ways of managing demand from transport users which are related to two variables, namely time and cost.

A combination of incentives and disincentives of this nature can be effective at controlling how and when passengers use the transport network. Examples include choosing one mode of transport over another because it is cheaper or faster than other modes.

9.1.3 The Capacity / Demand balance in Monrovia

9.1.3.1 Capacity

Around the Monrovia Arterial Road network there is an obvious problem with traffic flow. This affects the route from the junction of UN Drive / Somalia Drive on the north-western side, along the full length of Somalia Drive to the junction of Somalia Drive / Tubman Boulevard of the north-eastern side of the city, then south along Tubman Boulevard to ELWA junction.

These problems are well known and are being addressed by other projects, with conversion of Somalia Drive from a single lane to a dual-carriageway already under construction (due for completion in 2021), and the conversion of Tubman Boulevard from Somalia Drive to ELWA junction from a single to two lane currently going through Detailed Design. The junctions along both routes are also being upgraded as part of these projects.

Tubman Boulevard, Capitol by-pass/Halle Selassie Avenue and UN Drive are already two lanes in each direction and do not suffer from issues with capacity in engineering terms. Traffic counts undertaken in November 2016 indicate that peak traffic flows of 1900 vehicles per hour are still somewhat below the design capacity of Tubman Boulevard of 2600 vehicles per hour (DMRB TA79/99). Hence, although all three experience major traffic delays, these are actually down to bottlenecks at strategic location around the network rather than a capacity issue with the highway itself.

Specifically, these are at:

- > ELWA Junction
- > Red Light Junction (Somalia Drive and Tubman Boulevard)
- > SKD Boulevard / Tubman Boulevard Junction
- > Tubman Boulevard / Duport Road Junction
- > Johnson Street Bridge (both ends), and;
- > Junction of Tubman Boulevard / Camp Johnson Road / Capitol by-pass.

Major delays away from the arterial routes are also experienced at the junction of Caldwell Road and UN Drive. As this junction is a special case, it is considered as part of the improvements for the arterial road network assessed in this project.

In the case of Johnson Street Bridge, traffic which is two lanes in each direction on either side of the bridge is forced into a single lane, creating an obvious bottleneck.

In the case of the Junction of Tubman Boulevard / Camp Johnson Road / Capitol by-pass, traffic passing from Tubman Boulevard in a northerly direction and then turning left into Camp Johnson Road must cross the traffic travelling south along the Capital by-pass. It is the need for one traffic stream to give way to the other that creates this bottleneck, which regularly backs traffic up along Tubman Boulevard, especially in the morning peak times.

9.1.3.2 Demand

Demand on the network is estimated at 157,000 people per weekday, or 79,000 people travelling in each direction. The estimated number of vehicles carrying these passengers is around 40,000, or 20,000 in each direction. Based on observations, each vehicle has been assumed to carry an average of 4 passengers per vehicle.

Given that the vast majority of these are travelling by car, including taxi, it is obvious that if there was a better public transport system then the number of people using cars would be reduced, which would free up more space on road; for every bus load of passengers, this takes 10 taxis off the road (assumed length of 4 metres per taxi); equivalent to around 28 metres of extra space on the roads for every bus (assumed length of 12m) that replaces them.

Demand for transport around the city is estimated to grow at 5% per year, meaning that Monrovia's traffic problems will continue to worsen steadily unless action is taken.

9.1.4 Proposals

9.1.4.1 Convert the Arterial Road Network to Two Lanes in Each Direction

This proposal to increase capacity around the network is already being implemented as evidenced through the ongoing dualling of Somalia Drive, and recently proposed dualling of Tubman Boulevard from ELWA Junction to Coca-Cola Factory.

9.1.4.2 Remove Bottlenecks

There are two types of bottlenecks that cause delay on the arterial road network; those that are physical (e.g. where widening of the road may be needed), and those that are operational and relate to poor traffic management (e.g. where measures such as one-way systems or traffic signals may go a long way to resolving the problem).

Physical Bottlenecks

Many of the most well-known ones are already being dealt with as part of other schemes. These include the junctions of:

- UN Drive / Somalia Drive, which will be upgraded as part of the ongoing works to Somalia Drive (due for completion in 2020)
- ELWA Junction, which is proposed for widening as part of ELWA Junction to Coca-Cola (currently at the design stage but due for completion in 2021)
- > Duport Road / Tubman Boulevard, also being redeveloped under the ELWA Junction to Coca-Cola upgrade works
- Red Light (Somalia Drive and Tubman Boulevard), which is also being dealt with as part of the Somalia Drive ongoing works though will also be affected by the ELWA Junction to Coca-Cola upgrade.

Those for which solutions are still required are at:

- > Johnson Street Bridge, on both sides of the river
- > SKD Boulevard and Tubman Boulevard
- > Tubman Boulevard and Haile Selassie Avenue.

Of these, only the Johnson Street Bridge bottlenecks need any significant civil engineering works, whereas the other two bottlenecks can be dealt with through improved traffic management.

Johnson Street Bridge

Johnson Street Bridge suffers from a very obvious problem in terms of its capacity; it has two lanes of traffic merging onto it in both directions, yet it is only a single lane in each direction. Hence, forcing two lanes of traffic into one is the main cause of the problems experienced.

Figure 9-2: Traffic Merging into a One Lane at Johnson Street Bridge Northbound (left) and Southbound (right)



However, it is clear from the makeshift pedestrian walkways and concrete pedestrian barriers on either side of the bridge that it actually has, and was probably designed for, the ability to carry two lanes of traffic in each direction. Indeed, it is likely the pedestrian walkways on either side were developed following incidents occurring between pedestrians and vehicles in the past.

Hence, the solution is a simple one, which is to convert the existing bridge back to two lanes of traffic and to build a separate bridge across the river for pedestrians, or to add these to the outside of the existing bridge.

Operational Bottlenecks

These are by far the most prevalent causes of traffic delay in Monrovia and for which there are no plans presently for resolution. Indeed, hard engineering solutions such as improving physical capacity are only one way of improving traffic flow and reducing journey times. Management of the traffic is another highly effective way of improving traffic flow, yet in practice it is less widely understood than the concept of building new infrastructure, despite costing significantly less implement.

Traffic management proposals for Monrovia are hereafter referred to as the Monrovia City Traffic Management Plan (MCTMP).

9.1.5 The Monrovia City Traffic Management Plan (MCTMP)

The following measures, which may be considered as a suite of recommendations to be implemented together, are suggested. The purpose of the plan is to improve traffic flow around the city, reduce journey times, and reduce the cost of transport.

9.1.5.1 Extend the one-way system to the arterial road network

The concept of a one-way system in terms of improving traffic flow is based on the principle of removing conflict points between road users. All delays experienced on the network are caused by different road users wishing to occupy the same space at the same time. When this space becomes unavailable, delays occur.

Hence, if conflict points between road users are removed, then delays are also reduced. A one-way system, for example, will reduce conflict points by 50%.

Concepts of the possible one-way system are presented below. Exact details and routings, particularly at the intersections, are recommended for further development so that the number of conflict points between traffic movements can be minimized, as far as is reasonably practicable.

Eastbound

Some parts of downtown Monrovia already have a one-way system. Under the MCTMP, the one-way system would be significantly extended as follows so that Tubman Boulevard become one-way from the junction with Haile Selassie/Russel Avenue to ELWA Junction, as shown in Figure 9-3.

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Westbound

In the opposite direction, westbound traffic would run along a new route from ELWA junction, travelling south along ELWA Road, onto S.D. Cooper and then following the Oldest Congo Town Road, then Old Road and then taking the Cheeseman Avenue and Russel Avenue route into the downtown area as shown in Figure 9-4.



Figure 9-4: Westbound One-Way System

The route would two lanes wide and would require some upgrading of existing roads and some limited widening along certain sections of road which are narrow or where there has been encroachment into the right of way. These would effectively become new arterial roads.

Sinkor

At the sub-arterial level, additional one-way systems around Sinkor would also be implemented in order to minimize the number of conflict points from traffic merging onto either the west-bound or east-bound arterial routes.

9.1.5.2 Bus Priority Measures

Bus priority measures give enhanced priority to buses relative to other motorized transport, especially those with low occupancy rates per vehicle, such as private cars.

Under the MCTMP, Tubman Boulevard would remain with four lanes, but two of these would be turned over to dedicated bus lanes, one of which would be contraflow to the traffic and would run in a westbound direction. An example of how such an arrangement may look is shown in Figure 9-5.

Figure 9-5: 4-lane Highway Showing Directional Traffic Flow along Bus Lane (blue arrow), Other Traffic (yellow arrows) and Contraflow Bus Lane (green arrow)



Although the contraflow-bus lane would remain specific to Tubman Boulevard, additional bus lanes can be extended to include the rest of arterial network, including UN Drive up to its junction with Somalia Drive.

Proposals for Somalia Drive itself and for Red Light to ELWA Junction along Tubman Boulevard can be considered as a second phase of bus priority measures, once the ongoing projects there are closer to completion.

Improved bus stops and transport interchanges will also be required. These are discussed more in the following sections.

The current fleet of available buses is currently inadequate to supply Monrovia's needs. A new fleet is needed. Further details surrounding the need for buses around Monrovia may be found in the *MCC Transport Services Study*, which is currently under development but expected to be completed during 2017.

9.1.5.3 Traffic Signals, Crossing Points & Banning of Certain Traffic Movements

Traffic flow and road safety are both negatively affected by a lack of or poor-quality traffic signals and crossing points for pedestrians. The existing traffic signals in Monrovia should be replaced with more reliable models, which are set-up with the optimum signal staging and phases so as to maximize the efficiency of traffic flow whilst safeguarding pedestrians who need to cross the road.

Other crossing points that are clearer and better signed should also be implemented. This is a relatively cheap and simple measure to implement, involving only signs and road paint.

All major junctions should feature traffic signals and street lighting. All formalized crossing points for pedestrians whether featuring traffic signals or not should also have street lighting.

To reduce the number of conflict points between road users, certain traffic movements should be banned. This will both improve traffic flow and road safety. The proposed one-way system described in section 9.2.5 will go some way to addressing this, though banning of other movements, especially along Tubman Boulevard around Sinkor are also recommended.

The bottlenecks at SKD Boulevard / Tubman Boulevard and at Tubman Boulevard / Haile Selassie Avenue would be largely dealt with by these measures.

9.1.5.4 Loading, Waiting, Stopping and Parking Restrictions

Many delays to traffic are caused by vehicles stopping in the road to either set-down or collect passengers, or to load and unload goods. These types of activities should be banned during the busiest hours of the day to avoid traffic congestion and limited to the non-peak hours, i.e. between 9:30am and 3:30pm and from 6:30pm to 6:30am.

Restrictions should be extended around the entire arterial road network but tailored to the local requirements of each area.

9.1.5.5 <u>Summary</u>

Although relatively low-cost and simple measures, the power of traffic management solutions as described in this section should not be underestimated. They can be highly effective in influencing travel choices and behaviours of road users, since they use a combination of incentives and disincentives to influence the decisions people make in how to undertake a journey, with benefits and costs being a function of:

- > Journey time
- > Cost
- > Safety
- > Quality of experience.

Some classic examples of traffic management solutions include:

- Increasing the cost of parking downtown but providing it free at a Park and Ride location which has good public transport connections
- Providing bus lanes that make journey times faster than they are for cars whilst banning cars from certain streets that buses can use.

Banning of traffic from certain roads in Central Monrovia also allows for the possibility of pedestrianized zones, which can become locations where people gather for social and leisure activities as they do in other cities around the world.

9.1.6 Water Taxis

Monrovia is fortunate to have two navigable rivers running through it. These are the St Paul River, running East to West on the northern side of Caldwell Road and the Mesurado River, again running East to West only this time on the southern side of the city, to the south of Somalia Drive and to the north of Sinkor.

The St Paul and Mesurado are connected by a tributary towards the western end of both rivers that runs North to South. The tributary runs from the St Paul and passes under both Caldwell Bridge and Stockton Bridge (at Somalia Drive) before connecting to the Mesurado to the south.

Sections of both rivers and their connecting tributary could be utilized for their ability to carry passengers and goods via water taxis.

The main advantage of doing so would be reduced journey times as a result of not having travel through the traffic congested Caldwell Junction, but it is also likely that operating costs for water taxis would be lower than for regular taxis. This could make their operation both more profitable to the operators, and also encourage lower fares for passenger.

In addition to cost, for passengers the real value lies in the journey times during the peak hours. As the water transport routes are totally unaffected by traffic variations, journey time savings could be significant with water taxis being an estimated 2 to 4 times faster than road traffic.

However, there are three constraining factors on the operation of water taxis along the routes described as follows:

- > The water depth is shallow and as low as 2 feet in some places
- > Caldwell Bridge and Stockton Bridge are both very low making them difficult for boats to pass under
- > The rivers' tidal variations mean they are only navigable at certain times of the day.

Nevertheless, there remains the possibility of operating water taxis along the routes, with a preliminary site visit indicating that this is possible, subject to undertaking some dredging of the riverbed.

Three routes have been identified, as shown in Figure 9-6.

Figure 9-6: Proposed Water Taxi Routes



Route W1 – 12th Street to Benson Street

Utilising the deeper Mesurado River, this 4.5km route has the most potential in terms of outright passenger carrying capacity. By running between the proposed transport interchange at 12th Street (see section 9.2.5) and Benson Street, or further upstream if required, this route allows Sinkor and the downtown area to be completely by-passed, leading to quicker and more reliable journey times. Owing to the depth of the river, it is likely that larger numbers of passengers per water taxi are achievable than on the other routes. Landing stages at both ends of the route would be required.

Route W2 – Stockton Bridge to Vai Town Bridge

This 4.5km route runs parallel to UN Drive from its junction with Somalia Drive and would take passengers embarking at Somalia Drive to the Downtown market area, near the Vai Town Bridge, and back again.

Utilising the St Paul to Mesurado River tributary, this route would need to make use of boats with a shallower draft than on route W1, due to the lower depth of the water along this section. In order to begin

operating, this route would also need some dredging, including the removal of large amounts of discarded rubbish around the Struggle Community meander.

Landing stages at both ends of the route world need to be constructed.

Route W3 – Caldwell Bridge to Stockton Bridge

This 3.5km route runs parallel to UN Drive from Caldwell Junction and Somalia Drive, and back again. If set up in conjunction with route W2, it would relieve some of the daily traffic congestion problems at Caldwell Junction by encouraging passengers travelling from the east along Caldwell Road to take the water taxi instead, thereby by-passing Caldwell Junction entirely.

For safety reasons, passengers wishing to travel further south than Stockton Bridge would need to change boats here from W3 to W2, since the bridge is too low to pass under with a regular water taxi service.

Running along the same tributary as route W2, this route would also require some dredging, though likely less than the W2 route owing to the lesser amount of rubbish in the riverbed along this route. Landing stages would need to be constructed at both ends of the route.

Figure 9-7: Proposed Routes W1 (left) and W2 (right)



Depending on the success of the initial water taxi routes, additional water taxi services may be set up later. This could include a service along the St Paul River, which terminates at Caldwell Bridge.

9.1.7 12th Street to New Matadi Road Connection

The Inland Waterway Transport Route W1 can be optimised by connecting the northern end of 12th Street to New Matadi Housing Estate to New Matadi. This would greatly benefit both the communities at New Matadi and Old Matadi, who would have better access to both the road network in addition to Route W1.

These connections already exist informally, with footpaths and footbridges connecting both locations as shown in Figure 9-8.

Figure 9-8: Existing Footbridge at Northern End of 12th St (left) and Map of Link *(black, marked L6, right)*



Once complete, this route would form part of the sub-arterial one-way system on the northern side of Sinkor.

9.1.8 Transport Interchanges

With the proposed upgrading of the public transport network around the city, new transport interchanges will be required. These will generally take the form of a bus station, but with parking and drop-off / collection points for other modes of transport, including motorcycle, taxis, and local buses.

9.1.8.1 National Transport Interchanges

As described under section 8.5.5, National Transport Interchanges at Red Light, ELWA Junction and Caldwell Junction are also recommended. In practice, these already exist in an informal manner at all three locations; their lack of formal arrangement is a major contributory factor to traffic congestion at each of their respective locations.

Once formalized, all three would feature exchange points for long distance services. They would be multi-modal in terms of road transport, and should be destinations in their own right. In fact, many people travelling into Monrovia on a daily basis do so because they are unable to access the services they need or purchase the goods they require closer to home.

Creating transport interchanges with integrated bank branches, shops and more formalized market arrangements will assist greatly in managing demand and reduce the need for people to travel into downtown Monrovia to undertake their daily activities, which will save them time and allow them to contribute more time to economic output rather than travelling.

The formalizing of where vehicles are permitted to stop and how they circulate in these locations will also greatly improve traffic flow and road safety.

9.1.8.2 Small-Scale Local Transport Interchanges

Smaller, local transport interchanges at all the other major junctions are also recommended, such as at SKD Boulevard and Tubman Boulevard, UN Drive and Somalia Drive, Duport Road/Tubman Boulevard, and at various points along Somalia Drive.

These will primarily serve people wishing to change modes of transport as they approach the arterial road network, typically from motorcycle to bus or taxi.

9.1.9 Current traffic speeds around Monrovia

Presently, the estimated average speeds arounds the arterial network during the peak times are around 8 to 9km/h.

If the measures described above were implemented immediately, this would create an improved traffic flow and average speed in the peak hour of approximately 15km/h as shown in Figure 9-9, an increase of 6km/h over current speeds.

It would then take an estimated seven to ten years of traffic growth to reach the current levels of service, of 8 to 9km/h during the peak hour.

Without interventions of any sort, the average speed around the network during the peak times will decrease to around 5km/h by year 6 to 7 from now, which is walking pace.

Figure 9-9: Average Road Traffic Speeds on the Arterial Road Network With and Without Interventions



In practice, it will not be possible to implement all of these measures at the same time, hence, it is likely that a pattern of marginal gain in terms of traffic speeds will be accompanied by an increase in the numbers of people and vehicles using the network, year on year, reducing the apparent benefits.

Hence, additional solutions will need to be ready for implementation somewhere between Year 7 and Year 10 depending on traffic growth and the success of the proposed measures already described. These new measures should be planned for now.

9.2 Future Urban Mass Transit

Of the upmost importance in planning for an Urban Mass Transit System is that the measures described thus-far are complementary to any future ones.

Although more detailed feasibility studies will be required, the most obvious choice for implementation in Monrovia is a Bus Rapid Transit System (BRT).

9.2.1 Evolution of Urban Mass Transit and the role of BRT

As shown in Figure 9-10, BRT is the natural progression from on street buses, providing additional capacity and improved journey times when compared to buses operating in bus lanes. This is a function of their reduced boarding and alighting times for passengers, given BRT vehicles normally have a minimum of three sets of doors, but also their more segregated nature from other traffic when compared to buses alone reduces journey times.

Figure 9-10: Comparison of Transport Modes in terms of Capacity and Operating Speed (GIZ)

- Bus and BRT
 - Low inter-station spacing, small vehicles, poor acceleration, Bus priority
- LRT vs BRT
 - Dynamic performance, vehicle capacity.
- Tram vs LRT
 - Signalling, own ROW, vehicle capacity
- LRT vs Metro
 - Acceleration, signalling, longer vehicles, max speed
- Suburban rail vs Metro
 - Inter-station spacing, longer vehicles, max speed



Initial estimates of the likely capacity needed along Monrovia's transport corridors also indicate that BRT would be a good match for the city's future needs.

9.2.2 Bus Rapid Transit Systems

When compared to other at-grade mass transit systems, Bus Rapid Transit Systems tend to score higher on their cost-benefit analysis since although they have a slightly lower passenger carrying capacity than other modes such as Light Rail or Tram systems, the cost of creating the infrastructure on which they operate is lower since they can be run on the existing road surface and do not require overhead line equipment.

Figure 9-11: Bus Rapid Transit vehicle exterior and interior



Modern versions can include advanced features such as TV screens that can be used for advertising or entertainment, and free wifi, which encourages passengers to use the service whilst allowing them to increase their productivity by checking their emails, catching up with the latest news, and so on.

9.2.3 Bus Rapid Transit Routes

9.2.3.1 Arterial Road Network

The arterial roads around Monrovia would remain the main priority in any future mass-transit proposals. When passenger numbers demand it, Bus Rapid Transit (BRT) could replace or complement the proposed additional bus services operating around the arterial road network. These would likely be regular frequency orbital services, circulating around the arterial network in a clockwise and anticlockwise directions, throughout the day.

Additionally, by the time Monrovia is ready for BRT it will have been operating Bus Lanes and bus priority systems for a number of years. These can be converted to BRT lanes at a relatively low cost, with much of the same bus-related infrastructure being re-used, and passengers will already be familiar with the bus system which would likely ensure a smoother transition to BRT.

The proposed transport interchanges discussed in section 9.1.8 can also be designed and planned in such a way that they are ready to accept BRT when the time comes.

An additional transport interchange or interchanges closer to the downtown area may also be required, the exact size and location of which will need further research. Two options that have been suggested are at the southern end of Johnson Street Bridge, or alternatively, further out of town at the northern end of 12th Street in Sinkor. However, use of this location is dependent on a number of other factors, including the success of Water Taxi route W1, construction of the long-standing proposals to connect Kessely Boulevard and 12th Street with a bridge, and the future commercial usage of Spriggs Payne Airport.

In any case, a truly orbital bus service of any kind cannot be implemented before 2021 at the earliest, which is when the rehabilitation of Somalia Drive is due to be complete. The similar upgrade of Tubman Boulevard between ELWA Junction and Coca-Cola Factory has yet to be procured so may take even longer than this to complete, hence a phased approach to implementation is likely.

9.2.3.2 The Mano Railway Line

With an assumed functioning BRT around the arterial road network, attention could then be paid to the other corridors. One such corridor running from North to South from Po River to Caldwell Junction for a distance of approximately 10km, is the former route of the Mano Railway Line. Although now derelict in railway terms, the route itself remains largely intact despite being dismantled during the war, with much of the original sub-grade of the railway track remaining in situ.

As such, reconstruction of a rail line or road along the same alignment would be less costly than it would otherwise be if none of the earlier infrastructure remained.

The line could therefore be developed into a dedicated Bus Rapid Transit Route, which would allow extremely quick journey times along this north-south corridor since no other traffic would interact with the bus route.

Based on current passenger numbers, if operational it could carry 75,000 passengers per day.

9.2.3.3 Other Routes

In the longer term, additional routes including to and from Roberts International Airport could be developed.

9.2.4 Summary and Action Plan

Monrovia has a worsening problem with regards to traffic congestion and the associated issues of environmental pollution and road safety. However, owing to its relative lack of transport infrastructure development for almost 30 years, it has a unique opportunity to deal with its future transport challenges now since levels of vehicle ownership remain low and there is sufficient space available to construct the transport infrastructure Monrovia needs without too much trouble.

If this opportunity is taken, it could help the city catapult itself ahead of many others in the world, where there has in general been a failure to develop appropriate transport infrastructure solutions to urban development. This simply does not need to be the case for Monrovia and can be easily avoided by appropriate planning and implementation of the relatively simple measures described in this section.

9.2.4.1 Action Plan

Immediate Implementation

The following proposals are recommended for immediate implementation:

- > The Monrovia City Traffic Management Plan (MCTMP)
 - Extend the one-way system to the arterial road network
 - Bus priority measures and upgraded associated infrastructure including bus stops and bus lanes
 - Traffic signal and pedestrian crossing upgrades
 - Rationalizing and banning certain traffic movements
 - Implementation and enforcement of loading, waiting and stopping restrictions
 - Development of new long-distance transport interchanges at Caldwell Junction, Red Light and ELWA Junction.

Immediate Feasibility Studies followed by implementation

The following proposals are recommended for immediate feasibility studies and implementation as soon as possible:

- > Water taxi routes W1 to W3
- > New road connection between 12th Street and New Matadi
- > Small scale local transport interchanges at key junctions around Monrovia; exact locations to be scoped.

Feasibility Studies

The following proposal is recommended for an immediate feasibility study:

> Future urban mass-transit options study.
10. Local Access

10.1 Local Access: Feeder Roads

Feeder roads are those that supply traffic to the Primary or Secondary Roads. In terms of hierarchy, they sit below the Primary and Secondary Roads described in section 8.5, but above the motorcycle trails and river crossing described in section 10.2.

As such, they provide the essential links between the local, village level, and access to the National Road Network.

In Liberia, most feeder roads are made out of compacted earth with open, parallel side drainage on either side of the road as shown in figure 10.1. Water courses seeking to pass across the road are normally channeled underneath using combination of culverts, drifts and bridges.





Based on the *Feeder Roads Design Manual and Specification (2016),* the right of way as shown in figure 10.1 for a feeder road in Liberia should be 15m, with a carriageway width of between 4.5m to 6m, depending on the average number of vehicles using the road per day.

Ownership and Funding

The feeder road network is the responsibility of the individual counties in which the feeder roads are situated. However, the counties have not received the necessary funding for either rehabilitation or maintenance of their feeder road networks from Government for many years, though with the introduction of the Road Fund in 2016, this is starting to change.

Length and Condition

The total length of the feeder road network is estimated at 6,677km, based on surveys undertaken during 2016. The condition of the feeder road network was also assessed in 2016, with the combined results at the national level shown in

Table 10-1.

Table 10-1: Condition Survey Results of the Feeder Road Network (2016)

Condition Band	Percentage of network in condition band
Excellent	2%
Good	3%
Fair	34%
Poor	45%
Bad	16%

The individual condition bands are based on a combination of surveys undertaken which measured the ride smoothness of the road using specialized equipment to determine their roughness in terms of IRI (International Roughness Index), and visual inspections, based on the criteria given in Table 10-2.

Condition Band	Status
Excellent	Recently Graded and Re-graveled
Good	Minor Corrugations / Potholing / Isolated Potholing / Good Surface Drainage
Fair	Average Surface undulations / Isolated rough areas / Some Potholing
Poor	Bumpy narrow Surface / rough surface / overgrown shoulders and partly blocked Drainage
Bad	Very Bumpy / Frequent difficult areas / Narrow carriageway / No shoulders / Drainage not functioning

Table 10-2: Surface Condition Assessment Criteria for Unpaved Roads

Rehabilitation of Feeder Roads

Rehabilitation of the feeder road network is ongoing has been undertaken over the last eight years with Donor Support, including from USAID's FRAMP (Feeder Road Alternative Maintenance Project) and SIDA's LSFRP (Liberia Swedish Feeder Road Project).

SIDA has funded the rehabilitation of hundreds of kilometers of Feeder Road under the LSFRP since 2010. Phase 3 is of the program is currently under procurement and will see an additional 370km of road rehabilitated, and 111km of previously rehabilitated road maintained. These projects have targeted many of the counties in the south-east with low penetration rates (River Gee, Maryland, Grand Kru and Grand Gedeh).

As of 2016, USAID have targeted the counties of Lofa, Bong, Nimba and Grand Bassa. Other Donors, including the MCC, are also planning to fund the rehabilitation of feeder roads during 2018, though the specific counties targeted have yet to be confirmed.

Prioritization of Feeder Roads for Rehabilitation

With so much rehabilitation being funded by international donors who have their own methods of prioritization, and decisions yet to be made on which roads they will select, creating a rehabilitation plan for prioritization by individual road is unrealistic at present.

Furthermore, given that the counties are to be allocated funds annually to manage their own networks, they have the responsibility to undertake their own prioritization. At present, the counties are being supported in this role by the Road Maintenance Management Unit (RMMU) of the MPW, though as capacity is built within the counties themselves as part of other ongoing technical assistance, they will be able to take on increasing levels of responsibility themselves.

The current extents and condition of feeder roads by county is shown in Table 10-3.

	Condition Band						
County	Excellent	Good	Fair	Poor	Bad	Total	
Bomi	-	3	45	198	76	322	
Bong	3	22	260	272	86	643	
Gbarpolu	8	8	68	114	42	241	
Grand Bassa	1	9	251	370	139	771	
Grand Cape Mount	26	36	130	80	13	285	
Grand Gedeh	1	7	89	239	162	498	
Grand Kru	-	1	43	179	20	243	
Lofa	0	2	134	366	174	677	
Margibi	3	2	122	213	55	395	
Maryland	-	-	11	92	71	175	

Table 10-3: Length of Feeder Road Network (km) by County and Condition Band

Country	Condition Band					
County	Excellent	Good	Fair	Poor	Bad	Iotal
Monteserrado	8	3	8	76	26	121
Nimba	35	68	554	422	91	1,170
River Cess	12	56	379	132	30	607
River Gee	_	0	44	137	79	260
Sinoe	1	5	131	106	29	271
TOTAL	98	220	2,268	2,997	1,095	6,677

Hence, as a funding allocation formula has already been developed for the counties, this MMTMP can only go as far as recommending that:

- > Priority be given to maintaining basic access by undertaking spot improvements and emergency works where required, to ensure the road stays open 365 days per year.
- > When basic access is being maintained all year round, then rehabilitation of feeder roads is the next most important priority. Although it is expected that the counties will know best themselves which roads should be prioritized for rehabilitation, MCA should be used. This should combine the following criteria:
 - The current condition of the road, with those in a poorer condition having priority.
 - The location of the road relative to Secondary and Primary roads which are either already open, or otherwise due for rehabilitation.
 - The proposed locations of the motorcycle tracks and river crossings that will be prioritized as described above.
- The need for entirely new feeder roads can only realistically be assessed following the prioritization exercise undertaken for motorcycle tracks and river crossings. Where appropriate, the cost-benefit of developing new feeder roads should be compared to that of rehabilitating existing ones.

Costs of Rehabilitation

The cost of rehabilitation and maintenance of the feeder road network is a function of road length, current condition, and the unit costs for rehabilitation.

Based on the condition surveys undertaken, these have been calculated based on the following assumptions.

- > Roads in a Poor or Bad Condition require rehabilitation
- > The cost of rehabilitation, based on other projects in Liberia, is USD 30,000/km, inclusive of road structures.

In collaboration with the RMMU at MPW and the development partners currently undertaking rehabilitation of feeder roads across the country, the counties must co-ordinate their programs of rehabilitation and maintenance in order to ensure the most appropriate roads are prioritized in order to maximize the social and economic benefits.

This is already happening, but it must be maintained and continue being developed.

10.2 Local Access: Motorcycle Trails & Crossings

Only a small minority of rural people in Liberia own motorized transport, and so they depend on walking/carrying and/or some form of transport services to reach services and markets. The initial stage of rural transport (sometimes called the "first mile" although it may be over ten kilometers), generally involves walking/carrying to the nearest road. And once people reach a national road, there is an additional constraint in that on most feeder roads there are infrequent, unpredictable and expensive transport services. There is therefore a need to splice into the national transport system a "layer" of transport infrastructure and services that solves the missing first mile.

In Liberia, as in many other developing countries, there has been a boom in motorcycle ownership and transport services – including taxi services. Although motorcycle taxis are more expensive per kilometer than other transport options, they are more timely and convenient and therefore complement and link with larger transport options. Traffic counts show they are by far the most common vehicles in rural areas, and often, they are the only transport option available, as they can reach places other modes cannot. Some countries have special trails suitable for only bicycles and motorcycles that connect villages to the roads. This is an apt approach for Liberia too as it requires a relatively small investment with a high social return (even if some trails become obsolete as the feeder road network expands). The benefits to villagers include better access to health and education, better access to markets and rural employment as well as better rural penetration of government and NGO services (including vaccination and Ebola-prevention teams).

The concept of motorcycle trails, even though not official policy, is being implemented by some local communities already. However, such initiatives do not detract in any way from a larger program formulated at the MMTMP level. The new 'trail' category of access infrastructure is entirely complementary to feeder road programs and their strong synergy suggests that ensuring access trails and trail bridges be integral components of all subsequent feeder road investments.

The program would entail the construction of motorcycle trails connecting villages to the road network. These are approximately 2m-wide tracks from which trees and brush are cleared. Log bridges would be installed over streams and gullies, simple log culverts where needed, metal truss bridges (suitable for pedestrians and motorcycles) over small rivers, and suspension bridges (also for pedestrians and motorcycles) over large rivers.

Good local knowledge is required to locate and design each trail, and this should ideally be done at the very local level. From the MMTMP/SIP perspective, the aim is to provide an appropriate expenditure budget per county, which will then have to be operationalized locally.

The estimate of the required investment is based on an access index, indicating how far villages (rural communities with more than 30 inhabitants) are located from national roads. Based on bands of access (<2km, <4km, <6km, <8km, etc), the total length of trail required to connect villages can be estimated. The calculation assumes that each village in a particular band will connect to another village in the next band closer to the road. Only villages within 2km of the road are likely to connect directly to the road itself. This will result in a staggered system of shared trails and bridges, which is likely to be convenient, economical and socially acceptable. The estimated trail distances allow for curving trajectories and take into account the fact that some villages are located close to other villages. Table 10-4 indicates the other assumptions required for the calculation of investment requirements.

Item	Spacing	Unit rate (USD)
Trails	(based on location of villages)	1,000/km
Wooden Bridge	Every 2km	1,500/unit
Truss Bridge	Every 30km	24,000/unit
Suspension Bridge	Every 60km	112,000/unit

Table 10-4: Assumptions to Estimate Crossings Quantities

Table 10-5 indicates the estimated quantities for each county. The total investment amounts to some USD 66 million, or about USD 26 per person.

County	Villages	Population	Trails (km)	Wooden Bridge	Truss Bridge	Susp. Bridge
Bomi	481	80,936	524	262	17	9
Bong	1,844	316,116	3,056	1,528	102	51
Gbarpolu	293	81,363	548	274	18	9
Grand Bassa	1,436	207,614	2,405	1,202	80	40
Grand Gedeh	227	122,549	258	129	9	4
Grand Kru	165	57,633	267	134	9	4
Grand Cape Mount	500	124,971	705	353	24	12

 Table 10-5: Indicative Trails & Crossings Requirements per County

County	Villages	Population	Trails (km)	Wooden Bridge	Truss Bridge	Susp. Bridge
Lofa	914	274,511	1,134	567	38	19
Margibi	877	201,236	1,436	718	48	24
Maryland	212	135,804	281	140	9	5
Montserrado	721	139,122	899	449	30	15
Nimba	1,073	456,513	1,346	673	45	22
River Gee	194	66,388	300	150	10	5
Rivercess	430	69,411	896	448	30	15
Sinoe	475	98,685	938	469	31	16
Total	9,842	2,432,852	14,988	7,494	500	250
Rounded	10,000	2,500,000	15,000	7,500	500	250

The projections shown above are made at the master plan, parametric level of detail. More in-depth design level surveys will be required before implementation, especially as regards the higher-cost bridge requirements.

All of these investments have good potential to be implemented by community-based organizations, in a labor-intensive manner involving both men and women. Even the truss and suspension bridges can be implemented by community-based organizations, provided they have access to appropriate materials and technical advice. Some centralized standard designs and guidelines, techniques, training and advice should be made available to counties and local communities. Also, there will be a requirement to train community-based groups in trail construction, management and maintenance, and bridge maintenance and management.

It is proposed that a Trail and Trail Bridge Office be established as part of the county support office for feeder roads (refer section 4.4.3.4), charged with providing the necessary technical guidance and advice. The aim will be to empower people in all counties in trail and trail-bridge planning, training, community-based implementation and quality- assurance. This office, in collaboration with the relevant county authorities, could start by commissioning some initial studies on the planning and prioritization of trails and trail bridges, including suspension bridges over the larger rivers. This office will work very closely with the MPW feeder roads activities and donor-assisted projects at both central and devolved levels. A pragmatic initial approach could be to pilot the training, technologies and management skills in collaboration with an existing donor-supported feeder-road program. This could result in all 'off-road' villages within the 'catchment areas' of these feeder roads being connected to the feeder roads through trails and trail bridges. This could lead to rapid learning concerning effective implementation procedures as well as providing replicable examples of the complementarity and synergy of the trails and roads.

11. Project Prioritization

The previous chapters expounded on the programs making up the MMTMP, and identified the constituent projects. Now, the projects have to be ordered by importance and timing.

11.1 Project Prioritization & Scheduling

Considering the list of projects and the program for rolling out the list, then "vertically", projects need to be ranked from the most to the least important so that the those with the biggest contribution to the transport system and to society are positioned at the top of the list and can be attended to first. But, "horizontally" over time, there may be quite practical reasons for the most important projects not to be executed first.

11.1.1 Prioritization Approach

One approach to prioritization is to calibrate all projects on a single scale so that they can be compared quantitatively. This could be achieved by means of a Cost-Benefits Analysis (CBA) that considers all the projects' costs and benefits and determines the present-day net benefit of each. But the traditional CBA has various shortcomings in general and also in the context of Liberia today –

- > The classic CBA focuses exclusively on the transport economics (efficiency) aspects of a project, i.e. the allocation of resources between transport infrastructure providers and users. The aim is to establish which projects have the "least total transport" cost.
- The project performance data required for an economic CBA is only available for the roads sector (where needs have been modeled by means of HDM-4). Given the constraints of this master planning assignment, other, less-quantified techniques were applied to determine the need for projects (refer section 6.4).
- > The classic, economic CBA may be expanded to also incorporate social effects such as positive and negative externalities, indirect effects, etc. Putting aside the relative merits and drawbacks of such a broad CBA, given that a base, economic CBA cannot be computed, it is quite impractical to graft additional (social) impacts onto it. In any event, valuing such effects are at the best of times somewhat theoretical and/or subjective (not just in Liberia).

In short, apart from not being in a position to calibrate project CBAs accurately, the diverse nature of project impacts requires a more real-world approach to project prioritization. An alternative approach, used widely by decision-makers confronted with choosing from projects with asymmetric and/or incomplete information, is the multi-criterion analysis (MCA) method. The MCA integrates objective measurement and value judgement, but makes explicit and therefore manages the subjectivity involved. In other words, it allows the decision makers to include evaluation criteria they deem important, and to scale these criteria relative to one another, but in a manner that makes these positions transparent.

There would typically be four categories of criteria included in an MCA, i.e. -

- > Impacts relating to a better transport system (reduction in total transport cost)
- > Broader economic impacts resulting from a better transport system (economic growth, employment, etc.)
- > Impacts related to equity (poverty reduction, regional spread of benefits, national integration, etc.)
- > Impacts on the physical environment (pollution, water quality, etc.).¹²⁶

Setting up an MCA requires identifying the decision criteria, weighting the criteria for their relative importance, scoring the projects for each criterion, and aggregating the weighted score for each project.

¹²⁶ Adapted from Schutte IC & Brits A: "Prioritising Transport Infrastructure Projects", Southern African Business Review Volume 16 Number 3 2012

MCA Criteria

The criterion set applied to the NTMP is shown in Table 11-1. There are four sets of criteria. The first two correspond with the "transport system" category above, i.e. differentiating for the transport impacts of the project:

- > "Transport Economics" is what would be covered by the classic, narrow CBA.
- But "Network Integrity" checks not just the expected performance of the individual project, but also how that project fits into the overall transport system. The "integrity" criterion has various sub-criteria – to emphasize that the Liberian transport system is far from fully developed and does not yet fully connect the whole country.
- Economic Impacts" has the same aims as the "broader economic benefits" of the standard MCA referred to above. In the absence of a macro-economic model to forecast the quantitative effects (change in GDP, employment, etc.), these are captured qualitatively in terms of size (major economic centers served) and economic structure (range of economic sectors served).
- Political Considerations" refers to decision-makers' aims to spread development more evenly, both geographically ("Geographic equity") and in terms of poverty alleviation ("Social impact").

(The impact-on-physical-environment criterion category usually included in an MCA is included not as a ranking consideration here, but rather as a more absolute go vs. no-go consideration under section 11.1.2 below which deals with the circumstances that inhibit project roll-out.)

The criteria applied in the NTMP reflect two of the intrinsic features of MCA. Firstly, some effects cannot be completely ringfenced so that there is some overlap between them, e.g. county capitals under the "Backbone" consideration are sometimes also "Major Economic Centers". Secondly, there is some conflict between objectives, e.g. serving "Major Economic Centers" and "Diversity of Demand" will mostly exacerbate geographic inequity. But what it does achieve is to confirm the qualities of a project over a broad spectrum of issues (a project cannot rise to the top because it performs well under only a few criteria) and the "soft" considerations (strategic access, geographic integrity, social impact) at least provides an opportunity for projects that have large expected non-transport externalities to come into play.

Category Criterion		Motivation	Measure
	Backbone	Projects forming part of the main arterial transport system	Projects serving county capitals
Notwork	Strategic Access	Projects that serve areas that are important for non-economic purposes	E.g. some border posts, security high-risk area
Network Integrity	Contiguity	Project that is attached to the backbone (i.e. not islanded)	Project links to prior-existing links of at least the same status (e.g. primary road to primary road)
	Inter- Operability	Project that serves multi-modal nodes	E.g. major ports (FPM) and airports (RIA)
Transport Economics	Cost-Benefit justification	Project that results in least total transport cost	Projected EIRR, NPV, BCR, etc., or expected BCR, etc.
Economic	Major Economic Centers Served	Support nodes with highest economic momentum and potential	Locations with prominent industry/ies, large population
Impacts	Diversity of Demand Served	Project that promotes diversification and building of supply chains	Number of significant industries served
Political	Geographic Equity	Project located in an area away from the core transport system	Project serving area with low share of NTMP projects
Consider- ations	Social Impact	Project that has large, positive impacts on the poor	Impact on access to markets and social services. Poverty alleviation effects

Table 11-1: Prioritization Criteria

Criteria Weighting

Weights are assigned to the MCA criteria to reflect their relative importance to the decision. This is a subjective decision, but taken with the participation of persons whose perspectives on the issues enable them to take a broad view, and therefore to appreciate the potential tradeoffs among the criteria.

[Update after the workshop]

The weights deriving from that discussion are shown in Table 11-2.

MCA Scoring

A measurement scale and a measurement unit are required for each decision criterion. As noted before, for a number of reasons the criteria cannot all be priced accurately or at all, implying that the criteria cannot be reduced to a single, common, cardinal scale (such as USD). Rather, the approach is to classify impacts ordinally and award each a value on a scale of high to low. A three-tier scale is applied here and used across all the prioritization criteria. The individual scores are (only) important to differentiate *within* the criterion, not *between* criteria (which is achieved by weighting criteria – as discussed above). In some cases, the impact occurs or does not occur, in which case the mid-tier step is not required (or just scored at zero).

The MCA prioritization approach adopted for the Transport Master Plan is summarized in Table 11-2.

Prioritisation Criteria				Scoring			
Category	Criterion	Weight	Unit	Yes/ High	Maybe/ Med.	No/ Low	
	Backbone	1	Y/N	1	0	0	
Network Integrity	Strategic Access	1	Y/N	1	0	0	
	Contiguity	1	Y/N	1	0	0	
	Inter-Operability	1	Y/N	1	0	0	
Transport Economics	Cost-benefit justification	2	H/M/L	2	1	0	
	Major economic centers served	1	H/M/L	2	1	0	
Economic Impacts	Diversity of demand served	1	H/M/L	2	1	0	
	GDP, income, employment, etc.	e, employment, 1 H/M/L		2	1	0	
Political	Geographic equity	1	Y/N	1	0	0	
Considerations	Social impact	1	H/M/L	2	1	0	

Table 11-2:	MCA	Criteria.	Weights	& S	corina
		•••••••••••••••••••••••••••••••••••••••			

This approach differs from the prioritization method applied in the 2010 NTMP. There -

- > Modes were prioritized separately: roads; rail; coastal shipping; domestic air services; ports; and airports
- Different prioritization approaches were applied to each mode: roads and ports and airports were assessed in terms of a narrow (transport economic efficiency) CBA; rail projects according to the projected performance of the iron ore commodity; and coastal shipping and domestic air services based on financial viability.

The MCA approach adopted here, together with the scheduling considerations discussed below, provide an opportunity to rank and organize projects in an integrated, multi-modal fashion.

11.1.2 Scheduling

It would generally be expected that the most important (highest ranked) project be delivered first. However, when it should or can be delivered depends on the circumstances of that project. These are how "ready" the project is to be implemented, whether the project depends on other projects to be completed first, and whether there are external, non-project conditions hindering the implementation of the project.

Project Readiness

Readiness refers to what still needs to be done before the project can be delivered, and what will the cost and time implications be given the current status of the prioritized projects.

Project readiness is measured against a standard project lifecycle. A project follows a systematic development process where it matures from a concept through to a contract package that has obtained all the relevant approvals along the way. The stage in which a project finds itself is therefore an indication of the degree to which a project is ready for construction to begin, what steps are needed to bring the project to that point, and what the related cost and time implications are.

The preparation steps considered for the NTMP are the following:

- Concept, i.e. identification of the project and developing its basic concept. A consensus is developed on the project objectives, outputs and timeframe. The cost is determined to a range of ±50% reliability.
- > Pre-Feasibility aims to improve the costing reliability range (to ±25-30%) by carrying out further investigations, including the initial environmental screening.
- > Land Acquisition can now be carried out since the location and impacts of the project are quite clear.
- > Feasibility is confirmed and the costing reliability increased further (in the order of ±10-15%). The project detailing is done (including design) and the financial structuring resolved. This is also when the final decision is taken on the contract model (e.g. PPP), the procurement plan is decided and documents prepared.
- > Procurement, i.e. the process of appointing a contractor (or concessionaire).
- > Implementation, i.e. construction in the case of a physical project, or the rendering of services in the case of a study.

The focus of the NTMP is to identify and phase physical improvements to the national transport network. Most projects would therefore entail "construction". However, the physical projects are sometimes preceded, supported or enabled by non-physical projects. These types of endeavors are labeled "Study" in the scheduling framework.

Depending on a project's complexity, all the preparation steps may not be required. A distinction is therefore made between a "complex" case at the one end of the spectrum through to a "simple" project at the other. A complex project would typically be large, technically challenging, involve foreign advisors and contractors, and/or be located in a complicated area (built-up city, environmentally sensitive area, difficult terrain and soils, etc.). Most PPP projects would be classified as complex because of the intricate nature of the contracting and financing arrangements.

Table 11-3 shows the project preparation steps, together with their expected duration for different types of projects and expected cost (expressed as a percentage of the value of the project).

Dronaration Stens	Unit	Cor	Ctudy		
Freparation Steps	Onic	Simple Moderate Com		Complex	Study
Concept	Months	1	2	4	-
Pre-Feasibility	Months	1	3	6	-
Land Acquisition	Months	3	6	12	-
Feasibility/prelim. design	Months	2	4	6	-
Design	Months	3	12	24	3
Procurement	Months	2	3	6	3
Implementation	Months	12	24	36	6
Preparation Cost	% of Capex	5.0%	7.5%	10.0%	5.0%

Table 11-3: Project Preparation Steps, Duration & Cost

Project Dependencies

The NTMP attempts to systematically build out the national transport network. In the prioritization criteria, substantial weight is therefore given to a project that forms part of the backbone network, is contiguous to that network and links different transport modes. The timing of such a project could therefore quite easily be tied to another, enabling one being carried out first.

The more quantitative, prognosticating nature of the roads requirements analysis carried out for this NTMP means that the timing of roads projects is a fairly firm reference point for the staging of other (non-roads) projects. For example, investing in a domestic airport should probably be timed to coincide or slightly lag the upgrade of the primary road serving that airport.

Circumstances Inhibiting Implementation

Considerations of readiness and dependencies mostly have to do with the make-up of a specific project. But there are at least three potentially significant factors that may delay (inhibit) the project that all have to do with where the project is located and who will be overseeing it.

Environmental Issues

The construction and operation of transport infrastructure can cause a range of potential environmental and social impacts. These may result in a project not obtaining approval to proceed, or approval subject to the effects being mitigated to acceptable levels. The assessment and mitigation processes can be costly and time-consuming.

Land

The development of infrastructure projects often requires the acquisition of occupied land and the associated resettlement of the affected population. Effective land acquisition and resettlement approaches will ensure that communities and people are placed in a similar position as before the land acquisition.

Institutional Capacity

Projects may be delayed because of the frailty of the principals charged with letting them out. Most complex and even moderately complicated projects in Liberia (RIA terminal, FPM fuel facility, most primary roads projects, etc.) are being overseen by or strongly supported by development partners or units they underwrite. Chapter 4 provides an overview of the transport sector institutional landscape and possible high-level reforms to reinforce it and to ensure that institutional capacity will not inhibit rolling out projects in future. But for now, the scheduling framework imposes delivery capacity constraints in some cases. Apart from complex projects, the main example of projects constrained in this manner are those that should be decentralized (delegated) to second (county) and third tier (districts and local authorities) levels where the necessary capacity and skills may not yet exist, e.g. Feeder Roads projects and Motorcycle Trails & Crossings projects.

Following a similar logic as applied project internal complexity, Table 11-4 shows what provision is made in the NTMP for the three inhibitors discussed above.

	Inhibitore	Linit	Project Circumstances			
	minutors	Onic	ОК	Prob. OK	Not OK	
	Environmental	+years	-	1	20	
	Land Acquisition	+years	-	1	3	
	Delivery Capacity	+years	-	2	5	

Table 11-4: Project Inhibitors

11.2 Financial Envelope

The above discussion of prioritization and scheduling implicitly assumes that whatever is important and ready can indeed be implemented. But the overriding constraint on roll-out is self-evidently whether the financial means is available.

11.2.1 National Budget

Table 11-5 shows the recent and projected size and composition of the national budget. There are two distinct parts: the main ("on-budget") segment comprising funds that flow through Government's hands and additional ("off-budget") project aid, pooled funds and trust funds disbursed directly for specific projects. The main budget is in the order of USD 0,5-0,6 billion. The additional support was going to be about a quarter more in the 2015/16 financial year, but projected to decline over the next three years.

Capital expenditure is made on-budget Public Sector Investment Plan (PSIP), from which USD 12-13 million is earmarked for roads going forward. Of the off-budget support, some USD 84 million is earmarked for "Infrastructure & Basic Services", which expenditure category includes transport.

ltom	Approved	Revised		Projection	
item	FY15/16	FY15/16	FY16/17	FY17/18	FY18/19
Revenues	622.7	552.8	556.0	580.6	599.3
Own	483.7	416.3	525.8	549.0	566.7
Budget Support	114.8	112.3	30.2	31.6	32.6
Grants	56.2	53.7	30.2	31.6	32.6
Loans	58.6	58.6	-	-	-
Carry Forward	24.2	24.2	-	-	-
Expenditure On-Budget	622.7	552.8	556.0	579.8	599.3
General Recurrent	493.3	463.2	461.2	481.6	469.1
Debt Servicing	21.6	22.6	26.0	27.1	28.0
PSIP	107.8	67.0	68.8	71.1	102.2
(of which "ongoing roads")	27.0	6.6	12.6	13.1	13.6
Expenditure Off-Budget	774.5		512.7	261.6	153.8
Grants			441.1	245.9	153.8
Loans			71.6	15.7	-
(of which "I/structure & Basic Services")			83.9	40.0	14.5
(I/S & BS Grants)			53.9	31.0	14.5
(I/S & BS Loans)			30.0	9.0	-

Source: MFDP: "Budget Framework Paper, FY2016/17"

11.2.2 Off-Budget Transport Investments

Apart from the roads sector earmarking in the PSIP, the national budget does not specifically isolate transport investments. However, a fairly clear picture emerges from the records of the Aid Management & Coordination Unit of the MFDP, which tracks the off-budget contributions on a sectoral basis. The median annual expenditure on transport projects from 2009 to 2016 was about USD 80.5 million¹²⁷. Since 2012, all transport investments were made in the modes of roads, ports and airports, with roads obtaining about 80% of the funding.

¹²⁷ The Unit has been operational since 2009, which is the first year for which full annual amounts are available. The dataset was received in May 2017, implying that future commitments (beyond that date) are not yet finalized.

Figure 11-1: Total "Transport" in "Infrastructure & Basic Services"

Figure 11-2: Road, Port & Airport Shares of Transport Investment



Source: Calculated from data provided by MFDP Aid Management & Coordination Unit

In the Agenda for Transformation (AFT), the two key sectors for economic growth and diversification are Transport and Energy, and these are therefore also Government's investment priorities. It is therefore expected that these sectors will be protected and demonstrate a fairly stable investment pattern – even if the rest of the support budget comes under pressure. It is furthermore anticipated that for the non-roads modes (essentially ports and airports) loans will be on-lent to the relevant SOEs and therefore not place any pressure on the main budget. If the recent pattern continues, roads would be expected to continue obtaining about USD 66 million per annum, which together with the PSIP roads budget of between USD 10-20 million per annum would result in a realistic yearly roads budget of around USD 80 million.

The allocation to other modes has varied, driven by specific, once-off projects mainly at the Freeport of Monrovia and (more recently) Roberts International Airport. There appears to have been an appetite to fund these non-road developments in a range of USD 20-25 million per annum, and sometimes more. In total, the transport infrastructure funding envelope has generally not exceeded USD 100 million/annum.

In terms of who the likely development partners would be, Figure 11-3 shows that the "traditional" partners were mostly the World Bank and African Development Bank, with AfDB progressively displacing the WB. Recently, the roles of Japan (Somalia Drive project), USAID (feeder roads) and the "Arab" lenders have been increasing. Chinese support commenced in 2017 in the form of the China EXIM Bank loan for the RIA airport terminal. Traditional partners' contribution to roads had been 100% up to 2015, but reduced to about 80% in 2017 as the role of the Arab lenders increased.



Figure 11-3: Development Partner Roles in Roads, Airports & Ports

China

Arab

2017

Traditional

11.3 User Charging & Private Financing

User Charging & Private Financing

This section briefly considers the matters of financing (amortizing the up-front costs of the project), funding (how the project is ultimately paid for, i.e. the project revenue or income) and user charging (the extent to which the users themselves fund the project). Because Government has a constrained fiscal envelope (it cannot afford all priorities) and wants to serve as many needs as possible (deliver the most projects), it has to stretch its available means as far as possible. This it can achieve by making use of others' resources to finance or fund a project, and by shifting the responsibility to pay to the user.

Apart from Government's own fiscal position as discussed above, the two main considerations driving the funding and user charging options are the nature of the transport goods involved and the nature of the user thereof. As regards the type of asset, the transport system is made up of public good-type vs private good-type assets. The public good components are the ones of which the benefits extend beyond the direct user to the advantage of the general public, while the benefits of private goods pertain to users only. Intuitively, public benefit assets should be funded from Government resources and private-type assets by the user thereof. Generally, the minimum cost that any user should contribute is the direct marginal operating cost of the project (e.g. the incremental fuel cost of an additional passenger).

In principle, it would be inequitable for users to be charged more than the financial benefit they derive. However, there is a tolerance level of what users can afford. Especially in a low-income country like Liberia for many transport services users may not even be able to afford the marginal operating cost. Such costs will have to be cross-subsidized from other users or sponsored by Government or its development partners.

Extending the discussion to financing, Public-Private Partnerships (PPPs) aim to achieve both the financing and funding aims of Government. A PPP is an arrangement where the development and operation of a facility is delegated to a private party for a period, the private party arranges the required financing and it then recovers this and its other costs from the user of the facility. There are a variety of reasons why the private sector is expected to be more efficient than Government, including stronger incentives (especially if its own funds are at risk), innovation and specialization, and greater discipline to deliver on-time and on-budget. It is therefore expected that a competent private provider will deliver at a lower cost (properly adjusted for risk) than Government.

As shown in Table 11-6, there are many varieties of PPP, differing for where asset ownership vests, financing and funding responsibility, operation and flexibility that Government has to direct performance. Usually, the term PPP refers to the "concession" category of models shown below, where the private sector takes over and possibly improves a pre-existing facility through a lease or concession (e.g. the APMT terminal concession at the FPM) or develops a new facility (e.g. the concept with the dry port or the 12th Street bridge).

	Classification		Pl	nase	Asset	Private & U	lser Respo	onsibilities	Govt Ability
Category	Contract	Туре	Create	Operate	Ownership	Financing	Funding	Operation	to Control
Pure or corpo	ratized public o	delivery						N/A	Govt is the
Service Contract	0&M			х		Govt	Govt &		client
Management	Management			Х	Govt		User		
Contracts	Lease			Х		Govt/Pvte			Govt up-
	Availability	0&M		Х			Court	Duto	front locks
Concession	Availability	DCOM	Х	Х			GOVL	PVLE	into
Contracts	Build- Operate-	Supported BOT	х	х	_	Pvte	User & Govt		increasingly long-term
	Transfer	BOT	Х	Х	Pvte		Licor		agreements
Private/divest	ment						Oser		

Table 11-6: Typical Contracting Models

Governments mostly are under fiscal pressure and do not have the financing and funding scope to deliver all the projects they would ideally like to. Generally, the aim would be to achieve least cost

provision, to move the financing burden and risk away from Government and to the private sector – so that public resources can be freed up. Furthermore, Government would also prefer not to incur long-term commitments that may compromise its fiscal scope or flexibility.

From the private sector perspective, the attractiveness of projects depends on the type and extent of risk they are required to assume. Risks can broadly be categorized into three types: country (political stability, enforcement of contracts, exchange rate, convertibility, repatriation of earnings, etc.), technical (site, technology, resources, processes, etc.) and commercial (demand, client creditworthiness, affordability, etc.) risks. The general principle is that risks should be allocated to the party best able to manage risk.

Therefore, the appropriate delivery model would be one that falls in the overlap of projects that Government is keen (or forced by circumstances) to outsource to the private sector, and the type and degree of risks that the private sector is willing to accept.

The situation in Liberia today is that direct user charging for public-access transport infrastructure (i.e. excluding rail) is limited to the ports and main airport, although in both areas the user probably still does not carry the full asset cost since neither the NPA or LAA carry the cost of debt (loans) for their facilities.

Ea	cilities	Provision Model	Liser Charging	Financing
16		r rovision woder	User endrying	Thindheing
	Primary	Pure Govt (possibly moving	None (possibly moving to	Mostly Donors
Roads	Secondary	to corporatized Govt)	user responsibility for some O&M)	(grants and soft
	Others	Pure Govt	None	ioans)
Airports	RIA	Corporatized Cout	For O&M	Loan to Govt
Airports	Others		None	None
Ports	FPM	Concession & Corp. Govt	For O&M & some capital	Some PPP
FUILS	Others	Corporatized Govt	For O&M	None
Rail		Concession	Yes	PPP

Table 11-7: Current PPPs and User Charging

Looking forward, three groupings of financing and funding solutions are likely to emerge:

- For roads, to start alleviating the funding burden on donors and Government, there is expected to be movement towards some degree of user charging, at least for the direct maintenance costs of the main (primary and secondary) network. Given the public-good nature of roads, capital injections are still likely to come mainly from donors. Traffic levels will remain well below those required to make direct user charging (toll) viable, although this is a possibility for specific elements in the road system such as some terminals, or even a bridge.
- For the already-corporatized ports and airports, there will be a continuous trend towards making users fully responsible for all costs, including capital, especially at the main nodes (FPM and RIA) but increasingly at the smaller ones as well. Users are likely to insist on high service levels and efficiencies provided by private sector operators and concessionaires.
- There will remain a large share of projects in the plan which are strategic (e,g. linking border posts, ensuring regional linkages), contiguous (completion of the national road fabric like secondary roads) and directly social (e.g. feeder roads and motorcycle trails) motivated largely based on public benefit and which will continue to be funded and financed from the public purse and donor support. However, within this group, there are some projects which are promoted as a network/fabric investment now but which if successful will provide private benefits to specific users and may be converted into PPPs in future (e.g. some nodes in the national airport network and some components of the Nimba Corridor).

12. Strategic Investment Plan

This chapter presents the results of applying the prioritization and other constraining factors to all of the projects identified under the programs set out in chapters 7 to 10.

12.1 Long-List of Projects

Table 12-1 summarizes the portfolio of projects considered in the SIP. This is the complete list of projects not considering the financial envelope or other implementation constraints. The total number of projects and sub-programs identified is 225. In terms of cost, the Roads programs under National Connectivity & Mobility makes up two thirds, while the Nimba Corridor (which also includes roads projects) contributes a further 8%. The total unconstrained cost is USD 3.8 billion. The individual projects and their salient details are listed in Appendix B.

Category	Program	Number	USD million	%
International	By Air	8	79	2%
Connectivity	By Sea	10	36	1%
Regional	By Road	34	179	5%
Connectivity	By Rail	0	0	0%
	Domestic Aviation	9	12	0%
National	Nimba Corridor	7	290	8%
Mobility	Other Commodity Corridors	8	181	5%
	National Roads & Terminals	100	2,592	67%
Monrovia	Improvement of Arterials	16	63	2%
Urban Mobility	Future Mass Transit	3	100	3%
	Feeder Roads	15	154	6%
	Motorcycle Trails & Crossings	15	70	2%
Total		225	3,757	100%

Table 12-1: Projects & Unconstrained Value per SIP Program

12.2 Constraining the Long-List

The projects long-list is converted into the SIP proper through four steps, as illustrated in Figure 12-1 and explained below.



Figure 12-1: Reducing the Long-List to the SIP

- Step 1: Separate projects into fixed-date and discretionary date groups. The fixed-date projects are ones that are either already committed or projects that have a strong justification to be implemented by a specific date. Since the roads analysis is done on the most precise, quantitative basis, national roads projects can be timed fairly accurately, implying that these generally have fixed dates. The other important category of fixed-date projects are the so-called "entitlements", i.e. the minimum roads interventions to ensure that the road network remains open and passable (the programs discussed in sections 8.5.2, 8.5.3, 8.5.4 and 10.1). Discretionary-date projects are also desired, and usually as early as possible, but their implementation date cannot be justified as categorically. These projects will have to wait their turn more patiently.
- Step 2: Prioritize and Validate for Readiness. The projects in each group are prioritized as set out in section 11.1. Both groups are also subject to readiness considerations, i.e. notwithstanding the project priority and urgency, it is still subject to a minimum preparation and implementation period given its current status and circumstances (e.g. land issues).
- Step 3: Roll Out Fixed-Date Projects. The non-entitlement, fixed-date, prioritized and ready list is divided into two groups: national roads and other projects.

Roads have in the past taken up the bulk of transport infrastructure funding, and given the versatility of this mode, will continue to do so. In section 11.2, therefore, a separate roads funding envelope was calculated (around USD 80 million/annum). It should be noted, however, that for roads projects there is a feedback loop to step 1, i.e. the funding constraint imposed affects the choice and timing of roads projects. For example, not having the funds to pave a road now implies having to regravel it now in anticipation of paving it later. The process of selecting an appropriate roads roll-out and preservation strategy is discussed in section 6.5.3.

Other (non-road) investments are capped at an amount that can generally not exceed about USD 20-30 million/annum.

Any of these projects can "buy itself out" of the constrained list if it is self-funding, e.g. by means of a PPP.

When the annual funding cap is reached, lower-priority projects not yet funded are delayed – until they obtain a funding slot sometime in future.

Step 4: Roll Out Discretionary-Date Projects. The discretionary-date projects (also prioritized and readiness- validated) are available to take up any of the funding slack to the extent not utilized by the fixed-date projects. The same roll-over process then also applies to these projects when the overall funding cap is reached.

12.3 Summary SIP

The salient features of the constrained SIP are shown in the following figures.

Figure 12-2 shows how the prioritization and constraining process levels out the expenditure program. The national roads are targeted to around USD 80 million/annum and the total program to about USD 120 million/annum. The "overspend" in 2018 and 2019 relates to projects already being committed to.



Figure 12-2: Constrained SIP by Program

The effect of the constraining process is to reduce (actually, postpone) the total SIP to about USD 1.7 billion. This effect is further illustrated in Table 12-2, which indicates the impact per program. The major reductions are:

- > Local Trails: This program has a low a priority and is completely delayed (i.e. to beyond 2028)
- > Long-term Urban Mass Transit: Most of the BRT and related projects can only be attended to after 2028
- > Small Road Terminals. All the small terminals investments fall outside the 10-year timeframe
- Nimba Corridor: Although preparation of the roads projects on this corridor would have commenced, the actual construction cost will be incurred after 2028
- > <u>National Roads</u>: The discretionary-date terminals and bridge (rehabilitation and reconstruction) projects have been postponed.

	USD	million	Constrain	ing Effect
Program	Long-List	Constrained	Change	Share Post- Change
Int & Reg: Air	79	79	0%	5%
Int & Reg: Sea	36	26	-28%	2%
Int & Reg: Road	179	150	-16%	9%
Int & Reg: Rail	-	-	-	0%
Nat C&M: Air	12	11	-14%	1%
Nat C&M: Nimba	290	76	-74%	4%
Nat C&M: Corr	181	167	-8%	10%
Nat C&M: Road	2,592	975	-62%	57%
Nat C&M: SSS	-	-	-	0%
Urb: Arterials	63	63	0%	4%
Urb: Mass T/sit	100	10	-90%	1%
Loc: Feeders	154	154	0%	9%
Loc: Trails	70	-	-100%	0%
Total	3,757	1,711	-54%	100%

Table 12-2: Constraining Effect per Program

The relative share of the SIP per mode is shown in Figure 12-3. Primary roads make up 63%, Secondary roads 11% and Feeder roads 9%. Urban roads and Bridges each contribute 4%.



Figure 12-3: Modal Contribution to SIP

The same pattern is reflected in responsible agency, with the MPW/IIU responsible for executing 83% of the SIP projects.



Figure 12-4: Agency Responsibility

In terms of funding the SIP, a large share of projects are already spoken for in 2018 and 2019, but it is mostly not yet funded thereafter. There are three funding modalities that should be specifically pointed out:

> <u>Road Fund</u>: The three roads "entitlement" programs are all allocated to the Fund, i.e. the primary and secondary road spot improvement and reactive interventions programs, the periodic

maintenance of bridges, as well as the feeder road rehabilitation prorgam. This averages out at about USD 24 million/annum over the SIP.

- > <u>User-Funded</u>: These are projects of which the cost should essentially be recovered on an ongoing basis from users. Examples are port and airport projects where the respective agencies should take up loan financing to amortize these projects' cost.
- PPP: There are some projects which should also ultimately be paid for by users, but which have the potential to be outsourced to the private sector. Examples are the three major road terminals on the outskirts of Monrovia, the rail stations on the Nimba railway line, and the palm oil facility at Greenville Port.



Figure 12-5: SIP by Source of Funding

13. Managing the LMMTMP

This report, together with the accompanying prioritized and timed Strategic Investment Plan, documents "what" is required, and at the project level, also indicates "who" is ultimately the responsible implementing agent (i.e. who will sign the project contract). Furthermore, there is a good understanding of how "ready" the projects are, i.e. what remains to be done and roughly how long it is expected to take to achieve implementation.

In this final chapter, the attention turns to the "how" of implementation. However, it would be somewhat blase to provide the dedicated infrastructure agencies a checklist for project implementation management – this is their core mandate. Rather, the focus is on the overall management of the plan and the management of programs which cut across different modes and therefore have to be coordinated between them.

13.1 Ministerial Responsibility

As elaborated in section 4.3, it is foreseen that overall responsibility for the transport sector will migrate to the Ministry of Transport, and it is therefore this ministry that will be responsible for overseeing the implementation of the SIP.

13.1.1 MOT Organization

The MOT is today not equipped in terms of organization or capacity to ensure that the SIP is effectively implemented. It requires the establishment of a policy, economic regulation and sector agency oversight unit to properly lead the sector. This unit will have proper road, aviation and maritime expertise, and at least some rail know-how. Some development partners (notably GIZ at MOT and the World Bank at MPW) are already supporting institutional reform and capacity building initiatives in the sector, and their scope should be broadened to include the policy function.

It should be this unit that monitors the agencies' implementation of the SIP projects, provides ministeriallevel support when required, and coordinates with other ministries on aspects that intersect their domains, e.g. the President's Delivery Unit (PDU) and the Public Procurement and Concessions Commission (PPCC).

The SIP should be a standing item on the MOT's agenda. There should be sufficiently regular (quarterly) SIP monitoring meetings, involving the infrastructure agencies and other role players such as the MFDP, MCC and counties – as required. Consideration may also be given to providing the development partners observer status at these sessions.

13.1.2 Keeping the SIP Current

A further responsibility of the MOT policy unit will be to maintain the SIP. The short-term focus would be to update it for actual project progress, with the attention shifting in the medium-term to swapping out projects that have become superfluous and introducing new ones. However, it should be emphasized that the overall SIP is not just a "projects list". The temptation will be great to simply add opportunistic schemes that arise from time to time. The policy unit will be the gate-keeper of the SIP, and the "gate" for inclusion on the project list will be a proper assessment of how the new proposed project complements the programmatic structure of the SIP.

13.1.3 Communicating Progress

MOT needs to consider how to disseminate information on progress with the SIP. The Ministry's website already contains a "Media Center" where press releases, publications and documents, and photos are made available. This could easily be extended to also present periodic updates on the SIP.

Development partners will also for their own internal compliance obligations conduct periodic monitoring and evaluation of the programs they are involved in.

13.1.4 Planning & Transport Data

One of the main challenges in preparing this mater plan and SIP is the lack of, outdatedness and dispersion of transport-related data and information. It is already on the MOT's agenda to establish a data and information repository ("transport library"), and this process should be encouraged and supported. This capability is not just a nice-to-have, but is also a requirement of e.g. the international aviation and maritime agencies so that member states can periodically report on the status of these sectors.

13.2 Program Task Teams

The SIP projects all belong quite neatly to specific infrastructure agencies and entities. However, the gist of the SIP is program-level initiatives which, although still made up of projects, need to be coordinated at the program level to ensure synchronization at the project level. These programs require teams of people with different skill sets to work together across normal functional boundaries within and between departments and agencies.

It is therefore proposed that multi-functional, multi-agency teams be set up for the following programs:

- The <u>airport access program</u> (program 7.1) involving the redevelopment of RIA, the improvement of capacity and transport services on the airport road, and looking forward, the shifting of the domestic aviation spring-board from Spriggs Payne to the RIA airport hub. This will be a collaboration between LAA, IIU/PPW and MCC.
- The short and medium-term <u>city arterial plans</u> (programs 9.1 and 9.2), including roads, junctions, terminals, and the introduction of water taxi routes and initiating the BRT scheme. The key players on this team will be IIU/MPW and MCC, and because of the PPP potential (water taxis, terminals and even BRT), also PPCC.
- The <u>county roads programs</u> (programs 10.1 and 10.2) will require a forum where the counties and IIU/MPW can come together to address project implementation and also to manage the hand-over of these programs from national to county level.
- The <u>Nimba corridor program</u> (program 8.3) involving the opening up of port use/access rules, introducing a commercial rail service and upgrading the corridor roads should be coordinated between IIU/MPW, MOT and the NPA.
- > The terminals programs (urban and county-level), possibly even including the border post terminals, should be coordinated by the IIU/MPW, MCC and PPCC (at least some terminals will be attractive as PPP ventures).
- It may also be considered to establish a <u>Palm Oil facilitation working group</u> consisting of the NPA and IIU/MPW to coordinate how palm oil production in the south-east will be handled via FPM, Buchanan and eventually Greenville.

MOT should ultimately be responsible to coordinate the establishment and operation of these program task teams.

Appendix A: Cargo Projections

			2017	2022	2027	2032
Solf-Producod	BN10	Cassava	540	567	596	625
Basic Noods	BN20	S/Cane	274	287	302	317
Basic Neeus	BN30	Ban/Plantain	208	229	253	280
Substitutable	SI 10	Rice	499	550	608	671
Imports	SI20	Frozen Import	46	51	56	62
Imports	SI30	Cons. Goods - Self	55	70	90	115
	NS10	Cons. Goods - Import	809	1,032	1,317	1,681
	NS21	Gasoline	137	174	222	284
	NS22	Diesel	183	230	290	366
Non-	NS23	Other Petroleum	45	51	60	73
Substitutable	NS31	Cement bagged	457	538	633	699
Imports	NS32	Clinker	572	625	625	874
	NS40	Vehicles	20	20	20	20
	NS50	Fertilizer	24	28	31	35
	NS60	Other	234	238	244	250
	CE11	Iron Ore	8,500	14,500	14,500	14,500
Concossion	CE12	Gold & Diam. supplies	5	5	5	5
Exports	CE21	Rubber & Latex	100	100	100	100
LAPOILS	CE22	Palm Oil	232	640	1,048	1,456
	CE30	Forestry	422	422	422	422
Total			13,360	20,359	21,421	22,834

Total Projected Volumes (Production & Imports / Consumption & Exports)

Projected Volumes compared per Port

																		ŝ	8		2	4	22		5
		2032	'	'	'		1	'	1	1	'	1	'	'	1		'	-	8,00	1	10	1,35	4	'	9.5
	Cardno ITT	2027	•	•	,			•		•	•	•	•	•				15	8,000	•	100	992	8	•	9.155
	mjected (2022	•	•				•			•	•	•			•		15	8,000	•	100	590	8		8 752
		2017	•	•				•		•	•	•	•	•	•	•		15	2,000	•	100	186	48		2.349
		2030	•	•				•			•	•	•				•		17,000	,	40	450	56	76	17.622
	NTP 2010	2025	•	•		•				•		•	•	•	•	•			17,000		64	200	56	76	17.377
Exports	Projected	2020	•	•			•	•		•	•	•	•			•			12,000	•	40	100	56	76	17.272
		2015	•	•		•		•	•	•	•	•	•	•	•	•			3,000	•	40	20	100	40	3 200
	F																		g					9	G
		2015	'	'	'	1		'	'	1	'	1	'	'	1	(7)	'	'	39	ľ		'	1	11	8
		2014	•	•	,	•				•		•	•	•	•	0		,	751		•	•		150	<i>с</i> 06
	Actual	2013	•	•	•	•	16	•		•	•	•	•	•	•	•		•		•	•	•		152	167
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Port Buchanan

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Passengers																										
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If-Produced BN20	 Sugar Cane 	•		•		•		•					· ·			•	•		•					•	•	•
sic Needs BN30	Banana & Plantain	•											•			,	•				,			•		•
BN40	Wood & Charcoal (not projected separately)	•				-		'	,			_				-						_ 1		•		
hstitutahle Si10	Rice	•	•	•	•								•		•		•							•		•
norts SI20	Frozen Products Imports	•	•	•	•	•							-		•		•	•	•					•		•
SI30	Consumer Goods (self-produced)															-										
NS10	Containerized Consumer Goods (Imported)			10	22	3					14	18	23 3	0		•										
NS21	Gasoline	•		,	,	•	8	46	56	89			;			•		,		,	,			•	,	•
NS22	Diesel	,		,		•						9	9	9	•					,						•
on- NS23	Other Petroleum	•		•		•).											
bstitutable NS31	Cement bagged	•				•									•							1				•
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CE22 CE22	Palm Oil	,		,		•							'		•	,			•	25	100	2	8	300	00 00	00 00
CE30	Forestry														•		41	81	109	50	28		28	28 28	28 28 136 1	28 28 136 136
lancing BA	Balancing Amount			2	20	0	11	14	18	23		-	-				54	81	20	2,020	2,538 2	2	38 2,	38 2,538		38 2,538
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Appendix B: Projects Long-List

Appendix C: Strategic Investment Plan

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