

ENVIRONMENTAL, SOCIAL AND HEALTH IMPACT ASSESSMENT (ESHIA) FOR THE TRAIN 7 PROJECT

Message from the Managing Director

I hereby formally endorse the Environmental, Social and Health Impact Assessment (ESHIA) report for Nigeria LNG Ltd (NLNG) **Train 7 Project**. With this project, we hope to achieve our ambition for expansion in production to a cumulative 30 mtpa (30 million tonnes per annum) of Liquefied Natural Gas (LNG), thereby increasing our current capacity by over 30%. The **Train 7 Project** will consist of the construction and operation of one (1) additional Complete LNG Train (CT) and a Common Liquefaction Unit (CLU) with a total capacity of 7.4 mtpa (million tonnes per annum) of LNG.

The report articulates the outcomes of a detailed impact assessment for the Project. Great care has been taken to deal with the environmental aspects whilst explicitly taking into account social and community health aspects. At several instances, we consulted our most important stakeholders – our direct neighbours on Bonny Island – about the intricacies of the plans, the impacts and mitigations, and about their concerns and expectations.

We are confident that the **Train 7 Project** can be developed from an environmental, social and community health impact perspective. In addition, we are well aware that mitigation measures are required to ensure the Project will meet all our aspirations and standards. These measures are presented in this report and we are fully committed to their implementation.

The ESHIA demonstrates that the **Train 7 Project** fully complies with the applicable statutory requirements of Nigeria, International standards and standards subscribed to by our shareholders NNPC, Shell, Total and Eni. Hence, we submit this report fully confident about formal decision-making and approval. Consequently, we look forward to ultimately earn at completion of the expansion, a general mandate to proceed, i.e. “a social licence to operate”. For this purpose, we will also use this ESHIA as a tool to continue our communication with you as a Stakeholder. We are interested in hearing from you especially where you see opportunities for us to improve this report or even our performance in relation to environmental, social and community health. For such views and comments, you may contact us via the email address: T7-EIA.Comments@nlng.com]

See also our website for more information: <http://www.nlng.com/nignlng/home.aspx>



Tony Attah
Managing Director/CEO
Nigeria LNG Ltd
August 2019

A normal project development process is applied to the proposed expansion of the NLNG site with the **Train 7 Project**. Hence, parallel to the technical development, an Environmental, Social and (Community) Health Impact Assessment (ESHIA) is undertaken and a series of reports are prepared. The objective of the ESHIA process is to integrate environmental, social and health considerations into the development, design, construction and operation of the NLNG project. The term used in Nigerian legislation is EIA (Environmental Impact Assessment). However, the scope of an EIA is very similar to an Environmental, Social and Health Impact Assessment (ESHIA) which is the term often used by international funding institutions like the World Bank Group - it is just that the title does not explicitly mention all aspects (as is the case for the report submitted for the **SevenPlus** project which was termed an ESHA). Nigerian law requires such an EIA Report; NLNG and its shareholders also consider an EIA Report to be an effective tool to communicate with stakeholders about the expansion plans and to manage both environmental, social and health aspects of the construction and operation of the **Train 7 Project**.

This ESHIA Report presents the outcomes of the detailed baseline and impact studies for the proposed **Train 7 Project** and all actions that will be taken to mitigate adverse effects, and ensure positive impact occur, on people and the environment. The following summary of the studies is aligned with the overall ESHIA report (Volume 1) structure and follows the order of the chapters in the main report. Volume 2 also contains a number of appendices that are relied upon in Volume 1, including technical appendices covering the details assessment of such topics as air quality, water discharges and noise impact.

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0.2 Project proponent and scope of this impact assessment

0.2.1 Nigeria LNG Ltd and its aspirations

The head office of NLNG is in Port Harcourt; all production and export shipping activities take place on Bonny Island, Rivers State, Nigeria.

The founding partners of NLNG have a wealth of experience in developing oil and gas projects all over the world and are well-known in the crude oil and gas businesses. They form a strong team with decades of experience in sound environmental protection in design, construction and operation of large resource development projects.

The Mission Statement and HSE Policy of NLNG demonstrate the aim to fully integrate Health, Safety and the Environmental (HSE) aspects in the day-to-day management of the business. In this respect the international standards for sound entrepreneurship, as also adopted by NLNG's shareholders, are recognised and reflect support for and application of universal rules; these include compliance with Nigerian legislation, policies and principles of the shareholders, applicable international conventions and international standards issued by Export Credit Agencies, the World Bank Group, the World Health Organization, the International Maritime Organisation and others.

In line with these standards, NLNG aims to contribute to Sustainable Development (SD). This means that a strategy has been developed in line with current good practices to integrate

economic, social and environmental considerations in all project decisions and actions and to work with the host communities while ensuring a long-lasting partnership.

However, since the start-up of the first LNG train, the Company's rapid growth of both production of LNG and the required staff numbers have put pressure on the Company to continually meet its sustainability development goals. The need to keep "walking the talk" is fully recognised. That's why this ESHIA Report shows in its Management Plan (Chapters 7 and 8) dedicated improvement measures for overall performance and compliance assurance with what the Company stands for in terms of HSE and SD.

0.2.2 Scope of the ESHIA

The objective of the impact assessment process for the **Train 7 Project** is to integrate environmental, social and health considerations into the development, design, construction and operation of the Project. The scope of the **Train 7 Project** ESHIA comprises:

- Both construction and operation activities as described in Section 0.4.
- The Project Area; defined as the area that could be affected by the proposed activities. The area can be different for different Project hazards e.g. the area potentially affected by emissions to air is much larger than and different from the relevant area for the discharge of the treated effluent into Bonny River.
- Establishment of the environmental, social and health baseline conditions of the Project Area and identification of the sensitivities in terms of its functions and services.
- Identification and evaluation of the significance of hazards and impacts (both positive and negative) associated with the proposed activities.
- Identification and management of issues raised by stakeholders during the ongoing consultation process.
- Identification of appropriate management and mitigation/enhancement measures, where impacts exceed the acceptance levels as defined in the standards applicable to the Project.
- A plan to monitor the effectiveness of enhancement and mitigation measures related to the positive and negative impacts.

This ESHIA Report does not cover the exploration of gas and transport by pipeline from the wells to the NLNG site; much of this infrastructure is already in place and any new developments, if required, will be subject to their own studies. The capacity of the Bonny Channel does not need to be changed to facilitate the **Train 7 Project** but the Nigerian Port Authority are considering deepening/widening the Channel to allow two-way traffic of larger vessels. This deepening/widening activity will not be undertaken by NLNG and is not within the scope of this ESHIA. The ESHIA does not include the construction of the LNGCs (LNG Carriers) at foreign shipyards, nor the manufacturing of components of the LNG trains / piping / etc. in other countries.

The methodology of the environmental impact assessment is in conformance with statutory requirements and international norms. The Terms-of-Reference for the impact assessment was discussed in the scoping meetings and agreed with the Federal Ministry of Environment (FMEnv), the Department for Petroleum Resources (DPR) and NLNG's neighbours during the feasibility phase of the previous incarnation of the project (the SevenPlus project for Trains 7 and 8) as well as more recently for the **Train 7 Project**. The current update to that EIA for the **Train 7 Project** has been prepared in accordance with the list of preparers included at the beginning of this document.

An EIA Report was submitted in draft in September 2018 to the Federal Ministry of Environment (FMEnv) and the Department of Petroleum Resources (DPR). Comments were received in January 2019 and a final version was submitted to FMEnv and DPR in March 2019. FMEnv issued a permit in April 2019. This ESHIA Report is an update of that EIA report and includes additional information on design and baseline. DPR will continue to review the documents

submitted prior to considering the project for issuance of a permit to operate, once construction is completed.

0.3 Project justification

The proposed **Train 7 Project** will receive feed gas through a dedicated Gas Transmission System and will produce LNG, condensate and LPG (mainly propane and butane).

The capital investment for the **Train 7 Project** will be in the order of 3 to 5 billion USD subject to final design and scope with a design life of 25 years.

0.3.1 Need for and benefits of the Project

Nigeria is endowed with one the largest proven natural gas reserves in the world. The **Train 7 Project** is an essential element in the aspirations of the country to commercialise the gas reserves. The market for LNG from the **Train 7 Project**, is largely in Europe and Asia but commercial arrangements are yet to be made and will continue to be updated during the lifetime of the project.

0.3.2 Alternatives considered

During the feasibility phase of the **Train 7 Project**, five alternative locations were considered before selecting the chosen site. The site selection process considered various factors, including synergy with the existing facilities, ease of operation and maintenance, safety distances to existing settlements, cost-effectiveness and present and future land use. The best option, taking into account all these factors, was just southeast of the existing LNG trains at the existing NLNG site.

It was concluded that significant environmental, social and health issues would have to be addressed during the further development of the Project, including the extension and control of a safety zone between the industrial area and surrounding urban areas.

The industrial area is situated along Bonny River with the (to be) expanded NLNG site, with in the northeast the site of Shell Petroleum Development Company (SPDC) and to the southwest the site of Mobil Producing Nigeria (MPN), see purple coloured in Figure 0-2. The orange coloured urban area in the north is Bonny Town and New Finima / Amariari are situated to the south. The Residential Area for NLNG staff is surrounded by the Nature Park.



Source: RHDHV (2019)

Figure 0-2 Base map of Bonny Island, south western corner

Contributing to sustainable development requires balancing short and long-term interests, and integrating economic, environmental and social considerations into decision-making. A longer-term vision for the Bonny Kingdom and wider area is available in this respect. Furthermore, the public intuitively understands that environmental protection and economic growth can go hand in hand on Bonny Island, but this needs careful steering to prevent ecosystem deterioration, resource depletion, exposure to pollutants and urbanisation and social proliferation leading to irreversible and unsustainable trends in sectors, such as energy, agriculture, and fisheries. It's also for this reason that an integrated impact assessment was carried out for the **Train 7 Project** and many mitigation measures are incentives to direct further changes in society towards sustainability.

0.3.2.1 Economic sustainability

The huge revenues resulting from the commercialisation of the natural gas under the sales contracts will serve the direct interests of all shareholders, and through taxes and fees to the Nigerian Federal Government, and via these channels also Nigerian society at large. The challenge will continue to be for all parties involved to apply these revenues in a transparent and efficient way for sustainable development of the Niger Delta, which not only benefits from the blessings of the production of the energy sources, but also suffers from the negative consequences thereof.

0.3.2.2 Social responsibility

The **Train 7 Project** will provide employment and skill acquisition opportunities for Nigerians, and especially to Bonny inhabitants, through direct and indirect involvement of contractors, consultants, suppliers and other professionals. NLNG is fully committed to implement the approved Nigerian Content Plan (NCP) for the engineering, procurement and construction phases

of the Project. For this NCP the directives on local content recently issued by NCDMB have been used. Substantial direct employment opportunities exist during 4-year construction of the **Train 7 Project**. On completion, the **Train 7 Project** will be fully integrated into existing operations and up to 100 new long-term positions will be required for operations. Apart from direct benefits of employment, the Project will also provide indirect economic benefits in the local area, due to supplies of food, fuel, domestic goods and services.

However, it is also realised that these socio-economic changes are temporary successes, as after the construction works, thousands will depart and the area will be left with environmental and human impacts from increased urbanisation and rural land abandonment. And after the lifetime of the Project, the driving forces for the socio-economic boom will cease, thus underpinning the need to steer the rapidly changing economic and demographic landscape of the area.

NLNG is making an effort, as part of this further expansion, to improve its relationship with the neighbouring communities. The renewed continuation of relations with local communities is driven by engagement, participation, partnering and capacity building. This is particularly emphasized by the continued success in developing infrastructure services on the Island, funded by NLNG, for power and water supply for the Bonny Kingdom.

0.3.2.3 Environmental protection

In the context of the socio-economic changes that the oil and gas development brings along, this ESHA addresses impacts from climate change, air pollution, depletion of natural resources such as water, soil and biodiversity, and the disturbance caused to land-based and marine ecosystems.

Climate change is materialising, increasing air emissions on Bonny Island threaten the ambient air quality, and noise levels in urban areas approach the limits of acceptability. For the **Train 7 Project** sustained investments in improvement of energy efficiency, in dry-low NO_x technology and noise abatement are foreseen. Nevertheless, with the **Train 7 Project** the overall greenhouse gas (GHG) emissions of NLNG will increase.

The **Train 7 Project** will be capable of receiving Associated Gas (AG). This gas is co-produced with oil in the Niger Delta and is currently flared to the atmosphere to a great extent. However, although the **Train 7 Project** can process AG it is foreseen that most of the feed gas will be produced from newly to be commissioned and connected gas fields.

0.4 Project Description

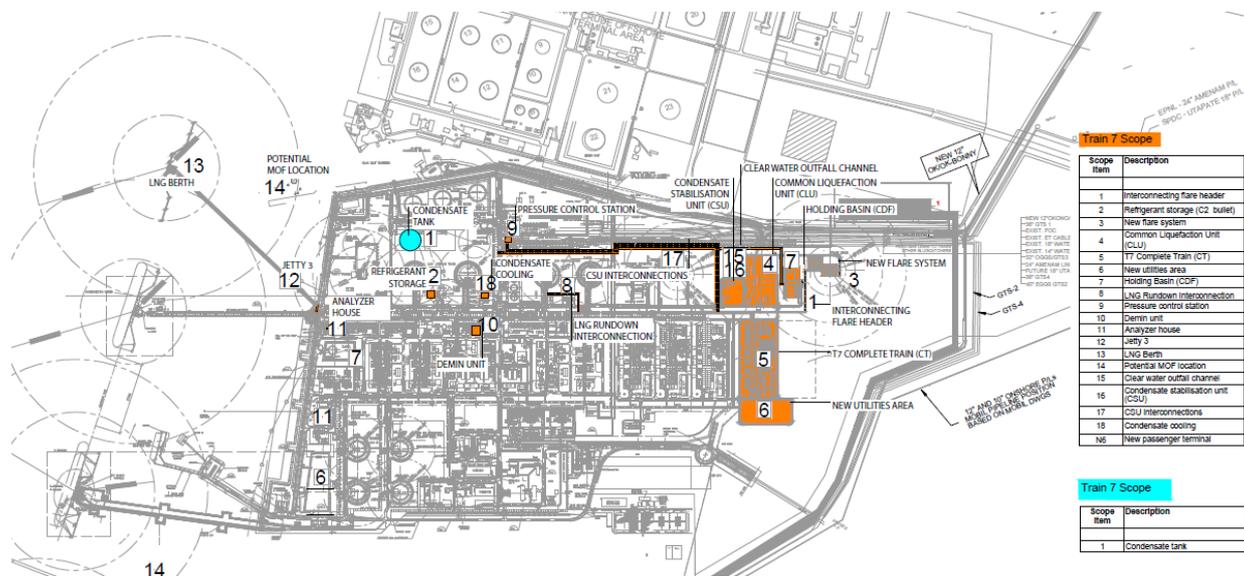
A stand-alone development is proposed, but once completed it will be fully integrated in the overall NLNG activities on Bonny Island. The major elements of the development concept are:

- Construction and operation of 1 additional Complete Train (CT), the Common Liquefaction Unit (CLU), a new LNG jetty, utilities, loading facilities, and tie-in with the existing 6-train plant on Bonny Island.
- Construct a New Worker Village to accommodate construction workers on up to 31 hectares of land which belongs to Brown-Omuso family.
- Redevelop parts of the existing Joint Venture (JV) camp facilities.
- Marine operations associated with the export of the products LNG, LPG and condensate.

The Basis-for-Design (BfD) was completed in March 2018. This was followed by FEED (Front End Engineering and Design) using two parallel (and competing) contractors, and the BDEP (Basic design Engineering Package) was completed in July 2019. Award of the EPC (Engineering, Procurement and Construction) contract is planned for Q4 2019 when Detailed Design (DD) will be undertaken by the EPC contractor. Activities at site for the main EPC contract are foreseen to commence late 2019 or early 2020, subject to approval by the Federal Ministry of

Environment (FMEnv) and the Department of Petroleum Resources (DPR). Final commissioning and start-up of the **Train 7 Project** is anticipated for 2024.

The **Train 7 Project** consist of several project elements some of which are firmly within the scope of the FEED Consortia/EPC contractor. Some elements will be constructed by NLNG and others are yet to be decided into which scope they will fall. Inclusion of some elements of the design are still to be determined. The Project elements are presented in orange and blue in Figure 0-3; the Complete Train (CT) in the east, north the Common Liquefaction Unit (CLU) and flare system and the new LNG jetty extending into Bonny River.



Source: NLNG (2018)

Figure 0-3 Overview of elements comprising the **Train 7 Project**

An overview of the main characteristics the **Train 7 Project** and how this related to the existing NLNG trains is presented in Table 0-1.

Table 0-1 Main elements and characteristics of the future 7-train NLNG plant

Projects	LNG trains	Feed Gas (mmscfd)	Type Feed Gas	LNG Capacity (mtpa)	Tanks	Jetties	Cooling
Base	1, 2	-	NAG	6.4	2 LNG 2 condensate	1 LNG & condensate 1 MOF	Water cooled
Expansion	3	-	NAG, AG	3.2	1 LNG 2 LPG	1 LPG	Water cooled
Plus	4, 5	-	NAG, AG	8.2		LNG facilities on LPG jetty 1 MOF	Air cooled
Six	6	-	NAG, AG	4.1	1 LNG 2 LPG 1 Condensate		Air cooled
Train 7 Project	7	-	NAG, AG	7.4	No extra storage required	1 LNG 1 Passenger	Air cooled
Total	1-7	4660	-	29.3	-	3 LNG, 1 MOF, 1 Passenger	-

Notes: mmscfd = million standard cubic feet per day, NAG = non-associated gas; AG = associated gas – see also Chapter 2

Many in-plant design mitigations are foreseen to reduce the negative impacts, and enhance the positive impacts of the **Train 7 Project** on people and the environment. These are discussed in

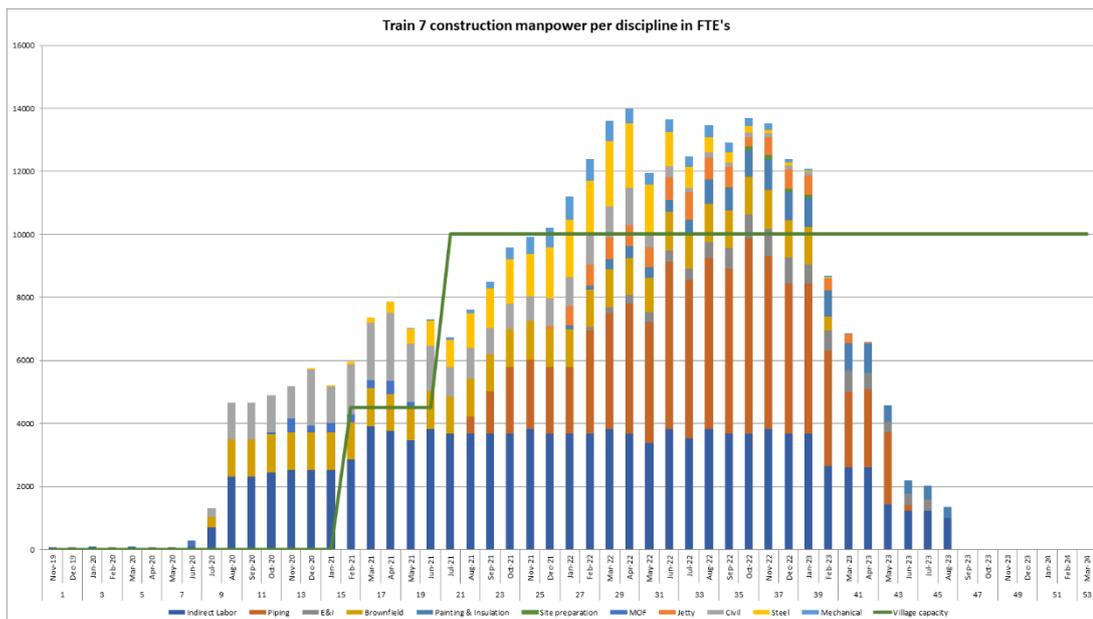
detail in the mitigation Section of the ESHIA Report (Volume 1, Chapter 7) and include for example:

- Maximising local and Nigerian content to enhance the benefits to Bonny Island and Nigeria.
- No routine flaring during normal operations to minimise impacts from noise and air emissions.
- A broad series of measures to minimise emissions of hydrocarbons from tanks, leaks and vessels whilst loading.
- Use of dry-low NOx (DLN) burners in gas turbines to minimise emissions to air of nitrogen oxides (NOx).
- Application of low-noise fans on the air coolers to limit the sound power of the trains.
- Spreading the movement of workers over a longer period or using more modern vehicles than may normally be available in Bonny/Port Harcourt.

0.4.1 Construction

For the construction phase, the existing Material Offloading Facility (MOF) will be used or an additional new MOF will be constructed to bring materials ashore, this has been under consideration by the FEED consortia and a decision will be taken in the light of requirements for construction but also continuing operation of the NLNG site. The expected workforce per discipline throughout construction phase of the **Train 7 Project** is shown in Figure 0-4; this shows a peak of 14 000 but can be scaled for any of the estimates that have been made (ranging from a peak workforce of 8300 to 14 000 full time equivalent (FTE) jobs. The range comes from including or excluding a variety ways of working and contingencies. The numbers of actual people that this equals to will vary depending on the number of work-hours and rotation cycles instituted by construction contractors. The workers will stay in several locations, workers living on Bonny Island and from nearby will stay in their own homes. Workers from the rest of Nigeria and overseas will stay in the New Worker Village, Joint Venture Village (the upgraded JV Camp) and Residential Area (RA) guesthouses. Some sub-contractors may also stay in other camps on Bonny Island, provided by their parent company.

The EPC contractor will continue to refine estimates throughout the process and suitable accommodation will be provided as needed. Primary responsibility for HSE and SD during construction rests with the EPC contractor; NLNG will monitor the performance for compliance with applicable, and contractually established, policies and standards.



Source: NLNG (2018)

Figure 0-4 Construction manpower per discipline across construction phase of the **Train 7 Project**

0.4.2 Operations

The facilities will be staffed with competent personnel who are well trained to handle both normal operations as well as to respond appropriately to upsets or emergency situations. Equipment will be maintained such that it performs efficiently and reliably.

Although the **Train 7 Project** is a stand-alone project, the baseline situation for this ESHIA does include the operation of trains 1 to 6. Therefore, the potential impacts of the **Train 7 Project** are superimposed on the existing baseline and, hence, the potential impact of the other LNG trains and, as far as possible, also other industrial activities. For some studies (e.g. noise and air emissions) sources from train 1-6 have also been included the modelling of impacts.

The overall potential risk posed by the LNG plant operation to third parties and the wider environment is managed through a number of methods including various levels of control of the areas situated within close proximity to the LNG plant. The extent of the areas for different controls is determined through the use of NLNG criteria for managing this risk and is defined in the Project documentation. The Quantitative Risk Assessment (QRA) carried out for the **SevenPlus** Project ESHA presents the range of zones, the most notable being the Safety Zone and the Sterile Zone.

- The **Safety Zone** (bounded by the 10^{-5} risk contour¹) is defined as an area where no other activities should take place. No public access is allowed and the area shall be directly within control of NLNG.
- The **Sterile Zone**, bounded by the 10^{-6} risk contour, is an area in which other activities (i.e. other than LNG production) are allowed if the area is controlled. Such an area can include an industrial activity without access to this site by the general public. No housing and no extensive office facilities facilitating large gatherings of people are allowed.

The QRA is being updated and is expected to be ready in late 2019. It is likely that the risk contours of the **Train 7 Project** will be similar to those presented in 2008. They may be slightly smaller or have a slightly different shape. Additionally, the settlers nearest to NLNG in 2008 along the main road by the Airport have now been rehoused in New Finima.

The marine traffic in the Bonny Channel will show a gradual increase. When Train 6 came into operation in 2007, the NLNG site increased the marine traffic through the Bonny Channel to a total of about 350 LNG carriers, 76 LPG ships and 39 condensate tanker movements annually. With the addition of the **Train 7 Project** shipping movements are expected to increase by about 20%.

0.5 Environmental and social setting including stakeholder engagement

0.5.1 The distant view

The Niger Delta is the second largest delta in the world and is the largest wetland in Africa. The region is divided into four main ecological zones; namely coastal inland zone, mangrove swamp zone, freshwater zone and lowland rainforest zone. Under the Ramsar Convention, signed by Nigeria in 2001, the Niger Delta undoubtedly qualifies as a wetland of major international importance.

¹ A risk of 10^{-5} means a risk 1 in 100 000 of fatal harm to a hypothetical individual on a yearly basis due to the exposure to hazards induced by the LNG activity. 10^{-6} is a one a million risk.

The following is a citation from the World Wildlife Fund's Terrestrial Ecoregions of the World (WWF, <http://www.worldwildlife.org/wildworld/>), which succinctly depicts the natural and social environment of the Delta.

"... The "Niger Delta Swamp Forests" ecoregion - belonging to the "Tropical and Subtropical Moist Broadleaf Forests" biome - is contained in a triangle with the town of Aboh on the Niger River being the northernmost tip. The Benin River forms the western boundary of the ecoregion where this ecoregion merges into the "Nigerian Lowland Forest" ecoregion. Along its southern side the "Niger Delta Swamp Forests" is separated from the Atlantic Ocean by a band of mangroves, which can reach up to 10 km inland. In front of the mangrove belt and close to the sea are ephemeral coastal barrier islands often clothed in transitional vegetation.

The Niger Delta is the product of both fluvial and marine sediment build-up since the upper Cretaceous, and its low relief is responsible for the meandering and frequent shifting of the Niger and its tributaries. Over time, the decreasing slope gradient of the Niger River bed and associated lower stream velocities has resulted in an increase of tidal activity in the exits of the numerous Niger distributaries, resulting in the formation of the Coastal Barrier Islands.

The soils of this ecoregion are all of fluvial origin, except for the Coastal Barrier Islands that consist of marine sand overlain with an organic surface layer. The continuous movement of the delta's creeks has resulted in a mosaic of soil types.

The climate of the Niger Delta is characterized by a long rainy season from March-April through October. Precipitation increases from the north of the delta (with an average of 2500 mm) to the coastal area where mean annual rainfall averages around 4000 mm, making it one of the wettest areas in Africa. The wet season peaks in July, and the only dry months are January and February. Relative humidity rarely dips below 60% and fluctuates between 90% and 100% for most of the year. During most of the rainy season cloud cover is nearly continuous resulting in 1500 mean annual sunshine hours and an average annual temperature of approximately 28° C.

The most important determinant of biological variation in the delta is its hydrology. In addition to precipitation, the major variation in the hydrological regime comes from the Atlantic Ocean's tidal movements and the Niger River flood. This flood begins toward the end of the rainy season in August, peaks in October, and tapers off in December.

The Niger Delta provides a small-scale representation of many of Africa's problems. A growing population, conflicts between different ethnic groups, national political instability, unsustainable exploitation of natural resources; all of these factors play a significant role in the problems the delta is presently facing. The single most pressing problem facing the delta presently is a lack of development, despite most of Nigeria's revenues coming from the oil found in this area. There is electricity only in a few of the delta's towns and fresh water and health care facilities are basically absent. Rightfully or not, the delta's inhabitants hold the oil industry responsible for this situation, and dissatisfaction has now reached such levels that the seizure and destruction of oil company property, as well as the kidnapping of oil company personnel, has become a common occurrence. As a result it has also become extremely difficult to engage in research or conservation activities...."

The Project is situated in Rivers State in the Bonny Local Government Area (LGA), see Figure 0-1. The main population centre in Bonny LGA is Bonny Town. Most of the remaining population lives in villages within a 5 km radius of NLNG, such as New Finima, Agalanga, Bonny Lighthouse, Amariari, Achiama, and Ayambo, and beyond, villages such as Oloma, Abalamabie, Peter side, Owukiri, and Epelema. Agalanga, Bamariari and Bonny Light House are transient settlements with populations swinging from rapid growth to virtual disappearance. Rivers State, in which Bonny LGA is located, was estimated to have an approximate population of 5 619 974 in 2009, up from 3 187 864 in 1991 using a 3.2% growth rate factor. The current population of Bonny LGA, as obtained through projections of estimates provided by the National Population Commission (NPC) based upon two censuses undertaken in 1991 and 2006, stood at 276 683 in 2014.

0.5.2 Zooming in

The first report on the status of the environment of Bonny Island was produced in 1987 by Professor Clifford TI Odu and Dr Brian Dicks of the Oil Pollution Research Unit. Associated with all industrial developments since then, many environmental and social baseline reports followed.

Extensive baseline work was initially carried out for the **SevenPlus** Project. For the **Train 7 Project** and in the intervening years (e.g. the Baseline Validation Report, Appendix 10), additional field surveys and up-to-date information was collected (in 2018 and 2019) on the natural and social setting of the Project area. Detailed studies on specific subjects, such as air emissions and noise were updated. All these reports are available as appendices to this impact assessment. In Chapter 4 (Volume 1) of this ESHIA Report the baseline results are summarized and compared to all the other relevant information that is available. Instead of trying to compress this wealth of information in this Executive Summary, the focus here will be on the striking features, such as: temporal and spatial changes compared to other baseline studies and the reference situation. Key aspects in terms of environmental and social functions and services provided by Bonny Island ecosystems will be described. All these sensitivities have been taken into account while assessing the impacts of the Project, together with a description of issues raised by key stakeholders.

The Island has a relatively flat topography lying just above sea level. The greater northern half is covered with mangroves around creeks and to the east of Bonny Town, next to the Opobo Channel. The southern part lies higher and contains typically (degraded) freshwater swamp forests, sometimes mixed with either mangrove, open swamp, dry land rainforest or dune slacks. There are over 120 towns and villages on the Island. The majority of these are small fishing villages, connected only by water transportation. In the southwest, urban, industrial and agricultural areas can also be found; see Figure 0-2. The main urban centres are Bonny Town to the north and New Finima in the south. Between these two centres is an industrial area with the Bonny Gas and Oil Terminal (BCOT) of SPDC, located in the northeast, with NLNG to the south and Mobil Producing Nigeria (MPN) Ltd in the southwest. The southern, Atlantic coast of Bonny Island encompasses a beach ridge barrier and a sandy beach. The coastal situation is characterised by a large, 20 km wide, offshore sand bank: the Bonny Bar. It protects the coastline against ocean currents and waves.

Between 2007 and 2015 the population of Bonny LGA increased significantly by 120%. There are many contributory factors to demographic changes in and around Bonny Island. These include the activities of the multinationals on Bonny Island such as SPDC, MPN and NLNG. At the peak of its workforce, there were 18 000 workers (not including families and associated immigrants) at the **Base** Project construction. This alone increased the Bonny LGA population by 28%. The construction of MPN plant will also have contributed to changes in the population numbers and structure on the Bonny Island. While it can be argued that most of the workers and their dependents left the Island at the end of construction, a sizeable proportion remained behind with their dependents, in search of future employment.

0.5.3 Striking features

In the early 1990s a series of interlinking developments occurred on Bonny Island, which had large-scale consequences on the local environment. Lots of people migrated from elsewhere in Nigeria to the Island. Foreigners joined them. People's usage of land shifted from "production and usage of natural resources" such as cropland and forest, to "built-up land", i.e. land for housing, industries, infrastructure, etc.

Many areas originally covered by - particularly swamp - forest now have other purposes and this change coincided with a loss of the natural habitats in those areas and an overall loss of biodiversity, particularly of the original wildlife, and a modified avifauna characterised by more domestic species. Further, some of the remaining habitats became dissected by Right-of-Ways (ROWS) for pipelines. In this context, NLNG established and continues to support the Finima

Nature Park on the Island to help conserve the Island's natural biodiversity. The location of the park is indicated in Figure 0-2.

The shift in land use reflects a chain of causes. Commercialisation of oil and gas in Nigeria required a further expansion of exploration activities and of treatment and export facilities. In this respect, the position of Bonny Island with its offshore approach channel to Bonny River and Port Harcourt was extremely suitable for treatment and export purposes. SPDC became the main player for oil, while NLNG (and to a lesser extent MPN) for gas. This expansion went together with an increase of all kinds of supporting businesses on the Island and a great increase in employment opportunities.

Particularly for the construction activities of the continuing developments of NLNG and MPN, large numbers of workers were needed. Thousands of job seekers with their families and followers came to the Island and joined the existing population. As the building of new industrial facilities continued over the last 20 years, many of the immigrants have settled in the villages on a semi-permanent or permanent basis, mainly in Bonny Town and New Finima. Popular transient squatter settlements are located close to New Finima, including Akusuugh 1 and 2, Nembe Camp and Agalagasugh. The construction of the new Bonny-Bodo Road has started and will likely be completed during the construction of the **Train 7 Project**, resulting in improved access to Bonny that may lead to a larger influx of people.

In socioeconomic terms, the developments in Bonny Island have historically been extraordinary fast – certainly when compared to the rest of the oil-province of Nigeria. This happened due to a lack of steering and controlling mechanisms to ensure “quality developments”, such as spatial planning for the area or planning authorities. The most recent Master Plan was updated in 2014 and serves as a blueprint to guide socio economic development in the Local Government Area to the year 2040.

Over the past 40 years, two Master Plans were developed for Bonny Kingdom – the first in 1973, and second in 2002 aimed to guide development of the area up to the year 2020. The Master Plan provides a framework for the coordination and fostering of development in the Bonny Local Government Area, including an analysis of existing conditions and proposals for economic, social, community and infrastructure development as well as environmental protection.

Despite the drafting and updating of the Master Plan, fast growth had its consequences for the quality of the environment. After all, more industries and more people produce more discharges such as emissions, effluents, noise, and wastes. With baseline information available since the earliest NLNG project, some changes over time in the quality of the surface water and ambient air are worth mentioning here.

Regarding surface water quality, there is a striking trend of decreasing levels of petroleum hydrocarbons with, nowadays, hardly measurable oil-in-water. This positive trend is clearly associated with better (bio)treated industrial effluents and less spillages. At the same time there has been a negative trend observable in ambient air quality, of which particularly the NO_x and SO_x levels at times approached the World Health Organisation (WHO) limits. This trend is not surprising given that industrialisation and urbanisation have increased over the same time. Private, small power generators were used widely. This situation however, has improved measurably since the Bonny Utilities Company (BUC) –set up by NLNG and the other Oil companies on the island – has begun to provide power to parts of the urban areas on the Island. Private generators are now mainly used for back-up power supply.

The pressure on the functions and services of the environment is noticeable not only on land, but also in the nearshore and offshore marine areas. Many fishery settlements in the Bonny River estuary are almost exclusively dependent on one specific aspect of the system: fishing. Space needed for shipping and associated activities like dredging, is still increasing in the Channel and in Bonny River. However, artisanal and industrial fishing are also increasing. Consequences for fish stocks are detectable by experts: commercially important stocks are presently under pressure. This is also related to the overall pressure on the biological environment, including

creeks, mangroves and estuaries, which are the primary habitat for spawning, reproduction and growth of these aquatic species.

Bonny Island is characterised by a high level of income inequality introduced by the presence of relatively highly paid oil and gas workers, whose standard of living sharply contrasts with the majority of local people, whom are dependent on traditional subsistence practices and occupations for their income. The most common types of residential properties in Bonny LGA include single family bungalows, tenement (rooming/terraced) houses and flats. Since 2006 there has been extensive piped water in Bonny Town and other areas, while some other communities largely depend on a combination of boreholes, standpipes and wells.

NLNG is contributing to the water supply by providing these communities with water towers, infrastructure and water tankers. Both Bonny Town and more recently New Finima have a steady supply of electricity. The most common form of sewage disposal is the water closet, however open defecation in the rivers and creeks is common. Lack of formal refuse or disposal systems gave rise to indiscriminate dumping of refuse in public areas, i.e. in the settlements, creeks, sea, and bush.

Poverty is high in the transient settlements. About 50% of households in these villages are poor by the country's standards, mainly due to unemployment and low pay associated with informal occupations (i.e. trading, food selling, carpentry) and subsistence living (i.e. fishing, farming, palm tapping). Housing is very poor quality and of a temporary nature; most houses have mud floors, and are made primarily with discarded cartons, plastic sheeting and random wood planking. Public services are largely non-existent in the transient settlements: there is no electricity, piped water, refuse or sewage disposal system.

Since the **Base** Project, NLNG has actively sponsored educational improvements in the communities, ranging from repairs and maintenance of existing schools, and the construction of a library and sports arena, to support of vocational training programmes, scholarship programmes, and donations of books and computers. Literacy in the Nigerian Delta is high at 78% compared with the national literacy rate of 68%, however like elsewhere in the country, the number and quality of educational institutions and teaching personnel in Bonny LGA remains low. Low government funding of public schools has resulted in major shortages of basic teaching materials and equipment, poor infrastructure maintenance, low teaching morale, very high teacher-student ratios, and outdated curricula. Access to schooling is a problem for children living in the peri-urban and rural areas, who must walk long distance to the nearest school.

The primary and secondary school attendance rates are similar for boys and for girls in Bonny (upwards of 70%), however far fewer girls than boys living in the transient villages attend secondary school (36% and 64% respectively), presumably to take care of siblings and perform domestic chores at home.

The communities in the survey area are serviced by eleven community health centres and Bonny General Hospital. The nearest tertiary care is located in Port Harcourt; the Braithwaite Memorial Specialist Hospital, and the University of Port Harcourt Teaching Hospital, meaning most community members are able to access health care within the prescribed 30 minutes. The primary health facilities offer mainly maternal and child health services including childhood immunisation with the capacity to treat minor injuries and endemic diseases. They also have the capacity to carry out HIV counselling and testing services, however pharmacies of health centres were not properly stocked with essential drugs and did not have a proper drug revolving fund.

Malaria and diarrhoeal disease are the most commonly reported diseases on Bonny Island. Twelve tuberculosis cases were reported in 2005. One of the most pressing health concerns facing the Island is HIV/AIDS. In July 2006, HIV prevalence was 7.8% on Bonny Island compared to 5-6% in the country overall. Improvements recorded in the annual report of 2013 from the Ibani-se HIV/AIDS Initiative show that seroprevalence has reduced from 8.5% to 5.9% in 2010 and to about 4.2% in 2018. This study also showed that intervention methods to change the sexual behaviour of the Bonny Island People had been effective. Through NLNG's support, the

child immunisation coverage on Bonny Island has markedly improved, protecting children from contracting the most common life-threatening diseases, i.e. tuberculosis, polio, diphtheria, tetanus, pertussis and measles. Vaccination rate against trivalent oral polio was 94% in 2005. This is the most impressive of the six diseases covered.

0.5.4 Sensitivities and issues

The baseline situation of the **Train 7 Project** area utilised in this report is the reference situation as obtained in early 2006 and supplemented with more recent information from different, publicly available sources and field surveys. This Project area is the area that will be affected by the Project activities.

The series of NLNG Projects has shown that the baseline situation on Bonny Island is continuously changing situation. Because of the difficulty to superimpose the **Train 7 Project** on such a dynamic baseline during the impact assessment process, a dedicated approach was selected - one which was already initiated for the **Six** Project. Here the “functions and services” of the environment are used, separated into the onshore and estuarine/offshore environments. An overview is presented in Table 0-2.

Table 0-2 Compilation of sensitivities (based on functions/services)

Functions / services	Examples
Provisioning services	Biotic products as food, meat, timber, medicinal plants
	Abiotic products as water, minerals, energy, fuel, oxygen
	Space and suitable substrate for infrastructure, habitation, nature protection, recreation
	Structure and functioning of ecosystems
	Biodiversity
Regulating services	Storage and recycling of nutrients, minerals
	Regulation of chemical composition of air, water, soil, climate
	Capacity to absorb and regulate contamination/wastes
Social/cultural services	Social and economic processes
	Representation of aesthetic, educational, scientific values
	Storage of historic, spiritual, religious information

Stakeholders raised many issues during a series of stakeholder engagement meetings and workshops (please refer to Section 0.5.5 and Chapter 4 for further detailing). These issues were summarized in 26 categories, which cover 5 main subjects:

- Land take/Land use Related Matters
- Migrant Influx
- Employment
- Quality of Primary and Secondary Education
- Social and Health Impacts Assessments

The issues are, in the same way as for the sensitivities, entirely integrated in the impact assessment process.

0.5.5 Stakeholder engagement

NLNG’s Social Performance relies on being a trusted partner of its stakeholders, with the objective of pursuing the sustainable development of NLNG’s Host Communities and helping to build a better Nigeria. This is in line with NLNG’s Sustainable Development Policy.

Stakeholder engagement is the vehicle through which issues of development are conceptualized in an atmosphere of mutual respect and trust between NLNG, local communities and other stakeholders. The aim of such engagement is to gather information on identified needs, concerns and lessons learned through dialogue with stakeholders. NLNG remains passionately interested in working with its stakeholders to identify mitigation measures to address any negative impacts of its operations and maximize the positive benefits of its presence to host communities. This

allows for public acceptance of NLNG's presence and a conducive environment in its areas of operations.

In the context of the **Train 7 Project**, a Stakeholder Engagement Plan (SEP) will help to ensure that the ESHIA addresses the most important community concerns about the project. The **Train 7 Project** consultation programme was developed to address the concerns and views of both primary and secondary stakeholders. The **Train 7 Project** consultation programme was developed to address the concerns and views of both primary and secondary stakeholders. In liaison with NLNG's Technical Advisers, relevant stakeholders are being identified and mapped since 2010 (full listing available in the SEP, see Appendix 22).

A workshop held in January 2018 (reported in the updated SEP, see Appendix 22), reviewed the stakeholder lists/mapping in detail and checked for relevance and validity. Its outcomes naturally dovetailed into the development of a robust SEP for the **Train 7 Project**. The SEP has now become the premise and basis for all future stakeholder engagement activities. It describes the consultation programme for all identified stakeholders, including relevant community organs.

All consultations/engagements concerning the **Train 7 Project** have been (or will be) conducted in close cooperation with NLNG's Community Relations Department, which maintains cordial relationships with NLNG's host communities, NLNG's Health, Safety, and Environment Department and NLNG's Technical Advisers.

It should be noted that the applicable content of the earlier ESHA prepared for the **SevenPlus Project** remains valid as approved in 2010. However, with a lull in activities and the renewed business interest in actualizing the project, albeit with a reduced scope Chapter 9 describes the engagements, meetings, and workshops held between NLNG and relevant stakeholders – Government, local host communities and representatives from NGOs. Stakeholder engagement and consultation will continue as per the SEP.

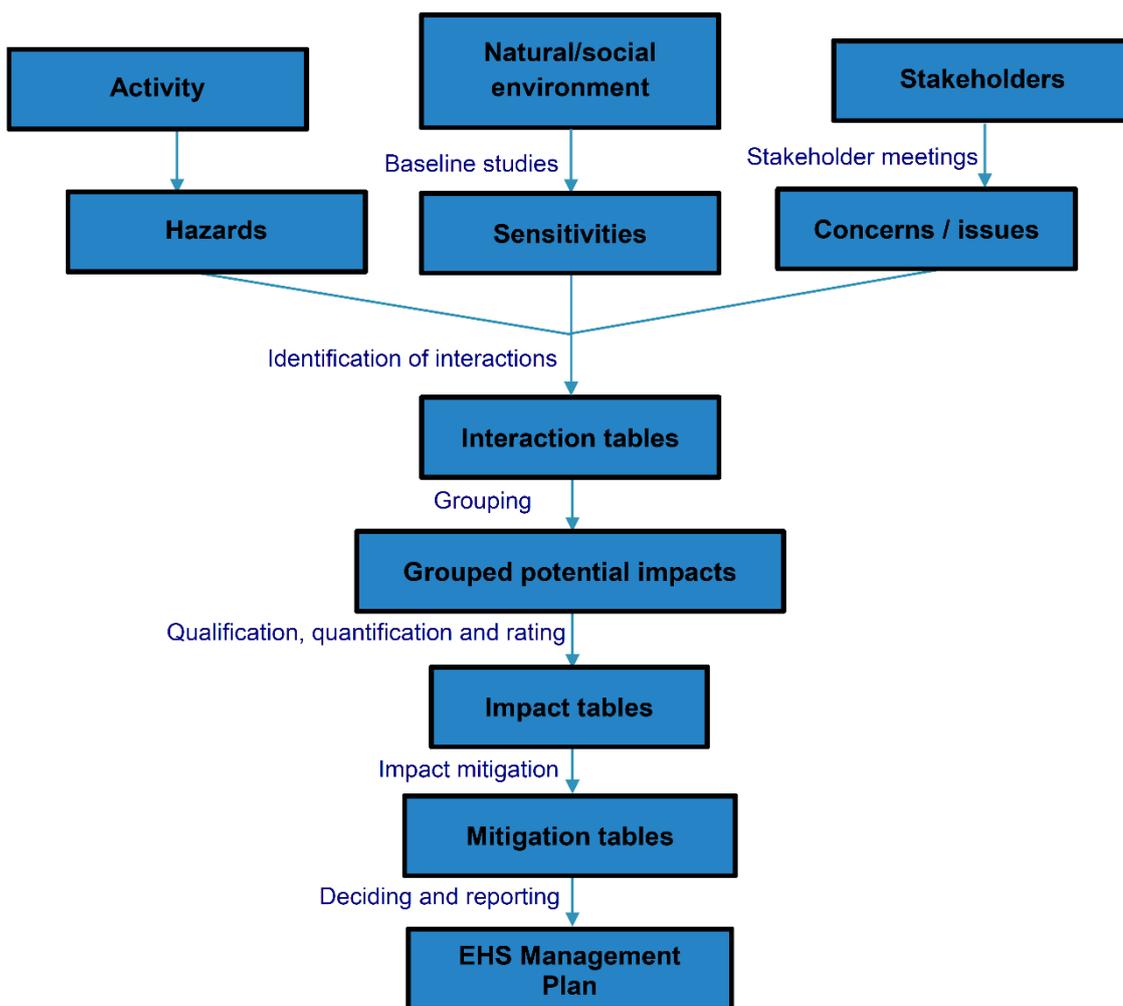
0.6 Impact assessment including cumulative impacts

The methodology for impact assessment follows the Nigerian statutory requirements and international standards. It is based on the approach developed for earlier NLNG projects. Recent international developments have been incorporated, such as the process for defining sensitivities of an area, of which the results are presented in Chapter 5.

0.6.1 Methodology

An overview of the impact assessment process for the **Train 7 Project** is given in Figure 0-5. The Project's **hazards**, notably the inputs (usage of natural and human resources) and outputs (invaluable stream like emissions, noise, wastes, etc.) for both construction and operations, have been brought together with the sensitivities and the issues raised by the stakeholders, in the Interaction Matrices in Chapter 5 of this ESHIA Report. Impacts can be negative or positive. Positive impacts are not ranked. Negative ones are. This resulted in an overview of all potential impacts. Each interaction was then assessed. Professional judgement, and sometimes numerical modelling, combined with detailed knowledge of the Project hazards and the conditions of the respective **sensitivities**, was used to determine the possibilities and magnitude of impacts.

Next, to simplify the impact identification process, interactions between similar hazards and their respective sensitivities were grouped together into a single impact. In the interaction matrices, interactions grouped in this way were given the same impact number, which was then entered into the Impacts Table (Chapter 7). Once all impacts for construction and operation phases had been identified, there were specific steps, which were followed to describe and ascribe the final significance rating of each impact.



Source: NLNG (2018)

Figure 0-5 The EIA/ESHIA process for the **Train 7 Project**

Once the degree of significance of an impact had been assessed, a decision had to be made about the need for mitigation (Chapter 7). This depended on the ‘impact acceptance’ or ‘impact tolerance’. For this Project, a NLNG-specific Impact Assessment Matrix (IAM) was developed (see Figure 0-6) which details the seriousness or significance of each of the impacts and demonstrates the need and type of managerial action to be taken.

Subsequently, the Impacts Tables were developed to identify each impact, along with the hazard, which caused the impact. In addition, each impact is described in terms of likelihood and potential consequence, together with the final impact rating attributed. Once all impacts had been identified and classified, mitigation measures were designed to minimise the adverse effects of the Project and to maximise the benefits. Mitigation measures were identified in the Mitigation Table in Chapter 7, which links each impact to its proposed mitigation. The key requirement for sustainable development is that mitigation measures proposed to prevent, minimise or compensate for any adverse impacts will be incorporated into the Environment, Social and Health Management Plan (ESHMP), together with any enhancement measures.

All impacts assessed according to the IAM (Figure 0-6) as being “major” were automatically classified as “intolerable” and must be mitigated. If an impact is rated moderate, the mitigation should bring the impact down to “ALARP” (As Low as Reasonably Practicable) level. This means

that mitigation should bring the negativity of the impact as low as possible using available finance, available time and the best available technology.

Impacts rated to be minor or negligible are marked as “to be managed” and can be dealt with through the normal elements of the Management Systems, including procedures, guidelines, extra resources in terms of manpower, etc. Positive impacts resulting from the Project are mentioned as to be enhanced, where possible.

		Potential consequences				
Likelihood	Positive	Hardly any	Little	Considerable	Great	Extreme
High	Positive	Moderate	Moderate	Major	Major	Major
Medium high	Positive	Minor	Moderate	Moderate	Major	Major
Medium	Positive	Minor	Minor	Moderate	Moderate	Major
Medium low	Positive	Negligible	Minor	Minor	Moderate	Moderate
Low	Positive	Negligible	Negligible	Minor	Minor	Moderate

Figure 0-6 Impact Assessment Matrix (IAM)

0.6.2 Main findings of the impact assessment

As earlier explained in this Executive Summary, the Project has been designed and will be executed and operated in compliance with applicable Nigerian and international requirements. Most of such standards are meant to prevent pollution of the environment by the “output hazards” (see 0.5.1 above), such as emissions, effluents, etc.; these are numerical criteria – such as a concentration limit for nitrogen oxides (NO_x) in stack emissions. Such standards applicable to this Project are presented in Volume 2, Appendix 21 of this report.

However, compliance with this kind of standards is not a guarantee of “no impact”. Impacts are a consequence of more than only the discharge under consideration: the overall environmental condition (the baseline), but also other discharges - eventually all in compliance with the applicable standards - have to be taken into account as well. In addition, the seriousness of impact is also determined by the sensitivity of elements in the environment, which may be affected.

Impacts on functions/services are more difficult to assess, as only “descriptive” standards are available, such as guidelines, good practices, intentions, etc.

For the following descriptions, only the “moderate” and “major” impacts are taken into account. Any impacts rated as “negligible”, “minor” or “positive” are not presented here.

Impacts are categorised into groups as follows (C for Construction and O for Operations, sequentially numbers (x)); impacts in Chapter 5, mitigation in Chapter 7 and monitoring in Chapter 8 use the same numbering unique to each impact identified.

- Land/space requirements (C1-x and O1-x);
- Materials and goods (C2-x and O2-x);
- Human resource needs (C3-x and O3-x);
- Emissions to air (C4-x and O4-x);

- Liquid effluent (C5-x and O6-x);
- Solid waste (C6-x and O6-x);
- Noise (C7-x and O7-x);
- Light (C8-x and O8-x);
- Heat (C9-x and O9-x); and
- Incidents (C10-x and O10-x).

0.6.2.1 Space requirements (on- and off-shore)

The Project will need space, at the NLNG site onshore about 98 hectares will be used for the **Train 7 Project**. Nearshore and offshore, an increasing area will be used for the new carrier jetty, a new MOF and for maintenance dredging and shipping.

Most of new areas onshore were originally secondary forest prior to NLNG's presence. All areas are now cleared and have been part of previous developments and their construction, with the exception of any additional land needed for the New Worker Village. New Worker Village will be fenced off to minimise encroachment into the neighbouring forest and Finima Nature Park. Land around the New Worker Village is a mix of farms, secondary forest, swamp and mangrove. The land identified for the New Worker Village (around 31 hectares) is a mix of forest and swamp. Clearance will affect the plants and animals. With this change from natural habitat to developed land, the biodiversity of the region will be affected as well. In addition, the natural capacity of the area to deal with drainage of excess water, and with possibly contaminated water, will be changed.

The land on which the plant will be built has been loaded with sand (taken from a stock pile near the NLNG Main Gate) to compact and stabilise the land. Once adequate settling and compaction has been confirmed (usually after 6-12 months of settling), the sand will mostly be removed and stored elsewhere on NLNG's land, to leave a level site.

The impact of the upgrading of the New Finima Road between the roundabout and the New Workers Village may be substantial and widening (if needed) to the west is favoured to minimise impact on the Nature Park and land-take of secondary forest.

In the nearshore and offshore areas, the proposed activities will locally affect water depth and sediments structure. This will be a consequence of the construction of the new carrier jetty and possibly a new MOF. Impacts of the increasing shipping activities on sedimentation and erosion patterns are likely.

0.6.2.2 Materials, goods, etc.

The Project will need water, chemicals, (building and office) materials and fuel during both construction and operation; food is to be supplied for the construction workers and later for the operational staff. These will be purchased locally as far as practical and this will have both a positive (enhancements to local economic prosperity) and negative (pressure on resources and potential inflation of prices). The project will also produce waste during construction and commissioning and operation phases. All RA utilities and services, including sewage collection and treatment and solid waste disposal are to be provided from the NLNG plant facilities.

0.6.2.3 Human resources

A large group of construction workers will be needed. The presence of all these people will have consequences for the original population on Bonny Island, both in terms of health – introduction and passing on of diseases, but also for existing habits and socio-cultural values. After the construction period, most of these job seekers will go elsewhere and this will lead to other effects on the local economy and social stability. A Nigerian Content Plan has also been developed to ensure that jobs are primarily provided to Nigerian nationals and especially Bonny indigenes.

0.6.2.4 Emissions to air

During the construction phase, most emissions will arise from transport while during the operations phase, the main emission sources are combustion sources onshore (gas turbines, flare, acid gas incinerator) and marine activities (tugs, LNG carriers etc.).

Nitrogen dioxide (NO₂), sulphur dioxide (SO₂), particulate matter (PM₁₀) and carbon monoxide (CO) are the main pollutants considered in the assessment. During construction ambient concentrations of pollutants resulting from emissions from buses moving construction workers to and from the site were predicted to comply with all Nigerian standards at all locations modelled. However, there were predicted to be exceedances of 1-hour international standards for NO₂.

During operations, emission concentrations arising each individual source (process stacks) were assumed to comply with the applicable statutory requirements. In reality emissions are likely to be lower, as plant is designed to operate below these concentrations rather than at them. The dispersion modelling also assumed that all stationary sources operate for the full duration of the year at full load. The actual operation of the Facility will be less, and therefore so will the emissions. Modelling of the dispersion of all emissions/pollutants was carried out to assess the impact of emissions associated with the Facility on the surrounding air quality. There were predicted to be exceedances of international 1 hour NO₂ and annual mean PM₁₀ air quality standards, as well as the Nigerian 24 hour standard for SO₂. The dispersion modelling highlighted that exceedances were predicted for the baseline (including existing Trains 1 – 6 operations and ship movements) and with inclusion of the **Train 7 Project**. Exceedances of the air quality standards were predicted at locations near to the coastline, and the largest contribution to pollutant concentrations are ships (LNG carriers and tugs). Use of ultra-low sulphur diesel significantly reduces the impact from emissions of SO₂.

0.6.2.5 Liquid effluents

The discharges of normal drainage and (treated) sewage / process water from the site will comply with applicable criteria. Dispersion of pollutants from the ETP shows that the additional effluent water released as a result of operations of the **Train 7 Project** into the Bonny River is negligible and no further mitigation is required.

Effluents from ships, such as bilge water, ballast water, etc., may affect the quality of the nearshore and offshore waters and consequently the marine organisms, including fish and the fisheries. Anti-fouling paints, used at the outer side of the ship, may also pose a serious hazard to marine life. For this reason, NLNG shall instruct international contractors to use only vessels that fully comply with the intentions of the International Convention on the Control of Harmful Anti-fouling Systems on Ships.

0.6.2.6 Solid wastes

Hazardous and non-hazardous (semi-)solid wastes may impact on different environmental compartments (air, water and soil), depending on the way these wastes are treated, incinerated or land-filled. Improperly handled waste poses a risk to human health.

0.6.2.7 Airborne Noise

Noise modelling has been performed for the **Train 7 Project**. The modelling was based on the measured noise of Trains 1-6 and a combination of manufacturer data and data from existing equipment that is similar to that proposed for the **Train 7 Project**. The noise calculations show that the Nigerian and international noise limits are met i.e. with the **Train 7 Project** operating it can be expected that the noise levels at the edges of the nearest communities are within the applicable standards as adopted by the Project during night time and daytime.

During the construction phase, temporarily higher noise levels will arise. The result of noise modelling suggest that the Nigerian and international noise limits will not be met in Amariare village waterfront as result pile driving activities. Given the setting and industrial nature of the site mitigation associated with noise from piling activities is not recommended.

0.6.2.8 Underwater Noise

For the construction of the marine facilities, underwater noise levels and noise propagation were calculated for the **Train 7 Project** activities to assess impacts on marine species. As a result of the assessment it was concluded that the piling activities for the marine facilities could potentially impact marine mammals, turtles, however these impacts is expected to be negligible. For the fish species impacts from piling are expected to be minor.

0.6.2.9 Light

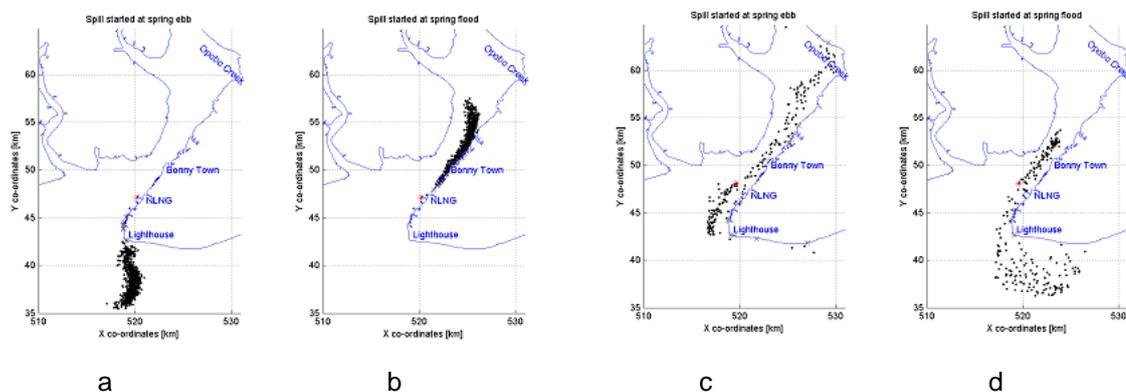
Light will be generated by traffic, the plant and by flaring; people and animals may be affected and/or attracted.

0.6.2.10 Heat

Flaring is the most important source of radiation; (migrating) birds and insects may be affected, especially during night-time.

0.6.2.11 Spills and Incidents

Spills and incidents may affect all environmental components and services through “acute” emissions, effluents and wastes. Modelling of condensate and oil spills was used to demonstrate the fate and effects of products spilled on the water surface. For a few examples of spill scenarios see Figure 0-7. Situations a and b refer to a scenario of 300 tonnes condensate spilled in 10 minutes; a at spring ebb tide and b at spring flood tide. Situations c and d refer to 3000 tonnes heavy fuel spilled in 2 days; c at spring ebb tide and d at spring flood tide. In a worst-case scenario, more than 30 km of shoreline can be covered with oil.



Source: NLNG (2018)

Figure 0-7 Examples of modelling of fate and behaviour of oil spilled at the NLNG Jetties

0.6.3 Cumulative effects

The assessment of any cumulative impacts caused by the Project - also in relation to other past, present and future developments - is a statutory requirement in Nigeria and is required by international guidelines. Chapter 6 of this report describes how NLNG attempts to deal with such cumulative effects in its impact assessments.

The effect of existing industrial and social developments (in and around Bonny Island) have been included in the baseline measurements taken historically and in 2018. By adding the impact of the **Train 7 Project** to this baseline a cumulative assessment has been carried out. This has also been done in other ways for noise and air quality. Noise and emissions to air from Trains 1-6 and the **Train 7 Project** have been modelled to enable a detailed assessment of cumulative impacts to be made, more so than would be possible from just measurements as the model can predict more details and more extensively than any monitoring could. The results are discussed above. It was not possible to do this kind of modelling of 3rd party activities due to a lack of emissions data.

However, cumulative impact is not always amenable to modelling and so for some aspects professional judgement has been used (e.g. social impacts).

Several activities directly or indirectly related to the NLNG developments, may take place in the offshore area. These include dredging of the Bonny Channel, to increase the capacity for shipping to and from the jetties of Bonny Island. Possibly combined (additive or synergistic) effects of all past and coming dredging activities on the coastal morphology, nearshore geohydrography, oceanography, marine resources and fisheries have not been assessed, as being outside the scope of this impact assessment.

The community has called for a “Carrying Capacity Study” (CCS) for the area, such study cannot be initiated by a single operator but is more properly initiated by the Federal Ministry of Environment (FMEv) and could be supported by the Joint Industry Companies (JIC). This study is likely to address cumulative effects of all kind of activities and developments on the Island.

0.7 Mitigation and enhancement

Mitigation measures have been identified and are designed for all potential impacts identified. NLNG recognises the importance of including effective mitigation in the Project where this is needed. Hence, the mitigation actions in this ESHIA Report represent commitments by NLNG Ltd. Where the potential for added value has been identified for positive impacts, these opportunities are considered as enhancement measures.

0.7.1 Mitigation measures for the Construction phase

A total of 9 positive and 49 negative impacts identified with a varying degree of significance is shown in the left diagram in Figure 0-8. Chapter 7 describes all actions which are needed to mitigate the “moderate” and “major” impacts as much as possible. After implementation of the mitigation measures, no “major” items and only one “moderate” item remain; this residual impact is shown in Figure 0-8. By mitigation, a shift becomes apparent to residual impacts with lower risk and/or lower consequences: the “negligible” and “minor” items increased from 28 to 48.

Impacts before mitigation							Residual impact after mitigation						
C	Potential Consequences						C	Potential Consequences					
Likelihood	Positive	Hardly any	Little	Considerable	Great	Extreme	Likelihood	Positive	Hardly any	Little	Considerable	Great	Extreme
High	Positive 9	Moderate 0	Moderate 3	Major 1	Major 0	Major 0	High	Positive 9	Moderate 0	Moderate 0	Major 0	Major 0	Major 0
Medium high		Minor 2	Moderate 2	Moderate 2	Major 3	Major 0	Medium high		Minor 2	Moderate 0	Moderate 0	Major 0	Major 0
Medium		Minor 1	Minor 7	Moderate 8	Moderate 0	Major 0	Medium		Minor 4	Minor 5	Moderate 0	Moderate 1	Major 0
Medium low		Negligible 1	Minor 6	Minor 2	Moderate 0	Moderate 1	Medium low		Negligible 3	Minor 5	Minor 8	Moderate 0	Moderate 0
Low		Negligible 5	Negligible 2	Minor 2	Minor 0	Moderate 1	Low		Negligible 5	Negligible 14	Minor 2	Minor 0	Moderate 0

Figure 0-8 **Train 7 Project** Construction phase. Impact significance before (L) & after (R) mitigation

The proposed mitigation actions are of a very diverse nature; some are organisational or procedural controls. The implementation thereof is highly determined by the efficacy of Company's and EPC Contractor's management systems.

0.7.2 Mitigation measures for the Operations phase

A total of 5 positive and 50 negative impacts identified with a varying degree of significance is shown in the left diagram in Figure 0-9. Chapter 7 presents all the actions in detail which are needed to mitigate these “moderate” and “major” impacts to as low as reasonably practicable (ALARP).

Impacts before mitigation							Residual impact after mitigation						
O	Potential Consequences						O	Potential Consequences					
Likelihood	Positive	Hardly any	Little	Considerable	Great	Extreme	Likelihood	Positive	Hardly any	Little	Considerable	Great	Extreme
High	Positive 5	Moderate 1	Moderate 0	Major 2	Major 1	Major 0	High	Positive 5	Moderate 0	Moderate 0	Major 0	Major 0	Major 0
Medium high		Minor 0	Moderate 2	Moderate 8	Major 1	Major 0	Medium high		Minor 2	Moderate 0	Moderate 0	Major 0	Major 0
Medium		Minor 1	Minor 1	Moderate 11	Moderate 2	Major 1	Medium		Minor 0	Minor 5	Moderate 1	Moderate 2	Major 0
Medium low		Negligible 1	Minor 1	Minor 1	Moderate 0	Moderate 0	Medium low		Negligible 8	Minor 2	Minor 7	Moderate 0	Moderate 0
Low		Negligible 3	Negligible 11	Minor 2	Minor 0	Moderate 0	Low		Negligible 5	Negligible 12	Minor 3	Minor 3	Moderate 0

Figure 0-9 Train 7 Project Operations phase. Impact significance before (L) & after (R) mitigation

After implementation of the mitigation measures, no “major” items and 3 “moderate” items remain (see Figure 0-9). By mitigation a shift becomes apparent to residual impacts with lower risk and/or lower consequences: the “negligible” and “minor” items increased from 21 to 47.

The mitigation actions for the Operations phase of the Project are of a very diverse nature; some are organisational or procedural controls. The implementation thereof will be highly determined by the efficacy of NLNG's management systems and for the extra resources (staff) required to manage all actions.

0.8 Environmental Social and Health Management Plan (ESHMP)

The last step in the ESHIA process involved the translation of the mitigation measures into an management plan, i.e. the Environmental, Social and Health Management Plan (ESHMP). This ESHMP provides a complete list of all mitigations and monitoring actions committed to by NLNG in relation to the Train 7 Project. Only impacts rated either as minor, moderate or major are mitigated. For some items rated negligible, positive or of neutral impact, there are enhancement actions which are included in the Management Plan as well. Other items will be managed through continuous improvement in NLNG's performance. The ESHMP also contains details regarding action parties, monitoring of implementation and review of performance. As such, this Plan will be integrated in NLNG's existing HSE-MS (Health, Safety and Environment Management System). Public reporting of the implementation of committed actions will also happen on NLNG's website.

This ESHMP also contains a number of actions aimed at optimisation of the HSE-MS. The need for this optimisation follows from the fact that the continuing expanding site with fast growing operations is not fully aligned with the required organisation and management systems for HSE (health, safety and environment) and SD (sustainable development). Adjustment and optimisation are specifically needed in the following elements of the Management System: “organisation and responsibilities”, “planning and procedures” and “implementation”.

As part of the Train 7 Project expansion and the associated ESHIA, NLNG recognises its role in improving the natural, social and health environment on Bonny Island and is eager to identify all

opportunities for enhancing positive effects or to identify opportunities to add benefits for local people. Thus, where neutral, negligible or positive impacts have been identified opportunities for enhancement have been proposed - these are also described in the mitigation tables.

0.9 Decommissioning and abandonment

Decommissioning of the facility will - as part of the decommissioning and abandonment of the whole LNG plant - be carried out at the end of the field life of the producing gas fields in accordance with legislation and best practice industry technology and required practices in place at that time. The aim is to decommission to, as near as possible, original conditions. Prior to that time a separate EIA/ESHIA Report will be prepared for this activity.

0.10 Summary, conclusions and recommendations

0.10.1 Summary

The Nigeria Liquefied Natural Gas Ltd (NLNG) **Train 7 Project**, for which this Environmental, Social and Health Impact Assessment (ESHIA) was prepared, is the further expansion of the Liquefied Natural Gas (LNG) plant on Bonny Island.

Early Works (site sand loading) were completed in mid-2019. Initial site activities for the main EPC contract are foreseen to commence late 2019 or early 2020. Final commissioning and start-up of the **Train 7 Project** is anticipated for 2024.

The history of NLNG shows a long and impressive sequence of projects. The ESHIA for the previous design for expansion – the **SevenPlus** Project – demonstrated that several criteria were being approached or exceeded. The **Train 7 Project** is smaller than the **SevenPlus** Project in many ways and baseline has also changed for the better (in terms of negative impact) and hence negative impact may also be smaller or non-existent e.g. some settlements have since been relocated to New Finima and so are no longer impacted by proximity to the NLNG site.

The **Train 7 Project** can be developed provided careful design, management and control are implemented. In the initial opportunity-framing workshop, a way forward was agreed with the application of very tough standards. The EIA process that followed was managed to integrate all aspects, standards and challenges and investigate if, and how the Project could be realised.

NLNG started this ESHIA process very early in design to enable mitigations and enhancements to be included in design, construction and operation to achieve an optimised design. This Report reflects the outcomes of this ESHIA process and takes into account in an integrated manner the natural environmental, human health, social, trans-boundary and global environmental aspects. Consultation with stakeholders was an integrated element of the EIA process.

NLNG's sustainability principle "to engage and work with stakeholders" entails a continuing dialogue with project-affected groups and local Non-Governmental Organisations (NGOs) about environmental and social aspects of the Project. Although the consultation process was characterised by several interfering ups and downs, stakeholders were engaged in the evaluation of the results of the impact assessment. The main deliverables of the ESHIA are the mitigation measures in the ESHMP (Environmental, Social and Health Management Plan). These are not only the committed actions by NLNG and its Contractor, but NLNG expects they will be fully supported by the stakeholders when all the latest suggestions are incorporated, making this Project a feasible and acceptable activity.

0.10.2 Conclusions

The main conclusions from this impact assessment are:

- The ESHIA carried out for the **Train 7 Project** demonstrates that this Project can be developed since all applicable conditions have been satisfactorily complied with:
 - Efforts to further mitigate hazards and effects to acceptable levels;
 - Full compliance with Nigerian statutory requirements, international standards and shareholder conditions;
 - A general mandate to proceed as a result of the consultation process with stakeholders.
- The Project will add to the substantial economic benefits for Nigeria from the liquefaction and export of gas in the form of generation of revenues from the sale of Nigeria's considerable under-utilised, low-cost, natural gas reserves.
- The **Train 7 Project** can also use associated gas which enables fields to be developed without the need for flaring.
- Employment opportunities will continue, as for the **Expansion, Plus** and **Six** Projects, in particular during the construction phase. The increased financial flows that this and the acquisition of materials generate will have continuing benefits for the local and regional economy. There are very ambitious targets for Nigerian content all through design construction and operation.
- The hazards of the **Train 7 Project** are similar in quality to those of the earlier Projects.
- The LNG site itself represented a long-term claim on land. This land, however, has currently an industrial function² and cannot be used for other purposes such as housing. The construction and operation of the **Train 7 Project** will need some additional land due to a new carrier jetty, road upgrading and widening, and Worker's Accommodation but not process areas.
- The quality of the **Train 7 Project** discharges – such as emissions, effluents, noise, etc. – fully complies with the Health Safety, Security Environment and Social Performance (HSSE&SP) Premises (Appendix 21), which were part of the **Train 7 Project** design process. The **Train 7 Project** also complies with the applicable Nigerian and international standards and guidelines. However, when the emissions and noise were added to the ambient conditions, comply with all Nigerian standards (except the 24-hr mean standard for carbon monoxide (CO) (because of already high existing concentrations not because of the impact of the modelled emissions)).
- During the consultation process the local stakeholders have brought up some outstanding issues. NLNG has taken efforts to improve and to implement previously agreed mitigation and enhancement measures, as well as outstanding promises.

² The control over additional space at the eastern and southern sides of the plant was required to enforce the safety and sterile zones. Compensation for the loss of natural habitat was realised through investment in nature conservation elsewhere. No persons were directly affected by the land take.

0.10.3 Recommendations

- Continue and document carefully the public consultation process through regular meetings in which all parties share concerns, experiences, observations and potential solutions. All relevant NLNG departments, including External Relations (ER), Community Development & Relations (ERC) and Environmental Affairs (HSE/1) Affairs should contribute. Tools to optimise communication, such as the NLNG website, should be used efficiently.
- Ensure the EPC contractor takes careful note of the ESHMP from the ESHIA for the **Train 7 Project** and incorporates the measures in their contractor HSSE system.
- Good alignment with the Bonny-Bodo road project and the **Train 7 Project**, to ensure that the road Section to the Workers Camp near Bonny Town will be available in time.
- Continue air quality and noise monitoring at and around the NLNG site.
- Upgrade and develop the port reception facilities of NLNG to accommodate the increased marine traffic, during construction and with the operation of a third LNG jetty. Inform the fishing community about the increased vessel movements during construction and operation of the third LNG jetty.
- Integrate the ESHMP resulting from the ESHIA for the **Train 7 Project** in the existing long-term management plans of NLNG Ltd under responsibility of the Social Investment and Sustainable Development Committee (SSDC).
- Integrate the reporting of the implementation of ESHMP Plans in the annual public reporting on Sustainable Development.