NIAF NIGERIA INFRASTRUCTURE ADVISORY FACILITY

A DFID Funded Programme
Implemented by Adam Smith International

Outline Business Case (OBC)

Gurara 30MW Hydropower Project

For [Federal Ministry of Water Resources]

DRAFT REPORT

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ABBREVIATIONS AND ACRONYMS

BPE	Bureau Privatisation Enterprise
DFID	Department for Infrastructure Development
EIA	Environmental Impact Assessment
FMARD	Federal Ministry of Agriculture and Rural Development
FMAWR	Federal Ministry of Agriculture and Water Resources
FMoF	Federal Ministry of Finance
FMoP	Federal Ministry of Power
FMoWR	Federal Ministry of Water Resources
GWH	Giga Watts Hour
GWMA	Gurara Water Management Authority
ICRC	Infrastructure Concession Regulatory Commission
MDA	Ministry, Department and Agencies
MW	Mega Watts
NIAF	Nigeria Infrastructure Advisory Facility
OBC	Outline Business Case
PPP	Public Private Partnership
RBDA	River Basin Development Authority
WADSCO	Water and Dams Services Company
WUA	Water Users Association

OUTLINE BUSINESS CASE (OBC) FOR THE CONCESSION OF THE 30MW GURARA HYDROPOWER PROJECT

FOR FEDERAL MINISTRY OF WATER RESOURCES

EXECUTIVE SUMMARY

1.1 Business Opportunity

Despite the abundance of water resources in Nigeria, uneven distribution due to insufficient water infrastructure and management has been a major challenge. This has resulted in increasing demand for water which exceeds supply in the Federal Capital Territory (FCT).

1.2 Solution

In the quest to meet the demand for water in the Federal Capital Territory, (FCT), the initiative to construct a dam close to the Gurara river was conceived by the Federal Ministry of Water Resources (FMoWR) to be the most sustainable, cost-effective and feasible option. The Gurara dam – situated 75km from the FCT – was designed and constructed with the main purpose of supplying water to the Lower Usuma dam to meet the demand for water. In addition to fulfilling the water supply needs, the dam has been equipped with world-class amenities for hydropower generation, irrigation, farming, tourism development and fishery farming.

The Federal Ministry of Water Resources (FMoWR) established the Gurara Water Management Authority (GWMA) to oversee the dam, which led to the initiation of construction on the Gurara I 30MW hydro power plant which was completed in 2011. Although currently not operational, the operations will commence upon completion of the 110km 132kV transmission line connecting the hydro power plant to the TCN Kudenda substation.

Presently, the GWMA is contemplating the hydro power plant management options. The intent is to outsource the management of the hydro power plant to a private party but the organisation has limited capabilities and experience with regard to implementing such outsourcing in the form of a concession agreement and obtaining the required documentation to make the plant operational. The GWMA has therefore requested the Nigerian Infrastructure Advisory Facility (NIAF) assistance in the implementation of their chosen management option.

1.3 Gurara I 30MW Hydropower Plant

The Gurara hydropower plant is expected to produce 115GWh of energy annually (a 44% capacity factor). The plant comprises three Kaplan turbines each driving a 12.5MVA alternator with a total power output of 30MW (37.5MVA at 0.8 power factor). A 4 metre diameter penstock is trifurcated just before power house into three by 3 metre diameter feeds to the turbines. The energy production from the proposed power plant would vary in line with seasonal rainfall, rising significantly during the months – August, September, and October - with the heaviest accumulation of rainfall. However, any increases in water supply for other dam related components will reduce the annual electrical energy produced.

Additional factors that need to be factored into consideration are the operating and maintenance costs of the plant, the Multi Year Tariff Order (MYTO) stipulating the allowable tariffs for the power generated, and the revenue stream the concessionaire can expect to generate from the power purchase agreement (PPA).

1.4 Managing the Water Requirements

The Gurara I multipurpose scheme (i) aims to satisfy the FCT water demand, (ii) will produce electricity for transmission to the Kudenda substation, and (iii) allows for the development of modern irrigation areas for intensive culture. Although the three elements form a fundamental part of the Gurara Water Transfer Project (GWTP), it is important to note that usage priorities have been delineated.

The priority water usage of the Gurara reservoir is for the water supply to FCT. In order to guarantee the water supply priorities, lower limits of reservoir levels have been defined for each month of the year which will limit hydroelectric turbine generator operations. The use of these limits should ensure that there is always reserve available for FCT supply and irrigation.

1.5 Connecting to the National Grid

A 110km 132kV transmission line is currently being constructed to connect the Gurara hydro power plant to the TCN Kudenda substation – anticipated completion in December 2014. Although susceptible to inclement weather, overhead lines were used as opposed to underground cables as it was determined that they provided the most economic solution to the transmission challenge and ultimately the least impact on end user bills.

The FMoWR will need to ensure the following processes have been concluded before the concessionaire is able to take over the operational and management aspects of the project.

Performance of an Evacuation Study: This is a study of new generation and its connectivity to the grid for evacuation of power to a load centre. The study also relates to existing facilities with a focus on alternative power evacuation plans for grid security purposes.

Application for a Generation License: For electricity to be generated from the Gurara hydropower plant, the FMoWR will need to apply for a generation license from the National Electricity Regulatory Commission (NERC).

Execution of a Transmission Line Agreement (TLA): This agreement will be between the FMoWR and the Transmission Service Provider (TSP) component of TCN. It should normally be put in place before the design and construction contract for the transmission line is awarded.

Execution of a Grid Connection Agreement (GCA): This agreement is a "standard regulated agreement" required under the Grid Code between the connecting user (in this case a power generator) and TCN. It is largely an engineering agreement and there are no payment terms in the agreement.

Execution of an Ancillary Services Agreement (ASA): This agreement encompasses three separate categories focusing on frequency control, network voltage control, and system restart (blackstart). ***Frequency controls*** are put in place to facilitate the maintenance of the frequency of the electrical system within a narrow band at any point in time. ***Voltage controls*** are put in place to control the voltage of the local area network to within the prescribed standards. ***System restart*** provisions are reserved for contingency situations in which there has been a whole or partial system black out and the electrical system must be restarted.

The connection to the national grid will culminate with the connection to the Kudenda substation, which is designed to TCN standard specs: two incoming 132kV bays and two 60MVA 132/33kV transformers.

1.6 Environmental Impact Assessment

There would be both positive and negative impacts on vegetation and wildlife within the envisaged reservoir and environs upstream of the dam. To counter the negative impacts, the following mitigation measures have been implemented: resettlement and compensation of all affected communities; relocation and resettlement of old, weak and very young wildlife that are vulnerable to loss by drowning within the reservoir; ensuring minimum year round Gurara river flow downstream of the dam through sluice gates or water bye-pass; provision of such wildlife migratory pathway as fish bye-pass; regular clearing of water weeds from the reservoir; routing of pipeline to avoid deep penetration into forest reserves; policing of forests and involvement of local people through effective alliance in executing mitigation measures.

1.7 Rationale for PPP/Risk Assessment

Public Private Partnership (PPP) is an agreement between the private sector and the public sector, for the rehabilitation, management, operations and maintenance of the existing infrastructure or the construction of new infrastructure, with sharing of risks between the two parties involved.

The proposed model for the concessioning of the hydropower component of the dam will require one concessionaire to take custody of the project for a period of time as determined by the financial analysis. Under this form of PPP, the concessionaire will be responsible for the use of the asset in generating hydropower, and connecting to the transmission network made available by the Transmission Company of Nigeria (TCN) on behalf of the federal government to the sub -station for distribution.

However, there are risks of certain events that could negatively impact the project if not properly mitigated. The following risk categories have been identified as being applicable to the Gurara hydropower project.

- Project Risk
- Financial Risk
- Operational Risk
- Legal Risk; and
- Other Risk

1.8 Procurement Process

The procurement of concessionary services for the hydropower project shall follow stipulated guidelines of the Infrastructure Concession Regulatory Commission (ICRC) Act and the Public Procurement Act (PPA). The ICRC Act is intended to ensure that projects or contracts for financing, construction, operation or maintenance of any infrastructure shall be procured by means of an open competitive bid. The PPA is intended to prevent fraudulent and unfair procurement, while ensuring that the prices paid for goods and services are fair and reasonable.

1.9 Project Management Structure

The management of the project should comprise pre-concession teams of various stakeholders working towards the engagement of the private sector. The teams will include members focused on the daily activities of the project and a separate team to ensure that tasks are carried out in with the highest degree of quality and professionalism.

1.10 Financial Assessment

To provide a sufficient basis for investment appraisal, the financial analysis model covers a 20 – year explicit forecast period from 2015 to 2034. The model is built around NERC's MYTO financial model (for generation) in order to maintain consistency with regulatory requirements and increase the likelihood of tariff and PPA approval by the Nigerian Electricity Regulatory Commission (NERC).

Assumptions related to the technical, commercial and operational aspects of the project analysed the macroeconomic parameters, taxation, reporting currency, funding, staffing, debtors and creditors, non-labour operations & maintenance (O&M) costs, and technical parameters for tariff revenue calculation. The projected Internal Rate of Return (IRR) and the Payback Period are presented below:

Summary	Scenario
Assumed Project Cost/Capex (N)	6,679,288,975
NPV (N) @ 20%	1,303,750,618

Equity IRR (%)	29%
Payback Period	10 years

OUTLINE BUSINESS CASE FOR THE CONCESSION OF THE GURARA IRRIGATION PROJECT (PHASE 1)

FOR FEDERAL MINISTRY OF WATER RESOURCES

2 INTRODUCTION

In 2014, the Federal Ministry of Water Resources (FMoWR) and the Nigerian Infrastructure Advisory Facility (NIAF) entered into an agreement for the development of an Outline Business Case (OBC) for the concessioning of the Gurara 30MW Hydropower project. The FMoWR is the custodian of all dams and water resource activities in Nigeria. The establishment of a PPP Unit in February 2012 to engage the private sector in operation and maintenance, funding of existing water infrastructures and the development of new infrastructures is viewed as a key step towards identifying potential PPP projects and accelerating project development and the delivery of additional water infrastructure. The role of the Unit covers:

- technical, financial and economic assessments of potential projects to examine their suitability for private sector concession; and
- development of the most promising project proposals and solicitation and negotiation of private sector participation.

NIAF was established by the UK Department for International Development (DFID) in response to a request made by the Government of Nigeria for support in the provision of technical assistance to enable the country to improve its infrastructure and the reliability of related services. The Facility is intended to support flexible and rapid response to the needs of Nigerian clients, and in particular to Government ministries, departments and agencies (MDAs) at the federal level and in selected states.

Following the completion of a successful first phase, the current NIAF programme has a broader sectoral composition than its predecessor programme, notably embracing urban development and climate change as key new themes, and is also intended to have a much broader geographical reach. Like its predecessor, it is intended to operate as a 'demand-driven' facility, responding to the needs of Government and other counterparts for assistance.

In collaboration with the FMoWR, NIAF developed a screening process through which all-prospective PPP projects identified by the Ministry navigate. As a result, the Gurara 30MW hydropower project has been identified as a viable candidate for PPP.

2.1 Objective of this study

This study has the following objectives:

i. Prepare an Outline Business Case (OBC) to determine the viability of the Gurara 30MW Hydropower project, and its ability to attract the private sector for concessioning of the facility.

2.2 Project Background and Description

Nigeria has an abundance of water resources - 267.3billion cubic metres of surface water and 53 billion cubic metres of ground water, with over 200 dams in different locations. However, even distribution of these resources has been a major problem due to increasing demand which exceeds supply primarily as a result of lack of water infrastructure and proper management. In the quest to meet the demand for water in the Federal Capital Territory, (FCT), the initiative to construct a dam close to the Gurara river was conceived to be the most sustainable, cost-effective and feasible option.

The Gurara dam was designed and constructed with the main purpose of supplying water to the Lower Usuma dam in the FCT to meet the demand for water. The dam situated 75km from the FCT has a crest of 3.2km in length, maximum height of 54metres and a reservoir capacity of 880MCM. The intake of the conveyance pipeline is located on the right bank, about 1.6km upstream of the dam. It has a 45km high intake tower comprising of four independent 4m high and 2.5m wide intakes equipped with stop-logs and fixed screens located at different elevation to allow withdrawal of water of the required quality. A hydraulic tunnel of 1.2km long, lined with concrete, with a 4.3m internal diameter extends from the tower, which is bored in the granitic hill of the right bank. A gate of 3.6m high and 4.45m wide is located at the entrance of the hydraulic tunnel.

In addition, the Ministry engaged a consultant to carryout studies on the Gurara site to determine other potential uses, besides the water supply project. Consequently, the dam has been equipped with world-class amenities for hydropower generation, irrigation farming, tourism development and fishery farming.

The FMoWR established the Gurara Water Management Authority (GWMA) and initiated the construction of Gurara I 30 MW hydro power plant which was completed in 2011. However, the hydro power plant is still not operational and will begin operations once a 110 km 132 kV transmission line connecting the hydro power plant to the TCN's Kudenda substation is completed (targeted completion date is December 2014).

2.3 Scope of Work

This Outline Business Case (OBC) is prepared in line with the National Policy on Public Private Partnership to assess the feasibility and bankability of the Gurara 30MW Hydropower project before attracting the private sector. This report will assess the following:

Task 1: Overview of the Gurara 30MW Hydropower Plant

- Review the existing condition of the plant and equipment
- Assess the technical viability of the plant
- Understanding of the operating and maintenance costs
- The Multi Year Tariff Order
- Understanding of potential revenue from the PPA

Task 2: Water Management Requirements

- Review existing documents relating to the management of water derived from the GWTP
- Identify water management priorities.

Task 3: Technical Component & Process for Connecting to the National Grid

- Outline steps involved in connecting to the national grid.

Task 4: Environmental Impact Assessment

- Review existing documents on the previous studies carried out on the proposed dam
- Review the previous Environmental Impact Assessment (EIA) studies carried out for the Gurara project
- Recommend options to mitigate negative environmental impacts

Task 5: Regulatory and Legal Requirements

- Examine the legal and regulatory environment relating to the construction and operation of the dam and associated power generation. Provide advice as regards any existing or anticipated legal constraints.

Task 6: Rationale for PPP/Risk Assessment

- Identify and assess all risk associated with the project, prepare risk matrix, propose mitigating measures and prepare guidelines and steps towards achieving the proposed PPP model.
- Review PPP models and propose the most suitable PPP type and period based on assessments of viability and bankability.

Task 7: Procurement Plan

- Narrative of the procurement process

Task 8: Project Management Structure

- Methodology for oversight of the project

Task 7: Financial Assessment

- A summary of the capital and operational expenditure relating to the project
- Implications of the MYTO Tariff
- Identify all revenue streams
- Identify all expenditure streams
- A full discounted cash flow model making assumptions on revenue and expenditure showing, break even and NPV calculations for the project incorporating assumed interest and inflation rates, over a 20 year period
- A projected framework balance sheet and profit loss statement for the hydropower project based on the cash flow model

3 THE GURARA I 30MW HYDROPOWER PLANT

3.1 Overview

The Federal Ministry of Agriculture and Water Resources decided to integrate a 30 MW hydroelectric power plant into the Gurara Dam Works which is expected, under central case assumptions, to produce 115 GWh of energy annually (a 44% annual capacity factor). The water from the Gurara reservoir will be used to produce hydroelectricity using the water that is available once the water supply demands have been satisfied.

The power plant comprises three Kaplan turbines each driving a 12.5MVA alternator with a total power output of 30MW (37.5MVA at 0.8 power factor). A 4 metre diameter penstock is trifurcated just before power house into three by three metre diameter feeds to the turbines. The three generators generate at 11kV and feed the station 11kV board which has several 1MVA auxiliary transformers for onsite supplies and two 25MVA 11/132kV ONAF cooled generator transformers with off load tap changers[1]. Each generator transformer feeds the 132kV busbar via an SF_6 circuit breaker. Based upon a site visit by NIAF team members, a visual inspection of the power house indicated that the equipment looks new and as far as could be seen in good condition and well constructed. Pre-commissioning of the plant has been done as far as possible in the absence of the transmission connection. Final commissioning of the power plant will take place once the 132kV grid connection has been completed.

The energy production from the proposed power plant would vary in line with seasonal rainfall. Average monthly production would be around 6GWh over the period January to June rising significantly during August, September and October (with a peak of around 20GWh in September) before falling again during November and December. As a consequence the monthly plant factor can vary from under 30% in May to over 90% in September[2].

However, it is important to note that any increase of water taken for irrigation purposes can significantly reduce the annual electrical energy produced. Under the scenarios investigated by Coyne et Bellier annual production varies between 116GWh[3] and 97GWh[4]. The energy production for the Case 1 option (116GWh/annum[5]) is illustrated in Figure 2.

[1] 5 taps at 2.5% intervals

[2] Capacity factor varies according to the scenario chosen. Coyne et Bellier identified different possible combinations of the water uses that led to 9 simulation cases of the Gurara water

[3] With firm energy (available 95% of the time) of 84GWh

[4] With firm energy (available 95% of the time) of 63GWh

[5] Design studies indicate that the gross water head will vary between 30.4 m and 44.4 m

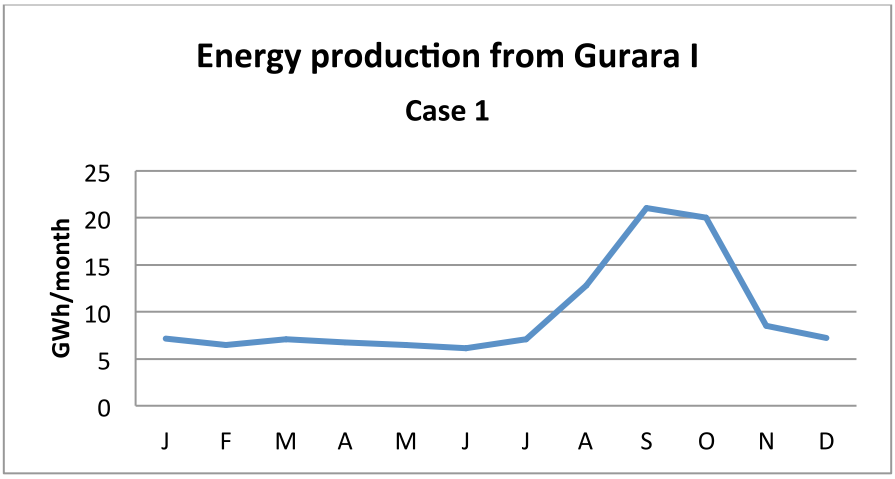


Figure 2

3.2 Operations and Maintenance

The operating and maintenance (O&M) costs of any hydro plant will include a variety of elements such as:

- The cost of starting up and shutting down the plant in response to changes in water level and the electricity market requirements;
- General tidying, inspection, clearing intake screens, consumables, and stock replenishment of minor spare parts;
- Routine maintenance, painting, periodic checks, repairs covering normal wear and tear and deterioration;
- Insurance, for third party risks (e.g. downstream flood), and possibly for breakdown;
- Payments for water rights (if applicable);
- Rates & taxes (if applicable);
- Licences and electricity market membership charges (if applicable);
- Grid connection charges (if applicable); and
- Administration; communications, secretarial, and professional fees.

Annual O&M costs are often quoted as a percentage of the investment cost per kW per annum. Typical values range from 0.5% to 4% and the International Energy Agency assumes a figure of 2.2% for large hydropower projects. This figure would usually include the refurbishment of the mechanical and electrical equipment such as turbine overhaul, generator rewinding and replacement of communication and control systems which would typically take place after approximately 20 years.

An alternative approach to estimating O&M costs is to use a figure of between US $5 to $20/MWh generated for new medium to large hydro plants[6] and approximately twice as much for small hydro. This would yield an annual O&M cost for the Gurara I project of between $1.2 million and $4.6 million associated with an annual production of 116GWh/annum.

3.3 The Multiyear Tariff Order

In 2008 NERC decided to introduce the Multi Year Tariff Order (MYTO) as the framework for determining the industry pricing structure. The MYTO methodology provides a fifteen year tariff path for the electricity industry with minor and major reviews bi-annually and every five years respectively. There are three separate Tariff Orders; one for each of the generation, transmission and distribution/retail sectors. The second MYTO Tariff Order issued by NERC covers the period 1 June 2012 to 31 May 2017. NERC intends MYTO 2 to be cost-reflective and to provide financial incentives for the urgently-needed increased investments in the industry.

NERC states that wholesale contract prices are established using a Long Run Marginal Cost (LRMC) methodology[7]. However, NERC has determined that the price of electricity to be paid to generators will be at the level required by an efficient new entrant to cover its life cycle costs.

NERC states that each new entrant IPP that requires a tariff beyond the MYTO benchmark should apply to the NERC for approval. In such case, the IPP will open its plans, accounts and financial model to scrutiny by the NERC, which will then apply prudence and relevance tests to determine whether such plant- and site-specific costs should be allowed in the tariff.

NERC has determined that the lowest cost new entrant generator is an open-cycle gas turbine (OCGT) using natural gas. Most new power stations completed or under construction in Nigeria are open cycle gas turbines. Given the current price of gas used for electricity generation, NERC is of the opinion that OCGTs produce electricity at a lower life cycle cost than either combined cycle gas turbines or coal-fired generation.

NERC's selection of the OCGT as the lowest price new entrant is based upon "the fact that natural gas is the most abundant and environmentally-appropriate fuel in Nigeria, and therefore that which gives Nigerian generators the greatest competitive advantage." However, new entrants, particularly in a number of locations where natural gas is not the most efficient fuel available, are entitled to submit

[6] The definition of small, medium and large hydro varies depending upon the source document. In this case medium is defined as 100MW to 300MW while large is defined as >300MW

[7] The calculation of the LRMC for generation requires the modelling of the system-wide supply-demand balance using a system-planning model to provide a system-wide generation expansion plan with a central load forecast. The load forecast is then incremented and decremented in order to provide the associated expansion series from which the LRMC for generation can be calculated.

bids for generating plant using the most efficient fuel for that particular site. This latter statement would apply to the Gurara I project.

For the next five years NERC has set a cap on energy from renewable sources at 10% of total energy sent out. This cap is to be reviewed whenever the Federal Government's policy on energy mix is established. For the purposes of qualifying as a Renewable Energy Source, small hydro is defined as those plants producing ***less than*** 30MW. With a nameplate rating of 30MW, Gurara I would thus be classified as a medium sized hydro plant[8] and there is no feed in tariff for such a plant and any price in a power purchase agreement would need to be negotiated.

NERC's MYTO 2 calculation of the wholesale Generation Prices for New Entrants Gas Power Plants is provided in the Table below. At current exchange rates the wholesale price in 2016 equates to approximately £59/MWh.

3.4 The Revenue stream from the PPA

The revenue stream of the Gurara I project will be determined by the level and the structure of the payments in the PPA. Such payments would normally comprise both capacity and energy payments and in the case of hydro plant should also include ancillary service payments. The structure of the PPA for Gurara I will need to be resolved along with the level of payments for energy and capacity.

One of the issues associated with a PPA for a multipurpose hydro electric plant is that, depending upon the dispatch arrangements, the concessionaire has very limited control over energy production or even the timing of the energy production as this is normally at the discretion of the System Operator and is dependent upon both the other water requirements associated with the project and the hydrology of the river basin. In such circumstances having incentives for energy production in the PPA has very limited value and can simply increase the risk to the concessionaire's revenue. Energy production will, of course, vary from year to year dependent upon the rainfall.

The amount of electricity produced by a hydroelectric plant will depend on a number of factors including:

- The mechanical availability of the plant;
- The technical efficiency of the turbine and generator;
- The flow of water down the river;
- The share of the water that is available to flow through the turbines;
- The level in the headpond and tailrace; and
- The dispatch regime.

[8] Medium sized hydro is defined by NERC to lie in the range 30MW to 100 MW.

All the above factors would suggest that the hydro plant concessionaire should be paid primarily for plant availability with a small energy-related component to provide an incentive to maximise the plant efficiency.

4 Water Management Requirements

The Gurara Water Transfer Project has been identified as the most feasible option for supplying water to the Federal Capital Territory (FCT). An inter-basin water transfer catching the river flow from Gurara I Dam and conveying it into the Lower Usuma reservoir in order to supplement the water inflows of Usuma basin through a 75 km long pipeline has been constructed.

The location of the Gurara I Dam is shown in Figure 1.

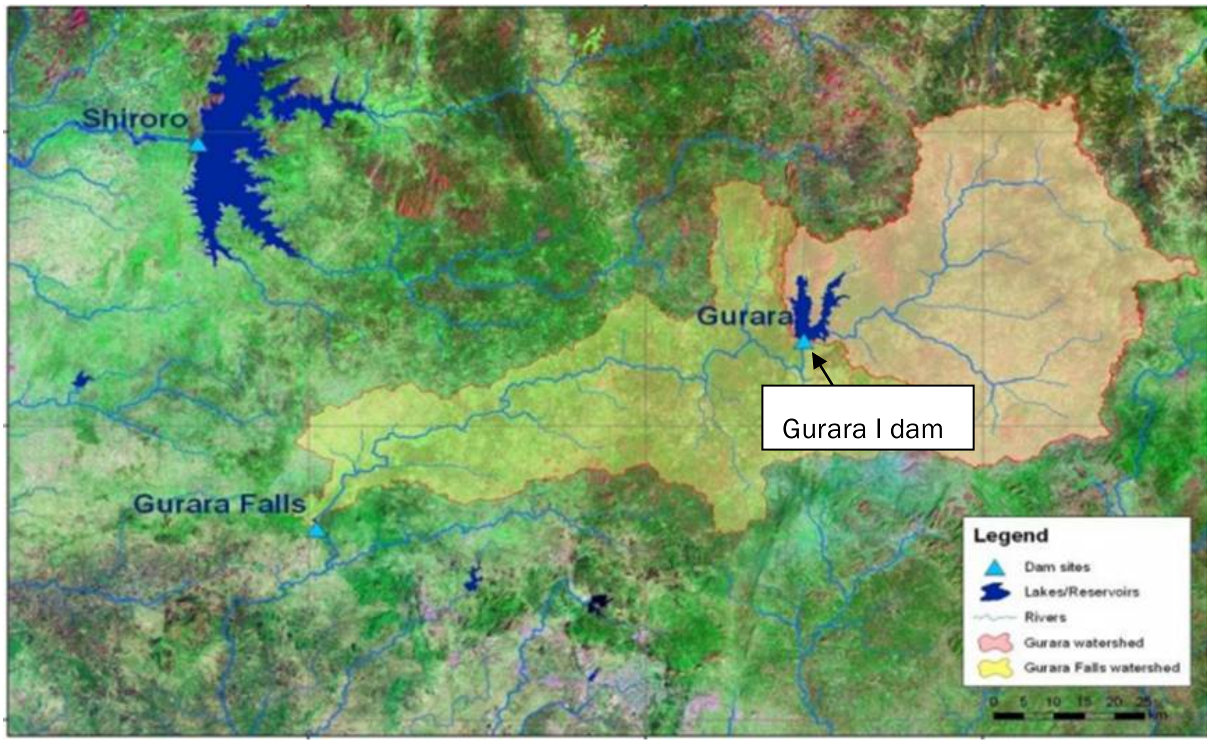


Figure 1 Gurara I Geographical Location

The Lower Usuma reservoir[9] is only used to supply drinking water to Abuja city. As the Usuma river inflows are now insufficient, water from Gurara reservoir is transferred to Lower Usuma by a pipeline in order to satisfy the drinking water demand.

Although the three elements of the multi-purpose scheme form a fundamental part of the GWTP, it is important to note that usage priorities have been delineated. The priority usage of water is in the following order: (i) satisfaction of the FCT water demand, (ii) production of electricity for transmission to the Kudenda substation, and (iii) development of modern irrigation areas.

[9] Lower Usuma Dam Water Treatment Plant (LUDWTP), located in Nigeria's capital city Abuja, is owned by Federal Capital Territory Water Board (FCTWB). Phases 3 and 4 of the project were commissioned in September 2013. Raw water for the new plants is being sourced from the Lower Usuma Dam (LUD) reservoir, which also supplies water to the phase 1 and 2 plants, and the new Gurara I reservoir. The new and existing facilities now provide a combined 720 million litres of clean drinking water per day to Abuja and its neighbouring areas.

In order to guarantee the water supply priorities, lower limits of reservoir levels have been defined for each month of the year which will limit hydroelectric turbine generator operations. The use of these limits should ensure that there is always reserve available for FCT supply.

Lack of water in the catchment area is more important during the driest months from February to June, as the FCT water demand remains the same throughout the year. The wet season begins in June and lasts 4 to 5 months until November. Most of the inflows to the Gurara reservoir come from the wet season and comprise some 85% of the annual inflows.

The water treatment plant's demand which must be satisfied was 30,000 m^3/h in 2008 and is forecast to rise to 40,000 m^3/h in 2018. The water that is transferred from the Gurara system should be limited to match any deficit of water at Lower Usuma. The raw water supply to Abuja will be delivered by both the Lower Usuma and Gurara reservoirs. Any shortfall of water at Lower Usuma to satisfy the Treatment Plant demand must be made up from water transferred by the water pipeline from Gurara to Lower Usuma.

5 TECHNICAL COMPONENT & PROCESS FOR CONNECTING TO THE NATIONAL GRID

A transmission line is required to carry the power from the power plant to the substation. Consequently, a 110 km 132 kV transmission line connecting the hydro power plant to the TCN's Kudenda substation is being constructed, with a targeted completion date of December 2014. This high voltage electricity transmission line takes the form of overhead lines, as studies have indicated these provide the most economic solution to the energy transmission challenge, and ultimately the least impact on end user bills.

Although overhead power lines are susceptible to the harsh elements of nature, which could result in extended power outages that in extreme cases cannot be restored for days, there were tangible justifications for the installation of overhead lines in lieu of underground lines from the Gurara hydropower plant to the Kudenda substation.

Construction Costs: The estimated cost for constructing underground transmission lines ranges from 4 to 60(the ratio increases with increasing voltage) times more expensive than overhead lines of the same voltage and same distance. In addition, while technologies are emerging for underground transmission lines, underground cables carry far less capacity than overhead lines in similar sized cables; therefore, much larger cables are required to achieve the same capacity.

Maintenance costs: There are several variables involved in the determination of maintenance costs of underground lines that make costing somewhat challenging to estimate. However, it is clear that the costs are significant and a key impediment to proceeding with this option. Some of the major elements that impact the maintenance cost for underground transmission cables include:

- **i.** **Cable repairs.** While the underground cables are better protected against weather and other conditions that can impact overhead lines, they are predisposed to insulation deterioration due to the loading cycles the lines undergo during their lifetimes. Over time, the cables' insulation weakens, which increases the potential for faults. If these faults occur, the cost of finding the location(s), trenching, cable splicing, and re-embedment is sometimes five to 10 times more expensive than repairing a fault in an overhead line where the conductors are visible, readily accessible and easier to repair.
- **ii.** **Cable outage durations.** The durations of underground cable outages vary widely depending on the operating voltage, site conditions, material accessibility and experience of repair personnel. The usual repair duration of cross-linked polyethelene (XLPE), a solid dielectric type of underground cable, ranges from five to nine days. Outages are longer for lines that use other nonsolid dielectric underground cables. In comparison, a fault or break in an overhead conductor usually can be located almost immediately and repaired within a shorter duration of time.
- **iii.** **Cable modifications.** While overhead power lines are easily tapped, rerouted or modified; underground cables are more difficult to modify after the cables have been

installed. Such modifications to underground power lines are more expensive because of the inability to readily access lines or relocate sections of lines.

It is to be noted that transmission companies only use cables when there is no other choice. TCN has no cables on its network. The overhead lines and accessories are built to standard international specifications. These specifications focus on the loading and strength requirements derived from reliability based design principles. However, to actually connect to the National Grid, the FMoWR will need to initiate the following processes:

Performance of an Evacuation Study: This is a study of new generation and its connectivity to the grid for evacuation of power to a load centre. The study also relates to existing facilities with a focus on alternative power evacuation plans for grid security purposes.

To meet TCN's requirement, the study will need to encompass the following studies:

Load Flow/Power Flow Studies: The purpose of load flow studies is to plan ahead and account for various hypothetical situations. For example, if a transmission line is to be taken offline for maintenance, these studies will determine if the remaining lines in the system have the capacity to handle the required load without exceeding their rated values.

Short Circuit/Fault Studies: The purpose of these studies is to provide information for the selection and programming of protection equipment (e.g. switch gear, relays, etc.) for the new generation facility.

Static and Dynamic Contingency Studies: The purpose of these studies is to assess the adequacy of the evacuation design to withstand credible contingencies and to access the reliability aspects of power evacuation.

Reactive Power Compensation Studies: The purpose of these studies is to ensure that power is supplied to load centres at acceptable voltage levels and with minimum transmission losses.

Application for a Generation License: For electricity to be generated from the Gurara hydropower plant, the FMoWR will need to apply for a generation license from the National Electricity Regulatory Commission (NERC). There are multiple steps involved with the submission of an application; see below:

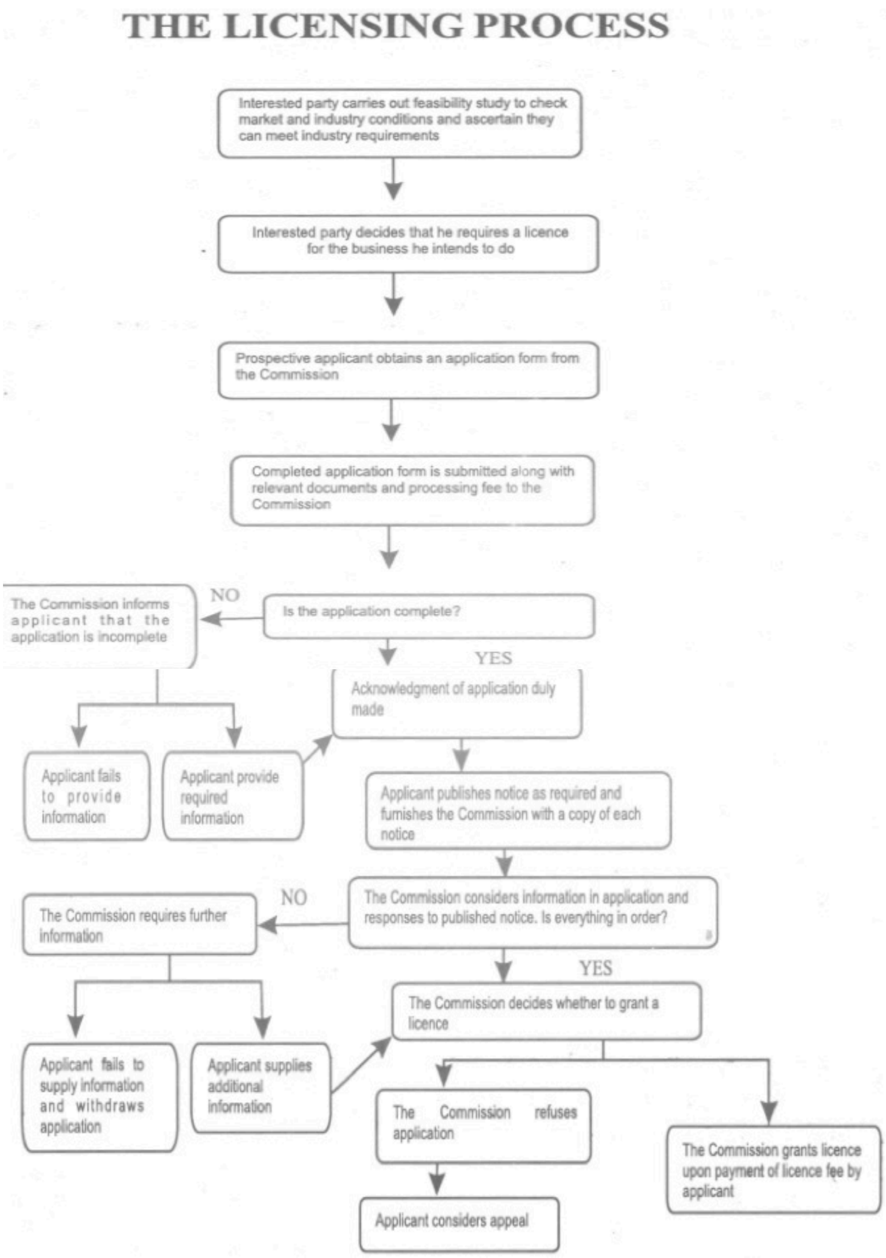


Figure 2 Generation License Procedure

Regulations preclude an entity from owning both generation and transmission licenses. The objective of the FMoWR is to transfer the ownership of the transmission line and assets to TCN. If TCN decides to take over the ownership, the FMoWR will need to sign three distinct contracts with TCN:

Execution of a Transmission Line Agreement (TLA): This agreement will be between the FMoWR and the Transmission Service Provider (TSP) component of TCN. It should normally be put in place before the design and construction contract for the transmission line is awarded. Main topics covered by the agreement are:

1. The transmission line shall be built in accordance with TCN standards (this might include restriction to reputable constructors acceptable to TCN). Note: TCN will not consent to operate and maintain the line if it's not at least of the same standard as its own lines.
2. Requirements for agreement on the design of the connection at the TCN far end substation.
3. Requirements for commissioning the transmission line.
4. Obligation on the TSP to operate and maintain the transmission line, while maintaining it at the same standards as existing lines.
5. Terms, conditions and process for the handover of ownership to TCN. This will include linkage to the constructor's warranty for the first one or two years.
6. In addition, this agreement addresses the repayment process for the construction costs of the line. This will normally be through the Power Purchase Agreement (PPA) for the off-take of power.

The TLA is not a "standard regulated agreement" as it is expected to vary significantly between connection sites.

Execution of a Grid Connection Agreement (GCA): This agreement is a "standard regulated agreement" required under the Grid Code between the connecting user (in this case a power generator) and TCN. It is largely an engineering agreement and there are no payment terms in the agreement. The GCA covers a broad spectrum of interface issues between the power generator and TCN, the major ones are:

1. Definition of limits on what can be exported to or imported from the system.
2. Requirements for commissioning the generator in synchronism with the system.
3. Commercial metering and associated data collection in order that the Market Operator can issue settlement statements concerning the monthly output from the power station. This is to the generator itself and to the PPA counterparty in order that payments can be made.
4. Requirements to obey the Grid Code and to assist in the control of system frequency and local voltage. This includes rights of the generator to desynchronise for extreme frequency and voltage.
5. Rights of TSP to de-energise the site for various technical reasons and for more general reasons such as non-payment (in other contracts or the Market Rules) or loss of Licence.
6. Requirements on communication and SCADA facilities.
7. The final and most important area is safety inter-relations at and around the interface boundary.

Execution of an Ancillary Services Agreement (ASA): There are three distinct categories of this agreement focusing on frequency control, network voltage control, and system restart (black start):

1. The *frequency control component* is put in place to facilitate the maintenance of the frequency of the electrical system within a narrow band at any point in time. Frequency deviation is a measure of the instantaneous mismatch between the generation and the load on the system. The primary method of control is through having generators operating below their full load

– called carrying reserve. This allows for two actions:

a. For small deviations in frequency generation, output is automatically increased or decreased appropriately.

b. When another generator trips, the generator automatically (and almost instantaneously) picks up to full load.

2. The *voltage control component* controls the voltage of the local area of the electrical network to within the prescribed standards.

3. The *system restart component* is reserved for contingency situations in which there has been a whole or partial system blackout and the electrical system must be restarted. The power station restarts itself without input from the system and then energises the system step by step.

In regards to Gurara, the voltage control capability will be required just to keep the voltage of the 132kV transmission line within limits, as it does not have the capability to black start the system. However, during the dryer periods of the year when it is not required to run at full load (to minimise water spillage) it can operate at 30% load i.e. 9MW and offer 21MW of reserve. This is 10% of the national requirement and valuable to the System Operator.

Recently certain considerations have been put forward for the establishment of an Independent System Operator (ISO). If this is the reality upon completion of the transmission line in December 2014, the process for connecting to the grid would change slightly. The principal change is that the GCA would be split into two documents:

1. A Grid and Market Operating Agreement which would extract those issues relating to the System Operator and the Market Operator; and

2. A (residual) GCA covering those issues only relating to the Transmission Service Provider.

5.1 Substation Connection Process

The Ministry of Power has funded the construction of the 132/33kV Kudenda substation. It is designed to TCN standard specs: two incoming 132kV bays and two 60MVA 132/33kV transformers. At present this substation is largely complete and the outstanding tasks are limited to primary wiring, control wiring and control panels. The transformers are in place and the 132kV bays are ready to receive the Gurara circuit. This substation will feed the Kudenda new industrial area of Kaduna. Once the substation is fully complete, it is anticipated that it will be taken over by TCN.

6 ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Introduction

Although there has been a widespread push to increase the utilization of renewable sources to pursue energy goals, these alternative sources of energy also present environmental impacts that need to be factored into consideration. This section describes the potential impacts to the environment as a result of the Gurara dam's inundation area, as well as upstream and downstream of the dam site.

During the construction phase of the hydropower plant, it was determined that the initial route of the transmission line between the switchyard of the Gurara plant and the Mando substation should be altered. The new route is from the Gurara plant to the Kudenda substation. Despite the fact that the environmental impact analysis was performed based on the initial route, several key personnel at the FMoWR have asserted that the Kundenda substation is included in the initial route and as a result there was no need for the initiation of a new environmental impact assessment.

6.2 Project Rationale

The rationale for the Gurara hydropower project is provided in greater detail below.

6.2.1 Need for Increased Electricity Generation in Nigeria

Studies have shown the existence of a positive correlation between electricity supply and economic development. For several years, Nigeria has experienced stunted expansion of its electricity generation, transmission, and distribution capacity. This has resulted in the crippling of the country's key industries. In a country with a rapidly increasing population, this has served as a catalyst for high levels of unemployement and a general sense of frustration in the society.

In an effort to rectify this problem, the federal government has set an ambitious goal of generating at least 20,000MW of generating capacity by the year 2020. The Gurara hydropower project will contribute towards this objective through the generation of 30MW of hydro power.

6.3 Environmental Impacts

The environmental impact of this inter-basin water transfer project on vegetation and wildlife manifests from strong habitat changes that are inevitable in the execution of the project. There would be both positive and negative impacts on vegetation and wildlife within the envisaged reservoir and environs upstream of the dam; various impacts on both vegetation and wildlife along the pipeline route and the immediate downstream section of the Upper Gurara dam; and, finally, positive impact on vegetation and wildlife within the Lower Usuma dam and environs.

Specifically, this project would impact negatively on the vegetation in the future reservoir area when impoundment drowns plant species, reducing soil pH and the oxygen demand of decomposer and other aquatic organisms that would transform the aquatic environment to an anaerobic state. A large number of aquatic weeds such as *Polygonum salcifolium* and *Pistia stratoites* together with macrophytic aquatic plants would invade the periphery of the reservoir.

An increase in the ground water level would encourage dense vegetation characterized by rainforest species such as *Milicia exeloa and Khaya grandifolia* among others. This positive impact would translate to increased organic matter production, food and habitat for wildlife.

On wildlife, loss of habitat, drowning of weak, young and old animal species, and out migration of animals are some of the negative impacts of the reservoir. However, an increase in the population of aquatic animals is expected as a positive impact while the influx of disease vectors such as water snails, mosquitoes and simulin flies which transmit schistosomiasis, malaria and onchocerciasis, respectively, are some anticipated negative impacts to be associated with the reservoir.

The negative effect on downstream areas of the dam includes stream channel contraction downstream of the dam, blocking of fish migratory/breeding pathways and general moisture deficit for vegetation and wildlife around the contraction zone. For the pipeline route, 50m wide by 75km long, traversing Giwa forest reserve, through Chinka-Douphe-Gami, Bwari - Jigo - Peyi - Ushafa light forest reserve, the negative impact on vegetation includes clear felling of trees and other plant species and the opening up of forest reserves to more aggressive exploitation of vegetal resources on both sides of the pipeline route. The impact on wildlife would be negative because the pipeline route would obliterate wildlife breeding sites and sanctuaries and deplete food sources through fragmentation of landuse leading to out migration of endangered species.

Around the Lower Usuma dam, the impact would be positive as increased water level to be maintained year round would encourage an expansion of the forest size and northward shift in the forest frontier. Areas over Peyi, Jigo, Bwari and Ushafa would transform from light to heavy forest. Terrestrial wildlife would be unaffected in this section of the project area, while a higher population of fish, zooplankton, phytoplankton and macrophytes are expected to occur.

6.3.1 Mitigation Measures

To counter the negative impacts, the following mitigation measures have been implemented: resettlement and compensation of all affected communities; relocation and resettlement of old, weak and very young wildlife that are vulnerable to loss by drawning within the reservoir; ensuring minimum year round Gurara river flow downstream of the dam through sluice gates or water bye-pass; provision of such wildlife migratory pathway as fish bye-pass; regular clearing of water weeds from the reservoir; routing of pipeline to avoid deep penetration into forest reserves; policing of forests and involvement of local people through effective alliance in executing mitigation measures.

Success of the mitigation measures can only be achieved through an effective monitoring and evaluation (M & E) programme. Such sustained programme must have within its terms the necessary fieldwork, observations and recording of changes in the population and diversity of vegetation and wildlife over the project area and region. The programme would also determine if observed changes are due to GWTP, would co-opt local people in programme execution and use appropriate incentives to enlist the support of the people, particularly through local NGOs. The (M & E) programme must be conducted at least twice yearly, once each during the dry and rainy seasons.

6.4 Environmental Impacts of the Transmission Line

The status and sensitivities of the various ecological and socio-economic related components of the transmission line currently under construction were also assessed. A summary of the significant impacts that would result from the proposed project activities and their suggested mitigation measures are presented below.

Potential and Associated Impacts	Mitigation Measures
• Risk of road accidents due to increased traffic on local roads during mobilisation of heavy equipment	• The contractor's trucks should be properly serviced/maintained before mobilisation • The contractor should mobilise heavy duty trucks at night to avoid traffic delays/accidents • Outriders should be engaged and used during mobilisation of heavy duty trucks and equipment • Radio/TV announcements should be made to inform the general public of activities/movements
• Socio-cultural conflicts due to difference in customs of migrant workers and local residents	• The contractor should educate its workers on the socio-cultural norms of the host communities
• Changes in demographic pattern/disruption of socio-cultural pattern	• The contractor should establish a self sustaining base campsite to mitigate the contribution of its project workers to demographic changes • Impact on demographic/socio-cultural pattern is residual and shall be monitored
• Risk of electrocution and burns during	• The contractor should adopt work

welding activities	place procedures in line with standard industrial practice • Specialised personal protective equipment (PPE) should be provided for all on site workers
• Loss of land use by local people due to placement of towers	• The contractor should employ due process of land acquisition and compensations
• Permanent loss of economic trees along and within the vicinity of the ROW	• ROW creation shall be carried out in such a way as to minimise loss of economic trees outside the required width of the ROW. • Adequate compensations shall be paid • Land owners shall be assisted in the acquisition of improved varieties of economic trees for replanting in alternative lands
• Changes in community health due to influx of labour and secondary settlers	• Prior to mobilisation the contractor shall screen all personnel for communicable and other diseases • Health and safety awareness training sessions shall be conducted for personnel
• Potential of epidemiological problems to workers exposed to (and residents near to) transmission line generating electromagnetic field	• The contractor shall maintain the selected route for the transmission line (with minimal nearness from areas of human activity)
• Risk of collusion of airplanes with transmission towers and lines	• Markers shall be installed in order to minimise risk of low-flying aircrafts(used for routine operations in the area) colliding with towers and wires

• Risk of electrocution from accidental damage to transmission line wires	• Towers shall be installed following the best engineering standard • The contractor shall carry out routine inspection of towers in order to allow early detection of damaged towers • Reported cases of damaged or fallen towers shall be promptly attended to • Adequate and automatic fault/damage detection system shall be installed • Personnel shall be trained on the detection/handling of such emergencies arising from accidental damage
• Explosion and fire hazards at the Kudenda substation	• The contractor shall install specialized fire detection/prevention equipment at the substation • Personnel shall be trained on emergency fire/explosion handling procedures • The contractor shall design and maintain work place procedures in line with industrial standards
• Fatal electric shock and severe burns to workers during maintenance work	• The contractor shall use only trained and competent personnel for all maintenance works • Maintenance personnel shall be provided with appropriate PPE
• Direct poisoning of wildlife and vegetation/soil contamination due to uncontrolled application of maintenance chemicals	• The contractor should employ selective chemical application • Aerial broadcast methods should be avoided

The impact assessment of the transmission line under construction indicated that it would impact positively on the economy of Kaduna State, contribute to socio-economic development within host communities and result in economic empowerment for the indigenes and residents as well. The adverse impact of the proposed project on the environment are localised and can successfully be mitigated if the recommended measures are strictly followed. In addition, the Environmental Monitoring Plan developed should ensure that the procedures for managing the adverse impacts of the project as well as the implementation of the environmental and social commitments made are developed and sustained throughout the project lifecycle.

6.5 Environmental Monitoring Plan

Monitoring is required to ensure the positive and negative impacts of the project on the environment are measured and recorded as well as other unforeseen factors affecting the environment.

As a result, it is recommended that a monitoring unit be set up within FMoWR for the environmental management of the project. The unit should comprise of environmentalists, conservationists, social safeguard specialists and field technicians. It will liaise with project stakeholders and provide regular updates based on their assessment of the on-going project from collated field data.

7 Regulatory and Legal Requirements

The regulatory and legal requirements governing the Gurara hydropower project are discussed in the NIAF "Note on Regulatory and Legal Requirements."

8 Rationale for PPP/Risk Assessment

8.1 PPP Rationale

Public Private Partnership (PPP) is an agreement between the private sector and the public sector, for the rehabilitation, management, operations and maintenance of the existing infrastructure or the construction of new infrastructure, with sharing of risks between the two parties involved.

The Federal Government has emphasized its commitment towards ensuring a steady and improved power supply through the use of the water bodies in the country with potentials for the generation of hydropower. The Ministry is dedicated to the efficient use of the water resources available for the generation of power to stabilize the grid and also increased access to power in the country.

The Federal Ministry of Water resources constructed the Gurara Phase 1 Multi-purpose dam to increase the availability of electricity. Therefore, there is a need to partner with the private sector in providing the relevant technical and financial competence required in the management, operations and maintenance of the hydropower plant. Contractors were recently engaged for the construction of the transmission lines required to transmit the generated electricity to the Kudenda substation in Kaduna State. Government does not have a good track record in regards to the management, operations and maintenance of infrastructure in the country, and is therefore interested in transferring its role in the operations and maintenance of infrastructure in the country to the private sector, in order to improve service delivery and optimise the use of existing infrastructure.

The Gurara multi-purpose dam is a world-class project, built to specification with the water supply component as the social benefit of the dam project, and the hydropower and irrigation component required to provide jobs and value to the country, through the generation of electricity and the production of food to increase food security. The intention for the construction of the project was to reduce the financial burden expected from the private sector, thereby increasing its attractiveness and viability.

The proposed model for the concessioning of the hydropower component of the dam will require one concessionaire to take custody of the project for a period of time as determined by the financial analysis. The GWMA will be responsible for the overall management and maintenance of the dam, including the release of water to the different water users. The entire project cannot be concessioned to the private sector as a result of its social commitment to supplement the water need in the Lower Usuma Dam.

Under this form of PPP, the concessionaire will be responsible for the use of the asset in generating hydropower, and connecting to the transmission network made available by the Transmission Company of Nigeria (TCN) on behalf of the federal government to the sub station for distribution. The concessionaire will be required to carryout the following activities:

- Use the available hydropower plant to generate power
- Make payment to Integrated Water Resources Management Commission (IWRMC)

- Pay concession fees

8.2 Risk Management

The effective management of risks for PPP projects determine the profitability and sustainability of the projects. Risk is the likelihood of an event that could lead to a negative effect on the project, on the structure of the project or the overall operations, which will have an effect on the revenue generation. This involves the identification of likely events and risks that can affect the project, assessment of the effects and possible mitigation measure and allocation of the identified risk to the party best suitable to manage the risk.

Risks allocations and sharing is a major difference between the traditional form of procurement and PPP form of procurement. The need to carryout a detailed assessment of possible risks in the country before engaging with the private sector is to ensure that the federal government employs all measures required to mitigate the unexpected. The implementation of any form of PPP includes risk sharing between the public and the private sector, meaning both parties have roles to play in the success of the project. The risk management section of the report will review the likelihood of unexpected events that affect the project either negatively or positively. Considering investments in infrastructure is a promise for service delivery of a specific product, it is critical to thoroughly review all factors capable of preventing the desired benefits. There are several steps involved which have been categorised in the steps below:

Step 1: Risk Identification

Step 2: Risk Assessment

Step 3: Risk Allocation

8.2.1 Risk Identification

Risk identification is an attempt to ascertain and outline possible risks that can affect the generation and evacuation of hydropower from the Gurara Phase 1 project. There are some standard risks that affect infrastructure project, some specific to the water sector and others to power generation. The Gurara Phase 1 project, which was constructed for multi-purposes - raw water supply, hydropower generation and irrigation - automatically poses great risk in the management of the different users and the water demand.

The successful generation of hydropower is tied to the timely availability of water for use; however, the same timely demand is required for the other components of the dam. The supply of raw water to the FCT, which is the main purpose for the construction of the dam is a social need that cannot be ignored or controlled, due to the increasing demand of the water users and growth in the country's capital. The concessionaire must be able to take into consideration these risks that will be addressed in this section of the report and other potential risks that might surface during the final handover of the project. The site engineer and contractors are currently working on the project, with the expectation to handover the project and its supporting component to the concessionaire in December 2014.

Several categories of risks have been listed below, which will be further broken down in the next section:

- Project Risk
- Financial Risk
- Operational Risk
- Legal Risk; and
- Other Risk

8.3 Risk Assessment

Following the list of possible risk identified in the previous section, it is necessary to understand the impact of each risk and its liability on the parties involved. The Risk Assessment of a PPP project is the process of thoroughly evaluating the risks factors under the different categories listed in the risk identification process. The Gurara I hydropower project has great value addition to the power sector in the country, even though it is a competing user of the dam reservoir; the project is still considered to be of high priority to the economy. This assessment helps protect the federal government and the private sector from the complex risk situations that could limit the benefits of the project and affect the expected output of energy generated and transmitted.

8.3.1 Project Risk

This category of risk refers to the uncertainty of the occurrence of certain events that are unique to the project, with the possibility of impacting negatively on the project. The nature of the infrastructure being considered for PPP attracts certain risks that are limited to the project. The Gurara Phase 1 Multipurpose dam has several fully completed components, with outstanding construction work required for the transmission lines for the hydropower component. There are a number of risks that have been identified to have an impact on the project under this category:

Design and Construction Risk: This is the risk associated with the delay in the design and construction of the infrastructure, either due to poor expertise employed in preparing the design leading to a major draw back during the construction phase, therefore leading to an extended project completion timeline and an increase in the contract cost.

The design and construction of the project has been fully carried out by the federal government, with the transmission network on-going which is expected to be completed in December 2014. The federal government has been responsible for all the construction work on the site to reduce the risk allocated to the private sector. An external contractor was engaged to prepare the design of the project with the competence and track record for the design and construction of similar projects in the country and other parts of the world. The firm carried out the design, which led to further engagement for the construction of the project. Presently the project has been constructed, with transmission line construction ongoing for the evacuation of the generated power to the sub station.

The federal government accepted this risk and provided a world-class structure for the generation of power. The project was completed in 2011, has never been used for the generation of hydropower as this was stalled due to the delay in the construction of the transmission component, which is currently being constructed. This risk has been mitigated by the Federal government and will not be shared with the private sector.

Land Acquisition Risk: The Federal government acquired the land around the Gurara phase 1 multipurpose dam before the construction of the project started. The Gurara Water Management Authority engaged the community and compensated the affected communities as a result of the construction of the dam. The land acquisition and compensation of the transmission lines corridor are currently on-going with the Kaduna state government providing assistance. This is critical to the completion of the lines, and also to the safety of the community currently living around the corridor.

The federal government has mitigated this risk, with its timely response in the acquisition and compensation of land for the Gurara 1 Multipurpose project and the transmission line.

Environmental and Social Impact Assessment (ESIA) Risk: This is the risk and uncertainty of adverse impacts resulting from the construction and operations of the project, as a result of pollution and other environmental hazards. The environmental and social impact of the project was considered before the design was finalised to determine the possible positive and negative impacts expected from the construction of the project in the proposed location. The assessment carried out in 2001 was thorough and determined the site was suitable for the construction and operation of the dam, and the different components, including the generation of hydropower. Several recommendations were made focused on providing additional value to the community for the construction of the project, including the access to 5MW of electricity and following the successful installation of a transformer and a substation, the construction of a school and other facilities.

This risk has been mitigated by the ESIA studies prepared, the proposed mitigation measures proposed before the construction of the project and the social benefits currently being enjoyed by the local community since the construction of the project started. The federal government is about to prepare a post environmental study on the project to assess the current positive and negative impacts of the project as built to ensure the smooth operations of the project, taking into consideration the status of the project when the initial ESIA was prepared.

Water Guarantee Risk: Water is the life of the project, without which no megawatt of hydropower can be generated from the use of the plant. The water guarantee is critical to the success of the project and is therefore a major risk that must be addressed to ensure the constant supply and release of water for hydropower generation. The federal government carried out several studies on the dam reservoir capacity and the different water users. The results of the studies proved to be positive, and confirmed the dam's capability of meeting the water demand on the different components, taking into consideration the expected drought in the northern parts of the country.

This risk has been mitigated by the studies prepared to determine the availability of water and ability to meet the water demand. However, there is a priority list of water supply in the event of a shortage, which is not anticipated due to the water flow rate. The concessionaire will sign a water rights agreement with the Nigeria Integrated Water Resources Management Commission (NIWRMC) for the use of water. This water license will include guidelines and the priority for water sharing in the event of shortage of water in the dam for different users.

8.3.2 Financial Risk

This risk refers to the inability of the concessionaire to propose a suitable financial structure for the funding of the management, operations and maintenance of the hydropower components, thereby leading to a difficulty in reaching financial close. The concessionaire is required to provide a suitable source of finance capable of sustaining the operations of the project to guarantee revenue generation. The federal government will transfer this risk to the private sector upon signing the concession agreement and the concessionaire will be responsible for following risks and activities:

- Foreign exchange rate risk;
- Increase in the local and international tax rate risks;
- Project cost estimates;
- Market risks

The federal government will not accept the market/demand risk of this project; this will be mitigated by the concessionaire. Consequently, the concessionaire is required to carry out its own surveys before signing the concession agreement with the government.

8.3.3 Operations and Maintenance Risk

The effective operations and maintenance of any infrastructure determines the sustained output over the life of the asset. This risk can occur either from the increased cost of operations and maintenance of the asset or the lack of the required skill and poor managing of the activities involved in hydropower generation. The concessionaire of the hydropower plant will be expected to sign a management, operations and maintenance contract with the project sponsors, and accept full responsibility of these functions with little or no contribution from the government due to the funds already invested in the project. During the concessionary period, the operator is expected to source for its own funding to meet the financial and the technical expertise required to carry out these functions.

This risk will be transferred to the private sector immediately the concession agreement is signed with the private partner. In addition, there are other risk factors that have been identified that could affect the optimum use of the asset:

Performance Risk: This risk is linked to the construction of the project, which can affect the smooth operations of the hydropower plant either due to an error in the construction of the power plant, the transmission lines or the required technical expertise required for the timely generation of hydropower, thereby leading to a failure in meeting its business justification. The occurrence of the risk can reduce the desired generation output of the plant, which has a major effect on the projected revenue.

This risk will be transferred to the concessionaire, as the federal government lacks the required skills and expertise to manage and guarantee performance of the plant. As a result, the concessionaire will be required to provide the required technical and financial skills to effectively manage the performance of the project.

Technical Loss Risk: This is a risk of a technical loss in the generation of power and the transmission to the Kudenda sub station located in Kaduna State. These losses can be assumed to occur as a result of the following activities involved in the generation of hydropower:

- Losses from the generator inadequacies
- Losses from the water energy as a result of the wall friction
- Losses from the use of the turbine in generation, which is recorded as very low as turbines have a capacity of at least 95%.
- Losses occurring between the turbines and the generators
- Losses from the transformer and other sources
- Losses occurring from the unavailability or the reduction in the supply of water for generation
- Reduction in generation capacity as a result of a breach in the dam reservoir

Although these losses have been highlighted, hydropower systems have proved to have high efficiencies of at least 90%. The Francis turbines, which is the type of turbine installed in the Gurara site for the generation of hydropower has an efficiency of 95% regardless of the losses. There are certain protection measures that are inbuilt in the system for immediate shutdown of the plant in the event of a major damage in the turbines. The concessionaire will be responsible for mitigating this risk due to its technical competence and its knowledge and track record of the use of a similar hydropower plant(s).

8.3.4 Legal and Regulatory Risk

This is the risk of unexpected changes in the legislation and policies governing the sector and country, as it affects the use of water from the dam for the generation of hydropower. The unexpected changes will affect the concessionaire's ability to effectively manage, operate and maintain the dam. This projects cuts across the water sector and the power sector of the country, which might be difficult to manage, as the water sector manages the use of water either for water supply, irrigation, and hydropower generation, while the power sector manages the pricing, transmission and use of electricity in the country. The legal environment of the country supports partnership with the private sector, following the creation of the Infrastructure Concession Regulatory Commission (ICRC), which reserves the right to manage and monitor all concessions in the country.

The federal government created the commission with the establishment of the Act in 2005 to increase the confidence of the private investors in the economy. Following the successful empowerment of the commission, it has played an active role in all the concessions since its creation. However, the concessionaire will be responsible for this risk, as the federal government will not give any guarantees in relating to the creation of new policies and laws required to improve the sector and economy. Often associated with this risk is:

Political Risk: This is the risk of favouritism and the pursuit of personal interest over the interest of the general public as it affects infrastructure development in the country. Sometimes, this might include the introduction of new policies, which is as a result of a change in leadership. The ICRC plays a major role in the protection and monitoring of contract compliance of all concessions, therefore this will be a shared risk between both parties involved in the occurrence of this event.

8.3.5 Other Risks

Force Majeure

This is an unexpected risk, which is usually caused by unforeseen and unpredictable events that are related to nature and cannot be avoided. These events which are usually referred to as acts of God, cannot be mitigated, as they are often random and occur as natural disasters including; tornadoes, floods, and earthquakes which could cause major damages to the project. This risk cannot be mitigated by the federal government or the private party alone, but will be shared by both parties involved.

Ownership Transfer Risk

This is the risk of dilapidated and condemned assets being transferred to government after the concession period. The concession contract will include the ownership transfer terms and conditions to protect the government from the risk of receiving assets in such state after the expiry of the concession contract. It will be necessary to include incentives and also penalties for the concessionaire's ability to meet the terms and conditions for the transfer of the asset.

8.4 Risk Allocation

This section of the report represents the risk matrix of the risk identified and the risk assessed in the previous section of the report. The risk matrix will show the different categories of risk and the risk factors.

8.4.1 Risk Matrix

The risk matrix of the different categories will show the risk factor, a brief description of the risk factor, the risk bearer – the party liable for the risk, the risk probability (indicating the degree – either high, low or moderate), and the proposed mitigation measures for the parties involved.

Project Risk Category

Risk Factor	Description	Risk Bearer	Risk Probability	Mitigating Measures
Design and Construction Risk	This is the risk associated with the delay in the design and construction of the infrastructure, either due to poor expertise employed in preparing the design resulting in major draw backs during the construction phase, thereby leading to an extended project completion timeline and an increase in the contract cost	Public Sector	Low	The federal government has already mitigated this risk, by the construction of the dam reservoir, hydropower plant and its components.
Land Acquisition	This is the risk associated with the acquisition of the land required to effectively perform required functions without any conflict form the host community, due to displacement from their settlement as a result of the project.	Public Sector	Low	The Federal Government has already acquired the land from the community and paid the required compensation before the construction work started.

ESIA Risk	This is the risk of unexpected environmental hazard from the environment and the community	Public Sector	Low	The Federal Government has prepared an Environmental and Social Impact Assessment on the project, which was carried out before construction commenced on the project. The construction included schools and other facilities, which are already being used by the community.
Water Guarantee Risk	This is the risk associated with the availability of water for the generation of hydropower.	Private Sector	Low	The Federal Government prepared a flow study on the Gurara River to confirm its ability to meet the water demand for raw water supply to the FCT, hydropower generation and irrigation farming – which came back with a positive result leading to the construction of the plant.

Financial Risk

Risk Factor	Description	Risk Bearer	Risk Probability	Mitigating Measures
Financial risk	This is the risk of the project not reaching financial closure and meeting its financial obligations due to the proposed financial structure.	Private Sector	High	The concessionaire must propose a suitable financial structure to mitigate this risk.

Operational Risk

Risk Factor	Description	Risk Bearer	Risk Probability	Mitigating Measures
Operations & Maintenance Risk	This risk is associated with the operation and maintenance of the project to ensure effective utilisation of the asset.	Private Sector	High	The concessionaire is expected to house the required expertise required to effectively operate and maintain the power plant and its components to ensure maximum benefits from the project.
Performance Risk	This is the risk that the hydropower plant will not function effectively to produce the required megawatts of electricity, therefore leading to a failure in meeting its business justification.	Private Sector	Moderate	The concessionaire is expected to house the required expertise for the effective utilisation of the asset, taking into consideration the technology used in the construction and the type of turbine.
Technical Loss Risk	This is the risk of a loss of power either from the unavailability of water to generate power or losses due to the poor management and use of the turbines and generators.	Private Sector	Moderate	The concessionaire is expected to maximise the use of the asset, and adhere strictly to the scheduled maintenance plan to prevent these losses.

Legal Risk

Risk Factor	Description	Risk Bearer	Risk Probability	Mitigating Measures
Legal & Regulatory Risk	This is the risk of unexpected changes in the legislation and policies governing the sector and country, as it affects the use of water from the dam for the	Private Sector	Moderate	The Federal government cannot bear any guarantee for this risk, but the

	generation of hydropower.			establishment of the ICRC with its roles and power allows it to manage and monitor all concessions, with the view to protecting all parties involved.
Political Risk	This is the risk of favouritism and the pursuit of personal interest over the interest of the general public as it affects infrastructure development in the country	Public & Private Sector	High	The ICRC will play a major role here, but in the event of this risk, both parties will be liable.

Other Risk

Risk Factor	Description	Risk Bearer	Risk Probability	Mitigating Measures
Force Majeure	This is an unexpected risk, which is usually caused by unforeseen and unpredictable events that are related to nature and cannot be avoided.	Public & Private Sector	Low	This risk cannot be mitigated, but both parties will share the risk in the event of any unforeseen natural disaster.
Ownership Transfer Risk	This is the risk of dilapidated and condemned assets being transferred to government after the concession period	Private Sector	Moderate	The Federal government will prepare the terms and conditions of the handover of the asset, and include it the concession agreement.

9 PROJECT MANAGEMENT STRUCTURE

9.1 Pre-Concession Team

The pre-concession team, includes the various stakeholders working together towards engaging the private sector, including the following:

- Project Delivery Team
- Project Steering Committee

9.1.1 The Project Delivery Team

The project delivery team is made up of representatives from the different stakeholders. The representatives nominated are usually technical officers with broad knowledge of the project and sector. They will be involved in the daily activities of the project and work towards the attainment of the project's objectives.

Proposed Members of the Project Delivery Team

- The PPP Unit, FMoWR – Head of the Project Delivery Team
- Representatives from the Department of Dams (FMWR)
- Representatives from the Federal Ministry of Power (FMoP)
- Representative from the Federal Ministry of Finance (FMoF)
- Representatives from the Federal Ministry of Environment (FME)
- Representatives from the Gurara Water Management Authority (GWMA)
- Representative from the Infrastructure Concession Regulatory Commission (ICRC)
- Representatives from the Nigerian Electricity Regulatory Commission (NERC)
- Representatives from the Transmission Company of Nigeria (TCN)

9.1.2 The Project Steering Committee

The Project Steering Committee is made up of leadership of the various stakeholders being represented on the Project Delivery Team. The committee is not involved in the daily or weekly activities of the project, but is required to hold meetings when necessary to receive updates on the progress of the concession, to ensure and provide overall guidance to the project and issue the necessary approvals.

This committee is critical and must ensure that the assigned tasks are carried out in the highest degree of professionalism, quality and integrity through open and transparent mechanisms.

Proposed Members of the Project Steering Committee

- Chairman of NERC
- Head of GWMA
- Managing Director of TCN
- Minister of Water Resources
- Minister of Finance
- Minister of Environment
- Minister of Power
- Director General, ICRC

10 Financial Assessment

10.1 Introduction

This section of the report presents the inputs and general parameters that form the basis of the financial appraisal of the Gurara I Power Project. It also presents the resulting financial forecasts demonstrating the financial viability of the project. To provide a sufficient basis for investment appraisal, the financial model covers a 20-year explicit forecast period from 2015 to 2034.

The model's tariff revenues are based on the provisions for Large Hydro plants in NERC's Multi-Year Tariff Order (MYTO). The Gurara financial model is built around NERC's MYTO financial model (for generation) in order to maintain consistency with regulatory requirements and also to increase the likelihood of tariff and PPA approval by NERC.

The tariff methodology used in the Nigerian market is called the Long Run Marginal Cost (LRMC) method. LRMC involves calculating the full life cycle cost of the lowest-efficient-cost new entrant generator, taking into account current costs of plant and equipment, return on capital, operation and maintenance, fuel costs, etc.

10.2 Assumptions

This sub-section of the report details the technical, commercial and operational assumptions used in the financial analysis of the project. With the exception of the final sub-heading, the following sub-headings discuss the parameters used for the projected financial statements and analysis. The final subheading provides the MYTO assumptions used for tariff calculations and highlights any deviations therein.

10.2.1 Macroeconomic Parameters

Nigerian inflation, US inflation and the Naira/USD exchange rate have been set at values corresponding to those published by NERC in the June 2014 Minor Review of tariffs i.e. 8% and N158.7/$1 respectively. The MYTO framework uses 2011 as its base year and different costs are inflated using the relevant rates depending on whether they are denoted in Naira or USD. It is expected that macroeconomic parameters will be adjusted in the PPA at least as often as NERC adjusts the tariff i.e. semi-annually.

10.2.2 Taxation

The financial forecasts take into consideration the current corporate tax rate of 30% and education tax rate of 2% on the taxable profits of companies operating in Nigeria. It is assumed that all set-up costs and other expenses are inclusive of Value Added Tax at 5%.

Companies Income Tax Act (CITA) allows "pioneer" industries, of which the power sector belongs to, a 3 year tax holiday which may be renewed for another two years (subject to approval upon application). The current scenario conservatively assumes only the first three years tax holiday is granted. CITA also provides for a 90% capital allowance charge in the first taxable year and 10% at the end of the project.

10.2.3 Reporting Currency

The project's functional currency shall be the Naira (N) and its financial projections have been prepared in the same currency. Free cash flow to equity and the resulting NPV and IRR calculations have also been presented in USD for convenience.

10.2.4 Funding

MYTO allows what it calls a "Large Hydro" plant i.e. a plant with 30MW capacity or higher, to recoup a capital cost of $1800/kW in the tariff. Figures for actual capital expenditure from the Ministry of Water Resources (detailed below) were used to arrive at a capital cost of $1403/kW.

Cost component	**Naira amount**
Civil works and equipment	4,188,982,058
Transmission line and ancillary works	2,490,306,917

MYTO assumes a debt to equity ratio of 70:30 and this has been maintained for this project. It allows nominal pre-tax return of 18% and 23% for debt and equity respectively which equates to a WACC of 20%.

10.2.5 Staffing

Staffing levels have been based on what is typically expected in similar projects in the Nigerian context. Labour rates are also based on NIAF research on similar recent projects in Nigeria. A breakdown of the annual labour costs is provided below.

TYPE	**QUANTITY**	**SALARY (USD)**	**SALARY (N)**
Plant Manager	1	44,000	6,600,000
Accountant	1	24,000	3,600,000
Plant Engineer	1	32,000	4,800,000
Asst. Engineer	1	24,000	3,600,000
Shift Supervisor	3	60,000	3,000,000
Electrical Technician	2	32,000	2,400,000
Mechanical Technician	2	32,000	2,400,000
Maintenance Technicians	3	48,000	2,400,000
Shift Support	3	43,200	2,160,000
Office Aid	1	12,000	1,800,000
Janitorial	3	28,800	1,440,000
Driver	2	12,800	960,000

Totals	**23**	**392,800**	**35,160,000**

A multiplier of 1.3 is applied to account for the costs of staff benefits that are separate from salaries.

10.2.6 Debtors and Creditors

It has been assumed that there will be payables and receivables of 30 days each at the end of every financial year.

10.2.7 Non-Labour Operations & Maintenance (O&M) Costs

O&M costs have been tentatively set using an industry rule of thumb from the International Energy Agency. It is expected that O&M costs range from 0.5% to 4% of investment costs. The calculation here assumes the higher figure of 4%.

Note: The investment costs used are those provided by NERC as "efficient" capital costs, not the Ministry's actual capital expenditure.

10.2.8 Technical Parameters for Tariff Revenue Calculation

The parameters in the table below are obtained primarily from the MYTO Generation Order which defines "large hydro" as a plant with 30MW capacity or higher. These are the parameters used to calculate the expected tariff revenue. It should be noted that the MYTO assumptions have been retained with the exception of plant capacity factor and capital costs where actual figures have been used. Plant capacity factor in MYTO is 65% however the Gurara plant was designed to have a capacity factor of 44% hence this has been used in the tariff calculation. As discussed in the 'Funding' subsection of this document, actual capital costs were $1403 rather than $1800.

	Description	Units	Large Hydro
1	Installed capacity	MW	≥30
2	Capital cost	US$/kW	1,403
3	O&M Cost (Fixed)	NGN/MW/Yr	2,217,000
4	O&M Cost(Variable)	NGN/MWh	140
5	Plant Capacity Factor	%	44%
6	Auxiliary Requirement	%	1
7	Economic life	Year	40
8	Construction period	Year	4
9	Sent-out efficiency	%	100
10	Fuel costs	$	-

10.3 Calculated Tariff

The output of the MYTO model provided the following tariffs:

	2015	2016	2017	2018	2019
Wholesale Contract Price (N/MWh)	13,295	14,346	15,482	16,710	18,036
HYPADEC charge (N/MWh)	1,329	1,435	1,548	1,671	1,804
Wholesale including HYPADEC (N/MWh)	14,624	15,781	17,031	18,381	19,840
Capacity Charge (N/MWh available)	11,875	12,812	13,824	14,918	16,099
Energy Charge (N/MWh)	2,749	2,969	3,207	3,463	3,740

The Wholesale Contract Price incorporates the allowed costs and rate of return for the project according to the tariff methodology. The HYPADEC charge fulfils a provision of the HYPADEC (Hydro-Electric Producing Areas Development Commission) Act (2012) which requires 10% of revenues to be paid to the HYPADEC in order to tackle environmental and community issues linked to operations. This has been calculated as a charge that is over and above the generator's revenues and is to be paid by the buyer of the energy produced.

In practice, the total Wholesale Contract Price is divided into a capacity and an energy charge. The capacity charge comprises fixed operation and maintenance cost, capital cost and two-third of tax (2/3) cost. While the energy charge comprises variable operation and maintenance cost, the transmission loss cost and a third (1/3) of tax cost. The capacity and energy charge will be included in the wholesale contract (PPA) and will be the basis for payments by the buyer.

10.4 Performance Summary

10.4.1 Overview of Project Performance

Year of Operation	Year 1	Year 3	Year 5	Year 7	Year 9	Year 10
Total Revenues (N' million)	1,658	1,931	2,249	2,621	3,055	3,299
EBIDTA (N' million)	1,179	1,386	1,629	1,914	2,248	2,436
Profit After Tax (N' million)	(89)	128	387	695	1,062	1,271
Cash Balance (N' million)	219	965	2,178	3,939	6,342	7,370
Debt Service Coverage Ratio (DSCR)	1.40 : 1	1.65 : 1	1.93 : 1	2.67: 1	2.66 : 1	2.88 : 1

10.4.2 Project Return on Investment, Net Present Value (NPV), Internal Rate of Return (IRR) & Pay Back Period

Free cash flows to equity are the cash amounts available to providers of equity finance after all debt funding requirements have been met. These cash flows are then discounted at the cost of capital to determine the Net Present Value (NPV).

The free cash flows generated during the 20 year explicit forecast period were discounted by the cost of capital of 20% for the Naira figures and 11% for the equivalent USD figures. The Internal Rate of Return (IRR) and the Payback Period for the projected are also presented below.

Summary	Scenario
Assumed Project Cost/Capex (N)	6,679,288,975
NPV (N) @ 20%	1,303,750,618
Equity IRR (%)	29%
Payback Period	10 years

11 Conclusion

In conclusion, the Gurara hydropower project is a viable candidate for concessioning through PPP. In comparison to proceeding with the untenable public sector route, the PPP option should deliver improved services and better value for money primarily through the appropriate transferring of risk, leveraging of private sector innovation, greater asset utilisation and an integrated life-cycle management, underpinned by private financing.

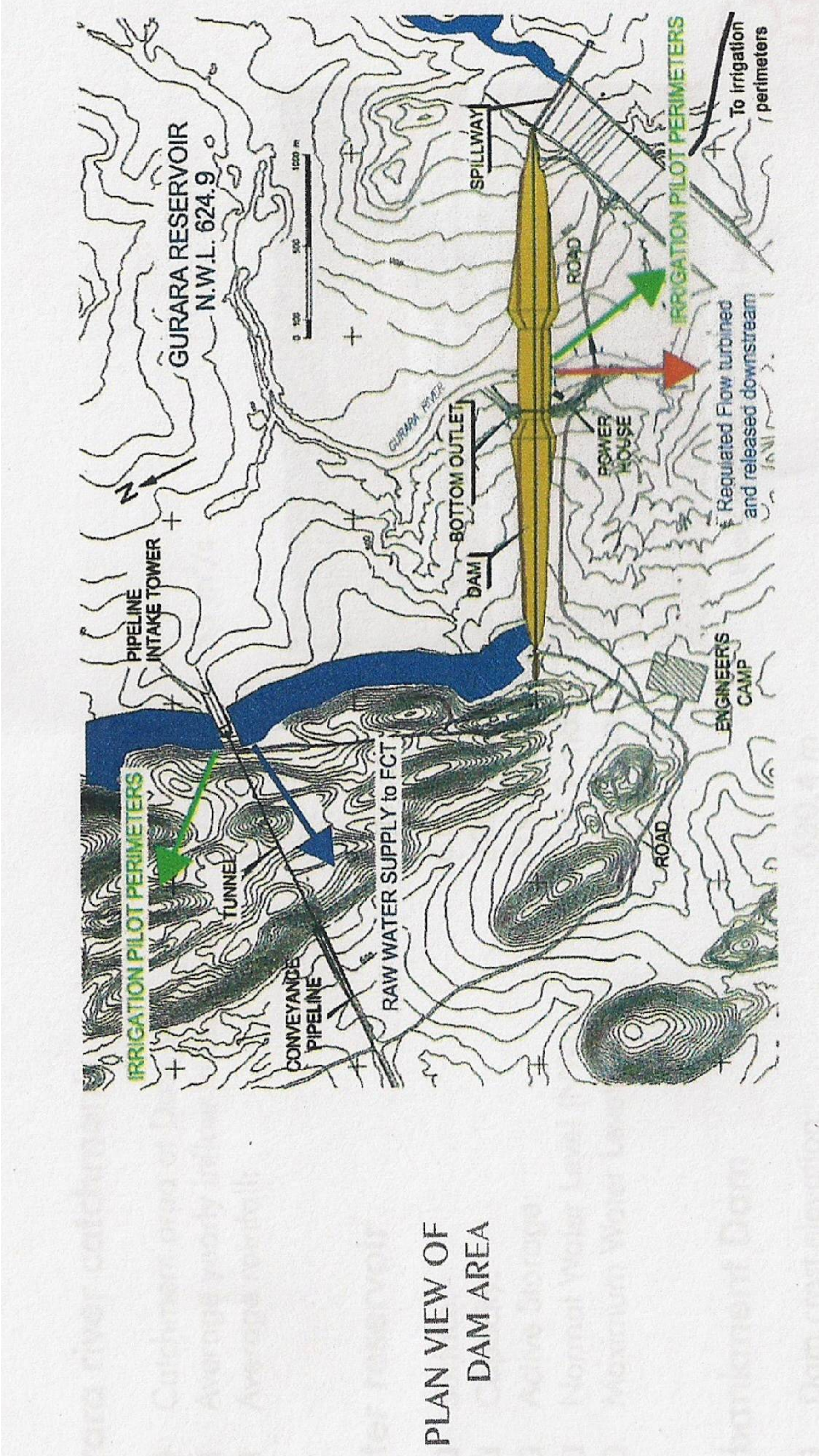
The PPP option would facilitate the effective utilisation of the best available skills, knowledge and resources. As a result, the FMoWR can focus its efforts on the delivery of core services, and use the savings generated to improve or expand other services.

ANNEXURES

ANNEX 1: SUMMARY ON THE HYDROPOWER COMPONENTS

Pictures of the Turbines, Plant, Generating set, Penstock and the intake tower (hydro)

ANNEX 2: PLAN VIEW OF THE DAM AREA



3: FINANCIAL ANALYSIS - SCENARIO "PROJECT CASH FLOWS"

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
GWh		113.4	113.4	113.4	113.4	113.4	113.4	113.4	113.4	113.4	113.4	113.4	113.4	113.4	113.4
N/MWh		11874.6	12811.8	13824.1	14917.7	16099.1	17375.3	18754.2	20243.9	21853.5	23592.7	25471.9	27502.6	29696.9	32068.2
		2749.4	2969.2	3206.6	3463.2	3740.4	4040.1	4363.8	4713.8	5091.9	5500.6	5942.3	6419.6	6935.5	7493.1
N/MWh		14624.0	15780.9	17030.7	18380.9	19839.5	21415.4	23118.0	24957.7	26945.4	29093.3	31414.2	33922.2	36632.4	39561.3
		1,346,542,137	1,452,816,228	1,567,612,666	1,691,620,446	1,825,584,490	1,970,310,197	2,126,668,366	2,295,600,511	2,478,124,616	2,675,341,357	2,888,440,832	3,118,709,834	3,367,539,721	3,636,434,927
		311,777,018	336,694,439	363,619,413	392,714,352	424,154,836	458,130,678	494,847,086	534,525,905	577,406,974	623,749,581	673,834,048	727,963,431	786,465,374	849,694,098
		1,658,319,155	1,789,510,667	1,931,232,080	2,084,334,798	2,249,739,325	2,428,440,875	2,621,515,452	2,830,126,416	3,055,531,589	3,299,090,938	3,562,274,880	3,846,673,265	4,154,005,095	4,486,129,025
	4,675,502,282														
	2,003,786,692														
		106,868,624	111,143,369	115,589,103	120,212,667	125,021,174	130,022,021	135,222,902	140,631,818	146,257,091	152,107,374	158,191,669	164,519,336	171,100,110	177,944,114
		160,302,935	172,806,564	186,285,476	200,815,744	216,479,372	233,364,763	251,567,214	271,189,457	292,342,234	315,144,929	339,726,233	366,224,879	394,790,420	425,584,072
		45,708,000	47,536,320	49,437,773	51,415,284	53,471,895	55,610,771	57,835,202	60,148,610	62,554,554	65,056,736	67,659,006	70,365,366	73,179,981	76,107,180
		165,831,915	178,951,067	193,123,208	208,433,480	224,973,933	242,844,088	262,151,545	283,012,642	305,553,159	329,909,094	356,227,488	384,667,327	415,400,510	448,612,902
		960,144,928	960,144,928	960,144,928	960,144,928	960,144,928	960,144,928	960,144,928	960,144,928	960,144,928	960,144,928	960,144,928	960,144,928	960,144,928	960,144,928
		-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	448,644,694	587,326,183	667,786,864	756,060,215	853,022,290
	6,679,288,975	1,438,856,402	1,470,582,248	1,504,580,488	1,541,022,102	1,580,091,301	1,621,986,570	1,666,921,791	1,715,127,454	1,766,851,966	2,271,007,755	2,469,275,507	2,613,708,700	2,770,676,162	2,941,415,487
	(2,003,786,692)	219,462,752	318,928,420	426,651,591	543,312,696	669,648,024	806,454,305	954,593,661	1,114,998,962	1,288,679,623	1,028,083,183	1,092,999,373	1,232,964,566	1,383,328,933	1,544,713,538
	(2,003,786,692)	219,462,752	318,928,420	426,651,591	543,312,696	669,648,024	806,454,305	954,593,661	1,114,998,962	1,288,679,623	1,028,083,183	1,092,999,373	1,232,964,566	1,383,328,933	1,544,713,538
20%															
1,303,750,618															
29%															
	(12,626,255)	1,317,027	1,822,794	2,322,355	2,816,539	3,306,155	3,791,989	4,274,807	4,755,357	5,234,369	3,977,025	4,026,806	4,326,155	4,622,614	4,916,101
11%															
13,878,412															
23%															
debt		1,345,439,596	1,458,024,414	1,579,919,727	1,711,891,104	1,854,766,885	2,009,443,321	2,176,890,134	2,358,156,531	2,554,377,710	2,766,781,899	2,996,697,972	3,245,563,684	3,514,934,585	3,806,493,658
DSCR		1.401288031	1.518546182	1.6455013	1.782950734	1.931757207	2.092854175	2.26725161	2.456042273	2.660408482	2.881629448				
LLCR		0.995479543	1.084458333	1.182628539	1.291350749	1.412310833									

4: Financial Analysis - SCENARIO "Income Statement"

	2014	2015	2016	2017	2018	2019	2020	2021
		1,346,542,137	1,452,816,228	1,567,612,666	1,691,620,446	1,825,584,490	1,970,310,197	2,126,668,366
		311,777,018	336,694,439	363,619,413	392,714,352	424,154,836	458,130,678	494,847,086
		1,658,319,155	1,789,510,667	1,931,232,080	2,084,334,798	2,249,739,325	2,428,440,875	2,621,515,452
		106,868,624	111,143,369	115,589,103	120,212,667	125,021,174	130,022,021	135,222,902
		160,302,935	172,806,564	186,285,476	200,815,744	216,479,372	233,364,763	251,567,214
		45,708,000	47,536,320	49,437,773	51,415,284	53,471,895	55,610,771	57,835,202
		165,831,915	178,951,067	193,123,208	208,433,480	224,973,933	242,844,088	262,151,545
s		478,711,474	510,437,320	544,435,560	580,877,175	619,946,373	661,841,642	706,776,863
		1,179,607,680	1,279,073,348	1,386,796,519	1,503,457,624	1,629,792,952	1,766,599,233	1,914,738,589
		0						
		333,964,449	333,964,449	333,964,449	333,964,449	333,964,449	333,964,449	333,964,449
		845,643,232	945,108,899	1,052,832,070	1,169,493,175	1,295,828,503	1,432,634,785	1,580,774,140
		935,100,456	930,091,562	924,080,889	916,868,081	908,212,712	897,826,269	885,362,537
		(89,457,225)	15,017,337	128,751,181	252,625,094	387,615,791	534,808,516	695,411,603
		-	-	-	-	-	-	-
		(89,457,225)	15,017,337	128,751,181	252,625,094	387,615,791	534,808,516	695,411,603
		(89,457,225)	(74,439,888)	54,311,293	306,936,387	694,552,179	1,229,360,695	1,924,772,298

	2022	2023	2024	2025	2026	2027	2028
	2,295,600,511	2,478,124,616	2,675,341,357	2,888,440,832	3,118,709,834	3,367,539,721	3,636,434,927
	534,525,905	577,406,974	623,749,581	673,834,048	727,963,431	786,465,374	849,694,098
	2,830,126,416	3,055,531,589	3,299,090,938	3,562,274,880	3,846,673,265	4,154,005,095	4,486,129,025
	140,631,818	146,257,091	152,107,374	158,191,669	164,519,336	171,100,110	177,944,114
	271,189,457	292,342,234	315,144,929	339,726,233	366,224,879	394,790,420	425,584,072
	60,148,610	62,554,554	65,056,736	67,659,006	70,365,366	73,179,981	76,107,180
	283,012,642	305,553,159	329,909,094	356,227,488	384,667,327	415,400,510	448,612,902
s	754,982,526	806,707,038	862,218,133	921,804,396	985,776,908	1,054,471,019	1,128,248,269
	2,075,143,890	2,248,824,551	2,436,872,805	2,640,470,484	2,860,896,358	3,099,534,076	3,357,880,756
	333,964,449	333,964,449	333,964,449	333,964,449	333,964,449	333,964,449	333,964,449
	1,741,179,441	1,914,860,102	2,102,908,357	2,306,506,035	2,526,931,909	2,765,569,627	3,023,916,307
	870,406,059	852,458,285	830,920,956	805,076,162	774,062,408	736,845,905	692,186,100
	870,773,382	1,062,401,818	1,271,987,400	1,501,429,873	1,752,869,500	2,028,723,723	2,331,730,207
	-	-	448,644,694	587,326,183	667,786,864	756,060,215	853,022,290
	870,773,382	1,062,401,818	823,342,706	914,103,690	1,085,082,637	1,272,663,508	1,478,707,917
	2,795,545,680	3,857,947,498	4,681,290,204	5,595,393,895	6,680,476,531	7,953,140,039	9,431,847,956

5: Financial Analysis – Scenario "Balance Sheet"

	2014	2015	2016	2017	2018	2019
t	6,679,288,975	6,345,324,526	6,011,360,077	5,677,395,629	5,343,431,180	5,009,466,731
	-					
	-	219,462,752	538,391,172	965,042,763	1,508,355,459	2,178,003,483
		-	-	-	-	-
	6,679,288,975	**6,564,787,279**	**6,549,751,250**	**6,642,438,392**	**6,851,786,639**	**7,187,470,215**
		0	0	0	0	0
ty						
	2,003,786,692	2,003,786,692	2,003,786,692	2,003,786,692	2,003,786,692	2,003,786,692
	4,675,502,282	4,650,457,811	4,620,404,445	4,584,340,406	4,541,063,560	4,489,131,343
	-	(89,457,225)	(74,439,888)	54,311,293	306,936,387	694,552,179
	6,679,288,975	**6,564,787,279**	**6,549,751,250**	**6,642,438,392**	**6,851,786,639**	**7,187,470,215**
	-	-	-	-	-	-

	2020	2021	2022	2023	2024	202
t	4,675,502,282	4,341,537,834	4,007,573,385	3,673,608,936	3,339,644,487	3,005,680,03
	2,984,457,789	3,939,051,450	5,054,050,412	6,342,730,035	7,370,813,218	8,463,812,59
	-	-	-	-	-	-
	7,659,960,071	**8,280,589,284**	**9,061,623,796**	**10,016,338,971**	**10,710,457,705**	**11,469,492,62**
	0	0	0	0	0	(
ty						
	2,003,786,692	2,003,786,692	2,003,786,692	2,003,786,692	2,003,786,692	2,003,786,69
	4,426,812,684	4,352,030,293	4,262,291,424	4,154,604,780	4,025,380,809	3,870,312,04
	1,229,360,695	1,924,772,298	2,795,545,680	3,857,947,498	4,681,290,204	5,595,393,89
	7,659,960,071	**8,280,589,284**	**9,061,623,796**	**10,016,338,971**	**10,710,457,705**	**11,469,492,62**
	-	-	-	-	-	-