**ZAMFARA STATE GOVERNMENT**

**AGRO CLIMATIC RESILIENCE IN SEMI ARID LANDSCAPES (ACReSAL) PROJECT**

# FINAL: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

## BULKA EROSION & STORMWATER MANAGEMENT SITE, GUSAU LGA, ZAMFARA STATE. NIGERIA.



**JUNE 2026**

# FINAL

# ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN (ESMP)

**FOR**

# BULKA EROSION & STORMWATER MANAGEMENT SITE, GUSAU LGA, ZAMFARA STATE. NIGERIA.

**Credit No.: IDA51050**
**Project ID: P124905**


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Agro-Climatic Resilience in Semi-Arid Landscapes (ACReSAL)

THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

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**DECEMBER 2025**

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## LIST OF ACRONYMS

| | |
|---|---|
| ACReSAL | Agro-Climatic Resilience in Semi-Arid Landscapes |
| AoI | Area of Interest |
| ARAP | Abbreviated Resettlement Action Plan |
| ARAR | Applicable or Relevant and Appropriate Requirements |
| ATSDR | Agency for Toxic Substance and Diseases Registry |
| BMP | Best Management Practices |
| CBO | Community Based Organization |
| CCDI | Childhood Cancer Data Initiative |
| CESMP | Contractor Environmental and Social Management Plan |
| CGRC | Community Grievance Redress Committee |
| CHMP | Cultural Heritage Management Plan |
| CIP | Community Involvement Program |
| CMP | Chemical Management Plan |
| dBA | Decibels |
| DTC | Direct Town cleaning\ |
| E&S | Environmental & Social |
| EIA | Environmental Impact Assessment |
| EPA | Environmental Protection Agency |
| ERIP | Emergency Response and Incident Plan |
| ESHS | Environmental, Social, Health and Safety |
| ESIA | Environmental and Social Impact Assessment |
| ESMF | Environmental and Social Management Framework |
| ESMMP | Environmental and Social Management and Monitoring Plan |
| ESMP | Environmental and Social Management Plan |

| | |
|---|---|
| ESO | Environmental Safeguards Officer |
| FBO | Faith-Based Organization |
| FEPA | Federal Environmental Protection Agency |
| FGD | Focused Group Discussion |
| FGN | Federal Government of Nigeria |
| FMAFS | Federal Ministry of Agriculture and Food Security |
| FMARD | Federal Ministry of Agriculture and Rural Development |
| FMEnv | Federal Ministry of Environment |
| FMWR | Federal Ministry of Water Resources |
| FoNGO | Focal Non-Governmental Organization |
| FPMU | Federal Project Management Unit |
| GBV | Gender Based Violence |
| GEF | Global Environmental Facility |
| GEMS | Global Environment Monitoring System |
| GIIP | Good International Industrial Practice |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| GRASS | Gully Rapid Action and Slope Stabilization |
| GRC | Grievance Redress Committee |
| GRM | Grievance Redress Mechanism |
| GRRM | Grievance Referral and Redress Mechanism |
| IDF | International Development Fund |
| ISDS | Integrated Safeguard Data Sheet |
| ITCZ | Inter-Tropical Convergence Zone |
| ITD | Inter-Tropical Discontinuity |

| | |
|---|---|
| ITF | Inter-Tropical Front |
| IUCN | International Union for Conservation of Nature and Natural Resources |
| KWW | Kentucky Water Watch |
| LGA | Local Government Area |
| LGRC | Local Government/ Community Grievance Redress Committee |
| NESREA | National Environmental Standards and Regulations Enforcement Agency |
| NGO | Non-governmental Organization |
| NGRC | National Grievance Redress Committee |
| NPE | National Policy on Environment |
| NRO | Natural Resources Officer |
| OSHA | Occupational Safety and Health |
| PAD | Project Appraisal Document |
| PAH | Project-Affected Household |
| PAP | Project-Affected Person |
| PC | Project Coordinator |
| PCC | Project Complaints Committee |
| PE | Project Engineer |
| PHCs | Primary Health Centres |
| PRS | Government's Poverty Reduction Strategy (PRS) |
| PSPs | Private Service Providers |
| RAP | Resettlement Action Plan |
| SCCF | Special Climate Change Fund |
| SEA | Sexual Exploitation and Abuse |
| SGRC | State Grievance Redress Committee |
| SIEP | Shell International Exploration & Production |

| | |
|---|---|
| SLO | Social and Livelihood Officer |
| SMLS | State Ministry of Lands and Survey |
| SMOH | State Ministry of Health |
| SMOW | State Ministry of Works and Housing |
| SPMU | State Project Management Unit |
| STDs | Sexually Transmitted Diseases |
| TBAs | Traditional Birth Attendants |
| ToR | Terms of Reference |
| UN | United Nations |
| UNEP | United Nations Environmental Programme |
| VOC | Volatile Organic Compound |
| WB | World Bank |
| WHO | World Health Organization |
| WMP | Waste Management Plan |
| ZESA | Zamfara Environmental Sanitation Agency |
| ZS-ACReSAL | Zamfara State Agro Climatic Resilience in Semi-Arid Landscapes |
| ZSG | Zamfara State Government of Nigeria |

# EXECUTIVE SUMMARY

## ES1: INTRODUCTION

The Federal Government of Nigeria (FGN) has initiated the implementation of the Agro-Climatic Resilience in Semi-Arid Landscapes (ACReSAL) Project funded by the World Bank. The project will help Nigeria address critical challenges of regional desertification control and landscape management in northern Nigeria.

The Bulka area in Gusau has been particularly affected by stormwater and erosion problems due to its topography, soil characteristics, and rapid urbanization. The area experiences recurrent flooding during the rainy season, causing damage to infrastructure, properties, and posing risks to human lives. These challenges have been exacerbated by climate change effects, which have led to more unpredictable and intense rainfall patterns. Over the years, the existing drainage infrastructure in the Bulka area has deteriorated due to inadequate maintenance, increased sedimentation, and structural failures. This has significantly reduced the capacity of the drainage system to effectively manage storm-water runoff, leading to increased flooding problems and infrastructural damage.

The Zamfara State government, through the Federal Ministry of Environment (FMEnv), has identified the urgent need to address these challenges through the implementation of comprehensive storm-water management and erosion control measures. The Bulka stormwater and erosion control project is therefore designed to provide sustainable solution to this, thereby enhancing the resilience of the community to the impacts of flooding and erosion.

### *Project Location*

Zamfara State lies between latitude $12.16667^0$N and $6.2500^0$E. The State is located in the Northwest geopolitical zone of Nigeria with Gusau being the capital of Zamfara State. Zamfara is one of the seven states that form the North-West geopolitical zone of Nigeria with an area of 38,418 square kilometres, and a population of 383,162 as of the 2006 census. It is bordered to the north by the Republic of the Niger for 32 km (20 miles), to the south by Kaduna State for 117 km (73 miles) and Niger for 38 km (24 miles), to the east by Katsina State, and to the west by the states of Sokoto and Kebbi.

The Bulka stormwater channel is located within the Gusau Metropolis and extends over a total length of approximately 5.68 kilometres (4+684.73 km). The channel originates near the Yanmangurori, Gusau, at coordinates Latitude 12.182759°N and Longitude 6.684205°E (start point) and ultimately discharges into the Koramar Wanke River behind Hayin Malam Ibrahim Mai Wa'azi at Latitude 12.174098°N and Longitude 6.644889°E (endpoint).

***Development Strategy***

The development methodology for the Bulka Stormwater and Erosion Control Project represents a meticulously planned, phased approach designed to maximize efficiency, minimize environmental disruption, and ensure the highest standards of technical execution. This strategy transforms the complex 5.6-kilometer drainage infrastructure project into a systematically managed urban transformation initiative.

Activities involved in the gully development includes

- Site Preparation
- Foundation Construction
- Channel Formation
- Secondary Infrastructure -
- Ecological Restoration

*Major Equipment to be deployed*

- Excavators – (Precision earth moving - Channel formation - Minimal ground disturbance)
- Concrete Mixers – (Consistent mix quality - On-site concrete production)
- Crane Systems – (Heavy component placement - Structural element positioning)
- Compaction Equipment (Ground stabilization - Layer-by-layer compaction)

*Materials*

- Reinforced Concrete -High durability - Corrosion resistance -Long-term structural integrity -
- Steel Reinforcement (enhanced bonding - Improved fatigue resistance)
- Geotextile - Material: - (Soil stabilization - Filtration - Erosion control)

**ES.02: LEGAL AND ADMINISTRATIVE FRAMEWORK**

The preparation of this ESMP was guided by the Environmental Impact Assessment Act No. 86, 1992 (codified as EIA Act CAP E12 LFN 2004). Other legal and regulatory frameworks applicable to the project include: The Climate change Act, 2021, The Land Use Act, Cap L5, LFN, 2004, Employee Compensation Act (2010), Labour Act (2004), Social Development Act (1974), The Child Rights Act (2003), etc., while the Federal Environmental Laws, Regulations and Guidelines are applied to ensure international best practices in infrastructure development with due considerations on the safety and health of the environment. Also applicable are the relevant Zamfara State Environmental Sanitation Agency Law No. 22, 2010.

According to the World Bank Environmental and Social Framework (ESF) Environmental and Social Risk Classification, the ACReSAL project has been classified as “High Risk”. The Bulka Subproject is a Category B project, given the scale of construction and development works will have significant impact of the localized environmental and social receptors. The ESMP has been prepared in line with the Environmental and Social Management Framework (ESMF) prepared for ACReSAL. Eight (8) Environmental and Social Standards (ESSs) are relevant to the ACReSAL

project, and include: ESS 1 - Assessment and Management of Environmental and Social Risks and Impacts, ESS 2 - Labour and Working Conditions, ESS 3 - Resource Efficiency and Pollution Prevention and Management, ESS 4 - Community Health and Safety, ESS 5 - Land Acquisition, Restrictions on Land Use and Involuntary Resettlement, ESS 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources, - ESS 8 Cultural Heritage and ESS10 - Stakeholder Engagement and Information Disclosure. Other International laws, treaties and conventions to which Nigeria is signatory include:

- Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes and
- their Disposal
- The United Nations Convention on Biological Diversity
- The United Nations Framework Convention on Climate Change
- Convention of the African Energy Commission

**ES 3: BIOPHYSICAL ENVIRONMENT**

The prevailing environmental condition of an area where a development project would be implemented requires a detailed environmental assessment. A detailed assessment of the biophysical environment of project area is one of the cardinal aims of any well-planned intervention programs such as the proposed Bulka intervention project.

The Nigeria Meteorological Agency (NiMet) is the custodian of and authority in charge of weather situation data in Nigeria. For this study, climatic data was sources from archival records available at the Data Management Unit (DMU) of the NiMet, and supported with data from relevant literature.

Data collected and sampling was carried out on field from 3rd of December 2025 till 4th of December, 2025. The were collected during the dry season period.

**Climate and Meteorology**

Five (5) weather/meteorological parameters were analysed for this study. These weather elements are Rainfall, Temperature, Wind Speed, Wind Direction, and Relative Humidity. Analysis of weather elements given as mean value over a long period shows the overall trends of increase and/or decrease. Micro-climatic elements in terms of duration or intensity, changes, fluctuations, and variations have considerable influence on human activities.

***Rainfall Characteristics***

Rainfall is the principal element controlling the climate in tropical regions, including Zamfara State. It is also the primary driver of stormwater runoff and hence the most critical meteorological parameter for the design of the Bulka Stormwater & Erosion Control Project. Based on historical data (1995-2024), the annual rainfall in Zamfara State ranges from 615.9mm to 1,442.2 mm, with a mean annual rainfall of approximately 858.42 mm. This indicates significant variability in annual

rainfall amounts. Out of the 30 years of records analysed, only in six years did the annual rainfall amount exceed 1,000 mm.

***Relative Humidity*** Relative humidity in Zamfara State, including Gusau, shows significant seasonal variations, corresponding to the wet and dry seasons. During the wet season (May to October), relative humidity increases substantially, with maximum values occurring in August when it can reach up to 77%.

***Temperature***

The temperature regime in Gusau, like the rest of Zamfara State, is characterized by high and relatively stable temperatures throughout the year, with seasonal fluctuations. Based on long-term records, the mean minimum temperature ranges from 16.9°C to 27.1°C, while the mean maximum temperature ranges from 31.3°C to 40.8°C.

***Wind speed***

Wind speed is relatively high throughout the year across Zamfara State, including Gusau. On average, wind velocity exceeds 28 km/h, while lesser winds decline month-on-month. Most days of the month, wind usually exceeds 19 km/h and rarely exceeds 28 km/h.

***Wind direction***

Wind direction is predominantly from the northeast during the dry season (harmattan) and from the southwest during the wet season (monsoon). This seasonal shift in wind direction corresponds to the movement of the Intertropical Convergence Zone (ITCZ) across the region.

The prevailing wind direction over the region is south westerly. Highest wind direction for the month and the year is South-West (SW), meanwhile, the wind pattern during dry season of November to March is usually north easterly

**Air and Noise Measurements**

Air quality levels were measured at strategic locations along the proposed project location (Bulka gully corridor). A total of 10 sampling points were delineated along the project corridor. The samples were collected for the duration of the study

Air quality measurements were taken across 10 locations. Air quality parameters measured include Carbon Monoxide (CO), Nitrogen Oxides (NOx), Sulfur Oxides (SOx), Volatile Organic Compounds (VOC), Suspended Particulate Matter (SPM 2.5, SPM 10). The results showed that, the measured concentrations for particulates had mean values of 133.93 µg/m3; and 234.84 µg/m3 respectively for SPM 2.5 and SPM 10. $SO_2$ was detected at all the sampling points, with concentration level ranging from 0 to 0.2 with a mean value of 0.15ppm. CO was obtained in all the sample stations and the level ranging from 1 – 14ppm. $CH_4$ was below detection of limit <0.04 across all stations. VOC was detected at all sapling points with values ranging from 13.2-315.2

ppm with mean value of 122.13ppm. Noise assessment shows that all values were below FMEnv regulatory limit.

**Soil Quality**

Soil samples were collected at 10 strategic locations along the proposed project corridor at depths of 0 to 30 cm using a calibrated (marked) stainless steel soil auger. Soil samples were collected into Ziploc bags and stored for analysis

***Physiochemical***

*pH*

pH is a commonly measured soil quality parameter. It determines the acidity, neutrality or alkalinity of a particular soil and indicates the availability of exchangeable cations (e.g., Ca2+, Mg2+, K+ etc.). The pH ranged from 6.2 – 7.6 with a mean of 6.6. The results shows that the soil of the study area is generally within safe limits of 6.5 – 8.5.

*Nutrients (Anions and Cations)*

Sulphate and Nitrate had mean values of 19.78 mg/kg and 11.08 mg/kg respectively.
Calcium (Ca), Magnesium (Mg), and Sodium (Na) had mean values of 15.58, 6.04, and 14.39 mg/kg respectively.

*Heavy Metals*

Several heavy metal parameters were analyzed for the Bulka ESMP. Iron contenthad a mean of 202.73mg/kg, manganese has mean value of 4.123mg/kg, and zinc had mean value 0f 1.608mg/kg.

*Soil Microbiology*

Microbiological parameters considered include Total plate count, total coliform, E. *coli*, etc. The microbial analysis showed the presence of microorganism such as E. c*oli* across all stations and presence of Salmonella in only 5 stations. *Vibrio cholerae* and *Pseudomonas acruginosa* were absent in all sample stations. The presence of E. coli within the soil can be attributed to visual evidence of open defecation within and around the project area and can pose health risk to people especially children within that area.

**Surface Water Characteristics**

Three (3) Surface water samples and two (2) controls were collected at upstream, midstream and downstream of the Koromar wanke river (locally called Gulbi). The river is the discharge point (end point) of the Bulka erosion site.

***Physiochemical***

pH values ranged from 8.7 – 9 with a mean value of 8.8. This result shows that waterbody is alkaline and slightly above WHO safe limit of 6.5 – 8.5.

Electrical Conductivity had mean EC values 377µs/cm. The electrical conductivity is influenced by the presence of Total solids in the water. There is a very high anthropogenic activity in the water body. Activities like sand mining, domestic washing, fishing, amongst others.

DO values recorded in the study ranged from 6.12 – 8.63mg/l with a mean value of 7.09 mg/l.

Turbidity had mean value 2.5NTU. this value is within the FMEnv regulatory limit of 5NTU
.

***Heavy Metals***

Natural waters contain very small quantities of several essential metals. Mean values across the Gulbi water includes; zinc (Zn) – 0.04, copper (Cu) - <0.07, Cadmium (Cd) - <0.03, lead (Pb) - <0.01, iron (Fe) – 0.05, Nickel (Ni) – 0.88, chromium (Cr) – 0.063, manganese (Mn) - <0.03, barium (Ba), vanadium (V) - <0.01 and mercury (Hg) - <0.001. All heavy metals had mean values within the FMEnv regulatory limits.

**Sediment Sampling**

The sediment sampling stations were co-located with the Surface water stations.

***Physico-chemical***

The pH of the sediment around the field ranged from 5.9 – 6.4 with an average of 6.2. Values obtained is within safe limit of 6.5-8.5
Total Organic Carbon (TOC) had mean values of 1840mg/kg.

***Heavy metals***

Iron (Fe) displayed the highest average concentration, reaching 86.80mg/kg which above FMEnv standard. Though Iron is not one of the most toxic metals, however, elevated levels has the ability to influence biogeochemical processes such as phosphorus binding and cause increased nutrient release during low or ambient levels of dissolved oxygen. The other analysed metals exhibited lower average concentrations: (Zn), 1.33mg/kg, and Copper (Cu), 0.704mg/kg.

**Groundwater Sampling**

Groundwater samples were collected from one (1) existing borehole and one (1) hand dug well.

**Physicochemical**

The pH concentration of the groundwater samples from within the project area of influence had a mean value of 7.35

Dissolved Oxygen (DO) had a mean value of 7.93mg/L.

Total suspended Solids (TSS) ranged from 0. 40 to 0.11 mg/L and had a mean value of 0.075mg/L.

Temperature had a mean value of $24^0$C.

***Heavy Metals***

Lead was not detected in any of the groundwater samples collected in all the stations.

Copper mean concentration recorded was 0.05mg/l. Results of all sampling station showed concentration was within WHO limit of 2.0mg/L.

Iron concentration was below equipment detection limit. Results of all sampling station showed that iron content in the water was not detected.

**Biodiversity Assessment**

The Bulka Erosion and Stormwater Management Project in Zamfara State was conceived as a strategic intervention to address the escalating challenges of land degradation, gully erosion, and biodiversity loss in Nigeria's semi-arid Sudan–Sahel transition zone. This ecological baseline study provides a comprehensive overview of vegetation, wildlife, hydrology, and anthropogenic pressures, while also outlining management strategies designed to ensure sustainable outcomes for both ecosystems and local communities.

The assessment reveals a landscape under considerable ecological stress. Settlement expansion and infrastructure development have fragmented riparian habitats, eliminated natural buffer zones, and reduced breeding and shelter sites for flora and fauna. Vegetation analysis recorded during field survey 4,871 individual plants across 57 species and 32 families, reflecting moderate diversity but clear signs of disturbance. Herbs dominated the flora, accounting for 66.9% of individuals, followed by shrubs (21.5%), lianas (6.9%), and trees (4.7%). Disturbance-adapted species such as *Typha latifolia* (524 individuals), *Lactuca sativa* (392), and *Amaranthus viridis* (330) were the most abundant, underscoring the pressure exerted by human activities. Tree species were limited, with *Mangifera indica* (89 individuals), *Azadirachta indica* (39), and *Acacia nilotica* (27) among the most common, while *Khaya senegalensis*, an ecologically significant savanna tree, was recorded in low numbers and is classified as Endangered (EN) on the IUCN Red List.

Biodiversity indices further highlight the uneven distribution of species across transects. Shannon–Wiener diversity values ranged from 1.59 in highly degraded sites to 2.12 in more intact plots, while Simpson's diversity varied between 0.80 and 0.86. These results indicate moderate overall diversity but poor evenness in disturbed areas, with invasive herbs dominating the vegetation structure. Wildlife surveys confirmed the presence of small mammals, reptiles, and amphibians, all assessed as Least Concern globally, except for the Lesser Kestrel (*Falco naumanni*), a Vulnerable migratory raptor observed foraging in open grasslands. Its presence underscores the international conservation significance of the project area.

**Hydrobiology Assessment**

Phytoplankton analysis generally (Figure 3.9) shows a community dominated by Diatoms (43.1%), followed by Green algae (42.3%), Blue-green algae (12.7%), and minor contributions from Golden algae (0.9%) and Dinoflagellates (1.1%).

Micro-zooplankton were recorded at all Zamfara headwater stations, comprising Rotifers, Cladocerans, Copepods**,** and occasional molluscan and fish larvae. Aggregated across stations, Copepods contributed ≈48.1% of total abundance, Cladocerans ≈19.8%**,** Rotifers ≈31%**,** and others (molluscan/fish larvae) ≈1.2%.
Within the copepods, the most abundant taxa were *Microcyclops varicans* (49ind./ml), *Metacyclops minutus* (35), and naupliar stages (28), while cladocerans were led by *Moina micrura* (40) and *Kurzia longirostris* (29). Rotifers were dominated by *Lecane leontina* (26), *Brachionus falcutus* (23), and *Lepadella ovalis* (22). The strong copepod signal and the consistent presence of cladocerans indicate oxygenated, moderately productive waters with functional hydrological connectivity, typical of Sahelo-Sudanian headwaters where flow variability sustains mixed grazer guilds.

**Fisheries Study of The Area**
The Zamfara headwaters form part of the Sokoto–Rima/Niger system, where seasonal floodplain connectivity drives fish recruitment, diversity, and artisanal catches (FAO, 2020; Oladipo *et al*., 2023).

A rapid fish survey across five sampling stations in the Zamfara River headwaters revealed a multi-species assemblage typical of Sahelian inland waters. Several juveniles were observed at all stations, confirming the ecological importance of these headwaters as breeding and nursery grounds. Generally, artisanal catches and literature indicate a multi-species fishery dominated by Tilapia (*Oreochromis* spp.) and African catfish (*Clarias gariepinus*), alongside characids (*Alestes*, *Brycinus*), *Synodontis* spp., and floodplain taxa such as *Heterotis niloticus* (FAO, 2020; Jeje & Fernando, 1992). In Northern Nigeria, *Synodontis eupterus* is well documented in River Rima for its commercial importance and reproductive traits, while characids show broad omnivory/planktivory and seasonal diet flexibility (Shinkafi & Daneji, 2011; Saliu, 2002; Echi & Ezenwaji, 2016).

**ES 4: SOCIOECONOMICS ASSESSMENT**
Zamfara State has a population of 3,278,873, with a projected population of 5,833,500 in 2022. The population growth is +3.4%/year (2006 - 2022), with a density of approximately 82/km2 and a total land area of 39,762 km2. Zamfara state's population comprises 50.07% male and 49.93% female. The age distribution showed that 47.97% are between 0 -14 years, while 49.19% are between 15-64 years, with only 2.84% 65 years and above. This population dynamics provide an excellent advantage to Zamfara state, which has a massive youthful population and less than 3% of the elderly, showing a dependency ratio of about one and, hence, a lower social support system

The Socioeconomics and Health Impact Assessment (SEHIA) for the Bulka Stormwater and Erosion Management Subproject has been undertaken to establish a detailed baseline understanding of the human environment that may be affected by the proposed intervention. Bulka community, located within Gusau Local Government Area (LGA) of Zamfara State, experiences recurrent flood events, drainage blockage, and progressive gully formation, which have resulted in displacement, loss of farmland, destruction of household assets, and heightened environmental and health risks during the field study. In total, 350 questionnaires were administered in Bulka community, but only 328 were successfully retrieved and valid for analysis, representing a 93.7 % response rate. The 328 respondents surveyed collectively account for a total of 1,485 household members within Bulka community. This indicates relatively large household sizes, which is characteristic of many communities in Zamfara State and reflects extended family living arrangements and strong kinship ties. The household data provide a critical basis for understanding population structure, dependency levels, and potential vulnerability to project impacts. Documenting household size and composition is essential for accurately assessing the scale of socioeconomic effects and for designing appropriate mitigation, compensation, and support measures for households affected by the project.

Based on the 2006 National Population Census and the NPC annual growth rate of 3.2%, the projected population of Gusau LGA for 2024 is estimated to be 620,000. Bulka community represents a peri-urban settlement within this LGA, with a relatively dense population due to its proximity to Gusau metropolis. Based on the 2006 census figures, the population of Zamfara state comprise of 50.07% male and 49.93% female. The age distribution showed that 47.97% are between 0 -14 years while 49.19% are between 15-64 years with only 2.84% 65 years and above. This population dynamics provide a good advantage to Zamfara state with huge youthful population and less than 3% elderly showing dependency ratio of about 1 and hence a lower social support system. The distribution between male and female also calls for an increased role for the women folks.

The survey data indicate a male–female distribution of 55.2 % male and 44.8 % female among households in Bulka community which reflects a higher representation of male respondents within the project area.

The occupational distribution data show that trading and retail activities constitute the largest source of household income, accounting for 33.8%. This underscores the importance of small-scale commerce and market-related activities in sustaining household livelihoods, consistent with the community's peri-urban character. Casual labour and daily wage activities represent the second most significant income source at 23.2%, indicating a substantial reliance on informal and often unstable employment. Farming and agriculture contribute 18.6% to household income, reaffirming the continued relevance of agricultural activities despite increasing urban influence. Formal employment accounts for 11.3%, reflecting limited access to stable salaried jobs within the

community. Income from petty services stands at 8.5%, while small-scale businesses contribute 2.75.

Approximate monthly income distribution of households in Bulka community, Gusau Local Government Area, Zamfara State, revealing generally low-income levels among respondents. A large proportion of respondents (38.1%) preferred not to disclose their monthly income, which may reflect concerns about privacy, taxation, or social sensitivity around income reporting. Among those who disclosed their earnings, 22% reported a monthly income of ₦30,000–₦49,999, making this the most common declared income bracket. This suggests that a significant share of households survive on relatively modest earnings. Further analysis shows that 13.1 percent of households earn between ₦50,000–₦89,999, while 10.4 percent fall within the ₦10,000–₦29,999 range, indicating the presence of low-income and economically vulnerable households. Higher income brackets are less common: 7.9% earn around ₦100,000, 7.0% earn between ₦100,000–₦199,999, and only 1.5 percent report incomes of ₦200,000 and above.

***Health Status and Access to Healthcare Services in Bulka***

The Bulka project area exhibits health characteristics typical of a peri-urban settlement, where rapid population growth and limited infrastructure place pressure on existing health services. The health status of residents is influenced by environmental conditions, access to healthcare, and socioeconomic factors. The health profile of Bulka community is strongly influenced by environmental conditions, access to healthcare services, and socioeconomic constraints. Survey findings show that malaria and fever (52.1%) are the most prevalent illnesses, largely attributable to poor drainage, stagnant water, and increased mosquito breeding associated with flooding. Diarrhoeal diseases (21.7%) and waterborne diseases such as cholera and typhoid (17.3%) further reflect inadequate access to safe drinking water, poor sanitation, and hygiene practices. Although respiratory infections (5.7%) and flood-related injuries (3.2%) are less common, they become more pronounced during the rainy season and periods of severe flooding.

Maternal and child health outcomes remain a concern. There is a high reliance on Traditional Birth Attendants (TBAs), especially for home deliveries, while utilization of Primary Health Centres (PHCs) and private clinics is moderate

***Desirability of the Subproject***

The survey results indicate a unanimous support (100%) among respondents for the implementation of the subproject in the community. All respondents expressed strong approval and emphasized the importance of the subproject proceeding as a matter of urgency. Many participants specifically indicated a clear preference for the subproject to be implemented before the next rainy season, citing recurring flooding, erosion, and associated risks to lives, property, and livelihoods. This high level of community acceptance underscores the perceived relevance and

necessity of the subproject and reflects the expectation that it will significantly improve environmental conditions, safety, and overall quality of life within the project area.

***Awareness and Perception of Respondents on ACReSAL Intervention***

All respondents and community members who participated in the consultation process demonstrated a high level of awareness and acceptance of the proposed ACReSAL intervention in the Bulka communities. Participants clearly acknowledged that the existing erosion and flooding conditions pose serious environmental, social, and safety risks to their lives, properties, and livelihoods. Respondents indicated that persistent erosion and flooding have restricted access to social amenities, damaged infrastructure, reduced economic opportunities, and generally negatively affected living conditions within the community. As a result, the remediation options presented during the consultations were widely welcomed and strongly supported by the community members due to the anticipated environmental restoration, improved safety, and enhanced socioeconomic conditions. The respondents expressed confidence that the proposed ACReSAL intervention would provide a long-term and sustainable solution to the erosion and flooding challenges, which they described as persistent and difficult to control. Overall, the consultations revealed strong community optimism and willingness to support the project, reflecting a shared belief that the intervention will significantly improve resilience, environmental stability, and quality of life in the Bulka communities.

***Participants' Feedback – Comments and Concerns***

During the Bulka community meetings, the District Head conveyed the appreciation and gratitude of the communities to ACReSAL, the Zamfara State Government, the Federal Government of Nigeria, and the World Bank for the proposed erosion and flood control intervention. Several other participants also expressed their views and made constructive comments and suggestions regarding the proposed subproject. All speakers affirmed their willingness to provide full cooperation and continuous support to the ESMP Consultant and all parties involved in the implementation of the subproject

The key environmental and social issues and concerns raised during the stakeholder and community consultations in Bulka communities include the following:

- Community safety ahead of the next rainy season, with strong concerns about the increasing severity of flooding and erosion and the associated risks to human lives and residential structures;
- Potential loss of crops, livestock, and household assets due to continued flooding, as well as the increased risk of water-related diseases such as typhoid, cholera, diarrheal diseases, and malaria;
- Restricted access to roads, farmlands, and grazing areas, which affects mobility, agricultural productivity, and livelihoods;

- Possible physical displacement of vulnerable persons and households during the construction and implementation phases of the subproject.

All issues and concerns raised by the community members were adequately addressed during the meetings through explanations and clarifications provided by the ESMP Consultant and the SPMU representatives

**ES.05: Potential Environmental and Social Impacts**

The scale of the proposed erosion control and channelization works is such that severe negative impacts are not anticipated. The negative environmental and social impacts will be localized in spatial extent, short in duration and can be reduced or minimized through compliance with the implementation of the appropriate mitigation measures.

**The positive potential environmental and social impacts presented include:**

- Prevention of soil loss, property damage, and sedimentation in waterways.
- Channelization will help manage storm water flow, reducing the risk of flooding and associated damage.
- Reduced sediment and pollutant loads in waterways.
- Enhanced infrastructure stability such as roads, bridges, and buildings, from damage caused by erosion.
- Increased public safety: By reducing the risk of flooding and erosion, these projects will help protect people and property.
- Economic benefits: By reducing damage to infrastructure and property, erosion control and channelization projects also have economic benefits;
- Rehabilitation of degraded lands and their conversion into productive land;
- Improved commercial activities;
- Employment opportunities;
- Improve the environment and aesthetics condition of the area;
- Increase accessibility to people's homes

Some negative environmental and social impacts envisaged due to the nature of the civil works which will involve the use of heavy-duty equipment, use of labour, use of resources, generation of waste, movement of equipment and materials to site

**Negative Environmental Impact**

- Air Pollution Impacts
  - Dust pollution
  - Gaseous Pollution
  - Noise Pollution
  - Water Pollution Impacts
  - Water Diversion and Flooding Impacts

- Flood and Erosion
- Increased Topsoil Soil Erosion and Sedimentation Impacts
- Loss of Biodiversity and Natural Habitat
- Materials Sourcing Impact

**Negative Social Impact**

- Labour Influx t
- Security Issues
- Cattle Rustling
- Risk of social conflict
- Increased risk of illicit behavior and crime:
- Influx of additional population ("followers"):
- Increased burden on and competition for shared resources and public service provision:
- Increased risk of communicable diseases and burden on local health services:
- Child labor and school dropout:
- Local inflation of prices:
- Increased pressure on accommodations and rents:
- Increase in traffic and related accidents:
- Public Health and Safety
- Traffic Impacts
- Health and Safety Impacts
- Gender Base Violence, Sexual Exploitation & Abuse/Sexual Harassment
- Interference with Business and Daily Activities during Demolition
- Unplanned/Unforeseen Impacts

The potential negative environmental and social impacts with mitigation measures are summarized below

Air Quality: *Increase in dust generation and spread of dust*

- Regular damping of unpaved roads or exposed soils/ground to control dust/particulate matter and keep it down.
- Locate material stockpile areas as far as practicable away from sensitive receptors.

*Increase in emission of air pollutants from vehicles, plant and equipment, machinery*

- Ensure vehicles/machines are switched off when not in use.
- Ensure only vehicles required to undertake works are operated on-site.
- Ensure all construction vehicles, plant and machinery are well maintained and in full operating condition

Noise and Vibration -*Public nuisance caused by construction activities*

- Install noise reduction devices such as silencers and mufflers as appropriate to mobile plant and equipment.

- Limit work to daylight hours. Schedule noisy construction activities during specific times in the day especially near the sensitive receptors.
- Identify and avoid subjecting the adjacent highly sensitive receptors to vibrations
- Ensure that residents and road users are given advance notice on timing and scale of works, as well as details of the GRM in the event of issues.

Waste Generation *Oil and other potential contaminants are not properly collected, managed and/or disposed*

- Proper storage, transport and disposal of hazardous wastes (oily wastes, used batteries, fuel drums) in the designated areas by the national authorities
- Construction waste and solid waste generated are not properly managed or disposed

*Waste resulting from packaging materials*

- Recyclable waste (including oil and some construction waste) collected separately and disposed of correctly and/or approved facility as per the EPA requirements

Flora and Fauna: *Permanent destruction or disturbance of flora and fauna and their habitat*

- Avoid unnecessary clearance of vegetation and indiscriminate destruction of habitats.

Health, safety and security Labour and working conditions: *Risk of increased SEA/SH and GBV particularly due to influx of workers*

- Implementation of GBVAP
- Code of Conduct to include SEA/SH and GBV prevention
- SPIU will request that contractors, suppliers and partners adhere to zero tolerance for SEAH and GBV and commit to taking adequate action if faced with SEAH allegations
- Contractual arrangements can be terminated if breaches confirmed

*Given the level of GBV tendencies within the communities, there is a risk that labour influx might exacerbate GBV concerns*

- Gender issues to be included in the ESMP
- Implementation of GAP
- Code of Conduct to include SEAH and GBV prevention
- PMU will request that contractors, suppliers and partners adhere to zero tolerance for SEAH and GBV and commit to taking adequate action if faced with SEAH allegations.

*Poor working conditions and workers health, work related incidents and injuries*

- Prepare and implement the OHSMP
- Train all staff in emergency preparedness and response.
- Keep a First Aid Kit on site and ensure that drinking water is provided.
- Personal Protection Equipment (PPEs) are provided to workers

This project may face an influx of labour as skilled labourers required might not be available in the communities along the project corridors. Therefore, Zamfara ACReSAL will take concrete

measures to avoid and mitigate potential labour influx-related risks such as workers' sexual relations with women/minors and resulting to unwanted pregnancies, presence of sex workers in the community, the spread of HIV/AIDS, sexual harassment of female employees, child labour and abuse, increased dropout rates from school, inadequate resettlement practices, and fear of retaliation, failure to ensure community participation, poor labour practice, and lack of road safety. These risks require careful consideration to improve social and environmental sustainability, resilience and social cohesion.

## ES.06: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

### Environmental and Social Mitigation Measures

Environmental and Social Mitigation Measures were prepared for all the identified potential impacts.

***Pre-Construction***: Proper awareness/sensitization of the host community on the project and involvement of community during preparation and implementation.

***Construction***: The expected activities during constructions include: Excavation, Channelization, Concretization, and Filling; Lining, and Re-vegetation.

Some of the recommended mitigation measures include: a distance gap of 30 metres between heavy duty machinery and filling material from the gully channel; avoidance of vibration induced machines; lowering of overhand before using excavator with a boom of at least 25 meters, limiting of civil work to dry season where applicable, tree planting, proper handling of waste, spraying of water to prevent dust, use of PPE, where possible, construction activities should be limited to day time, ensuring that all regulations on wild animals and their related habitats are strictly adhered to, prioritizing GBV/SEA, HIV/AIDS and STD awareness programme and placing speed limits signboards at strategic locations. Also, the Contractor and Consultants are expected to hire, to the maximum extent, skilled and unskilled workers from affected local communities in the project area.

***Operation***: Maintenance operations should be designed according to environmental safety guidelines, periodic checks on ambient environmental quality particularly air and provision of speed limits signboards.

### *Capacity Building and Training*

Capacity building measures will be required to ensure that institutions involved in implementing the various ESMP components have the necessary knowledge and skills to fulfil their roles. A capacity building plan, recommended modules and its associated cost implications have been documented in this report.

### *ESMP Budget*

To effectively implement the mitigation and monitoring measures recommended in this ESMP, necessary provision will have to be made. The cost of these measures has been estimated and included in the ESMP and presented in Table 6.14 below. The cost of mitigation to be implemented by the Contractor will be included in the contract as part of the implementation cost by the Contractor. The overall total estimated cost for the ESMP implementation, monitoring and capacity building for all intervention packages is estimated at **Seventy-four Thousand, Eight Hundred and Forty Six US Dollars and Fifty Cents Only (USD 74,846.50).** This is equivalent to **One Hundred and Seven Million, Thirty Thousand, Five hundred and Fifty Naira Only (₦107,030,550.00).**

**Table: Overall ESMP Cost Estimate for the Intervention Works**

| Item | Responsibility | Cost Estimate in Nigerian Naira (N) | Cost Estimate in US Dollars (US$) * |
|---|---|---|---|
| ESMP Implementation | Contractor | 35,000,000.00 | 24,475.50 |
| Monitoring | Zamfara ACReSAL SPIU, Supervising Consultant, Other relevant MDAs | 37,700,000.00 | 26,363.60 |
| Training and capacity building | Zamfara ACReSAL SPIU | 21,600,500 | 15,105.00 |
| Disclosure | Zamfara ACReSAL SPIU | 3,000,000 | 2,097.90 |
| **Sub-Total** | | **97,300,500** | **6,8042.00** |
| Contingency | 10% of Sub- Total | 9,730,050 | 6,804.00 |
| **Total** | | **107,030,550.00** | **74,846.50** |

***Note:** All conversions were done using the Central Bank of Nigeria (CBN) current exchange rate of 1USD = 1,430 NGN as at January 2026.*

***Disclosure***

Following the review and clearance of this ESMP by the World Bank, the ESMP will be disclosed in the country and in the World Bank Infoshop . The SPIU shall disclose the ESMP in line with the Nigerian EIA laws for 21 days. This will include a formal registration of the ESMP with the FMEnv and receipt of guidelines for the disclosure from the EA department including the locations to disclose the documents.

**ES 07: GRIEVANCES REDRESS MECHANISM (GRM)**

The community traditional land dispute resolution structure currently constitutes the nucleus of traditional resolution of disputes among community members on matters of land. It is therefore wise and advisable that this structure be necessarily retained in the event of any grievance or dispute relating to the ESMP implementation. Inputs from the leadership may also be limited to providing recommendations as to how a specific dispute is to be addressed.

The Zamfara State ACReSAL has established a Grievance Redress Mechanism following the World Bank's approaches to GRM and FPMU Grievance Mechanism Framework. The framework has five levels of addressing grievances (Level 1: Community Level of Grievance Redress; Level 2: Local Government/ Community Grievance Redress Committee (LGRC); Level 3: State Grievance Redress Committee (SGRC); Level 4: National Grievance Redress Committee (NGRC) and Level 5: the Courts). It should be noted that grievances should follow the level sequence based on the demands and outcomes of the issues at hand. However, when the parties involved in grievances have utilized the provisions of the first four levels, they can then utilize the Law Courts (Level 5).

**E.S.09: Conclusion and Recommendation**

Specifically, the project aims to tackle the problem of land degradation through integrated watershed management. While the project implementation is expected to have certain adverse effects on the biophysical and social environment, these impacts will be localized in spatial extent and short-term. They can be effectively avoided or managed through the application of appropriate mitigation measures proffered in the Environmental and Social Management Plan (ESMP), sound design, adherence to good construction practices, effective maintenance, and robust supervision and enforcement during project implementation.

The ESMP has provided in detail the mitigation measures for identified potential adverse impacts associated with the various phases of the project, and a monitoring program to ensure compliance. In concluding, with adequate application of mitigation measures the impacts will be avoided, reduced or mitigated, and in very few cases they may be offset.

The intervention sub-project with the associated activities outlined in this ESMP will have highly beneficial impacts by improving critical service delivery infrastructure within the communities, through which resilience would be strengthened, livelihood opportunities can be enhanced and social cohesion, improved. Although, the channelization, construction & civil works that will be implemented will lead to some limited adverse environmental and social impacts which will largely be localized in spatial extent, short term and occurring within less sensitive environmental areas. These will be managed through the application of the appropriate mitigation measures stated in the ESMP which would be included in the contractor's agreement, good practices, adequate supervision and enforcement during project implementation.

The effective implementation of mitigation measures in this ESMP will help to avoid, reduce or mitigate/manage the potential adverse impacts and risks associated with the Bulka subproject.

# CHAPTER ONE: INTRODUCTION

## 1.1 Background

The Federal Government of Nigeria (FGN) has initiated the implementation of the Agro-Climatic Resilience in Semi-Arid Landscapes (ACReSAL) Project funded by the World Bank. The project will help Nigeria address critical challenges of regional desertification control and landscape management in northern Nigeria.

Zamfara State, created in 1996, is located in the northwestern part of Nigeria with a land area of approximately 38,418 square kilometres. The State is characterized by a tropical savannah climate with distinct wet and dry season. Gusau, the State capital, experiences significant rainfall during the wet season, which often leads to stormwater management challenges and erosion issues.

The Bulka area in Gusau has been particularly affected by stormwater and erosion problems due to its topography, soil characteristics, and rapid urbanization. The area experiences recurrent flooding during the rainy season, causing damage to infrastructure, properties, and posing risks to human lives. These challenges have been exacerbated by climate change effects, which have led to more unpredictable and intense rainfall patterns. Over the years, the existing drainage infrastructure in the Bulka area has deteriorated due to inadequate maintenance, increased sedimentation, and structural failures. This has significantly reduced the capacity of the drainage system to effectively manage storm-water runoff, leading to increased flooding problems and infrastructural damage.

The Zamfara State government, through the Federal Ministry of Environment (FMEnv), has identified the urgent need to address these challenges through the implementation of comprehensive storm-water management and erosion control measures. The Bulka stormwater and erosion control project is therefore designed to provide sustainable solution to this problems, thereby enhancing the resilience of the community to the impacts of flooding and erosion.

The proposed ACReSAL intervention is targeted at arresting flood-degraded landscape and improving the sustainable productivity of land in the targeted areas of degraded landscapes. The project also aims to support communities with improved capacity and investments to improve sustainable livelihoods

## 1.1 The ACReSAL Project Components

The project has the following components and sub-components:

- **Component A: Dryland Watershed Management**. This component will implement integrated watershed management planning and address the challenges of large-scale watershed degradation in northern Nigeria. There are three sub-components under this component include:

- **Sub-component A1 (Strategic Watershed Management)** to support large-scale integrated watershed planning and implementation.
- **Sub-component A2 (Watershed Infrastructure)** will support large landscape-level investments, as prioritized in the strategic watershed plans related to water resources (e.g., surface and groundwater storage, managed aquifer recharge, riverbank restoration, gully rehabilitation, irrigation, improved water systems), to environmental management (stabilization of sand-dunes, forest management, afforestation), and agricultural investments at large scale,
- **Sub-component A3 (Special Ecosystems)** this subcomponent will improve the management of special ecosystems, including wetlands, desert oases, and protected areas. Investments could include those related to wetland improvements, monitoring systems, water management, biodiversity conservation, stabilization of oasis buffer areas and improved water provision, and improving management systems for targeted protected areas.

- **Component B: Community Climate Resilience:** This will address challenges of dryland management at the local level, and support communities and households in targeted watersheds with investments and new approaches to become climate resilient. This component **has** the following sub-components i.e.
  - **Sub-component B1 (Community Strengthening),** this subcomponent aims to strengthen the capacity of communities for sustainable natural resource use and management. It will support the needs of vulnerable and marginalized groups and address inequality, promote peacebuilding initiative and ownership,
  - **Sub-component B2 (Community Investments)** This subcomponent will finance physical investments in community-level infrastructure, landscape restoration in selected degraded areas, and support farmers at the household level to optimize climate-smart rainfed agriculture and farmer-led irrigation.
- **Component C: Institutional Strengthening and Project Management** aims to improve the enabling institutional and policy foundation for multi-sectoral integrated landscape management and support project management. **This sub-component** has the following other sub-components i.e.:
  - **Sub-component C1 (Institutional and Policy Strengthening)** is aimed at improving the enabling institutional and policy foundation for integrated landscape management in Nigeria, focusing **on improving** the institutional infrastructure (IT, connectivity, and office improvements) in key agencies at the federal and state levels, setting up the data, analytics, and decision support framework with a strong capacity-building and outreach for both in-person and virtual training,
  - **Sub-component C2 (Project Management)** will support the overall project monitoring and management.
- **Component D: The Contingency Emergency Response Component (CERC)** provides immediate support to an eligible crisis or emergency. The CERC is a financing mechanism

available to Borrowers in IPF operations to access funds rapidly to respond to an eligible crisis or emergency (including disasters and health emergencies).

## 1.2 Project Location

Zamfara State lies between latitude 12.166670N and 6.25000E. The State is located in the Northwest geopolitical zone of Nigeria with Gusau being the capital of Zamfara State. Zamfara is one of the seven states that form the North-West geopolitical zone of Nigeria with an area of 38,418 square kilometres, and a population of 383,162 as of the 2006 census. It is bordered to the north by the Republic of the Niger for 32 km (20 miles), to the south by Kaduna State for 117 km (73 miles) and Niger for 38 km (24 miles), to the east by Katsina State, and to the west by the states of Sokoto and Kebbi.

**Figure 1.1** shows the location of Zamfara State in Nigeria while **Figure 1.2** shows the administrative location of Gusau LGA within Zamfara State.




**Figure 1.1: Map of Nigeria showing Zamfara State**




**Figure 1.2: Administrative Location of Zamfara State**

Bulka Area in Gusau metropolis has been subjected to severe flood and erosion problems. The Bulka gully is considered significant in Zamfara State creating severe structural and environmental damage to the area and causing destruction to homes, properties, and risk to lives as well as causing major siltation at Koromar wanke River (Gulbi), which is the end point of the gully.

The channel originates near the yan mangurori – the Federal Medical Centre (FMC) Gusau, towards the Koromar Wanke River (Gulbi) behind hayin malam Ibrahim mai wa'azi. The coordinates for the start point and end point are detailed in **Table 1.1** below.

**Table 1.1: Description Of Bulka Stormwater Location**

| S/N | DESCRIPTION | LOCATION | LATITUDE | | LONGITUDE |
|---|---|---|---|---|---|
| 1 | The Bulka storm-water channel is located within the Gusau metropolis and extends over a total length of approximately 5.68 km. The channel originates near the yan mangurori and ultimately discharges into koramar Wanke River (Gulbi) behind hayin malam Ibrahim. | Bulka, Gusau Metropolis, Gusau LGA | **Start point** | 12.182759°N | 6.684205°E |
| | | | **End point** | 12.174098 ° N | 6.644889°E. |

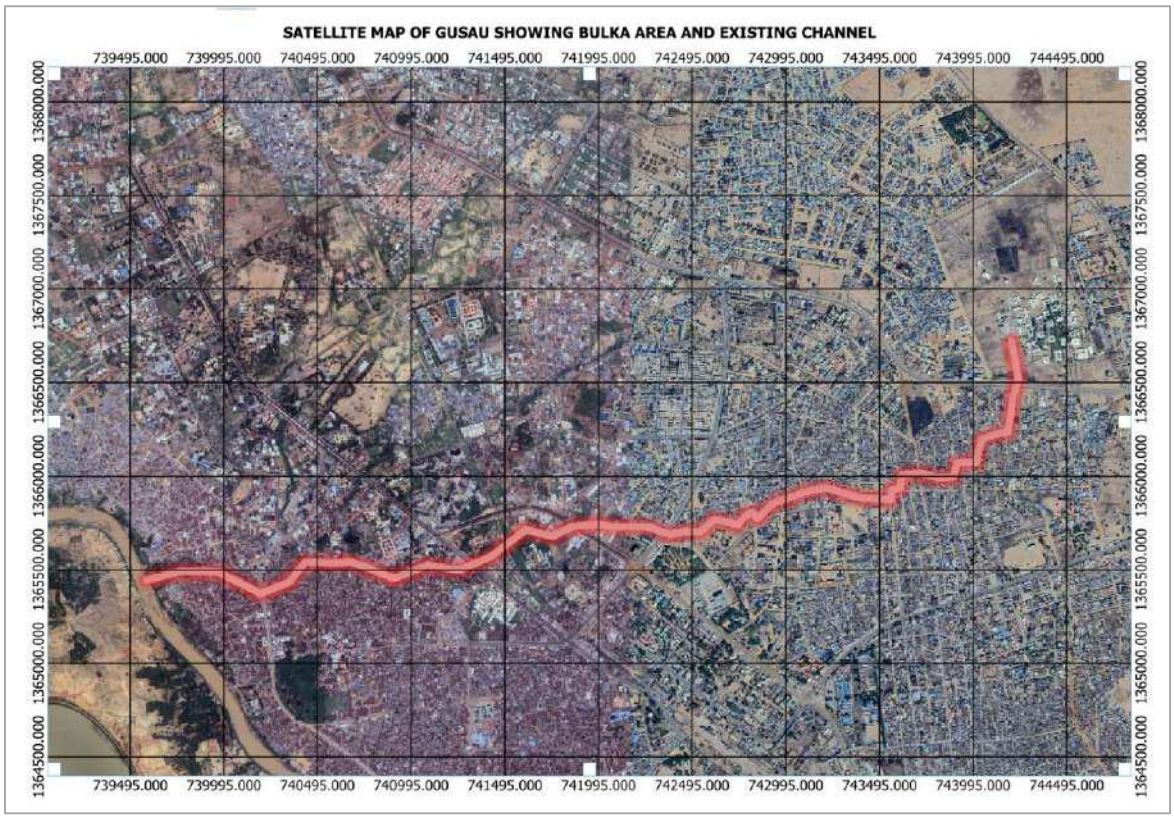



**Figure 1.3: Satellite Imagery of Project Corridor / Location**

### 1.2.1 Bulka Terrain and Drainage Features

Erosion is one of the major environmental threats that has devastating effects on the quality and productive capacity of arable lands with its attendant consequences on food insecurity. Rapid anthropogenic interference has greatly resulted in land degradation and the most important climate variable in erosion processes is rainfall erosivity, which is related to rainfall amount and rainfall intensity.

The stormwater channel traverses a densely populated urban corridor and plays a critical role in draining surface runoff from several neighbourhoods and public infrastructure areas. Its route passes behind Kanoma Mosques and the residence of the Commissioner of Police, moves through the Premier Area and Ungwan Dallatu, and crosses Alfigir Road, running parallel to the Central Bank of Nigeria (CBN) fence. Further along, the channel intersects the main road between the Central Police Station and Government House, and passes across the railway line, approximately 100 meters opposite the Government House. It continues towards Bello Barau Road, in front of Sambo Dan'Ashapa Mosque, behind the Matrix Petrol Filling Station, and flows through Hayin Danhausa and Gadan Baga, before reaching its final discharge point.

The existing drainage infrastructure in Gusau reveals extended periods of environmental neglect, urban pressures, and systemic infrastructure challenges. Key issues include:

- ***Erosion-induced deterioration***: Extensive erosion has created deep gullies, collapsed channel walls, and fundamentally altered original drainage pathways
- ***Human activities and urban encroachment***: Unplanned construction and aggressive urban development have compromised original drainage infrastructure
- ***Refuse dumping***: Drainage infrastructure has become repositories for urban waste, leading to blockages, water flow capacity reduction, and environmental pollution
- ***Siltation***: Sediment accumulation has reduced channel depths in some sections

The existing drainage infrastructure in the Bulka area consists of a network of primary and secondary drains, culverts, and bridges. However, many of these structures are inadequate, damaged, or silted up, reducing their capacity to effectively convey stormwater runoff. Areas with steep slopes or highly erodible soils are particularly vulnerable to erosion during high-intensity rainfall events, leading to gully formation and sedimentation of downstream drainage structures. The natural drainage system in the area is influenced by the Sokoto River and its tributaries, which form part of the larger Niger River basin. The general drainage pattern is dendritic, with smaller streams and gullies converging to form larger channels that eventually drain into the main river system. These areas require specific erosion control measures to prevent further degradation.


GPS Map Camera
Gusau, Zamfara, Nigeria
5jgv+4qv, Gusau, Zamfara 632101, Nigeria
Lat 12.173981° Long 6.643942°
Thursday, 04/12/2025 11:09 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
5jgv+4qv, Gusau, Zamfara 632101, Nigeria
Lat 12.173713° Long 6.645238°
Thursday, 04/12/2025 11:03 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
5mf2+cqq, Gusau, Zamfara 632101, Nigeria
Lat 12.173545° Long 6.651545°
Thursday, 04/12/2025 10:45 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
5mf2+cqq, Gusau, Zamfara 632101, Nigeria
Lat 12.173706° Long 6.653005°
Thursday, 04/12/2025 10:37 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
5mf4+8g2, Sabon Fegi Area, Gusau, Zamfara 632101, Nigeria
Lat 12.173324° Long 6.656177°
Thursday, 04/12/2025 10:19 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
5mf5+mgc, Road, Gusau, Zamfara 632101, Nigeria
Lat 12.174253° Long 6.658643°
Thursday, 04/12/2025 10:08 AM GMT +01:00
Google




**Plate 1.1: Cross-Sections of the Bulka Stormwater/Erosion Control Site**

## 1.3 Project Development Objective (PDO)

The project development objective (PDO) of ACReSAL Project intends to **increase the adoption of climate resilient landscape management practices** in targeted watersheds of northern Nigeria and to strengthen Nigeria's long-term framework for integrated landscape management. The ACReSAL project seeks to build on the lessons from the many international development partners including the World Bank Group and help develop a more integrated, spatial, multisectoral approach to build community resilience as well as improve the sustainable productivity of its natural resources. In particular, the project will support activities to develop multi-sectoral approaches for desertification control and landscape management, improve community livelihoods and resilience, and strengthen institutions.

ACReSAL project targets 19 states and the Federal Capital Territory (FCT) in dry areas of northern Nigeria characterized by:

- Low precipitation and sparse vegetative cover
- High poverty rates and low literacy levels
- Environmental fragility, conflict, and violence
- Degradation of natural resources
- Poor agricultural productivity
- Climate risks and desertification
- Limited penetration of modern technology
- Weak institutional capacity

Addressing these multifaceted challenges requires coordinated efforts across multiple sectors, with integrated watershed management serving as the operational framework.

### 1.3.1 Rationale for ACRESAL Intervention

The major objectives of the ACReSAL Project is to increase the adoption of climate resilient landscape management practices in targeted watersheds of northern Nigeria. Bulka community within the Gusau Local Government Area (LGA) of the Zamfara State whose residents experience heavy flooding and erosion every year due to the nature of the landscape and inadequate drainage systems during heavy rainfalls necessitates the intervention of the ACReSAL project. The flood and erosion hazards within these communities perennially cause major property losses to residents and on a particular occasion, the loss of life. The hazards remain a serious threat to lives in the communities, destroying homes and farmlands as well as unprecedented siltation of community stream resulting in the existing gully formations now needing intervention.

The Bulka Stormwater & Erosion Control Project is necessitated by several factors:

- ❖ Frequent Flooding: The Bulka area experiences regular flooding during the rainy season, which causes significant damage to infrastructure, properties, and occasionally leads to loss of lives. This recurrent flooding has devastating effects on the socio-economic well-being of the community.

- Erosion Problems: The area is susceptible to erosion due to the nature of the soil, topography, and high-intensity rainfall events. This has led to the formation of gullies, land degradation, and sedimentation of existing drainage channels.
- Deteriorated Drainage Infrastructure: The existing drainage infrastructure in the Bulka area has deteriorated over time, reducing its capacity to effectively manage stormwater runoff. Many of the drainage channels are partially or completely silted, and several hydraulic structures are damaged or non-functional.
- Climate Change Impacts: Climate change has led to more unpredictable and intense rainfall patterns in the region, exacerbating the flooding and erosion problems. There is a need for climate-resilient stormwater management solutions to address these challenges.
- Urbanization and Land Use Changes: Rapid urbanization and changes in land use in the Bulka area have increased impervious surfaces, leading to increased runoff volumes and reduced infiltration. This has put additional pressure on the existing drainage infrastructure.
- Public Health Concerns: Flooding and stagnant water in the area create breeding grounds for disease vectors such as mosquitoes, leading to increased incidence of waterborne and vector-borne diseases.

The Bulka Stormwater & Erosion Control Project therefore aims to address these challenges through the implementation of comprehensive stormwater management and erosion control measures. The project is aligned with the Zamfara State Government's commitment to enhance the resilience of communities to climate change impacts and improve the overall quality of life for its citizens through the ACReSAL project.

### 1.3.2 Objectives of the ESMP

The main objective of the ESMP is to identify and analyze the potential environmental and social (E&S) impacts (positive and negative) of the proposed Bulka intervention sub-project. It also ensures that infrastructures and other activities being considered under the Bulka subproject are in compliance with statutory regulations and World Bank standards.

The specific objectives of the ESMP are to:

- Establish the site-specific biophysical, socio-economic and health baseline conditions of the project area (i.e. the receiving environment);
- Integration of all stakeholders concern and views into the Bulka intervention project design;
- To identify and assess potential and associated E&S impacts of the Bulka intervention project;
- Develop appropriate mitigation measures to address negative E&S impacts and proactively promote and maximize positive E&S impacts associated with the Bulka intervention project;
- Identify and implement legal and institutional frameworks, as well as international standards and guidelines for the Bulka intervention project;
- Develop a comprehensive and cost-effective management plan to monitor adequacy mitigation measures across all phases of the project;
- Obtain the necessary permits and approvals prior to project implementation.

## 1.4 Scope of the Assignment

The assignment is for the preparation of a site specific ESMP for Bulka Stormwater and Erosion control project in Gusau LGA, Zamfara State. The scope for this ESMP was developed in accordance with applicable regulatory guidelines and international best practises. This included the following:

- Review of existing literature on the environmental and social characterization of the study area. Which includes but not limited to the underlisted:
  - ACReSAL - Environmental and Social Management Framework (ESMF);
  - Resettlement Policy Framework (RPF);
  - Stakeholders' Engagement Plan;
  - Labour Management Procedure;
  - Security Risk Management Framework;
  - ACReSAL Project Appraisal Document (PAD);
  - ACReSAL Project Implementation Manual (PIM);
  - Engineering and Intervention design;
  - Other peer reviewed, regulatory approved and internationally accepted documents. Journals and reports.
- Field data gathering and measurement of microclimatic conditions, air quality and noise levels at pre-determined locations (as necessary).
- Groundwater, soil, sediments, surface water, plankton & benthic macro invertebrates and fisheries sampling from pre-determined locations (as necessary).
- Public/Stakeholder Engagement and gender issues assessment: Qualitative and quantitative socio-economic data of the environment to be potentially impacted by the project, including the neighbouring communities, the current infrastructural status in the project areas were obtained during field survey;
- Laboratory analyses of the collected, groundwater, soil, sediments, surface water, plankton & benthic macro invertebrates and fish samples.
- Preparation of a detailed environmental and social management plan consisting of a well-documented set of potential environmental and social issues with appropriate mitigation measures, monitoring, and institutional actions to be taken before, during and after implementation to eliminate the identified adverse environmental and social impacts, offset them, or reduce them to acceptable levels. It also includes the measures required to implement these actions, costing, and responsibility, addressing the adequacy of the monitoring and institutional arrangements in the intervention site.

## 1.5 Description of the Proposed Interventions / Rehabilitation Activities

The proposed ACReSAL intervention at the Bulka Flood Control Project involves the construction of about 5.6-kilometer engineered waterway through key urban sectors, transforming the city's relationship with seasonal precipitation. The Bulka storm-water channel is located within the Gusau metropolis and extends over a total length of approximately 5.68 kilometer (4+684.73 km). The channel originates near the yan mangurori, Gusau at coordinates Latitude 12.182759°N and

Longitude 6.684205°E, and ultimately discharges into koramar Wanke River behind hayin malam Ibrahim mai wa'azi at Latitude 12.174098 ° N and Longitude 6.644889°E.

Other activities associated with the subprojects during the pre-construction, construction, and operation phases of the works are:

*Construction Phase*

- Mobilization of personnel and equipment
- Site preparation (cordoning-off, fencing, vegetation removal, excavations, earth works)
- Waste removal
- Demolition of existing structures like houses (518 PAPs as detailed in the RAP for the Bulka intervention area) and failed hydraulic infrastructure.
- Rehabilitation of access routes for heavy-duty equipment conveyance Laying of Precast, Concrete works
- Pavement and surfacing – Laying of prime coat, asphaltic concrete binder, surface dressing, etc.
- Installation of signage and markings
- Power generation
- Reclamation of degraded land area by sand filing or stabilization of dormant gully fingers.
- Bioremediation and creation of buffer zones along the gully channel using grasses like vertiva and majorly other indigenous and cover grasses
- Commissioning

*Operation and Maintenance Phase*

- Maintenance and repairs

*Decommissioning of Equipment and Workers*

- Temporary structures dismantling and cleaning
- Employee Training and Demobilization
- Residual wastes handling
- Project site cleanup

***Development Strategy for Bulka Intervention Site***

The development methodology for the Bulka Stormwater and Erosion Control Project represents a meticulously planned, phased approach designed to maximize efficiency, minimize environmental disruption, and ensure the highest standards of technical execution. This strategy transforms the complex 5.6-kilometer drainage infrastructure project into a systematically managed urban transformation initiative.

**Table 1.2: Development Strategy for Bulka Gully Site**

| S/N | Phase | Project Activities |
|---|---|---|
| 1 | Site Preparation | - Utility relocation - Initial ground clearing – Temporary structures |
| 2 | Foundation Construction | Excavation - Ground stabilization - Structural reinforcement |
| 3 | Channel Formation | - Channel lining - Hydraulic structures - Erosion control |
| 4 | Secondary Infrastructure - | Inlet/outlet structures - Culvert interfaces - Flow control mechanisms |
| 5 | Ecological Restoration | Vegetation establishment - Ecological corridor creation |

***Equipment and Materials***

The materials and equipment selection for the Bulka Stormwater Management Project represents a critical intersection of technical performance, local economic considerations, and sustainable infrastructure development.

**Table 1.3: Major Equipment and Material Specifications**

| S/N | Category | Specification | Recommended Source |
|---|---|---|---|
| **Equipment** | | | |
| 1 | Excavators – (Precision earth moving - Channel formation - Minimal ground disturbance) | Operating Weight: 20-30 tonnes - Engine Power: 150-250 HP - Bucket Capacity: 1-1.5 $m^3$ - | Local equipment rental - Potential lease purchase |
| 2 | Concrete Mixers (Consistent mix quality - On-site concrete production) | Capacity: 4-6 $m^3$ - Mobile configuration - Computerized batching | - Local construction equipment supplier |
| 3 | Crane Systems – (Heavy component placement - Structural element positioning ) | Lifting Capacity: 50-100 tonnes - Boom Length: 30-50 meters - | Specialized rental - Limited-term lease |
| 4 | Compaction Equipment (Ground stabilization - Layer-by-layer compaction) | Vibratory Rollers - Plate Compactors - Dynamic Compaction Capabilities | Local equipment market - Targeted procurement |
| Materials | | | |
| | Reinforced Concrete - High durability - Corrosion resistance - Long-term structural integrity - | Compressive Strength: 40 MPa - Water-Cement Ratio: Maximum 0.45 - Cement Type: Sulfate resistant Portland cement | Local cement manufacturers - Imported specialized |
| | Steel Reinforcement (nhanced bonding - Improved fatigue resistance) | - Grade: High-yield deformed bars - Coating: Epoxy-coated - Diameter: 12-25 mm - | Nigerian steel mills - Import substitution Strategy |
| | Geotextile - Material: - (Soil stabilization - Filtration - Erosion control) | Polypropylene - Tensile Strength: 50-100 kN/m - UV Resistance: Minimum 70% | Specialized import - Limited local manufacturing |

Other related activities are staging area creation, and material sourcing. Heavy equipment and machinery may be used for clearing vegetation, bulldozers, and excavators for creating staging areas, and campsites, and demolition of existing structures. Compactors may be used for levelling materials like sand, laterite, gravels etc., and payloaders for transporting materials like gravels, laterites, sand etc. Construction vehicles for transporting materials to site and off-site, drainage trencher for creating trenches/drainage. The proposed structural members and construction components of the erosion and flood control project will be constructed with concrete, steel, and other construction materials to conform with the work description in the engineering design.

## 1.6 Rationale for ESMP

The proposed remediation works for intervention at the Bulka Flood Control Project site are classified as a Category B project according to the World Bank's Environmental and Social Standard (ESS). The categorization is justified based on the potential negative impacts of the project on the biophysical and social environment. Considering the nature of works, their scope, geographic coverage, the following World Bank's Environmental and Social Standards will apply. These standards (listed below), when triggered requires that an ESMP be prepared.

| | |
|---|---|
| ESS1: | Assessment and Management of Environmental and Social Risks and Impacts |
| ESS2: | Labor and Working Conditions |
| ESS3: | Resource Efficiency and Pollution Prevention and Management |
| ESS4: | Community Health and Safety |
| ESS5: | Land Acquisition, Restrictions on Land Use and Involuntary Resettlement |
| ESS6: | Biodiversity Conservation and Sustainable Management of Living Natural Resources |
| ESS8: | Cultural Heritage |
| ESS10: | Stakeholder Engagement and Information Disclosure |

In fulfillment of the above safeguard requirements and considering the level of significance of the environmental and social impacts associated with the Bulka intervention project, this ESMP shall serve as a safeguard instrument that documents the necessary mitigation, monitoring and institutional actions to be carried out with the implementation of the project to eliminate adverse environmental and social impacts or reduce them to an acceptable level.

The potential impacts associated with the phases of the designed site intervention consisting of pre-construction, construction, and operation and maintenance (O&M) are developed and appropriate mitigation measures established for the impacts. This Environmental and Social Management Plan (ESMP) includes measures needed to implement the identified actions, addressing the adequacy of the monitoring and institutional arrangements for the upper and lower watersheds on a sustainable basis. ESMP provides necessary institutional framework and monitoring actions to be taken before, during and after the construction and development works.

## 1.7 Structure of the ESMP

The ESMP is structured in line with the FMEnv procedural guidelines, this EIA draft report has been structured as follows:

**Table 1.4: EMSP Reporting Structure**

| *Chapter* | Title | Description |
|---|---|---|
| ***Preliminary Pages*** | | Cover Page, Document Control Page, Table of Contents, List of Acronyms and their definitions, Acknowledgement and Executive Summary |
| ***Chapter One*** | **Introduction** | Overview of the proposed project, detailed project location, scope of work, objectives of the ESMP, Rationale for the ESMP and the methodology followed to prepare the ESMP., |
| ***Chapter Two*** | **Institutional and Legal Framework for Environmental and Social Management** | Discussion of the World Bank Environmental and Social Standards triggered by ACReSAL and relevance to the proposed project activities. Description of the requirements of the World Bank and how they are addressed in this ESMP.<br>A summary of Local, State, and Federal regulations, international conventions, and administrative frameworks relevant to the proposed project activities and how they are addressed in the ESMP. |
| ***Chapter Three*** | **Baseline Environment** | Description of environmental baseline conditions, including physical (e.g., terrain, land use, climate, geomorphological) and biological (e.g. flora and fauna, sensitive areas, etc.) |
| ***Chapter Four*** | **Stakeholder Consultations** | List of the relevant stakeholders relevant to the proposed subproject activities.<br>Description of socioeconomic baseline conditions. Analysis of existing livelihoods opportunities, income, gender characteristics, age profile, health, transport access, existing community structures – at watershed, community, household, and individual levels. Other topics as relevant (e.g., Gender Based Violence, Sexual Exploitation and Abuse, Child Labour, Gender Discrimination, Security issues, etc.). |
| ***Chapter Five*** | **Assessment of Potential Impacts and Analysis of Alternatives** | Potential and associated environmental impacts of the project, including the methodology of assessing the impacts.<br>Discussion of the alternative locations and engineering designs considered for the proposed interventions, and the rationale for selecting the chosen option. |
| ***Chapter Six*** | **Environmental and Social Management Plan (ESMP),** | Identification of potential E&S impacts and mitigation measures and risks associated with the proposed interventions.<br>Description of the proposed mitigation measures to address the above risks – To include all prevalent emerging issues and their Management Plans. |
| ***Chapter Seven*** | **Summary, Recommendations and Conclusion** | Conclusion, and recommendation |
| ***References; and Annexures*** | | Citations and other supporting documents reviewed during the assessment are presented in the list of references.<br>Technical and non-technical annexes to the report is affixed in this section |

# CHAPTER 2: INSTITUTIONAL AND LEGAL FRAMEWORK

## 2.1 Introduction

This ESMP is guided by the requirements of the EIA Act Cap E12, LFN, 2004, which is the relevant national policy, legal, regulatory, and administrative frameworks that guide environmental sustainability of developmental activities. It also provides a detailed discussion of Zamfara State policies, legislation, regulations and guidelines on environmental issues that apply to the proposed Bulka intervention project. In addition, the World Bank environmental and social Safeguards and requirements were identified, and those triggered by the proposed Bulka intervention project are outlined in this section.

These legal requirements and regulations are summarized below:

## 2.2 Federal Policy, Legal, Regulatory and Administrative Frameworks

Pursuant to Section 20 of the Nigerian 1999 Constitution, the state is empowered to protect and improve the environment and safeguard the water, air, and land, forest, and wildlife of Nigeria. The power to regulate all environmental matters in Nigeria is vested in the Federal Ministry of Environment (FMEnv) – a mandate that previously rested with the now defunct Federal Environmental Protection Agency (FEPA) set up by Federal Act 88, of 1988.

The applicable environmental laws include the Environmental Impact Assessment Act Cap E12 LFN, 2004; the National Guidelines and Standards for Environmental Pollution Control in Nigeria (March 1991); the National Environmental Standards and Regulations Enforcement Agency (establishment) Act 2007 (NESREA), the Land Use Act 2004; Amongst others.

**Table 2.1** summarizes the provisions of the National policies, laws, institutional and regulatory frameworks relevant to the proposed ACReSAL project activities

**Table 2.1: National Policy, Legal and Institutional Framework**

| National Policy, Legal/Regulatory Instrument and Institutional Frameworks | | | | |
|---|---|---|---|---|
| **S/N** | **Policy / Legal Instrument** | **Year** | **Provision** | **Applicability to the proposed Bulka Intervention Project** |
| *1* | ***Environmental Impact Assessment Act, Cap E12,*** | 2004 | This Act sets out the general principles, procedures and methods to enable the prior consideration of environmental impact assessment on certain public or private programmes. It further provides that before a decision is taken to undertake or authorize the undertaking of any activity, those matters that may likely or to a significant extent affect the environment or have an environmental effect on those activities shall first be taken into account. There are nineteen thematic areas of mandatory study activities. The drivers of deforestation and forest degradation for which mandatory study is required include: agriculture, infrastructure, logging and conversion of forest to other land use, mining and housing. Environmental sensitivity and the area coverage of a programme are some of the criteria for an environmental assessment | This act is applicable to all projects in Nigeria both public and private, stakeholders and environment within territorial boundaries of Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| *2* | ***The National Guidelines and Standards for Environmental Pollution Control in Nigeria*** | 1991 | These represent the basic instrument for monitoring and controlling pollution in Nigeria | The National Guidelines and Standards for Environmental Pollution Control is applicable to the proposed Bulka Intervention Project. |
| *3* | ***National Guidelines on Environmental Management Systems.*** | 1999 | This establishes the requirements for an Environmental Management System (EMS) in all organizations/facilities in Nigeria. | The National Guidelines on Environmental Management Systems is applicable to the proposed Bulka Intervention Project. |
| *4* | ***The National Environmental Standards and Regulations Enforcement Agency Act (NESREA).*** | 2007 | This makes provision for solid waste management and its administration and prescribes sanctions for offences or acts, which run contrary to proper and adequate waste disposal procedures and practices | The NESREA Act is applicable to all public and private project in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| *5* | ***Land Use Act*** | 1978 (Modified 1990) | This is the primary legal means to acquire land in the country. The Act vests all land in the territory of each State in the federation in the Governor of the State and requires that such land shall be held in trust and administered for the use and | The Land Use Act is applicable to the proposed Bulka Intervention Project. |

| | | | | |
|---|---|---|---|---|
| | | | common benefit of all Nigerians in accordance with the provisions of this Act | |
| ***6*** | ***National Environmental (Noise Standards and Control) Regulations*** | 2009 | The objective of the Regulations is to ensure maintenance of a healthy environment for all people in Nigeria, the tranquility of their surroundings and their psychological wellbeing by regulating noise levels. The Instrument prescribes maximum permissible noise levels of a facility or activity to which a person may be exposed as 60dB and 40dB for day and night respectively | The noise standard regulation is applicable to all public and private project in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***7*** | ***National Environmental (Air Quality Control) Regulations, S. I. No 88, 2021 (Amended)*** | 2014 | The purpose of these regulations is to provide for improved control of the nation's air quality to such extent that would enhance the protection of flora and fauna, human health, and other resources affected by air quality deteriorations. | The Air Quality Control regulation is applicable to all public and private project in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***8*** | ***National Environmental (Soil Erosion & Flood Control) Regulations (S.I. 12)*** | 2011 | The purpose of this Regulation is to establish technically feasible and economically reasonable standards and procedures to achieve appropriate level of management and conservation practices to abate soil erosion, siltation and sedimentation of the waters of Nigeria, due to soil erosion and flood aggravated by non-agricultural earth-disturbing activities. | This regulation is applicable to all public and private project in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***9*** | ***National Environmental (Construction Sector) Regulations (S.I No. 19)*** | 2011 | The purpose of these regulations is to prevent and minimize pollution from construction, decommissioning and demolition activities in the Nigerian environment. It stipulates that new projects in the construction sector shall apply cost-effective, up-to-date, efficient, best available technology, to minimize pollution to the barest degree practicable. In addition, every operator or facility shall carry out an EIA and submit an EMP for new projects or modification including expansion of existing ones before commencement of activity | The regulation is applicable to all public and private project in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***10*** | ***National Waste Management Regulations*** | 1991 | This regulation which is updated under the National Environmental (Sanitation and Waste Control) Regulations 2009, S.I. No. 28 mandates the collection, treatment, and disposal of solid and hazardous waste from municipal and | This regulation is applicable to all public and private project in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |

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| | | | industrial sources. It provides the legal framework for the adoption of sustainable and environment friendly practices in environmental sanitation and waste management to minimize pollution | |
| ***11*** | ***National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations.*** | 1991 | Regulates the collections, treatment and disposal of solid and hazardous wastes from municipal and industrial sources. | This waste regulation is applicable to all public and private project in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***12*** | ***Climate Change Act*** | 2021 | The Nigeria Climate Change Act 2021 outlines an ambitious framework for integrating climate actions into national development priorities, with a target of achieving net-zero emissions between 2050 and 2070. The Act requires the Ministry of Environment to establish a carbon budget and take measures to limit global temperature increases to within 2°C and to pursue efforts to limit it to 1.5°C above pre-industrial levels. Additionally, the Act mandates the development of a National Climate Change Action Plan every five years to ensure consistency with carbon budget goals, identify actions for climate adaptation and mitigation, and promote a low-carbon, environmentally sustainable, and climate-resilient society. The Act applies to both public and private entities in Nigeria, requiring them to implement mechanisms to achieve annual carbon emission reduction targets, designate a climate change officer responsible for reporting to the National Climate Change Secretariats, and foster a low-carbon, sustainable, and climate-resilient society. | The Act applies to both public and private entities in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***13*** | ***The Labour Act*** | 2004 | This Act is the principal and most direct legislation on employment matters in Nigeria. It is a piece of legislation, which seeks to protect the employment rights of individual workers, and it includes matters such as classification of worker types, wages, contracts, employment terms and conditions, and recruitment. | The Act applies to both public and private entities in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***14*** | ***Factories Act*** | 2004 | The Act is the primary legislation for the protection of the safety, health and welfare of workers. It has its broad objective to make elaborate provisions for the health, safety and welfare of the | The Act applies to both public and private entities in Nigeria. Thus, it is applicable to the |

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| | | | workers exposed to occupational hazards by taking measures to prevent accidents and injuries. | proposed Bulka Intervention Project. |
| ***15*** | ***Child Rights Act*** | 2003 | The Act serves as a legal documentation and protection of Children rights and responsibilities in Nigeria. It also acts as legislation against Human trafficking since it forbids children from being "separated from parents against their will, except where it is in the best interest of the child. | The Act applies to both public and private entities in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***16*** | ***Employee's Compensation Act*** | 2010 | The Act make provisions for compensations for any death, injury, disease or disability arising out of or in the course of employment; and for related matters. | The Act applies to both public and private entities in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***17*** | ***Violence Against Persons Prohibition (VAPP) Act*** | 2020 | The Act provides protections against offenses that affect women disproportionately, including a prohibition of female genital mutilation, forceful ejection from home, forced financial dependence or economic abuse, forced isolation, emotional, verbal and psychological abuse etc. | The Act applies to both public and private entities in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***18*** | ***The National Policy on Environment (NPE) of 1989*** | (Revised 2016) | The mandates of the NPE include among others:<br>• Ensuring the quality of the environment is adequate for good health and well-being;<br>• Promoting sustainable use of natural resources and the restoration and maintenance of the biological diversity of ecosystems;<br>• Promoting an understanding of the essential linkages between the environment, social and economic development issues;<br>Encouraging individual and community participation in environmental improvement initiatives. | The policy applies to both public and private entities in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***19*** | ***National Gender Policy*** | 2006 | The goal of the National Gender Policy is to build a just society devoid of discrimination, harness the full potentials of all social groups regardless of sex or circumstance, promote the enjoyment of fundamental human rights and protect the health, social, economic and political well-being of all citizens in order to achieve equitable rapid economic growth; evolve an evidence based planning and governance system where human, social, financial and technological resources are efficiently and effectively deployed for sustainable development. | The policy applies to both public and private entities in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***20*** | ***National Cultural Policy*** | 1988 | The goal of this policy is to affirm the authentic cultural values and cultural heritage; building up of a national cultural identity | The policy applies to both public and private entities in Nigeria. |

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| | | | and parallel affirmation of cultural identities of different ethnic groups. | Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***21*** | ***National Erosion and Flood Control Policy*** | 2005 | The general soil erosion & flood control guidelines provide necessary instructions for soil and water resources users to develop, implement and monitor plans that are to assure erosion and flood hazard mitigation. The maintenance of levees and other protective structures are also to be developed at areas with potential impacts. In addition to this, all requests for project plan approvals must include soil type and drainage pattern/structures in and around project area and the likely impact of the project on these duly certified. | The policy applies to both public and private entities in Nigeria. Thus, it is applicable to the proposed Bulka Intervention Project. |
| ***22*** | ***The Federal Ministry of Environment (FMEnv)*** | 1999 | FMEnv is the apex body charged with the responsibility to administrate and enforce environmental laws in Nigeria. The FMEnv prohibits public and private sectors from embarking on major developmental projects or activities without due consideration, at early stages, for environmental and social impacts. In addition to the EIA Act, the Ministry has produced sectorial including sectorial guidelines on infrastructure development which will be duly considered in the implementation of this project. | The Federal Ministry of Environment (FMEnv) has the power to regulate all environmental matters in Nigeria for both public and private entities. Thus, the Bulka intervention project falls under their purview. |
| ***23*** | ***Federal Ministry of Works and Housing*** | | The Federal Ministry of Works and Housing is a Professional Service Ministry charged with the responsibility of providing Technical Services such has Design, Construction and Maintenance of Federal Roads, and provision of Mechanical and Electrical Services as well as provision of adequate and affordable housing for all Nigerians in both urban and rural areas in secure, healthy and decent environment through access to a functional Nigerian road. | The Federal Ministry of Works and Housing (FMWH) has the power to regulate all construction activities in Nigeria for both public and private entities. Thus, the Bulka intervention project falls under their purview. |
| ***24*** | ***Federal Ministry of Labour and Employment*** | | The Federal Ministry of Labour and Productivity has been in existence (with different names) since 1939, with the central purpose of ensuring cordial relations between workers and employers in the public and private sectors. | The Federal Ministry of Labour applies to both public and private entities. Thus, the Bulka intervention project falls under their purview. |
| ***25*** | ***Federal Ministry of Women Affairs and Social Development*** | | The broad mandate of the Ministry is to advise the Government on gender and children's issues and issues affecting persons with disabilities and the elderly. The Ministry also initiates policy guidelines and leads the process of ensuring gender equality and mainstreaming at both the national and international levels. | The Federal Ministry of Women Affairs and Social Development applies to both public and private entities. Thus, the Bulka intervention project falls under their purview. |

## 2.3 State Policy, Legal, Regulatory and Administrative Frameworks

The proposed project falls within the purview of the Zamfara State Government. The key state administrative laws and legal instruments that are relevant to the project are summarized below.

**Table 2.2** summarizes the provisions of the State policies, laws, institutional and regulatory frameworks relevant to the proposed ACReSAL project activities.

**Table 2.2: Applicable State Policy, Legal and Institutional Framework**

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| *1* | ***Zamfara Environmental Sanitation Agency (ZESA) Law No. 22,*** | 2010 | The law authorizes the agency to:<br>i. Collect and dispose of both wet and dry refuse (solid and liquid) including human waste.<br>ii. Control of industrial waste (liquid emission) and air pollution.<br>iii. In consultation with FEPA ensure implementation and enforcement of FEPA's regulations in the state where applicable.<br>iv. Collaborate with the FEPA in conducting public investigation of measure environmental pollution.<br>v. Cooperate with federal and state ministries, local government council's statutory bodies, research and educational institutions on matters related to environmental protection.<br>vi. In collaboration with FEPA, conduct public investigation and pollution. | The law is applicable to the implementation of the proposed Bulka intervention project |
| *2* | ***Zamfara State Ministry of Agriculture*** | | The Ministry is responsible for formulating and implementing policies, projects and programmes of the government for the development of the agricultural sector and to monitor the implementation of the following policy objectives:<br>• Attainment of self-sufficiency in the essential food products for enhanced food security.<br>• Increase production of Agricultural raw material to meet the growing demand in the agro-allied industries.<br>• Increase in production of exportable products to attract foreign exchange earnings for the State.<br>• Modernization of agricultural production, processing, storage and distribution through the infusion of improved technological packages and management so that agriculture can be more expensive to the demands of other sectors of the economy.<br>• Create more agricultural and rural employment opportunities and improve the living standards of farmers and rural dwellers through enhanced income.<br>• Protection and improvement of Agricultural Land resources and safety of the environment through appropriate farming systems.<br>• Establish formal support institutions and operation of administrative organs to facilitate the integrated development and realization of the State's agricultural potentials. | The ACReSAL project implementation is in collaboration with Federal Ministry of Agriculture and Food Security (FMAFS), thus, the Zamfara State Ministry of Agriculture and Natural Resources is applicable. |

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| | | | • Train and retrain and enlightened human resource stock to make agriculture a business and not a hobby. | |
| ***3*** | ***Zamfara State Ministry of Environment and Natural Resources*** | | Zamfara State Ministry of Environment and Natural Resources was created with the statutory responsibility to attend to issues of water supply, ecological and environmental challenges. The Ministry manages both human and industrial waste, protects and conserve the environment, and enforces laws on the environment in the State. The Ministry undertakes the following core functions:<br>• Public Health and Sanitation; monthly sanitation exercise early Flood warning system monitoring.<br>• Urban Renewal executes the following installation of directional signs.<br>• Environmental impact assessment (EIA).<br>• Beautification and greening of major streets.<br>• Waste Management Waste management and recycling plant. o Collaboration with private service providers, PSPs for effective waste management.<br>• Direct Town cleaning (DTC). | The Zamfara State Ministry of Environment is responsible for overseeing all development projects in Zamfara state including the proposed Bulka intervention project, to ensure its sustainability |
| ***4*** | ***Zamfara Environmental Sanitation Agency (ZESA)*** | | Zamfara Environmental Sanitation Agency is an agency charged with the responsibility of waste collection, pollution control, Inspection and enforcement of environmental laws, streets and drainage evacuation | ZESA is the implementation arm of the ministry of environment and directly involved in the Bulka intervention programme to ensure its sustainability |

## 2.4 International Standards, Treaties, Conventions, Frameworks and Regulations

Nigeria is signatory to several international conventions and treaties relating to industry, development, and environmental management. In certain cases, conventions and agreements have influenced policy, guidelines and regulations and must be complied with during the planning, construction, and operation of the proposed Bulka intervention project.

### 2.4.1 Applicable Conventions & Treaties

Many of these conventions support the use of environmental studies as key tools for achieving pollution control, sustainable environmental development, and preservation of habitats of global significance. Some of the ratified conventions are listed below.

**Table 2.3: Applicable Conventions & Treaties,**

| Date of Ratified by Nigeria | Convention | Objective of Convention |
|---|---|---|
| 1994 | United Nations (UN) Convention on Biological Diversity (1992) | • Conservation of biological diversity,<br>• The sustainable use of its components, and<br>• The fair and equitable sharing of benefits arising out of the utilization |
| 1960 | The International Labor Organization (ILO) 1919 | • Promote and realize standards and fundamental principles and rights at work<br>• Create greater opportunities for women and men to decent employment and income<br>• Enhance the coverage and effectiveness of social protection for all, and<br>• Strengthen tripartism and social dialogue |
| 1994 | Framework Convention on Climate Change (1992) | Stabilization of greenhouse gas concentrations in the atmosphere at safe level |
| 1986 | Convention on the conservation of Migratory Species of Wild Animals Bonn, 1979 | Conservation and management of Migratory Species<br>Protection of Endangered Migratory Species<br>Migratory species habitat conservation, management and restoration<br>International collaboration among migratory regions, as migratory species depend on multiple countries during their life cycles.<br>Reduction of threats to migratory species |
| 1968 | African Convention on Conservation of Nature and Natural Resources (1968) | Adopt the measures necessary to ensure conservation, utilization and development of soil, water, flora and faunal resources in accordance with scientific principles and with due regard to the best interests of the people. |

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| 1972 | Convention Concerning the Protection of the World Cultural and Natural Heritage Sites (or World Heritage Convention) | The convention sets aside areas of cultural and natural heritage for protection. The latter is defined as areas with outstanding universal value from the aesthetic, scientific and conservation points of view. |
| 1992 | The Basel Convention on the Control of Transboundary Movement of Hazardous Waste and Disposal (1989) | This convention focuses attention on the hazards of the generation and disposal of hazardous wastes. The convention defines the wastes to be regulated and controls their trans-boundary movement to protect human and environmental health against their adverse effects. The agreement aims to address the problems and challenges posed by hazardous waste and to protect human health and the environment by minimizing hazardous waste production whenever possible through an "integrated life-cycle approach", which involves strong controls from the generation of a hazardous waste to its storage, transport, treatment, reuse, recycling, recovery and final disposal. The key objectives of the Basel Convention are:<br>• To minimize the generation of hazardous wastes in terms of quantity and hazardousness; and,<br>• To reduce the movement of hazardous wastes by disposing off as close as possible to the source. |
| 2015 | The Paris Agreement (United Nations Framework Convention on Climate Change (1992) – Updated Paris COP 21 Agreement in 2015 and ratified by Nigeria in 2017;) | The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to increase the ability of countries to deal with the impacts of climate change, and at making finance flows consistent with a low GHG emissions and climate-resilient pathway |
| 2007 | Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989) | The treaty started addressing e-waste issues since 2002, which include, among others,<br>• Environmentally sound management;<br>• Prevention of illegal traffic to developing countries; |

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| | | • Building capacity around the world to better manage e-waste. |
| 2020 | Doha Amendment of the Kyoto Protocol to the United Nations Framework Convention on Climate Change | The Amendment sets a goal of reducing greenhouse gas (GHG) emissions by 18% compared to 1990 levels for participating countries. This, according to the UNFCCC, "represents an increase from an average reduction of 5% compared to 1990 levels" during the Kyoto Protocol's first commitment period from 2008-2012. |
| ***Other relevant conventions and treaties include***:<br>• United Nations Guiding Principle on the Human Environment<br>• Public Health legislations and regulations<br>• Convention on the Protection and Promotion of the Diversity of Cultural Expressions<br>• International Labor Organization (ILO): ILO-OSH 2001 - Guidelines on Occupational Safety and Health (OSH) Management Systems | | |

### 2.4.2 The World Bank Environmental and Social Framework (ESF)

The World Bank ESF documents the Environmental and Social Standards (ESS) designed to help ensure that infrastructure projects proposed for Bank financing are environmentally and socially sustainable and thus improve decision-making. The Bank has ten Environmental and Social Standards (ESS1-10) and requires that all environmental and social risks and impacts of the project be addressed as part of the environmental and social assessment conducted in accordance with ESS1. ESS2–10 set out the obligations of the Project Owner in identifying and addressing environmental and social risks and impacts that may require particular attention. These Standards establish objectives and requirements to avoid, minimize, reduce and mitigate risks and impacts, and where significant residual impacts remain, to compensate for or offset such impacts.

Based on the specific activities proposed for the scope of construction and rehabilitation works designed for the Bulka interventions, **Table 2.4** (Applicable Safeguard Standards for Bulka Subprojects) summarizes the World Bank Safeguard Requirements determined to be applicable to the subprojects. The following eight of the ten WB Environmental and Social Standards (ESSs) are applicable due to the potential environmental and social risks and impacts associated with the subprojects, as specified in the Terms of Reference (ToR):

- ESS1: Assessment & Management of Environmental and Social Risks & Impacts;
- ESS2: Labour and Working Conditions;
- ESS3: Resource Efficiency and Pollution Prevention and Management;
- ESS4: Community Health and Safety;
- ESS5: Land acquisition, Restriction of land use and Involuntary Resettlement;
- ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;

- ESS8: Cultural Heritage; and
- ESS10: Stakeholder Engagement and Information Disclosure.

**Table 2.4: Applicable Environmental and Social Standards for Zamfara ACReSAL Subprojects (Bulka Intervention Project)**

| Environmental and Social Standards (ESS) | Description o | Triggered | How it will be addressed |
|---|---|---|---|
| **Environmental and Social Standards 1 (ESS 1)** | This Standard requires that an assessment and evaluation of environmental & social risks and impacts are carried out for certain category of projects, the adoption of mitigation hierarchy for impact management and ensuring that the vulnerable are not disproportionately affected. ESS 1 also seeks to ensure that environmental & social laws, regulations & procedures are followed.<br><br>The proposed project entails civil engineering works with activities such as site clearing, use of heavy equipment, concrete works, labour influx etc. and may trigger some site-specific environmental and social impacts including waste generation, OHS risks, disturbance of economic activities, community health & safety risks, potential GBV/SEA/SH risks, child labour etc. | Yes | An ESMF has been prepared for ACReSAL and site-specific mitigation measures developed in this ESMP |
| **Environmental and Social Standards 2 (ESS 2)** | This ESS is focused on Labour and Working Condition. It seeks to ensure that there is fair treatment, non-discrimination & equal opportunity for project workers and that there is no forced labour and child labour. it recognizes the rights of workers to freedom of association & collective bargaining and that accessible means to raise workplace concerns is provided along with the provision and use of PPEs.<br><br>This is triggered by the proposed project activities as it provides a means for people to earn a living and thus will attract influx of labour. | Yes | Site-specific mitigation measures are developed in this ESMP to uphold good labour practices and working conditions. |
| **Environmental and Social Standards 3 (ESS 3)** | The Bank's ESS on resource efficiency and pollution prevention and management is to assist sustainable use of resources (energy, water and raw materials). reduction of impacts on human health, the Environment. and hazardous & non-hazardous waste including measures to avoid or minimize generation. The standard checks for Climate Change pollutants., use of pesticide & measures to minimize and manage the risks and impacts.<br><br>This is triggered by the proposed project activities as resources which could lead to waste generation and contribute to Climate Change are used in the projects. | Yes | Site-specific mitigation measures are developed in this ESMP to optimize resource efficiency, pollution prevention and management |

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| **Environmental and Social Standards 4 (ESS 4)** | The objective of this Standard on Community Health and Safety is to prevent adverse impact on the health & safety of project affected communities during project life-cycle and that project security is carried out in a manner that avoids or minimizes risks. The project implementation should contain Climate Change considerations in infrastructure design and construction, effective measures to address emergency events, measures to avoid or minimize community exposure to project-related traffic & road safety risks, diseases and hazardous materials.<br><br>This is triggered by the proposed project as project route traverses through built up areas. | Yes | This ESMP contains mitigation and monitoring plan that assures Community Health and Safety throughout project life cycle. |
| **Environmental and Social Standards 5 (ESS 5)** | This standard on Land Acquisition, Restrictions on Land Use & Involuntary Resettlement seeks to avoid, where feasible, or minimize, while exploring all viable alternative project designs, displacement and having to resettle people.<br>The ESS 5 aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts it covers direct economic and social impacts that both result from Bank-assisted investment projects, and are caused by (a) the involuntary taking of land resulting in (i) relocation or loss of shelter; (ii) loss of assets or access to assets, or (iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or (b) the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons. The Standard prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to project appraisal of proposed projects.<br>The activities under the project will require the acquisition of land due to the narrow nature of the existing storm water ways. Some economic housing structures/land seen on the proposed RoW will be impacted, Temporal restriction of access to the assets of some persons and other social issues may occur. | Yes | A resettlement policy framework (RPF) has been prepared for the ACReSAL Project<br>A standalone RAP will also be prepared to ensure the PAPs are properly captured including appropriate compensation measures. |
| **Environmental and Social Standards 6 (ESS 6)** | The ESS 6 focuses on Biodiversity Conservation and Sustainable Management of Living Natural Resources.<br>The aim is to ensure that mitigation hierarchy and precautionary approach is adopted in the design and implementation of projects that could have an impact on biodiversity. It also seeks to promotes sustainable management of living natural resources, supports livelihood of local community and adoption of practices that integrate conservation. | Yes | This ESMP shall contain management and monitoring measures that will promote biodiversity |

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| | The proposed civil works will impact biodiversity at some sections along the project RoW. | | conservation and livelihood support |
| **Environmental and Social Standards 8 (ESS 8)** | ESS 8 on Cultural Heritage aims to ensure that Cultural Heritage is protected & preserved from the adverse impacts of project activities and that there is equitable sharing of benefits from the use of cultural heritage. To this end, a Stakeholder Engagement Plan (SEP). Regarding Cultural Heritage .and a Cultural Heritage Management Plan (CHMP) are essential tools. | Yes | A Stakeholder Engagement Plan (SEP) .and a Cultural Heritage Management Plan (CHMP) are essential components of this ESMP. |
| **Environmental and Social Standards 10 (ESS 10)** | The ESS 10 focuses on Stakeholder Engagement and Information Disclosure.<br>The objective of ESS 10 is to ensure that Stakeholders' views are considered in project design, that there is a Stakeholder Engagement Plan (SEP) throughout the project life cycle. and that there is an adequate and workable Grievance Redress Mechanism (GRM). Thus, appropriate project information is disclosed to Stakeholders in a timely, understandable, accessible and appropriate manner.<br><br>The activities under this project will trigger this ESS 10. | Yes | A Grievance Redress Mechanism (GRM and Stakeholder Engagement Plan are an integral component of this ESMP |

### 2.4.3 World Bank Group Environmental, Health, and Safety General Guidelines

These guidelines are technical reference documents with general and industry-specific examples of good international industry practice. The EHS guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group and that are generally considered to be achievable for infrastructural developments including construction.

***Environmental, Health, and Safety Guidelines for Construction Materials Extraction***

This document includes information relevant to construction materials extraction activities such as aggregates, limestone, slates, sand, gravel, clay, gypsum, feldspar, silica sands, and quartzite, as well as to the extraction of dimension stone. It addresses stand-alone projects and extraction activities supporting construction, civil works, and cement projects. Although the construction materials extraction guidelines emphasize major and complex extraction schemes, the concepts are also applicable to small operations.

## 2.5 Gaps between Nigerian Legislation and World Bank Policies

The gaps between the triggered Nigerian current legislation and WB policies as they relate to this project are summarized in **Table 2.5** below:

**Table 2.5: Gaps between Nigeria Legislation and Triggered World Bank ESSs**

| Applicable WB Standards | Nigerian Legislation | World Bank ESS | Gaps Between the Policies |
|---|---|---|---|
| ESS1 Environmental Assessment | National EIA Act 1992, Clause 2 provides that public or private sector of the economy shall not undertake or embark on or authorize projects or activities without prior consideration of the effects on the environment. The act makes EIA mandatory for any development project and prescribes the procedures for conducting and reporting EIA studies. As part of the effective utilization of the EIA tool, the ministry has produced sectoral guidelines. Responsibility for monitoring of EIA activities lies with the NESREA and State ministries of environment but these agencies lack the logistic capability to carry out the tasks assigned to it by law | An EA is conducted to ensure that Bank-financed projects are environmentally sound and sustainable, and that decision- making is improved through appropriate analysis of actions and of their likely environmental impacts. Any World Bank project that is likely to have potential adverse environmental risks and impacts in its area of influence requires an EA indicating the potential risks, mitigation measures and environmental management framework or plan. | Nigeria currently has a comprehensive framework for assessing and managing the environmental impacts of development projects<br>Essentially, there is no difference between the main framework of both policies |
| ESS2 Labor and Working Conditions | The EIA Act in consonance with the NESREA Act recognizes the need for compliance enforcement of the provisions of international agreements, conventions and treaties on the environment and labor matters.<br>These provisions bring the Nigerian EIA Act to par with the World Bank ESS2. | ESS2 recognizes the importance of employment creation and income generation in the pursuit of poverty reduction and inclusive economic growth. Borrowers can promote sound worker-management relationships and enhance the development benefits of a project by treating workers in the project fairly and providing safe and healthy working conditions. | Essentially, there is no difference between the main framework of both policies. |
| ESS3 Resource Efficiency and Pollution Prevention and Management | The policies, standards, legislation and guidelines under the EIA Act in consonance with the NESREA Act set out compliance requirements to address water quality, environmental health and sanitation, including pollution abatement. The legislations provide enforcement compliance with guidelines and legislations on sustainable management of the ecosystem, biodiversity conservation and the development of Nigeria's natural resources.<br>The regulations seek to use the most appropriate means to prevent and combat various atmospheric pollution; and to address standards applicable to emission from any new mobile or stationary source which causes or contributes to air pollution and may reasonably be anticipated to endanger public health or welfare using | ESS3 recognizes that economic activity and urbanization often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services and the environment at the local, regional, and global levels. The current and projected atmospheric concentration of greenhouse gases (GHG) threatens the welfare of current and future generations. At the same time, more efficient and effective resource use, pollution prevention and GHG emission avoidance, and mitigation technologies and practices have become more accessible and achievable. | Essentially, there is no difference between the main framework of both policies. |

| Applicable WB Standards | Nigerian Legislation | World Bank ESS | Gaps Between the Policies |
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| | appropriate means to reduce emission to permissible levels. | This ESS sets out the requirements to address resource efficiency and pollution prevention and management throughout the project life cycle consistent with GIIP. | |
| ESS4 Community Health and Safety | In consonance with the NESREA Act, Section 20(1), the EIA Act provides the specifications and standards to protect and enhance the quality of Nigeria's air resources, so as to promote public health, welfare and the natural development and productive capacity of the nations' human, animal, marine or plant life including, in particular, minimum essential air quality standards for human, animal, marine or plant health; and the control of concentration of substances in the air which separately or in combination are likely to result in damage or deterioration of the environmental and human health; | ESS4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience acceleration or intensification of impacts due to project activities.<br><br>ESS4 addresses the health, safety, and security risks and impacts on project-affected communities and the corresponding responsibility of Borrowers to avoid or minimize such risks and impacts, with particular attention to people who, because of their peculiar circumstances, may be vulnerable. | Essentially, there is no difference between the main framework of both policies. |
| ESS5 Involuntary Resettlement | The basic legal framework for the acquisition of land in Nigeria is the Land Use Act 1978 as amended under the Amended Land Use Act of 2004, Chapter L5 under the laws of the Federation of Nigeria. The Part 1 of the amended Act 2004 vests all land within the urban areas of any Nigerian State in the Executive Governor of that state. Land within the rural areas of the state is vested on the Local Government. Part VI, Section 29 of the law provides for compensation to the holder of any land title when such land is to be acquired for public purposes. For developed land, the Governor (in the case of urban areas) or Local Government (in the case of rural areas) may, in lieu of compensation, offer resettlement in any other place as reasonable alternative accommodation and in acceptance of resettlement, the holder's right to compensation shall be deemed to have been duly satisfied. | Key objectives of the World Bank's policy on involuntary land acquisition are to avoid or minimize involuntary resettlement where feasible, exploring all viable alternative project designs; assist displaced persons in improving their former living standards, income earning capacity and production level, or at least in restoring them; encourage community participation in planning and implementing resettlement; and provide assistance to affected people regardless of the legality of land tenure. The policy covers not only physical relocation, but any loss of land or other assets resulting in relocation, or loss of shelter; loss of assets or access to assets; loss of income sources or means of livelihood whether the affected people must move to another location. When the policy is | Essentially, there is no difference between the main framework of both policies. Lands that would be acquired for this project shall be fully compensated for in accordance with the World Bank policy and principles. The Nigerian regulations while also lacking clear responsibility for monitoring of activities associated with compensations further lack the logistic capability for any agency to carry out the tasks assigned to it by the law.<br>In this case the policy of the bank prevails. |

| Applicable WB Standards | Nigerian Legislation | World Bank ESS | Gaps Between the Policies |
|---|---|---|---|
| | Although the Land Use Act is not strictly an Act for environmental protection, protection of the environment is one of the considerations which a holder of certificate of occupancy has to observe. | triggered, a Resettlement Action Plan (RAP), must be prepared. An abbreviated plan may be developed when less than 200 people are affected by the project. In situations where all the precise impacts cannot be assessed during project preparation, provisions are made for preparing a Resettlement Policy Framework (RPF). The RAP/RPF must ensure that all Bank's policy provisions detailed in ESS5 are addressed particularly the payment of compensation for affected assets at their replacement cost | |
| ESS6: Biodiversity Conservation & Sustainable Management of Living Natural Resources | The policies, standards, legislation and guidelines under the EIA Act in consonance with the NESREA Act set out compliance requirements to address biodiversity. The legislations provide enforcement compliance with guidelines and legislations on sustainable management of the ecosystem, biodiversity conservation and the development of Nigeria's natural resources | Protecting and conserving biodiversity and sustainably managing living natural resources are fundamental to sustainable development. Biodiversity often underpins ecosystem services valued by humans. This standard recognizes the importance of maintaining core ecological functions of habitats, including forests, and the biodiversity they support. It also recognizes the need to consider the livelihood of project-affected parties, including Indigenous Peoples, whose access to, or use of, biodiversity or living natural resources may be affected by a project. | Essentially, there is no difference between the main framework of both policies. |
| ESS10 Stakeholders Engagement and Information Disclosure | The EIA Act in consonance with the NESREA Act recognizes the need to create public awareness and provide environmental education on sustainable environmental management, promote private sector compliance with environmental regulations | This ESS recognizes the importance of open and transparent engagement between the Borrower and project stakeholders as an essential element of good international practice. Effective stakeholder engagement can improve the environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.<br><br>Stakeholder engagement is an inclusive process conducted throughout the project life cycle. Where properly designed and implemented, it | Essentially, there is no difference between the main framework of both policies. Lands that would be acquired for this project shall be fully compensated for in accordance with the World Bank policy and principles. The Nigerian regulations while also lacking clear responsibility for monitoring of activities associated with compensations further lack the logistic capability for any agency to carry out the tasks assigned to it by the law. |

| Applicable WB Standards | Nigerian Legislation | World Bank ESS | Gaps Between the Policies |
|---|---|---|---|
| | | supports the development of strong, constructive and responsive relationships that are important for successful management of a project's environmental and social risks. Stakeholder engagement is most effective when initiated at an early stage of the project development process and is an integral part of early project decisions and the assessment, management and monitoring of the project's environmental and social risks and impacts. | In this case the policy of the bank prevails. |

# CHAPTER 3: BIOPHYSICAL ENVIRONMENT

## 3.1 Introduction

This Section discusses the project area of influence as well as the general and specific baseline conditions that characterize the subproject areas. The discussions are in three parts consisting of (i) the project area of influence; (ii) general environmental conditions; and, (iii) site specific environmental conditions focusing on the Bulka stormwater/erosion corridors that make up the subproject areas.

The baseline environmental (air, noise, soil, groundwater, surface water, sediment and biodiversity) conditions of the proposed Bulka intervention site is documented in this chapter; against which the potential and cumulative impacts associated with the project were assessed. This is an essential part of the overall ESMP process, as it provides information on the characteristics and features of the proposed project environment. This section also contains the background/scientific basis for predicting, evaluating and mitigating the impacts of the planned project activities on the environment, monitoring environmental changes in the area, and is very essential for decision making in event of future project design, operation and management and decommissioning.

## 3.2 Watershed Characteristics

The watershed characteristics was studied using site investigation and topographic maps, i.e., watershed size and shape, stream slope, stream length and land slope were determined from topographic satellite DEM data. The catchment area of each watershed on the gullies was delineated from the DEM data of 12m x 12m resolution. The sizes of each catchment area, length of mainstream, and average slope, were determined using Arc hydro tools extension on ARC GIS ArcMAp-10 software. The drainage network and watershed catchment areas for Bulka is shown in **Figure 3.1.**

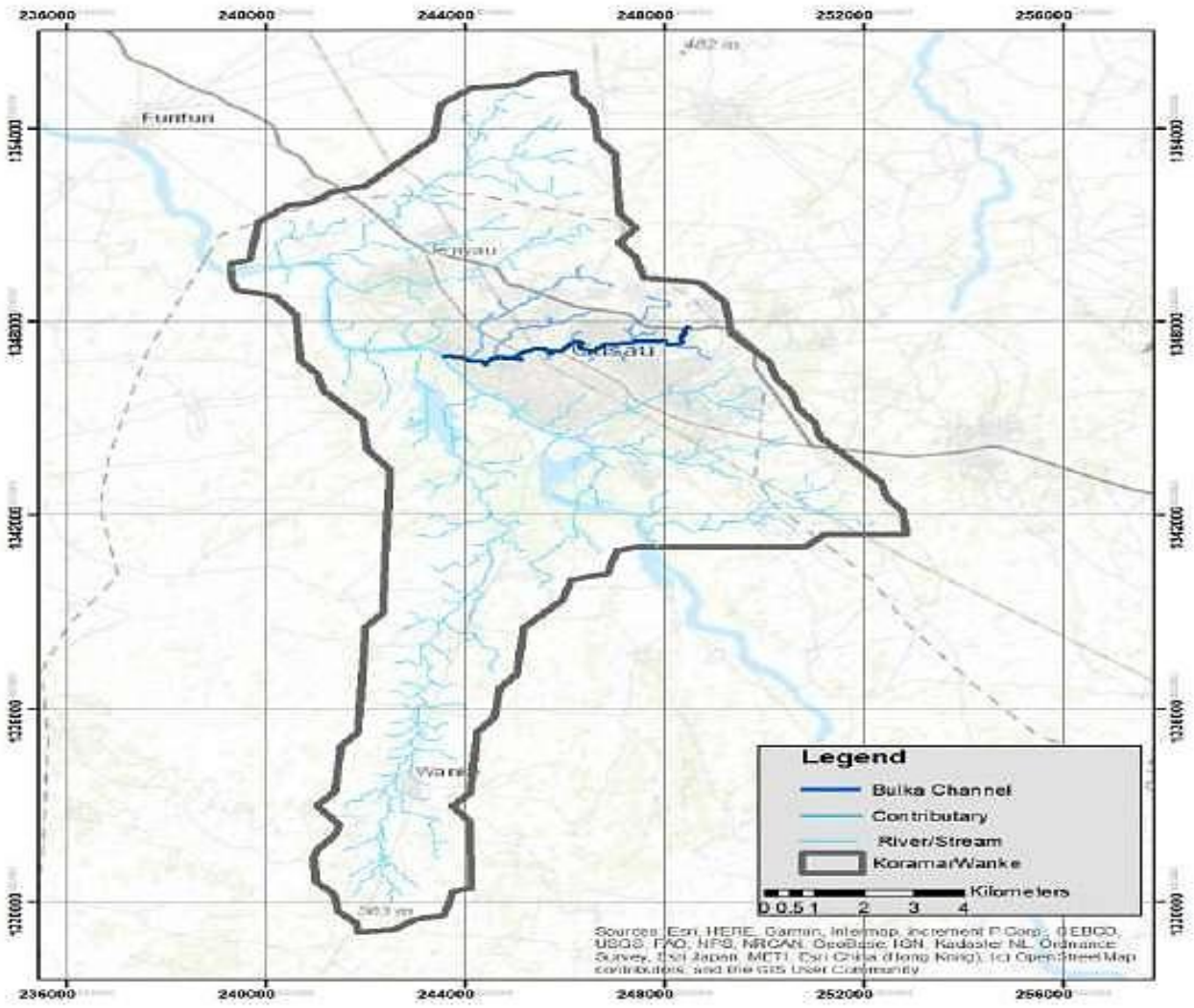



**Figure 3.1: Map Showing Bulka Drainage and Catchment Area in Gusau Metropolis**

## 3.3 Description of the Existing Biophysical Environmental Conditions

The prevailing environmental condition of an area where a development project would be implemented requires a detailed environmental assessment. A detailed assessment of the biophysical environment of project area is one of the cardinal aims of any well-planned intervention programs such as the proposed Bulka intervention project. The baseline physical environment data description and documentation typically serve two main purposes;

- It provides a benchmark against which future assessments can be compared to determine changes in environmental characteristics over time.
- Environmental impacts (positive and negative) prediction, identification, and quantification is facilitated by the superimposition of the technical details of the proposed program on the baseline (existing) environmental conditions. In addition, this understanding will foster and aid the process of developing and proffering cost-effective measures that will mitigate any negative impacts that will be identified and enhance the beneficial impacts.

### 3.3.1 Climate and Meteorology

The climate of Zamfara State is tropical savannah as postulated by Koppen's system of climate classification which is the most recognised system of climate classification. This climate type is characterized by conventional rainfall and the amount of precipitation received in the region is relatively high and it is expressed as the contrast between a dry season and a wet season. These two seasons are very dependent on the two prevailing air masses blowing over the country at different times of the year; the dry north-easterly air mass of Saharan origin, and the humid maritime air mass blowing from over the Atlantic. These air masses result in the Inter-Tropical Convergence Zone (ITCZ) which is commonly referred to as Inter-Tropical Discontinuity (ITD) or the Inter-Tropical Front (ITF).

The Front is associated with the northward and southward movement of wind. The movement of the ITCZ is the warm humid maritime Tropical (mT) air masses with north-easterly winds. As noted by Ojo, 1972, these air masses are the major controlling factors of the region's atmospheric characteristics which causes the marked variations in the wet and dry seasons in the area.

Five (5) weather/meteorological parameters were analysed for this study. These weather elements are Rainfall, Temperature, Wind Speed, Wind Direction, and Relative Humidity. Analysis of weather elements given as mean value over a long period shows the overall trends of increase and/or decrease. Micro-climatic elements in terms of duration or intensity, changes, fluctuations, and variations have considerable influence on human activities.

The Nigeria Meteorological Agency (NiMet) is the custodian of and authority in charge of weather situation data in Nigeria. For this study, climatic data was sources from archival records available at the Data Management Unit (DMU) of the NiMet, and supported with data from relevant literature.

***Rainfall Characteristics***

Rainfall is the principal element controlling the climate in tropical regions, including Zamfara State. It is also the primary driver of stormwater runoff and hence the most critical meteorological parameter for the design of the Bulka Stormwater & Erosion Control Project. Based on historical data (1995-2024), the annual rainfall in Zamfara State ranges from 615.9mm to 1,442.2 mm, with a mean annual rainfall of approximately 858.42 mm. This indicates significant variability in annual rainfall amounts. Out of the 30 years of records analysed, only in six years did the annual rainfall amount exceed 1,000 mm (NiMet, DMU).

The monthly rainfall distribution follows a unimodal pattern, with the highest rainfall occurring in August (over 200 mm), which accounts for about 30% of the total annual rainfall. The onset of the rainy season typically occurs in May/June, while the cessation occurs in October. The number of rainy days per year ranges from 30 to 70, with an average of about 50 days. Rainfall intensity in the area is generally high, with about 50% of the rain falling in the first 30% of the duration of a

typical storm event. This high-intensity rainfall characteristic is particularly important for the design of drainage systems, as it results in high peak flows that must be safely conveyed through the drainage network.

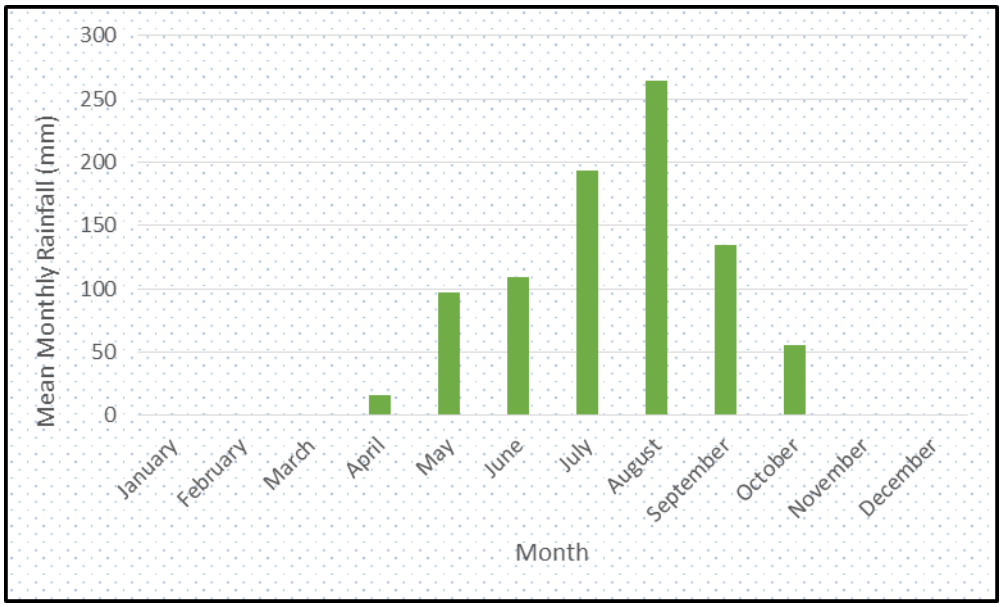



**Figure 3.2: Mean Monthly Rainfall Characteristics in the Study Area**

***Relative Humidity***

Relative humidity in Zamfara State, including Gusau, shows significant seasonal variations, corresponding to the wet and dry seasons. During the wet season (May to October), relative humidity increases substantially, with maximum values occurring in August when it can reach up to 77%. This high humidity is due to the influence of the moist southern winds that dominate during this period. During the dry season (November to April), relative humidity decreases significantly, with minimum values of around 18% occurring towards the end of the harmattan season. This low humidity, combined with high temperatures, results in high evaporation rates during the dry season. Diurnal variations in relative humidity are also significant, with higher values typically occurring in the morning and evening compared to midday. This pattern is consistent throughout the year, although the magnitude of the diurnal range varies seasonally. The relative humidity has implications for evaporation rates, soil moisture retention, and vegetation cover, all of which influence the generation of surface runoff and the effectiveness of various erosion control measures

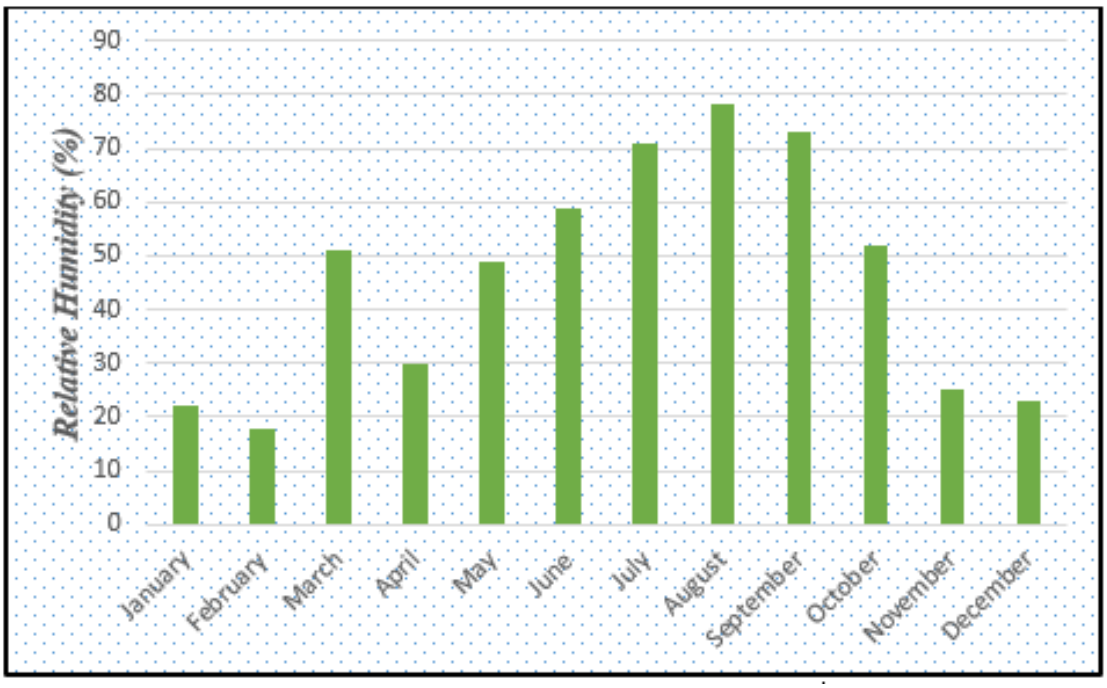



**Figure 3.3: Mean monthly Relative Humidity in the study area**

***Temperature***

The temperature regime in Gusau, like the rest of Zamfara State, is characterized by high and relatively stable temperatures throughout the year, with seasonal fluctuations. Based on long-term records, the mean minimum temperature ranges from 16.9°C to 27.1°C, while the mean maximum temperature ranges from 31.3°C to 40.8°C. The monthly temperature trend shows a slight drop between July and September, coinciding with the peak of the rainy season. The coolest months are January and August; January coincides with the harmattan season, while the low temperature in August is attributed to the peak rainfall months.

As expected, temperatures are generally higher during the dry season and lower during the wet season. The highest temperatures occur in April, just before the onset of the rainy season, when maximum temperatures can exceed 40°C. The lowest temperatures occur in January during the harmattan period, when minimum temperatures can fall below 16°C. The high temperatures, especially during the dry season, contribute to high evaporation rates, which can affect soil moisture content and vegetation cover.

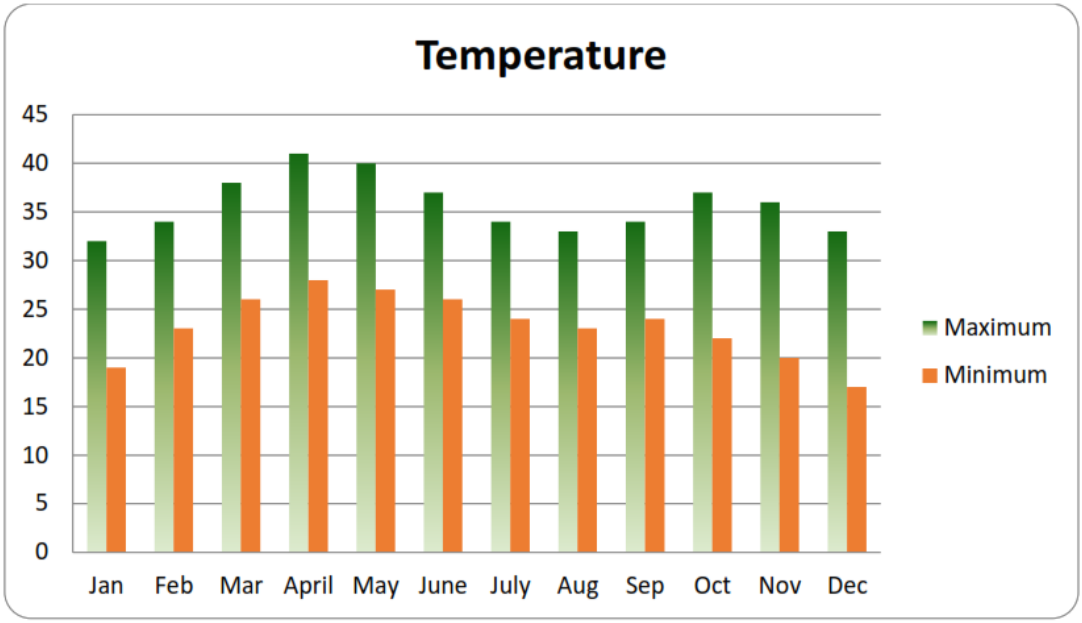



**Figure 3.4: Mean Monthly Temperature in the study area**

***Wind speed***

Wind speed is relatively high throughout the year across Zamfara State, including Gusau. On average, wind velocity exceeds 28 km/h, while lesser winds decline month-on-month. Most days of the month, wind usually exceeds 19 km/h and rarely exceeds 28 km/h. Wind erosion is a significant concern, especially during the dry season when soil is exposed and vegetation cover is minimal. During the rainy season, when the intertropical zone of discontinuity moves northwards, wind velocity becomes very high, leading to erosional activities. This annual phenomenon starts in the last week of December, gathers momentum, and peaks in June, occurring at least nine days in the month. This is majorly driven by the absence of high canopy and broadleaved dense trees, which could act as windbreakers, and serve as nature-based solutions against the wind erosion problem in the area.

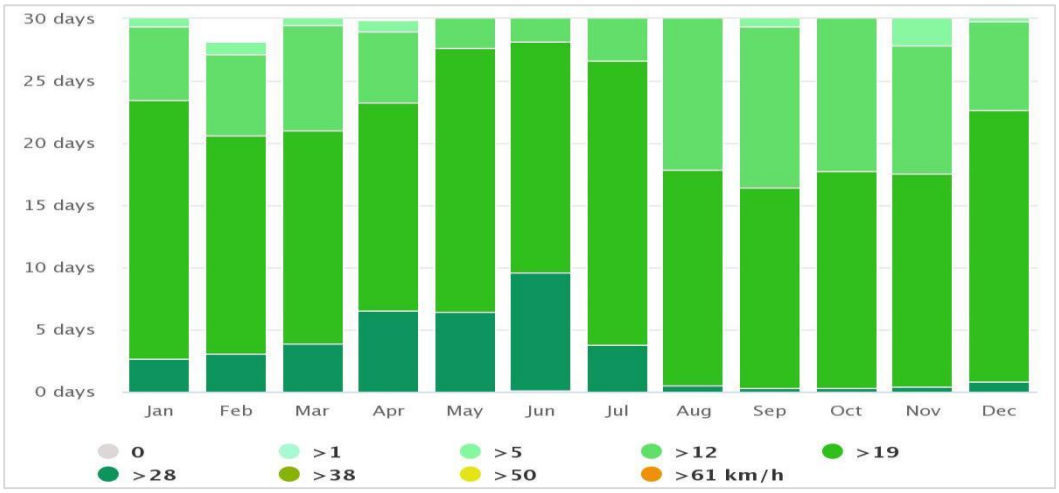



**Figure 3.5: Wind Velocity Frequency Per Number of Days in a Month in Zamfara State**

***Wind direction***

Wind direction is predominantly from the northeast during the dry season (harmattan) and from the southwest during the wet season (monsoon). This seasonal shift in wind direction corresponds to the movement of the Intertropical Convergence Zone (ITCZ) across the region.

The prevailing wind direction over the region is south westerly. Highest wind direction for the month and the year is South-West (SW), meanwhile, the wind pattern during dry season of November to March is usually north easterly. Therefore, the wind pattern is greatly influenced by the prevailing season. The north easterly winds periodically raised dust particles into the atmosphere over the region, following the occasional strengthening of the surface high pressure.

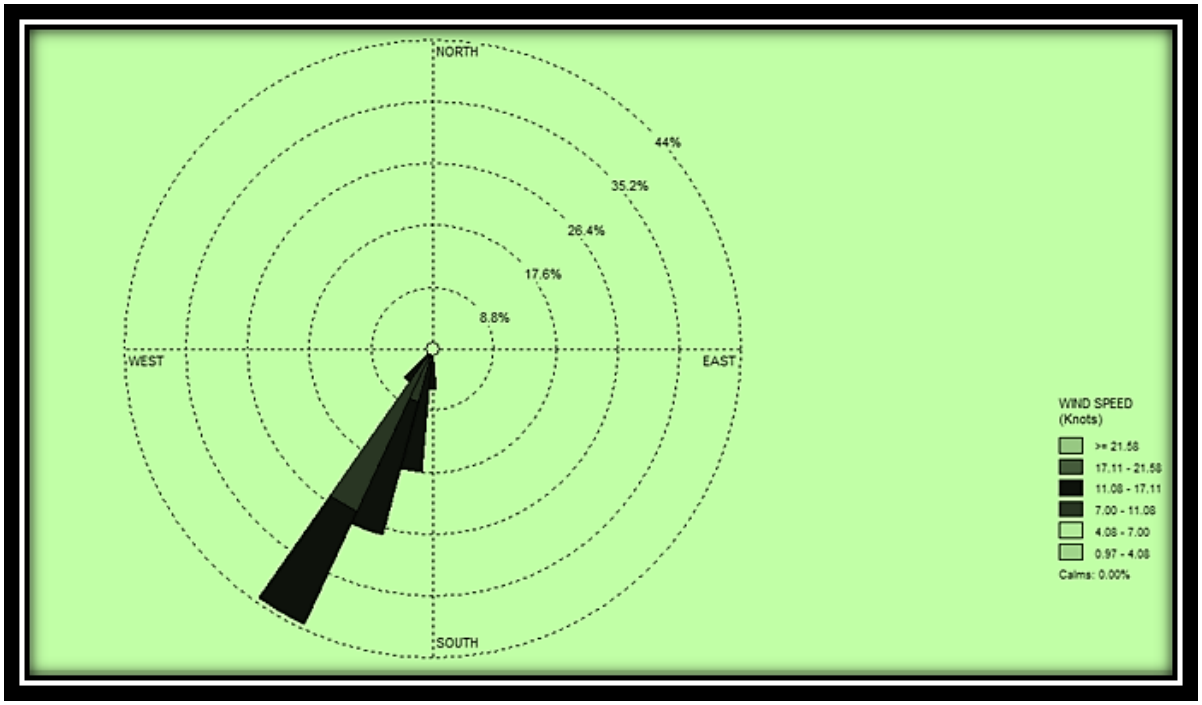



**Figure 3.6: Mean Wind Speed and Direction in the Project State**

### 3.3.2 Air Quality and Noise Measurement

Air emissions are pollutant gases and particles released into the atmosphere which can cause mild to severe harm on humans and the environment. On the other hand, Noise is a periodic fluctuation of air pressure. Apart from causing disturbance to the affairs of man, long term exposure to excessive noise can damage health and have psychological effects (WHO, 2011).

Air quality and ambient noise studies were conducted at 10 designated stations within the AoI (500m on both sides of the gully) using Air quality gas monitor. Each parameter measurement, methods and principles adopted for each parameter were based on sensitivity, stability, repeatability and capability for calibration during analysis. The handheld air quality monitors are specifically designed to give accurate ambient gas measurement, with dedicated sensor per parameter. Concentrations of particulate matter (PM2.5and PM10) and gaseous parameters $SO_2$,

$H_2S$, CO, $CH_4$, and VOCs were determined by turning on the meter and allowing the required warming time before reading measurement off the screen. A digital sound level meter was used for noise measurement of the project area alongside the control station. Noise measurement was taken in dB (A). The values obtained are indicated in **Table 3.1** below.



**Plate 3.1: Air quality and Noise Measurements**

**Table 3.1: Ambient Air Quality and Noise Measurements in the Study Area**

| Parameters | Latitude | Longitude | Temp (°C) | $SPM_{2.5}$ ($\mu g/m^3$) | $SPM_{10}$ ($\mu g/m^3$) | Humidity (%) | $SO_2$ (ppm) | $NO_2$ ppm) | $CH_4$ (ppm) | $H_2S$ (ppm) | CO (ppm) | VOC (ppm) | Noise Level (dB)A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AQ1 | 12.181857 | 6.683431 | 32 | 155.25 | 667.75 | 52 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 13.2 | 46.4 |
| AQ2 | 12.182226 | 6.683343 | 31 | 38.62 | 167.90 | 32 | 0.2 | 0.1 | 0.0 | 0.0 | 5 | 14.32 | 66.1 |
| AQ3 | 12.179800 | 6.680713 | 34 | 83.72 | 30.56 | 31 | 0.2 | 0.1 | 0.0 | 0.2 | 14 | 315.2 | 53.3 |
| AQ4 | 12.179800 | 6.680713 | 36 | 76.54 | 48.67 | 30 | 0.1 | 0.1 | 0.0 | 0.0 | 1 | 125.13 | 49.8 |
| AQ5 | 12.177407 | 6.675538 | 34 | 223.40 | 241.21 | 31 | 0.2 | 0.2 | 0.0 | 0.0 | 4 | 132.1 | 47.2 |
| AQ6 | 12.174000 | 6.660401 | 33 | 215.50 | 163.21 | 31 | 0.2 | 0.1 | 0.0 | 2.5 | 6 | 138.5 | 56.6 |
| AQ7 | 12.173967 | 6.664200 | 34 | 146.00 | 176.32 | 50 | 0.2 | 0.2 | 0.0 | 2.2 | 0 | 136.2 | 56.6 |
| AQ8 | 12.172956 | 6.644392 | 29 | 133.50 | 341.25 | 50 | 0.2 | 0.2 | 0.0 | 0.0 | 1 | 167.20 | 57.6 |
| AQ9 | 12.171363 | 6.644308 | 29 | 133.10 | 170.25 | 50 | 0.1 | 0.1 | 0.0 | 0.0 | 0 | 166.20 | 46.4 |
| AQ10 | 12.171266 | 6.644888 | 28 | 133.70 | 341.25 | 50 | 0.1 | 0.1 | 0.0 | 0.0 | 0 | 13.20 | 46.3 |
| AQCTRL | 12.1751416 | 6.643601 9 | 27 | 13.62 | 54.6 | 34 | 0.0 | 0.01 | 0.0 | 0.0 | 0 | 0.341 | 52.0 |
| | | | | | | | | | | | | | |
| Mean | | | 32 | 133.93 | 234.84 | 40.7 | 0.15 | 0.12 | 0 | 0.49 | 3.1 | 122.13 | 52.63 |
| FMEnv Limit ($\mu g/m^3$) | | | - | 250 | | | 50 | 30 | | 5 | 10 | | 90 |
| WHO ($\mu g/m^3$) | | | - | 100-150 | | | - | | | | 10 | | |

Source: *Hardan Consulting Field Survey 2025*

***Suspended Particulates Matters***

Suspended Particulate Matter (SPM) constitutes the sum of all solid and liquid particles suspended in air, ranging in size from 0.1 micrometer to about 30 micrometer in diameter, many of which are hazardous. This complex mixture contains for instance dust, pollen, soot, smoke, and liquid droplets.

Ambient particulate matter is responsible for harmful effects on health, even in the absence of other air pollutants. Both fine and coarse particles have been shown to affect health, in particular the respiratory system. Fine particles are more dangerous than coarse particles. Apart from the size of the particles, other specific physical, chemical, and biological characteristics that can influence harmful health effects include the presence of metals, PAHs, other organic components, or certain toxins.

Particulates were detected in all the locations sampled. The measured concentrations had mean values of 133.93 $\mu g/m^3$; and 234.84 $\mu g/m^3$ respectively for SPM 2.5 and SPM 10. These high values could be attributed to high anthropogenic activities and the arid nature of the project area where particulates are easily dispersed through the area by dry winds. Values were above regulatory limits, indicating the need to ensure proper management procedures in the receiving atmospheric environment during the implementation of the proposed project.

***Sulphur Dioxide ($SO_2$)***

Sulphur iv oxide in the air results primarily from activities associated with the burning of fossil fuels (coal, oil) such as at power plants or from copper smelting. Exposure occurs from breathing and it affects the lungs and at high levels may result in burning of the nose and throat, breathing difficulties, and severe airway obstructions (ATSDR, 1999). Sulphur iv oxide is known to be a harsh irritant, and is capable of aggravating asthma, bronchitis and emphysema and promoting impaired functions in the human system (CCDI, 2001).

$SO_2$ was detected at all the sampling points, with concentration level ranging from 0 to 0.2 with a mean value of 0.15ppm. This value exceeds the NESREA 24hour regulatory limit. Therefore, prolonged exposure can result in respiratory conditions in especially in children.

***Nitrogen Dioxide ($NO_2$)***

Many chemical species of nitrogen oxides (NOx) exist, but the air pollutant species of most interest from the point of view of human health is nitrogen dioxide ($NO_2$), Nitrous Oxide, $N_2O$ being a major contributor to global atmospheric warming potential. On a global scale, emissions of nitrogen oxides from natural sources far outweigh those generated by human activities. Natural sources include intrusion of stratospheric nitrogen oxides, bacterial and volcanic action, and lightning. Because natural emissions are distributed over the entire surface of the earth, however, the resulting background atmospheric concentrations are very small. The major source of anthropogenic emissions of nitrogen oxides into the atmosphere is the combustion of fossil fuels

in stationary sources, (gas flares, heating, power generation) and in motor vehicles (internal combustion engines). The mean results of 0.12ppm obtained was within NESREA/FMEnv regulatory limits.

***Carbon II oxide***

Carbon ii oxide (CO) is a poisonous, colorless, odorless and tasteless gas resulting from the incomplete burning of material containing carbon such as natural gas, gasoline, kerosene, oil, propane, coal, or wood (OSHA, 2012). Adverse health effect has been observed with carbon ii oxide concentrations of 12 - 17ppm for 8 hours (Canter and Hill, 1977) while prolonged (45 minutes to 3 hours) exposure to concentrations of CO between 200ppm and 800ppm often results in severe headache, dizziness, nausea and convulsions (CCDI, 2001). CO was obtained in all the sample stations and had a mean value of 3.1ppm. This value was within FMEnv/NESREA regulatory limit.

***Methane***

Methane, $CH_4$, is a colorless, odorless gas with a wide distribution in nature. It is the principal component of natural gas. Anaerobic bacterial decomposition of plant and animal matter, such as occurs under water, produces marsh gas, which is another name for methane. It is nontoxic when inhaled, but it can produce suffocation by reducing the concentration of oxygen inhaled. $CH_4$ was below detection limit across all stations

***Volatile Organic Compounds***

Volatile organic compounds (VOCs) are a large group of organic chemicals that include any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate). VOCs are of interest in part because they participate in atmospheric photochemical reactions that contribute to ozone formation, they play a role in formation of secondary organic aerosols, which are found in airborne particulate matter, and because many individual VOCs are known to be harmful to human health. VOCs are emitted from a variety of sources, including motor vehicles, chemical manufacturing facilities, refineries, factories, consumer and commercial products, and natural (biogenic) sources (mainly trees), and health effects vary by pollutant (EPA, 2018). VOC was detected at all sampling points with values ranging from 13.2-315.2 ppm with mean value of 122.13ppm. These high values of VOC can be attributed to several anthropogenic activities, car usage, fossil burning etc. Values exceed FMEnv safe limits for VOC. High VOC is a public health risk and in the long run can result in health risk such as headaches, nausea, respiratory discomforts.

***Noise***

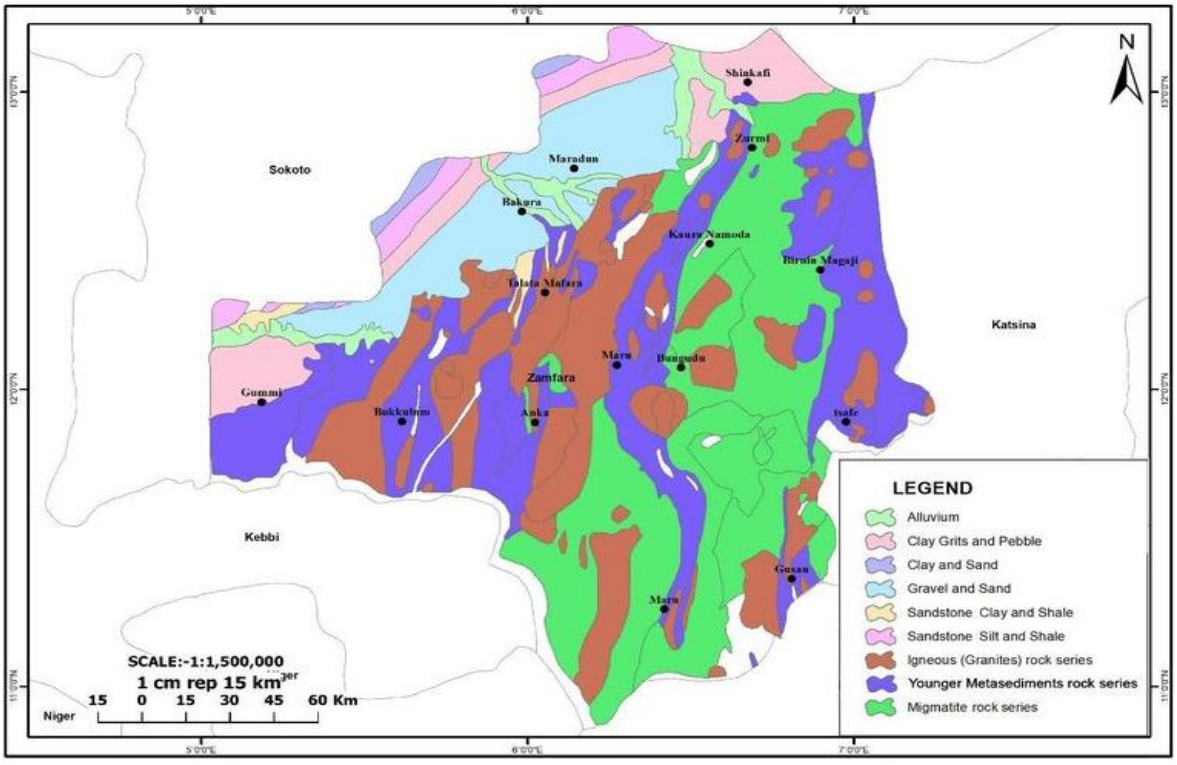
Noise is a pressure variation (wave) that travels through air, producing excessive or unwanted sound which potentially results in annoyance and/or hearing loss. Apart from causing disturbance to the affairs of man, long term exposure to excessive noise can damage health and have psychological effects (SIEP, 1995; Oguntoke *et al*., 2015; Oguntoke *et al*.,2019). The effects of

noise on residents generally relate to the annoyance/nuisance caused by the short and long term high noise levels. Also, disturbance to wildlife is significant especially during breeding seasons and/or when rare species are present. The regulatory limit for noise provided by the FMEnv (90dB) is specific to the workplace. However, noise due to construction activities are expected to rise. The noise measurements recorded at all sampling stations were within FMEnv regulatory limit as stated in **Table 3.1** above.

### 3.3.3 Geology and Hydrogeology

Zamfara State, including Gusau where the Bulka project is located, is predominantly underlain by Precambrian Basement Complex rocks, which cover about 90% of the state. The Basement Complex consists mainly of igneous and metamorphic rocks, including granites, gneisses, schists, and migmatites. In terms of hydrogeology, the project area falls within the crystalline zone of the Basement Complex in the Sokoto basin. Groundwater availability in this zone is generally unpredictable, as the crystalline rocks are inherently impervious. However, secondary aquifer characteristics can develop through fracturing, fissuring, jointing, and weathering, enabling some groundwater storage.

The natural drainage system in the area is influenced by the Sokoto River and its tributaries, which form part of the larger Niger River basin. The general drainage pattern is dendritic, with smaller streams and gullies converging to form larger channels that eventually drain into the main river system.




*Source: Nigeria Geological Survey Agency, 2006*

**Figure 3.7: General Geological Map of Zamfara State**

### 3.3.3.1 Soil Quality

Soil properties that are often studied include its physio-chemical and nutrients properties for the baseline study. The quality (chemical composition) of soil is particularly essential for agriculture/crop cultivation. The physio-chemical characteristics of soil reflect the nature, properties, as well as the degree of interaction with other environmental components. It also reflects the potential and vulnerability of soil to extraneous factors. Generally, soil plays significant roles in man's quest for continuous agriculture/crop cultivation and sustainable development in the changing global climate reality.

Soil samples were collected at 10 strategic locations along the proposed project corridor at depths of 0 to 30 cm using a calibrated (marked) stainless steel soil auger. Soil samples were collected into Ziploc bags and stored for analysis. Appropriate quality assurance and quality control (QA/QC) measures were implemented during the sampling activities. The QA/QC measures included: regular cleaning of the soil auger after each sampling event to avoid cross-contamination, wrapping of soil sample in foil paper and separation of samples meant for microbiology. In addition, soil samples were properly labelled with a unique code to avoid a possible mix-up while in transit to the Country laboratory.



**Plate 3.2: Soil Sampling**

**Table 3.2: Soil Physico-chemical, Heavy Metals and Nutrients Parameters**

| Parameter | Unit | Mean | max | min | Limits |
|---|---|---|---|---|---|
| ***Physico-Chemical Properties*** | | | | | |
| pH | - | 6.6 | 7 | 6.2 | 6.5 – 8.5 |
| Texture | - | Range: Sandy – Loamy – Loam Clay-Silty loam | | | - |
| Grain Size | Mm | 0.01-2.0 | 0.01-2.0 | 0.01-2.0 | - |
| Porosity | % | 62.1 | 75.6 | 43.4 | - |
| Permeability | Cm/s | 8.94E-04 | 8.2E-03 | 1.2E-06 | - |
| Bulk Density | $Kg/m^3$ | 1000.75 | 1501 | 639.6 | - |
| Particle Size 0.356 | % | 22.3 | 45.1 | 4.1 | - |
| Particle Size 0.25 | % | 9.374 | 15 | 4.28 | - |

| | | | | | |
|---|---|---|---|---|---|
| Particle Size 0.15 | % | 12.72 | 17.7 | 5.8 | - |
| Particle Size 0.063 | % | 48.09 | 62.6 | 30.6 | - |
| Moisture Content | % | 7.851 | 16.4 | 1.14 | - |
| Colour | - | Brown to Dark brown | | | |
| Total Nitrogen | Mg/kg | 125 | 200 | 65 | |
| Total Organic Compounds | Mg/kg | 1500 | 2400 | 780 | NS |
| Oil & Grease | Mg/kg | 0 | 0 | 0 | NS |
| ***Nutrients (Cations and Anions)*** | | | | | |
| Calcium (Ca") | mg/kg | 15.58 | 22.1 | 11.4 | NS |
| Magnesium (Mg") | mg/kg | 6.04 | 8.4 | 3.9 | NS |
| Ammonium (NH.*) | mg/kg | 0.29 | 0.45 | 0.12 | - |
| Potassium (K°) | mg/kg | 9.55 | 14.2 | 5.8 | 725 |
| Mn* ion | mg/kg | 4.04 | 7.6 | 1.05 | - |
| Sodium (Na') | mg/kg | 14.39 | 24.5 | 6.4 | NS |
| Chloride (CI) | mg/kg | 26.35 | 42.5 | 15.2 | 500 |
| Sulphate (SO?) | mg/kg | 19.78 | 38.2 | 8.2 | 500 |
| Nitrate (NO,) | mg/kg | 11.08 | 22.1 | 4.1 | NS |
| Phosphate (PO/) | mg/kg | 1.35 | 3.1 | 0.42 | NS |
| Carbonate (CO.) | mg/kg | 0.05 | 0.08 | 0.02 | - |
| ***Heavy Metals*** | | | | | |
| Mn | mg/kg | 4.123 | 7.6 | 1.05 | - |
| Iron (Fe) | mg/kg | 202.73 | 271.3 | 136.3 | NS |
| Copper (Cu) | mg/kg | 0.64 | 1.76 | 0.32 | 50-100 |
| Zinc (Zn) | mg/kg | 1.6082 | 3.383 | 0.376 | NS |
| Mercury (Ho) | mg/kg | 0 | 0 | 0 | NS |
| Lead (Pb) | mg/kg | 0.013 | 0.024 | 0.007 | NS |
| Nickel (Ni) | mg/kg | 1.362 | 3.069 | 0.155 | NS |
| Cadmium (Cd) | mg/kg | 0 | 0 | 0 | - |
| Chromium (Cr) | mg/kg | 0.035 | 0.055 | 0.015 | - |
| Vanadium (V) | mg/kg | 0.011 | 0.018 | 0.006 | NS |
| Arsenic (As) | mg/kg | 0.002 | 0.003 | 0.001 | - |
| Barium (Ba) | mg/kg | 0.259 | 0.38 | 0.188 | - |

*Hardan Consulting Field Survey 2025*

***Physiochemical***

*pH*

pH is a commonly measured soil quality parameter. It determines the acidity, neutrality or alkalinity of a particular soil and indicates the availability of exchangeable cations (e.g., $Ca^{2+}$, $Mg^{2+}$, $K^{+}$ etc.). The pH ranged from 6.2 – 7.6 with a mean of 6.6. The results shows that the soil of the study area is generally within safe limits of 6.5-8.5.

***Nutrients (Anions and Cations)***

The overall mean concentrations of the study area soil exchangeable cations (macro nutrients) of Magnesium (Mg), Calcium (Ca), Sodium (Na), and Potassium (K) are 6.04mg/kg, 14.39mk/kg, and 9.55mg/kg respectively. None of these soil exchangeable cations concentrations contravene their limits where stated.

Furthermore, the mean soil anions (micro nutrients) of Sulphate ($SO_4^{2-}$), phosphate ($PO_4^{3-}$), Chloride ($Cl^-$) and Nitrate ($NO_3^-$) are 19.78mg/kg, 1.35mg/kg, 26.35mg/kg and 11.08mg/kg. Generally, soil micro nutrients are within their specified limits where stated, also they are within the natural occurrence levels for tropical soils as canvassed by the Alloway, 1991.

***Heavy Metals***

Several heavy metal parameters were analyzed for the Bulka ESMP. Iron was the dominant heavy metal in the project area followed by Manganese, then Zinc and the least most abundant was cadmium and mercury. Iron content was had a mean of 202.73mg/kg, manganese have mean value of 4.123mg/kg, and zinc had mean value 0f 1.608mg/kg.

***Soil Microbiology***

Microbiological parameters considered include Total plate count, total coliform, E. *coli*, etc. The microbial analysis showed the presence of microorganism such as E. Coli across all stations and presence of Salmonella in only 5 stations. The presence of these microbes poses public health risk to residents of the community. Consistent open defecation is the major reason for the presence of these microbes in the soil. *Vibrio cholerae and Pseudomonas acruginosa* were absent in all sample stations.

### 3.3.3.2 Surface Water Characteristics

Surface water samples were collected upstream, midstream and downstream from the Koromar wanke river (locally called Gulbi). The river is the discharge point of the Bulka intervention stormwater channel. The water samples were collected for physico-chemical, microbial and heavy metals analysis. All the collected samples were stored in the refrigerator/ice-chest (with ice packs) at $4\pm2^0$C while on the field and afterwards were transported to the laboratory for analysis. In-situ measurements were done at each station for fast changing parameters such as of pH, temperature, dissolved oxygen (DO), salinity, total dissolved solids (TDS), conductivity and turbidity using a calibrated multiparameter water quality checker.




**Plate 3.3: Surface Water Sampling and In-situ Analysis**

**Table 3.3: Physiochemical, Heavy metal and Microbiological Characteristics of Surface Water Samples**

| Parameter | Unit | SW1 | SW2 | SW3 | Ctrl1 | Ctrl2 | Mean | Max | Min | WHO | NESREA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Physico-chemical | | | | | | | | | | | |
| Temperature | °C | 24 | 24 | 24 | 25 | 25 | 24 | 24 | 24 | -- | - |
| pH | - | 9 | 8.8 | 8.7 | 7.9 | 7.8 | 8.83 | 9 | 8.7 | 6.5-8.5 | 6.5-8.5 |
| Dissolved Oxygen | mg/L | 6.12 | 6.52 | 8.63 | 8.26 | 8.5 | 7.09 | 8.63 | 6.12 | 6.5-8 | |
| Conductivity | HS/cm | 374 | 391 | 366 | 369 | 2,340 | 377 | 391 | 366 | 1000 | NS |
| Salinity | mg/L | 188 | 197 | 184 | 188 | 1,170 | 189.67 | 197 | 184 | - | - |
| Colour | TCU | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | - | - |
| Alkalinity | mg/L | 70 | 71 | 78 | 78 | 86 | 73 | 78 | 70 | 200-600 | |
| Total Hardness | mg/L | 111 | 129 | 83 | 181 | 103 | 107.67 | 129 | 83 | | |
| COD | mg/L | 100 | 480 | 1,122 | 1,126 | 1,120 | 567.33 | 1122 | 100 | - | - |
| BOD | mg/L | 14.2 | 160 | 375 | 377 | 373 | 183.07 | 375 | 14.2 | - | - |
| TSS | mg/L | 0.06 | 0.05 | 4.29 | 4.29 | 0,12 | 1.47 | 4.29 | 0.05 | 30 | NS |
| TDS | mg/L | 200 | 208 | 192 | 190 | 216 | 200 | 208 | 192 | 600 | 40,000 |
| Turbidity | NTU | <1 | 3 | 2 | 27 | 21 | 2.5 | 3 | 2 | 5 | |
| Oil & Grease | mg/L | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - |
| Redox Potential | mV | -142 | -112 | -105 | 145 | 162 | -119.67 | -105 | -142 | - | - |
| Total Organic Carbon | mg/L | 3.5 | 144 | 336 | 336 | 336 | 161.17 | 336 | 3.5 | - | - |
| Anions and Cations | | | | | | | | | | | |
| Calcium (Ca**) | mg/L | 26.36 | 34.8 | 22.4 | 41.2 | 18 | 27.85 | 34.8 | 22.4 | 75 | 180 |
| Magnesium (Mg**) | mg/L | 11 | 24 | 25 | 19 | 13.8 0 | 20 | 25 | 11 | 50 | 40 |
| Ammonium ($NH_3$) | mg/L | 0.02 | 0.08 | 0.12 | 0.15 | 0.09 | 0.073 | 0.12 | 0.02 | - | - |
| Potassium (K*) | mg/L | 4.1 | 4.1 | 3.8 | 4.2 | 4,6 | 4 | 4.1 | 3.8 | NS | 50 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Manganese (Mn* ion) | mg/L | <0.03 | <0.03 | <0.03 | <0.03 | 0.34 | <0.03 | <0.03 | <0.03 | - | -- |
| Sodium (Na*) | mg/L | 19 | 23.2 | 18 | 16.8 | 27.4 | 20.067 | 23.2 | 18 | NS | 120 |
| Chloride (CH) | mg/L | 19.9 | 24.9 | 19.7 | 18.2 | 28.2 | 21.5 | 24.9 | 19.7 | - | - |
| Sulphate (SO?) | mg/L | 18 | 3 | 22 | 14 | 20 | 14.33 | 22 | 3 | - | - |
| Nitrate (NOs) | mg/L | >20 | >20 | >20% | >20 | >20 | >20 | >20 | >20 | - | - |
| Phosphate (PO) | mg/L | 0.12 | 0.12 | 0.141 | 0.16 | 0.11 | 0.127 | 0.141 | 0.12 | - | - |
| Carbonate ($CO_2$) | mg/L | 6.4 | 14.2 | 15.6 | 15.6 | 17.2 | 12.067 | 15.6 | 6.4 | - | - |
| Heavy Metals | | | | | | | | | | | |
| Manganese (Mn) | mg/L | <0.03 | <0.03 | <0.03 | <0.03 | 0.34 | <0.03 | <0.03 | <0.03 | - | - |
| Iron (Fe) | mg/L | 0.05 | <0.01 | <0.01 | <0.01 | <0.04 | 0.05 | 0.05 | 0.05 | - | - |
| Copper (Cu) | mg/L | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | 2 | 0.01 |
| Zinc (Zn) | mg/L | <0.03 | <0.03 | 0.04 | 0.04 | <0.03 | 0.04 | 0.04 | 0.04 | 5 | 2 |
| Mercury (Hg) | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | - | - |
| Lead (Pb) | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | |
| Nickel (No) | mg/L | 0.93 | 0.77 | 0.94 | 1.08 | 0.41 | 0.88 | 0.94 | 0.77 | | |
| Cadmium (Cd) | mg/L | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | | |
| Chromium (Cr) | mg/L | 0.07 | 0.05 | 0.07 | 0.07 | 0.09 | 0.063333 | 0.07 | 0.05 | | |
| Vanadium (V) | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | |
| Arsenic (As) | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | |
| Barium (Ba) | mg/L | 0.02 | 0.02 | 0.03 | 0.04 | 0.04 | 0.023 | 0.03 | 0.02 | | |
| Fluoride (F) | mg/L | 0.38 | 0.41 | 0.38 | 0.42 | 0.45 | 0.39 | 0.41 | 0.38 | | |
| Microbial | | | | | | | | | | | |
| Total Plate Count | cfu/ml | 357 | 351 | 395 | 301 | 421 | 367.67 | 395 | 351 | | |
| Total Coliform | cfu/ml | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| E. coli | cfu/ml | Present | Present | Absent | Present | Present | | | | | |
| Salmonella | cfu/ml | Absent | Absent | Absent | Absent | Absent | | | | | |
| Vibrio cholerae | cfu/ml | Absent | Absent | Absent | Absent | Absent | | | | | |
| Pseudomonas aeruginosa | cfu/ml | Absent | Absent | Absent | Absent | Absent | | | | | |
| Clostridium | cfu/ml | Absent | Absent | Absent | Absent | Absent | | | | | |
| Yeast & Mould | cfu/ml | Absent | 3 | 10 | 3 | 7 | 6.5 | 10 | 3 | | |

*Hardan Consulting Field Survey 2025*

**Physiochemical**

*pH*

The acidic or basic nature of a solution is expressed as pH, which is determined by the hydrogen ion ($H^+$) concentration in a solution. In natural waters, this is usually dependent on the carbonic acid equilibrium. A pH range of 6.0 to 9.0 is normal for aquatic life (KWW, 2001). The pH of an aquatic ecosystem is important because it is closely related to biological productivity (UNEP/GEMS, 2008). The pH values of the surface water ranged from 8.7 – 9 with a mean value is 8.8. The result shows that the surface water is alkaline and slightly above safe limits of WHO and NESREA for 6.5-8.5. This slightly high alkalinity could be attributed to continuous direct washing of cloths in the waterbody by the community and the entire runoff from the Bulka gully drains into the river.

*Electrical Conductivity*

Electrical Conductivity (EC), also called specific conductance, is a measure of the ability of a water sample to convey an electrical current and it is related to the concentration of ionized substances in water. The mean EC values recorded in the study was 377µs/cm. These values are characteristics of freshwater stream/river environments.

*Dissolved Oxygen (DO)*

DO is essential to all forms of aquatic life, including those organisms responsible for the self-purification processes in natural waters. The mean DO values recorded in the study ranged from 6.12 – 8.63mg/l with a mean value was 7.09 mg/l. Concentrations above 5 mg/l may adversely affect the functioning and survival of biological communities and below 2 mg/l may lead to the death of most fish (Chapman, 1996).

*Turbidity*

The Turbidity is an indication of the extent to which light passing through the water is reduced by floating suspended solids and colloidal materials. High turbidity lowers the light penetration through the water, which results to lower primary productivity in the water. It also reduces the aesthetic values. The mean value for the turbidity was 2.5NTU while the control points had high turbidity range of over 20NTU which could be attributed to human activities such as sand Minning, fishing, domestic washing, etc.

**Cations**

Sodium (Na), Potassium (K), Calcium (Ca) and Magnesium (Mg), the earth metals in solution constitute the exchangeable cations. The mean concentration of sodium was 20.067, Potassium was 4, Calcium was 27 and Magnesium was 20.

*Chloride*

Cl had mean value of 21.3mg/l. Chloride is not considered as being harmful to human health. Chloride values above 250 mg/l produce a salty taste which makes the water unpalatable. High chloride values are harmful to plants; some damages may occur at levels as low as 70 – 250 mg/l (Radojevic and Bashkin, 1999).

*Phosphate*

Phosphate had a mean value of 0.127. Sulphate concentrations in natural water are usually between 2 and 80 mg/l; high concentration (>400 mg/l) may make water unpleasant to drink.

***Heavy Metals***

Natural waters contain very small quantities of several essential metals. Mean values across the Gulbi water includes; zinc (Zn) – 0.04, copper (Cu) - <0.07, Cadmium (Cd) - <0.03, lead (Pb) - <0.01, iron (Fe) – 0.05, Nickel (Ni) – 0.88, chromium (Cr) – 0.063, manganese (Mn) - <0.03, barium (Ba), vanadium (V) - <0.01 and mercury (Hg) - <0.001. These metals, also called trace or

heavy metals are required by plants and animals in minute quantities. They are toxic in relatively high concentrations, persistent, easily assimilated and bio-accumulated in the protoplasm of aquatic organisms. The concentrations of heavy metals in the water samples were generally low and, in some cases, not detected. All heavy metals had mean values less than the regulatory limits of WHO.

***Surface Water Microbiology***

Total microbial plate count in the surface water ranged from no growth 351-395cfu/ml, with a mean value of 367.67cfu/ml. The predominant genera of bacteria isolated from the surface water were *E. Coli* Open defecation and runoff from the Bulka gully are the major contributors to the presence of these microbes in the waterbody. *Salmonella, Vibrio cholerae, Pseudomonas aeruginosa and Clostridium* were absent.

#### 3.3.3.3 Sediment Sampling

The sediment sampling stations were co-located with the Surface water stations. Consequently, sediment samples were also collected at the same upstream, midstream and downstream stations. Given the shallow nature of the waterbody, a sediment scooper was deployed manually for sediment collection. On retrieval, r transferred into well labelled ziploc for physico-chemical analysis and plastic vials for microbiological analysis. These samples were then preserved at 4±2°C in a refrigerator/ice chest.



**Plate 3.4: Sediment Sampling in Koromar Wanke River**

**Table 3.4: Analysis of Sediments Characteristics**

| Parameters | Unit | Sed 1 | Sed 2 | Sed 3 | Ctrl 1 | Ctrl 2 | Mean | Max | Min |
|---|---|---|---|---|---|---|---|---|---|
| **Physico-chemical** | | | | | | | | | |
| pH | - | 5.9 | 6.4 | 6.2 | 6.2 | 6.3 | 6.2 | 6.4 | 5.9 |
| Texture | - | Sandy | Sandy | Sandy | Clay Loam | Sandy | | | |
| Grain Size | mm | 0.05-2.0 | 0.05-2.0 | 0.05-2.0 | 0.002-2.0 | 0.05-2.0 | | | |
| Porosity | % | 41 | 53.6 | 26.6 | 31 | 26.6 | 40.4 | 53.6 | 26.6 |
| Permeability Bulk Density | cm/s | $5.5\times10^{-4}$ | $6.2\times10^{-4}$ | $1.2\times10^{-4}$ | $1.5\times10^{-6}$ | $2.1x10^{-4}$ | $3.0x10^{-4}$ | $6.2\times10^{-4}$ | $1.2\times10^{-4}$ |
| Bulk Density | kg/m) | 1550 | 1220 | 1936 | 1828 | 1910 | 1568.67 | 1936 | 1220 |
| Particle Size 0,356 | % | 5.2 | 4.4 | 6.3 | 41.3 | 3.4 | 5.3 | 6.3 | 4.4 |
| Particle Size 0.25 | % | 6.3 | 6.1 | 7.7 | 5.3 | 4.7 | 6.7 | 7.7 | 6.1 |
| Particle Size 0.15 | % | 9.5 | 7.6 | 10 | 6.1 | 7.1 | 9.03 | 10 | 7.6 |
| Particle Size 0.063 | % | 67 | 64.5 | 60.3 | 72 | 59 | 63.93 | 67 | 60.3 |
| Moisture Content | % | - | - | - | - | - | - | - | - |
| Colour | - | Brown | Brown | Brown | Dark Brown | Brown | 0 | 0 | 0 |
| Total Nitrogen | mg/kg | 70 | 300 | 90 | 400 | 150 | 153.33 | 300 | 70 |
| Total Organic Compounds | mg/kg | 840 | 3600 | 1080 | 4800 | 1800 | 1840 | 3600 | 840 |
| Oil & Grease | mg/kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cations and Anions | | | | | | | | | |
| Calcium (Ca?) | mg/kg | 31 | 28.4 | 22.4 | 18.5 | 24.1 | 27.27 | 31 | 22.4 |
| Magnesium (Mg*) | mg/kg | 12.4 | 10.15 | 8.1 | 7.2 | 9.4 | 10.22 | 12.4 | 8.1 |
| Ammonium (NH.) | mg/kg | 0.65 | 0.88 | 0.52 | 0.42 | 0.48 | 0.68 | 0.88 | 0.52 |
| Potassium (K*) | mg/kg | 18.5 | 22.1 | 14.6 | 11.8 | 16.2 | 18.4 | 22.1 | 14.6 |
| Manganese (Mn"*) | mg/kg | 9.4 | 8.2 | 6.15 | 4.1 | 6.55 | 7.92 | 9.4 | 6.15 |
| Sodium (Na') | mg/kg | 31 | 26.5 | 21.8 | 15.4 | 22.3 | 26.43 | 31 | 21.8 |
| Chloride (CI) | mg/kg | 48.2 | 44.2 | 36.5 | 32.1 | 38.4 | 42.97 | 48.2 | 36.5 |
| Sulphate (SO? ) | mg/kg | 45.5 | 41.8 | 34.2 | 24.5 | 36.1 | 40.5 | 45.5 | 34.2 |
| Nitrate (NOr) | mg/kg | 18.5 | 18.2 | 14.8 | 12.6 | 15.5 | 17.17 | 18.5 | 14.8 |
| Phosphate (PO)) | mg/kg | 4.2 | 4.8 | 2.1 | 1.85 | 2.45 | 3.7 | 4.8 | 2.1 |
| Carbonate (CO.") | mg/kg | 0.04 | 0.02 | <0.01 | <0.01 | <0.01 | 0.03 | 0.04 | 0.02 |
| Heavy Metals | | | | | | | | | |
| Manganese (Mn) | mg/kg | 9.4 | 8.2 | 6.15 | 4.1 | 6.55 | 7.92 | 9.4 | 6.15 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Iron (Fe) | mg/kg | 94.47 | 94.31 | 71.63 | 180.7 | 120.4 | 86.80 | 94.47 | 71.63 |
| Copper (Cu) | mg/kg | 0.733 | 0.736 | 0.644 | 0.867 | 0.565 | 0.704 | 0.736 | 0.644 |
| Zinc (Zn) | mg/kg | 2.133 | 1.034 | 0.823 | 3.667 | 1.89 | 1.33 | 2.133 | 0.823 |
| Mercury (Hg) | mg/kg | <0.001 | <0.001 | 0.081 | <0.001 | <0.001 | 0.081 | 0.081 | 0.081 |
| Lead (Pb) | mg/kg | 0.012 | 0.01 | 0.008 | 0.018 | 0.012 | 0.01 | 0.012 | 0.008 |
| Nickel (Ni) | mg/kg | 0.844 | 0.132 | 0,000 | 0.821 | 0.425 | 0.488 | 0.844 | 0.132 |
| Cadmium (Cd) | mg/kg | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0 | 0 | 0 |
| Chromium (Cr) | mg/kg | 0.065 | 0.045 | 0.032 | 0.038 | 0.035 | 0.047 | 0.065 | 0.032 |
| Vanadium (V) | mg/kg | 0.022 | 0.018 | 0.01 | 0.012 | 0.014 | 0.017 | 0.022 | 0.01 |
| Arsenic (As) | mg/kg | 0.004 | 0.002 | 0.001 | 0.001 | 0.002 | 0.002 | 0.004 | 0.001 |
| Barium (Ba) | mg/kg | 0.41 | 0.365 | 0.285 | 0.295 | 0.315 | 0.35 | 0.41 | 0.285 |
| Microbiology | | | | | | | | | |
| Total Plate Count | cfu/g | $0.10\times10^3$ | $0.015\times10^3$ | $0.005\times10^3$ | $0.015\times10^3$ | $0.033\times10^3$ | $0.040\text{x}10^3$ | $0.10\times10^3$ | $0.005\times10^3$ |
| Total Coliform | cfu/g | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E. coli | - | Absent | Present | Present | Present | Present | 0 | 0 | 0 |
| Salmonella | - | Absent | Absent | Absent | Absent | Absent | 0 | 0 | 0 |
| Vibrio cholerae | - | Absent | Absent | Absent | Absent | Absent | 0 | 0 | 0 |
| Pseudomonas aeruginosa | - | Absent | Absent | Absent | Absent | Absent | 0 | 0 | 0 |
| Clostridium spp. | - | Absent | Absent | Absent | Absent | Absent | 0 | 0 | 0 |
| Yeast & Mould | cfu/g | 1 | 0 | 0 | 4 | 3 | 0.333 | 1 | 0 |

***Physico-chemical***

*pH*

The pH of the sediment around the field ranged from 5.9 – 6.4 with an average of 6.82. Control station showed a similar pH value of 6.3. The pH levels of sediments across all sampled stations were predominantly neutral, except for station 1 which was slightly acidic.

*Total Organic Carbon (TOC)*

Total organic carbon (TOC) is a measure of the organic carbon present in a sediment sample. TOC is a measure of the carbon contained within a sediment organic matter content and the bulk of organic carbon in sediment is composed of humic substances and degraded plant/ animal materials. The TOC influences many sediment characteristics including colour, nutrients holding capacity (cations and anion exchange capacity), nutrients turn over and stability. TOC in the sediment for the field and control stations had mean values of 1840mg/kg and 3300mg/kg respectively.

***Cations and Anions***

*Anions*

Anions characterized in sediment around the field include Chloride ($Cl^-$), Sulphate ($SO_4^{2-}$), Nitrate ($NO_3^-$), Carbonate ($CO_2^{3-}$). and Phosphate ($PO_4^{3-}$). The average values for followed a consistent trend of $Cl^-$ (42.97mg/kg), $SO_4^{2-}$ (40.5mg/kg) $CO_2^{3-}$. (<0.01mg/kg) $NO_3^-$ (17.17mg/kg) $PO_4^{3-}$ (3.7mg/kg).

*Cations*

Cations analysed in the sediment include Sodium (Na+), Potassium (K+), Calcium (Ca2+), Magnesium (Mg2+) and Ammonium (NH4+). The average cation concentrations in the field followed the order: $Ca^{2+}$ (27.27mg/kg) $Na^+$ (26.43mg/kg) $Mg^{2+}$ (10.72mg/kg) K+ (18.4mg/kg) $NH_4^+$ (0.68mg/kg).

***Heavy metals***

Most of the metals in their stable state are derived from natural weathering and other anthropogenic inputs such as dredged material and oil well drilling mud. A more important source of metals in sediments is physical and chemical reactions taking place in water column.

Iron (Fe) displayed the highest average concentration, reaching 86.80mg/kg. The remaining metals exhibited lower average concentrations: (Zn), 1.33mg/kg, and Copper (Cu), 0.704mg/kg.

***Sediment Microbiology***

Microbiological parameters considered include Total plate count, total coliform, E. *coli*, etc. The microbial analysis showed the presence of microorganism such as E. c*oli* across all stations and control stations. Open defecation and runoff from the Bulka gully are the major contributors to the presence of these microbes in the waterbody

### 3.3.3.4 Groundwater Sampling

Groundwater samples were collected from one (1) existing borehole and one (1) hand dug well. Activities at each station included in-situ measurements (field analyses) of pH, temperature, dissolved oxygen (DO), salinity, total dissolved solids (TDS), conductivity, and turbidity using a calibrated multiparameter water quality checker. After in-situ measurements, samples for laboratory analyses were collected and sub-sampled into appropriate containers and preserved. All the collected samples were stored in the refrigerator/ice-chest (with ice packs) at 4±2°C while on the field and afterwards were transported to the laboratory for analysis.




**Plate 3.5: Groundwater Sampling and In-situ Analysis**

**Table 3.5: Analysis of Groundwater Characteristics**

| Parameter | Unit | GW1 | GW2 | Mean | Max | Min | WHO | NESREA |
|---|---|---|---|---|---|---|---|---|
| *Physico-chemical* | | | | | | | | |
| Temperature | °C | 24 | 24 | 24 | 24 | 24 | | |
| pH | - | 7 | 7.7 | 7.35 | 7.7 | 7 | 6.5-8.5 | 6.5-8.5 |
| Dissolved Oxygen | mg/L | 9.06 | 6.8 | 7.93 | 9.06 | 6.8 | | |
| Conductivity | HS/cm | 3,850 | 2,346 | 3098 | 3850 | 2346 | 1000 | 1000 |
| Salinity | mg/L | 1,930 | 1,210 | 1570 | 1930 | 1210 | | |
| Colour | TCU | 11 | <5 | 11 | 11 | 11 | | |
| Alkalinity | mg/L | 252 | 354 | 303 | 354 | 252 | 200-600 | NS |
| Total Hardness | mg/L | 112 | >300 | 112 | 112 | 112 | 50 | 50 |
| COD | mg/L | 10 | 15 | 12.5 | 15 | 10 | | |
| BOD | mg/L | 1.8 | 3.5 | 2.65 | 3.5 | 1.8 | | |
| TSS | mg/L | 0.11 | 0.04 | 0.075 | 0.11 | 0.04 | 30 | NS |
| TDS | mg/L | 1,915 | 1,185 | 1550 | 1915 | 1185 | 600 | 500- |
| Turbidity | NTU | <1 | <1 | <1 | <1 | <1 | 5 | |
| Oil & Grease | mg/L | 0 | 0 | 0 | 0 | 0 | | |
| Redox Potential | mV | 210 | 182 | 196 | 210 | 182 | | |
| Total Organic Carbon | mg/L | 0.85 | 4.8 | 2.83 | 4.8 | 0.85 | | |
| *Nutrients (Anions and Cations)* | | | | | | | | |
| Calcium | mg/L | 2.8 | 82.4 | 42.6 | 82.4 | 2.8 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Magnesium | mg/L | >50 | >50 | >50 | >50 | >50 | | |
| Ammonium | mg/L | <0.01 | 0.056 | 0.056 | 0.056 | 0.056 | | |
| Potassium | mg/L | 6.4 | 0.2 | 3.3 | 6.4 | 0.2 | | |
| Manganese | mg/L | <0.03 | 0.23 | 0.23 | 0.23 | 0.23 | | |
| Sodium | mg/L | 32 | 27.4 | 29.7 | 32 | 27.4 | | |
| Chloride | mg/L | 33.6 | 44.1 | 38.85 | 44.1 | 33.6 | 50 | 250 |
| Sulphate | mg/L | >200 | >200 | >200 | >200 | >200 | 500 | 100 |
| Nitrate | mg/L | >20 | >20 | >20 | >20 | >20 | 100-500 | 150 |
| Phosphate | mg/L | 0.08 | 0.15 | 0.115 | 0.15 | 0.08 | | |
| Carbonate | mg/L | 12.4 | 18.4 | 15.4 | 18.4 | 12.4 | | |
| *Heavy Metals* | | | | | | | | |
| Manganese (Mn) | mg/L | <0.03 | 0.23 | 0.23 | 0.23 | 0.23 | | |
| Iron (Fe) | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | |
| Copper (Cu) | mg/L | 0.08 | <0.07 | 0.08 | 0.08 | 0.08 | | |
| Zinc (Zn) | mg/L | <0.03 | 0.48 | 0.48 | 0.48 | 0.48 | | |
| Mercury (Hg) | mg/L | <0,00l | <0.001 | <0.001 | <0.001 | <0.001 | | |
| Lead (Pb) | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | |
| Nickel (Ni) | mg/L | 0.42 | 0.94 | 0.68 | 0.94 | 0.42 | | |
| Cadmium (Cd) | mg/L | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | | |
| Chromium (Cr) | mg/L | 0.07 | 0.05 | 0.06 | 0.07 | 0.05 | | |
| Vanadium (V) | mg/L | <001 | <0.01 | <0.01 | <0.01 | <0.01 | | |
| Arsenic (As) | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | |
| Barium (Ba) | mg/L | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | | |
| Fluoride (F) | mg/L | 0.88 | 0.51 | 0.695 | 0.88 | 0.51 | | |
| *Microbiology* | | | | | | | | |
| Total Plate Count | cfu/ml | 375 | 150 | 262.5 | 375 | 150 | | |
| Total Coliform | cfu/ml | 0 | 0 | 0 | 0 | 0 | | |
| *E. coli* | cfu/ml | Present | Present | | | | | |
| *Salmonella* | cfu/ml | Absent | Present | | | | | |
| *Vibrio cholerae* | cfu/ml | Absent | Absent | | | | | |
| *Pseudomonas aeruginosa* | cfu/ml | Absent | Absent | | | | | |
| *Clostridium* | cfu/ml | Absent | Absent | | | | | |
| Yeast & Mould | cfu/ml | Absent | 0 | 0 | 0 | 0 | | |

**Physiochemical**

*pH*

pH of water determines the solubility of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals. pH is therefore an index of groundwater pollution. Although pH has no direct health implication on humans, high pH encrusts water pipes and water using appliances with deposits; and depresses the effectiveness of groundwater disinfectants. pH 9.2 would markedly impair the portability of drinking water (WHO 2011). The pH concentration

of the groundwater samples from within the project area of influence had a mean value of 7.35mg/L.

*Dissolved Oxygen*

Dissolved Oxygen (DO) is a measure of the amount of gaseous oxygen dissolved in the water sample. It is an indicator of biological activity in a water body and is essentially for aerobic respiration. The DO concentration of the groundwater samples from Bulka had a mean value of 7.93mg/L respectively.

*Total suspended Solids (TSS)*

These are minerals and organic materials present in water. It enters groundwater through runoff from industrial, urban or agricultural areas. Elevated TSS causes rise in groundwater temperature which in turn supports growth of some microbial organisms. The TSS of the groundwater sample from the sampling area ranged from 0. 40to 0.11 mg/L and had a mean value of 0.075mg/L.

*Temperature*

The rate of chemical reactions generally increases as temperature increases. Groundwater with higher temperatures tend to dissolve more minerals from the rocks in the aquifer and therefore have a higher electrical conductivity (EC). High temperature negatively impacts water quality by enhancing the growth of micro-organisms which may increase taste, odour, colour and corrosion problems. Temperature above ambient level is therefore an index of groundwater pollution. The Temperature of the groundwater sample from Bulka are had a mean value of $24^0$C.

*Electrical Conductivity*

Electrical conductivity gives an indication of the amount of total dissolved substitution in water. Pure water containing less or no organic salt is an excellent insulator which cannot conduct electricity, hence any water with EC concentration above WHO/FMEnv limits is said to be polluted (IFC EHS 2007). The EC of the groundwater sample from the project area of influence had a mean value of 3098 µs/cm. The high values of EC is proportional to high values in the TDS. This value is greatly influenced by sewage contamination, agricultural runoff, etc. the close proximity of the sample groundwater to the erosion site makes it possible that to have high EC values.

*Nutrients (Nitrate, Sulphate, Carbonate and Phosphate)*

Nutrients are essential for the growth of micro-organisms in groundwater. Excessive concentrations of nutrients in drinking water, however, promote bacterial growth, as well as imparting bitter taste (WHO 2011). High level of nutrients in groundwater is attributed to failing septic systems, excessive use of agriculture fertilizers, leachable from refuse dumps and industrial discharges. Nutrients level above the maximum permissible limits in drinking water, indicates pollution, and thus poses some health challenges (WHO 2011). Nitrate, Sulphate, Carbonate and Phosphate recorded mean concentrations of <20mg/L, <200mg/L, 15.4mg/L and 0.115mg/L respectively in groundwater samples. The values a within FMEnv regulatory limit.

**Heavy Metals**

*Lead*

Lead is a cumulative poison, toxic in small concentrations. Pb level in groundwater above WHO/FMEnv limits can cause lethargy, loss of appetite, constipation, anaemia, abdominal pain, gradual paralysis in the muscles, and death. Lead was not detected in any of the groundwater samples collected in all the stations.

*Copper*

Copper is both an essential nutrient and a drinking-water contaminant. Cu concentrations in groundwater vary widely as a result of variations in water characteristics, such as pH, hardness and copper availability in the distribution system. Copper is an essential nutrient, but at high doses it has been shown to cause stomach and intestinal distress, liver, kidney damage and anaemia (WHO, 2006). Copper mean concentration recorded was 0.05mg/l. Results of all sampling station showed concentration was within WHO limit.

*Iron*

Iron is the second most abundant metal in earth's crust. It is an essential element in human nutrition. The minimum daily requirement of iron ranges from about 10 to 50 mg/day (FAO/WHO 1988). Iron can be a troublesome chemical in water supplies. Making up at least 5 percent of the earth's crust, iron is one of the earth's most plentiful resources. Rainwater as it infiltrates the soil and underlying geologic formations dissolves iron, causing it to seep into aquifers that serve as sources of groundwater for wells. Although present in drinking water, iron is seldom found at concentrations greater than 10 milligrams per liter (mg/L) or 10 parts per million. However, as little as 0.3 mg/l can cause water to turn a reddish brown color. High concentration can also promote growth of certain kinds of bacteria that clog pipes and well openings of boreholes. Iron concentration was below equipment detection limit. Results of all sampling station showed that iron content in the water was not detected.

*Zinc*

Zinc levels in groundwater normally do not exceed 0.05 mg/l. Zinc is found naturally at low concentrations in my rocks and soils principally as sulphide ores and to a lesser degree as carbonates. Most zinc is introduced into water by artificial pathways such as byproducts of steel production or coal –fired power station or from burning of waste materials, from fertilizer that may leach into groundwater. Zinc is considered an essential trace metal which functions as a catalyst for enzymatic activity in human bodies. Drinking water contains this trace metal in very small quantities which may reduce the possibility of its deficiency in the diet. However, its accumulation in the human body causes harmful effects such as stomach cramps, nausea, vomiting, decrease good cholesterol and acceleration of anaemic conditions (Reda, 2016). Zinc concentration of 0.48mg/l was detected in only one sampling point.

**Ground Water Microbiology**

The portable in a drinking-water well may contain a wide variety of microbes without presenting a public health risk. However, groundwater in some areas becomes contaminated by the faecal material of humans and other animals.

Water containing faecal material may seep into the groundwater from the land surface or from underground sources of contamination. Major surface sources include, wastewater and bio solids from sewage treatment facilities that have been applied to land as a soil conditioner; seepage from shallow artificial ponds (lagoons) used for processing sewage; seepage from contaminated lakes and other surface-water bodies; urban runoff; faeces from cattle and other livestock operations; and improperly constructed sanitary landfills where garbage are disposed. Faecal contamination also can reach the groundwater from underground sources, such as improperly functioning septic tank systems, underground reservoirs for liquid household sewage (cesspools), or leaking underground sewer lines.

Microbial plant count shows that mean colony count for micro-organisms in the groundwater is 262.5cfu/ml. The most predominant bacteria include *E. coli* which was present in both water samples. This could be attributed to proximity of the groundwater station to the gully causing contamination of the water. This poses serious health risk to the community as they use the water for cooking and drinking in most housholds.

### 3.3.4 Biodiversity Assessment

The biodiversity assessment provides a structured framework to ensure that ecological and social considerations are fully integrated into project planning, design, and implementation. The study is designed to establish a clear understanding of the existing ecological conditions and to evaluate how erosion control and stormwater interventions may affect local biodiversity and ecosystem services. A comprehensive inventory of flora, fauna, and habitat types within the project's influence area has been undertaken to identify critical habitats and species of conservation concern, including those that are endemic, rare, or threatened. This baseline enables the project to detect potential risks to biodiversity and ecosystem integrity while also highlighting opportunities for conservation and habitat restoration.

The scope of the assessment covers both direct and indirect impact zones. The Direct Impact Zone (DIZ) encompasses the immediate project footprint, including construction areas, drainage channels, and erosion control structures. The Indirect Impact Zone (IIZ) extends up to 500 meters beyond the footprint to capture secondary impacts such as hydrological changes, sedimentation, noise, and dust. Within these zones, terrestrial and aquatic biodiversity surveys were conducted, vegetation mapping and wildlife observations were recorded, and habitat characterization was carried out to evaluate potential impacts across all phases of the project.

The relevance of this biodiversity assessment to the ESMP is underscored by its alignment with international best practice, particularly IFC Performance Standard 6 (PS6), which emphasizes

biodiversity conservation and sustainable management of living natural resources. The project adopts a mitigation hierarchy; avoid, minimize, restore, and offset to reduce adverse impacts and promote biodiversity conservation. Measures are being developed to safeguard species listed under the IUCN Red List, the Nigerian Endangered Species Act, and other relevant conservation frameworks.

Beyond ecological safeguards, the study emphasizes the integration of biodiversity considerations into engineering design, construction scheduling, and operational protocols. Drainage channels, slope stabilization, and vegetation restoration are being planned to minimize ecological disruption while enhancing habitat resilience. The ESMP also prioritizes transparent engagement with regulatory authorities, local communities, and conservation stakeholders to ensure inclusive decision-making, particularly where biodiversity intersects with local livelihoods, cultural values, and ecosystem services.

A robust monitoring and adaptive management system will be established to track biodiversity indicators and social outcomes throughout the project lifecycle. This ensures that environmental and social safeguards remain effective under changing ecological and climatic conditions. By embedding biodiversity conservation into erosion control and stormwater management, the project contributes to sustainable land use, enhances community resilience, and supports national and global commitments such as ***SDG 15 (Life on Land) and SDG 13 (Climate Action).***

#### 3.3.4.1 Assessment Methodology

A multi-tiered approach was adopted, combining systematic field surveys and quantitative biodiversity metrics to generate reliable baseline data and impact predictions.
Surveys were conducted to document vegetation types, wildlife presence, and habitat conditions. Standard ecological sampling techniques—including transect walks, quadrat sampling, and point counts were employed to capture species diversity and abundance. Geographic Information Systems (GIS) were utilized to map land cover, erosion gullies, drainage channels, and habitat distribution. This spatial data provided insights into fragmentation patterns, connectivity, and potential zones of ecological sensitivity. For Quantitative Biodiversity Metrics**,** Indices such as species richness, Shannon–Wiener diversity, and habitat quality scores were applied to evaluate ecological integrity. These metrics allowed for comparative analysis between direct impact zones (project footprint) and indirect impact zones (buffer areas). The assessment incorporated IFC PS6 criteria to identify habitats of conservation importance, including those supporting endemic, rare, or threatened species

***Field Survey Design***

Fieldwork was conducted during the dry season (December 3–5, 2025) using stratified sampling Techniques employed include:

a) **Transect Surveys:** Linear transects were established along the alignment to record vegetation structure, species composition, and incidental wildlife sightings. Observations included canopy cover estimation and GPS mapping of ecologically significant features.

b) **Quadrat Sampling:** Vegetation was assessed using 10 m × 10 m quadrats placed at 500 m intervals along transects. All plant species within each quadrat were identified and their abundance estimated using Braun-Blanquet cover-abundance scales. Structural attributes and floristic composition of vegetation communities along the project corridor was investigated. The sampling locations along the study area were chosen at every 500m interval; the coordinates and habitat description of the sampling locations are presented below (Table 3.6). Biometric field inventory method; involving morphometric measurements, enumeration and application of allometric equations was employed for data collection. Plant identification was conducted using the line transect-quadrat method. A total of Ten (10) sampling transects were distributed across the study area.

**Table 3.6: Coordinates of the Transect Sites along the Bulka Stormwater Corridor**

| | | | |
|---|---|---|---|
| **T** | 1 | 6 | M |
| **T** | 1 | 6 | C h |
| **T -Commissioner of** | 1 | 6 | C h |
| **T** | 1 | 6 | C h |
| **T** | 1 | 6 | C h |
| **TVI-Jifatu** | 1 | 6 | C h |
| **TVII-Yardole** | 1 2 | 6 67’82.75” | C h a |
| **TVIII-Hayin Mal Ibrahim** | 1 2 | 6 67’54.87” | C h a |
| **TIX-Gusau River A** | 1 2 | 6 65’25.42” | C h a |
| **TX-Gusau River B** | 1 2 | 6 64’28.71” | C h a |

*T- Transect*

Vegetation variables investigated included:

- plant crown cover;
- tree density;
- species diversity;

- diameter at breast height (Plate 3.6)

Distance-based (point-centre quarter) technique was employed to determine the plant cover. The distance technique also allowed density of flora composition to be calculated, if the average space occupied by individual plant can be determined. That is, this technique assumes:
Plants occupy circular areas; and
Plants are randomly distributed.

Tree density is therefore determined using the equation:

$$D = \frac{A}{(Xd)2}$$

Where:
D= density
A= area of interest (e.g. $m^2$)
d= distance measured in the field
X= varies depending on assumptions about distance between plants or points to a plant.




**Plate 3. 6: Diameter at Breast Height Measurement**

c) **Avifauna Surveys:** Birds were surveyed using the point count method (Bibby 2004). Observers recorded all species seen or heard within a fixed radius during 10-minute intervals, aided by binoculars and field guides.

d) **Mammals, Reptiles, and Amphibians:** Data were collected through incidental sightings, hunter interviews, and camera traps deployed near riparian habitats and areas with wildlife activity signs. Amphibians were surveyed diurnally near moist microhabitats and stream banks (Brown *et al*., 2023)

e) **Arthropod Survey:** Opportunistic sampling of arthropods and soil macroinvertebrates was conducted in riparian zones and savanna patches. Specimens such as butterflies, moths, dragonflies, damselflies, ants, and beetles were identified to functional groups (pollinators, decomposers, predators) to evaluate ecosystem services.

***Data Analysis***

Species data were analyzed using standard biodiversity indices to quantify ecological diversity and community structure:

- ***Species Richness (S):*** Total number of species recorded per site.
- ***Shannon-Wiener Index*** **(H'):**
  $H' = -\sum(pi \ln pi)$
  where (pi) is the proportion of individuals belonging to species (i). This index measures species diversity and accounts for both richness and evenness.
- ***Simpson's Index (D):***
  $D = 1 - \sum pi^2$ indicating the probability that two randomly selected individuals belong to different species. Higher values reflect greater diversity.
- ***Evenness (E):***
  $E = H'/InS$ assessing how evenly individuals are distributed among species.

### 3.3.4.2 Ecological Zone and Vegetation Assessment

The project area lies within the **Sudan Savanna ecological zone** of northwestern Nigeria, which is characterized by a tropical climate with distinct wet and dry seasons. Vegetation in this zone typically consists of open savanna woodland interspersed with shrubs and grasses (White, 1983; Keay, 1971; FAO, 2010). However, the natural vegetation has been substantially modified by anthropogenic activities, including urban expansion, infrastructure development, and agricultural practices. These modifications are consistent with broader land-use change trends documented for Gusau and other semi-arid urban centers in northern Nigeria (Nwilo *et al*., 2020;).

The dominant vegetation types include Woody species with *Acacia nilotica, Combretum glutinosum, Faidherbia albida, Balanites aegyptiaca,* and *Parkia biglobosa*. These species are drought-tolerant and play critical roles in soil stabilization and provision of non-timber forest products. Grasses and ground cover include *Andropogon gayanus, Hyparrhenia* spp., *Cenchrus biflorus, and Pennisetum pedicellatum.* These grasses provide fodder for livestock and contribute to soil binding, though much of the cover has been degraded by overgrazing. While riparian vegetation along seasonal streams and wetlands, include species such *as Mitragyna inermis* and *Phoenix reclinata*, offering microhabitats for aquatic and terrestrial biodiversity. The current status shows deforestation and fuelwood harvesting by the Local communities for energy, leading to unsustainable extraction of native trees.

***Floristic Composition and Diversity***

A comprehensive floristic survey recorded **57 plant species** distributed across **32 families**, with a total abundance of **4,871 individuals** (Tables 3.7 and 3.8). The vegetation is dominated by herbs, which account for 66.9 percent of individuals, followed by shrubs (21.5 percent), lianas (6.9 percent), and trees (4.7 percent). This life-form distribution reflects the high disturbance pressure within the project area, where ruderal herbs and invasive weeds colonize ephemeral channels and open spaces, while only a limited number of agroforestry and economic tree species persist in relatively undisturbed microhabitats (Nwilo *et al*., 2020).

The most abundant families include **Asteraceae (824 individuals), Typhaceae (524), Amaranthaceae (463), Poaceae (449),** and **Fabaceae (396).** In contrast, families such as **Balanitaceae (1 individual), Rutaceae (3), Annonaceae/Moraceae (4 each), Calophyllaceae (5),** and **Oleaceae (7)** were poorly represented. These findings are consistent with the floristic composition of the Sudan Savanna described by Keay (1959) and corroborated by recent studies in Zamfara State (Abubakar *et al*., 2023).

***Species Abundance and Distribution***

The five most abundant species were *Typha latifolia* (524 individuals), *Lactuca sativa* (392), *Amaranthus viridis* (330), *Sorghum bicolor* (256), and *Luffa sp.* (210). These species are recognized indicators of disturbance and invasive tendencies in tropical ecosystems (GISD, 2023; IUCN-ISSG, 2022). Conversely, the least abundant species included *Balanites aegyptiaca* (1), *Khaya senegalensis* (2), *Acacia sieberiana* and *Citrus sinensis* (3 each), *Ficus thonningii* and *Polyalthia longifolia* (4 each), and *Calophyllum inophyllum* (5). Although scarce, these species are of considerable ecological and economic importance, contributing to soil fertility, erosion control, and agroforestry systems (Kinyilli *et al*., 2020).

***Tree Composition***

Tree species were relatively underrepresented, constituting only 4.7 percent of total individuals. The most abundant tree species were *Mangifera indica* (89 individuals), *Azadirachta indica* (39), *Acacia nilotica* (27), *Hyphaene thebaica* (10), and *Anacardium occidentale* (9). These species are typically retained near compounds and riparian zones due to their economic value and cultural significance. In contrast, native savanna trees such as *Balanites aegyptiaca*, *Khaya senegalensis*, *Acacia sieberiana*, *Ficus thonningii*, and *Polyalthia longifolia* were represented by fewer than five individuals, underscoring their vulnerability to land-use pressures and competition from invasive species.

**Table 3.7: Flora Compositions, and Conservation Status IUCN of the Plants in the Study Areas**

| S/N | Scientific Name | Common Name | Local Name | Family | IUCN Status |
|---|---|---|---|---|---|
| 1 | *Ageratum conyzoides* | Goat weed | - | Asteraceae | NE |
| 2 | *Setaria* spp. | Foxtail grasses | - | Poaceae | NE |
| 3 | *Chromolaena odorata* | Siam weed | - | Asteraceae | NE |
| 4 | *Sida acuta* | Broomweed | - | Malvaceae | NE |
| 5 | *Senna obtusifolia* | Sicklepod | - | Fabaceae | LC |
| 6 | *Hyptis suaveolen* | Bushmint | Daidoya | Lamiaceae | NE |
| 7 | *Calotropis procera* | Sodom apple | Bambambele | Apocynaceae | LC |
| 8 | *Jatropha curcas* | Physic nut | - | Euphorbiaceae | LC |
| 9 | *Dichrostachys cinerea* | Sickle bush | - | Fabaceae | LC |
| 10 | *Combretum spp.* | Bushwillow | - | Combretaceae | NE |
| 11 | *Mangifera indica* | Mango | Mangworo | Anacardiaceae | DD |
| 12 | *Parkia biglobosa* | African locust bean | Dawadawa | Fabaceae | LC |
| 13 | *Balanites aegyptiaca* | Desert date | Aduwa | Zygophyllaceae | LC |
| 14 | *Faidherbia albida* | Winter thorn | - | Fabaceae | LC |
| 15 | *Azadirachta indica* | Neem | dóógón yáàròò | Meliaceae | LC |
| 16 | *Citrus × sinensis* | Orange | Lemu | Rutaceae | NE |
| 17 | *Amaranthus viridis* | Spinach | Ayoyo | Amaranthaceae | NE |
| 18 | *Gomphrena celosioides* | Bachelor's button | - | Amaranthaceae | NE |
| 19 | *Anacardium occidentale* | Cashew | Kashu | Anacardiaceae | LC |
| 20 | *Polyalthia longifolia* | Masquerade tree | - | Annonaceae | NE |
| 21 | *Leptadenia hastata* | Yadiya | - | Apocynaceae | NE |
| 22 | *Hyphaene thebaica* | Doum palm | Goruba | Arecaceae | LC |
| 23 | *Lactuca sativa* | Lettuce | Latus | Asteraceae | NE |
| 24 | *Erigeron bonariensis* | Hairy fleabane | - | Asteraceae | NE |
| 25 | *Hygrophila auriculata* | Elephant's pubic hair | - | Asteraceae | NE |
| 26 | *Bidens pilosa* | Spanish needle | - | Asteraceae | NE |
| 27 | *Terminalia mantaly* | Satellite tree | - | Combretaceae | NE |
| 28 | *Combretum micranthum* | Tiger bush | - | Combretaceae | NE |
| 29 | *Ipomea carnea* | Bindweed | - | Convolvulaceae | NE |
| 30 | *Dichondra micranth* | Lawnleaf | - | Convolvulaceae | NE |
| 31 | *Luffa cylindrica* | Sponge gourd | - | Cucurbitaceae | NE |
| 32 | *Curcubita maxima* | Pumpkin | Kabewa | Cucurbitaceae | LC |
| 33 | *Luffa sp.* | Soursop | Sorsop | Cucurbitaceae | NE |
| 34 | *Cyperus rotundus* | Nut grass | Guda | Cyperaceae | NE |
| 35 | *Jatropha gossypiifolia* | Bellyache bush | - | Euphorbiaceae | NE |
| 36 | *Ricinus communis* | Castor | Kasto | Euphorbiaceae | LC |
| 37 | *Acacia nilotica* | Mimosa | - | Fabaceae | LC |
| 38 | *Senegalia ataxacantha* | Flame thorn | - | Fabaceae | NE |
| 39 | *Senna tora* | Sickle senna | - | Fabaceae | LC |
| 40 | *Acacia sieberiana* | White thorn | - | Fabaceae | LC |
| 41 | *Cassia occidentalis* | Coffee senna | - | Fabaceae | LC |
| 42 | *Satureja hortensis* | Summer savory | - | Lamiaceae | NE |
| 43 | *Adansonia digitata* | Baobab | kuka | Malvaceae | LC |
| 44 | *Morus nigra* | Black mulberry | | Moraceae | NE |
| 45 | *Khaya senegalensis* | Mahogany | madaci | Meliaceae | EN |
| 46 | *Ficus thonningii* | Strangler fig | - | Moraceae | NE |
| 47 | *Musa acuminata* | Banana | Ayaba | Musaceae | LC |
| 48 | *Olea europaea* | Olive | | Oleaceae | LC |
| 49 | *Paspalum dilatatum* | Dallis grass | - | Panicoideae | NE |

| | | | | | |
|---|---|---|---|---|---|
| 50 | *Sorghum bicolor* | Guinea corn | Dawa | Poaceae | LC |
| 51 | *Urochloa brizantha* | Palisade grass | - | Poaceae | NE |
| 52 | *Digitaria sanguinalis* | Hairy crabgrass | - | Poaceae | NE |
| 53 | *Persicaria maculosa* | Redshank | - | Polygonaceae | NE |
| 54 | *Ziziphus mauritiana* | Jujube | - | Rhamnaceae | LC |
| 55 | *Datura stramonium* | Thorn apple | | Solanaceae | NE |
| 56 | *Capsicum annuum* | Chilli pepper | Tatase | Solanaceae | LC |
| 57 | *Solanum lycopersicum* | Tomato | tomati | Solanaceae | LC |

**N.B:** EN (Endangered); DD (Data Deficient); LC (Least Concerned); VU (Vulnerable)

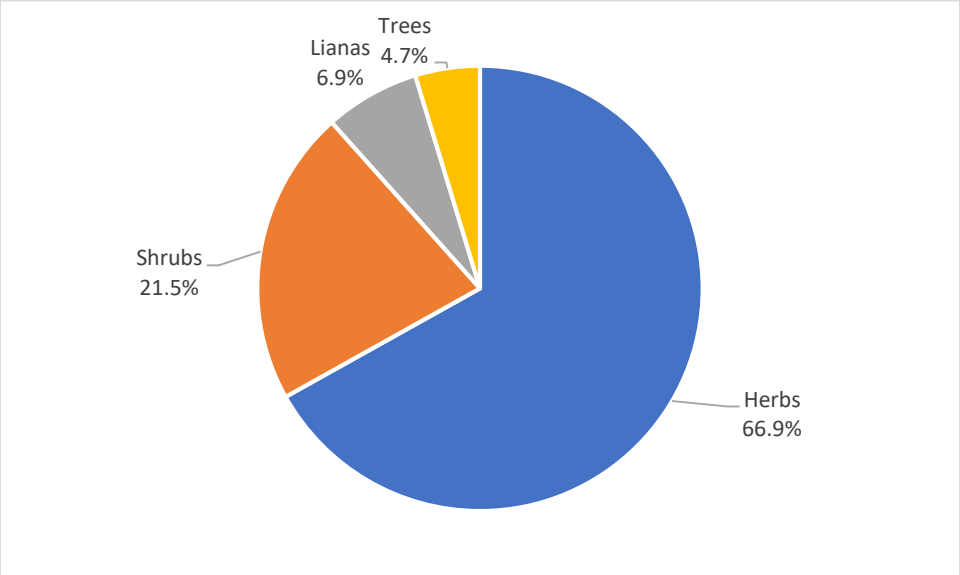



**Figure 3.8: Percentage Composition of Plant Species at the Project Site**

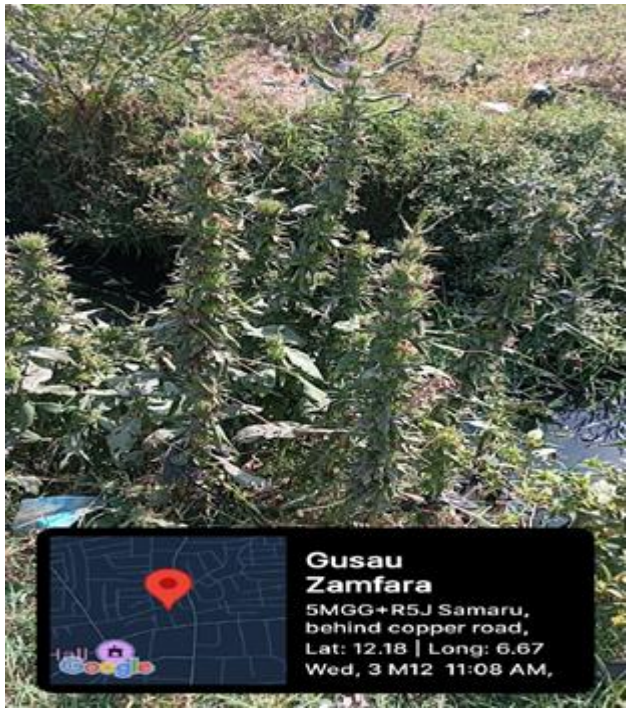
**Table 3.8: Classification and distribution of plant species at Project Sites**

| S/N | Family | Scientific Name | Common Name | Hausa Name | Habit | T-I | T-II | T-III | T-IV | T-V | T-VI | T-VII | I-VIII | T-IX | T-X | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Amaranthaceae | *Amaranthus viridis* | Spinach | Alayyahu | Herb | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69 | 97 | 164 | **330** |
| 2 | Amaranthaceae | *Gomphrena celosioides* | Bachelor's button | | Herb | 0 | 0 | 0 | 0 | 76 | 34 | 0 | 23 | 0 | 0 | **133** |
| 3 | Anacardiaceae | *Mangifera indica* | Mango | Mangwaro | Tree | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 64 | **89** |
| 4 | Anacardiaceae | *Anacardium occidentale* | Cashew | Kashuna | Tree | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 4 | **9** |
| 5 | Annonaceae | *Polyalthia longifolia* | Masquerade tree | Itacen Ashoka | Tree | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| 6 | Apocynaceae | *Leptadenia hastata* | Tears | Yadiya | Lianas | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 | 35 | 21 | **79** |
| 7 | Arecaceae | *Hyphaene thebaica* | Doum palm or gingerbread | Goruba | Tree | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 3 | **10** |
| 8 | Asclepiaceae | *Calotropis procera* | Sodom apple | Tunfafia | Shrub | 0 | 0 | 0 | 0 | 0 | 25 | 0 | 21 | 0 | 1 | **47** |
| 9 | Asteraceae | *Lactuca sativa* | Lettuce | Salad | Herb | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 238 | 154 | **392** |
| 10 | Asteraceae | *Erigeron bonariensis* | Hairy fleabane | Geron-Tsuntsaye | Shrub | 0 | 9 | 5 | 12 | 1 | 0 | 0 | 0 | 0 | 0 | **27** |
| 11 | Asteraceae | *Hygrophila auriculata* | Elephant's pubic hair | Zazar Giwa | Shrub | 122 | 0 | 24 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | **169** |
| 12 | Asteraceae | *Bidens pilosa* | Spanish needle | Zuma-zuma | Herb | 0 | 0 | 0 | 0 | 0 | 34 | 0 | 0 | 54 | 0 | **88** |
| 13 | Asteraceae | *Ageratum conyzoides* | Goatweed | Baren gona | Herb | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59 | 28 | 56 | **143** |
| 14 | Asteraceae | *Chromolaena odorata* | Siam weed | | Herb | 0 | 0 | 0 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | **5** |
| 15 | Balanitaceae | *Balanites aegyptiaca* | Desert date | Aduwa | Tree | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** |
| 16 | Brassicaceae | *Diplotaxis tenuifolia* | Wild rocket | arugula | Herb | 0 | 0 | 0 | 0 | 0 | 27 | 0 | 0 | 33 | 0 | **60** |
| 17 | Calophyllaceae | *Calophyllum inophyllum* | Mastwood | | Tree | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 2 | **5** |
| 18 | Caricaceae | *Carica papaya* | Pawpaw | Gwanda | Shrub | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 11 | **15** |
| 19 | Combretaceae | *Terminalia mantaly* | Satellite tree | Satalait | Herb | 3 | 7 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | **16** |
| 20 | Combretaceae | *Combretum micranthum* | Tiger bush | Geza | Shrub | 0 | 0 | 0 | 54 | 89 | 42 | 0 | 0 | 0 | 0 | **185** |
| 21 | Convolvulaceae | *Ipomea carnea* | Bindweeds | *Kashe Rafi* | Shrub | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 78 | 104 | **182** |
| 22 | Convolvulaceae | *Dichondra micranth* | Lawnleaf | | Herb | 0 | 0 | 93 | 0 | 0 | 0 | 0 | 0 | 21 | 0 | **114** |
| 23 | Cucurbitaceae | *Luffa cylindrical* | Sponge gourd | | Lianas | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 12 | 0 | **13** |
| 24 | Cucurbitaceae | *Curcubita maxima* | Pumpkin | Kabushi | Lianas | 1 | 0 | 2 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | **24** |
| 25 | Cucurbitaceae | *Luffa sp.* | Soursop | Soso | ianas | 0 | 0 | 45 | 0 | 42 | 72 | 0 | 51 | 0 | 0 | **210** |
| 26 | Cyperaceae | *Cyperus rotundus* | Nut grass | Girgiri | Herb | 0 | 0 | 0 | 0 | 114 | 85 | 0 | 0 | 0 | 0 | **199** |
| 27 | Euphorbiaceae | *Jatropha gossypiifolia* | *Bellyache bush* | | Shrub | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 6 | 0 | 0 | **18** |
| 28 | Euphorbiaceae | *Jatropha curcus* | *Barbados* | | Shrub | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 9 | 0 | **12** |
| 29 | Euphorbiaceae | *Ricinus communis* | Castor | Zirmani | Shrub | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 66 | 0 | 0 | **66** |
| 30 | Fabaceae | *Acacia nilotica* | Mimosa | Bagaruwa | Tree | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 0 | **27** |
| 31 | Fabaceae | *Senegalia ataxacantha* | Flame thorn | Sarkakiyaa | Lianas | 3 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | **11** |
| 32 | Fabaceae | *Senna tora* | Sickle senna | Tafasa | Herb | 0 | 0 | 0 | 0 | 0 | 26 | 0 | 49 | 0 | 0 | **75** |
| 33 | Fabaceae | *Senna obtusifolia* | coffee weed | Tasba | Herb | 0 | 0 | 0 | 37 | 0 | 0 | 0 | 0 | 0 | 31 | **68** |
| 34 | Fabaceae | *Acacia sieberiana* | White thorn | Farar kaya | Tree | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | **3** |
| 35 | Fabaceae | *Cassia occidentalis* | Coffee senna | Sangasanga | Herb | 0 | 89 | 21 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | **142** |
| 36 | Lamiaceae | *Satureja hortensis* | Summer Savory | | Herb | 0 | 0 | 2 | 0 | 0 | 69 | 0 | 0 | 0 | 0 | **71** |
| 37 | Malvaceae | *Adansonia digitata* | Baobab | Kuka | Tree | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | **8** |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38 | Malvaceae | *Sida acuta* | teaweed | Kalkashin kwa | Herb | 0 | 117 | 0 | 11 | 0 | 57 | 0 | 0 | 0 | 0 | **185** |
| 39 | Moraceae | *Morus nigra* | Black mulberry | | Tree | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 0 | 0 | **8** |
| 40 | Meliaceae | *Azadirachta indica* | Neem | Dogonyaro | Tree | 3 | 0 | 0 | 0 | 0 | 7 | 29 | 0 | 0 | 0 | **39** |
| 41 | Meliaceae | *Khaya senegalensis* | Mahogany | Madocci | Tree | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** |
| 42 | Moraceae | *Ficus thonningii* | Strangler Fig | Chediya | Tree | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| 43 | Musaceae | *Musa acuminate* | Banana | Ayaba | Shrub | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 54 | 8 | **62** |
| 44 | Oleaceae | *Olea europaea* L. | Olive | Zaitun | Tree | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **7** |
| 45 | Panicoideae | *Paspalum dilatatum* | Dallis grass | Dallis na damo | Herb | 0 | 0 | 81 | 0 | 0 | 36 | 0 | 0 | 0 | 0 | **117** |
| 46 | Poaceae | *Sorghum bicolor* | Guinea corn | Dawa | Shrub | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 254 | **256** |
| 47 | Poaceae | *Urochloa brizantha* | Palisade grass | Gawrare | Herb | 141 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | **163** |
| 48 | Poaceae | *Digitaria sanguinalis* | Hairy crabgrass | Acha daji | Herb | 0 | 0 | 23 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | **30** |
| 49 | Polygonaceae | *Persicaria maculosa* | Redshank / Jesusplant | Shama | Herb | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 63 | 0 | **67** |
| 50 | Rhamnaceae | *Ziziphus mauritiana* | Jujube | Magarya | Shrub | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 6 | 0 | 0 | **10** |
| 51 | Rutaceae | *Citrus sinensis* | Orange | Lemun Zaki | Tree | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | **3** |
| 52 | Sapindaceae | *Acer negundo* | Box elder | | Shrub | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 7 | 0 | **8** |
| 53 | Solanaceae | *Datura stramonium* | Hairy thorn apple | Babba juji | Herb | 0 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | **32** |
| 54 | Solanaceae | *Capsicum annuum* | Chilli pepper | Tattasai | Herb | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 54 | 131 | **185** |
| 55 | Solanaceae | *Physalis angulata* | Ground cherry | Matsarmana | Herb | 0 | 0 | 0 | 0 | 77 | 0 | 0 | 3 | 0 | 0 | **80** |
| 56 | Solanaceae | *Solanum lycopersicum* | Tomato | Tumatur | Herb | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | **39** |
| 57 | Typhaceae | *Typha latifolia* | Bulrush | Kachala | Herb | 0 | 213 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 311 | **524** |
| **Total** | | | | | | **277** | **448** | **297** | **189** | **454** | **549** | **47** | **388** | **856** | **1366** | **4871** |

**Table 3.9: Species Floristic Indices of the Project Area, Gusau Zamfara State, Nigeria**

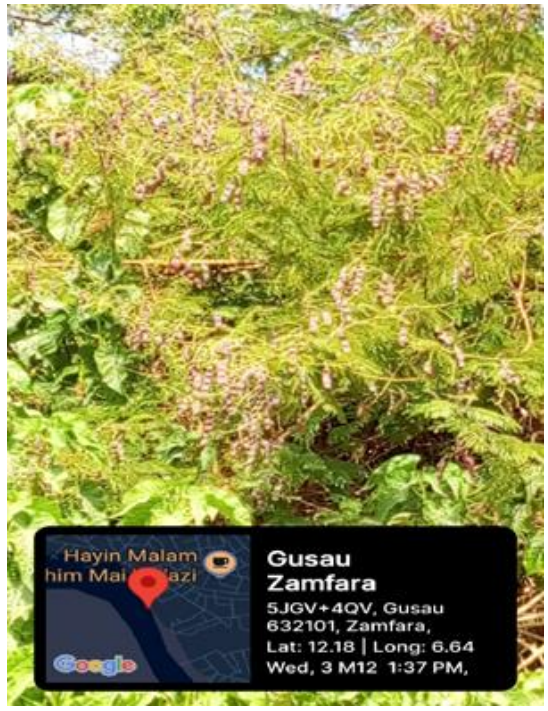
| Floristic Features | | | Results |
|---|---|---|---|
| Species Attributes | Species Diversity | | 57 |
| | Species Abundance | | 4,871 |
| | Five most abundant plant species | | *Typha latifolia* (524); *Lactuca sativa* (392); *Amaranthus viridis* (330); *Sorghum bicolor* (256); and *Luffa sp.*(210) |
| | Five least abundant plant species | | *Balanites aegyptiaca* (1); *Khaya senegalensis* (2); *Acacia sieberiana*/ *Citrus sinensis* (3); *Ficus thonningii* / *Polyalthia longifolia* (4); *Calophyllum inophyllum* (5) |
| | Five most abundant tree species | | *Mangifera indica* (89); *Azadirachta indica* (39); *Acacia nilotica* (27); *Hyphaene thebaica* (10); *Anacardium occidentale* (9) |
| | Five least abundant tree species | | *Balanites aegyptiaca* (1); *Khaya senegalensis* (2); *Acacia sieberiana*/ *Citrus sinensis* (3); *Ficus thonningii* / *Polyalthia longifolia* (4); *Calophyllum inophyllum* (5) |
| | Species habit | 24-Herb | 3258 (66.9%) |
| | | 5-Lianas | 337 (6.9%) |
| | | 11-Shrub | 1047 (21.5%) |
| | | 16-Trees | 229 (4.7%) |
| Family Attributes | Family diversity | | 32 families; Amaranthaceae; Anacardiaceae; Annonaceae; Apocynaceae; Arecaceae; Asclepiaceae; Asteraceae; Balanitaceae; Brassicaceae; Calophyllaceae; Caricaceae; Combretaceae; Convolvulaceae; Cucurbitaceae; Cyperaceae; Euphorbiaceae; Fabaceae; Lamiaceae; Malvaceae; Moraceae; Meliaceae; Moraceae; Musaceae; Oleaceae; Panicoideae; Poaceae; Polygonaceae; Rhamnaceae; Rutaceae; Sapindaceae; Solanaceae; Typhaceae |
| | Five most abundant families | | Asteraceae / Fabaceae (6); Solanaceae (4); Poaceae (3); Cucurbitaceae/ Euphorbiaceae (3) |
| | Five Families with most individuals | | Asteraceae (824); Typhaceae (524); Amaranthaceae (463); Poaceae (449); Fabaceae (396). |
| | Five Families with least individuals | | Balanitaceae (1); Rutaceae (3); Annonaceae / Moraceae (4); Calophyllaceae (5); Oleaceae (7). |




*Hygrophila auriculata*




*Urochloa brizantha*




*Senegalia ataxacantha*

**Plate 3.7: Vegetation Sampling at a Transects I (FMC Stream)**




*Erigeron bonariensis*




*Senna occidentalis*

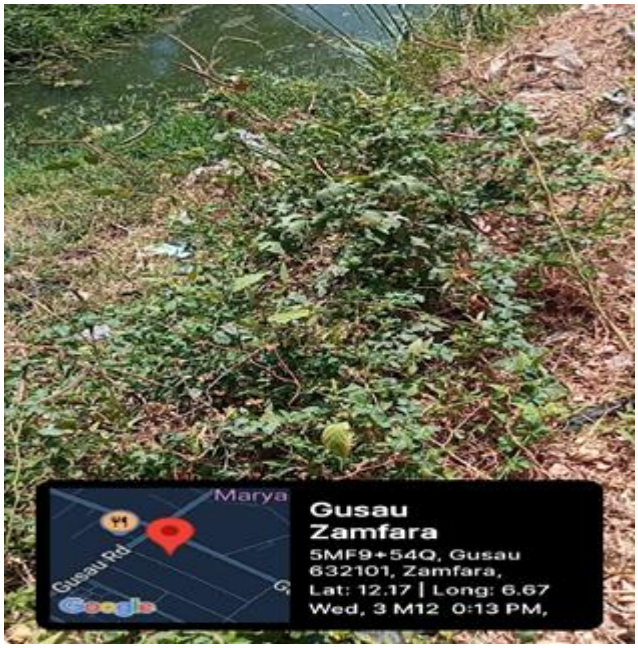



*Typha latifolia*

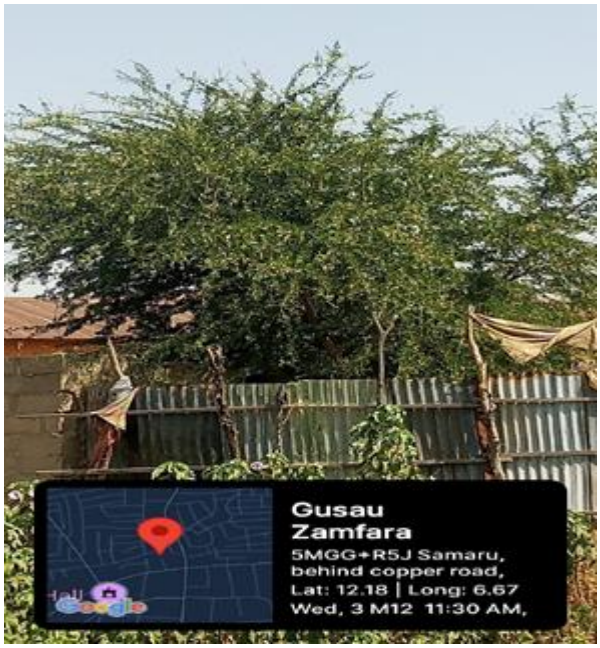



*Sida acuta*

**Plate 3.8: Vegetation Composition at Transect II (Masjid Kanoma)**




***Senna occidentalis***




***Balanites aegyptiaca***

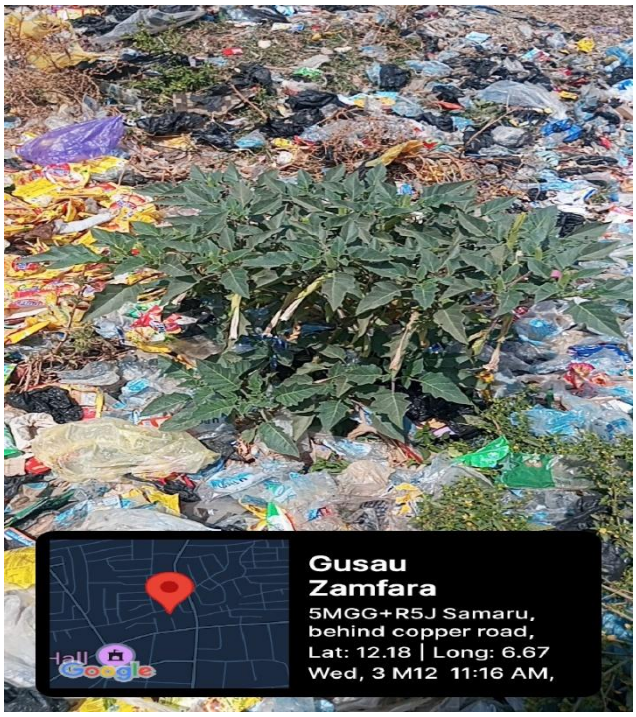



***Dichondra micranth***

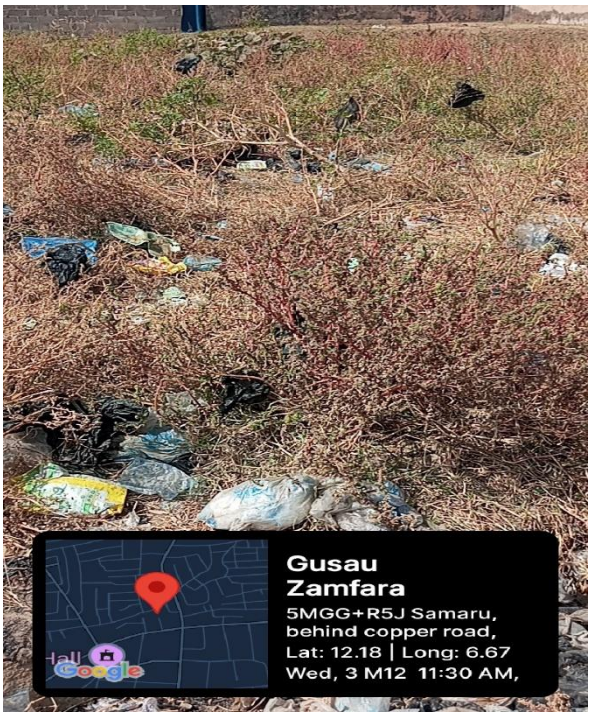



***Luffa* sp.**

**Plate 3.9: Vegetation Composition at Transects III (CP)**

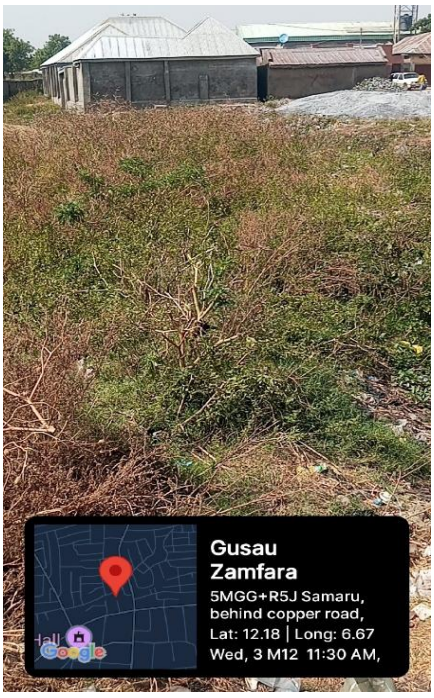



*Datura stramonium*

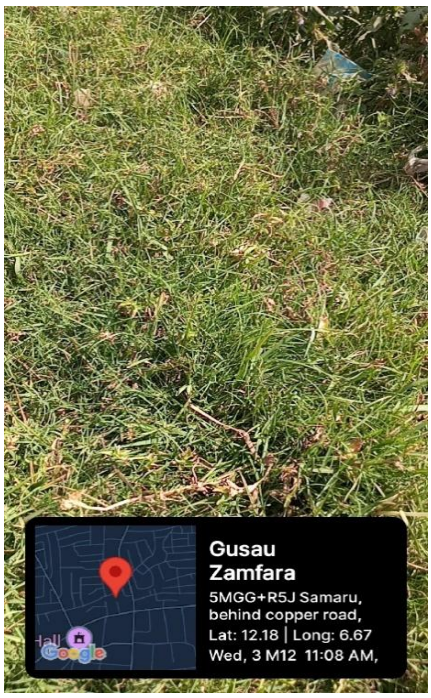



*Combretum micranthum*

**Plate 3.10: Vegetation Composition at Transect IV (Hayin Buba)**



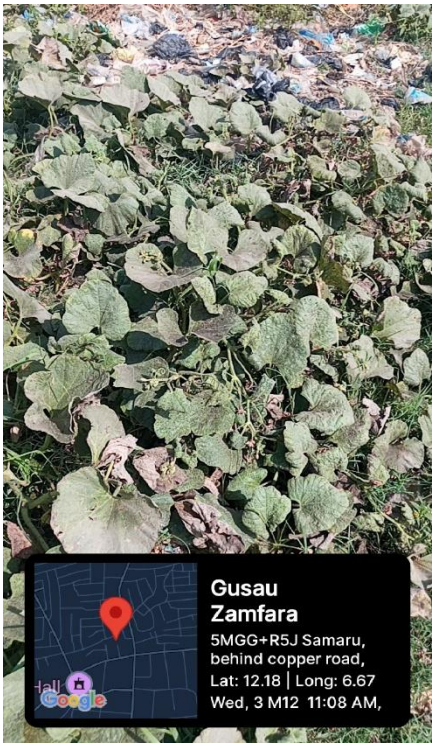

*Combretum micranthum*



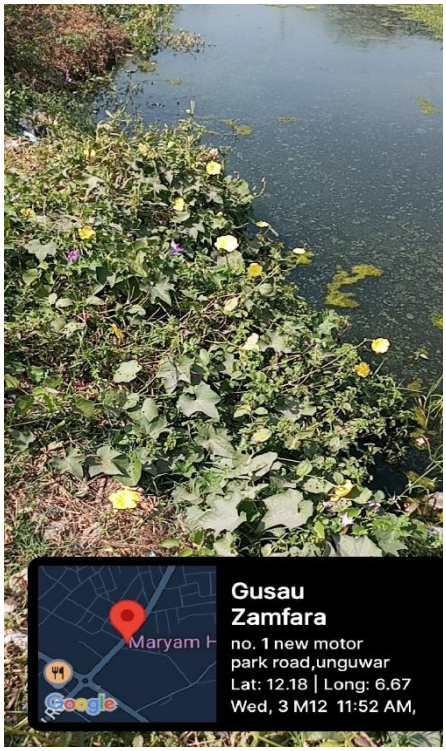

*Cyperus rotundus*




*Physalis angulate*




*Curcubita maxima*




*Luffa* **sp.**




*Cyperus rotundus*

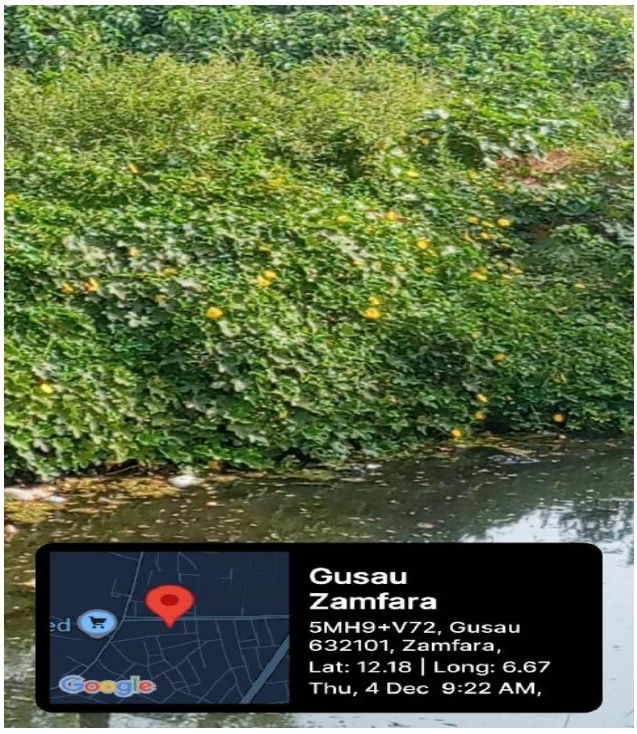
**Plate 3.11: Vegetation Composition at Transect V (Eid Masjid)**



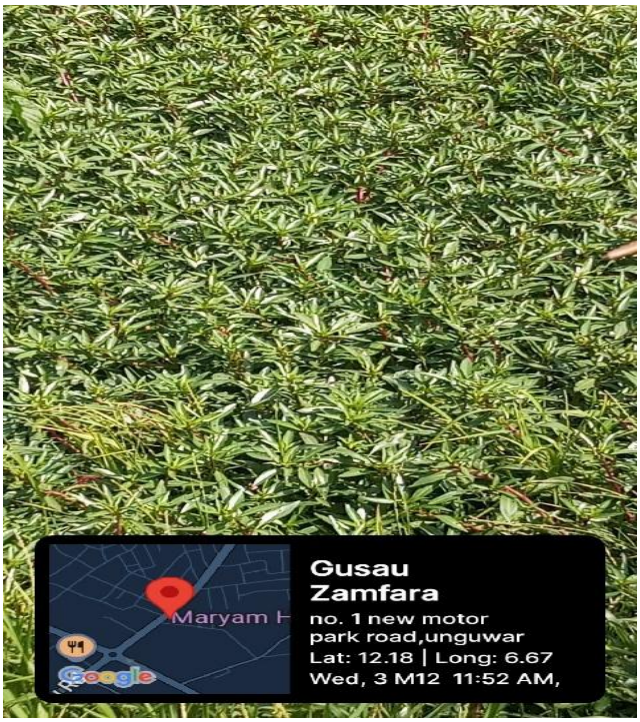

***Bidens pilosa***




***Calotropis procera***




***Luffa* sp.**



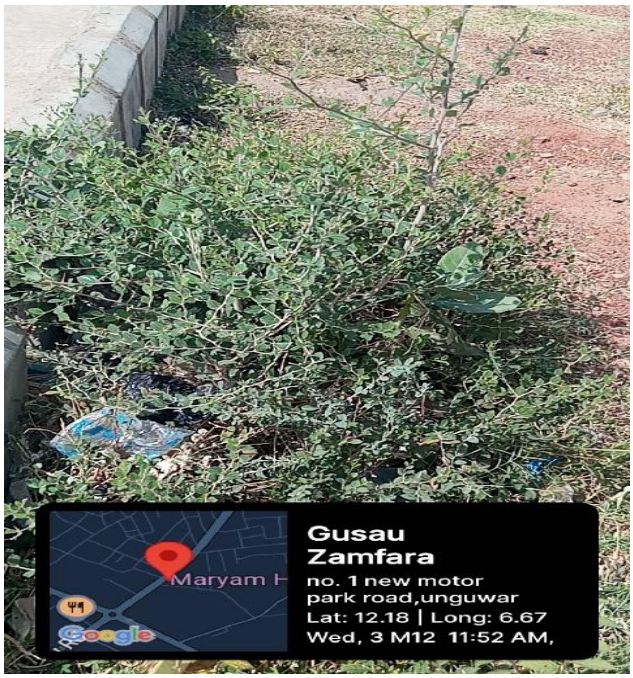

***Satureja hortensis***

**Plate 3.12: Vegetation Composition at Transect VI (Jifatu)**




***Jatropha gossypiifolia*** ***Morus nigra***

**Plate 3.13: Vegetation Composition at Transect VII (Yardole)**




***Ziziphus mauritiana***




***Ageratum conyzoides***




***Ricinus communis***

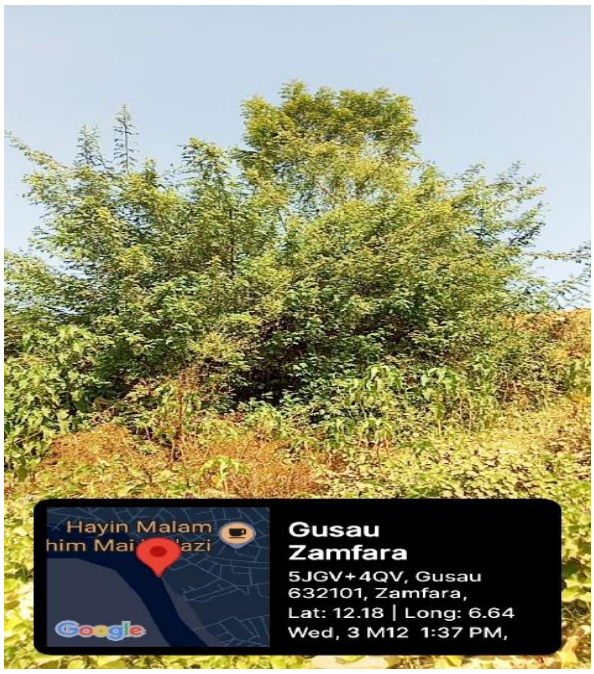



***Luffa* sp.**

**Plate 3.14: Vegetation Composition at Transects at VIII (Hayin Mal Ibrahim)**



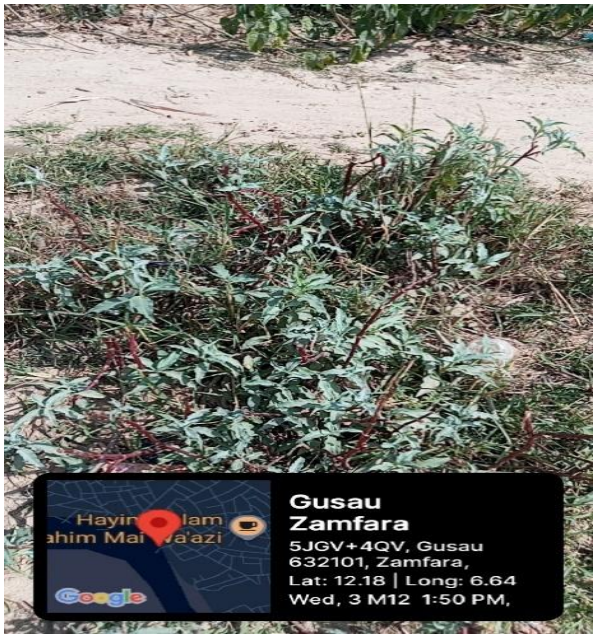

*Adamsonia digitata*




*Acer negundo*




*Anacardium occidentale*

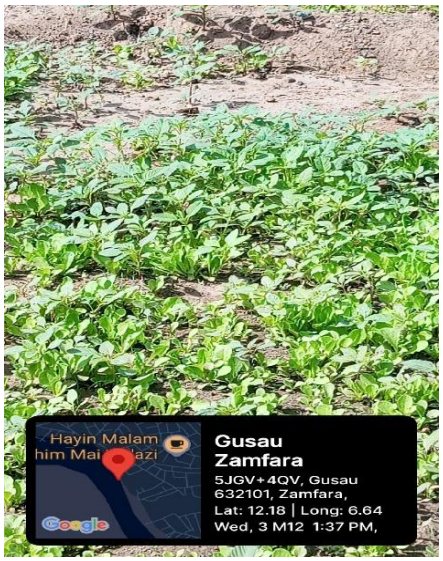



*Persicaria maculosa*

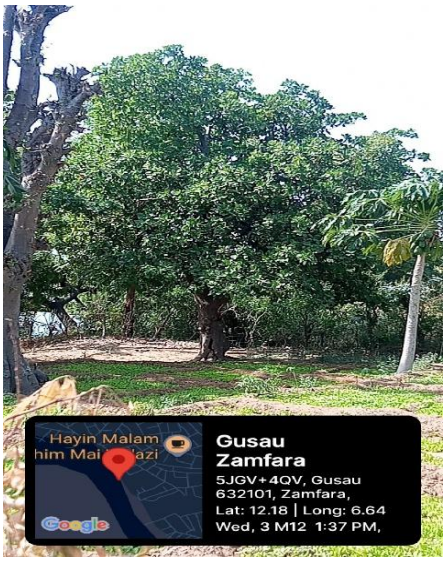
**Plate 3.15: Vegetation Composition IX (Gusau River A)**



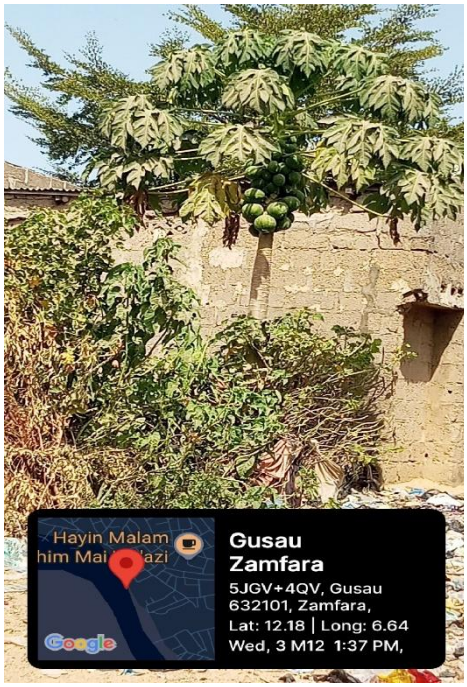

*Hyphaene thebaica*




*Amaranthus viridis*



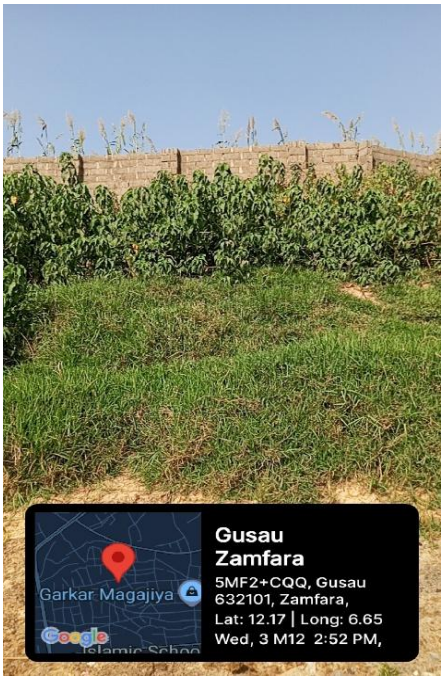

*Calophyllum inophyllum*




*Carica papaya*




*Sorghum bicolor*




*Typha latifolia*

**Plate 3.16: Vegetation Composition at Transects IX (Gusau River B)**

### 3.3.4.3 Wildlife Assessment

The wildlife assessment focused on terrestrial vertebrate fauna, specifically mammals, birds, reptiles, and amphibians within the Bulka Erosion and Stormwater Management Project Area. Data collection was informed by rapid field surveys, focal group discussions with local hunters, and secondary references to the **IUCN Red List** and Nigeria's national conservation status framework.

The Bulka Project Area lies within the Sudan Savanna ecological zone of northwestern Nigeria, characterized by open grasslands interspersed with shrubs and scattered trees. This habitat supports a variety of terrestrial and aquatic fauna, although anthropogenic pressures such as farming, settlement expansion, and infrastructure development have significantly altered natural habitats. Wildlife assessment in this context focuses on species occurrence, ecological roles, and conservation status based on the International Union for Conservation of Nature (IUCN) Red List and Nigeria's national conservation regulations.

**Mammals**

Historically, the Sudan Savanna supported large mammals such as antelopes (*Kobus kob*, *Tragelaphus scriptus*), warthogs (*Phacochoerus africanus*), and primates (*Papio anubis* – Olive Baboon). However, recent studies (Bello et al., 2021; IUCN, 2023) indicate that these species are now largely restricted to protected areas due to habitat fragmentation and hunting pressure. In the Bulka area, mammalian fauna is dominated by Small mammals particularly, *Cricetomys gambianus* (Gambian pouched rat), *Arvicanthis niloticus* (Nile grass rat), and insectivores such as shrews. Domestic and semi-wild species include Goats, sheep, and cattle are prevalent, reflecting pastoral land use. Focal group consultations with experienced hunters confirmed the presence of several mammal species, whose activity signs (tracks, droppings, and burrows) were observed during the survey (Table 3.10). All recorded species are currently listed as *Least Concern (LC)* on the IUCN Red List, though some are subject to local hunting pressure.

**Table 3.10: Mammals Recorded in the Project Area**

| Common Name | Scientific Name | IUCN Status | Notes |
|---|---|---|---|
| Gambian pouched rat | *Cricetomys gambianus* | LC | Common in farmlands and near settlements |
| Nile grass rat | *Arvicanthis niloticus* | LC | Abundant in grassland and cultivated fields |
| Shrews | *Crocidura* spp. | LC | Found in moist microhabitats |
| Antelope (historical) | *Kobus kob* | NT (National) | Formerly present; now rare due to hunting |
| Goat (domestic) | *Capra hircus* | Not Assessed | Common livestock species |
| Sheep (domestic) | *Ovis aries* | Not Assessed | Common livestock species |
| Cattle (domestic) | *Bos taurus indicus* | Not Assessed | Widespread in pastoral systems |
| African crested porcupine | *Hystrix cristata* | LC | Occasionally hunted for bushmeat |
| Hedgehog | *Atelerix albiventris* | LC | Found in savanna habitats |
| Olive baboon (rare) | *Papio anubis* | LC | Reported historically; now very scarce |

**Birds**

Avifaunal diversity in the Bulka Project Area reflects the ecological characteristics of the Sudan Savanna, which supports a mix of open-country species, riparian birds, and migratory species. Data collection combined rapid field observations, interviews with local hunters and farmers, and secondary references to the *IUCN Red List*, Nigeria's Wildlife Act, and regional ornithological surveys (Bello *et al.*, 2021; Birdlife International, 2023). Birds play critical ecological roles in seed dispersal, pest control, and nutrient cycling. The surveyed area, with its mosaic of farmlands, riparian strips, and scattered trees, provides suitable habitats for granivorous, insectivorous, and omnivorous species. Focal group discussions confirmed the presence of several common savanna birds, while field surveys recorded species visually and through calls. Most species recorded are listed as *Least Concern (LC)* on the IUCN Red List, although some migratory raptors and wetland birds are globally threatened. Nigeria's Wildlife Act provides legal protection for all raptors and migratory species. One of the key findings of this study was the sighting of the Lesser Kestrel (*Falco naumanni*) as the only species in the Bulka Project Area bird list classified as Vulnerable (VU) on the IUCN Red List. This status reflects global population declines driven by habitat loss, agricultural intensification, and reduction in insect prey availability. The Lesser Kestrel is a small migratory raptor that breeds in southern Europe and Asia and winters in Africa, including the Sudan Savanna zone of Nigeria. It plays a vital role in controlling insect populations, particularly grasshoppers and locusts, which are common in savanna ecosystems. However, the conservation concerns include the conversion of natural grasslands to intensive agriculture and infrastructure development reduces suitable foraging areas and widespread application of agrochemicals in farmlands diminishes insect prey and poses poisoning risks to them. Furthermore, their nesting and roosting sites are vulnerable to human disturbance and destruction. The implication for this ESMP report therefore underlines the presence of a vulnerable migratory species in the project area which points to the need for habitat protection, especially riparian zones and open grasslands. Compliance with Nigeria's Wildlife Act and international conventions (e.g., CMS – Convention on Migratory Species) is mandatory to protect this species.

**Table 3.11: Birds Recorded in the Project Area and Neighbouring Regions**

| Common Name | Scientific Name | IUCN Status | Notes |
|---|---|---|---|
| Village Weaver | *Ploceus cucullatus* | LC | Common in farmlands and near settlements |
| Northern Red Bishop | *Euplectes franciscanus* | LC | Abundant in grasslands during breeding season |
| Pied Kingfisher | *Ceryle rudis* | LC | Observed along riparian zones |
| Grey Heron | *Ardea cinerea* | LC | Found near seasonal water bodies |
| Black Kite | *Milvus migrans* | LC | Frequently seen soaring over open areas |
| Common Kestrel | *Falco tinnunculus* | LC | Resident raptor; hunts small mammals |
| Lesser Kestrel (migratory) | *Falco naumanni* | VU | Globally Vulnerable; migratory species |
| Speckled Pigeon | *Columba guinea* | LC | Common around human habitation |
| African Pied Crow | *Corvus albus* | LC | Scavenger; widespread in settlements |

| | | | |
|---|---|---|---|
| Senegal Coucal | *Centropus senegalensis* | LC | Common in shrubland and farmlands |
| African Grey Hornbill | *Tockus nasutus* | LC | Found in wooded savanna |
| Abyssinian Roller | *Coracias abyssinicus* | LC | Common in open savanna; striking plumage |
| Red-eyed Dove | *Streptopelia semitorquata* | LC | Common near farms and villages |
| Laughing Dove | *Spilopelia senegalensis* | LC | Widespread in semi-arid zones |
| Yellow-billed Shrike | *Corvinella corvina* | LC | Seen in scattered trees and farmlands |
| African Paradise Flycatcher | *Terpsiphone viridis* | LC | Occurs in riparian vegetation |
| Cattle Egret | *Bubulcus ibis* | LC | Common around livestock and wetlands |
| Spur-winged Lapwing | *Vanellus spinosus* | LC | Found near water bodies and open fields |
| African Jacana | *Actophilornis africanus* | LC | Wetland species; seasonal presence |

**Reptiles**

The Bulka Project Area lies in the Sudan Savanna belt of north-western Nigeria, a mosaic of open grasslands, shrubs, scattered trees, riparian strips, and cultivated lands. These habitats support a characteristic reptile assemblage dominated by lizards (Agamidae**,** Gekkonidae**)** and snakes (Elapidae, Viperidae, Pythonidae)**,** with riparian corridors functioning as movement and foraging zones. Our assessment combined rapid field surveys **(**day/night visual encounter), key informant interviews (local hunters/farmers), and desktop review of regional herpetological literature and conservation sources (IUCN Red List, Reptile Database, GBIF). Riparian complexity is highlighted globally as a positive predictor of reptile diversity and abundance—an insight relevant to Bulka's drainage corridors and seasonal streams. Nigeria's savanna herpetofauna is well documented in northern ecosystems (e.g., Gashaka Gumti National Park and adjacent savannas), where Agama lizards, house geckos, cobras, vipers, and pythons are typical; forest edges and farmlands often host generalist lizards and human-commensal geckos**.** Findings from those northern landscapes show higher herpetofaunal diversity in structurally heterogeneous savanna–forest mosaics, mirroring conditions at Bulka's riparian margins and mixed land use.

From a conservation perspective, agricultural expansion, bushmeat trade, and settlement encroachment are primary pressures on reptiles in Nigeria and West Africa, with vulnerability elevated for large-bodied species (e.g., Varanus monitors, rock pythons) and riparian specialists. Continental assessments confirm land conversion for farming as a leading threat to African reptiles.

Field signs and interviews indicate that *open-country lizards*: *Agama* spp. (commonly *Agama agama*) on walls, boulders, and tree bases; active diurnal insectivores. Human-commensal geckos (*Hemidactylus* spp. ), frequent on buildings and ornamental trees; adaptable to both dry and wet seasons. Riparian/large reptiles: *Varanus niloticus* (Nile monitor) along streambanks and farm edges; subject to hunting/trade in parts of Nigeria. Venomous snakes like *Naja nigricollis* (black-necked spitting cobra), *Bitis arietans* (puff adder); typical savanna assemblage, often near

farmlands/ruderal habitats. Large constrictors (near water/edge habitats) such as *Python sebae* (African rock python); West African populations face declines due to harvest/trade pressure. These taxa are consistent with inventories from northern Nigeria's savanna parks and agricultural landscapes, including reported Hemidactylus, Python, and Lycophidion clades in regional molecular surveys. The *IUCN Red List* statuses for the most likely Bulka species are summarised below, with notes tailored to Sudan Savanna conditions and local pressures**.** Where genus-level presence is indicated (e.g., *Hemidactylus* house geckos), the table references species commonly recorded in Nigeria and neighbouring West African savannas.

**Table 3.12: Reptiles Recorded/Expected in the Bulka Project Area**

| Common Name | Scientific Name | IUCN Status | Notes / Habitat in Bulka |
|---|---|---|---|
| Common/Rainbow Agama | *Agama agama* | **LC** | Widespread diurnal lizard on walls/rocks; typical of savanna towns and villages. |
| Brooke's House Gecko (house gecko) | *Hemidactylus brookii* | **LC** | Frequent on buildings/ornamental trees; highly adaptable in suburban/rural settings. |
| Angulate House Gecko (house gecko complex) | *Hemidactylus angulatus* s.l. | — (taxonomy complex) | Savanna/degraded forest gecko; widespread across Nigeria and Sahel–Sudan belts (taxonomy under review). |
| Chameleon | | | |
| Nile Monitor | *Varanus niloticus* (complex) | — (taxonomic split; LC/NE regionally) | Riparian/agricultural edges; subject to hunting/trade in parts of Nigeria. |
| Black-necked Spitting Cobra | *Naja nigricollis* | LC | Common savanna cobra; human–snake conflict where vegetation is sparse; medically important. |
| Puff Adder | *Bitis arietans* | LC | Widespread viper in open savanna/farms; responsible for many bites continent-wide. |
| African Rock Python | *Python sebae* | NT (West Africa assessments) | Large constrictor near wetlands/farm edges; declining due to harvest, habitat loss. |
| Sand/Grassland Snakes (e.g., *Lycophidion* spp.) | *Lycophidion* spp. | LC (species dependent) | Small nocturnal snakes; documented regionally; often detected in molecular surveys. |

**Notes:**

• "LC" = Least Concern; "NT" = Near Threatened. Some West African assessments report declines for ***Python sebae*;** Varanus taxonomy in Nigeria is debated (*V. niloticus* vs *V. ornatus*) and local exploitation is reported status varies with treatment. • House geckos present taxonomic complexity (*Hemidactylus* spp***.); H. brookii*** is assessed LC by IUCN and is a reasonable proxy for Bulka's building-associated geckos.

## Amphibians

Amphibians are critical components of ecosystems, serving as indicators of environmental health due to their sensitivity to water quality and habitat changes. The Bulka Erosion and Stormwater Management Project Area lies within the Sudan Savanna ecological zone of northwestern Nigeria, characterized by seasonal streams, riparian strips, and irrigated farmlands. These habitats provide breeding sites for amphibians during the rainy season and in artificial water bodies such as irrigation canals. Data for this assessment were derived from *Rapid field surveys* (night call surveys and visual encounter surveys), *Key informant interviews* with local farmers and hunters and *Literature review* of regional herpetofauna (e.g., Nneji et al., 2019; IUCN Red List, 2023).

Amphibians in the Sudan Savanna are strongly associated with *Riparian zones* along seasonal streams (Transects I, II, VIII, IX, X), Temporary rain pools and puddles in farmlands, and Irrigation canals and reservoirs supporting year-round farming. These microhabitats are essential for breeding and larval development. Studies in northern Nigeria (e.g., Gashaka Gumti National Park) confirm that amphibian richness peaks in structurally complex riparian habitats and declines in heavily modified agricultural landscapes (Nneji *et al*., 2019).

***Species Composition***

Field observations and literature indicate the presence of common savanna amphibians, dominated by families Ptychadenidae**,** Phrynobatrachidae**,** and Dicroglossidae. Most species recorded or expected in Bulka are Least Concern (LC) globally, but local threats include: Agrochemical runoff from irrigated farms, Habitat loss due to drainage channel modification and Overharvesting for food in some communities.

**Table 3.13: Amphibians Recorded/Expected in Bulka Project Area and Neighbouring Sudan Savanna**

| Common Name | Scientific Name | IUCN Status | Notes / Habitat in Bulka |
|---|---|---|---|
| African Tiger Frog | *Hoplobatrachus occipitalis* | LC | Large frog; common in pools, irrigation canals, farm ponds. |
| Mascarene Grass Frog | *Ptychadena mascareniensis* | LC | Calls at dusk near wet fields; widespread in savanna. |
| Ridged Grass Frogs | *Ptychadena spp.* | LC | Occur in open grasslands and agro-habitats. |
| White-lipped Frog | *Amnirana albolabris* | LC | Found along shaded riparian drains and forest edges. |
| Puddle Frogs | *Phrynobatrachus spp.* | LC | Breed in temporary rain pools and shallow puddles. |
| Clawed Frog | *Xenopus cf. muelleri* | LC | Permanent/seasonal water bodies; irrigation canals. |
| Senegal Kassina | *Kassina senegalensis* | LC | Arboreal calls from grass tussocks near pools. |
| Cassino Kassina | *Kassina cassinoides* | LC | Open country; calling from grassy margins of ponds. |

**Arthropods and Soil Invertebrates**

Arthropods (insects, arachnids) are fundamental to pollination**,** decomposition**,** soil aeration, and natural pest control. Their diversity and abundance offer rapid indicators of habitat quality and the impacts of land use and agrochemicals. Survey Methods employed included Rapid field methods: pitfall traps**,** sweep netting**,** visual encounter surveys**,** key informant interviews with local farmers on pest dynamics and pollinators and Literature review of Sudan Savanna arthropod communities. From the study, Riparian strips were associated with ground beetles (Carabidae), ants (Formicidae), spiders (Araneae) while Irrigated farmlands had pollinators (Apidae), predatory insects (Mantodea, Odonata) and Erosion-prone/bare soils had detritivores and termites (Isoptera). For species composition, Formicidae (ants), Carabidae (ground beetles), Acrididae (grasshoppers), Araneidae (orb-weaver spiders), Apidae (bees), and Libellulidae (dragonflies) were recorded, supporting pest suppression and nutrient cycling.

**Table 3.14: Representative Arthropods in Bulka Area**

| Common Name | Scientific Name (indicative) | Functional Role | Notes / Habitat |
|---|---|---|---|
| Harvester Ant | *Messor* spp. | Soil turnover | Common in dry, sandy soils |
| Ground Beetle | *Carabidae* spp. | Predation on pests | Riparian margins, field edges |
| Grasshopper | *Acrididae* spp. | Herbivory | Open farmlands and grasslands |
| Orb-weaver Spider | *Araneidae* spp. | Predation | Vegetation edges, shrublands |
| Honeybee | *Apis mellifera* | Pollination | Flowering crops; irrigated farms |
| Dragonfly | *Libellulidae* spp. | Predation (aquatic/terrestrial) | Near canals, ponds, streams |

***Soil Invertebrates***

Soil invertebrates (earthworms, termites, nematodes, micro-arthropods) drive soil structure formation**,** organic matter decomposition, and nutrient cycling, improving water infiltration and plant productivity. Moist riparian soils harboured earthworms (Eudrilidae). While Agroecosystems had termites (Macrotermitinae) and free-living nematodes with diversity declining with excessive tillage and chemicals. Bare, compacted soils had reduced macrofauna; dominance of stress-tolerant taxa (Table 3.15).

**Table 3.15: Representative Soil Invertebrates in Bulka Area**

| Common Name | Scientific Name (indicative) | Functional Role | Notes / Habitat |
|---|---|---|---|
| Earthworm | *Eudrilus eugeniae* | Soil aeration | Moist riparian soils, irrigated beds |
| Termite | *Macrotermes* spp. | Decomposition | Mounds near farmland margins |
| Soil Nematode | *Meloidogyne* spp. | Root parasitism | Irrigated farms; monitor crop health |
| Springtail | *Collembola* spp. | Detritivory | Leaf litter in shaded riparian areas |
| Woodlouse | *Isopoda* spp. | Fragmentation | Under stones, damp microhabitats |



*A common Kestrel perched on a mango tree*



*Red eyed dove*



*Butterflies seen on excavated sand close to a stream*



*A Flappet Lark surveys its prey from the top of a twig*



A Common Bulbul perched on the branch of *Parkia biglobosa*



A Laughing Dove perched on an electric wire

**Plate 3.17: Representative Birds in The Sample Location**

### 3.3.4.4 Ecosystem Services – Provisioning, Regulating, And Cultural Ecosystem Services.

The project area provides critical ecosystem services that sustain local livelihoods, regulate environmental processes, and preserve cultural identity. Understanding these services is essential for designing effective erosion control and biodiversity management strategies.

*A. Provisioning Services (Direct Benefits)*

1. Food Crops: Millet (*Cenchrus americanus*), sorghum (*Sorghum bicolor*), cowpea (*Vigna unguiculata*), rice (*Oryza sativa*), maize (*Zea mays*), groundnut (*Arachis hypogaea*), sesame (*Sesamum indicum*), tomato (*Solanum lycopersicum*), pepper (*Capsicum spp.*), and onion (*Allium cepa*).
2. Livestock Products: Cattle, goats, and sheep provide meat, milk, hides, and manure.

3. Fuelwood & Timber: Trees such as *Vitellaria paradoxa* (shea), *Parkia biglobosa* (locust bean), and *Azadirachta indica* (neem) supply firewood, charcoal, and construction materials.
4. Medicinal Plants: Indigenous species are used in traditional medicine for treating ailments.
5. Water Resources: Streams and seasonal rivers provide water for irrigation, domestic use, and livestock.

*B. Regulating Services (Environmental Balance)*

1. Climate Regulation**:** Vegetation cover sequesters carbon and moderates local temperatures.
2. Soil Fertility & Erosion Control: Roots of crops and trees stabilize soil, reducing gully erosion and desertification.
3. Water Purification: Wetlands and riparian vegetation filter pollutants, improving water quality.
4. Pollination & Pest Control: Insects and birds support crop pollination, while natural predators regulate pests.
5. Flood Regulation: Natural vegetation buffers against seasonal flooding, protecting farmlands and settlements.

*C. Cultural Services (Intangible Values)*

1. Spiritual & Religious Values: Sacred groves, trees, and rivers hold cultural significance and are used in rituals.
2. Traditional Knowledge: Farming practices, seed selection, and herbal medicine are passed down generations.
3. Recreation & Aesthetics: Landscapes, rivers, and wildlife provide scenic beauty and opportunities for eco-tourism.
4. Cultural Identity: Crops like millet and sorghum are central to local cuisine and festivals, reinforcing community bonds.

***Common Crops and Economic Plants in the Project Area***

The agricultural landscape of the Bulka project area is characterized by a diverse mix of staple cereals, legumes, oilseeds, and horticultural crops that underpin both household subsistence and commercial livelihoods. As shown in Tables 3.16 and 3.17, cereals such as pearl millet (*Cenchrus americanus*), sorghum (*Sorghum bicolor*), rice (*Oryza sativa*), maize (*Zea mays*), and wheat (*Triticum aestivum*) dominate cultivation, serving as staple foods, animal feed, and raw materials for brewing and industrial starch production. Legumes including cowpea (*Vigna unguiculata*) and groundnut (*Arachis hypogaea*) provide essential protein, improve soil fertility, and support oil extraction and cash income.

Oilseed crops like sesame (*Sesamum indicum*) are valued for seasoning and export, while horticultural crops such as tomato (*Solanum lycopersicum*), pepper (*Capsicum* spp.), and onion (*Allium cepa*) contribute to household nutrition, spice markets, and income generation. Collectively, these crops reflect a resilient farming system adapted to semi-arid conditions,

balancing subsistence needs with economic opportunities, and highlighting the importance of agriculture in sustaining food security and livelihoods within the project area.

**Table 3.16: Common Crops Cultivated In The Project Area**

| S/N | Family | Scientific Name | Common Name |
|---|---|---|---|
| 1. | Poaceae | *Cenchrus americanus* | Pearl Millet |
| 2. | Poaceae | *Sorghum bicolor* | Sorghum |
| 3. | Fabaceae | *Vigna unguiculata* | Cowpea (Beans) |
| 4. | Poaceae | *Oryza sativa* | Rice |
| 5. | Poaceae | *Zea mays* | Maize (Corn) |
| 6. | Fabaceae | *Arachis hypogaea* | Groundnut |
| 7. | Pedaliaceae | *Sesamum indicum* | Sesame |
| 8. | Poaceae | *Triticum aestivum* | Wheat |
| 9. | Solanaceae | *Solanum lycopersicum* | Tomato |
| 10. | Solanaceae | *Capsicum spp.* | Pepper |
| 11. | Amaryllidaceae | *Allium cepa* | Onion |

**Table 3.17: Checklist of Common Economic Plants/Crops Encountered in the Project Area**

| Scientific Name | Common Name | Uses and Purpose |
|---|---|---|
| *Cenchrus americanus* | Pearl Millet | Staple food, animal feed, drought-resistant cereal crop |
| *Sorghum bicolor* | Sorghum | Food grain, brewing, animal fodder |
| *Vigna unguiculata* | Cowpea (Beans) | Protein source, consumed as food, fodder, and for soil fertility improvement |
| *Oryza sativa* | Rice | Staple food, commercial crop, used in local and industrial food processing |
| *Zea mays* | Maize (Corn) | Staple food, animal feed, brewing, industrial starch production |
| *Arachis hypogaea* | Groundnut | Oil extraction, food, animal feed, cash crop |
| *Sesamum indicum* | Sesame | Oilseed crop, export commodity, food seasoning |
| *Triticum aestivum* | Wheat | Staple food (flour for bread/pasta), grown in irrigated dry-season farming |
| *Solanum lycopersicum* | Tomato | Vegetable, consumed fresh or processed, income generation |
| *Capsicum spp.* | Pepper | Spice, vegetable, income crop, local and export markets |
| *Allium cepa* | Onion | Vegetable, seasoning, widely cultivated for household and commercial purposes |
| *Cenchrus americanus* | Pearl Millet | Staple food, animal feed, drought-resistant cereal crop |
| *Sorghum bicolor* | Sorghum | Food grain, brewing, animal fodder |
| *Vigna unguiculata* | Cowpea (Beans) | Protein source, consumed as food, fodder, and for soil fertility improvement |
| *Oryza sativa* | Rice | Staple food, commercial crop, used in local and industrial food processing |
| *Zea mays* | Maize (Corn) | Staple food, animal feed, brewing, industrial starch production |
| *Arachis hypogaea* | Groundnut | Oil extraction, food, animal feed, cash crop |
| *Sesamum indicum* | Sesame | Oilseed crop, export commodity, food seasoning |
| *Triticum aestivum* | Wheat | Staple food (flour for bread/pasta), grown in irrigated dry-season farming |
| *Solanum lycopersicum* | Tomato | Vegetable, consumed fresh or processed, income generation |

### 3.3.5 Hydrobiology Assessment

The biological component of the assessment focused on four major groups: *phytoplankton, zooplankton, fisheries, and macrobenthos.* For phytoplankton, the study will involve identification to the nearest taxonomic level, assessment of species diversity (composition, distribution, and density), and evaluation of productivity through chlorophyll concentration measurements. Similarly, zooplankton will be identified to the nearest taxonomic level, and their diversity, distribution, and density will be analyzed to understand their role in the aquatic food web. The macrobenthos study will examine benthic macro-invertebrates, which serve as critical indicators of water quality and ecosystem health. These organisms will be identified to the nearest taxonomic level, and their species distribution, abundance, diversity, and density will be documented.

The fisheries assessment was extensive, covering species identification, diversity, and population structure. Key aspects include mapping fish spawning areas, evaluating fish catch where possible, and studying food and feeding habits. Additional investigations will focus on fish stock assessment, migration patterns, breeding habits, and the presence of protected species. Catch Assessment Surveys (CAS) will be conducted to quantify fishing activities and determine the sustainability of current practices. This component will also identify breeding sites, migration routes, and assess the impact of anthropogenic activities such as sand mining and waste discharge on fish habitats.

**Plankton Sampling**

Plankton samples were collected using a 30 µm mesh plankton net towed horizontally for 10 meters along the flow direction. Samples were preserved immediately with 1% Lugol's iodine for phytoplankton and 4% formalin for zooplankton (Sournia, 1986; Arimoro *et al*., 2018). Samples were taken to the laboratory Samples were allowed to settle for 24 hours, after which two-thirds of the supernatant was decanted to concentrate organisms. Ten drops from each sample were examined under a Wild II binocular compound microscope at ×10 and ×40 magnifications. Identification followed standard taxonomic keys (Janse Van Vuuren *et al*., 2006; Edward & David, 2010; Shiel, 1995). Quantification employed the drop-count method (Akachukwu *et a*l 2025), expressed as organisms per milliliter (org/mL).



**Plate 3.18: Plankton sampling in Zamfara headwater stream**

***Macroinvertebrate Sampling***

Macroinvertebrates were captured using a D-frame net (250 µm mesh) following a multi-habitat approach**,** targeting vegetation, sand, gravel, riffles, and pools. Samples were preserved in 70**%** ethanol to prevent degradation (Arimoro & James, 2008). In the laboratory samples were washed through a 250 µm sieve to remove debris and sorted manually under a dissecting microscope. Identification was carried out to family or genus level using regional pictorial guides (Arimoro & James, 2008). Abundance was recorded as individuals per sample and converted to density estimates.

### 3.3.5.1 Phytoplankton And Zooplankton – Species Composition, And Abundance

Table 3.18 presents the diversity, abundance, and distribution of phytoplankton species recorded across the sampled stations of the Zamfara headwater streams revealed a diverse algal community comprising Diatoms (Bacillariophyceae), Green algae (Chlorophyceae, Oedogoniophyceae, Euglenophyceae), Blue-green algae (Cyanophyceae), and minor representatives of Golden algae (Chrysophyceae) and Dinoflagellates. The combined dataset indicates a total abundance exceeding 900 cells/ml across all stations, with species richness spanning 32 taxa. Diatoms dominated the phytoplankton structure, with genera such as *Coscinodiscus*, *Melosira*, *Navicula*, *Nitzschia*, and *Surirella* occurring consistently. This dominance suggests oxygenated waters with moderate silica availability, typical of flowing headwater systems. The presence of centric diatoms (*Coscinodiscus eccentricus, C. radiatus*) alongside pennate forms reflects a mix of lotic and lentic microhabitats, possibly linked to seasonal flow variability and localized pooling.

Green algae were well represented, particularly desmids (*Closterium*, *Cosmarium*, *Micrasterias*) and filamentous forms (*Ulothrix*), indicating good light penetration and relatively clear water conditions. Euglenoids (*Trachelomonas lacustris*, *Phacus caudatus*) appeared in moderate numbers, pointing to organic enrichment pulses without severe oxygen depletion. Blue-green algae

(Cyanobacteria) such as *Microcystis aeruginosa*, *Oscillatoria limnetica*, and *Anabaena* were recorded at all stations, with higher counts in some locations. Their presence signals localized nutrient enrichment, likely from agricultural runoff or domestic inputs. Although not dominant, these taxa warrant attention due to their potential to produce toxins under favourable conditions. Minor occurrences of Golden algae (*Dinobryon cylindricum*) and Dinoflagellates (*Peridinium cinctum, Centritractus dubius*) suggest transitional conditions and relatively low turbidity in certain segments. Phytoplankton analysis generally (Figure 3.9) shows a community dominated by Diatoms (43.1%), followed by Green algae (42.3%), Blue-green algae (12.7%), and minor contributions from Golden algae (0.9%) and Dinoflagellates (1.1%).

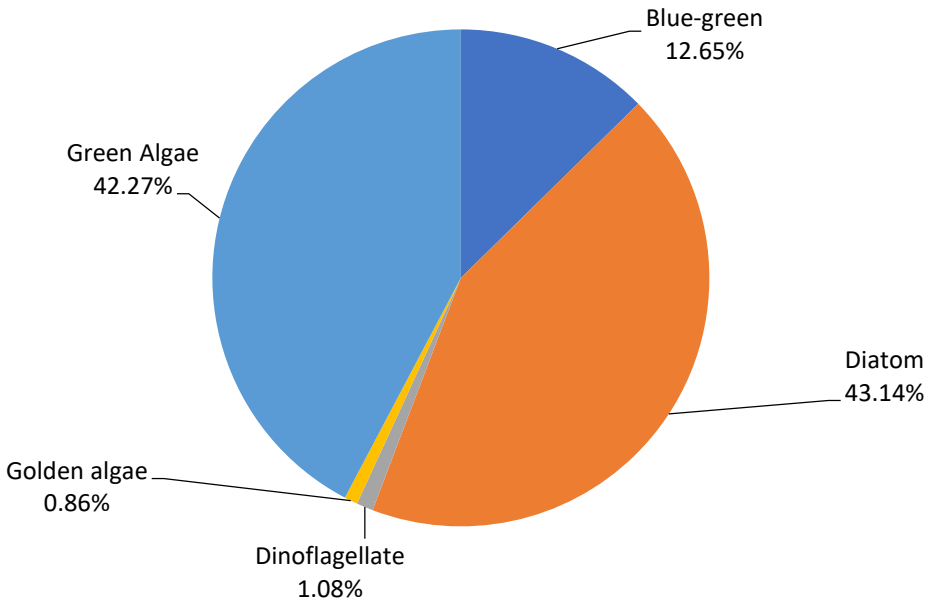
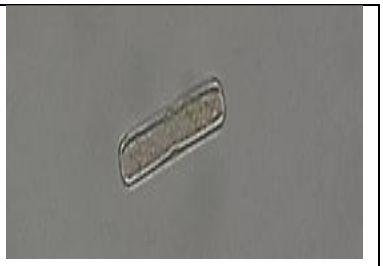
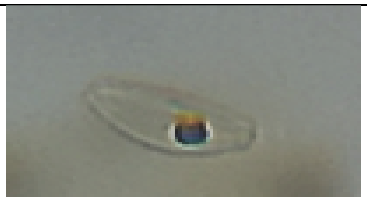
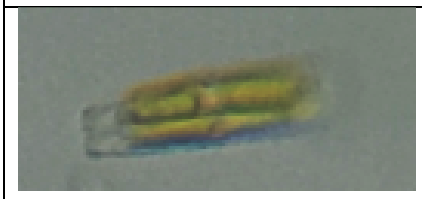
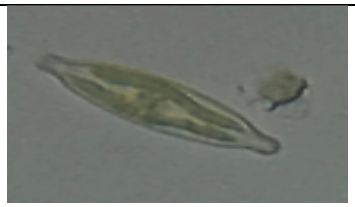
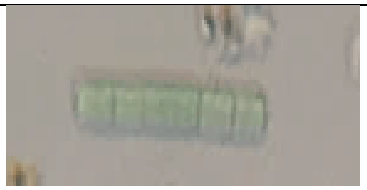
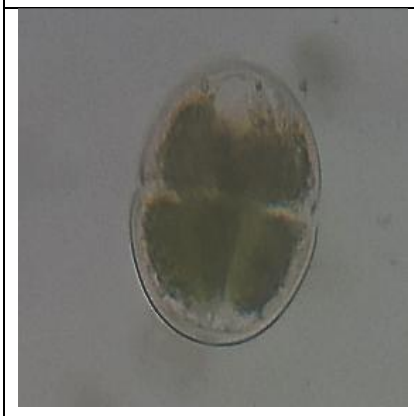



**Figure 3.9: Percentage composition of major phytoplankton groups in the sample locations of the study area.**

The phytoplankton profile demonstrates moderate ecological integrity with emerging nutrient stress signals**.** Diatoms dominate the community (≈51.8%), including *Coscinodiscus*, *Melosira*, *Navicula*, *Nitzschia*, and *Surirella*, which are reliable indicators of oxygenated waters and good baseline quality**.** Their prevalence suggests that the Zamfara headwater streams still maintain healthy flow regimes and silica availability, essential for sustaining aquatic biodiversity. The presence of centric diatoms (*Coscinodiscus eccentricus, C. radiatus*) alongside pennate forms reflects mixed lotic and lentic microhabitats, consistent with observations in Northern Nigerian rivers such as the Upper Dilimi River (Ali *et al*., 2015).

However, the consistent presence of cyanobacteria (≈12.4%)**,** notably *Microcystis aeruginosa*, *Oscillatoria limnetica*, and *Anabaena*, signals incipient eutrophication risk. These taxa are well-documented indicators of nutrient enrichment and potential toxin production under stagnant or low-flow conditions (Abubakar & Abdullahi, 2015; Adamu, 2023). Similar transitions from

diatom–green algae dominance to cyanobacterial proliferation—have been observed in Kubanni and Bomo Reservoirs (Zaria)**,** Jakara Dam (Kano)**,** and Hadejia–Nguru wetlands, driven by agricultural runoff and urban discharge (Abolude et al., 2012; Tanimu & Ibrahim, 2012; Maishanu et al., 2019). Recent studies in Thomas Dam (Kano) and Kalgo River (Kebbi) reinforce that unchecked nutrient loading accelerates this shift, compromising water quality and ecosystem services (Shafiu, 2024; Salisu *et al*., 2024).

| | | |
|---|---|---|
|  *Surirella* sp |  *Nitzschia* sp |  *Pinnularia* sp |
|  *Synedra ulna* |  *Haematococcus* sp |  *Cymbella* sp |
|  *Achnathidium* sp |  *Navicula* sp |  *Melosira* sp |
|  *Cosmarium* sp |  *Closterium* sp |  *Closterium* sp |

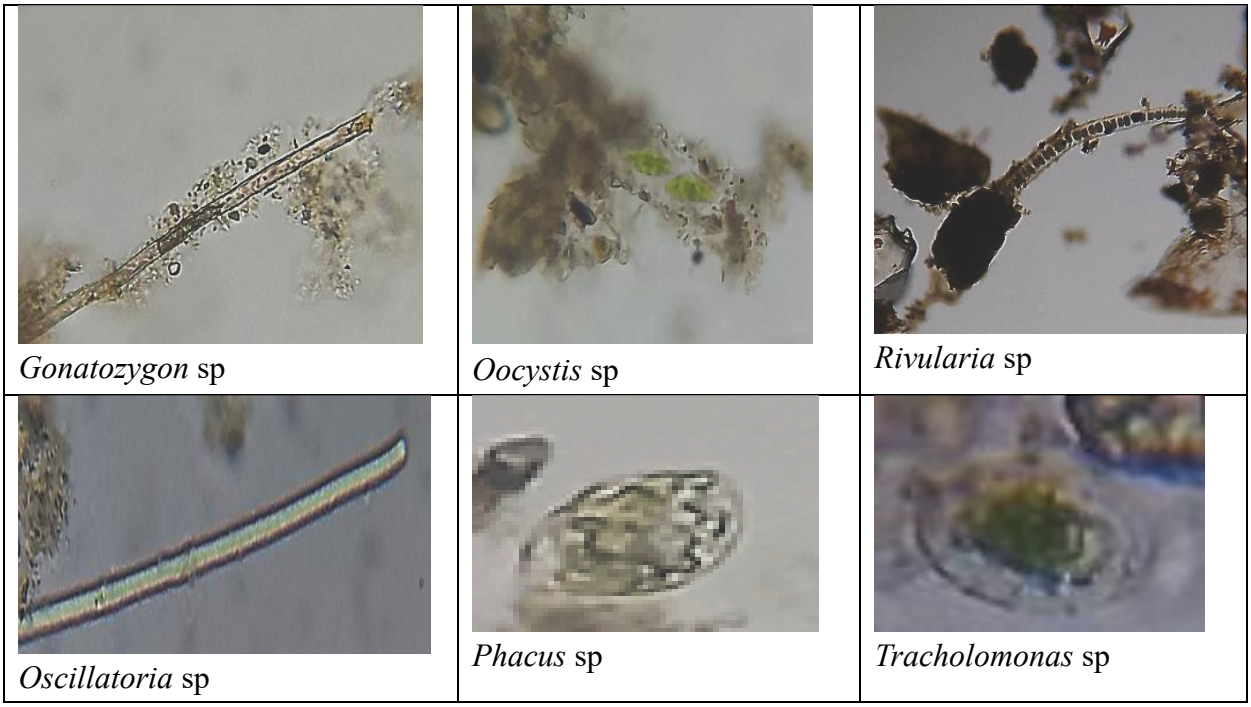



**Plate 3.19. Phytoplankton Microphotograph**

**Micro-Zooplankton Distribution**

Micro-zooplankton were recorded at all Zamfara headwater stations, comprising Rotifers, Cladocerans, Copepods**,** and occasional molluscan and fish larvae. Aggregated across stations, Copepods contributed ≈48.1% of total abundance, Cladocerans ≈19.8%**,** Rotifers ≈31%**,** and others (molluscan/fish larvae) ≈1.2% (**Figure3.10**).

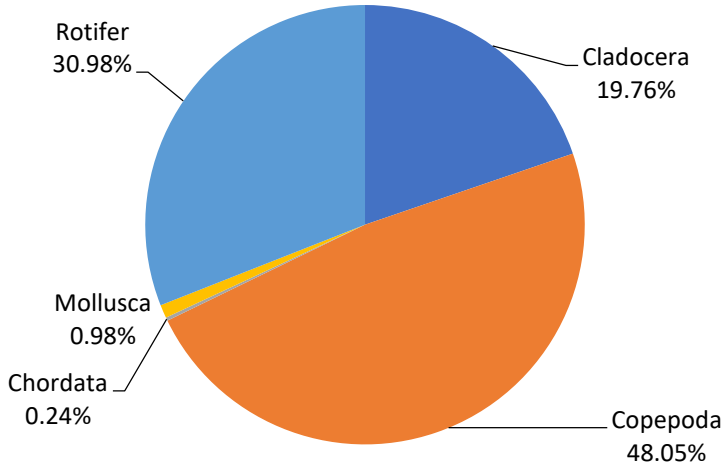
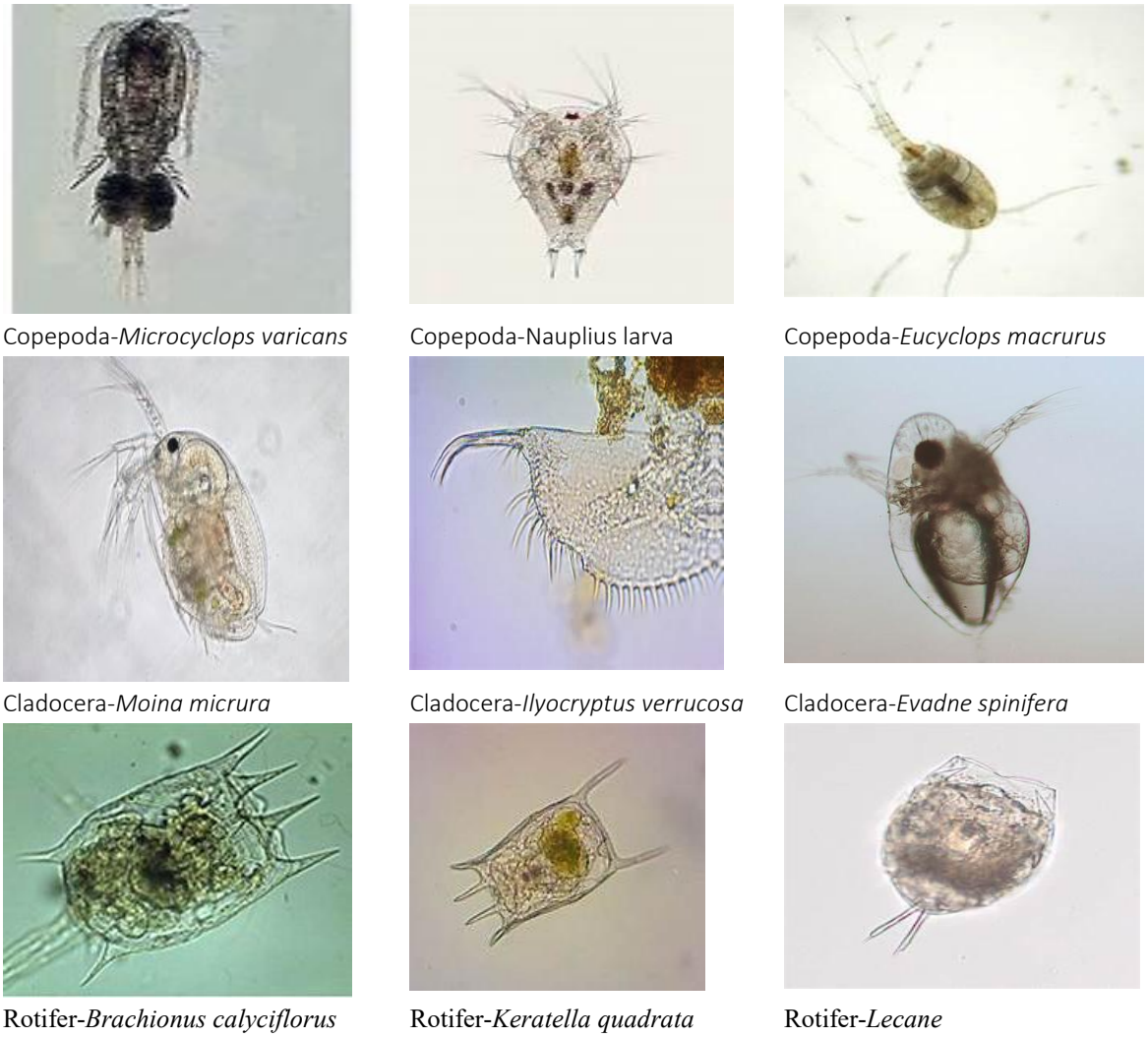



**Figure 3.10: Percentage composition of major microzooplankton groups in the sample locations of the study area.**

Within the copepods, the most abundant taxa were *Microcyclops varicans* (49ind./ml), *Metacyclops minutus* (35), and naupliar stages (28), while cladocerans were led by *Moina micrura* (40) and *Kurzia longirostris* (29). Rotifers were dominated by *Lecane leontina* (26), *Brachionus falcutus* (23), and *Lepadella ovalis* (22). The strong copepod signal and the consistent presence of cladocerans indicate oxygenated, moderately productive waters with functional hydrological connectivity, typical of Sahelo-Sudanian headwaters where flow variability sustains mixed grazer guilds.

Rotifer representation, especially *Brachionus* and *Lecane* points to localized nutrient enrichment and organic inputs**;** yet their co-occurrence with cladocerans and adult copepods suggests that enrichment is episodic rather than chronic**,** allowing grazer communities to persist. The incidental gastropod and fish larvae confirm trophic linkages and nursery functions along the corridor. These patterns are consistent with Northern Nigerian evidence that zooplankton communities track water quality and hydrology**.** In Wushishi (Tungan Kawo) Dam, zooplankton responded measurably to deteriorating water quality with rotifers increasing under enrichment while crustaceans declined under stress (Mohammed *et al.*, 2016; 2019). Seasonal analyses at Thomas Dam (Kano) and Lake Tiga showed wet-season nutrient pulses and dry-season oxygen constraints driving shifts among rotifers, cladocerans, and copepods (Nafi'u & Ibrahim, 2017; Akindele & Adeniyi, 2013).

In Afrotropical ephemeral streams impacted by human activity, rotifers have proven sensitive and useful ecological indicators**,** with community composition reflecting disturbance intensity (Edegbene *et. al*., 2022). Historic and recent work across the Middle Niger–Sokoto basin and Niger River tributaries confirms that hydrological regime and environmental heterogeneity shape zooplankton associations and periodicity (Jeje & Fernando, 1992; Souley Adamou et al., 2023). Post-dredging assessments and reservoir studies around Zaria, Katsina, and Gusau (Yardantsi**)** likewise link community structure to abiotic drivers, sewage discharges, metals, and seasonality**,** underlining the need for early warning and mitigation (Bamaiyi *et al*., 2021; Ibrahim & Abdulkarim, 2017; Jabbi & Isah, 2022; Tanko, Chia, & Nuhu, 2016).



Copepoda-*Microcyclops varicans* | Copepoda-Nauplius larva | Copepoda-*Eucyclops macrurus*

Cladocera-*Moina micrura* | Cladocera-*Ilyocryptus verrucosa* | Cladocera-*Evadne spinifera*

Rotifer-*Brachionus calyciflorus* | Rotifer-*Keratella quadrata* | Rotifer-*Lecane*

**Plate 3.20. Zooplankton Microphotograph**

### 3.3.5.2 Benthic Macrofauna – Species Distribution, Diversity, And Ecological Assessment

Macroinvertebrates are widely recognized as reliable indicators of stream health because they integrate the effects of multiple stressors over time. Their presence, diversity, and composition reflect water quality, habitat stability, and organic enrichment. In the Zamfara headwater streams, the benthic macrofauna community was assessed to determine ecological integrity and identify potential stress signals. The results reveal a community structure that is taxonomically diverse yet ecologically patchy, typical of headwater systems with variable substrate and flow conditions.

**Species Distribution and Composition**

The benthic macrofauna community across the Zamfara headwater streams was relatively sparse, with total abundance ranging from three individuals at SW3 to eight individuals at SW1 and SWCont2. Species richness varied between two and seven taxa per station, indicating low overall density and uneven distribution. Three major phyla were represented: Mollusca (Gastropoda), Annelida (Oligochaeta), and Arthropoda, which included insect orders such as Ephemeroptera, Diptera, Coleoptera, and Odonata. Gastropods such as *Lymnaea natalensis*, *Melanoides*

*tuberculata*, and *Bulinus forskali* occurred at SW1, SW2, and SWCont2, suggesting stable microhabitats with moderate organic matter. These taxa are moderately tolerant and often associated with slow-flowing, nutrient-enriched conditions. Oligochaetes (*Nais communis*, *Dero digitata*) were recorded at multiple stations, indicating fine sediment and organic deposition. Their presence is a classic indicator of organic enrichment and low dissolved oxygen tolerance, consistent with localized runoff influence.

Sensitive insect taxa such as Ephemeropterans (*Afrobaetis sp.*, *Elassoneuria candida*, *Pseudocloeon glaucum*) were found at SW1 and SWCont2, reflecting good water quality and oxygenation in these segments. Conversely, Chironomids (*Chironomus sp.*, *Tanypus sp.*, *Cryptochironomus sp.*) dominated SWCont1 and appeared in other stations, signaling moderate to high tolerance to organic pollution and sediment stress.

**Diversity and Tolerance Indices**

Diversity indices provide further insight into ecological status. SWCont2 exhibited the highest Margalef index (2.89) and Shannon diversity (H′ = 0.83), reflecting a relatively balanced and heterogeneous community. In contrast, SWCont1 recorded the lowest diversity (Margalef = 0.72; H′ = 0.24), dominated by tolerant chironomids, which is consistent with stress conditions. Evenness values were generally high (>0.8), indicating that while species richness was low, individuals were evenly distributed among the few taxa present—a pattern typical of disturbed systems where sensitive taxa have been lost.

**Multimetric Index (MMI) Assessment**

To strengthen interpretation, the Edegbene *et al*. (2024) multimetric index (MMI) approach was applied. This method combines multiple metrics into a single continuous score, offering a more robust assessment than single indices. From the available data, two metrics were computed: Diptera richness and Pielou's equitability (J). These were normalized and averaged to produce a provisional MMI score for each station: SW3 scored highest (MMI = 1.00), followed by SWCont2 (0.70) and SW1 (0.66), suggesting relatively better ecological conditions while SW2 (0.40) and SWCont1 (0.50) scored lowest, indicating moderate to heavy impact, likely from nutrient enrichment and sedimentation. However, SW3's high score must be interpreted cautiously because its total abundance was very low (N = 3), and its assemblage was dominated by tolerant taxa. These findings align with regional studies in Nigerian streams, where sensitive taxa such as Ephemeroptera decline under organic loading, while tolerant groups like Chironomidae and oligochaetes proliferate. The multimetric approach recommended by Edegbene et al. emphasizes continuous scoring and local calibration, ensuring that ecological classifications reflect bioregional realities. For full compliance with this framework, future monitoring should incorporate additional metrics such as percentage Hemiptera and percentage of large-bodied individuals (>40 mm), which were not available in the current dataset.

**Regional Context**

These patterns mirror findings from Northern Nigerian aquatic ecosystems. Research in Wushishi Dam and Shiroro Lake demonstrated that oligochaetes and chironomids proliferate under deteriorating water quality, while ephemeropterans decline with increasing organic load (Mohammed *et al*., 2016; Mohammed *et al*., 2024). Similar observations in Lake Tiga, Thomas Dam, and Makera Drain confirm that macrofauna composition responds strongly to sedimentation, nutrient enrichment, and hydrological alteration (Nafi'u & Ibrahim, 2017; Tanimu *et al*., 2022). Studies in the Middle Niger–Sokoto Basin and River Benue further emphasize the role of sensitive taxa (Ephemeroptera, Odonata) as indicators of high-quality habitats, contrasting with tolerant oligochaetes and chironomids in impacted zones (Jeje & Fernando, 1992; Agouru & Audu, 2012).

**Table 3.18: Diversity Indices of Macroinvertebrates per Station**

| Station | Total Abundance | No. of Species | Margalef Index | Shannon H′ | Simpson (1–D) | Evenness (J) |
|---|---|---|---|---|---|---|
| SW1 | 8 | 6 | 2.4 | 0.75 | 0.78 | 0.97 |
| SW2 | 7 | 5 | 2.06 | 0.67 | 0.74 | 0.96 |
| SW3 | 3 | 3 | 1.82 | 0.48 | 0.66 | 1.00 |
| SWCont1 | 4 | 2 | 0.72 | 0.24 | 0.5 | 0.81 |
| SWCont2 | 8 | 7 | 2.89 | 0.83 | 0.8 | 0.98 |



*Chironomus* sp



*Bulinus* sp.



*Melanoides* sp



*Canthyporus* sp.



*Zyxomma* sp



*Nais* sp

| | | |
|---|---|---|
|  |  |  |
| *Stenelmis* sp | *Pseudagrion* sp | *Elassoneuria candida* |

**Plate 3.21. Image Of Some Macroinvertebrates Recovered In The Sampling Stations**

### 3.3.6 Fisheries Study of The Area

The Zamfara headwaters form part of the Sokoto–Rima/Niger system, where seasonal floodplain connectivity drives fish recruitment, diversity, and artisanal catches (FAO, 2020; Oladipo *et al*., 2023). Classic FAO basin accounts for the Niger/Sokoto system describe extensive floodplains, flood ponds, and pools that concentrate fish during drawdown—supporting daily catches that rise markedly in peak seasons (FAO, 2020). Recent hydrological modeling for the Zamfara watershed shows high evapotranspiration, modest runoff, and notable surface–groundwater exchange, all which shape access to nursery floodplains and the timing of fish movements (Shuaibu & Murana, 2024; Shuaibu & Murana, 2023).

**Fishing Practices**

Hand nets and traps dominate in headwater areas. Fishing intensity increases during the wet season (June–September). Fish are often sold fresh or smoked in local markets and Fishing coexists with other activities like sand mining and vegetable farming, which can degrade aquatic habitats.

**Species Composition and Diversity**

A rapid fish survey across five sampling stations in the Zamfara River headwaters revealed a multi-species assemblage typical of Sahelian inland waters. Several juveniles were observed at all stations, confirming the ecological importance of these headwaters as breeding and nursery grounds. Generally, artisanal catches and literature indicate a multi-species fishery dominated by Tilapia (*Oreochromis* spp.) and African catfish (*Clarias gariepinus*), alongside characids (*Alestes*, *Brycinus*), *Synodontis* spp., and floodplain taxa such as *Heterotis niloticus* (FAO, 2020; Jeje & Fernando, 1992). In Northern Nigeria, *Synodontis eupterus* is well documented in River Rima for its commercial importance and reproductive traits, while characids show broad omnivory/planktivory and seasonal diet flexibility (Shinkafi & Daneji, 2011; Saliu, 2002; Echi & Ezenwaji, 2016). Diversity peaks during wet season when lateral connectivity expands habitat niches; diversity contracts in dry months as fish retreat to pools/refugia (FAO, 2020; Oladipo *et al*., 2023).

**Table 3.19: Fish Species Occurrence and Habitat Associations**

| Station | Species Recorded | Juveniles Observed | Dominant Habitat Features |
|---|---|---|---|
| SW 1 | *Oreochromis* spp. (Tilapia), *Clarias gariepinus* (African catfish), *Alestes* spp. | Yes | Shallow margins, moderate flow, sandy substrate |
| SW2 | *Oreochromis* spp., *Clarias gariepinus*, *Synodontis* spp. | Yes | Marginal vegetation, submerged plants |
| SW3 | *Oreochromis* spp., *Clarias gariepinus*, *Synodontis* spp., *Brycinus* spp. | Yes | Slower flow, floodplain pools, fine sediments |
| Control 1 | *Oreochromis* spp., *Synodontis* spp., *Alestes/Brycinus* spp. | Yes | Intact riparian zone, vegetated margins |
| Control 2 | *Oreochromis* spp., *Clarias gariepinus*, *Synodontis* spp., *Heterotis niloticus* | Yes | Floodplain connectivity, oxbow pools, dense cover |

*Upper and Middle stations*: dominated by shallow, flowing habitats with marginal vegetation, suitable for Tilapia and juvenile catfish. *Lower station*: slower flow and floodplain pools favour *Synodontis* and *Brycinus* species while *Control sites*: intact riparian buffers and oxbow pools provide refuge for juveniles and support species like *Heterotis niloticus*, indicating high ecological integrity.

**Key Observations**

Tilapia and juvenile catfish were present at all stations, confirming widespread breeding activity. *Synodontis* spp. occurred in middle, lower, and control stations, associated with benthic habitats. Characids (*Alestes*/*Brycinus*) were recorded in flowing sections and control sites. *Heterotis niloticus* was observed only at Control 2, highlighting the conservation value of floodplain connectivity. Juveniles of multiple species were abundant, reinforcing the role of these headwaters as critical nursery habitats.

**Breeding Habits and Spawning Areas**

Floodplain wetlands, backwaters, and vegetated margins serve as primary spawning and nursery grounds. Tilapia and *Clarias* use nest/substrate sites in sheltered margins, while characids and Synodontis spawn on rising water, with multiple spawning recorded for *Synodontis eupterus* (peak July–September) in River Rima (Shinkafi & Daneji, 2011; Shinkafi & Hassan, 2011). Heterotis niloticus shows wet-season fecundity peaks and planktophagy; maintaining floodplain access is crucial for its recruitment (Odo et al., 2010; Fubara & Vincent-Akpu, 2025).

Spawning hot-spots (ESMP targets): shallow vegetated floodplains, backwaters adjacent to agricultural fields (risk of runoff), and oxbow lakes—priority areas for closed-season enforcement and sand mining controls.

**Food and Feeding Habits**

Tilapia: omnivorous—algae, detritus, and small invertebrates; efficient use of floodplain margins (FAO, 2020). Clarias gariepinus: carnivorous/opportunistic—benthos, small fish, detritus; reproduction and culture performance vary by strain and environment (Uruku & Maryam, 2025; Ayandiran *et al*., 2024) while Characids (*Brycinus*, *Alestes*): euryphagous/planktivorous; Nigerian studies report diverse plant/animal diets with condition factors linked to habitat quality (Saliu,

2002; Echi & Ezenwaji, 2016). Synodontis spp.: detritivores/insectivores; bottom feeding confirmed in River Rima (Shinkafi *et al*., 2010) while Heterotis: planktophagous/omnivorous; strong aquaculture potential and conservation interest (Odo *et al*., 2010; Ogunji *et al*., 2025).

**Migration Patterns and Distribution**

Fish undertake lateral migrations into floodplains during rising water (spawning/feeding) and return migrations to channels/pools during drawdown; some taxa (characids) also exhibit longitudinal migrations (Jeje & Fernando, 1992). Sahelian flood-pulse literature highlights that hydro-climatic variability and dam-related flow changes can reduce floodplain inundation, affecting fisheries resilience and catch (Baker *et al*., 2024; WorldFish, 2011).

**Catch Assessment Survey (CAS) and Fishery Activities**

Artisanal fishers report peak catches July–September dominated by tilapia and catfish, with average daily catch per fisher ranging from ~5–15 kg in peak season and 1–3 kg in dry months; fish are sold fresh or smoked (FAO, 2020). CAS/Frame surveys in comparable Northern systems show gear dominance by gillnets, need for mesh-size regulations, and the value of co-management; these templates are directly transferable to Zamfara headwaters (Abubakar *et al.*, 2025; Umar *et al*., 2025).

**Fish Stock Assessment (Indicators)**

Observed stocks appear moderate, but declining catches where spawning areas overlap sand mining/unregulated wet-season fishing suggest pressure (FAO, 2020; Oladipo *et al*., 2023). CPUE trends**,** length–frequency and condition factors (e.g., for *Synodontis* in River Rima) should be tracked across seasons; wet-season condition improvements reflect recruitment pulses (Shinkafi & Hassan, 2011; Gusau *et al*., 2018).

**Protected/Vulnerable Species and Biosecurity**

While critically endangered fishes are not reported here, ***Heterotis niloticus*** shows declines in some Nigerian reservoirs, warranting conservation attention; floodplain connectivity and exploitation controls are recommended (Mustapha, 2010; Oladimeji *et al*., 2022). Metal bioaccumulation studies in Rima (e.g., *Bagrus bayad*) underline the need for water-quality monitoring in ESMP (Rabi'u *et al*., 2025).

# CHAPTER FOUR: SOCIOECONOMIC CHARACTERISTICS AND CONSULTATION WITH STAKEHOLDERS

## 4.1 Introduction

The Socioeconomics and Health Impact Assessment (SEHIA) for the Bulka Stormwater and Erosion Management Subproject has been undertaken to establish a detailed baseline understanding of the human environment that may be affected by the proposed Bulka Stormwater/Erosion intervention project. Bulka community, located within Gusau Local Government Area (LGA) of Zamfara State, experiences recurrent flood events, drainage blockage, and progressive gully formation, which have resulted in displacement, loss of farmland, destruction of household assets, and heightened environmental and health risks. This assessment provides key information required for the identification of potential project impacts, formulation of mitigation measures, and strategic planning for sustainable implementation in alignment with the World Bank Environmental and Social Framework (ESF), Federal Ministry of Environment (FMEnv) regulations, and ACReSAL project guidelines.

A combination of quantitative and qualitative methods was adopted to collect socioeconomics data. Quantitative data was obtained through household surveys, which provided demographic characteristics, livelihood patterns, education profiles, health status, and economic variables. Qualitative data was collected from extensive stakeholder consultations including Focus Group Discussions (FGDs), Key Informant Interviews (KIIs), participatory community meetings, and direct field observations. These consultations enhanced understanding of the community's perceptions, social dynamics, vulnerabilities, coping mechanisms, and expectations of the ACReSAL intervention. The assessment covered the following key thematic areas:

- Demographic profile
- Land use and settlement characteristics
- Livelihood systems and income patterns
- Education and literacy levels
- Health infrastructure and common diseases
- Water and sanitation practices
- Social and cultural structures
- Stakeholder concerns and community expectations
- Gender considerations and vulnerable groups

### 4.1.1 Socioeconomic Study

The results of the socioeconomic study form an important component of the environmental and social baseline data and will be used to assess project-specific risks and socio-health implications on the affected communities.

### 4.1.2 Methodology for the Socioeconomic Study

This study employed a cross-sectional survey design, which enables the collection of data at a single point in time from respondents across the Bulka community in Gusau LGA, Zamfara State. The use of a cross-sectional design is justified for several reasons. The study adopted both descriptive and explanatory approaches, which are appropriate for systematically capturing and presenting the views, attitudes, and lived experiences of respondents. By integrating quantitative and qualitative data, the research design ensures both breadth and depth of analysis, thereby providing a robust basis for evidence-informed environmental and social baseline data that will be used to assess project-specific risks and impacts on the affected communities. However, the sample size for the survey was 355. This survey utilized a stratified sampling technique alongside purposive sampling to address the absence of a reliable sampling frame and the prevailing security complexities in Zamfara State, to ensure inclusion of households along the erosion corridor, those living within the likely impact zone, and households vulnerable to flooding and a total of 328 responses were recorded during the data collection exercise.

**(a) Quantitative Data Collection**

A structured questionnaire was developed and administered to households within the immediate project area and the wider Bulka settlement. The questionnaire captured:

- Household composition and demographic characteristics
- Educational attainment
- Occupations and income distribution
- Access to health services
- Land ownership, asset inventory, and land use
- Water, sanitation, and waste disposal systems
- Perceived impacts of erosion and storm water flooding
- Household health conditions and disease prevalence

**(b) Qualitative Data Collection**

In-depth qualitative tools included:

1. **Focus Group Discussions (FGDs)** with:
    - Men
    - Women
    - Youth
    - Elderly and vulnerable groups
2. **Key Informant Interviews (KIIs)** with:
    - District Head of the area
    - Leaders of women associations
    - Market leaders
    - Local ACReSAL SPMU representatives

### 4.1.3 Public/Stakeholder Consultation:

The activity was conducted as part of a participatory approach designed to obtain an in-depth understanding of the social issues and risks associated with the subprojects, as perceived by the affected communities. Public meetings were held at designated community facilities within the immediate impact areas of the subprojects to ensure inclusive engagement and locally grounded inputs. **Table 4.1** presents a matrix of meetings held with the Bulka community**,** including the venues where community engagements and socioeconomic/census documentation exercises were conducted within the subproject area. The table highlights the range of stakeholder consultations, focus group discussions, and data collection activities undertaken to ensure inclusive participation and comprehensive coverage of the affected communities. The minutes of meetings and attendance records for these engagements are provided in Annexures of this report serving as supporting documentation for the consultation process and demonstrating compliance with stakeholder engagement and disclosure requirements.

**Table 4.1: Schedule of Community/stakeholder Meetings and Socioeconomic Documentation**

| District/ Community | Type of Meeting | Location | Date(s) Held | Number of Attendees |
|---|---|---|---|---|
| Bulka Community | District Head and Community Leaders Consultation (KII) | Community Square | December 3, 2025 | 25 |
| | Focus Group Discussions (with Men, Women and Youth) | Community Square | December 3, 2025 | 99 |
| | Socioeconomic Survey and Census Documentation | Community Square | December 3- 6, 2025 | 355(Men and Women) |
| | Gender Assessment and interviews | Community Square | December 3&4, 2025 | 107 |

### 4.1.4 Use of Maps and Geospatial Tools

High-resolution satellite imagery and local boundary maps were used to:

- Identify settlement clusters
- Map structures and farmlands within the erosion corridor
- Assess vegetation cover and land use
- Understand topographical features influencing stormwater flow

This supported identification of households or assets potentially at risk.

## 4.2 Description of Population, Demographic Characteristics and Cultural Environment

### 4.2.1 Population Estimates

Based on the 2006 National Population Census and the NPC annual growth rate of 3.2%, the projected population of Gusau LGA for 2024 is estimated to be 620,000. Bulka community represents a peri-urban settlement within this LGA, with a relatively dense population due to its proximity to Gusau metropolis. Based on the 2006 census figures, the population of Zamfara state comprise of 50.07% male and 49.93% female. The age distribution showed that 47.97% are between 0 -14 years while 49.19% are between 15-64 years with only 2.84% 65 years and above. This population dynamics provide a good advantage to Zamfara state with huge youthful population and less than 3% elderly showing dependency ratio of about 1 and hence a lower social support system. The distribution between male and female also calls for an increased role for the women folks.

### 4.2.2 Ethnic Groups

The people of Bulka community is ethnically diverse but dominated by Hausa ethnic group**,** with a significant presence of Fulani and a few other minority groups including Dakarkari, Yoruba, Igbo, and Gwari settlers engaged in commerce and artisan work. These ethnic groups possess shared as well as distinct cultural values, social structures, and traditional practices that shape everyday life in the community. The social and cultural fabric of Bulka community is closely linked to ethnic identity, with customs, norms, and belief systems influencing patterns of interaction, leadership, and communal relations. Kinship networks play major roles in:

- Conflict resolution
- Land allocation
- Traditional governance
- Social cohesion

Cultural practices in Bulka community are strongly rooted in kinship ties, extended family systems, and clan affiliations**,** which serve as the foundation for social organization. Social cohesion is reinforced through religious and cultural activities, particularly Islamic festivals, naming ceremonies, marriages, and communal gatherings. These events provide opportunities for strengthening inter-ethnic relations and reinforcing shared values, especially between the Hausa and Fulani populations who have long coexisted in the area. Bulka community is essentially a semi-urban to rural settlement, with residents largely engaged in trading, farming, and livestock rearing. Agricultural activities form the backbone of the local economy, with common crops including millet, sorghum, maize, cowpea, and groundnut. Livestock such as cattle, goats, and sheep are also reared, particularly among Fulani households, contributing significantly to household income and food security. These economic activities are closely tied to traditional knowledge systems passed down through generations.

Historically, families and clans in Bulka community trace their origins through genealogical lineages**,** which continue to influence social status, leadership, and political organization.

Traditional leadership and local politics are largely structured around clan and family affiliations, with elders playing key roles in decision-making and conflict resolution. Clanism and kinship therefore remain central to the operation of cultural, political, and informal service institutions within the community. Overall, Bulka community retains strong rural characteristics, with socio-cultural traditions and communal solidarity playing a vital role in shaping development processes and social life.

### 4.2.3 Religion

The residents of Bulka community in Gusau Local Government Area of Zamfara State are predominantly Muslims, reflecting the religious profile of the wider Gusau area and Zamfara State. Islam plays a central role in shaping the social, cultural, and moral life of the community, influencing daily activities, social relations, and communal norms. Although Islam is the dominant religion, a small proportion of the population practices Christianity or other belief systems. These religious groups coexist peacefully within the community, with mutual respect and tolerance guiding interfaith interactions. Religious practices and institutions, particularly mosques and churches, serve not only as places of worship but also as important centers for social interaction, moral instruction, and community mobilization. Overall, the religious composition of Bulka community contributes to social cohesion and collective identity, while also allowing for diversity in belief and practice within a generally harmonious social environment.

**Table 4.2: Religious Distribution within study area**

| Religious Distribution | No. | % |
|---|---|---|
| Muslim/Islam | 323 | 98% |
| Christian | 5 | 2% |

*Source: Hardan Consulting Survey, 2025*

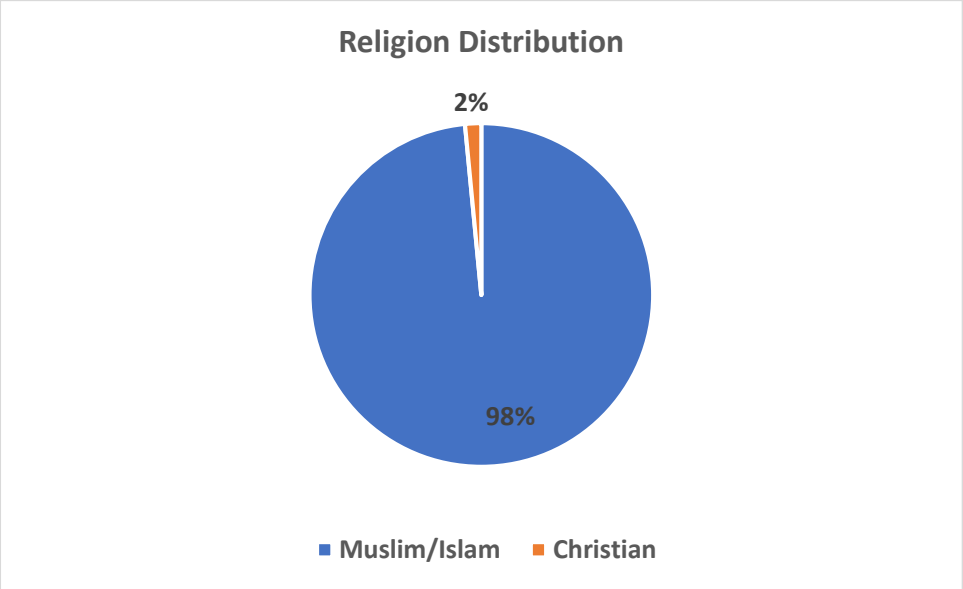



**Figure 4.1: Religious Distribution within study area**

### 4.2.4 Cultural Resources

No major archaeological or historical relics were identified in the immediate impact zone. Also, no sacred trees, cultural event grounds, and informal shrines exist.

## 4.3 Land Tenure and Settlement Pattern

### 4.3.1 Land Use and Land Ownership in Bulka Community

Land use in Bulka community is diverse and multifunctional, combining residential housing, agriculture, grazing, small-scale commerce, and community facilities such as schools and mosques. This mixed land-use pattern reflects the community's peri-urban character and increases competition for land, particularly in low-lying areas. The erosion corridor cuts across farmlands, roadside settlements, and residential clusters, exposing both livelihood assets and housing to erosion and flooding risks.

### 4.3.2 Customary Land Tenure System

In Bulka community, land ownership and control are largely governed by customary land tenure practices that have evolved over time and are deeply rooted in tradition and social organization. Three major forms of customary land tenure are commonly recognized in the community: (i) individual land ownership, (ii) family land ownership, and (iii) communal land ownership. Individual land ownership exists for both indigenes and long-term residents of Bulka community. Such lands may be acquired through inheritance, allocation by traditional authorities, or, in some cases, through informal agreements recognized by community leaders. Although individuals exercise control over these lands, ownership rights are still influenced by customary norms and the authority of traditional institutions. Family land ownership is one of the most prevalent forms of tenure in the community. Family lands are typically inherited through generational lineage and are held in trust for present and future members of the family. These lands are generally not sold, as they are considered ancestral property. Family heads, in consultation with elders, oversee the allocation and use of such lands among family members, particularly for residential and agricultural purposes. Communal land ownership refers to lands collectively held by the community as a whole. These lands are reserved for common use, community development projects, grazing, or rotational agricultural activities among community members. Communal lands are managed by traditional authorities and community leaders and are not subject to sale. This form of land tenure reinforces social cohesion and ensures equitable access to land resources within Bulka community.

Landownership data indicate that most households claim ownership, with 75% holding formal titles. However, a notable proportion of landholders lack secure tenure, as 14% own land without formal documentation, while 10% are renters and 1% rely on customary or free access. These groups are more vulnerable to land loss and displacement, especially within the erosion corridor, due to limited tenure security. The coexistence of mixed land uses and varying levels of tenure security heightens vulnerability to erosion impacts in Bulka community and underscores the need

for careful land management, inclusive consultations, and equitable mitigation measures during project implementation.

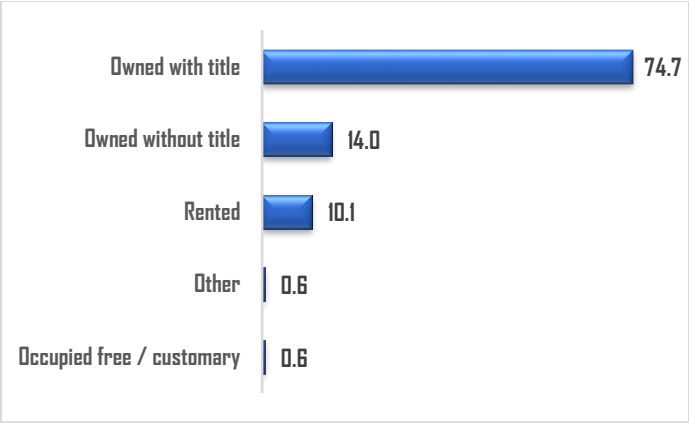



**Figure 4.2: Land Ownership in Bulka Community**

### 4.3.3 Climate Change Effects

Climate change is expected to have significant impacts on roads and highways, particularly in vulnerable communities such as Bulka community. Changes in climatic conditions are increasingly influencing the performance, durability, and safety of road infrastructure. Rising temperatures can lead to the softening and deformation of road surfaces, especially asphalt pavements, resulting in rutting, cracking, and reduced lifespan of roads. In addition, prolonged heat can weaken construction materials and increase maintenance demands. These effects are more pronounced in areas where roads are already under stress from heavy use or poor construction standards. Increased rainfall, more intense storms, and greater storm frequency are among the most critical climate-related threats to road infrastructure. These conditions result in higher volumes of surface runoff, leading to frequent flooding, erosion of road embankments, and damage to drainage systems. Fast-flowing and destructive water velocities can wash away road bases, culverts, and shoulders, making roads unsafe or impassable.

Overall, the combined effects of climate change higher temperatures, heavier rainfall, and more frequent extreme weather events are likely to increase flood risks, accelerate road deterioration, and raise maintenance costs. Without climate-resilient design and effective drainage systems, roads and highways in the area may continue to experience repeated damage, disrupting transportation, economic activities, and access to essential services.

## 4.4 Analysis of Bulka Socioeconomic Survey

Accurate assessment of the potential impacts of the subproject on individuals living or earning their livelihoods within Bulka community, requires the availability of reliable social and economic baseline data. Without such data, it would be difficult to objectively determine the extent to which the subproject may influence the wellbeing, livelihoods, and living conditions of the affected population. The socioeconomic study was therefore undertaken to evaluate existing social and economic conditions in the subproject area and to anticipate the likely changes that may arise as a

result of subproject implementation. The study provides a baseline against which future impacts, mitigation measures, and support interventions can be measured and monitored over time. The socioeconomic survey was conducted alongside a census of subproject-affected persons (SAPs) to comprehensively profile households and individuals within the impacted areas of Bulka community. Data were collected through mixed method (quantitative and qualitative). Structured questionnaires administered to residents who are most likely to be directly or indirectly affected by the subproject activities. The analysis presented is based on the responses obtained from these questionnaires. The findings form the basis for identifying key socioeconomic characteristics, vulnerabilities, and potential impact pathways. On the strength of the responses gathered during the survey exercise, the following determinations and interpretations are made regarding the socioeconomic conditions of the Bulka community and the anticipated effects of the subproject.

### 4.4.1 Objectives of the Socioeconomic Survey

The main objectives of the socioeconomic survey conducted in Bulka are as follows:

1. To collect comprehensive information on the existing socioeconomic conditions of the population within the Bulka project area;
2. To utilize the collected socioeconomic data in establishing a baseline for assessing the social and economic impacts of the proposed project;
3. To analyze the relationships and interactions among key socioeconomic and demographic variables within the project area;
4. To elicit and document the perceptions of respondents regarding the environmental effects of the project and their vulnerability to potential socioeconomic changes arising from project implementation; and
5. To provide a benchmark dataset for future monitoring and evaluation of socioeconomic changes and improvements resulting from the project.

The respondents included in the socioeconomic survey comprised the following categories of affected persons within Bulka community:

1. Owners of buildings or structures located within twenty (20) metres on either side of the edges of the Bulka gully or erosion channel;
2. Owners of buildings or structures situated in areas that may be used as construction staging or temporary work areas during the project implementation phase;
3. Residents or tenants occupying the buildings or structures identified in items (1) and (2), whether permanent or temporary, and whether used for residential or commercial purposes;
4. Landowners along the proposed gully or flood rehabilitation corridor whose lands may be required for the execution of the project; and
5. Owners of economic trees and crops located within the project setback areas whose lands may be affected during stabilization and rehabilitation of the gully edges.

The socioeconomic survey was carried out in conjunction with a census of project-affected persons (PAPs) to adequately profile the impacted areas of Bulka community and to generate reliable

baseline data. These data serve as reference points against which mitigation measures, compensation, and support mechanisms will be assessed. The analysis presented is based on responses obtained from structured questionnaires administered to residents most likely to be affected by the project. Based on the findings of the survey exercise, the following determinations were made.

### 4.4.2 Respondents and Household Distribution in the Project Area

This section presents the response pattern of residents within the project area to the socioeconomic survey administered during the field study. In total, 355 questionnaires were administered in Bulka community, but only 328 were successfully retrieved and valid for analysis, representing a 93.7 % response rate. The 328 respondents surveyed collectively account for a total of 1,485 household members within Bulka community. This indicates relatively large household sizes, which is characteristic of many communities in Zamfara State and reflects extended family living arrangements and strong kinship ties. The household data provide a critical basis for understanding population structure, dependency levels, and potential vulnerability to project impacts. Documenting household size and composition is essential for accurately assessing the scale of socioeconomic effects and for designing appropriate mitigation, compensation, and support measures for households affected by the project.

### 4.4.3 Gender, Age and Household Size Distribution

The age distribution of household members in Bulka community, Gusau Local Government Area, Zamfara State, indicates a population that is largely within the economically active and productive age groups. The survey results show that 15 percent of household members are 25 years and below, while 19 percent fall within the 26–36 years' age bracket. A significant proportion of the population, 53 percent, is within the 37–47 years' age group, indicating a strong concentration of adults in their prime working and income-generating years. In contrast, 13 percent of household members are 48 years and above, representing the older segment of the community. Overall, the age distribution suggests that Bulka community has a predominantly youthful and economically active population, which has important implications for livelihood patterns, labor availability, and vulnerability to project impacts. The dominance of working-age adults also implies a high potential for participation in project-related activities, while the presence of younger and older dependents highlights the need for mitigation measures that consider household welfare and social protection.

***Gender Composition***

The survey data indicate a male–female distribution of 55.2 % male and 44.8 % female among households in Bulka community. This household gender composition is illustrated in Figure 3.13 and reflects a higher representation of male respondents within the project area. Women in the project area are primarily engaged in petty trading, small-scale economic activities, and home-keeping, which contribute to household welfare and income. Men, on the other hand, are more involved in activities such as farming, trading, and other income-generating occupations. Despite the difference in numerical representation, both men and women play important and

complementary roles in sustaining family livelihoods. Their shared responsibility in meeting household needs underscores the importance of incorporating a gender-sensitive approach in project planning and implementation, ensuring that the impacts, benefits, and mitigation measures adequately address the needs and contributions of all household members.

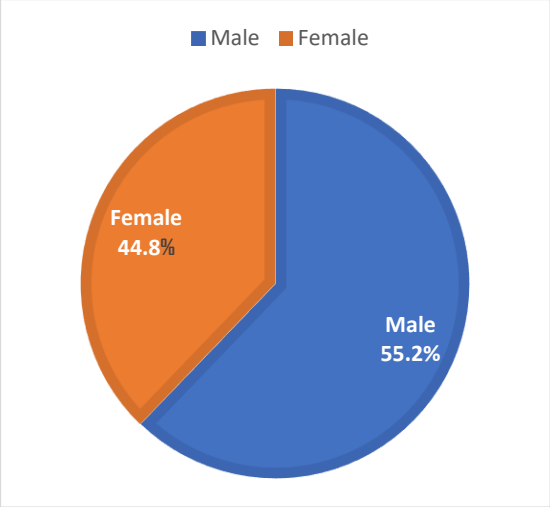



**Figure 4.3: Gender Distribution from Respondents**

***Household Size and Composition***

**Figure 3.14** illustrates the household size distribution within the project area. The data show that small households constitute the majority, with 197 households (60.06%), indicating that most families have relatively few members. This may reflect a growing trend toward nuclear family structures or household segmentation within the community. Medium-sized households account for 109 households (33.23%), representing a substantial proportion of the population and suggesting the continued presence of extended family arrangements. In contrast, large households are relatively few, with 18 households (5.49%), while very large households are minimal, numbering only 4 households (1.22%). Overall, the distribution suggests that although extended family systems still exist, smaller household units dominate the project area. This pattern has important implications for socioeconomic planning, vulnerability assessment, and mitigation measures, as household size influences dependency ratios, income distribution, and the scale of potential project impacts on families. Household sizes range between 4 and 12 persons, with an average of 6–7 persons per household. Extended family settings are common, and compound living arrangements allow families to share resources and social responsibilities.

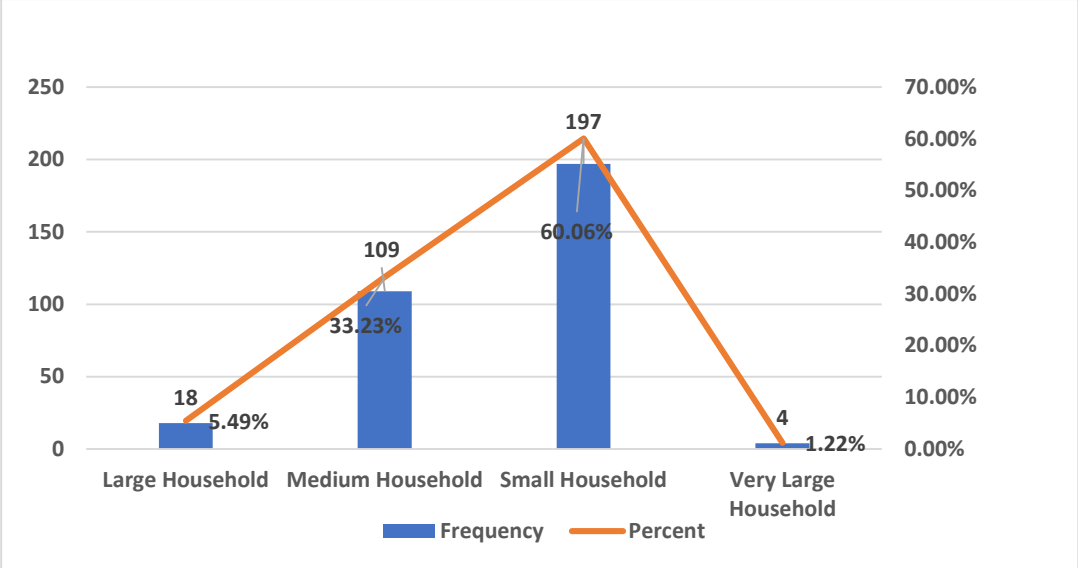



**Figure 4.4: Bulka Household Size Distribution**

***Distribution of Household Head by Sex***

**Figure 3.15** presents the distribution of household headship by gender in Bulka community. The data show that 81 percent of households are male-headed, while 19 percent are female-headed. This pattern reflects prevailing socio-cultural norms in the area, where men are traditionally recognized as household heads and primary decision-makers. The relatively smaller proportion of female-headed households may be associated with factors such as widowhood, divorce, male migration, or economic independence of women. The high prevalence of male-headed households suggests that men are more likely to control household resources, land, and key decisions related to livelihoods and property. However, the presence of female-headed households, (though fewer) highlights a potentially vulnerable group that may face greater socioeconomic challenges, including limited access to land, income opportunities, and social support. Therefore, the distribution underscores the importance of inclusive and gender-sensitive project interventions, ensuring that female-headed households are adequately identified, consulted, and supported, particularly in mitigation, compensation, and livelihood restoration measures.

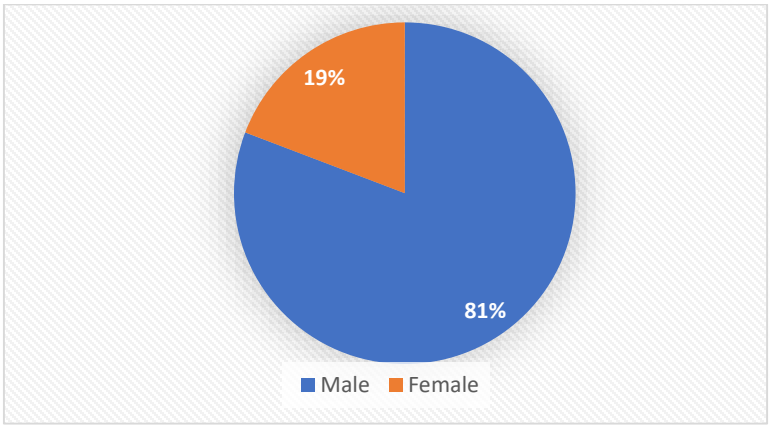



**Figure 4.5: Distribution of Household Head by Gender**

### 4.4.4 Marital Status of Respondents

The marital status distribution of respondents reflects typical demographic patterns observed in northern Nigerian communities. The majority of respondents (60%) are married, indicating a strong prevalence of family-based household structures. This is followed by 25% single respondents, largely comprising youths and unmarried adults. Widowed individuals account for 8%, reflecting marital transitions often associated with age and health-related factors, while 7% are divorced or separated, highlighting the presence of marital dissolution within the community. Overall, the pattern underscores the dominance of marriage as a social institution, with implications for household size, dependency ratios, and social support systems within the community.

### 4.4.5 Occupation and Income Distribution of Households

The occupational distribution data show that trading and retail activities constitute the largest source of household income, accounting for 33.8%. This underscores the importance of small-scale commerce and market-related activities in sustaining household livelihoods, consistent with the community's peri-urban character**.** Casual labour and daily wage activities represent the second most significant income source at 23.2%, indicating a substantial reliance on informal and often unstable employment. Farming and agriculture contribute 18.6% to household income, reaffirming the continued relevance of agricultural activities despite increasing urban influence. Formal employment accounts for 11.3%, reflecting limited access to stable salaried jobs within the community. Income from petty services stands at 8.5%, while small-scale businesses contribute 2.75**.** Minor income sources include other activities (1.5%) and remittances (0.3%)**,** suggesting that external financial support plays a very limited role in household livelihoods. Overall, the income profile indicates that households in Bulka community are predominantly dependent on informal and semi-formal economic activities, which are often sensitive to environmental shocks and project-related disruptions. This highlights the importance of incorporating livelihood protection and enhancement measures in project planning and implementation.

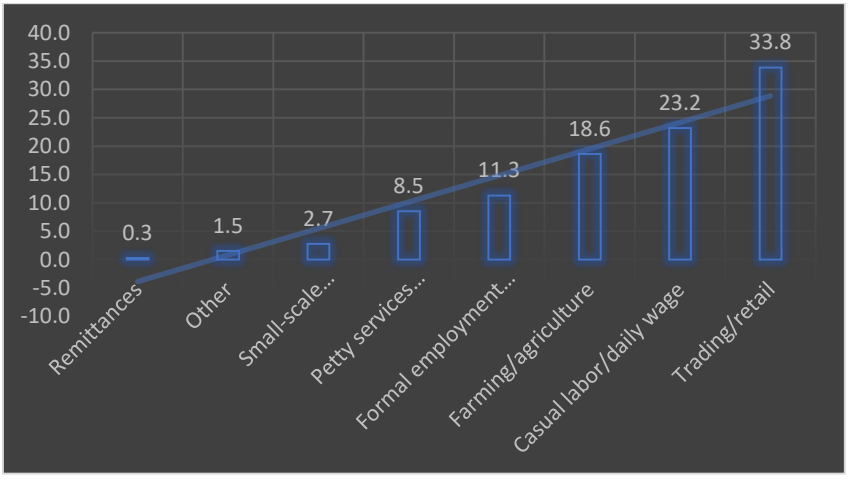



**Figure 4.6: Distribution of Source of Household Income**

**Figure 3.17** below shows the approximate monthly income distribution of households in Bulka community, Gusau Local Government Area, Zamfara State, revealing generally low-income levels among respondents. A large proportion of respondents (38.1%) preferred not to disclose their monthly income, which may reflect concerns about privacy, taxation, or social sensitivity around income reporting. Among those who disclosed their earnings, 22% reported a monthly income of ₦30,000–₦49,999**,** making this the most common declared income bracket. This suggests that a significant share of households survive on relatively modest earnings. Further analysis shows that 13.1 percent of households earn between ₦50,000–₦89,999**,** while 10.4 percent fall within the ₦10,000–₦29,999 range, indicating the presence of low-income and economically vulnerable households. Higher income brackets are less common: 7.9% earn around ₦100,000**,** 7.0% earn between ₦100,000–₦199,999, and only 1.5 percent report incomes of ₦200,000 and above. Overall, the income distribution highlights a community that is largely low-income**,** with heavy dependence on informal and unstable livelihood sources. This income profile suggests a high level of economic vulnerability, underscoring the importance of project interventions that minimize livelihood disruption and, where possible, create employment and income-enhancing opportunities for affected households.

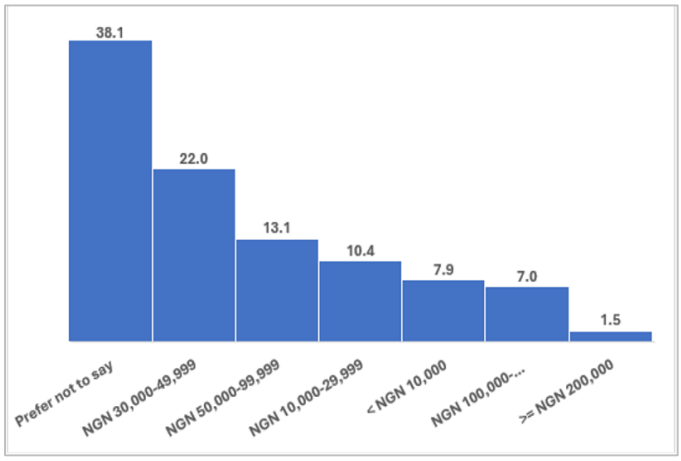



**Figure 4.7: Approximate Monthly Income Distribution in Bulka**

Findings from the Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) conducted with community leaders, traders, farmers, artisans, women, and youth groups in Bulka communities strongly corroborate the quantitative results on occupational and income distribution.

*Participants consistently emphasized that trading and small-scale retail activities constitute the primary means of livelihood for most households. Market women, shop owners, and petty traders noted that daily sales from food items, household goods, and farm produce are critical for meeting basic household needs. However, they also stressed that these activities are highly vulnerable to flooding, which often restricts access to markets, damages goods, and reduces customer flow during the rainy season.* (FGD: female participant)

*Discussions with youths and male focus groups revealed a heavy dependence on casual labor and daily wage employment, particularly in construction, transportation, loading/offloading, and other informal services. Participants highlighted the instability and unpredictability of such income sources, noting that flooding, erosion, and poor road conditions frequently disrupt daily work opportunities and earnings*. (FGD: Male participant)

*Community leader acknowledged that agriculture remains an important livelihood activity, especially crop farming and small-scale livestock rearing. However, he noted a gradual decline in agricultural productivity due to loss of farmlands, soil erosion, and flood damage, which has forced many households to diversify into trading or casual labor.* (KII: community leader)

*Key informants further revealed that formal salaried employment opportunities are limited within Bulka communities, with only a small proportion of residents employed as civil servants or in private sector jobs. He highlighted members' engagement in petty services and home-based economic activities, which provide supplementary income but are often low-yielding and insecure.* (KII: community leader)

Overall, KII and FGD findings underscore the need for livelihood protection, temporary income support, and local employment opportunities during project implementation to safeguard vulnerable households and maximize the long-term socioeconomic benefits of the subproject.

### 4.4.6 Access to health infrastructure

***Health Status and Access to Healthcare Services in Bulka***

The Bulka project area exhibits health characteristics typical of a peri-urban settlement, where rapid population growth and limited infrastructure place pressure on existing health services. The health status of residents is influenced by environmental conditions, access to healthcare, and socioeconomic factors. The health profile of Bulka community is strongly influenced by environmental conditions, access to healthcare services, and socioeconomic constraints. Survey findings show that malaria and fever (52.1%) are the most prevalent illnesses, largely attributable to poor drainage, stagnant water, and increased mosquito breeding associated with flooding. Diarrhoeal diseases (21.7%) and waterborne diseases such as cholera and typhoid (17.3%) further reflect inadequate access to safe drinking water, poor sanitation, and hygiene practices. Although respiratory infections (5.7%) and flood-related injuries (3.2%) are less common, they become more pronounced during the rainy season and periods of severe flooding.

***Maternal and Child Health***

Maternal and child health outcomes remain a concern. There is a high reliance on Traditional Birth Attendants (TBAs), especially for home deliveries, while utilization of Primary Health Centres (PHCs) and private clinics is moderate. Access to skilled birth attendants is limited due to high cost of healthcare services, long distances to health facilities, and shortages of trained health personnel, as highlighted in **Figure 3.18**. Inconsistent immunization coverage further increases the

risk of preventable childhood diseases. Health service utilization patterns show that the public clinic/health centre is the first point of care for most households (70.1%), indicating the central role of PHCs in community health delivery. However, 19.5% of respondents seek care from pharmacies or chemist shops, suggesting gaps in access, affordability, or perceived quality of formal healthcare services. A smaller proportion use private clinics (7.9%) or rely on home remedies (1.8%). (**Table 4.3**)

Despite their importance, existing health facilities face significant challenges, including shortages of qualified staff, limited diagnostic capacity, irregular drug supply, and weak emergency response systems. These limitations reduce the effectiveness of healthcare delivery and heighten community vulnerability, particularly during flooding events. Overall, the findings indicate that environmental degradation, flooding, and weak health infrastructure jointly undermine health outcomes in Bulka community. The proposed ACReSAL intervention, by improving drainage and reducing flooding, is expected to deliver important public health benefits, including reduced disease burden, improved access to health facilities, and enhanced community resilience.

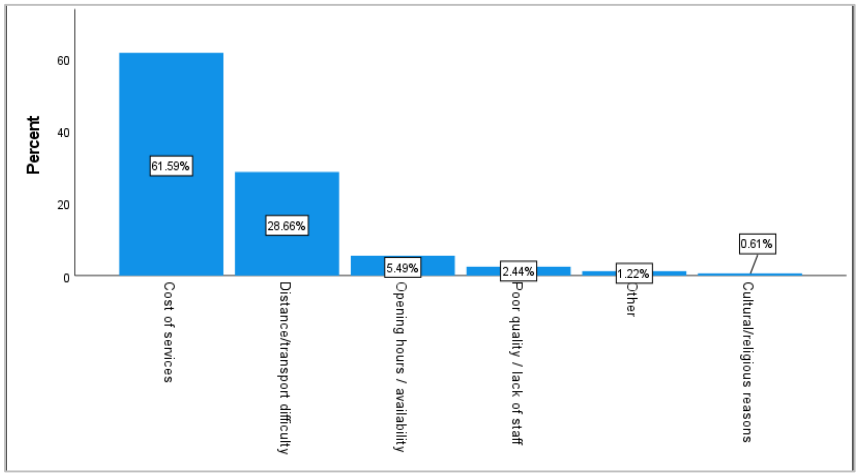



**Figure 4.8 Main Barriers to Utilization of Healthcare Services**

**Table 4.3: Responses of Household Members on First Point to Seek Medical Attention**

| Response | Frequency | Percentage |
|---|---|---|
| Home remedies/self-medication | 6 | 1.8% |
| Pharmacy/chemist shop | 64 | 19.5% |
| Private clinic/hospital | 26 | 7.9% |
| Public clinic/health center | 230 | 70.1% |
| Others | 2 | 0.6% |
| **Total** | **328** | **100%** |

Insights from the KIIs and FGDs in Bulka communities provide important qualitative context to the quantitative findings on health status and access to healthcare services. Thus the reveal the following.

*Participants reported that malaria and fever are the most common health problems, particularly during and immediately after the rainy season*. (KII: traditional leader)
*Community members linked the high incidence of malaria to stagnant water, blocked drainage channels, and frequent flooding, which create favorable breeding conditions for mosquitoes*. (FGD: men elders)

*Women's and youth FGDs also highlighted recurring cases of diarrhoea, typhoid, and cholera, especially among children, which were attributed to the use of unsafe water sources during floods*. (FGD: Youth)

*Discussions on maternal and child health revealed a strong reliance on Traditional Birth Attendants (TBAs) for home deliveries. Women explained that TBAs are preferred because they are closer, more affordable, and culturally familiar, compared to health facilities that are often far away and costly*. (FGD: Women)

*Key informants from the health sector acknowledged that while PHCs serve as the main source of healthcare, cost of healthcare services, shortages of skilled health personnel, limited drugs, and inadequate equipment constrain service delivery. These challenges discourage regular facility-based deliveries and contribute to inconsistent immunization coverage.* (KII: community leaders)

Participants further emphasized that cost of services, distance to health facilities, and poor road conditions during the rainy season significantly limit access to healthcare. Several respondents noted that flooding often makes roads impassable, delaying or preventing access to PHCs and forcing households to rely on pharmacies, chemist shops, or self-medication as first options for treatment. (FGD: community elders)

### 4.4.7 Access to Socioeconomic Infrastructure

Access to key socioeconomic infrastructure in Bulka community—particularly roads, electricity, transportation, and potable water—is generally poor and highly vulnerable to seasonal flooding. The condition of these infrastructures significantly affects mobility, public health, and livelihood activities, especially during the rainy season. Survey results indicate that road infrastructure is severely constrained, with 75.9% of respondents reporting that roads become frequently impassable during the rainy season (**Table 4.4**). This condition limits access to markets, schools, health facilities, and emergency services, thereby increasing social and economic vulnerability.

Transport accessibility ratings further reinforce this challenge. As shown in **Table 4.5**, a combined 71.3% of respondents rated transportation conditions as "poor" or "very poor" during the rainy

season, while only 8.8% described access as good. This highlights the strong linkage between flooding, road degradation, and reduced mobility within the community. Access to potable water is also a major concern. The main sources of drinking water (**Figure 3.19**) are largely surface water, shallow wells, and other unimproved sources, which are highly susceptible to contamination. Responses on water quality (**Figure 3.20**) show that a significant proportion of households reported their water sources are often or sometimes affected by flooding and contamination during the rainy season, increasing the risk of waterborne diseases such as cholera, typhoid, and diarrhea. Electricity supply in Bulka community is irregular and unreliable, further constraining household welfare and small-scale economic activities such as trading, food processing, and cold storage. Overall, the findings reveal that seasonal flooding compounds existing infrastructure deficits, undermining transportation, water safety, health outcomes, and economic productivity. These conditions strongly justify the proposed ACReSAL intervention, which is expected to improve drainage, enhance road accessibility, protect water sources, and strengthen the overall resilience of socioeconomic infrastructure in Bulka community.

**Table 4.4: Roads Frequently Impassable During Rainy Season**

| Response | Frequency | Percentage |
|---|---|---|
| **Yes** | 429 | 75.9% |
| **No** | 79 | 24.1% |
| **Total** | 328 | 100% |

**Table 4.5: Transport Accessibility Rating During Rainy Season**

| Response | Frequency | Percentage |
|---|---|---|
| Good | 29 | 8.8 |
| Fair | 65 | 19.8 |
| Poor | 108 | 32.9 |
| Very poor | 126 | 38.4 |
| **Total** | 328 | 100% |

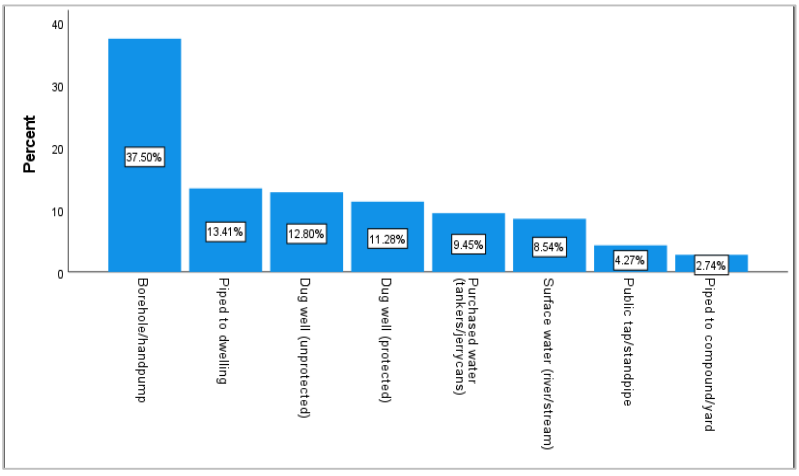



**Figure 4.9: Main Source of Portable Water**

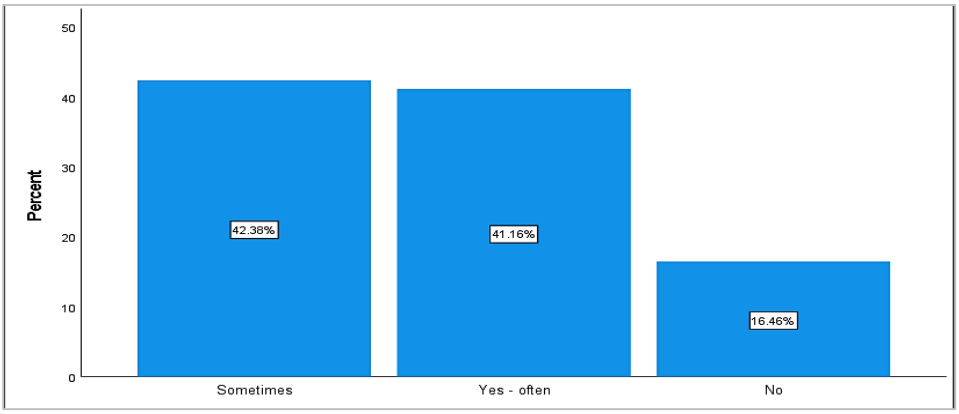



**Figure 4.10: Response to Main Water Source Affected by Flooding**

With the implementation of the project, it is anticipated that there will be an influx of workers and associated populations into the community. This population increase is likely to result in heightened demand for existing social infrastructure and amenities. Consequently, pressure on already limited resources such as water supply, electricity, transportation networks, and other public services is expected to intensify. The increased utilization of existing facilities may lead to faster deterioration, congestion, and reduced service quality if not properly managed. Therefore, proactive planning and the provision of support infrastructure will be essential to mitigate potential strain on social services and to ensure that both residents and incoming project personnel can access basic amenities without undue hardship.

Findings from KIIs and FGDs reveals the following qualitative support for the quantitative results on access to socioeconomic infrastructure;
*Participants across all discussion groups emphasized that road conditions significantly deteriorate during the rainy season, with flooding and erosion rendering many access roads impassable.* (FGD: Both groups)

*Community members reported that this situation restricts movement, disrupts economic activities, delays access to markets and schools, and makes it difficult to reach health facilities, particularly during emergencies, they noted an increased in transportation costs and loss of income due to damaged roads and reduced customer access.* (FGD: Youth)

*Participant also highlighted persistent challenges with access to potable water, most households rely on shallow wells, surface water, or vendor-supplied water, which are easily contaminated during periods of flooding*. (KII: Community leader)

*Women, who are primarily responsible for water collection, reported that floods often pollute water sources, forcing households to either travel longer distances for safer water or resort to unsafe sources*. (FGD: Female participant)

*KII respondent linked the frequent outbreaks of diarrhea and waterborne diseases to this seasonal contamination of drinking water*. (KII: Traditional leaders)

*Electricity supply was described by respondents as irregular and unreliable, with frequent outages that affect household comfort and limit income-generating activities such as food processing, refrigeration, and small-scale trading.* (KII: Community leader)

*Youth group noted that unreliable power supply also affects children's ability to study at night and increases household expenditure on alternative energy sources*. (FGD: Youth)

Overall, KIIs and FGDs reveal that seasonal flooding amplifies existing infrastructure deficits, deepening socioeconomic vulnerability in Bulka community. Participants expressed strong expectations that the proposed ACReSAL intervention would improve drainage, reduce flooding, restore road accessibility, protect water sources, and indirectly enhance public health and economic productivity. There was broad consensus that addressing these infrastructure challenges is critical to improving resilience, livelihoods, and overall quality of life in Bulka community.

### 4.4.8 Desirability of the Subproject

The survey results indicate unanimous support (100%) among respondents for the implementation of the subproject in the community. All respondents expressed strong approval and emphasized the importance of the subproject proceeding as a matter of urgency. Many participants specifically indicated a clear preference for the subproject to be implemented before the next rainy season**,** citing recurring flooding, erosion, and associated risks to lives, property, and livelihoods. This high level of community acceptance underscores the perceived relevance and necessity of the subproject and reflects the expectation that it will significantly improve environmental conditions, safety, and overall quality of life within the project area.

### 4.4.9 Potential Security Risk Challenges

The implementation of the Bulka subproject in Gusau Local Government Area, Zamfara State, is expected to attract an influx of people into the community. These are likely to include individuals seeking employment with project contractors, service providers offering various social and commercial services, and others aiming to benefit from opportunities associated with the subproject. As experienced in similar projects, such population movements may also create opportunities for the entry of undesirable elements, including individuals with criminal intentions, into Bulka community. The increased movement and concentration of people within the project area may lead to a higher risk of criminal activities, such as theft, vandalism, and other forms of social disturbance. This situation is likely to place additional pressure on existing security arrangements, including the police, local vigilante groups, and other community-based security structures operating within Bulka community. Furthermore, the cumulative unemployment that may result from the influx of job seekers who are unable to secure employment on the project could contribute to social tension and insecurity. Idle youths and unmet employment expectations

may heighten the risk of petty crimes and conflicts, posing challenges to both community safety and security institutions. It is therefore important to anticipate these risks and put in place proactive security and community engagement measures, including collaboration with security agencies and local leadership, to ensure a safe and orderly project implementation process.

### 4.4.10 Conflict Resolution

The survey results indicate unanimous preference (100%) among respondents in Bulka community, Gusau Local Government Area, Zamfara State, for resolving conflicts through informal and traditional conflict resolution mechanisms that are already established within the community. These traditional approaches are considered more accessible, culturally acceptable, and effective in maintaining social harmony. Although the formal court system is recognized as an alternative avenue for dispute resolution, none of the respondents favored it as their primary means of resolving conflicts. This perception is largely due to factors such as cost, time consumption, procedural complexity, and limited familiarity with formal legal processes. Importantly, no respondent expressed indifference toward conflict resolution approaches, indicating a strong collective consensus. The findings underscore the central role of traditional leaders, elders, and community-based mechanisms in conflict management within Bulka community, and highlight the importance of integrating these structures into project grievance redress and dispute resolution frameworks.

## 4.5 Public/Stakeholders' Consultation and Participation

Public and stakeholder participation formed a vital component of the development of this Environmental and Social Management Plan (ESMP) for Bulka communities, Gusau Local Government Area, Zamfara State. The process involved the early identification and engagement of all relevant stakeholders in the affected areas, including community leaders, interest groups, and individuals or groups potentially affected by the subproject. Engaging stakeholders from the outset ensured transparency, inclusiveness, and informed decision-making throughout the planning process. The direct involvement and active participation of community members and other stakeholders in the planning and management of the subproject are best and essential for the timely resolution of potential conflicts and social concerns. Effective consultation also promotes efficient use of resources, enhances project benefits, and expands socioeconomic opportunities for communities within the subproject area.

The process of consultation in Bulka communities was designed to encourage active and sustained participation, particularly among residents living within or close to the subproject corridor. This approach was intended to foster a strong sense of belonging and community ownership as well as to enhance the long-term sustainability of the subproject. Through consultations and stakeholder engagement, community members and potential Project Affected Persons (PAPs) were provided with opportunities to contribute ideas and express concerns aimed at strengthening the subproject, avoiding adverse impacts, and minimizing potential setback or conflicts. Stakeholder consultations are intended to remain an ongoing process throughout the entire subproject lifecycle, ensuring

continuous communication and feedback. This phase of engagement also involved conducting FGDS and KII interviews with community leaders, women, men, and youth, and the administration of structured socioeconomic questionnaires at the household level within potentially affected areas along the drainage corridor, providing essential baseline data to inform impact assessment, mitigation measures, and monitoring activities.

### 4.5.1 Community/Stakeholders' Participation

Community and stakeholder participation plays a critical role in improving understanding of the subproject and strengthening communication between the State Project Management Unit (SPMU), consultants, contractors, and the host community**.** Active engagement ensures that project objectives, activities, and potential impacts are clearly explained and well understood by all concerned parties. However, by actively involving relevant stakeholders particularly Project Affected Persons (PAPs) and organizations with direct or indirect interests in the subproject, the decision-making process is significantly enhanced. Such inclusive participation allows community members to contribute local knowledge, express concerns, and offer suggestions that can improve project design and implementation. Overall, effective community and stakeholder participation fosters transparency, trust, and shared ownership of the subproject, reduces the likelihood of tension or conflicts, and supports the successful and sustainable implementation of project activities within Bulka communities and the wider project area.

### 4.5.2 Objectives of the Community Consultations

The objectives of the public and stakeholders' participation and consultation process for the subproject are to:

- Request inputs, views, and concerns from affected communities in relation to the subproject, and to obtain relevant local and traditional knowledge that can support informed and culturally appropriate decision-making;
- Facilitate the identification and assessment of alternatives, mitigation measures, and trade-offs, ensuring that significant social and environmental impacts are not overlooked and that potential benefits to the communities are maximized;
- Reduce the likelihood of conflict through the early identification and resolution of contentious issues, while also enhancing public trust and confidence in the subproject; and
- Provide opportunities for the public to positively influence subproject design and implementation**,** thereby improving transparency, inclusiveness, and accountability in decision-making processes.

### 4.5.3 Public Consultation Methodology

Although, much of the methods adopted in this survey has been discussed earlier in section 4. but for the sake of emphasis especially in this section, a brief highlight will also be relevant, and therefore, the methodology adopted in this Environmental and Social Management Plan (ESMP) for the Bulka subproject, was a mixed qualitative and quantitative approach**.** This approach provided an effective framework for wide-ranging interaction with subproject communities and

relevant stakeholder groups. The consultation process was grounded in a participatory methodology, incorporating community meetings, public discussions, and engagements with key informants such as District Heads, Village Heads, Council members, Local Government officials, and relevant state project officers**,** among others.

A brief description of the consultation methods adopted is presented below:

1. **Rapid Assessment Technique**
   This technique involved a prompt professional assessment of the potential social and environmental impacts of the subproject. The assessment was based on the proximity of residential and commercial assets to the proposed drainage and erosion control corridors, the anticipated nature and intensity of impacts, and their overall significance within the Bulka project area. Property owners likely to be affected were directly engaged in discussions to enhance mutual understanding, clarify concerns, and manage expectations.

2. **Socioeconomic Survey**
   The socioeconomic survey involved the administration of structured questionnaires designed to generate baseline information on the socioeconomic characteristics of households and businesses residing or operating within the subproject area. This was complemented by formal and informal interviews and discussions with key informant and focus groups, including community elders, men, women and youth, to gain deeper insight into community dynamics, livelihoods, and vulnerabilities.

3. **Public Meetings**
   Public meetings were conducted as a core component of the participatory process to obtain community perspectives on the social issues, risks, and potential impacts associated with the subproject. These meetings were held at various locations within the immediate impact zones of the Bulka communities to ensure broad participation and inclusiveness. The engagements provided a platform for information sharing, feedback, and consensus-building between the project team and community members. Overall, the consultation methodology ensured inclusive participation, transparency, and effective communication**,** thereby strengthening community ownership and supporting the sustainable implementation of the Bulka subproject.

### 4.5.4 Stakeholders' Identification

Stakeholder identification for the Bulka subproject, was carried out to ensure inclusive participation and effective management of social and environmental issues associated with the subproject. Based on the degree to which individuals or groups are affected by, or have an interest in, the subproject activities, five broad categories of stakeholders were identified. These stakeholder groups were actively consulted and encouraged to participate throughout the subproject development process, as summarized in **Table 4.6**. The identified stakeholders include individuals and groups who live in close proximity to the drainage corridor**,** as well as those who may see, hear, or otherwise experience the effects of the subproject**.** They also include persons who

may be temporarily displaced or required to relocate due to construction activities, and those who have traditional, administrative, or institutional interests in development activities or policy decisions affecting the subproject area, regardless of whether they reside within the immediate project vicinity. In addition, stakeholders include individuals who infrequently use the land on which the subproject is located but whose livelihoods or access rights may still be affected.

The stakeholder identification process adopted for the Bulka subproject involved the following steps. First, there was the identification of parties whose official, social, economic, or cultural roles have direct or indirect relevance to the subproject activities**.** These parties include individuals, community groups, traditional institutions, government agencies, and other organizations that may be affected by or have influence over the drainage rehabilitation activities. Second, a stakeholder register was developed, and specific stakeholder interests in relation to the subproject were identified.

Key issues considered during this process included:
(a) the potential benefits of the subproject to each stakeholder group;
(b) possible changes to regular activities or livelihoods that may arise as a result of the subproject;
(c) subproject activities that could result in damage, inconvenience, or conflict for particular stakeholders.

This structured approach to stakeholder identification ensures that all relevant interests are recognized and addressed, thereby supporting effective consultation, conflict prevention, and the sustainable implementation of the Bulka subproject

**Table 4.6: Identified Stakeholder Groups**

| Stakeholder Group | Description (Bulka Communities) | Relevance to the Subproject |
|---|---|---|
| Group 1: Project Affected Persons (PAPs) | Individuals or households in Bulka communities whose residences, farmlands, economic trees, businesses, or other livelihood assets are located within the proposed drainage and erosion control corridor and within 20 meters on either side of the corridor. | These stakeholders constitute the Project Affected Persons (PAPs) and Project Affected Households (PAHs) under World Bank ESF. They are entitled to impact mitigation measures, compensation where applicable, livelihood restoration, and continuous engagement |
| Group 2: Traditional and Community Leadership | Traditional rulers, district heads, village heads, ward heads, elders, and other recognized community leadership structures in Bulka communities with customary and | They provide community entry, legitimacy, and mobilization support, facilitate conflict resolution using customary mechanisms, and serve as key |

| | | |
|---|---|---|
| | administrative oversight over land and development activities. | liaison points for consultation, disclosure, and grievance redress. |
| Group 3: Host Community Members | Residents of Bulka communities whose daily activities (farming, trading, commuting, or access to social services) bring them close to the subproject area but whose assets are located outside the immediate drainage corridor. | While not directly affected, this group may experience indirect impacts such as temporary access restrictions or benefits such as improved flood control. They are critical to social acceptance, sustainability, and community ownership of the subproject. |
| Group 4: Community-Based and Civil Society Organizations | Community-Based Organizations (CBOs), Faith-Based Organizations (FBOs), women groups, youth associations, and Non-Governmental Organizations (NGOs) operating within Bulka communities. | These groups support social inclusion, vulnerable group engagement, environmental awareness, and health and safety sensitization, and act as channels for information dissemination and feedback. |
| Group 5: Government and Political Stakeholders | Elected political office holders, Local Government officials, relevant State Ministries, Departments and Agencies (MDAs), and Zamfara State ACReSAL Project Management structures. | They are responsible for policy guidance, institutional oversight, coordination, and compliance with World Bank ESF requirements, including monitoring, grievance management, and implementation of mitigation measures. |

## 4.6 GBV/SEA/SH Assessment

Gender based violence is a common social problem in Nigeria especially in the Northern parts of Nigeria. Types of social issues prevalent in Zamfara state ranges from domestic violence, sexual exploitation to forced and early marriage, child labour and deprivation of resources. FDG interview suggests that the most common type of GBV in the state is early/child and forced marriage. The major drivers of these forms of GBV as experienced in the state are the religious and cultural norms and values governing this part of the country, also poverty and insecurity drives this practice. Despite the United Nations measures (Article 1 of the United Nations Convention on the Rights of the Child and section 227 of the Child Rights Act, 2003 which considers a child as anyone below 18,) set out to protect the interest of young girls regarding child marriage and child sexual abuse, the historical practise of child/forced marriage is still in existence in some communities in Zamfara as well as some other northern states. The Summary of consultations with various groups from the areas within the Bulka community (project site) and other stakeholders (community heads, women leader, etc) are highlighted below.

These discussions took place 3rd to 4th December 2025 (each meeting lasted for approximately 1hour 30minutes per group) in which women above 35 years of age participated and formed the women's group (74 women), youth females between 18 and 34 years (33 youth) constituted the female youth group and a group of men in the men group. Prior to the group discussions, the **consent form** was read, and consent was obtained from the participants before proceeding with the group discussion. A focus group discussion guide of 29 questions was used to facilitate the meeting for the various groups.

The groups were disaggregated by gender and age to ensure confidentiality and protection of all participants (age 18 to 35 for the youths and above 35 years for the older group). The participants were generally responsive. They also understood the meaning of GBV, its types and forms (child abuse, rape, early marriage, forced marriage and domestic violence). As regarding the safety of their community, they stated that their community is not very safe especially for young girls (9 to 17 years).

There are police stations and service providers at the local government secretariat they report security and gender issues respectively. According to the participants, female children from age 9 and above are at risk of GBV and this is so because they move around the community freely. There are no NGOs in this community to the best of their knowledge. Women in this community get married from the age of 15 while men get married from the age of 25 and this is dependent on their educational background; the lower the level of education, the earlier it is for them to get married but for the women; educational level is immaterial. Most parents marry off their young girls due to poverty.

Women report family crisis to her family members or village heads when they occur depending on nature of the crisis. Medical issues are reported to the primary health care centres. These health centres are accessible and the qualities of the services they render are satisfactory.

***GBV issues and drivers identified in the Bulka Intervention Area***

- High unemployment and lack of capital limit women's ability to start small businesses.
- Adolescent girls (ages 9–17) are identified as the most vulnerable group.
- Teen girls are especially at risk in the evening when they are sent to markets to sell food or drinks, where attacks commonly occur.
- Extreme poverty continues to fuel harmful cultural practices:
- Increase in child marriages among economically disadvantaged families.
- Girls are withdrawn from school to get married, assist with household responsibilities and support income-generating activities
- Girls often face Domestic violence, often linked to men having multiple wives (up to 3 or more).
- Violent incidents arise due to power imbalance within marriage, men asserting dominance and control and conflicts among co-wives

- Some men physically assault their wives, especially when a wife refuses sexual access or disagreements occur among co-wives
- Gender inequality continues to shape women's vulnerability in the family structured into marriage between ages 15–17, mostly to older men, due to their parents' inability to provide for them.

### 4.6.1 Perceptions of Gender-Based Violence in the Community

These stakeholders described GBV as a persistent and multifaceted problem, disproportionately affecting adolescent girls between the ages of 9 and 17 years. According to them, teenage girls often face heightened vulnerability due to their involvement in daily household errands, petty trading, and movement across various locations within the community. Such activities frequently expose them to interactions with adult men, some of whom exploit these encounters.

### 4.6.2 Awareness and Perception of Respondents on ACReSAL Intervention

All respondents and community members who participated in the consultation process demonstrated a high level of awareness and acceptance of the proposed ACReSAL intervention in the Bulka communities. Participants clearly acknowledged that the existing erosion and flooding conditions pose serious environmental, social, and safety risks to their lives, properties, and livelihoods. Respondents indicated that persistent erosion and flooding have restricted access to social amenities**,** damaged infrastructure, reduced economic opportunities, and generally negatively affected living conditions within the community. As a result, the remediation options presented during the consultations were widely welcomed and strongly supported by the community members due to the anticipated environmental restoration, improved safety, and enhanced socioeconomic conditions. The respondents expressed confidence that the proposed ACReSAL intervention would provide a long-term and sustainable solution to the erosion and flooding challenges, which they described as persistent and difficult to control. Overall, the consultations revealed strong community optimism and willingness to support the project, reflecting a shared belief that the intervention will significantly improve resilience, environmental stability, and quality of life in the Bulka communities.

### 4.6.3 Participants' Feedback – Comments and Concerns

During the Bulka community meetings**,** the District Head conveyed the appreciation and gratitude of the communities to ACReSAL, the Zamfara State Government, the Federal Government of Nigeria, and the World Bank for the proposed erosion and flood control intervention. Several other participants also expressed their views and made constructive comments and suggestions regarding the proposed subproject. All speakers affirmed their willingness to provide full cooperation and continuous support to the ESMP Consultant, and all parties involved in the implementation of the subproject. Photographs taken during the various community meetings are presented in the Annexure of this report.

The key environmental and social issues and concerns raised during the stakeholder and community consultations in Bulka communities include the following:

1. Community safety ahead of the next rainy season**,** with strong concerns about the increasing severity of flooding and erosion and the associated risks to human lives and residential structures;
2. Potential loss of crops, livestock, and household assets due to continued flooding, as well as the increased risk of water-related diseases such as typhoid, cholera, diarrheal diseases, and malaria**;**
3. Restricted access to roads, farmlands, and grazing areas**,** which affects mobility, agricultural productivity, and livelihoods;
4. Possible physical displacement of vulnerable persons and households during the construction and implementation phases of the subproject.

All issues and concerns raised by the community members were adequately addressed during the meetings through explanations and clarifications provided by the ESMP Consultant and the SPMU representatives. Specific mitigation measures responding to these concerns are further detailed under the impact mitigation measures section of this ESMP. Consultation and stakeholder engagement for the Bulka subproject will continue throughout the entire project lifecycle, ensuring that community members and Project Affected Persons (PAPs) are given sustained opportunities to contribute to project planning and implementation. This continuous engagement approach is aimed at strengthening the subproject, minimizing negative impacts, and reducing the likelihood of conflicts—particularly with respect to resettlement, compensation, and livelihood restoration issues**,** in line with World Bank ESF and ACReSAL requirements. Information and data collection for the ESMP involved a wide range of activities, including interviews and discussions with community members possessing historical knowledge of the project area, as well as an assessment of the history and patterns of flooding and erosion.

## 4.7 Summary, Conclusions and Recommendations

***Summary***

The study assessed the environmental, socioeconomic and health conditions of the Bulka communities in Gusau LGA, Zamfara State, in relation to the proposed ACReSAL erosion and stormwater drainage intervention. Findings show that the communities are significantly affected by recurrent flooding and erosion, leading to loss of lives, property, livelihoods, and access to social infrastructure. Community consultations revealed strong awareness of the problem, unanimous support for the subproject, and willingness to cooperate with implementing agencies. Key risks identified include temporary displacement, pressure on social services, security concerns, and potential GBV/SEA/SH risks due to labour influx.

***Conclusion***

The proposed ACReSAL intervention is timely, socially acceptable, and environmentally necessary. The subproject is expected to significantly reduce flooding and erosion risks, improve

community safety, restore access to farmlands and infrastructure, and enhance overall socioeconomic and health conditions in the Bulka communities. With proper implementation of mitigation measures in line with the World Bank Environmental and Social Framework and ACReSAL safeguards, the subproject will generate substantial positive and sustainable impacts while minimizing adverse effects.

***Recommendations***

1. The subproject should be implemented as a matter of urgency, preferably before the next rainy season.
2. All identified environmental and social mitigation measures should be strictly implemented and monitored, particularly those relating to resettlement, livelihood restoration, and community safety.
3. Continuous stakeholder engagement and information disclosure should be maintained throughout the project lifecycle.
4. A functional Grievance Redress Mechanism (GRM) should be strengthened and made accessible to all community members.
5. Specific measures should be enforced to manage labour influx, security risks, and GBV/SEA/SH, including worker codes of conduct and community sensitization.

Overall, effective coordination among ACReSAL, government institutions, contractors, and the Bulka communities is essential to ensure successful and sustainable project outcomes.

# CHAPTER FIVE: POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION.

## 5.1 General

This chapter presents the associated environmental and social impacts (adverse or beneficial, direct or indirect, wholly or partially) posed to the biophysical/ecological, socio- economic and health of the environment by Bulka intervention project. It also outlines the necessary mitigation measures put in place to minimize and manage such impacts.

The assessment of the impacts project on the immediate environment requires a stepwise process listed as thus:

- Identification of associated and potential impacts.
- Characterization of the impacts in terms of sensitivity and the exposure of natural and social environments.
- Consequence and likelihood evaluation of the significance of identified impacts.
- Draw-up measures for mitigation of the impacts either through avoidance, reduction, management and compensation if need be; and
- Development of comprehensive environmental and social management plan to manage significant impacts all through the project life cycle.

The highlighted procedure is an adaptation from the ISO 14001:2015 Environmental Management System.

## 5.2 Impact Assessment Procedure/Methodology

An environmental and social assessment was conducted to determine the scope and significance of the proposed project's potential environmental impacts, as well as the institutions, businesses, communities, and other stakeholders directly impacted by the project, the method to be used in the investigation, how to incorporate the observations into the project, and the level of additional environmental analysis required.

A variety of methods exist for environmental and social impact assessment. The following steps were employed in preparation of this ESMP:

- Identification of effects
- Prediction of effects
- Evaluation and Interpretation of impacts
- Communication
- Inspection procedures

The Scientific Committee on the Problems of the Environment (SCOPE, 1979) suggests that the following qualities should be considered while choosing Impact assessment methods:

| | |
|---|---|
| **Comprehensiveness** | ability to handle all possible range of elements and combinations thereof |
| **Selectivity** | capability to identify early in the process those aspects that are significant |
| **Mutual exclusiveness** | should be able to examine every component of an impact from different perspectives |
| **Confidence limits** | is the method able to ascertain and isolate Uncertainties |
| **Objectivity** | should allow no bias either from the assessor or project initiator |
| **Interactions** | should be able to examine both sides of a coin and provide feedback. |

### 5.2.1 Basis for Screening

In assessing the impacts of the proposed project the following information were used:

- Knowledge of the project activities, construction activities, operational activities, demobilization procedures.
- The results of baseline studies (biophysical, health and socio-economic)
- Findings of previous Environmental Assessment studies and Audits of similar projects and other literature findings on the primary project activities,
- Comparison with WB/FMEnv/WHO guidelines and standards,
- Series of expert group discussions and seminars,
- Past experience on other ESMP projects.

The criteria applied to the screening of various activities were:

- Magnitude -Probable level of severity.
- Prevalence -likely extent of the impact.
- Duration and frequency - long-term, short-term or intermittent.
- Risks - Probability of serious impacts.
- Importance - value attached to the undisturbed project environment.

### 5.2.2 Scoping

Scoping identifies the various aspects (activities) of the project that could have significant impact on the environment and people. It identifies issues of critical concerns. Scoping of the proposed project also seeks to provide solutions to issues such as:

- What are the potential impact from the execution and operation of the proposed Bulka gully project?
- What will be the magnitude, extent and duration of the impacts?
- Of what relevance are the impacts on the environment within local, contexts?
- What mitigation or amelioration measures can be put in place to reduce or avoid the negative impacts or to enhance and maximize positive impact?

Consequently, scoping was used to identify the biophysical, health, and socio-economic components of the environment that will significantly be affected by the proposed project activities. The project activities that will have impact on the environment and socio economy of the people are:

- Land Acquisition/Right of Way (RoW)
- Material Procurement and Transportation
- Site Preparation/clearing
- Civil works
- Operation and maintenance activities
- Demobilization from site.

### 5.2.3 Project Environmental Components and Impact Indicators

The project activities shall interact with components of the environment, and their impact indicators shall be monitored to quantify the level of impact. Environmental components and impact indicators are as presented in table 5.1 below. Table 5.2 outlines environmental and social aspects of the project.

**Table 5.1: Phases of Project Development Activities and Sources of Impact.**

| S/N | Project Phase | Activities/Sources of Impact |
|---|---|---|
| 1. | Preconstruction | Equipment and materials mobilization, Road traffic, bush clearing, waste clearing and disposal, |
| 2. | Construction | Grading, compaction, waste management, movement of materials off and to site, Road traffic, Influx of people, loud and heavy-duty equipment, exhaust fumes, vibrations from blasting, SEA, GBV & related issues |
| 3. | Commissioning and Operation/Maintenance | Commissioning, waste generation, water flow and surface water impacts, |
| 4. | Decommissioning and abandonment | Removal/dismantling of equipment and structures, waste disposal, residual contamination, Road traffic, scrap metals, |

### 5.2.4 Identification of Impacts and Activities Interactions

Details of the plant construction, operations and decommissioning activities that could engender environmental impacts are as follows:

- Site preparation (Bush clearing/creation of access road and camping)
- Mobilization of construction materials and equipment
- Recruitment and community engagement
- On-site fabrication (metal works etc.)
- Channel foundation and structures (grading, compactions, trenching and piling)
- Waste management
- Fuel storage/hazardous material handling
- Fire/explosion & Incident/Accidents (Unplanned activity e.g. trip and fall hazard)
- Commissioning/Testing Industrial operations

- Noise and fugitive emissions (particulates and gases)
- Abandonment/Restoration

At this stage of the impact assessment, a wide range of environmental components which project activities may possibly interact were considered. The components that were not relevant to the project were not considered. The environmental components considered are presented in Table 5.2.

**Table 5.2: Impactable Components and Associated Impact Indicators**

| S/N | Impactable Components of the Environment | Impact Indicators |
|---|---|---|
| 1. | Climate | Humidity, temperature, rainfall, wind speed and direction |
| 2. | Air | Particulates, NOx, SOx, CO, $H_2S$ |
| 3. | Surface Water and Groundwater | Dissolved and suspended solids, pH, BOD, COD, turbidity, toxicity, heavy metals and microbial loads. |
| 4. | Hydrology | Drainage/Discharge, Hydrologic Balance, Sedimentation, Flooding |
| 5. | Soil/Land | Erosion, Fertility/Farming, Hunting, Recreation, soil physicochemical compositions, microbial composition; particle size description. |
| 6. | Ecology | Habitat fragmentation, accessibility to conservation areas, loss of economic trees, forced migration of species, endangered species. |
| 7. | Archaeological Sites | Cultural relics, Cultural Sites. |
| 8. | Noise & Vibration | Daytime disturbance, Hearing loss, Communication Interference, Nighttime disturbance. |
| 9. | Socio-Economic/Health | Population, Social Structure, Income, Settlement pattern, Employment, Agriculture, Health, Safety and Security. |
| 10. | Hydrobiology and Fisheries | Sp. types, diversity, spawning area, fish stock assessment, fish migration pattern, breeding habits, catch assessment survey (CAS), migration routes |

### 5.2.5 Impact Categorization

Associated and potential impacts of the proposed project have been categorized as follows:

**Box 1: Impact types and descriptions**

| NATURE OF IMPACTS | |
|---|---|
| Positive: | These are beneficial impacts which are improvement to the baseline or an introduction of a new, desirable factor. |
| Negative Impacts: | These are adverse impacts which are an antagonistic change from the baseline or an introduction of a new, undesirable factor |
| Direct Impacts: | These are obvious impacts that are directly related to the proposed project activities |
| Indirect Impacts: | These are the changes that are less obvious or impacts are further away from the impact source. |
| Cumulative Impacts: | Impacts arising from the interaction of project components or activities with other activities of the past, those occurring simultaneously, or in the future. |
| Residual Impacts: | These are impacts that remain even after mitigation measures have been applied. |
| **REVERSIBILITY / IRREVERSIBILITY** | |
| Reversible Impacts: | These are impacts that do not cause permanent change to the components of the environment. |

| | |
|---|---|
| Irreversible Impacts: | These impacts cause permanent impairment to the environmental component of the area. |
| **DURATION OF IMPACTS** | |
| Long Term: | Predicted adverse impacts which remains long after mitigation measures have been applied. |
| Short term: | Impacts that are removed after application of mitigation measures |

### 5.2.6 Checklist of Associated and Potential Impacts

The potential/associated impacts and the indicator parameters for different project stages and activities, is given in Table 5.3 below

**Table 5.3: Associated and Potential Impacts and Indicator Parameters for the Proposed Projects.**

| Project Phase | Project Activity | Potential/Associated Impacts |
|---|---|---|
| Pre-construction | Land /geological surveys<br>Acquisition of RoW<br>Site preparation<br>Soil Testing<br>Equipment and materials mobilization | • Vegetation loss, wildlife migration from vegetation clearing<br>• Increased traffic, waste clearing and disposal<br>• Community issues due to Land acquisition, displacement, loss of livelihood and employment<br>• Exposure of soil to weather conditions soil strata Inversion<br>• Noise Generation<br>• Dust and gaseous emission from exhaust<br>• Security risk and concerns<br>• Trip and fall hazards, cuts and burns, object at heights leading to injuries/fatalities |
| Construction | Access to site<br>Material Transportation<br>Base Camps/ site offices<br>Project security<br>Influx of people<br>Engineering works<br>Waste Disposal<br>Gender Based Violence | • Alteration of hydrological pattern leading to soil erosion<br>• Air pollution from fugitive emissions and dust<br>• Noise generation and vibrations from heavy duty equipment and blasting activities<br>• Temporary obstruction of human & vehicular movement during clearing of site<br>• Increased accident risk, vehicular exhaust gas<br>• Vegetation loss, life migration habitat loss.<br>• Armed attack, youth restiveness, kidnapping,<br>• Increase in infectious disease especially STD, social conflicts/vices due to influx of persons<br>• Change in land use<br>• Possible community agitations from unsettled and unresolved disputes over land and/or employment<br>• Public nuisance from noise generation and Air pollution from construction equipment and materials<br>• Respiratory/ health hazards to onsite personnel due to the release of fumes & dust from construction equipment<br>• Soil/Wate contamination, impact on fisheries in nearby streams from surface runoff and accidental discharge of diesel. Concrete mix, etc.<br>• Generation of solid and liquid waste<br>• Sexual Exploitation and Abuse, sexual harassment, Violence Against Women, Violence Against Children<br>• Generation of employment for local suppliers and local small traders |
| Operation | Storm water Channelization and Erosion Control | Reduced Erosion<br>Flood Mitigation<br>Improved Water Quality<br>Improved aesthetic quality |

| Project Phase | Project Activity | Potential/Associated Impacts |
|---|---|---|
| | | Separation of close community members due to expansion, channelization and cordoning-off of the gully<br>Increased water discharged into the receiving water body (Gulbi). |
| Demobilization of Equipment from Site | Removal of equipment, machinery and unused materials from site | Workplace accidents/ incidents<br>Alteration of hydrological pattern<br>Waste generation from demobilization activities<br>Increased dust and vehicular emissions during haulage of unused components from site by heavy-duty vehicles<br>Traffic obstruction from removal and transportation of decommissioned structures and equipment |

## 5.3 Impact Evaluation

Evaluation of each of the impacts identified is based on defined criteria used to determine the significance of the impacts. There is no generally accepted definition of 'significance' and its determination is therefore partially subjective. For the purposes of this ESMP, the definition of significance below is adopted.

*"An impact in the judgement of the Impact Assessment (IA) team is assessed significant when in isolation or combination with other impacts, it should, be considered in the decision-making process which also includes the proffering mitigation measures and consenting conditions (from authorities and stakeholders)."*

The criteria considered in the evaluation of significance were legal and regulatory requirement, magnitude, frequency of occurrence, importance or sensitivity, public interest or perception as well as likelihood and consequence. Each criterion and weighing scale are described briefly below.

**Table 5.4: Impact Significance Evaluation**

| Criteria | Rating | Condition |
|---|---|---|
| *Legal/Regulatory Requirements (L)*<br><br>Status of compliance with relevant Nigerian legislation, policies and plans and any relevant Nigerian or industry policies, standards or guidelines.<br><br>Requirements have been identified from laws/guidelines reviewed in chapter one. | Low (1) | No legal/regulatory requirement for carrying out project activity |
| | Medium (3) | Legal/regulatory requirement exist for carrying out activity |
| | High (5) | A permit is required prior to carrying out project activity which may result in impact on the environment |
| *Magnitude (M)*<br><br>The magnitude (including scale and duration) of the change to the natural or socio-economic environment, expressed, wherever practicable, in quantitative and/or qualitative terms. | Low (1) | This means that no further mitigation may be required |
| | Medium (3) | This means that the impact can be mitigated with additional controls and modifications |

| | | |
|---|---|---|
| Magnitude is viewed from perspective of environmental/social receptors affected by considering likely perceived importance as understood through stakeholder engagement and similar project experience | High (5) | This means that the impact require avoidance or major control/mitigation |
| *Frequency of Impacts Occurrence (F)*<br><br>Evaluation of the frequency was based on the historical records of periodicity of occurrences of accidents, spills, fires, social strive, etc. Information of such is obtained through stakeholder sessions, experts experience and professional judgment. | Low (1) | Low frequency of impact (occur in just about one occasion during the project execution period) |
| | Medium (3) | Intermittent frequency of impact (occur in only a few occasions during the project execution period) |
| | High (5) | High frequency of impact (occur continuously and almost throughout the project execution period) |
| *Importance and Sensitivity (I)*<br><br>The importance, nature and sensitivity of the impact receptor (physical, biological, or human). Where the receptor is physical, the assessment considers quality, sensitivity to change and importance of the receptor. For a human receptor, the sensitivity of the household, community or wider societal group is considered | Low (1) | Alteration in value, function or service of impacted resource that are not obvious. E.g. non-detectable impact (e.g., emissions from automobile equipment) |
| | Medium (3) | Measurable reduction or disruption in value, function or service of impacted resource. E.g., loss time injury from minor burns |
| | High (5) | Major reduction or disruption in value, function or service of impacted resource. E.g., impairment of endangered, protected habitat, species |
| *Public Interest/Perception (P)*<br><br>The perceptions of stakeholders, expressed as opinions around certain issues, can be as important as actual impacts.<br><br>Consequently, the concept of perception is explicitly brought into the evaluation of significance after an impact is evaluated. When an impact is of significant stakeholder concern, this may be cause to raise the significance rating. This prompts the formulation of appropriate mitigation measures which focus on the source of the impact and also address stakeholder perceptions.<br><br>The risk of not addressing stakeholder perceptions is that reputational damage could arise, resulting in the loss of a 'social license to operate'.. | Low (1) | Unlikely adverse perception among stakeholders / public |
| | Medium (3) | Possibility of adverse perception among the public and other stakeholders |
| | High (5) | Pose major public concern among population in the project region<br><br>Major reduction in social, cultural, economic value |

| | |
|---|---|
| *Likelihood / Consequence*<br>The likelihood (probability) that the identified impact shall occur. This is estimated based upon experience and/or evidence that such an outcome has previously occurred.<br><br>Furthermore, in the event an impact has occurred, there is a consequence. Therefore, a likelihood/consequence matrix has been developed as additional criteria for significance rating. | See Table 5.5, Table 5.6 and Figure 5.1 |

**Table 5.5: Consequence Ratings**

| Category | Ranking | Definition |
|---|---|---|
| **Severe** | **5** | Trans-boundary and/or national scale impact resulting in:<br>• long term and profound change and/or damage to the natural environment and its ecological processes; and/or<br>• Increase in threat for rare and endangered species of fauna and flora identified in national and global listings.<br>• Natural habitat restoration time greater than 10 years and requiring large-scale and long-term intervention.<br>• Breach of statutory environmental regulations and/or company policy and/or greater than 200% exceedance of international, national, industry and/or operator standard for an emission parameter.<br>• Negative widespread national and international media coverage.<br>• Significant long-term financial loss. |
| **Major** | **4** | Regional to national scale impact resulting in:<br>• medium term change and/or damage to the natural environment and its ecological processes;<br>• reduction in regional habitat and species diversity; and/or<br>• Direct loss of habitat for endemic, rare and endangered species of fauna and/or flora and for species' continued persistence and viability.<br>• Natural habitat restoration time 5 to 10 years and requiring substantial intervention.<br>• Breach of environmental regulations and company policy and/or 100 to 200% exceedance of international, national, industry and/or operator standard for an emission parameter.<br>• Sustained adverse national media attention<br>• Significant medium term financial loss |
| **Moderate** | **3** | Local to regional scale impact resulting in:<br>• short term change and/or damage to the natural environment and its ecological processes.<br>• Direct loss of habitat crucial for species' (including listed species) continued persistence and viability.<br>• introduction of exotic species of fauna or invasive floral species replacing resident 'natural communities' within the project area; and<br>• Environmental stress lowering reproductive rates of species within the project area.<br>• Natural restoration time 2 to 5 years and requiring intervention.<br>• Potential breach of environmental regulations and company policy and/or 50 to 100% exceedance of international, national, industry and/or operator standard for an emission parameter<br>• Complaints from the public, authorities and possible local media attention<br>• Medium term financial loss |
| **Minor** | **2** | Local scale impact resulting in:<br>• short term change and/or damage to the local natural environment and its ecological processes;<br>• short-term decrease in species diversity in selected biotopes/areas within the project area; and/or<br>• Increased mortality of fauna species due to direct impact from project activities.<br>• Natural restoration within 2 years requiring minimal or no intervention.<br>• 10 to 50% exceedance of international, national, industry and/or operator standard for an emission parameter.<br>• Public perception/concern<br>• Short term financial loss |

| Category | Ranking | Definition |
|---|---|---|
| **Negligible** | **1** | • Impact largely not discernible on a local scale being absorbed by the natural environment; areas adjacent to disturbed areas absorb exodus of species able to disperse<br>• Restoration within 6 months without intervention.<br>• Up to 10% exceedance of international, national, industry and/or operator standard for an emission parameter.<br>• Public perception/concern.<br>• Minimal financial loss. |

**Table 5.6: Likelihood Ratings**

| Likelihood / Probability Rating | Attribute – Environmental / Socioeconomic (workers/public) |
|---|---|
| A | • No known occurrence in Zamfara state in over 1,000 years |
| B | • Has occurred in Zamfara between 100 – 1,000 years |
| C | • Incident has occurred in Zamfara between 10 – 100 years |
| D | • Happens several times/year in Zamfara between 1 - 10 years |
| E | • Happens several times/year in Zamfara <1 year |

These consequence ratings (Table 5.5) combined with likelihood ratings (Table 5.6) are put in the matrix below.

| | | | Likelihood of Occurrence | | | | |
|---|---|---|---|---|---|---|---|
| | | | **A** | **B** | **C** | **D** | **E** |
| | | | No known occurrence in Zamfara state in over 1,000 years | Has occurred in Zamfara between 100 – 1,000 years | Incident has occurred in Zamfara between 10 – 100 years | Happens several times/year in Zamfara between 1 - 10 years | Happens several times/year in Zamfara <1 year |
| **Severity** | **1** | Negligible | **1A** | **1B** | **1C** | **1D** | **1E** |
| | **2** | Minor | **2A** | **2B** | **2C** | **2D** | **2E** |
| | **3** | Moderate | **3A** | **3B** | **3C** | **3D** | **3E** |
| | **4** | Major | **4A** | **4B** | **4C** | **4D** | **4E** |
| | **5** | Severe | **5A** | **5B** | **5C** | **5D** | **5E** |

**Low Risk** **Medium Risk** **High Risk**

**Figure 5.1: Likelihood / Consequence Risk Assessment Matrix**

### 5.3.1 Impact Significance Categories Definition

The overall significance of potential impacts (taking into cognizance the evaluation criteria as well as product of likelihood and consequence) of the proposed project are described below:

- **Positive impacts**. e.g. economic benefits or opportunities for employment or reduce flooding and erosion
- **Negligible or insignificant impact (Grey)** - impacts for which (L+M+F+I+P) is ≤5 with a consequence/likelihood rating of: 1A, 1B, 1C, 1D, 1E; and may not require any mitigation
- **Minor significance (Blue)** - impacts for which (L+M+F+I+P) is ≤6-9 with a consequence/likelihood rating of: 1A, 1B, 1C, 1D, 1E, 2A, 2B, 2C, 3A, 3B, 4A;
- **Medium significance (Yellow)**- impacts for which (L+M+F+I+P) is between 10 - 14 with a consequence/likelihood rating of: 2D, 2E, 3C, 3D, 4B, 4C, 5A, 5B;
- **Major significance (Red)**- impacts for which (L+M+F+I+P) is ≥15 with a consequence/likelihood rating of: 3E, 4D, 4E, 5C, 5D and 5E.

### 5.3.2 Potential Significant Adverse Environmental and Social Impacts of the Proposed Project

The proposed erosion control and channelization projects could potentially cause impacts on the environmental and socio-economic components of the project areas. The projects will be beneficial especially in areas of reduced erosion, flood mitigation, improved Water Quality and improved aesthetic quality. Nonetheless, civil works have the potential to generate adverse impacts on the environment and immediate communities. These unfavourable impacts need to be prevented or managed to enhance the sustainability of the projects. This section presents an extensive analysis of the identified potential beneficial and adverse impacts associated with the proposed projects in Bulka, Gusau LGA of Zamfara State.

**Construction Phase Negative Impacts**

**A. Environmental Impact**

**Air Pollution Impacts**

Air quality would be disturbed during the construction stage due to vehicular movement, and the release of particulate matter PM2.5 from vehicular emission. Construction activities will generate dust and pollute the surrounding area.

- **Dust pollution**

Dust will arise from demolition materials, drainage and road construction work due to excavation work, movement of vehicles, stock piling of materials, dust from uncovered trucks bringing in construction materials/sand and general earth works at the site. Loading of cement and dry sand gravel to concrete mixer, and the addition of water to make concrete will generate dust. Dust and fumes will have major direct but short-term impacts during the project construction phase.

- **Gaseous Pollution**

Reduced air quality may be due to fuel powered equipment including vehicles engines and construction equipment and dust from the field area. The emission from the machinery used in

earthwork activities will also degrade the air quality of the site. Exhaust fumes will mainly come from construction plant, machinery and vehicles in operation; all these will affect human and the environment.

**Noise Pollution Impacts**

Construction works will be conducted along the drainage sections in the neighborhoods, where there are houses, schools and clinics, religious places and small-scale businesses. Noise will be produced by construction vehicles, structure demolition, plant and machinery during delivery of materials, processing of materials, and actual construction work which will affect, commercial areas/shops, worshiping areas.

**Water Pollution Impacts**

During the construction stage, different types of activities such as cutting, earthwork, and concrete work due to accidental discharge of cement and other chemicals like epoxy and paints could result in deteriorating the surface water quality with downstream impact along RoW water channel. Oil and lubricants from vehicle repairs and, discharges of eroded soils, seepages of untreated/partially treated effluents from toilets/septic could also flow into waterways. Inadequacies in waste management practices during construction could cause littering during waste collection, transportation and disposal, which could cause clogging of drainage.

**Water Diversion and Flooding Impacts**

Insufficient diversions/bypasses around culverts under construction could cause a disturbance to construction activity as well as create a nuisance for the community and project workers.

**Increased Topsoil Soil Erosion and Sedimentation Impacts**

Soil erosion is likely to occur during slope cuts and excavation works due to cleared embankment area. Clearing of demolished debris for channel expansion, construction of culverts and site drains, detours for collecting construction materials from quarries/borrow areas will expose soils during rainy seasons and may result in incremental soil erosion and sedimentation of stream courses.

**Loss of Biodiversity and Natural Habitat**

ESS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources could be triggered through poor construction preparation practices along the water channels. Also, construction works would necessitate clearance of natural vegetation especially at burrow site for laterite sourcing and storm water drainage over site loaded with wastes, oils, sediments.

**Materials Sourcing Impact**

The channels construction including other aspects of the intervention project require materials such as stones, gravel, sand and water for the construction activities and will be obtained from quarries and land. Since substantial quantities of these materials will be required for the construction of the channel, the availability and sustainability of such resources at the extraction sites will be

negatively affected, as they are not renewable in the short term. In addition, the sites from which the materials will be extracted may be affected in several ways including landscape changes, risk of displacement of people (agricultural land), animals' outmigration and vegetation removal, poor visual quality and opening of depressions on the surface leading that could lead to destruction of crops, injuries to human and animal.

B. **Social Impact Assessment**

The project will have both, negative (such as dust, noise, loss of livelihood, land acquisition etc.,) and positive impact (temporary employment, supporting small businesses) from social point of view. Impacts during construction will be limited to duration of construction works, these impacts are mainly reversible and local. In this context resettlement and land acquisition issues shall be considered separately. Issues related to the involuntary resettlement, including land acquisition, will be covered under the resettlement planning.

**Security Issues**

There is increase in security threats all over the country. Identified threats are insurgencies, which include Cattle rustling, Farmers/Herders conflicts, Homicide, Armed robbery, Kidnapping, Terrorism, Banditry, Burglary, Rape etc. In all these Terrorism, Homicide, Kidnapping, Cattle rustling, Farmers/ Herders Conflicts, Youth Restiveness are the most common security issues at the state level. These identified security issues are not common in the project site at Bulka in Gusau Local Government Area is free from these mentioned criminal activities.

**Labour Influx Management**

Migrant workers may be semi-skilled or brought in where the requirement of labour is large. Preference should be given to offering these jobs to PAPs and other residents within the neighborhoods. The bid documents should specify that the contractor shall give preference to residents of the neighborhoods for unskilled labour required. However skilled labour would also be required for technical support and construction which could be primarily migrant workers from places outside the project area. Labor influx for the proposed construction works can lead to a variety of adverse social and environmental risks and impacts as outlined below:

- **Risk of social conflict**: Conflicts may arise between the local community and the migrant workers, which may be related to competition for limited local resources such as water accommodation, electricity, job opportunities e.tc. Tensions may also arise between different groups within the labor force, and pre-existing conflicts in the local community may be exacerbated.
- **Increased risk of illicit behavior and crime**: The influx of migrant workers into the communities may increase the rate of crimes and/or a perception of insecurity by the local community. Possible illicit behaviour or crimes include theft, physical assaults, substance abuse, prostitution and human trafficking. Local law enforcement may not be sufficiently equipped to deal with the temporary increase in local population.

- **Influx of additional population ("followers")**: There is a potential for people migrate to the project area in addition to the labor force, thereby exacerbating the problems of labor influx. These could be family members of workers, as well as traders, suppliers and other service providers, particularly in areas where the local capacity to provide goods and services.
- **Impacts on community dynamics**: Depending on the number of migrant workers and their engagement with the host community, the composition of the local community, and with it the community dynamics, may change significantly. Pre-existing social conflict may intensify as a result of such changes.
- **Increased burden on and competition for shared resources and public service provision**: The presence of migrant workers (including their families) can generate additional demand on shared community resources, (such as water, toilets, public spaces etc) it also has a toll on the provision of public services, such as electricity, medical services, transport, education and social services. This is particularly the case when the influx of migrant workers is not accommodated by additional or separate supply systems.
- **Increased risk of communicable diseases and burden on local health services**: The influx of migrant workers may bring communicable diseases to the project area, including sexually transmitted diseases (STDs), or the incoming migrant workers may be exposed to diseases to which they have low resistance. This can result in an additional burden on local health resources. Workers with health concerns relating to substance abuse, mental issues or STDs may not wish to visit the project's medical facility and instead go anonymously to local medical providers, thereby placing further stress on local resources. Local health and rescue facilities may also be overwhelmed and/or ill-equipped to address the work-related accidents that can occur in large construction sites.
- **Child labor and school dropout:** Increased opportunities for the host community to sell goods and services to the project workers can lead to child labor to produce and deliver these goods and services, which in turn can lead to enhanced school dropout.
- **Local inflation of prices**: A significant increase in demand for goods and services due to labor influx may lead to local price hikes and/or crowding out of community consumers.
- **Increased pressure on accommodations and rents**: Depending on project worker income and form of accommodation provided, there may be increased demand for accommodations, which again may lead to price hikes and crowding out of local residents.
- **Increase in traffic and related accidents**: Delivery of supplies for the works and the transportation of workers and visitors can lead to an increase in traffic, increase in accidents, as well as additional burden on the transportation infrastructure.

**Public Health and Safety**

Impacts on Public health and safety may arise during the phases of pre-construction, construction and decommissioning phases. During the pre-construction and construction phases, dismantling of the structures for channel construction, drainage and other subprojects activities may result in the following health hazards:

- Dismantling of impacted properties has tendency to trigger psychological impacts on their owners and others associated with them due to their attachment to the affected structures.
- Unhygienic sanitary conditions in the labour camps might also result in impact on health of workers as well as the local population with propensity for disease transmission
- The migrant workers and their dependents could arrive the neighborhoods with communicable diseases such as sexually transmitted diseases (STDs) like AIDS.

**Traffic Impacts**

The proposed project activities could significantly impact traffic movement through haulage of materials and other associated activities. It should be noted that the traffic concerns will be critical at intersections into the communities. The traffic obstruction impact should be avoided as far as possible by proper planning of construction works. If traffic diversion and/or road closure is required for the proposed works, prior consent from the Federal road Safety Corps will be required and prior information to affected areas and the public should be disseminated through consultations and the media by SPMU. The potential impact is negative but short-term and reversible by mitigation measures.

**Health and Safety Impacts**

During the construction stage, there shall be impacts on the health, safety and hygienic conditions of both the workforce and the local community. The potential impacts on the local communities shall be direct, such as being struck by moving vehicles within and outside the sub-project area and indirect through the decrease in air quality surrounding the sub-project area. The air quality will reduce as a result of increased dust generated from construction area and on transport routes, as well as due to emissions from plants and vehicles. The impact will continue for the duration of the works and can be mitigated by using water bowsers, speed traps and road signages.

**Gender Base Violence, Sexual Exploitation & Abuse/Sexual Harassment**

Construction workers are predominantly younger males. Those who are away from home on the construction job are typically separated from their family and act outside their normal sphere of social control. This can lead to inappropriate and criminal behaviour, such as sexual harassment of women and girls, exploitative sexual relations, and illicit sexual relations with minors from the communities.

During construction, the vulnerable residents of the host communities, such as youth and women, may be subjected and exploitative tendencies due to social interaction between community members, casual workers who are coming from different places during construction phase, which may result in gender-based violence (GBV), sexual exploitation and abuse (SEA) as well as attitude and behavioral changes among local people. All these are to be considered among the impacts of Gender Violation issues especially during compensation for the affected properties.

**Interference with Business and Daily Activities during Demolition**

Demolition of structures along the setback will lead to interference with informal business activities and basic earning. Most of these businesses acquire loans from relatives and micro finance, banks to stock merchandise. Traders, pharmacists, informal markets, mobile money stands, and motorcycles parking sites will be affected.

**Unplanned/Unforeseen Impacts - Fire Outbreak**

Risks to human safety related to fire from unsafe handling of construction material including fuel and other substances. The scope of these impacts is limited; they are for the workers and depend on compliance with safety requirements.

**Table 5.7: Significance Ranking of Identified Impacts for the Bulka Project During Pre-Construction**

| Pre-Construction Phase | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Impacts Summary** | **L** | **M** | **F** | **I** | **P** | **Likelihood** | **Impact Rating** |
| | **Environmental** | | | | | | | |
| | • Loss of biodiversity and vegetation within the site through site clearing, however, the site will not be cleared at the same time but in batches.<br>• Vegetation removal may lead to loss of habitat for endangered fauna species such | Med (3) | Med (3) | Low (1) | Med (3) | Low (1) | 2C | Minor |
| • Preliminary site surveys and investigation works<br>• Mobilization of personnel and equipment for site preparation activities<br>• Continuous Community engagement<br>• Site preparation activities including fencing, vegetation removal, excavations, earth works. | • Air quality pollution as a result of fugitive emissions from dust generated and equipment usage although only while the pre-construction activities are going on, | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | • Pre-construction operations which include grading, filling, excavation, earthwork and movement of vehicles and heavy construction equipment will disrupt topsoil. The disruption of soil profile-mostly loss of topsoil, will increase the erosion potential at the project site, | Low (1) | Med (3) | High (5) | Med (3) | Med (3) | 3E | Major |
| | • Increased noise levels and vibrations within the project area from movement of heavy-duty equipment could affect the local settlements and wildlife | Med (3) | Med (3) | Med (3) | Low (1) | Low (1) | 2D | Medium |
| | • Contamination of the surface water (Gulbi) as a result of siltation caused by increased erosion during site preparation | Low (1) | Med (3) | High (5) | Med (3) | Med (3) | 3E | Major |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | • Generation of solid waste (scrap metal, wood, sand, concrete, iron rods, paper) | Med (3) | Med (3) | Med (3) | Low (1) | Low (1) | 2D | Medium |
| | **Social** | | | | | | | |
| | • Provision of employments, skilled and unskilled, traders, businesses, etc | - | - | - | - | - | - | Positive |
| | • Stock piling and dust from materials and vehicular movement, may impair the visual aesthetics and raise grievances from community | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | High |
| | • Community agitations over improper resettlement of landowners or compensation | Med (3) | Med (3) | Med (3) | Low (1) | Low (1) | 2D | Medium |
| | • Conflicts over employment issues | Med (3) | Med (3) | Med (3) | Low (1) | Low (1) | 2D | Medium |
| | • Increased level of poverty due to loss of farmlands which are major source of livelihoods | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | • Economic loss arising from clearing of farmlands and crops | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | • Assault of workers, kidnapping and vandalization of equipment | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | • Impact on land use as available land for community use and expansion will be affected since a vast portion of land has been affected by the stormwater channel. Hence, potential agricultural land is also lost. | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | **Occupational Health and Safety** | | | | | | | |
| | • Increase in vehicular movement and traffic around | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | the project site leading to potential road accidents. Trips, falls and injuries from open excavations | | | | | | | |
| | • Trips, falls and injuries from open excavations and working at heights and use of heavy machineries and equipment. | Med (3) | Med (3) | Med (3) | Low (1) | Low (1) | 2D | Medium |

**Table 5.8: Significance Ranking of Identified Impacts for the Bulka Project During Construction and Installations**

| | Impacts Summary | L | M | F | I | P | Likelihood | Impacts Rating |
|---|---|---|---|---|---|---|---|---|
| • Mobilization of personnel and equipment<br>• Installation of signage, markings and cordoning-off<br>• Soil excavation,<br>• foundations and channel structures construction,<br>• Location and developments of borrow pits<br>• Laying of precast, Concrete works<br>• other associated earthen works etc;<br>• Generation of Solid waste and waste removal<br>• Commissioning | **Environmental** | | | | | | | |
| | • Emissions generated from vehicle exhaust, dust and machinery engine emissions could potentially impact air quality | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | • Increased noise levels within the project site during the use heavy equipment such as excavator, bull dozer, cement trucks and vehicular movement and blasting activities | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | • Site runoff resulting from dust suppression sprays, cement works, oils, grease from machinery and vehicles as well as waste water from erosion of temporary stockpile. | Med (3) | Med (3) | Med (3) | Low (1) | Low (1) | 2D | Medium |
| | • The impact on surface water quality, hydrobiology and fisheries as a result of run offs and sand filling | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | • Increased use of natural resources such as water for construction activities and other high demand for water | Med (3) | Med (3) | Med (3) | Low (1) | Low (1) | 2D | Medium |
| | • Generation of potential non-hazardous wastes such as metal | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | scraps, and plastics, hazardous materials such as paints and maintenance fluids for equipment (i.e. spent oils, spent lube, waste oil filters etc.) and non- hazardous wastes in the form of sanitary and domestic wastes | | | | | | | |
| | • Construction activities will alter and lead to loss of the existing fauna and flora habitat (landscaped area with trees) and diversity around the facility. | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | **Social** | | | | | | | |
| | • Provision of employments, skilled and unskilled, traders, businesses, etc | - | - | - | - | - | - | Positive |
| | • During construction, there may be contamination of the surface water (Gulbi) due to runoff from construction materials, etc., affecting usability of the water by the community | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | • Construction activities may also bring about noise pollution, thus, being a nuisance to residents nearby, passers-by and others. | Med (3) | Med(3) | Low(1) | Med(3) | Med(3) | 3C | Medium |
| | • There will be traffic congestions especially along the road as a result of heavy-duty vehicles conveying construction materials to site and construction activities along the roads | Med (3) | Med(3) | Low(1) | Med(3) | Med(3) | 3C | Medium |
| | • Possible conflict between contractor personnel and community | Low (1) | Med (3) | Low(1) | Med(3) | Low(1) | 1C | Minor |
| | • Grievances of the Interested and Affected Parties (IAPs) may result to violent attacks to the lives of the site construction workers, civil workers and other project related people. | Low(1) | Med(3) | Med(3) | Low(1) | Med(3) | 3C | Medium |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | • Potential impact from spread of sexually transmitted diseases and Gender Based Violence (GBV) and Sexual Exploitation and Abuse (SEA) | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | • Children/teenagers may be exposed to child labour and risk becoming dropouts due to the availability of work during the construction activities. | Med (3) | Med (3) | Med (3) | Med (3) | Med (3) | 4D | Major |
| | **Occupational Health and Safety** | | | | | | | |
| | • Increased dust in the ambient air in working zones; | Med (3) | Med (3) | Med (3) | Med (3) | Low (1) | 2B | Moderate |
| | • Heat stress from increased exposure of construction workers to the sun; | Med (3) | Med (3) | Med (3) | Med (3) | Low (1) | 2B | Moderate |
| | • Work site accident and injuries, trips, falls and burns; | Med (3) | Med (3) | Med (3) | Med (3) | Low (1) | 2B | Moderate |
| | • Increased risk of infections and spread of communicable diseases due to influx of people. | Med (3) | Med (3) | Med (3) | Med (3) | Low (1) | 2B | Moderate |
| | • Impacts from noise and vibration levels; | Med (3) | Med (3) | Med (3) | Med (3) | Low (1) | 2B | Moderate |

**Table 5.9: Significance Ranking of Identified Impacts for the Bulka Project During Operations**

| **Operations Phase** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| • Operation of the stormwater channel<br>• Routine maintenance of installed facilities, | **Impacts Summary** | **L** | **M** | **F** | **I** | **P** | **Likelihood** | **Impacts Rating** |
| | **Environmental** | | | | | | | |
| | • Reduced/controlled Erosion and adequate Flood Mitigation | - | - | - | - | - | - | Positive |
| | • Improved Water Quality and carrying capacity | - | - | - | - | - | - | Positive |
| | • Increased water discharged into the receiving water body (Gulbi). | Med (3) | Med (3) | Med (3) | Med (3) | Low (1) | 2B | Moderate |
| | **Social** | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | • Improved aesthetic quality | - | - | - | - | - | - | Positive |
| | • Separation of close community members due to expansion, channelization and cordoning-off of the gully | Low (1) | Low (1) | Low(1) | Med(3) | Low(1) | 1C | Minor |

**Table 5.10: Significance Ranking of Identified Impacts for the Bulka Project During Decommissioning & Abandonment**

| **Decommissioning & Abandonment Phase** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Impacts Summary** | **L** | **M** | **F** | **I** | **P** | **Likelihood** | **Impacts Rating** |
| | **Environmental** | | | | | | | |
| • Shutdown of activities,<br>• Demobilization of decommissioned equipment,<br>• Waste generation and management of residual waste materials<br>• Site Restoration activities – clean-up of site and landscaping | • Disturbance to soil profile, and potential contamination from surface runoff during abandonment. | Med (3) | Low (1) | Med (3) | Low (1) | Med (3) | 2C | Minor |
| | • Surface water (adjoining rivers) contamination from runoff resulting from dust suppression sprays, oils and grease from machinery and vehicles used for dismantling works. | Med (3) | Med (3) | Low (1) | Low (1) | Low (1) | 2C | Minor |
| | • Improper management and disposal of waste | Low (1) | Med (3) | Low (1) | Med (3) | Med (3) | 3C | Moderate |
| | • Air pollution as a result of dust and fumes from heavy equipment movement during dismantling | Low (1) | Med (3) | Low (1) | Med (3) | Med (3) | 3C | Moderate |
| | • Increased noise levels within community during dismantling activities. | Low (1) | Med (3) | Low (1) | Med (3) | Med (3) | 3C | Moderate |
| | **Occupational and Community Health** | | | | | | | |
| | • Air pollution resulting in illnesses such as swollen eye, difficulty in breathing, catarrh and bronchitis (respiratory tract infections). | Med (3) | Med (3) | Low (1) | Low (1) | Med (3) | 3C | Moderate |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | • On-site traffic congestion and risk of road traffic accidents during dismantling and movement of equipment. | Low (1) | Low (1) | Low (1) | Med (3) | Med (3) | 2C | Minor |
| | • Trips, slips and falls of workers during dismantling of equipment and machinery | Med (3) | Med (3) | Low (1) | Med (3) | Med (3) | 2D | Moderate |
| | **Social** | | | | | | | |
| | • Loss of temporary and permanent business /employment/means of livelihood due to work completion and workers disengagement. | Med (3) | Low (1) | Low (1) | Med (3) | Med (3) | 2D | Moderate |
| | • Reduced social vices, GBV /SEA possible cases due to workers disengagement and demobilization from project site | Low (1) | Low (1) | Low (1) | Med (3) | Med (3) | 2C | Minor |
| | • Traffic obstruction from transportation of decommissioned structures and equipment | Med (3) | Low (1) | Low (1) | Med (3) | Med (3) | 2D | Moderate |

### 5.3.3 Cumulative /Secondary Impacts

The envisaged cumulative /secondary impacts arising from the gully erosion control works is considered minimal. This is the situation since the project area is not located close to any environmentally sensitive area and there is no known environmental degrading facility close to the project location. Most importantly, the project is an intervention work to rehabilitate the devastation of the environment and social health due to gully erosion that could eventually impact on the community should the intervention not take place as scheduled. This will enhance public good with no disruption of travels on the road corridor threatened by the erosion. The project plan includes the planting of vegetation which are environmentally supportive.

### 5.3.4 Environmental justice

The gully erosion control work serves as a remedy to avoid the further devastation of the community with the potential to have gullies by erosion which is already causing some anxiety to all members of the communities. Thus, the outcome is not meant for a particular section of the society, irrespective of status. The neighbourhoods within which the intervention will take place will rather be enhanced and not affected negatively by the physical environmental impacts more than other areas.

### 5.3.5 Climate Change Impact

The carbon footprint of the proposed project will result from the direct use of hydrocarbon products for powering heavy-duty trucks and vehicles as well as soil excavation and the clearing of vegetation including trees with carbon sink potentials during the project construction phase. However, it is expected that the impacts will be minimal with adequate mitigation measures in place.

## 5.4 Mitigation/Enhancement Measures

Based on the impacts identified, appropriate corresponding mitigation measures have been identified to prevent, minimise, mitigate or compensate for adverse environmental and/or social impacts. In addition, enhancement measures have been developed in order to improve project environmental and social performance. The roles and responsibilities to implement these measures are clearly defined alongside the budget for the measures estimated.

Based on overall significance ratings (Major, Medium or Minor) in **chapter five**, the expected residual rankings after mitigation are classified as “Negligible, Low and Moderate”.

The mitigation measures as presented in **Table 6.1** below have been proffered with reference to the following considerations

- National and international guidelines and regulatory requirements;
- Best industry practices and best available technologies;
- Available resources and competencies, On-site conditions; and Public concerns

### 5.4.1 Mitigation Measures Hierarchy

The measures proposed are specific, measurable, achievable and relevant to the proposed intervention and time based (SMART). The measures also considered the environmental laws in Nigeria, and internationally and the principles of sustainable development and best available technology. The principle of mitigation hierarchy outlined below was also considered:

- **Avoidance** – methods aimed at preventing the occurrence of negative impacts, and/or impeding such occurrence from having harmful environmental/social outcomes;
- **Minimization** – limiting or reducing the degree, extent, magnitude, or duration of adverse impacts. Reduction can be achieved by scaling down, relocating, or redesigning elements of a project;
- **Control** – ensuring that occurring impacts are reduced to a level as low as reasonably practicable;
- **Compensation** - recompense for residual impacts through offsets.

**Table 5.11-5.14** below outlines preferred mitigation measures for the identified impacts.

**Table 5.11: Mitigation Measures of Identified Impacts for the Bulka Stormwater Project During Pre-Construction**

| Pre-Construction Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** |
| • Preliminary site surveys and investigation works<br>• Mobilization of personnel and equipment for site preparation activities<br>• Continuous Community engagement<br>• Site preparation activities including fencing, vegetation removal, excavations, earth works | **Environmental** | | | |
| | • Loss of biodiversity and vegetation within the site through site clearing, however, the site will not be cleared at the same time but in batches.<br>• Vegetation removal may lead to loss of habitat for endangered fauna species such | Minor | • Site clearing shall be limited to the area required for the project.<br>• Green area and replantation shall be designated along the project RoW.<br>• Rehabilitation of cleared areas with selected species, and ecosystem restoration in habitats of conservation value, using specialist advice and input, backed up by a long-term monitoring programme and corrective actions as necessary<br>• Development and Implementation of a Biodiversity Action Plan | Negligible |
| | • Air quality pollution as a result of fugitive emissions from dust generated and equipment usage although only while the pre-construction activities are going on, | Major | • Dust emissions must be kept to a minimum level through regular sprinkling of water (at least every hour during work hours of the day).<br>• All excavation work will be sprinkled with water to control dust;<br>• Ensure vehicles/machines are switched off when not in use.<br>• Ensure only vehicles required to undertake works are operated on-site.<br>• Ensure all construction vehicles, plant and machinery are well maintained and in full operating condition.<br>• Effective preventative maintenance established to ensure all construction equipment and electricity generators are maintained in good working conditions | Minor |
| | • Pre-construction operations which include grading, filling, excavation, earthwork and movement of vehicles and heavy construction equipment will disrupt topsoil. The disruption of soil profile- mostly loss of topsoil, will increase the erosion potential at the project site, | Major | • Topsoil stripped off due to preconstruction activities shall be stockpiled for rehabilitation works.<br>• Ensure topsoil are not stored in large heaps. Store removed topsoils in low mounds of no more than 1 to 2m high are recommended, reuse stored topsoil as needed.<br>• Avoid stripping soils when they are wet, as this can cause compaction and loss of structure. | Moderate |

| Pre-Construction Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** |
| | | | • Backfill excavated areas with non-polluting soils or overburden.<br>• Sufficient ground cover will be added to protect the topsoil from rain, wind and other natural elements that gradually erodes the top layer of the soil.<br>• All cut slopes, embankments, and other erosion-prone working areas will be stabilized to the extent feasible while work is going on. | |
| | • Increased noise levels and vibrations within the project area from movement of heavy-duty equipment could affect the local settlements and wildlife | Moderate | • Ensure equipment and machinery to be used for site preparation and clearing activities are climate friendly, well maintained and soundproof.<br>• Maintain, equipment and automobiles at optimal functioning levels<br>• Machinery, vehicles and instruments that emit high levels of noise should be used on a phased basis to reduce the overall impact of the vibrations and noise.<br>• Ensure noise generated are within the permissible limits as prescribed u der the NESREA regulation 2009 for Noise standards and control as specified in S.I No 35.<br>• Workers, especially those working with machines, vehicles and instruments that emit high levels of noise/vibrations are supplied with ear plugs and earmuffs to reduce the risk of hearing impairment. | Minor |
| | • Contamination of the surface water (Gulbi) as a result of siltation caused by increased erosion during site preparation | Major | • Install silt traps in points of entry into water channels to catch silt before exiting the site<br>• Plan a maintenance and cleaning program to keep water channels free of trapped silt<br>• Refuelling, maintenance and wash-down of construction vehicles and equipment will only occur in designated areas and away from surface water bodies, and provided with secondary impermeable containment measures<br>• Water quality analysis by third party consultants | Moderate |

| Pre-Construction Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** |
| | • Generation of solid waste (scrap metal, wood, sand, concrete, iron rods, paper) | Major | • Waste bins will be provided at all construction sites for the disposal of the various types of wastes generated by the project. These bins will be clearly marked to facilitate segregation of waste, for collection, transportation and disposal.<br>• Separation of domestic and hazardous waste at the source shall be strictly enforced.<br>• Where possible, wastes will be re-used or recycled. This is a requirements for waste oils, other hydrocarbons and tires and other hazardous and non-hazardous wastes<br>• Burning of waste will not be permitted<br>• All personnel will be trained in the appropriate management of waste according to the WMP.<br>• Proper storage, transport and disposal of hazardous wastes (oily wastes, used batteries, fuel drums) in the designated areas by the national/local authorities in accordance with National Environmental Law. | Moderate |
| | **Social** | | | |
| | • Impact on population hence social and health vulnerability of locals as there would be an influx of workers in the host communities due to the preparatory activities. | Moderate | • Contractor shall ensure an awareness and hygiene campaign. Workers and local residents shall be sensitized on health risks particularly of STIs/STDs.<br>• Encourage hiring, as practicable of appropriately qualified workers from areas in the vicinity of the project to discourage preventable influx of persons.<br>• Work with contractors to ensure that specialized skill workers from outside the areas have access to proper accommodations and other basic infrastructure.<br>• Keep project delivery on schedule to avoid prolonged stay and unwanted invites to migrant workers. | Minor |
| | • Impact on land use as available land for community use and expansion will be affected for the channel development.. | Major | • All affected parties due to the physical displacement of land shall be compensated appropriately.<br>• Stakeholders Engagement Plan developed and implemented | Moderate |

| Pre-Construction Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** |
| | | | • Develop and implement Resettlement Action Plan (RAP),<br>• Ensure commensurate compensation<br>• Develop livelihood restoration plan | |
| | **Occupational Health and Safety** | | | |
| | • Increase in vehicular movement and traffic around the project site leading to potential road accidents. | Major | • Road traffic management personnel shall be employed to constantly ensure traffic is managed for vehicles and automobiles leaving the.<br>• Temporary speed bumps to be installed on the major road around the area.<br>• Signages with speed limits should be displayed at various areas. | Moderate |
| | • Trips, falls and injuries from open excavations and working at heights | Major | • First aid kits on site and registration with nearby health primary health centre in host communities.<br>• Provide adequate lighting for night works if night time works are necessary.<br>• Open excavations shall be properly cordoned off using caution tapes.<br>• Ensure all staff wear appropriate PPEs.<br>• Implement health awareness programme.<br>• Ensure safety signages are on display at strategic locations. | Moderate |

**Table 5.12: Mitigation Measures of Identified Impacts for the Bulka Stormwater Project During Construction and Installation**

| Construction and Installations Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Ratir** | **Mitigation Measures** | **Impact Residu Rating** |
| | **Environmental** | | | |
| • Mobilization of personnel and equipment<br>• Installation of signage, | • Emissions generated from vehicle exhaust, dust and machinery engine emissions could potentially pollute air, | Major | • Procure equipment and machines that are climate friendly and have low carbon emission capacity (like for diesel generators, on-site vehicles, etc)<br>• Where possible only keep diesel generators and engine off automobiles on when in use.<br>• Air quality monitoring on site. | Moderate |

| Construction and Installations Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Ratin** | **Mitigation Measures** | **Impact Residu Rating** |
| markings and cordoning-off<br>• Soil excavation,<br>• foundations and channel structures construction,<br>• Location and developments of borrow pits<br>• Laying of precast, Concrete works<br>• other associated earthen works etc;<br>• Generation of Solid waste and waste removal<br>• Commissioning | | | • Ensure that emission levels of machinery are within permissible limits, based on the best site practices and relevant dust control measures set out in the Air pollution control regulations by NESREA for Construction sector | |
| | • Increased noise levels within the project site during the use heavy equipment such as excavator, bull dozer, cement trucks and vehicular movement. | Major | • Proper sound management during work hours.<br>• Monitor sound levels throughout the construction period.<br>• Procure equipment and machines that are climate friendly and sound proof.<br>• Maintain, equipment and other transport automobiles to optimal functioning levels.<br>• Machinery, vehicles and instruments that emit high levels of noise are used on a phased basis to reduce the overall impact.<br>• Ensure noise generated are within the permissible limits as prescribed u der the NESREA regulation 2009 for Noise standards and control as specified in S.I No 35.<br>• Workers, especially those working with machines, vehicles and instruments that emit high levels of noise/vibrations are supplied with ear plugs and ear muffs to reduce the risk of hearing impairment. | Moderate |
| | • Site runoff resulting from dust suppression sprays, cement works, oils, grease from machinery and vehicles as well as wastewater from erosion of temporary stockpile. | Moderate | • Runoff from activities should be restricted to site by constructing diversion channels or holding structures such as banks, drains, dams, etc., to reduce the potential of soil erosion and water pollution and cut-off drains to divert surface runoff from exposed soils or construction areas.<br>• Employ good site management practices as outlined in NESREA regulation 2011 for Construction sector.<br>• All drainage and effluent from storage areas, workshops and camp sites shall be captured and treated before being discharged into the drainage system in line with applicable government water pollution control regulations. | Minor |

| Construction and Installations Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Ratin** | **Mitigation Measures** | **Impact Residu Rating** |
| | • Generation of potential non-hazardous wastes such as metal scraps, and plastics, hazardous materials such as paints and maintenance fluids for equipment (i.e. spent oils, spent lube, waste oil filters etc.) and non- hazardous wastes in the form of sanitary and domestic wastes | Major | • Ensure various wastes streams generated on-site are segregated and containerized in colour-coded bins.<br>• Maintain inventory of daily waste generated.<br>• Construction waste shall not be left in stockpiles along the road, but removed and reused or disposed of on a daily basis.<br>• Liquid waste from concrete works, grease, chemicals and oil spill should be immediately mopped up.<br>• Remove toxic materials and dispose of them in designated sites.<br>• Surface runoffs should be properly channelled to drainage.<br>• Register with state waste management board for proper waste treatment and disposal.<br>• All waste containers, litter and any other waste generated during the construction shall be collected and disposed of at designated disposal sites in line with applicable government waste management regulations.<br>• Use existing, approved sites, do not establishment new sites. | Moderate |
| | **Social** | | | |
| | • Grievances of the PAPs may result to violent attacks to the lives of the site construction workers, civil workers and other project related people. | Moderate | • Establish and maintain a robust grievance redress mechanism to manage emergence of such issues from PAPs.<br>• Continuous stakeholders and community engagement through all phases of project. Stakeholders Engagement Plan to form a basis for this continuous consultation. | Minor |

| Construction and Installations Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Ratir** | **Mitigation Measures** | **Impact Residu Rating** |
| | • Potential impact from spread of sexually transmitted diseases and Gender Based Violence (GBV) and Sexual Exploitation and Abuse (SEA) due to influx of construction workers into site | Major | • Code of conduct should be developed by contractor creating awareness and showing commitment to ensuring workers do not engage in SEA and GBV throughout duration of construction.<br>• Awareness campaigns targeting project workers, senior management, contractors, subcontractors and their spouses, communities near project facilities, risk groups (commercial sex workers, truck drivers) –<br>• Prevention, voluntary counselling for HIV testing, as well as antiretroviral treatment for employees and surrounding communities<br>• Stakeholders Engagement Plan developed and implemented<br>• Clearly define the GBV requirements and expectations in the bid documents for a GBV action plan, Code of conduct for workers and adequate costing for implementing the GBV plan.<br>• The contractor ESMP and should among others, set out the mechanism for receiving, reviewing and addressing GBV complaints in a confidential manner, workers SEA/SH code of conduct and the accountable framework, mapping of GBV response actors within the project areas and working with them to provide quality survivor centered services including case management, referral services and linkage to others services not provided by them, etc. | Moderate |
| | • The increased vehicular movement and speed may result in road safety issues like traffic accidents within project area. | | • Community consultations and meetings on the ongoing works and related hazards will be held.<br>• Active sites will be sealed off from the public using reflective tapes and cones; where necessary road diversions will be created.<br>• Safety initiatives will be developed and implemented, including:<br>o Ensuring that only qualified (licenced) drivers operate machinery; | |

| Construction and Installations Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Ratin** | **Mitigation Measures** | **Impact Residu Rating** |
| | | | ○ Implementing speed limits and traffic control measures in appropriate locations;<br>○ Implementing safety signage;<br>○ Installing speed control devices on trucks<br>○ Movement of large construction machinery will be guided by a flagman. | |
| | **Occupational Health and Safety** | | | |
| | • Work site accident and injuries, trips, falls and burns; | Moderate | • First aid kits on site and registration with nearby health primary health centre in host communities.<br>• Provide adequate lighting for night works if nighttime works are necessary.<br>• Open excavations shall be properly cordoned off using caution tapes.<br>• Ensure all staff wear appropriate PPEs.<br>• Implement health awareness programme.<br>• Ensure safety signages are on display at strategic locations. | Minor |
| | • Increased risk of infections and spread of communicable diseases due to influx of people. | Moderate | • Labour Management Plans shall be prepared by Project Contractor(s) based on the Project Labour Management Procedures for approval by the Bank/SPIU to guide labour relations<br>• Contractors and Sub-contractors will be required to hire labour through a structured HR process onduct health awareness, education, healthcare trainings, immunization programs and health service provision.<br>• Awareness campaigns targeting project workers, senior management, contractors, subcontractors and their spouses, communities near project facilities, risk groups (commercial sex workers, truck drivers).<br>• Prevention, voluntary counselling for HIV testing, as well as antiretroviral treatment for employees and surrounding communities | Minor |
| | • Risk of Worker being Kidnapped and killed/ workers being killed by terrorists or loss of their properties to armed robbers. | High | • Appoint a Safety and Security Focal Officer to over see Security issues.<br>• The officer prepares and implements a Security plan to guide the implementation of the project in Bulka. | Moderate |

| Construction and Installations Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Ratir** | **Mitigation Measures** | **Impact Residu Rating** |
| | | | • Engage and train the Uniform Security personnel (NCDC) on the Ethics and Code of Conduction to work in Bank Assisted projects.<br>• Also, train the PIU workers/contractor workers.<br>• Ensure synergy with other Security forces like the Police, DSS, Nigerian Military etc.<br>• Monitor and Keep Records. | |

**Table 5.13: Mitigation Measures of Identified Impacts for the Bulka Stormwater Project During Operations**

| Operations Phase | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation/Enhancement Measures** | **Impact Residual Rating** |
| • Operation of the stormwater channel<br>• Routine maintenance of installed facilities, | **Environmental** | | | |
| | • Reduced/controlled Erosion and adequate Flood Mitigation | Positive | • Regular monitoring of stormwater channel structures<br>• Waste removal to prevent clogging of drainage system<br>• Community sensitisation on the need to maintain the gully channel and not throw solid waste into the channel | Positive |
| | • Improved Water carrying capacity | Positive | | Positive |
| | • Increased water discharged into the receiving water body (Gulbi). | Moderate | • Dredging and Desilting of the Gulbi water area (Discharge point) to ensure it conveniently collects more water | Minor |
| | **Social** | | | |
| | • Improved aesthetic quality | Positive | • Regular monitoring of stormwater channel structures<br>• Waste removal to prevent clogging of drainage system<br>• Community sensitisation on the need to maintain the gully channel and not throw solid waste into the channel | Positive |
| | • Separation of close community members due to expansion, channelization and cordoning-off of the gully | Minor | • Create alternative routes to connect communities | Negligible |

**Table 5.14: Mitigation Measures of Identified Impacts for the Bulka Stormwater Project During Decommissioning & Abandonment**

| Decommissioning & Abandonment | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** |
| | **Environmental** | | | |
| | • Disturbance to soil profile, and potential contamination from surface runoff during abandonment. | Minor | • Backfill excavated areas with soils or overburden that is free of foreign material that could pollute groundwater and soil.<br>• Carry out internal environmental assessment to check activities and status of construction activities while in process.<br>• Manage and dispose of waste from erosion through building drainage channels connecting to the treatment plant. | Negligible |
| • Shutdown of activities,<br>• Demobilization of decommissioned equipment,<br>• Waste generation and management of residual waste materials<br>• Site Restoration activities – clean-up of site and landscaping | • Surface water (adjoining rivers) contamination from runoff resulting from dust suppression sprays, oils and grease from machinery and vehicles used for dismantling works. | Minor | • Restrict runoff to site by constructing diversion channels or holding structures such as banks, drains, dams, etc., to reduce the potential of soil erosion and water pollution and cut-off drains to divert surface runoff from exposed soils or construction areas.<br>• Wash water from washing out of equipment shall not be discharged into water courses or road drains.<br>• Ensure equipment used are designed to cause less disturbance and harm to the aquatic ecology when cutting through existing river.<br>• Employ good site management practices as outlined in NESREA regulation 2011 for Construction sector.<br>• All drainage and effluent from storage areas, workshops and camp sites shall be captured and treated before being discharged into the drainage system in line with applicable government water pollution control regulations.<br>• To the extent practicable, reinstate natural drainage patterns where they have been altered or impaired.<br>• Provide absorbent materials and other containment equipment on site for quick response to any form of spill. | Negligible |
| | • Improper management and disposal of waste | Moderate | • Ensure various wastes streams generated on-site are segregated and containerized in colour-coded bins.<br>• Maintain inventory of daily waste generated. | Minor |

| Decommissioning & Abandonment | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** |
| | | | • Liquid waste from concrete works, grease, chemicals and oil spill should be immediately mopped up.<br>• Remove toxic materials and dispose of them in designated sites.<br>• Surface runoffs should be properly channelled to drainage.<br>• Register with state waste management board for proper waste treatment and disposal.<br>• All waste containers, litter and any other waste generated during the construction shall be collected and disposed of at designated disposal sites in line with applicable government waste management regulations.<br>• Use existing, approved sites, do not establishment new sites. | |
| | • Air pollution as a result of dust and fumes from heavy equipment movement during dismantling | Moderate | • Dust minimization measures shall be implemented including watering of the construction areas, including the road surfaces under construction.<br>• Soil stockpiles and stores of friable material will be covered to reduce the potential for fugitive emissions of dust where possible.<br>• Vehicles carrying friable materials will be enclosed or sheeted.<br>• Loading, unloading and handling of dusty materials will only be carried out in designated areas.<br>• Ensure vehicles/machines are switched off when not in use.<br>• Ensure only vehicles required to undertake works are operated on-site.<br>• Ensure all construction vehicles, plant and machinery are well maintained and in full operating condition.<br>• Effective preventative maintenance established to ensure all construction equipment and electricity generators are maintained in good working order and do not adversely impact air quality due to inadequate maintenance or damage. | Mnor |

| Decommissioning & Abandonment | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** |
| | • Increased noise levels within community during dismantling activities. | Moderate | • Install noise reduction devices such as silencers and mufflers as appropriate to mobile plant and equipment.<br>• Limit the active construction site to not more than 500 meters per 2.0 km lengths<br>• Limit work to daylight hours. Schedule noisy construction activities during specific times in the day especially near the sensitive receptors<br>• Advance notice will be given to communities if short-term noisy construction activities are to take place, which could cause these levels to be exceeded. | Minor |
| | **Occupational and Community Health** | | | |
| | • Air pollution resulting in illnesses such as swollen eye, difficulty in breathing, catarrh and bronchitis (respiratory tract infections). | Minor | • Vehicles carrying friable materials will be enclosed or sheeted.<br>• Loading, unloading and handling of dusty materials will only be carried out in designated areas.<br>• Regular damping of unpaved roads or exposed soils/ground to control dust/particulate matter and keep it down.<br>• Workers would be provided with adequate PPE<br>• Ensure vehicles/machines are switched off when not in use.<br>• Ensure only vehicles required to undertake works are operated on-site.<br>• Ensure all construction vehicles, plant and machinery are well maintained and in full operating condition. | Negligible |
| | • On-site traffic congestion and risk of road traffic accidents during dismantling and movement of equipment. | Moderate | • Proper diversion and signage shall be provided<br>• Traffic management plan will be prepared and implemented<br>• Prohibit trucks from parking along the access roads<br>• Plan work activities to avoid heavy duty movement during peak hours<br>• Ensure equipment and automobiles are properly maintained | Minor |
| | • Trips, slips and falls of workers during dismantling of equipment and machinery | Moderate | • Ensure all staff utilize appropriate PPEs.<br>• Record, review and improve on HSE KPI's throughout the project. | |

| Decommissioning & Abandonment | | | | |
|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** |
| | | | • Ensure all staff are properly trained and certified in their relevant work function. | |
| | **Social** | | | |
| | • Loss of temporary and permanent business /employment/means of livelihood due to work completion and workers disengagement. | Moderate | • Empowerment of disengaged works and recommendation to other employers and contractors for hire.<br>• Prompt payment and if possible, re-engagement during subsequent phases of the project.<br>• Training in other vocations and capacity building plans for skilled and unskilled workforce | Minor |
| | • Reduced social vices, GBV /SEA possible cases due to workers disengagement and demobilization from project site | Minor | • Ward off unauthorized persons with appropriate signs.<br>• Secure the area with security personnel from the communities.<br>• Empower disengaged workers and recommended to other employers and contractors for hire. | Negligible |
| | • Traffic obstruction from transportation of decommissioned structures and equipment | Moderate | • Community consultations and meetings on the ongoing works and related hazards will be held.<br>• Active sites will be sealed off from the public using reflective tapes and cones; where necessary road diversions will be created.<br>• Safety initiatives will be developed and implemented, including:<br>– Ensuring that only qualified (licenced) drivers operate machinery;<br>– Implementing speed limits and traffic control measures in appropriate locations;<br>– Implementing safety signage;<br>– Installing speed control devices on trucks<br>• Movement of large construction machinery will be guided by a flag woman/flagman. | Minor |

### 5.4.2 Initiatives to Complement Mitigation/Enhancement Measures

**Security Measures**

To ensure adequate security protection of the community and the workers in the Agro-Climatic Resilience in Semi-Arid Landscapes (ACReSAL) Project area against criminal/ terror attacks, the SPMU shall ensure the implementation of the following additional mitigation measures.

- Appoint a safety and security focal officer to over see Security issues.
- The appointed safety and security focal officer prepare a Security plan to guide the implementation of the project in Bulka.
- Engage and train the Uniform Security personnel (NSCDC) on the Ethics and Code of Conduction to work in Bank Assisted projects.
- Also, train the PIU workers and contractor workers on security issues.
- Ensure synergy with other Security forces like the Police, DSS, Nigerian Military etc.
- Monitor and Keep Records.
- Welfare of Security officers MUST be prioritized.
- Standard Operating Procedures should be created and adopted.
- Responsibilities MUST be defined for every officer.
- Security officers MUST visible.
- Surveillance and Patrols MUST be constantly carried out and appropriate strategies to gather Intelligence MUST be apt.
- Ensure working in Synergy with other security agents to harnonise Intelligence.
- The activities of the Security officers MUST be supervised and monitored by their superiors.
- Site Access be defined and controlled.
- Safety of the life of contractors, workers, community members and their properties SHALL be prioritized.

**Labour Influx**

During project implementation, the arrival of construction workers and the associated influx of camp followers or business opportunists in the project area may result in some labour influx-related risks such as workers' sexual exploitation of minors, presence of sex workers in the project communities, the spread of HIV/AIDS and other STDs/STIs, sexual harassment, sexual exploitation and abuse, child labour and abuse, increased drop-out rates from school, poor community participation, poor labour practice, and increase risk of road accident. These risks require an action plan to improve the social sustainability of the project as well as resilience and social cohesion in the affected communities.

To ensure adequate protection of project communities against the vices highlighted above, the SPIU shall ensure the implementation of the following additional mitigation measures:

a. Assessing living conditions of workers' camps to ensure appropriate living conditions and location to ensure it is not close to schools, marketplace or anywhere women/girls access to avoid any form of GBV.

b. Establishing proper agreement with host communities on location of contractor's camp and yard.
c. Establishing and enforcing a mandatory Code of Conduct for the contractors, Supervision consultants and anyone working in the project, and an Action Plan for implementation.
d. Ensuring appropriate location for these camps.
e. Taking countermeasures - indicated in the ESMP - to reduce the impact of the labour influx on public services.
f. Devising and implementing a strategy for maximizing employment opportunities for the local population, including women.

A Supervision Consultant (GBV consultant and the SPIU GBV officer) shall be responsible for monitoring the contractor's performance and adherence to the guideline of its Sexual Exploitation and Abuse (SEA) obligations, with a protocol in place for immediate, timely, mandatory, and confidential reporting cases of incidents in the project communities.

**Gender- Based Violence**

Nigeria has ratified or acceded to the core international human rights treaties and is party to the major regional human rights instrument which obliged States to respect, protect and fulfil human rights of all persons within the territory and subject to the jurisdiction of the State, without discrimination. Rape may violate several human rights obligations enshrined in the instruments ratified by Nigeria and is also a form of gender-based violence and a brutal manifestation of violence against women. As a State party to the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) and the protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (the ''Maputo Protocol'', Nigeria has made legally binding commitments to exercise due diligence to combat gender - based violence and discrimination. Accordingly, Nigeria has an obligation to take all appropriate measures to prevent rape, ensure that there are adequate sanctions for rape in law and in practice and ensure access to reparation for the victims. Furthermore, several human rights instruments require Nigeria to take special measures to protect the rights of individuals who are vulnerable to sexual violence, namely, women, children and persons with disabilities.

The GBV Action Plan includes specific arrangements for the project by which GBV risks will be addressed. This includes considerations such as:
a) Awareness Raising Strategy, which describes how workers and local communities will be sensitized to GBV risks, and the worker's responsibilities under the CoC;
b) GBV Services Providers to which GBV survivors will be referred, and the services which will be available.
c) GBV Allegation Procedures which states how the project will provide information to employees and the community on how to report cases of GBV, Code of Conduct breaches to the GRM.
d) Sensitization on the importance of addressing SEA/SH on the project, and the mechanisms that will be implemented.

e) Conduct GBV/SEA assessment at project sites
f) Strengthen Institutional capacity for GBV/SEA risk mitigation and response.
g) GBV/SEA sensitive channels for reporting in GRM

During construction activities, the presence of young girls or middle-aged women engaging in trading activities (sales of foods, drinks etc.) is inevitable given the additional business opportunities that the projects will create. It is reasonable to assume that women might face some form of sexual violence in the project sites. GBV risks in the project areas might include Intimate Partner Violence (IPV), public harassment including verbal insults, physical abuse, rape, women and child trafficking. The development and implementation of specific GBV risk prevention and mitigation strategies, tailored to local contexts, will be critical. Therefore, it is important for SPIU to include in the bidding documents ('pre-qualification' and 'employers' requirements') key principles and specific requirements to address GBV to reduce and mitigate the risks of GBV especially during project implementation. Some of these measures are included as part of mitigation measures and form part of the development of the GBV action plan. Additional measures include:

- GBV/SEA assessment of project.
- Mandatory contractors' code of conduct on sexual harassment.
- Monthly site visits by the safeguard unit/GBV officer to monitor GBV/SEA during construction/implementation phase.
- Community and workers' sensitization on GBV/SEA.
- Provision of referral units for survivors of GBV/SEA.
- Provisions in contracts for dedicated payments to contractors for GBV/SEA prevention activities against evidence of completion.
- Contractor and SPIU requirement to ensure a minimum target of female employment with incremental rewards for the obtainment of this target. Contractors also need to develop GBV action plan

**Camp Site Management**

The workers' Camp Site Management Plan for the project should address specific activities that will be undertaken to minimize the impacts resulting from siting a worker's camp on the local project communities. Elements for managing risks associated with the workers' campsite under the proposed project include:

- The Contractor shall ensure that site workers camp is constructed at designated location approved by the SPIU.
- On-site Social and Health Care Facilities: Provision of basic on-site social and medical facilities such as first aid, basic health care centre, food service, mobile toilet etc. to reduce pressure on community facility.
- Campsite Safety and Security: Provision of 24-hour security stationed at the Campsite to ensure the security and safety of the construction workforce and construction equipment.

- Campsite Waste Management: Adequate waste management of sewage and other forms of waste within the campsite. The Campsite shall be equipped with independent toilet facilities for male and female workers respectively, in order to discourage irregular waste disposal. Furthermore, standards must be instituted for personal and public hygiene among project workers. Additionally, project workers shall be properly trained in personal hygiene.
- Establishment and Training of Workers on Code of Conduct: The Supervising Engineer and Safeguards Unit shall ensure that Contractors establish a Workers' Code of Conduct (CoC). The CoC will help mitigate some of the social and environmental impacts of labour influx such as the risk of social conflict, increased risk of illicit behaviour and crime, increased burden on and competition for public service provision, wastewater discharges, increased demand on freshwater resources, and inadequate waste disposal and illegal waste disposal sites etc., will help keep workers in check on the rules and regulations binding their engagement. Contractors shall ensure the provision of training to the workforce on code of conduct and ensure strict compliance.
- Training programs: Conduct and ensure key staff, including contractors, receive training regarding the likelihood, significance and management of influx-related issues such as HIV/AIDS, GBV, SEA, VAC etc.
- Regular E&S compliance Monitoring: The E&S officers of the SPIU shall monitor for change throughout the project cycle to ensure compliance and on mitigation effectiveness from projects/contractors. Ensure a documented monitoring program that tracks key social outcomes, changes, and issues at regular intervals throughout the project lifecycle.

## 5.5 Project Alternatives

Every project requiring an environmental study in the fold of ESMP must be guided by scientifically crafted project alternatives. Thus, Project Alternatives here refer to a comparison of possible actions and modes taken and changes to be considered regarding the implementation of the proposed project at the Bulka Stormwater / Erosion site. Weighing the strengths of these alternatives to select the most appropriate, in terms of addressing the key issues, also becomes a vital step in the ESMP. The choice will be centred on the fundamentals of achieving the threshold of the set criteria concerning all the considered environmental and social variables that are vital to the project (i.e. Applicable or Relevant and Appropriate Requirements (ARAR)).

### 5.5.1 Delayed-Action and Right-Away Action Alternatives

**Delayed-Action**

The delayed-action alternative advocates a deferred option which will result into further damages and degradation of the watershed and increase the cost of rehabilitation in the long run. The consequence of this alternative is that inflation will increase the project costing, and the integration of other economic factors may further cause huge changes in the accrued cost of materials, thereby increasing the financial burden of the entire project. Apart from high project cost, there are no definite advantage identifiable with this alternative in the short-term. This is to the extent that any

incurred damages may eliminate the gains from long-standing effects. This alternative is therefore, undesirable and not recommended for the project.

**Right-Away Action:**
As the term suggests, it means get-go and get it done! It suggests that an immediate action would be taken to address the damages posed by the current status of the gully. This action also suggests prompt and speedy attention to address the issues and to consolidate on the accrued benefits from both the short-term and long-term effectiveness. The influence of inflation and other economic forces will have minimal or little influence on the cost of materials. Accordingly, it will make the anticipated financial burden of the rehabilitation a convincing assessment. This alternative, together with other alternatives, is recommended.

### 5.5.2 Use of Civil Works, Bioengineering and Technological Options

**Civil Works**: This entails constructions and all civil and engineering works as well as the enhancements associated with the project. Civil works are expected to be intense, spanning the broad spectrum of the affected and high-risk areas which demands such level of activities.

**Bioengineering:** This action involves stable seeding and planting of vegetation as part of the gully stabilization measures following construction of the civil engineering measures. The procedure of combining natural vegetation with civil works birth the tag the name bioengineering. The approach involves the use of vegetation, which will stem runoff velocities, holds the soil together, provides habitat for wildlife and is visually pleasing. This approach is also less costly. However, it is imperative to select the appropriate species that are preferably indigenous, and at the least non-invasive so as to integrate vegetal symbiosis as constituent of the project.

**Technological Options:** For the anticipated rehabilitation of the flood-induced damage at the erosion site, all elements of the watershed, particularly the environmental and social components, will be considered. These will be captured as the relevant components of the natural and human environment at the risk of destruction, including the soil, public infrastructure, social and community infrastructures and facilities, will be secured in the affected communities of concern. With regards to topography alteration and slope instability, the technological option will ensure that construction works will be done according to local relief and hydrology, and height of bank stabilisation is done to the local relief. Excavation/scooping will be top down, and no down or base cutting with huge rock hanging will be allowed.

However, the procedure for the restoration works and associated enhancements of the site will involve intensive civil works across the broad spectrum of the affected and high-risk areas. Consequently, construction works (civil works option), synchronised with bioengineering and technological methods, will be adopted in restoring and enhancing the affected areas as presented in the ACReSAL process. The adverse impacts of these activities will be highly reduced in such a way that the benefits will offset the demerits.

The merits of the Civil Works, synchronized with the bioengineering approach in the right-away alternative outweigh the No-Action alternative and it is, therefore, recommended. The three alternatives and technological options as enunciated are summarised in Table 5.15. As shown in the table, Civil Work synchronised with bioengineering technology in the right-away action alternative will provide the solution that the ACReSAL sought while the No-Action alternative will undoubtedly aggravate the problem being experienced in the area.

- Old drainage systems should be maintained and new ones prioritized;
- Ensure that engineering designs are designed with respect to local topography;
- Excavation / scooping should be top down and no down or base cutting with huge rock hanging.
- Height of bank stabilisation to the local relief;
- Depth and area extent of excavation;
- Number and area extent of cut and fill.

**Table 5.15: Appraisal of the 'No Action' Alternative and Use of Civil Works**

| Criteria | Delayed Action | Right Away Action | Biological works alone | Civil works alone | The Civil works & Bioengineering (Biological & the construction of Hard Structures) |
|---|---|---|---|---|---|
| General Safeguard of Environment and Human Health (General protection mechanisms) | This will not benefit the concerned stakeholders and community residents. The damage might potentially become catastrophic, and the level of human and material losses may be well beyond repair with economic loss of materials worth millions of naira. The delay action may lead to restiveness in the area. Also delays in the mobilization of the contractor or by other administrative bureaucratic processes. | This will be the right step to safeguard the environment and human well-being from further degradation | The remediation of the biological life form will involve afforestation. It will lead to the improvement of life, properties and infrastructures will be secured, lives saved, resources recovered, transportation facilities enhanced and general restoration of livelihood. It will benefit the Project Affected People and the residents. | The implementation of this proposed project will lead to the improvement of life. Infrastructures will be secured, lives saved, resources recovered, transportation facilities enhanced and general restoration of livelihood. It will benefit the Project Affected People and the residents. | The rehabilitation of degraded environment, watershed management, landscape investment, and special ecosystems management. coupled with remediation of the biological life form will result into better and an improved life. Public Infrastructures will be secured, lives saved, resources recovered, transportation facilities enhanced and general restoration of livelihood. It will benefit the Project Affected People and the residents. |

| | | | | | |
|---|---|---|---|---|---|
| Short-Term Usefulness | Delayed action will contribute nothing to short – term usefulness. | This will be an immediate derivable benefit and a sustained long-term benefit will be achieved. | The timeline for the biological works is long term. Nevertheless, the benefits derivable can only be optimized if combined with civil work. Even under a Delayed-Action alternative the combination of the two will provide useful results. | The timeline for the civil work is long term. Nevertheless, the benefits derivable are still better than a No-Action and Delayed-Action alternatives. With biological works alone, the short-term civil work will not provide long-term effectiveness value that biological alternative adds to the final solution. | The timeline for the civil and biological works are long term. Nevertheless, the benefits derivable are still better than biological or civil work alone. |
| Long-Term Effectiveness and Permanence | Already incurred damages may obliterate the gains from long-term effectiveness, and the cost of intervention may increase due to inflation. | This alternative perfectly meets both the long-term and short-term effectiveness and permanence criteria. | The biological works alone will provide long-term effectiveness for the watershed but may not be sustainable without the civil works. | Civil works alone will provide a long-term use for the watershed but may not be sustainable without the biological works because of the unforeseen long-term effect of water erosion. | The combination of the Civil and Biological works will provide long-term effectiveness for the watershed |

# CHAPTER 6: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

## 6.0 Introduction

This chapter discusses the Environmental and Social Management Plan (ESMP) for the Bulka subproject. It is necessary to achieve the health, safety, and environmental regulatory compliance objectives of the project. Environmental and social management systems/procedures are developed to establish sound basis for mitigation, monitoring and management at the project level. The E&S requirements are integrated into existing procedures to ensure that project bottlenecks are not created. To this end, the Plan has focused on specific steps to be taken with respect to implementation of the mitigation measures and monitoring activities for the environmental and social impacts identified in Chapter 5.

The plan highlights the specific mitigation measures that would be taken and the entities responsible for carrying them out. This ESMP also contains a monitoring plan indicating the responsible parties, the frequency of monitoring, key indicators and the reporting format, and provides for necessary capacity building to facilitate the ESMP implementation. Cost estimates for implementation of the various mitigation measures, monitoring plan and capacity building are also given. The projected implementation budget will enable the ESMP to be an integral part of financing for the Construction and operational works in the project.

The objectives of the ESMP contained in this section are as follows:

- To monitor compliance with all the mitigation measures and commitments as discussed in the ESMP during the implementation of the proposed project;
- To ensure best practices management as a commitment for continuous improvement in environmental performance;
- To monitor compliance with legal standards and limits for wastes discharges;
- To identify areas where there is need to develop capacity to implement the recommendations of the ESMP and provide for the requisite training and capacity building
- To provide early warning signals on potential environmental degradation for appropriate actions to be taken to prevent or minimize environmental consequences.

## 6.1 Discussion on the Mitigation Measures for Implementation

Based on the environmental and social impact categories identified in Chapter 5 (see Section 5.5), the ESMP implementation for Bulka intervention subprojects addresses measures that cover the following significant impacts during the pre-Construction, Construction and the post Construction (operation) phases of the project implementation:

Social Impacts:

- Disruption of routine community activities (temporary) and associated disturbances
- Labor influx
- Potential child labor and forced labor

- Security challenges for workers and equipment
- Occupational health and safety
- Community health and safety
- Vulnerable groups
- Potential grievance situations
- Insecurity and GBV risks during the construction and operational phases
- Potential constraints in project sustainability.

The mitigation measures proposed for these social impacts are addressed in Section 5 above

Environmental Impacts:

- Air quality and dust
- Surface and ground water quality
- Noise and vibration
- Vegetation loss
- Public/Occupational Health and Safety
- Traffic and Transportation
- Earth movement
- Solid and liquid wastes
- Landscape change

These impacts are addressed hereunder as:

*1)* Dust control and air quality management;
*2)* Water resources, erosion control and flood prevention management;
*3)* Noise and vibration exposure management;
*4)* Flora and fauna removal management;
*5)* Public and occupational health and safety management;
*6)* Construction operation and slope stabilization;
7) Road diversion and accident prevention;
8) Waste management;
9) Temporary project office site management; and,
10) Post construction management.

The mitigation measures proposed for these environmental impacts are also addressed in Section 5above

## 6.2 Environmental and Social Impact Mitigation Measures

The environmental and social impacts mitigation measures to address the identified impact categories for the Bulka intervention subproject will be implemented by the Construction Contractors selected for the subprojects who shall be solely responsible through the course of the project and shall be contractually required to develop all the necessary site-specific management

plans associated with the mitigation of the impact areas. The monitoring aspects of the project implementation shall be carried out by other identified Agencies and organizations including the SPMU-ESO, SLO, SMEnv., SMoW, SMLS, Community leaders, Site Committees, NGOs/CBOs, etc in accordance with the provisions and requirements of this ESMP.

## 6.3 Institutional Responsibilities and Accountabilities

The structure and reporting arrangements for the implementation of the ESMP are integrated into the overall project monitoring and evaluation program for the Bulka Stormwater/Erosion control project. The key actors as well as the roles and responsibilities of the various institutions in the ESMP implementation are as shown in Table 6.1. The matrix includes listing of all entities (public and private) responsible for designing and implementing the various aspects of the plan. The need for additional capacity building for the involved institutions and actors, including long-term consultation and training program for the implementing agency are also built into the structure.

**Table 6.1: Institutional Responsibilities**

| Institutional Category | Project Implementation Phase | Roles & Responsibilities |
|---|---|---|
| Zamfara State Ministry of Environment and Forestry (SMEnv) | All Phases (Preconstruction, Construction and Post Construction) | • Lead role to ensure adherence to the ESMP and applicable standards, environmental and social liability investigations, Monitoring and evaluation process and criteria<br>• Executing agency with overall responsibility for ACRESAL implementation in the State.<br>• Ensure that sufficient funds are made available to the SPMU;<br>• Ensure that SPMU, regardless of financing source, complies with the provisions of the ESMP and WB safeguard policy.<br>• Ensure that SPMU complies with ZSG environmental policies and regulations.<br>• Ensure that the SPMU retain dedicated Technical Support for the project duration including safeguard specialists to oversee ESMP implementation.<br>• Ensure that SPMU monitor environmental protection and mitigation measures in the ESMP and those activities that are embodied in the detailed designs;<br>• Ensure that SPMU has secured environmental clearances certification from FMEnv and WB prior to award and/or commencement of civil works contracts;<br>• Ensure that SPMU establishes and implements an environmental grievance mechanism, as described in the ESMP, to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the project's environmental performance<br>• Ensure that the bidding and contract documents include the ESMP;<br>• Ensure that SPMU submits semi-annual monitoring reports on the ESMP implementation to WB and FPMU. |
| SPMU (Safeguard Officers, PRO, Project Engineer, M&E) | Pre-Construction Phase | • Ensure that bidding and contract documents include the ESMP;<br>• Review and approve all required management plans necessary for the pre-construction, construction and post construction phases of the project;<br>• Undertake monitoring of the implementation of the ESMP (mitigation and monitoring measures) with support from the appointed Focal NGO, the Site Committee, the Contractor and other stakeholders. |

| Institutional Category | Project Implementation Phase | Roles & Responsibilities |
|---|---|---|
| | | • Report to WB and FPMU on all aspects of social and environmental management and monitoring at required frequency;<br>• Submit monthly and quarterly or semi-annual monitoring reports on ESMP implementation to FPMU and WB;<br>• Participate in grievance mechanism, as described in the this document, to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the sub-project's environmental performance<br>• Based on the results of the ESMP monitoring, identify environmental corrective actions and prepare a corrective action plan<br>• Maintain and manage all funds effectively and efficiently for the project;<br>• Coordinate all policies, programmes and actions associated with the intervention construction works;<br>• Ensure the smooth and efficient implementation of the preconstruction phase of project's various programmes;<br>• Have custody of a copy of the ESMP and disseminate information contained therein accordingly. |
| | Construction Phase | • Cooperate with the Steering/Technical Committees to provide guidance to the technical aspects of all project activities;<br>• Provide oversight of contractors work plan and E&S implementation schedule;<br>• Conduct weekly or routine site inspection and monitor implementation of E&S safeguards;<br>• Receive and review reports from the contractor;<br>• Prepare and submit weekly/monthly and subsequent quarterly and annual reports to the SPMU Project Coordinator, FPMU and the WB. |
| | Post Construction Phase | • Ensure proper closures of all contractor's temporary facilities;<br>• Ensure that the terms of Agreement between the Contractor and the community and land owners are fulfilled. |
| FPMU | All Phases (Pre-construction, Construction and Post Construction) | • Project assessment and monitoring of the ESMP implementation and the construction activities.<br>• |
| World Bank | All Phases (Pre-Construction, Construction and Post Construction) | • Assessment of specific and general project implementation;<br>• Recommend additional measures for strengthening the management framework and implementation performance. |
| State Ministry of Works and Infrastructural Development | Pre-Construction and Construction Phases | • Provide necessary preconstruction and construction support to the SPMU<br>• Site assessment and monitoring of construction works and engineering activities; |
| State Ministry of Lands & Survey and Housing (SMLS) | Pre-Construction Phase | • Compliance overseer at State Level, on matters of land acquisition, compensation and other resettlement issues |
| FMEnv, NESREA, Other MDAs | Pre-Construction and Construction Phases | • Intervene in areas under their jurisdiction as and when project demands |
| Contractor (Site Manager, Site Engineers/ Supervisors) | Pre-Construction Phase | • Recruit qualified environmental safeguard specialist to ensure compliance with environmental statutory and contractual obligations and proper implementation of the ESMP<br>• Implement all the provisions of the ESMP in coordination with the SPMU and other relevant authorities |

| Institutional Category | Project Implementation Phase | Roles & Responsibilities |
|---|---|---|
| | | • Develop and submit for SPMU and FPMU approvals specific management plans as provided in the ESMP.<br>• Provide sufficient funding and human resources for proper and timely implementation of required mitigation measures in the ESMP<br>• Implement additional environmental mitigation measures for unexpected impacts, as necessary<br>• Develop a work plan which incorporates schedule for E&S safeguards implementation;<br>• Submit the work plan and schedule of E&S safeguard implementation to the SPMU;<br>• Train/create awareness of all personnel/workers on relevant E&S safeguard measures and their obligations;<br>• Ensure land disturbance activities are conducted in accordance with relevant legislation and the ESMP;<br>• Communicate content of ESMP to all employees and contractor agents;<br>• Provide oversight function during mobilization to ensure adherence to good practice and the ESMP |
| | Construction Phase | • Implement all E&S safeguards and other mitigation measures as planned;<br>• Submit monthly and quarterly implementation reports on E&S safeguards to SPMU;<br>• Comply with BEME specification in procurement of material and construction, and adherence to the ESMP and good construction practices;<br>• Ensure land disturbance activities are conducted in accordance with relevant legislation and the ESMP;<br>• Provide adequate onsite waste collection bins, ensure proper disposal, not to litter and not to create environmental nuisance;<br>• Provide oversight function during construction to ensure adherence to good practice and the ESMP |
| | Post Construction Phase | • Provide oversight function during decommissioning to ensure adherence to good practice and the ESMP |
| Site Committee | All Phases (Preconstruction, Construction and Post Construction) | • Monitor and ensure compliance to ESMP provisions as well as contractor implementation quality |
| Local government | All Phases (Preconstruction, Construction and Post Construction) | • Provide support in monitoring project execution within their domains to ensure compliance with the ESMP and other relevant requirements |
| Local Community | All Phases (Preconstruction, Construction and Post Construction) | • Promote environmental awareness;<br>• Assist and liaise with other stakeholders to ensure proper siting and provision of approval for such sites;<br>• Support with provision of necessary infrastructures and engage/encourage carrying out comprehensive and practical awareness campaign for the proposed project, amongst the various relevant grass roots interest groups. |
| CDOs | All Phases (Preconstruction, Construction and | • Ensure community participation by mobilizing, sensitizing community members; |

| Institutional Category | Project Implementation Phase | Roles & Responsibilities |
|---|---|---|
| | Post Construction) | |
| Focal NGO | All Phases (Preconstruction, Construction and Post Construction) | • Assist to ensure effective response actions, to evolve and devise sustainable environmental strategies and rehabilitation techniques, organize, coordinate and ensure safe use of volunteers in a response action, & provide wide support in management planning, institutional/governance issues and other livelihood related matter, awareness campaigns |
| General Public | All Phases (Preconstruction, Construction and Post Construction) | • Identify issues that could derail the project;<br>• Support project impacts mitigation measures as well as awareness campaigns. |

A summary of the impact mitigations and monitoring plan for the pre-Construction, Construction, and post-Construction phases of the project with the associated monitoring frequencies, responsible parties and projected costs are presented in Table 6.2-6.5.

## Table 6.2: Environmental and Social Management Action Plan for the Bulka Project During Pre-Construction Phase

| Pre-Construction Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Mitigation** | **Parameters for Monitoring** | **Performance indicators** | **Frequency for Monitoring** | **Responsible / Action party** | **Cost (~~N~~)** |
| • Preliminary site surveys and investigation works Mobilization of personnel and equipment for site preparation activities<br>• Continuous Community engagement<br>• Site preparation activities including fencing, vegetation removal, excavations, earth works. | **Environmental** | | | | | | | | |
| | • Loss of biodiversity and vegetation within the site through site clearing, however, the site will not be cleared at the same time but in batches.<br>• Vegetation removal may lead to loss of habitat for endangered fauna species such | Minor | • Site clearing shall be limited to the area required for the project.<br>• Green area and replantation shall be designated along the project RoW.<br>• Rehabilitation of cleared areas with selected species, and ecosystem restoration in habitats of conservation value, using specialist advice and input, backed up by a long-term monitoring programme and corrective actions as necessary<br>• Development and Implementation of a Biodiversity Action Plan | Negligible | • Clearly defined boundaries of protected areas Evidence of re vegetated on Evidence of erosion control measures drainage | Visual observation | Daily and weekly | • Contractor /HSE Manager/<br>• ESO | 250,000 |
| | • Air pollution as a result of fugitive emissions from dust generated and equipment usage although, only while the pre-construction activities are going on, | Major | • Dust emissions must be kept to a minimum level through regular sprinkling of water (at least every hour during work hours of the day).<br>• All excavation work will be sprinkled with water to control dust;<br>• Ensure vehicles/machines are switched off when not in use.<br>• Ensure only vehicles required to undertake works are operated on-site.<br>• Ensure all construction vehicles, plant and machinery are well maintained and in full operating condition.<br>• Effective preventative maintenance established to ensure all construction equipment and electricity generators are maintained in good working conditions | Minor | • Particulates<br>• NOx. SOx, CO, VOC etc | Regulatory Limits | weekly | • Contractor /HSE Manager<br>• ESO<br>• State Ministry of Environment | 1,000,000 |

| Pre-Construction Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Mitigation** | **Parameters for Monitoring** | **Performance indicators** | **Frequency for Monitoring** | **Responsible / Action party** | **Cost (~~₦~~)** |
| | • Generation of solid waste (scrap metal, wood, sand, concrete, iron rods, paper) | Major | • Waste bins will be provided at all construction sites for the disposal of the various types of wastes generated by the project. These bins will be clearly marked to facilitate segregation of waste, for collection, transportation and disposal.<br>• Separation of domestic and hazardous waste at the source shall be strictly enforced.<br>• Where possible, wastes will be re-used or recycled. This is a requirements for waste oils, other hydrocarbons and tires and other hazardous and non-hazardous wastes<br>• Burning of waste will not be permitted<br>• All personnel will be trained in the appropriate management of waste according to the WMP.<br>• Proper storage, transport and disposal of hazardous wastes (oily wastes, used batteries, fuel drums) in the designated areas by the national/local authorities in accordance with National Environmental Law. | Moderate | • Waste Consignment notes<br>• Waste segregation on site<br>• Waste management plan | Effectiveness of WMP | Daily and weekly | • Contractor /HSE Manager<br>• ESO | 250,000 |
| | • Pre-construction operations which include grading, filling, excavation, earthwork and movement of vehicles and heavy construction equipment will disrupt topsoil. The disruption of soil profile- mostly loss of topsoil, will increase the erosion potential at the project site, | Major | • Topsoil stripped off due to preconstruction activities shall be stockpiled for rehabilitation works.<br>• Ensure topsoil are not stored in large heaps. Store removed topsoils in low mounds of no more than 1 to 2m high are recommended, reuse stored topsoil as needed. | Moderate | • Soil quality Parameters<br>• Physic—chemical properties, texture and structure, Heavy metals, | Regulatory limits | Monthly | • Contractor /HSE Manager<br>• ESO<br>• State Ministry of Environment | 2,500,000 |

| Pre-Construction Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Mitigation** | **Parameters for Monitoring** | **Performance indicators** | **Frequency for Monitoring** | **Responsible / Action party** | **Cost (~~N~~)** |
| | | | • Avoid stripping soils when they are wet, as this can cause compaction and loss of structure.<br>• Backfill excavated areas with non-polluting soils or overburden.<br>• Sufficient ground cover will be added to protect the topsoil from rain, wind and other natural elements that gradually erodes the top layer of the soil.<br>• All cut slopes, embankments, and other erosion-prone working areas will be stabilized to the extent feasible while work is going on. | | Microbiology | | | | |
| | • Increased noise levels and vibrations within the project area from movement of heavy-duty equipment could affect the local settlements and wildlife; | Moderate | • Ensure equipment and machinery to be used for site preparation and clearing activities are climate friendly, well maintained and soundproof.<br>• Maintain, equipment and automobiles at optimal functioning levels<br>• Machinery, vehicles and instruments that emit high levels of noise should be used on a phased basis to reduce the overall impact of the vibrations and noise.<br>• Ensure noise generated are within the permissible limits as prescribed u der the NESREA regulation 2009 for Noise standards and control as specified in S.I No 35.<br>• Workers, especially those working with machines, vehicles and instruments that emit high levels of noise/vibrations are supplied with ear plugs and earmuffs to reduce the risk of hearing impairment. | Minor | • Noise levels | Regulatory Limits | Daily / Weekly | • Contractor /HSE Manager<br>• ESO<br>• State Ministry of Environment | 350,000 |

| Pre-Construction Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Mitigation** | **Parameters for Monitoring** | **Performance indicators** | **Frequency for Monitoring** | **Responsible / Action party** | **Cost (~~₦~~)** |
| | • Contamination of the surface water (Gulbi) as a result of siltation caused by increased erosion during site preparation | Major | • Install silt traps in points of entry into water channels to catch silt before exiting the site<br>• Plan a maintenance and cleaning program to keep water channels free of trapped silt<br>• Refuelling, maintenance and wash-down of construction vehicles and equipment will only occur in designated areas and away from surface water bodies, and provided with secondary impermeable containment measures<br>• Water quality analysis by third party consultants | Moderate | • Water quality Physico-chemical properties Heavy metals, Microbials | Regulatory Limits maintenance and cleaning program for water channels | Weekly/monthly | • Contractor /HSE Manager<br>• ESO<br>• State Ministry of Environment | 1,500,000 |
| | **Social** | | | | | | | | |
| | • Impact on population hence social and health vulnerability of locals as there would be an influx of workers in the host communities due to the preparatory activities. | Moderate | • Contractor shall ensure an awareness and hygiene campaign. Workers and local residents shall be sensitized on health risks particularly of STIs/STDs.<br>• Encourage hiring, as practicable of appropriately qualified workers from areas in the vicinity of the project to discourage preventable influx of persons.<br>• Work with contractors to ensure that specialized skill workers from outside the areas have access to proper accommodations and other basic infrastructure.<br>• Keep project delivery on schedule to avoid prolonged stay and unwanted invites to migrant workers. | Minor | • Community health and Safety Management Plan | No of community persons engaged | Monthly | • Contractor HSE/HR Manager<br>• GRM officer<br>• SLO<br>• State Ministry of Environment | 500,000 |

| Pre-Construction Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Mitigation** | **Parameters for Monitoring** | **Performance indicators** | **Frequency for Monitoring** | **Responsible / Action party** | **Cost (~~N~~)** |
| | • Impact on land use as available land for community use and expansion will be affected since a vast portion of land has been acquired for other use by the Bulka channelization project | Major | • All affected parties due to the physical displacement of land shall be compensated appropriately.<br>• Stakeholders Engagement Plan developed and implemented<br>• Develop and implement Resettlement Action Plan (RAP),<br>• Ensure commensurate compensation<br>• Develop livelihood restoration plan | Moderate | • Evidence of stakeholders' engagement sessions and grievance resolved.<br>• Records of RAP implementation | No and rate of compensation<br>No/rate of grievance addressed | One off | • Contractor HSE/HR Manager<br>• GRM officer<br>• SLO<br>• State Ministry of Environment | 500,00 |
| | **Occupational Health and Safety** | | | | | | | | |
| | • Increase in vehicular movement and traffic around the project site leading to potential road accidents. | Major | • Road traffic management personnel shall be employed to constantly ensure traffic is managed for vehicles and automobiles leaving the.<br>• Temporary speed bumps to be installed on the major road around the area.<br>• Signages with speed limits should be displayed at various areas. | Moderate | • Traffic management framework<br>• | Efficacy of traffic management measures | Weekly | Contractor HSE Manager ESO | 250,000 |
| | • Trips, falls and injuries from open excavations and working at heights | Major | • First aid kits on site and registration with nearby health primary health centre in host communities.<br>• Provide adequate lighting for night works if night time works are necessary.<br>• Open excavations shall be properly cordoned off using caution tapes.<br>• Ensure all staff wear appropriate PPEs.<br>• Implement health awareness programme.<br>• Ensure safety signages are on display at strategic locations. | Moderate | • HSE Records<br>• Hazards Observations, and Incident Reports<br>• Stop Work Cards | LTI, Fatalities | Daily, Weekly and Monthly | HSE Manager ESO | 1,500,000 |

## Table 6.3: Environmental and Social Management Action Plan for the Bulka Project During Construction Phase

| Construction and Installations Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / /Action party** | **Cost (₦)** |
| | **Environmental** | | | | | | | | |
| • Mobilization of personnel and equipment<br>• Installation of signage, markings and cordoning-off<br>• Soil excavation,<br>• foundations and channel structures construction,<br>• Location and developments of borrow pits<br>• Laying of precast, Concrete works<br>• other associated earthen works etc;<br>• Generation of Solid waste and waste removal<br>• Commissioning | • Emissions generated from vehicle exhaust, dust and machinery engine emissions could potentially pollute air, | Major | • Procure equipment and machines that are climate friendly and have low carbon emission capacity (like for diesel generators, on-site vehicles, etc)<br>• Where possible only keep diesel generators and engine off automobiles on when in use.<br>• Air quality monitoring on site.<br>• Ensure that emission levels of machinery are within permissible limits, based on the best site practices and relevant dust control measures set out in the Air pollution control regulations by NESREA for Construction sector | Moderate | • Particulates<br>• NOx. SOx, CO, etc | Regulatory Limits | Weekly and Monthly | • Contractor HSE Manager<br>• ESO<br>• FMEnv<br>• State Ministry of Environment | 1,500,000 |
| | • Increased noise levels within the project site during the use heavy equipment such as excavator, bulldozer, cement trucks and vehicular movement. | Major | • Procure equipment and machines that are climate friendly and have low carbon emission capacity (like for diesel generators, on-site vehicles, etc)<br>• Where possible only keep diesel generators and engine off automobiles on when in use.<br>• Air quality monitoring on site.<br>• Ensure that emission levels of machinery are within permissible limits, based on the best site practices and relevant dust control measures set out in the Air pollution control regulations by NESREA for Construction sector<br>• Proper sound management during work hours.<br>• Monitor sound levels throughout the construction period. | Moderate | • Noise levels | Regulatory Limits | Daily / Weekly and Monthly | • Contractor HSE Manager<br>• ESO<br>• FMEnv<br>• State Ministry of Environment | 350,000 |

| Construction and Installations Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / /Action party** | **Cost (~~₦~~)** |
| | | | • Procure equipment and machines that are climate friendly and soundproof.<br>• Maintain, equipment and other transport automobiles to optimal functioning levels.<br>• Machinery, vehicles and instruments that emit high levels of noise are used on a phased basis to reduce the overall impact.<br>• Ensure noise generated are within the permissible limits as prescribed u der the NESREA regulation 2009 for Noise standards and control as specified in S.I No 35.<br>• Workers, especially those working with machines, vehicles and instruments that emit high levels of noise/vibrations are supplied with ear plugs and earmuffs to reduce the risk of hearing impairment. | | | | | | |
| | • Site runoff resulting from dust suppression sprays, cement works, oils, grease from machinery and vehicles as well as wastewater from erosion of temporary stockpile. | Moderate | • Runoff from activities should be restricted to site by constructing diversion channels or holding structures such as banks, drains, dams, etc., to reduce the potential of soil erosion and water pollution and cut-off drains to divert surface runoff from exposed soils or construction areas.<br>• Employ good site management practices as outlined in NESREA regulation 2011 for Construction sector.<br>• All effluent from work areas shall be captured and reused for construction mixing and works | Minor | • Waste Management Plan,<br>• Water / Soil quality: Physico-chemical properties Heavy metals, Microbials | Regulatory Limits | Daily / weekly and Monthly | • Contractor HSE Manager<br>• ESO | 2,000,000 |
| | • Generation of potential non-hazardous wastes such as metal scraps, and plastics, hazardous materials such as | Major | • Ensure various wastes streams generated on-site are segregated and containerized in colour-coded bins. | Moderate | • Observations,<br>• Waste Manageme | Effectiveness of WMP | Daily and weekly | • Contractor HSE Manager<br>• ESO | 1,250,000 |

| Construction and Installations Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / /Action party** | **Cost (₦)** |
| | paints and maintenance fluids for equipment (i.e. spent oils, spent lube, waste oil filters etc.) and non- hazardous wastes in the form of sanitary and domestic wastes | | • Maintain inventory of daily waste generated.<br>• Construction waste shall not be left in stockpiles along the road but removed and reused or disposed of on a daily basis.<br>• Liquid waste from concrete works, grease, chemicals and oil spill should be immediately mopped up.<br>• Remove toxic materials and dispose of them in designated sites.<br>• Surface runoffs should be properly channelled to drainage.<br>• Register with state waste management board for proper waste treatment and disposal.<br>• All waste containers, litter and any other waste generated during the construction shall be collected and disposed of at designated disposal sites in line with applicable government waste management regulations.<br>• Use existing, approved sites, do not establishment new sites. | | nt Plan,<br>• Waste consign,ent notes<br>• Waste segregation | | | | |
| | **Social** | | | | | | | | |
| | • Grievances of the PAPs may result to violent attacks to the lives of the site construction workers, civil workers and other project related people. | Moderate | • Establish and maintain a robust grievance redress mechanism to manage emergence of such issues from PAPs.<br>• Continuous stakeholders and community engagement through all phases of project. Stakeholders Engagement Plan to form a basis for this continuous consultation. | Minor | • Records of RAP implementation.<br>• Evidence of stakeholders' engagement sessions and | Number of grievances addressed No. Of satisfied PAPs | Continuous | • Contractor HSE Manager<br>• GRM officer<br>• SLO | 3,500,000 |

| Construction and Installations Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / /Action party** | **Cost (₦)** |
| | | | | | grievance resolved. | | | | |
| | • Potential impact from spread of sexually transmitted diseases and Gender Based Violence (GBV) and Sexual Exploitation and Abuse (SEA) due to influx of construction workers into site | Major | • Code of conduct should be developed by contractor creating awareness and showing commitment to ensuring workers do not engage in SEA and GBV throughout duration of construction.<br>• Awareness campaigns targeting project workers, senior management, contractors, subcontractors and their spouses, communities near project facilities, risk groups (commercial sex workers, truck drivers) –<br>• Prevention, voluntary counselling for HIV testing, as well as antiretroviral treatment for employees and surrounding communities<br>• Stakeholders Engagement Plan developed and implemented<br>• Clearly define the GBV requirements and expectations in the bid documents for a GBV action plan, Code of conduct for workers and adequate costing for implementing the GBV plan.<br>• The contractor ESMP and should among others, set out the mechanism for receiving, reviewing and addressing GBV complaints in a confidential manner, workers SEA/SH code of conduct and the accountable framework, mapping of GBV response actors within the project areas and working with them to provide quality survivor centered services including case management, referral services and linkage | Moderate | • Community health and Safety Management Plan<br>• GBV/SEA plan<br>• Code of Conduct | No. Awareness /sensitization/trainings conducted for GBV/SEA issues<br>No. Addressed GBV cases | Weekly/Monthly | • Contractor HSE/HR Manager<br>• GRM officer<br>• SLO | 2,500,000 |

| Construction and Installations Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / /Action party** | **Cost (₦)** |
| | | | to others services not provided by them, etc. | | | | | | |
| | • The increased vehicular movement and speed may result in road safety issues like traffic accidents within project area. | Major | • Community consultations and meetings on the ongoing works and related hazards will be held.<br>• Active sites will be sealed off from the public using reflective tapes and cones; where necessary road diversions will be created.<br>• Safety initiatives will be developed and implemented, including:<br>• Ensuring that only qualified (licenced) drivers operate machinery;<br>• Implementing speed limits and traffic control measures in appropriate locations;<br>• Implementing safety signage;<br>• Installing speed control devices on trucks<br>• Movement of large construction machinery will be guided by a flagman. | Moderate | • Traffic management plan<br>• Traffic Incident cases | Efficacy of traffic management measures | Weekly | • Contractor HSE Manager<br>• ESO<br>• | 1,250,000 |
| | **Occupational Health and Safety** | | | | | | | | |
| | • Work site accident and injuries, trips, falls and burns; | Moderate | • First aid kits on site and registration with nearby health primary health centre in host communities.<br>• Provide adequate lighting for night works if nighttime works are necessary.<br>• Open excavations shall be properly cordoned off using caution tapes.<br>• Ensure all staff wear appropriate PPEs.<br>• Implement health awareness programme.<br>• Ensure safety signages are on display at strategic locations. | Minor | • HSE Records, Hazards Observations, and Incident Reports<br>• Stop Work Cards<br>• PPE records | No. LTI cases<br>No. Of fatalities<br>Near misses<br>No. of non-conformances | Daily, Weekly and Monthly. | HSE Manage ESOr | 1,500,000 |
| | • Increased risk of infections and spread of communicable | Medium | • Labour Management Plans shall be prepared by Project Contractor(s) based on the Project Labour Management | Low | • Community health and Safety | No. staff and community | Monthly | Contractor HSE/HR Manager | 1,000,000 |

| Construction and Installations Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / /Action party** | **Cost (~~₦~~)** |
| | diseases due to influx of people. | | Procedures for approval by the Bank/SPIU to guide labour relations<br>• Contractors and Sub-contractors will be required to hire labour through a structured HR process conduct health awareness, education, healthcare trainings, immunization programs and health service provision.<br>• Awareness campaigns targeting project workers, senior management, contractors, subcontractors and their spouses, communities near project facilities, risk groups (commercial sex workers, truck drivers).<br>• Prevention, voluntary counselling for HIV testing, as well as antiretroviral treatment for employees and surrounding communities | | Management Plan<br>• Labor management records<br>• Training/awareness records<br>• Code of conduct records | trainings GBV/SEA cases managed | | SLO GRM Officer | |
| | • Risk of Worker being Kidnapped and killed/ workers being killed by terrorists or loss of their properties to armed robbers. | High | • Appoint a Safety and Security Focal Officer to oversee Security issues.<br>• The officer prepares and implements a Security plan to guide the implementation of the project in Bulka.<br>• Engage and train the Uniform Security personnel (NCDC) on the Ethics and Code of Conduction to work in Bank Assisted projects.<br>• Also, train the PIU workers/contractor workers.<br>• Ensure synergy with other Security forces like the Police, DSS, Nigerian Military etc.<br>• Monitor and Keep Records. | Moderate | • Security records<br>• Security Competence records | Security threat ratings | Weekly | Contractor HSE/HR Manager Security Management officer SLO | 2,500,000 |

## Table 6.4: Environmental and Social Management Action Plan for the Bulka Project During Operations Phase

| Operations | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** | **Parameters for Monitoring** | **Performance indicator** | **Frequency for Monitoring** | **Responsible / Action party** | |
| • Operation of the stormwater channel<br>• Routine maintenance of installed facilities | **Environmental** | | | | | | | | |
| | • Reduced/controlled Erosion and adequate Flood Mitigation | Positive | • Regular monitoring of stormwater channel structures<br>• Waste removal to prevent clogging of drainage system<br>• Community sensitisation on the need to maintain the gully channel and not throw solid waste into the channel | Moderate | • Grievance records of flooding around the Bulka area | Water carrying capacity | Biannually | SMEnv Community project management team | N/A |
| | • Improved Water carrying capacity | Positive | | Moderate | | | | | |
| | • Increased water discharged into the receiving water body (Gulbi). | Moderate | • Dredging and Desilting of the Gulbi water area (Discharge point) to ensure it conveniently collects more water | Minor | • Grievance records of flooding around the Bulka area | Water carrying capacity in Gulbi | Biannually | | |
| | **Social** | | | | | | | | |
| | • Improved aesthetic quality | Positive | • Regular monitoring of stormwater channel structures<br>• Waste removal to prevent clogging of drainage system<br>• Community sensitisation on the need to maintain the gully channel and not throw solid waste into the channel | Positive | • Monitoring records | Flood rate waste management | Biannually | ESO State Waste Management Authority Community project management team | N/A |
| | • Separation of close community members due to expansion, channelization and cordoning-off of the gully | Minor | • Create alternative routes to connect communities | Negligible | • NA | NA | NA | NA | NA |

## Table 6.5: Environmental and Social Management Action Plan for the Bulka Project During Decommissioning and Abandonment Phase

| Decommissioning & Abandonment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / Action party** | **Cost (₦)** |
| | **Environmental** | | | | | | | | |
| | • Disturbance to soil profile, and potential contamination from surface runoff during abandonment. | Minor | • Backfill excavated areas with soils or overburden that is free of foreign material that could pollute groundwater and soil.<br>• Carry out internal environmental assessment to check activities and status of construction activities while in process.<br>• Manage and dispose of waste from erosion through building drainage channels connecting to the treatment plant. | Negligible | • Soil Quality parameters<br>• Soil texture and structure | Regulatory limits | Monthly | Contractor<br>HSE Manager<br>ESO<br>SMEnv<br>NESREA | 2,000,000 |
| • Shutdown of activities,<br>• Demobilization of decommissioned equipment,<br>• Waste generation and management of residual waste materials<br>• Site Restoration activities – clean-up of site and landscaping | • Surface water (adjoining rivers) contamination from runoff resulting from dust suppression sprays, oils and grease from machinery and vehicles used for dismantling works. | Minor | • Restrict runoff to site by constructing diversion channels or holding structures such as banks, drains, dams, etc., to reduce the potential of soil erosion and water pollution and cut-off drains to divert surface runoff from exposed soils or construction areas.<br>• Wash water from washing out of equipment shall not be discharged into water courses or road drains.<br>• Ensure equipment used are designed to cause less disturbance and harm to the aquatic ecology when cutting through existing river.<br>• Employ good site management practices as outlined in NESREA regulation 2011 for Construction sector.<br>• All drainage and effluent from storage areas, workshops and camp sites shall be captured and treated before being discharged into the drainage system in line with applicable government water pollution control regulations. | Negligible | • Water Quality Parameters | Regulatory Limits | Monthly | Contractor<br>HSE Manager<br>ESO<br>SMEnv<br>NESREA | 1,500,000 |

| Decommissioning & Abandonment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / Action party** | **Cost (₦)** |
| | | | • To the extent practicable, reinstate natural drainage patterns where they have been altered or impaired.<br>• Provide absorbent materials and other containment equipment on site for quick response to any form of spill. | | | | | | |
| | • Air pollution as a result of dust and fumes from heavy equipment movement during dismantling | Moderate | • Plan work activities to avoid heavy duty movement during peak hours<br>• Ensure equipment and automobiles are properly maintained<br>• Water the ground hourly to avoid or minimize dust | Minor | • Air quality parameters<br>• Particulates | Regulatory limit | Monthly | Contractor<br>HSE Manager<br>ESO<br>SMEnv<br>NESREA | 1,000,000 |
| | • Improper management and disposal of waste | Moderate | • Ensure various wastes streams generated on-site are segregated and containerized in colour-coded bins.<br>• Maintain inventory of daily waste generated.<br>• Liquid waste from concrete works, grease, chemicals and oil spill should be immediately mopped up.<br>• Remove toxic materials and dispose of them in designated sites.<br>• Surface runoffs should be properly channelled to drainage.<br>• Register with state waste management board for proper waste treatment and disposal.<br>• All waste containers, litter and any other waste generated during the construction shall be collected and disposed of at designated disposal sites in line with applicable government waste management regulations. | Minor | • Waste management plan<br>• Waste consignment notes | Waste segregation | Monthly | Contractor<br>HSE Manager<br>ESO<br>State waste management authority | 500,000 |

| Decommissioning & Abandonment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / Action party** | **Cost (₦)** |
| | | | • Use existing, approved sites, do not establishment new sites. | | | | | | |
| | • Increased noise levels within community during dismantling activities. | Moderate | • Install noise reduction devices such as silencers and mufflers as appropriate to mobile plant and equipment.<br>• Limit the active construction site to not more than 500 meters per 2.0 km lengths<br>• Limit work to daylight hours. Schedule noisy construction activities during specific times in the day especially near the sensitive receptors<br>• Advance notice will be given to communities if short-term noisy construction activities are to take place, which could cause these levels to be exceeded. | Minor | • Noise levels | Regulatory limits | Weekly | Contractor<br>HSE Manager<br>SMEnv<br>NESREA | 350,000 |
| | **Occupational and Community Health** | | | | | | | | |
| | • Air pollution resulting in illnesses such as swollen eye, difficulty in breathing, catarrh and bronchitis (respiratory tract infections). | Minor | • Vehicles carrying friable materials will be enclosed or sheeted.<br>• Loading, unloading and handling of dusty materials will only be carried out in designated areas.<br>• Regular damping of unpaved roads or exposed soils/ground to control dust/particulate matter and keep it down.<br>• Workers would be provided with adequate PPE<br>• Ensure vehicles/machines are switched off when not in use.<br>• Ensure only vehicles required to undertake works are operated on-site.<br>• Ensure all construction vehicles, plant and machinery are well maintained and in full operating condition. | Negligible | • GRM cases<br>• Health report cases | No of health issues reported | Monthly | Contractor<br>HSE Manager<br>SMEnv<br>NESREA | 1,000,000 |

| Decommissioning & Abandonment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / Action party** | **Cost (₦)** |
| | • On-site traffic congestion and risk of road traffic accidents during dismantling and movement of equipment. | Moderate | • Proper diversion and signage shall be provided<br>• Traffic management plan will be prepared and implemented<br>• Prohibit trucks from parking along the access roads<br>• Plan work activities to avoid heavy duty movement during peak hours<br>• Ensure equipment and automobiles are properly maintained | Negligible | • Traffic management plan | Traffic cases | Weekly | Contractor HSE Manager ESO | 350,000 |
| | • Trips, slips and falls of workers during dismantling of equipment and machinery | Moderate | • Ensure all staff utilize appropriate PPEs.<br>• Record, review and improve on HSE KPI's throughout the project.<br>• Ensure all staff are properly trained and certified in their relevant work function. | Minor | • Incidence records<br>• risk assessments reports | LTI Fatalities | Daily and weekly | Contractor HSE Manager ESO | 1,500,000 |
| | **Social** | | | | | | | | |
| | • Loss of temporary and permanent business /employment/means of livelihood due to work completion and workers disengagement. | Moderate | • Empowerment of disengaged works and recommendation to other employers and contractors for hire.<br>• Prompt payment and if possible, re-engagement during subsequent phases of the project.<br>• Training in other vocations and capacity building plans for skilled and unskilled workforce | Minor | • Evidence of workers' engagement sessions<br>• Records of trainings and certificates | Rate of livelihood restored | As required | Contractor and HR Manager SLO GRM | 2,700,0000 |
| | • Reduced social vices, GBV /SEA possible cases due to workers disengagement and demobilization from project site | Minor | • Ward off unauthorized persons with appropriate signs.<br>• Secure the area with security personnel from the communities.<br>• Empower disengaged workers and recommended to other employers and contractors for hire. | Negligible | • Grievance records<br>• Records of trainings and certificates | GBV/SEA cases addressed | Monthly | Contractor HR Manager SLO GRM | 1,500,000 |

| Decommissioning & Abandonment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Project Activities** | **Identified Associated and Potential impacts** | **Impact Rating** | **Mitigation Measures** | **Impact Residual Rating** | **Parameters for Monitoring** | **Performance Indicators** | **Frequency for Monitoring** | **Responsible / Action party** | **Cost (₦)** |
| | • Traffic obstruction from transportation of decommissioned structures and equipment | Moderate | • Community consultations and meetings on the ongoing works and related hazards will be held.<br>• Active sites will be sealed off from the public using reflective tapes and cones; where necessary road diversions will be created.<br>• Safety initiatives will be developed and implemented, including:<br>• Ensuring that only qualified (licenced) drivers operate machinery;<br>• Implementing speed limits and traffic control measures in appropriate locations;<br>• Implementing safety signage;<br>• Installing speed control devices on trucks<br>• Movement of large construction machinery will be guided by a flag woman/flagman. | Minor | • Traffic management plan | Traffic congestions | Weekly | Contractor<br>HSE Manager<br>SLO<br>GRM | 350,000 |

Based on Table 6.2-6.5, a summary of the proposed E&S mitigation monitoring costs through the pre-Construction, Construction and post-Construction phases of the project are presented in Table 6.6.

**Table 6.6: Summary of Mitigation Monitoring Cost by Project Phase**

| Project Impact Area | Associated Monitoring Costs (₦) | | | |
|---|---|---|---|---|
| | Pre-Construction | Construction | Post Construction | TOTAL |
| **Bulka Stormwater/Erosion Intervention Subproject** | | | | |
| Social Impacts | 1,000,000 | 7,250,000 | 4,550,000 | 12,800,000.00 |
| Environmental Impacts | 4,850,000 | 5,100,000 | 5,350,000 | 15,300,000.00 |
| Occupational health and Safety | 1,750,000 | 5,000,000 | 2,850,000 | 9,600,000.00 |
| **TOTAL** | **7,600,000.00** | 17,350,000 | **12,750,000.00** | **37,700,000.00** |

## 6.4 Capacity of Zamfara SPMU to Implement the ESMP

### 6.4.1 Capacity and Training Needs

To achieve effective ESMP implementation, there is need to strengthen relevant competencies on environmental and social management at primarily the State level and secondarily, the LGA and community levels including contractors. This will stimulate the required collaboration among the key actors. Experience has shown that strengthening capacity involves more than improving technical skills, developing new systems or establishing quality assurance and improving standards. While these are important, strengthening capacity is, however, essentially about changing behavior towards achieving desired goals.

The capacity building should include equipping individuals with understanding, skills and access to information and training that enables them to perform effectively. Personnel of the erosion control intervention project need to understand the purpose of the ESMP and their expected roles during its implementation. The target groups for the training will include:

- SPMU Environmental & Social (E&S) Safeguard Officers and Project Engineers (PE);
- Contractor's personnel;
- Construction workers and site personnel; and,
- Select members from the project communities (Bulka ).

The SPMU Environmental & Social (E&S) Safeguard Officers and contractors will require capacity building in the implementation of the project's environmental and social safeguards and general project planning and management interfaced with E&S components. Capacity requirements are also necessary in the areas of E&S monitoring and reporting, adherence to the required E&S principles, standards and commitments. The construction workers and select members of the project communities will undergo training on public awareness creation/educational techniques (on environmental, social and health issues) and first aid procedures.

### 6.4.2 Capacity Building Cost

To enhance the respective roles and collaboration of the relevant stakeholders, the broad areas for capacity building and effective ESMP implementation are identified and shown in Table 6.7.

**Table 6.7: Capacity Building for ESMP Implementation and Monitoring.**

| Training Description | Participants | Duration | Responsibility | Training Cost (₦) | Training Cost ($) |
|---|---|---|---|---|---|
| **ESMP mitigation measures and procedures for implementation** | Contractors | 1 day | Independent E&S Consultant | 2,750,000 | 1,923.08 |
| **Monitoring and Evaluation Basics - Establishing Monitoring Indicators and Evaluating Performance.**<br><br>**Environmental and Social Health and Safety (ESHS) Performance Monitoring** | SPMUs; Safeguards Unit, M&E Officer; Supervisory Consultants. | 2 days | Independent E&S Consultant/ FPMU E&S TAs | 3,500,000 | 2,447.55 |
| **Training on Code of Conduct, Labour Influx, OHS Management, Fire and Life Safety, C-ESMP, Onsite Waste Management, GRM, GBV-GRM, Stakeholder Engagement** | SPMU, Supervising Consultants, Contractors, GRCs, other relevant institutions stated in the ESMP, etc. | 3 days during preconstruction and refresher training quarterly | Independent E&S Consultant/ FPMU E&S TAs | 5,550,000 | 3,881.12 |
| **Training of Contractor Drivers and SPMU Drivers Awareness for communities especially children on road use safety practices** | SPMU, Contractor drivers, Supervising Consultants, Traffic Control Team | 1 day during pre-construction.<br>1 day during construction phase | FRSC | 1,100,000 | 769.23 |
| **Awareness campaign on preventing STI/STDs** | Contractor workers, SPMU Officers, Supervising Consultant | 1 day during pre-construction.<br>1 day during construction phase | Healthcare workers | 3,200,500 | 2,238.11 |
| **SH/SEA and VAC Awareness and Application to the rehabilitation/construction works – orientation on acceptable behaviours for construction personnel on/off-site. GBV prevention, mitigation and response** | SPMU, Supervising Consultants, Contractors | 2 days | WBG/FPMU GBV Specialist | 5,500,000 | 3,846.15 |
| **Total Cost for Capacity Building for ESMP Implementation and Monitoring** | | | | **21,600,500** | **15,105** |

*CBN rate at Jan 2026: ₦1430 to $1*

The total cost for capacity building for ESMP Mitigation and Monitoring Program is estimated at**, Fourteen Thousand, Four Hundred US Dollars, only ($15,501)**. This is equivalent to **Twenty-One Million, Six Hundred Thousand, Five Hundred Naira, only (₦21,600,500).**

## 6.5 Measures for Non-Compliance

Provisions for addressing non-compliance will be clearly outlined in the bidding documents and contracts. In cases where the Contractor fails to fulfil ESHS obligations or contractual tasks, the Project Manager has the authority to withhold the corresponding value of pending work or obligations until satisfactory completion is confirmed. Additionally, if rectification or replacement is necessary, associated costs can be withheld until these actions are successfully carried out, as determined by the Project Manager's assessment. For repeated instances of non-compliance, the Resident Engineer overseeing supervision may consider suitable alternative actions outlined in the contract. These measures could include suggesting to the client the activation of the Performance Security.

Failure to perform includes, but is not limited to, the following:

- Non-compliance with any ESHS obligations or work described in the Works' Requirements, such as working outside site boundaries, excessive dust, failure to maintain public roads in a safe condition, damage to offsite vegetation, pollution of water courses from oils or sedimentation, land contamination (e.g., from oils, human waste), damage to archaeology or cultural heritage features, and air pollution resulting from unauthorized and/or inefficient combustion.
- Failure to regularly review and update the C-ESMP in a timely manner to address emerging ESHS issues or anticipated risks and impacts.
- Failure to implement the C-ESMP, including the provision of required training or sensitization.
- Undertaking Works or related activities without appropriate consents/permits.
- Failure to submit ESHS reports or submit them in a timely manner.
- Failure to implement remediation as instructed by the Engineer within the specified timeframe to address non-compliance.
- A written notification from the resident engineer 10 days after the agreed date for the submission of monthly environmental reports if no written explanation is submitted by the environmental officer of the contractor.
- Failure to submit a declaration of methods for operations that require it, resulting in the immediate suspension of activities by the Resident Engineer until the document is approved.
- Financial penalties imposed on the employer if workers at the workplace do not have their personal protective equipment (e.g., gloves, jackets, boots).
- Contractors penalized with a written notice if they do not comply with the approved methodology for the work. In case of recurrence, the Resident Engineer may take further

appropriate measures as outlined in the contract, including advising the client to call the Performance Security.

## 6.6 Monitoring and Reporting

The monitoring plan (Internal and External Monitoring) for the ESMP is presented in the Table 6.8 below. Monitoring results shall be documented with preventive/corrective actions to be implemented.

**Table 6.8: Monitoring Procedures**

| Monitoring | Action | Responsibility | When | Deliverables |
|---|---|---|---|---|
| **Internal Monitoring** | Regular site visit (to ensure that the mitigation measures and actions specified in the monitoring plan and as bound by the contract is satisfactorily implemented). | SPMU Environmental and Social Livelihood Officers<br><br>FPMU Safeguards Unit | During Preconstruction, Construction and Operation Phase | Monthly Monitoring Reports and documentation |
| | Site visit for monitoring and inspection to ensure Contractors adhere strictly to the engineering designs and specifications for the project | Supervision Consultants | During Construction Phase | Observations and Monthly Monitoring Reports to be compiled and presented to the SPMU |
| **External Monitoring** | Regular site visits to ensure project is implemented in an environmentally and socially sustainable manner using the monitoring indicators specified in the monitoring plan and other national and international environmental guidelines/ laws | FMEnv, Zamfara State Ministry of Environment, ZEPA, NGOs/CBOs, etc. | During the preconstruction, construction and operation phases. | Inspect monitoring reports from safeguard units and provide feedback and enforce corrective actions where required. |

### *Reporting Procedures*

The reporting procedures presented in Table 6.9 below, have been developed in order to ensure that the Zamfara ACReSAL SPMU are able to receive feedback from the implementation of the ESMP on an ongoing basis and to take rapid corrective actions if there are issues of non-conformance.

**Table 6.9: Reporting Procedures**

| Phase | Responsibilities | Deliverables | Accountability |
|---|---|---|---|
| **Construction** | SPMU Safeguard Unit | Two (2) monitoring Reports First to be prepared midway into the civil works and the other upon completion of all construction activities. | SPMU, FMEnv on request |
| | | Additional Reports according to specific conditions e.g., Incidents/Accidents, serious environmental/ social risks & impacts. | |
| | Contractors | Report on Environmental and Social compliance during civil works | SPMU, Supervisory Consultants. |
| **Completion of construction and demobilization of Contractors from site** | SPMU Safeguards Units | Final Monitoring Report including all monitoring activities throughout project implementation | SPMU, FPMU, Report to be archived and made available to the World Bank, & FMEnv on request |

***Record Keeping and Control***

The Contractors are required to keep records providing evidence of ongoing mitigation activities. Such records may include C-ESMPs, site monitoring plan, OHS Policy, site specific OHS plan, emergency response and preparedness procedures, waste inventory and management procedures (type, quantity, transportation and final disposal), site instructions, training records, complaints records, incident report, inspection, maintenance and equipment calibration records. These documents should be made available to the SPMU Safeguards Unit upon request. The SPMU Safeguard Unit is also required to keep records to provide evidence of monitoring activities and effectiveness of the monitoring plan. The site monitoring plan identified problems/corrective actions and monitoring reports are to be kept by the Safeguard Unit and be made available to relevant regulators upon request. In addition, all significant communications with FMEnv, the ZEPA and other relevant authorities should be documented and kept. These documents are required to track performance to achieve and demonstrate compliance with the monitoring plan and applicable regulatory requirements.

## 6.7 ESMP Implementation Schedule

The activities related to E&S management and monitoring have to be integrated in the overall construction schedule. The project implementation phase for the construction under the Zamfara ACReSAL project will be completed in eighteen (18) months period. The implementation schedule is presented in Table 6.10 below.

**Table 6.10: Tentative ESMP Implementation Schedule**

| No. | Activity Description | Responsibility | Prior to Contract Award | Pre-Construction 1-2Months | Construction 16-17Months | Operation Post-18 Months |
|---|---|---|---|---|---|---|
| 1 | **Clearance & Disclosure of ESMP** | SPMU | √ | | | |
| 2 | **Finalization of Engineering Designs** | SPMU/Engineering Design Consultant | √ | | | |
| 3 | **Inclusion of E&S Requirements in Bid Documents** | SPMU/Safeguards Unit | √ | | | |
| 4 | **Review and Approval of Contractor's ESMP, Waste & Safety Plan** | SPMU Safeguards Unit | √ | | | |
| 5 | **Capacity building** | FPMU/SPMU | | √ | | |
| 6 | **Mobilization to site** | Contractor | | √ | | |
| 7 | **Implementation of Mitigation Measures** | Contractor, GRC, SPMU, Comm. Specialist, etc. | | √ | √ | √ |
| 8 | **Supervising ESMP Implementation** | SPMU Safeguards Unit and Supervisory Consultant | | √ | √ | √ |
| 9 | **Monitoring & Reporting on ESMP Implementation** | SPMU Safeguards Unit/Supervisory Consultant/Relevant MDAs | | √ | √ | √ |
| 10 | **E&S Training** | FPMU, Independent E&S Consultant | √ | √ | √ | |
| 11 | **E&S Monitoring and Auditing** | SPMU, FPMU and Independent E&S Consultant | | | √ | √ |

## 6.8 Contractual Measures

Most of the mitigation measures are the obligation of the Contractors during all phases of the project. Consequently, the Contractors will have to prepare their proposals considering the measures as well as the detailed general E&S management conditions during civil works. Table 6.11 below presents the Contractual Measures.

**Table 6.11: Contractual Measures**

| Action | Remarks |
|---|---|
| The measures as described in this ESMP shall be included in the tender documents with appropriate flexibility to adjust these measures to site circumstances, and that the potential contractor will have to prepare their proposals taking into account these measures | The non-inclusion of these measures in the proposal will lead to a disqualification of the proponent;<br><br>The contract with the successful bidder should contain these environmental and social management measures as firm conditions to be complied with. |
| Specifically, the measures should be translated into a suite of E&S specifications that are written in the same language style and format as the rest of the contract document | This approach will ensure that the E&S controls integrate seamlessly into the tender documents and are presented in a familiar form to the Contractors |
| Cost of applicable mitigation measures only be added to the cost of the contract document as provisional sum | The Contractor must consider and put the cost for the applicable E&S mitigation requirements specified in the ESMP. |
| **Code of Conduct – Preventing GBV and Violence Against Child (VAC):** A Code of Conduct should be prepared by the Contractor and signed; and forms part of the engagement agreement. To a minimum, the Code of Conduct should address: Standards of Conduct such as (a) Conflicts of interest (b) Quality of products and services, (c) Health and Safety- reporting injuries and unsafe conditions (d) Workplace violence, labour and human rights, ethics, reporting violations, (e) Sex with any person under 18 is prohibited, etc. | The Code of Conduct indicates the Contractors' commitment to be of best behaviour and comply professionally with the requirements of its engagement and Bank's safeguards. |
| **Individual Code of Conduct Preventing SH/SEA and Violence Against Child (VAC):** To a minimum, the individual code of conduct should spell out acceptable behaviour, consequence of violation, the routes for resolution of conflicts in any instance where personal interests conflict general interests regarding to the project work, outside work conduct, due diligence in providing required services, individual commitment to sustainable environmental practice during project implementation activities, etc. | The Individual Code of Conduct indicates the Contractor worker's commitment to be of best behaviour and comply professionally with the requirements of his/her engagement. |
| The procurement process should ensure that in addition to submission of CESMP, signing and filing of CoC, Contractors also include their employment policy based on the requirements of the Employees Compensation Act 2010 which establishes the procedure, processes and compliance to contribution to the employee compensation fund which is to be used to compensate the workers in case of injury, work-induced disability or facilities. | The project should ensure that the Contractors fulfils this requirement and are reliable especially when work related accidents/incidents, occurs so that the well-being and well-fare of the workers is taken into consideration. |

## 6.9 ESMP Disclosure

Following the ESMP clearance by the WB, the SPMU shall disclose the ESMP in line with the Nigerian EIA laws for 21 days. This will include a formal registration of the ESMP with the FMEnv and receipt of guidelines for the disclosure from the EA department including the locations to disclose the documents. At a minimum, the aspects to be followed through for the ESMP disclosure is provided in the Table 6.12 below.

**Table 6.12: ESMP Disclosure**

| No | Action | Remarks | Cost (NGN) |
|---|---|---|---|
| 1. | **Registration of the ESMP at the FMEnv** | Based on fixed statutory fees by the FMEnv | ₦ 50,000.00 |
| 2. | **In-house technical review** | Based on fixed statutory fees by the FMEnv | ₦ 200,000 |
| 3. | **IMM FMEnv Statutory Cost** | Based on fixed statutory fees by the FMEnv | ₦ 500,000 |
| 4. | **Final Access Charges** | Based on fixed statutory fees by the FMEnv | ₦250,000 |
| 5. | **Disclosure on 2 National Newspapers and local news paper** | This entails advert in 2 newspapers (actual costs will be determined at the point of placing the advert and varies depending on the paper) | ₦ 500,000 |
| 6. | **Radio announcement of the ESMP at the state** | The SPIU will conduct radio announcement that has state coverage for the ESMP, to air for 10 working days (actual cost will depend on the station) | ₦ 750,000 |
| 7. | **Printing of Hard Copies for Display Centres** | N150,000 (estimated) X 5 copies | ₦ 750,000 |
| 8. | **Disclosure at the World Bank External Website** | The ESMP will be disclosed according to the World Bank Disclosure OP17.50 | N/A |
| | **Total** | | **₦ 3,000,000** |

***Note: Actual costs will be provided at the point of disclosure***

## 6.10 Cost Estimates for ESMP Implementation

To effectively implement the mitigation and monitoring measures recommended in this ESMP, necessary provision will have to be made. The cost of these measures has been estimated and included in the ESMP and presented in Table 6.13 below. The cost of mitigation to be implemented by the Contractor will be included in the contract as part of the implementation cost by the Contractor. The overall total estimated cost for the ESMP implementation, monitoring and capacity building for all intervention packages is estimated at **Seventy-four Thousand, Eight Hundred and Forty-Six US Dollars and Fifty Cents Only (USD 74,846.50).** This is equivalent to **One Hundred and Seven Million, Thirty Thousand, Five hundred and Fifty Naira Only (₦107,030,550.00).**

**Table 6.13: Overall ESMP Cost Estimate for the Intervention Works**

| Item | Responsibility | Cost Estimate in Nigerian Naira (N) | Cost Estimate in US Dollars (US$) * |
|---|---|---|---|
| ESMP Implementation | Contractor | 35,000,000.00 | 24,475.50 |
| Monitoring | Zamfara ACReSAL SPIU, Supervising Consultant, Other relevant MDAs | 37,700,000.00 | 26,363.60 |
| Training and capacity building | Zamfara ACReSAL SPIU | 21,600,500 | 15,105.00 |
| Disclosure | Zamfara ACReSAL SPIU | 3,000,000 | 2,097.90 |
| **Sub-Total** | | **97,300,500** | **6,8042.00** |
| Contingency | 10% of Sub- Total | 9,730,050 | 6,804.00 |
| **Total** | | **107,030,550.00** | **74,846.50** |

***Note:** All conversions were done using the Central Bank of Nigeria (CBN) current exchange rate of 1USD = 1,430 NGN as of January 2026.*

# CHAPTER SEVEN – GRIEVANCE REDRESS MECHANISM

## 7.1 Introduction

The overall Grievance Redress Mechanism (GRM) prepared for the ACReSAL Project is an instrument through which dispute resolution under the project is sought and provided. It involves the receipt and processing of complaints from individuals or groups negatively affected by activities financed under the ACReSAL project, and as required under ESS10 (Stakeholder Engagement and Information Disclosure) of the ESF. The GRM will assist the PMU at the federal level to ensure that deliberate processes and procedures are put in place to capture, assess and respond to concerns from project beneficiaries, project executors and the general public during the implementation of the project. This process is also expected to be domesticated at the state level to address project related concerns in each participating state; in this case, Zamfara State. Following detailed site visits to the Bulka Stormwater/Erosion Sites and comprehensive stakeholders' consultations at the community level and with the Zamfara State ACReSAL PMU. This Grievance Redress Mechanism (GRM) has been prepared to address issues of grievances and displeasure that may occur while carrying out the intervention works for the sub-project.

## 7.2 Potential Grievances Related to the ACReSAL Project

Specifically, the potential grievances that may arise from the ACReSAL project are as follows;

- Involuntarily Resettlement (Disruption of public access and disturbance resulting to loss of business days and associated income)
- Land Acquisition
- Restriction of Access to economic sources
- Non-Payment of Compensation
- Reduction of land available for other uses
- Loss of jobs permanently due to displacement of farmers.
- GBV/SEA/SH
- Labor and Working Conditions
- Labor Influx
- Potential Risk of social conflict with communities as a result of labour influx;
- Herdsmen-Farmers clashes
- Security Risks issues
- Delay in execution of project leading to breakdown of trust
- Failure to generate opportunities for employment, training, supply or community development
- Failure to follow-through on commitments in a given timeframe
- Heavy equipment movement and operation in public areas,
- Accidents or injuries due to construction
- Air pollution from construction machinery,

### Interest Groups

The key interest groups in this regard are:

- Community based influencers supporting the project who are liable to be accused of benefit

capture, exclusion and marginalization
- Persons who have suffered from the impacts of the Bulka stormwater/erosion over the past 20 years
- The owners of the physical structures (residential and commercial buildings, fences, septic tanks, shops, kiosks, locally made bathrooms, etc.) that may be taken down during the demolition of structures within the 3m setback and construction works
- Owners of economic trees
- Farmers
- Owners of shines, tombstones.
- Landowners whose lands may be used as borrow pits
- Gully users, including individuals who fish at the discharge end of the Bulka erosion site and the Korromar Wanke River (Gulbi), as well as those who dig into the ground to collect water for cooking, drinking, and other domestic uses, etc.
- Motorcyclists
- Marketers
- Bulka community
- Ward heads and community leaders of the various villages
- Women groups
- Project employed labour
- Youth groups
- Local Non-Governmental Organizations (NGOs) focused on Sanitation and Environment
- Zamfara State Environmental Protection Agency (ZEPA)

**Disadvantaged or Vulnerable Groups**

Key disadvantaged or vulnerable groups identified are:

- Site workers – Some unskilled personnel may not be issued formal letters of engagement; or proper conditions for work. In some cases, contractors could exploit some unskilled personnel who may be illiterate and lack understanding of their rights according to the Nigerian Labour Law (2004) and ESS 2.
- Potential child labourers and hawkers
- Potential victims of GBV, sexual harassment and abuse who are made vulnerable due to poverty and unemployment
- Unemployed youth open to violence
- Elderly people
- Physically and mentally challenged people
- Any minority groups

## 7.3 Objectives of the GRM for the Bulka Stormwater/Erosion Control Sub-projects

The specific objectives of the GRM are to:

- Resolve the grievances when they occur, and mitigate their consequences, as well as

preventing them from escalating.

- Achieve resolution of project related grievances and conflicts in a transparent, timely and efficient manner.
- Achieve improvement and restore relationships among people and communities affected by conflicts arising from project activities.
- Enable the voiceless and the vulnerable (such as the poor, elderly, landless, women, persons with disabilities, marginalized and communities around project intervention areas) have a voice through the GRM system.

For ACReSAL, the GRM has been designed with the objective of solving disputes at the earliest possible time, which is in the interest of all parties concerned; it thus implicitly discourages referring such matters to the law courts for resolution, which would take a considerably longer time.

## 7.4 Strategies for Resolving Identified Grievances

The strategies, to be taken to resolve grievances include:

a) **Sensitization/Stakeholders Engagement:** The best approach for managing grievances is continuous engagement. Adequate sensitization with a broad or wider section of relevant stakeholders will significantly reduce the number of complaints emanating from targeted communities. As soon as a complaint is received and documented, consultation/discussion should immediately begin with the individual. And it should also be expanded to include more persons in the process as the need arises. *Note: This is not the case for GBV incidents*. Public consultation and participations are essential because they afford stakeholders especially potential persons who may have complaint and the general, public the opportunity to contribute to both the design and implementation of the project activities and reduce the likelihood for conflicts. The more direct involvement of the local level people in the planning and management processes (precisely those from the project area), the greater the likelihood that resource use and potential problems will be solved as well as the likelihood of development opportunities occurring in a balanced way and to the benefit of the sub-project communities.

**b) Formation and Operationalization of GRM Governance Structures:** This structure is designed to a National Grievance Redress Specialist and Formation of Federal Grievance Redress Committee. The FPMU further ensures that same structures are replicated at the State and Community level as necessary. In other words, the Zamfara ACReSAL shall have a similar GRM governance structure. To address grievances At the PMU levels, workers should be informed of the project level and all other grievance resolution systems provided under the project. Workers may use these mechanisms without retribution, and the grievance and conflict resolution systems do not impede access to other judicial, administrative remedies available under the law or through existing arbitration procedures, or substitute for grievance systems provided through collective agreements.

c) **Payment of Compensation and Entitlement:** Upon the preparation and disclosure of the RAP for the Bulka stormwater/erosion control, in line with the RPF prepared for the ACReSAL Project, compensation and entitlement should be paid to PAPs prior to the commencement of any activities at the project site. This will reduce the number of complaints emanating from project areas.

d) **Involuntary Resettlement/Land Acquisition:** Where land acquisition is inevitable, the Zamfara ACReSAL SPMU should replace such land with land resource in another location, and agreeable by the complainant. The compensation will be paid in kind or cash for value of land.

**e) Restriction of Access to economic sources/Loss of Jobs Permanently/Reduction of Land for other Uses:** Such category of persons may be compensated with cash, a new place of business or other benefits including provision of livelihood restoration support.

f) **Herdsmen-Farmers Clashes:** Grazing routes and grazing reserves should be provided outside the corridor of the Zamfara ACReSAL project site for herdsmen to prevent crisis between them and the local farmers. Series of consultation should be held with the herdsmen and the leaders early enough and during the project implementation stages to forestall crisis.

**Reasons why a complaint or feedback may be deemed not eligible and rejected include:**

- The complaint does not pertain to the project
- The issues raised in the complaint does not fall within the scope of issues the grievance mechanism is authorized to address, and
- The complainant has no standing to file e.g. not a member of the project community and not affected by the project activities.

## 7.5 Grievance Uptake Points for the ACReSAL Project

There shall be at least three uptake points for grievances arising from the Zamfara ACReSAL subproject activities:

- GRC secretariat at the community Level
- SPMU offices at the State Level
- FPMU Office at National Level

### 7.5.1 Grievance Escalation Protocol

- As the first order of call-in resolving grievances, the Community Grievance Redress Committee (GRC) members will deal with any grievance that comes up. This will ensure equal treatment across cases and elimination of nuisance claims and satisfy legitimate claimants at prevailing cost.
- If grievances are not resolved at the Community, the community grievance redress committee shall immediately refer the grievance to the SPMU for further mediation and resolution.

- If the grievances are not resolved at the SPMU level, the SPMU shall immediately escalate it to the FPMU for final mediation.
- The judicial system will be the last resort to redress the issues if informal conciliation does not resolve the matter. This, admittedly, is a costly and time-consuming procedure. Nevertheless, affected persons will be exempted from administrative and legal fees incurred pursuant to this grievance redress procedure.

## 7.6 Grievance Redress Process for the Sub-Project GRM

In its simplest form, grievance mechanism can be broken down into the following primary processes:

- **Receive and Register Grievances:** The Zamfara State ACReSAL will enable aggrieved stakeholders ("complainants ") to communicate their grievances through a variety of channels (e.g., phone, letter, email, website, meeting, grievance complaint boxes etc.). As noted above, the purpose of the GRM is to provide an accessible, rapid, and effective response to concerned stakeholders, especially to vulnerable groups who often lack access to the formal legal system. Zamfara ACReSAL first GRM responsibility is to ensure that potentially affected stakeholders understand what the GRM is for, the different options that they have for conveying their grievances, as well as where they can get help and advice about how to do so. Appropriate oral and written communication in local languages through the media and in higher- risk communities shall be developed and disseminated.

- **Acknowledge, Assess, Assign**
  - ✓ ***Acknowledging receipt****:* The SPMUs Social and Livelihoods Officer (SLO), who receives a grievance, should provide a timely response and acknowledgement to the complainant(s). This grievance will be logged and reviewed for eligibility, and if eligible, it will generate an initial organizational response. Usually, an initial acknowledgement should come within 2-3 days of receipt and can be in the form of a standard letter or an email, with a clearly identified point of contact, a brief description of the process that will be followed, and a reference name and number for the complaint. Where those receiving the complaints for the organization are themselves authorized to log the complaint, they can immediately acknowledge receipt and logging of the complaint and inform the complainant of the procedure for assessing eligibility and generating an initial response.

  - ✓ ***Assessing eligibility for the GRM****:* This will be a procedural step to ensure that the issue being raised is relevant to the Bulka stormwater/erosion control sub-project. It is often better to ensure a relatively low barrier to entry with quick turn-around rather than to prevent users having their issues considered. A decision on eligibility is only meant to trigger an initial assessment and response. It is not an admission that the organization has caused an impact, or a commitment to provide the complainant with any specific form of redress. At this point, no response should be committal. The staff responsible for the initial

response needs to follow clear guidelines on what kinds of issues are eligible to be handled through the GRM, what issues should be referred to other mechanisms (such as GBV, internal audit departments, internal and external anti-corruption offices, police, etc.), and what issues or contexts may not be eligible for an organizational response.

- **Develop a proposed response:** The SLO/team responsible for crafting a response needs to determine whether the grievance can be addressed directly through a relatively simple action; or whether the grievance is complex enough that it requires additional assessment and engagement with the complainant and other stakeholders to determine how best to respond. Many complaints can be resolved through direct and relatively straightforward action on the part of the organization or program: e.g., investigating alleged damage caused by a vehicle; changing the time and location of a consultation; or making public information more accessible in a community.

- **Communicate proposed response to complainant and seek agreement on the response**
  The GRM is responsible for communicating the proposed response to the complainant in a timely fashion, using a language that is easily understandable to the complainant. Responders may also contact the complainant by telephone or set up a meeting to review and discuss the initial approach with the complainant. The response should include a clear explanation, on why the response is being proposed; what the response would be; and what the complainant's choices are. Those choices may include agreement to proceed, request for a review of an eligibility decision a referral decision, further dialogue on a proposed action, or participation in a proposed assessment and engagement process. In addition, the response should note any other organizational, judicial or non-judicial but official government avenues for redress that the complainant may wish to consider. Though practices vary, communication and conclusion of the reported grievance should normally occur within 14-21 days from receipt of a complaint. In the case of complaints alleging serious harm or serious rights violations, the GRM's standard operating procedures should call for a fast-track response, whether by the GRM or by immediate referral to another office or organization. Hence an immediate notification to the complainant about the decision.

- **Implement the response to resolve the grievance**
  - ✓ When there is an agreement between a complainant and the GRM staff to move forward with the proposed action or stakeholder process, then the response should be implemented.
  - ✓ In cases where the initial response is to initiate broader stakeholder assessment and engagement, the assessment process may be conducted by the GRM staffs themselves, by consultants or others perceived as impartial and effective by the organization, the complainant, and other stakeholders.
  - ✓ The main purpose of the assessment and Engagement process is to clarify:
    - ♦ The issues and events that have led to the complaint
    - ♦ The stakeholders involved in those issues and events

- The stakeholders' views, interests, and concerns on the relevant issues
- Whether key stakeholders are willing and able to engage in a joint, collaborative process (which may include joint fact finding, dialogue or negotiation) to resolve the issues
- How the stakeholders will be represented, and what their decision-making authority will be
- What work plan and time frame the stakeholders would use to work through the issues
- What resources they will need, and who will contribute them.

✓ In some cases, the stakeholder's assessment will produce clarity and agreement among the key stakeholders on a collaborative approach to resolving the issues raised in the complaint. In others, the assessment may determine what one or more key stakeholders are unable or unwilling to participate. Whether or not a collaborative process appears viable, the GRM staff needs to communicate the assessment findings to the complainant and other stakeholders, with a recommendation on whether and how to proceed.

✓ If a collaborative approach is possible, then the GRM staff is usually in charge of overseeing it. GRM staff may directly facilitate the stakeholders' work on the issues, contract with a consultant facilitator, or use traditional and local consultation and dispute resolution procedures and leaders/facilitators.

✓ If the engagement process produces agreement on actions to resolve the complaint, then the GRM staff is responsible for overseeing implementation of those actions. In a multi-stakeholder context, several actors may be involved in the solution. It is important for GRM staff and the stakeholders to monitor implementation jointly, and to "come back to the table" to deal with challenges during implementation.

- **Review the response if unsuccessful:** As noted above, in some cases it may not be possible to reach an agreement with the complainant on the proposed response. In a multi-stakeholder dispute, an assessment process may lead to the conclusion that a collaborative approach is not feasible. When a collaborative approach is used, good faith efforts may not succeed in resolving key issues. In any of these situations, the GRM staff should review the situation with the complainant and see whether any modification of the response might meet the concerns of the complainant, the organization, and other stakeholders. If not, the GRM staff should inform the complainant about other alternatives that may be available, including the use of other administrative mechanisms or judicial for recourse. Whatever alternative the complainant chooses, it is important for the GRM staff to document their discussion with the complainant and the complainant's informed choice among alternatives.

- **Close out or refer the grievance**
  - ✓ The final step is to close out the grievance. If the response has been successful, the GRM staff should document the satisfactory resolution. In cases where there have been major risks, impacts or negative publicity, it may be appropriate to include written documentation from the complainant indicating satisfaction with the response. In others, it will be sufficient for the GRM staff to note the actions taken and also ensure that the response is satisfactory to the complainant and the organization. In more complex and unusual grievance situations, it may be useful to document key lessons learned as well. For each complaint, a file should be opened where signed minutes of meetings held, photographs, satisfaction closure letter from complainant etc. will be preserve for future reference before signing off in the grievance logbook.

  - ✓ If the grievance has not been resolved, the GRM staff should document steps taken, communication with the complainant (and other stakeholders if there has been substantial effort to initiate or complete a multi- stakeholder process), and the decisions made by the organization and the complainant about referral or recourse to other alternatives, including legal alternatives.

  - ✓ In general, GRM documentation on particular cases should maintain confidentiality about details, while making public aggregate statistics on the number and type of complaints received, actions taken and outcomes reached. It may be appropriate in some cases to make basic information about the identity of complainants publicly available, with the consent of the complainant.

  - ✓ Accurate case documentation using an electronic database is essential for public accountability, organizational learning, and resource planning. In the context of the ACReSAL Project, it also contributes to the maintenance of the benefit-sharing and safeguards aspects of the country's monitoring activities. Therefore, closing a case is both a formal way to account for the response to a particular grievance, and a critically important moment for ensuring that key information and lessons are captured.

  - ✓ As final measure for management of grievances, the FPMU/Zamfara ACReSAL SPMU shall track and evaluate outcomes as well as preparing a trimester report to the management on the nature and resolution of the grievances.

Figure 7.1 below shows a schematic diagram of the ACReSAL GRM, which has been adopted for the Bulka stormwater/erosion control sub-project.

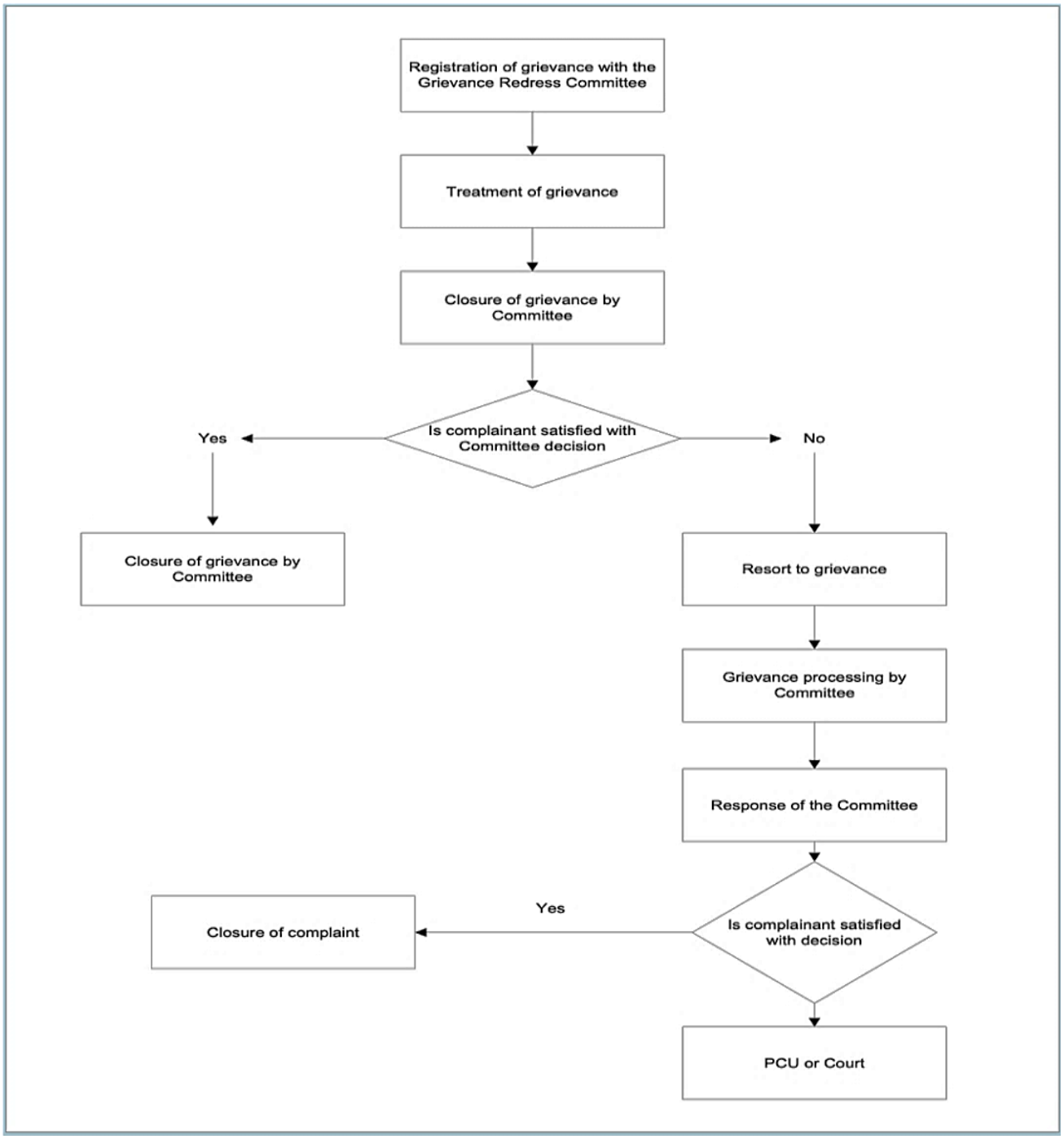



**Figure 7.1: ACReSAL GRM Process**

# CHAPTER 8: CONCLUSION AND RECOMMENDATIONS

## 8.1 Conclusion

Specifically, the project aims to tackle the problem of land degradation through integrated watershed management. While the project implementation is expected to have certain adverse effects on the biophysical and social environment, these impacts will be localized in spatial extent and short-term. They can be effectively avoided or managed through the application of appropriate mitigation measures proffered in the Environmental and Social Management Plan (ESMP), sound design, adherence to good construction practices, effective maintenance, and robust supervision and enforcement during project implementation.

The ESMP has provided in detail the mitigation measures for identified potential adverse impacts associated with the various phases of the project, and a monitoring program to ensure compliance. In concluding, with adequate application of mitigation measures the impacts will be avoided, reduced or mitigated, and in very few cases they may be offset.

## 8.2 Recommendations

The intervention sub-project with the associated activities outlined in this ESMP will have highly beneficial impacts by improving critical service delivery infrastructure within the communities, through which resilience would be strengthened, livelihood opportunities can be enhanced and social cohesion, improved. Although, the channelization, construction & civil works that will be implemented will lead to some limited adverse environmental and social impacts which will largely be localized in spatial extent, short term and occurring within less sensitive environmental areas. These will be managed through the application of the appropriate mitigation measures stated in the ESMP which would be included in the contractor's agreement, good practices, adequate supervision and enforcement during project implementation.

Consequently, there is therefore no major environmental or social issue to impede the implementation of the proposed project. Nevertheless, some additional recommendations that will enhance the overall sustainability of the project are as follows:

- Priority should be given to local workers to stimulate local socioeconomic activities, improve livelihood and poverty reduction in the affected communities. \
- Ensure opinion of persons in affected communities is given priority in appropriation of mitigation measures.
- All bare and exposed soils should be re-vegetated with native vegetation immediately to prevent triggers to erosion,
- Regular monitoring of outfalls, especially after rainfall to prevent debris build up and blockages that can trigger flooding
- Maintenance works should be carried out in an environmentally sustainable and socially responsible and inclusive manner;

- The safeguard unit of SPMU should ensure active monitoring to ensure the contractor adhere strictly to the requirements of this ESMP especially in the application of mitigation measures
- The SPMU should ensure that the relevant sections of the ESMP should be made available to contractors

**References**

Abubakar, I., Bello, B. M., Tukur, K., Maiakwai, N. S., & Sani, M. M. (2023). Checklist, Diversity and Abundance of the Flora in some Selected Local Government of Zamfara State, Northwestern Nigeria. *UMYU Scientifica*, *2*(3), 153-164.

Abubakar, M. M., Muhammad, S. I., Kura, N. U., Fagge, A. M., & Ringim, A. S. (2025). Frame and catch assessment survey of the fisheries in the Hadejia–Nguru wetlands. *Journal of Biodiversity and Greenery Research*, 11(4), 70–78.

ACReSAL (2025). *Sokoto-Zamfara Strategic Catchment Management Plan*. https://acresal.gov.ng

ACReSAL. (2025). Project Procurement Strategy: Agro-Climatic Resilience in Semi-Arid Landscapes, Nigeria.

Africa Check (2018). FACTSHEET: Grading Nigeria's progress in education https://africacheck.org/factsheets/factsheet-grading-nigerias-progress-in-education/

Ajayi, A. et al. (2024). *Hydrological Modeling of Sokoto-Zamfara Basin Using SWAT*. Nigerian Journal of Technology. https://www.ajol.info

Akachukwu, E. N., Obi-Iyeke, G. E., Ajai, A. I., Mohammed, A. Z., & Arimoro, F. O. (2025). Phytoplankton as indicators of ecological changes in Afrotropical reservoirs. *Environmental Monitoring and Assessment*, *197*(7), 777.

Akindele, E. O., & Adeniyi, I. F. (2013). Zooplankton composition and community structure in Lake Tiga, Kano, Nigeria. *African Journal of Aquatic Science*, 38(2), 237–246.

Akintola, J. O. (1986): Rainfall distribution in Nigeria, 1892-1983. Published by Impact Publishers (Nig.) Ltd. Ibadan, 380p. ISBN 978-2386-02-2.

Akintola, J. O. (1986): Rainfall distribution in Nigeria, 1892-1983. Published by Impact Publishers (Nig.) Ltd. Ibadan, 380p. ISBN 978-2386-02-2.

Akobundu, I. O. and C. W Agyakwa (1989) A handbook of West African Weeds, IITA Press, Ibadan, Nigeria.

Ali, A. D., Ezra, A. G., & Abdul, S. D. (2015). Species composition and distribution of freshwater diatoms from Upper Dilimi River, Jos, Nigeria. *International Journal of Biological and Chemical Sciences*, 9(3), 1234–1246.

Amana, G.U., Ozougwu, J.C., Okoye, I.C., et al. (2021). *Abundance and seasonality of phytoplankton, zooplankton and anuran species in selected wetlands of Kogi State, Nigeria*. Asian Journal of Research in Zoology.

Amobi, M. I., Nasir, M. U., Okpoko, V. O., Ndukwe, N. N., Edeh, I. C., & Ede, A. (2024). Physico-Chemical Parameters and Zooplankton Community of Pindiga Pond, Gombe State, Nigeria. *Journal of Science and Technology (FUKASHERE)*.

Andem, A. B., Ibor, O. R., Oku, E. E., Ekanem, S. B., Chukwuka, A. V., & Adeogun, A. O. (2022). Urbanisation gradients, riparian-loss and contaminant effects on macroinvertebrate distribution within a tropical river (Nigeria). *Chemistry and Ecology*, *38*(6), 503-526.

Anifowoshe, A.T., et al. (2022). *Plankton composition and distribution in some selected rivers within Ilorin, Kwara State, North Central Nigeria*. Manila Journal of Science, 15(2):19–33.
APHA (1999); American Public Health Association.

APHA (2017). *Standard Methods for the Examination of Water and Wastewater*. American Public Health Association.

Arimoro F.O, Edema N.E and Amaka R. (2008). Response of phytoplankton to abattoir wastes and other anthropogenic activities in a stream in the Niger Delta. Tropical Freshwater Biology, 17(1), 37 – 52.

Arimoro F.O.and Ogana A.O (2010). Response of Zooplankton to abattoir wastes and other anthropogenic activities in a stream in the Niger Delta. The Open Environmental & Biological Monitoring, 3:1-11.

Arimoro, F. O., & James, H. M. (2008). Preliminary pictorial guide to the macroinvertebrates of Delta State Rivers, Southern Nigeria. *Albany Museum, Grahamstown*.

ASTM International Standard Worldwide, ASTM International, West Conshohocken, PA, 2015, www.astm.org

Baker, C., de Koning, P., & Diallo, M. (2024). *Sustaining the Inner Niger Delta lifeline*. Alliance for Global Water Adaptation. https://www.alliance4water.org/wr4er-cases/sustaining-the-inner-niger-delta-lifeline [tropicalstudies.org]

Balogun, K. J and Ajani, E.K. (2015). Spatial and temporal variations of phytoplankton pigments, nutrients and primary productivity in water column of Badagry Creek, Nigeria. American Journal of Research Communication 3.7: 157 – 172.

Bibby, C. J. (2004). Bird diversity survey methods. In *Bird ecology and conservation: A handbook of techniques*.

BirdLife International. (2016). *Peliperdix albogularis (White-throated Francolin)*. The IUCN Red List of Threatened Species 2016: e.T22678994A92808678. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22678994A92808678.en

BirdLife International. (2018). *Stephanoaetus coronatus*. The IUCN Red List of Threatened Species 2018: e.T22696016A131981774. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22696016A131981774.en

EPA (2000) EPA. Compilation of Air Pollutant Emission Factors Volume I: Stationary Point and Area Sources, 5th ed. United States Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park NC 27711, USA, 1995.

FAO. (2020). *Inland fishery resources of Nigeria: The Niger/Sokoto river basin*. Food and Agriculture Organization. https://www.fao.org/4/T1230E/T1230E06.htm

Federal Environmental Protection Agency (1991). Guidelines to Standards for Environmental Pollution Control in Nigeria. Federal Environmental Protection Agency (FEPA).

Federal Environmental Protection Agency (1994). Environmental Impact Assessment Procedural Guideline

Federal Ministry of Environment (1999): National Guidelines and Standards for Water Quality in Nigeria.

Fischer, R. A., & Fischenich, J. C. (2000). *Design recommendations for riparian corridors*. U.S. Army Engineer Research and Development Center.

Gambo, M., Yusuf, A., & Bello, S. (2025). Modelling erosion vulnerability in Nigerian catchments using GIS and RUSLE. *Environmental Earth Sciences, 84*(2), 45–59.

GISD. (2023). *Global Invasive Species Database*. IUCN-ISSG.

Global Invasive Species Database (GISD). (2023). *Global Invasive Species Database*. Invasive Species Specialist Group (ISSG) of the IUCN Species Survival Commission. Retrieved from https://www.iucngisd.org/gisd/

International Finance Corporation Performance Standards on Environmental and Social Sustainability, 2012.

International Organization for Standardization (ISO) 14001:2015 Environmental Management Systems.

Invasive Species Specialist Group (IUCN-ISSG). (2022). *Global Invasive Species Database*. International Union for Conservation of Nature. Retrieved from https://www.iucngisd.org/gisd/
IUCN. (2023). *The IUCN Red List of Threatened Species*. Version 2023-2. Retrieved from https://www.iucnredlist.org

Keay, R. W. J. (1971). An Example of Sudan Zone Vegetation in Nigeria. In S. R. Eyre (Ed.), *World Vegetation Types* (pp. 70–80). Palgrave Macmillan. https://doi.org/10.1007/978-1-349-15440-1_5

Kinyili, B. M., Ndunda, E., & Kitur, E. (2020). Socio-economic and institutional factors influencing adoption of agroforestry in arid and semi-arid (ASALs) areas of Sub-Saharan Africa. *International Journal of Forestry and Horticulture (IJFH)*, *6*(1), 8-18.

Langendoen, E. J., Richard Lowrance, R., & Simon, A. (2009). Assessing the impact of riparian processes on streambank stability. *Ecohydrology: Ecosystems, Land and Water Process Interactions, Ecohydrogeomorphology*, *2*(3), 360-369.

Leopold, L. B., Clarke, E. E., Hanhew, B. B., and Balsey, Jr (1971): A procedure for Evaluating Environmental Impacts. Geological Survey Circular 645. Government Printing Office, Washington, D. C pp 331-398.

Lind, L., Hasselquist, E. M., & Laudon, H. (2019). Towards ecologically functional riparian zones: A meta-analysis to develop guidelines for protecting ecosystem functions and biodiversity in agricultural landscapes. *Journal of environmental management*, *249*, 109391.

Maishanu, H. M., Rahama, M. A., & Mainasara, M. M. (2019). Influence of human activities on the phytoplankton communities of River Rima in Kwalkwalwa area of Sokoto State, Nigeria. *Science World Journal*, 14(2), 1–8.

National Bureau of Statistics (2016); 2015 Statistical Report on Women and Men in Nigeria. Abuja: National Bureau of Statistics

National Bureau of Statistics (2019); Labor Force Statistics - Volume I: Unemployment and Underemployment Report Q4 2017-Q3 2018. Abuja: National Bureau of Statistics

National Bureau of Statistics (NBS) and Central Bank of Nigeria. 2006. The Nigerian Statistical Fact Sheets on Economic and Social Development. Abuja, Nigeria.

National Bureau of Statistics (NBS). 2010. Annual Abstract of Statistics. Abuja,

National Bureau of Statistics (NBS). 2010. Nigerian Poverty Profile Report, Press Briefing by Statistician General. Website.

National Bureau of Statistics (NBS). 2011. 'General Household Survey' in 2011 Annual Socio-Economic Report. Abuja, Nigeria.

National Bureau of Statistics, (2010); The National Literacy Survey June, 2010. Retrieved from https://www.nigerianstat.gov.ng/pdfuploads/National%20Literacy%20Survey,%202010.p

National Population Commission (NPC) and ICF Macro. 2009.

National Population Commission (NPC). 2010. Priority Table Vol. IV: Population Distribution by Age and Sex (State and Local Government Area). Abuja,

Nigeria Demographic and Health Survey (NDHS) 2008. Abuja, Nigeria: National Population Commission and ICF Macro.

Nigeria Demographic and Health Survey 2008. Abuja, Nigeria: National Population Commission and ICF Macro. Nigeria. Pisces, Newbury.

Nigeria National Bureau of Statistics (NBS). 2010. National Literacy Survey. Abuja, Nigeria.

Nigeria. National Population Commission (NPC). 2010. Priority Table Vol. VII: Population Distribution by Age, Sex and Educational Attainment (State and Local Government Area). Abuja, Nigeria.

Nneji, L. M., Adeola, A. C., Okeyoyin, A., Oladipo, O. C., Saidu, Y., Samuel, D., ... & Ugwumba, A. A. A. (2019). Diversity and distribution of amphibians and reptiles in Gashaka Gumti National Park, Nigeria. *Herpetology Notes*, *12*, 543-559.

Nwilo, P. C., Olayinka, D. N., Okolie, C. J., Emmanuel, E. I., Orji, M. J., & Daramola, O. E. (2020). Impacts of land cover changes on desertification in northern Nigeria and implications on the Lake Chad Basin. *Journal of Arid Environments*, *181*, 104190.

Salisu, N., Umar, J., Magami, I. M., et al. (2024). Assessment of the impact of anthropogenic activities on physicochemical parameters and phytoplankton compositions of Kalgo River, Kebbi State. *UMYU Journal of Microbiology Research*, 12(1), 45–56.

Shafiu, N. (2024). Phytoplankton as indicators of water quality in Thomas Dam, Dambatta, Kano State, Nigeria. *Academia.edu*.

Tanimu, Y., & Ibrahim, A. (2012). Phytoplankton composition and water quality of Hadejia–Nguru wetlands, Nigeria. *Journal of Ecology and Natural Environment*, 4(6), 150–158.

Tanko, M. H., & Bawale, A. S. (2025). Quantifying the Spatiotemporal Nexus between Deforestation and Land Surface Temperature Rise in a Semi-Arid African City: A 20-Year Geospatial Analysis of Katsina Metropolis, Nigeria. *Kaduna Journal of Geography*, *7*(1), 19-26.

White, F. (1983). *The Vegetation of Africa*. UNESCO.

Wikipedia (2025). *Zamfara River*. https://en.wikipedia.org/wiki/Zamfara_River

Wikiwand (2025). *Zamfara River Overview*. https://www.wikiwand.com/en/articles/Zamfara_River

World Bank Group (2007): Environmental, Health, and Safety (EHS) - General EHS Guidelines

World Bank Pollution Prevention and Abatement Handbook 1998 (updated in 2007)

World Bank. (2007). Pollution Prevention and Abatement Handbook, Washington, DC: World Bank, United States.

World Health Organisation (1996): pH in Drinking-water, Background Document for Development of WHO Guidelines for Drinking-water Quality. 2nd ed. Vol. 2 Health Criteria and other Supporting Information.

World Health Organisation (2006): World Health Statistics/Global Health Observatory on Life Expectancy for Countries.

World Health Organization (WHO). 2012. Nigeria Country Profile.

World Health Organization, Geneva. World Health Organization (1999): Guidelines for Community Noise, Originally Prepared and Published in 1995 by the Stockholm University and Karolinska Institute.

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**ANNEX 1**

# TERMS OF REFERENCE

**FOR THE**

**ENGAGEMENT OF CONSULTANT TO PREPARE AN ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) FOR BULKA EROSION & STORMWATER MANAGEMENT SITE IN ZAMFARA STATE**

**UNDER**

**ZAMFARA STATE AGRO-CLIMATIC RESILIENCE IN SEMI-ARID LANDSCAPES (ACReSAL) PROJECT**

**SEPTEMBER, 2025**

## 1.0 BACKGROUND

The Federal Government of Nigeria (FGN) has initiated the implementation of an Agro-Climatic Resilience in Semi-Arid Landscapes (ACReSAL) Project funded by the World Bank. The project will help Nigeria address critical challenges of regional desertification control and landscape management in northern Nigeria. In 2020, the FGN had for planting planned to plant 30 million trees to control desertification. For effective implementation of issues related to the already planned rehabilitation of 20 Oases in the current medium-term sector strategy, establishing 550 hectares of rangelands in the Frontline States, stabilizing and restoration of 160 hectares of active sand dunes in eight of the 11 frontline States, and continued assessment of the extent and magnitude of drought and desertification in Nigeria.

Sustainable natural resources management is critical to addressing land degradation and building climate resiliency in the Semi-Arid Landscapes in Nigeria. The issues require urgent and focused action to scale-up cost-effective land restoration practices to ensure more sustainable future food and water security in a changing climate. An integrated approach which collectively focuses on reducing exposure, managing sensitivity and increasing the coping capacity of all major factors of production is critical for building resiliency in dryland. Integrated catchment management is an appropriate framework to help address the natural resources management and human development challenges outlined above, but these are not yet carried out at a large scale in the country, including the northern regions.

Zamfara State, created in 1996, is located in the northwestern part of Nigeria with a land area of approximately 38,418 square kilometres. The State is characterized by a tropical savannah climate with distinct wet and dry season. Gusau, the State capital, experiences significant rainfall during the wet season, which often leads to stormwater management challenges and erosion issues.

The Bulka area in Gusau has been particularly affected by stormwater and erosion problems due to its topography, soil characteristics, and rapid urbanization. The area experiences recurrent flooding during the rainy season, causing damage to infrastructure, properties, and posing risks to human lives. These challenges have been exacerbated by climate change effects, which have led to more unpredictable and intense rainfall patterns.

Over the years, the existing drainage infrastructure in the Bulka area has deteriorated due to inadequate maintenance, increased sedimentation, and structural failures. This has significantly reduced the capacity of the drainage system to effectively manage storm-water runoff, leading to increased flooding and erosion problems.

The Zamfara State government, through the Ministry of Environment, has identified the urgent need to address these challenged through the implementation of comprehensive storm-water management and erosion control measures. The Bulka storm-water and erosion control project is therefore designed to provide sustainable solution to these problem is therefore designed to provide sustainable solutions to the problems, thereby enhancing the resilience of the community to the impacts of flooding and erosion.




***Figure 2Map of Nigeria showing Zamfara State***

The proposed ACReSAL intervention is targeted at arresting flood-degraded landscape and improving the sustainable productivity of land in the targeted areas of degraded landscapes. The project also aims to support communities with improved capacity and investments to improve sustainable livelihoods.

## 1.1 PROJECT DEVELOPMENT OBJECTIVE (PDO)

The project development objective (PDO) of ACReSAL Project is to increase the adoption of climate resilient landscape management practices in targeted watersheds of northern Nigeria and to strengthen Nigeria's long-term framework for integrated landscape management. The ACReSAL project seeks to build on the lessons from the many international development partners including the World Bank Group and help develop a more integrated, spatial, multisectoral approach to build community resilience as well as improve the sustainable productivity of its natural resources. In particular, the project will support activities to develop multi-sectoral approaches for desertification control and landscape management, improve community livelihoods and resilience, and strengthen institutions.

## 1.2 THE ACReSAL PROJECT COMPONENTS

The project has the following components and sub-components:

Component A: Dryland Watershed Management. This component will implement integrated watershed management planning and address the challenges of large-scale watershed degradation in northern Nigeria. There are three sub-components under this component i.e.:

Sub-component A1 (Strategic Watershed Management) to support large-scale integrated watershed planning and implementation.
Sub-component A2 (Watershed Infrastructure) will support large landscape-level investments, as prioritized in the strategic watershed plans related to water resources (e.g., surface and groundwater storage, managed aquifer recharge, riverbank restoration, gully rehabilitation, irrigation, improved water systems), to environmental management (stabilization of sand-dunes, forest management, afforestation), and agricultural investments at large scale,
Sub-component A3 (Special Ecosystems) this subcomponent will improve the management of special ecosystems, including wetlands, desert oases, and protected areas. Investments could include those related to wetland improvements, monitoring systems, water management, biodiversity conservation, stabilization of oasis buffer areas and improved water provision, and improving management systems for targeted protected areas.
Component B: Community Climate Resilience: This will address challenges of dryland management at the local level, and support communities and households in targeted watersheds with investments and new approaches to become climate resilient. This component has the following sub-components i.e.
Sub-component B1 (Community Strengthening), this subcomponent aims to strengthen the capacity of communities for sustainable natural resource use and management. It will support the needs of vulnerable and marginalized groups and address inequality, promote peacebuilding initiative and ownership,
Sub-component B2 (Community Investments) This subcomponent will finance physical investments in community-level infrastructure, landscape restoration in selected degraded areas, and support farmers at the household level to optimize climate-smart rainfed agriculture and farmer-led irrigation.
Component C: Institutional Strengthening and Project Management aims to improve the enabling institutional and policy foundation for multi-sectoral integrated landscape management and support project management. This sub-component has the following other sub-components i.e.:
Sub-component C1 (Institutional and Policy Strengthening) is aimed at improving the enabling institutional and policy foundation for integrated landscape management in Nigeria, focusing on improving the institutional infrastructure (IT, connectivity, and office improvements) in key agencies at the federal and state levels, setting up the data, analytics, and decision support framework with a strong capacity-building and outreach for both in-person and virtual training,
Sub-component C2 (Project Management) will support the overall project monitoring and management.
Component D: The Contingency Emergency Response Component (CERC) provides immediate support to an eligible crisis or emergency. The CERC is a financing mechanism available to Borrowers in IPF operations to access funds rapidly to respond to an eligible crisis or emergency (including disasters and health emergencies).

### 1.3.1 PROPOSED CONSTRUCTION/REHABILITATION ACTIVITIES

The proposed ACReSAL intervention at the Bulka Flood Control Project involves the construction of about 5.6-kilometer engineered waterway through key urban sectors, transforming the city's relationship with seasonal precipitation. The Bulka storm-water channel is located within the Gusau metropolis and extends over a total length of approximately 5.68 kilometer (4+684.73 km). The channel originates near the yan mangurori, Gusau at coordinates Latitude 12.182759°N and Longitude 6.684205°E, and ultimately discharges into koramar Wanke River behind hayin malam Ibrahim mai wa'azi at Latitude 12.174098 ° N and Longitude 6.644889°E.

Other activities associated with the subprojects during the pre-construction, construction, and operation phases of the works are:

a) Clearing of vegetation to create access and expansion work where relevant.
b) Demolition of existing structures like houses and failed hydraulic infrastructure.
c) Rehabilitation of access routes for heavy-duty equipment conveyance.
d) Reclamation of degraded land area by sand filing or stabilization of dormant gully fingers.
e) Bioremediation and creation of buffer zones along the gully channel.

Other related activities are staging area creation, campsite establishment for workers and material sourcing. Heavy equipment and machinery may be used for clearing vegetation, bulldozers, and excavators for creating staging areas, and campsites, and demolition of existing structures. Compactors may be used for levelling materials like sand, laterite, gravels etc., and payloaders for transporting materials like gravels, laterites, sand etc. Construction vehicles for transporting materials to site and off-site, drainage trencher for creating trenches/drainage. The proposed structural members and construction components of the erosion and flood control project will be constructed with concrete, steel, and other construction materials to conform with the work description in the engineering design.

*Considering the nature of these works, their scope, geographic coverage, and client's capacity, the following World Bank's Environmental and Social Standards will apply. Viz*

- ESS1 Assessment and Management of Environmental and Social Risks and Impacts,
- ESS2 Labor and Working Conditions,
- ESS3 Resource Efficiency and Pollution Prevention and Management,
- ESS4: Community Health and Safety,
- ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement,
- ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources,
- ESS8: Cultural Heritage,
- ESS10: Stakeholder Engagement and Information Disclosure

At project preparation, six Environmental and Social standards framework instruments were prepared: an Environmental and Social Management Framework (ESMF) a Resettlement Policy Framework (RPF), Integrated Pest Management Plan, Stakeholders engagement Plan, Labour Management Procedure and Security Risk Management Framework. These ESF instruments are

frameworks that need to be translated into specific cost, measurable, and monitorable actions for specific sites intervention through the preparation of site-specific management and action plans.

*ESMF.* In general, the ESMF specifies the procedures to be used for preparing, approving, and implementing (1) Environmental/Social Assessments (ESAs or an EA) and/or (2) Environmental/Social Management Plans (ESMPs, or alternately both an EMP and SMP) for individual civil works packages developed for each project. ESMPs are essential elements for Category B projects i.e. Moderate Risk.

RPF. The Resettlement Policy Framework is prepared as a stand-alone document to provide guidance, and a procedure and process for preparing ARAP/RAP which may be carried out when the subcomponents' locations are known and more detailed information on subcomponents becomes available. It sets out the resettlement and compensation principles, organizational arrangements, and design criteria to be applied to meet the needs of project affected people and specifies the contents of a Resettlement Action Plan (RAP) for each site-specific investment.

ESMP assists in eliminating adverse environmental and social impacts, offset them, or reduce them to acceptable levels. It will include measures needed to implement the mitigation actions, addressing the adequacy of the monitoring and institutional arrangements for the upper and lower watersheds in the intervention sites.

In each intervention site, the consultant will visit the full sub-watershed as delimited in the given gully stabilization design. The consultant will consider the proposed civil engineering designs, vegetative land management measures and other activities aimed at reducing or managing runoff that would be carried out within the sub-watershed. The consultant will assess natural resources and infrastructure to be potentially affected during project implementation and operation and select the management strategies needed to ensure that environmental risks are appropriately mitigated.

## 2.0 OBJECTIVE AND SCOPE OF THE CONSULTANCY

The objective of the consulting services is to prepare an Environmental and Social Management Plan (ESMP) for the sub-project in Bulka Erosion control site in Zamfara State in line with the guidelines of the World Bank/IDA. ESMP assists to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. The ESMP is site specific and includes the measures needed to implement these actions, addressing the adequacy of the monitoring and institutional arrangements for the upper and lower watersheds in the intervention sites. The project activities for the implementation of the proposed intervention are broadly classified into pre-construction, construction, and operation phases. The activities in each phase are described below.

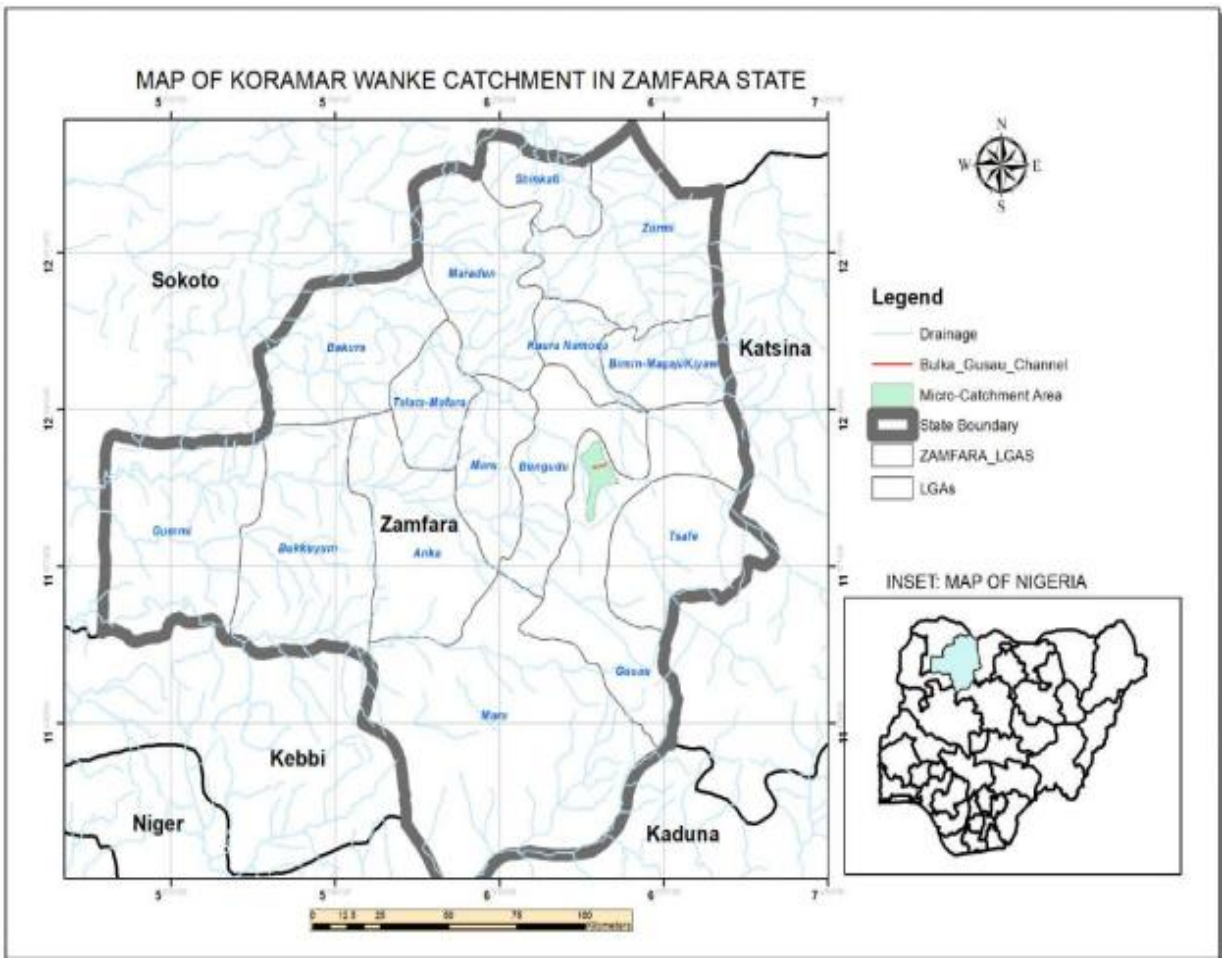
**Table 1: Proposed Project Activities by Phases**

| Phase | Activties | Duration | Dependencies |
|---|---|---|---|
| Mobilization & Preliminaries | Site investigation, baseline studies, permits, etc. | 6 | _ |
| | Stakeholder engagement & resettlement | 5 | Concurrent with above |
| | Site clearance and preparation | 8 | After investigation begins |

| | | | |
|---|---|---|---|
| Foundation & Earthworks | Excavation and foundation stabilization | 8 | After site prep |
| | | 6 | After excavation starts |
| Channel construction | Section 1 (1.4km) channel works | 24 | After foundation phase |
| | Section 2 (1.7km) | 28 | Staggered start with the above |
| | Section 3 (1.0km) | 20 | After Northern/central |
| | Section 4 (0.6km) | 16 | Final segment |
| Hydraulic structures | Inlets, outlets, drop structure, culvert | 12 | Channel work underway |
| | Retention pond (3 unit) | 8 | Parallel with above |
| Flow control systems | Flow regulation, energy dissipation, overflow setup | 6 | After inlet/outlet work |
| Erosion control & system finishing | Vegetation planting, riprap, weeping hole integration | 8 | After major civil work |
| | Geotextile and armouring | 6 | Parallel with above |
| Commissioning & Handover | Final testing, cleanup, community sensitization | 4 | After all installation |
| | Environmental compliance audits | 2 | Final checks |

***Source: Adapted from ZM-ACReSAL Detailed Engineering Design (2025)***

The ESMP is site-specific and includes the measures needed to implement actions, addressing the adequacy of the monitoring and institutional arrangements for the upper and lower watersheds in the intervention site. ESMP assists to avoid, minimize, restore and offset environmental and social impacts to reduce development impacts and control any negative effects on the environment.




**The project area (Bulka) is located in Gusau at latitude 12.182759°N and longitude 6.684205°E**

## 2.1 SUB PROJECT DESCRIPTIONAND LOCATION

The Bulka stormwater channel is located within the Gusau Metropolis and extends over a total length of approximately 5.68 kilometres (4+684.73 km). The channel originates near the Yanmangurori, Gusau, at coordinates Latitude 12.182759°N and Longitude 6.684205°E, and ultimately discharges into the Koramar Wanke River behind Hayin Malam Ibrahim Mai Wa'azi at Latitude 12.174098°N and Longitude 6.644889°E. The stormwater channel traverses a densely populated urban corridor and plays a critical role in draining surface runoff from several neighbourhoods and public infrastructure areas. Its route passes behind Kanoma Mosques and the residence of the Commissioner of Police, moves through the Premier Area and Ungwan Dallatu, and crosses Alfigir Road, running parallel to the Central Bank of Nigeria (CBN) fence. Further along, the channel intersects the main road between the Central Police Station and Government House, and passes across the railway line, approximately 100 meters opposite the Government House. It continues towards Bello Barau Road, in front of Sambo Dan'Ashapa Mosque, behind the Matrix Petrol Filling Station, and flows through Hayin Danhausa and Gadan Baga, before reaching its final discharge point. This topographic survey provides detailed spatial data on the

alignment, gradient, and Surrounding land features of the Bulka stormwater channel to inform effective drainage planning, flood mitigation, and potential rehabilitation works**.**

### 2.1.1 CHARACTERISTICS OF BULKA SITE

The catchment is in a built-up area and its area is 10.97 km$^2$, with overall slope gradient: Gradient: 0.506% In delineating the catchment into sub-catchments, the rational method of discharge estimation was conveniently used as it considers are as less than 5.68 km$^2$. These sub-catchments were delineated with respect to the Natural Drainage Lines, Digital Elevation Model (DEM), Gully Path, Longest Flow Path and Discharge Point as shown in Figures below

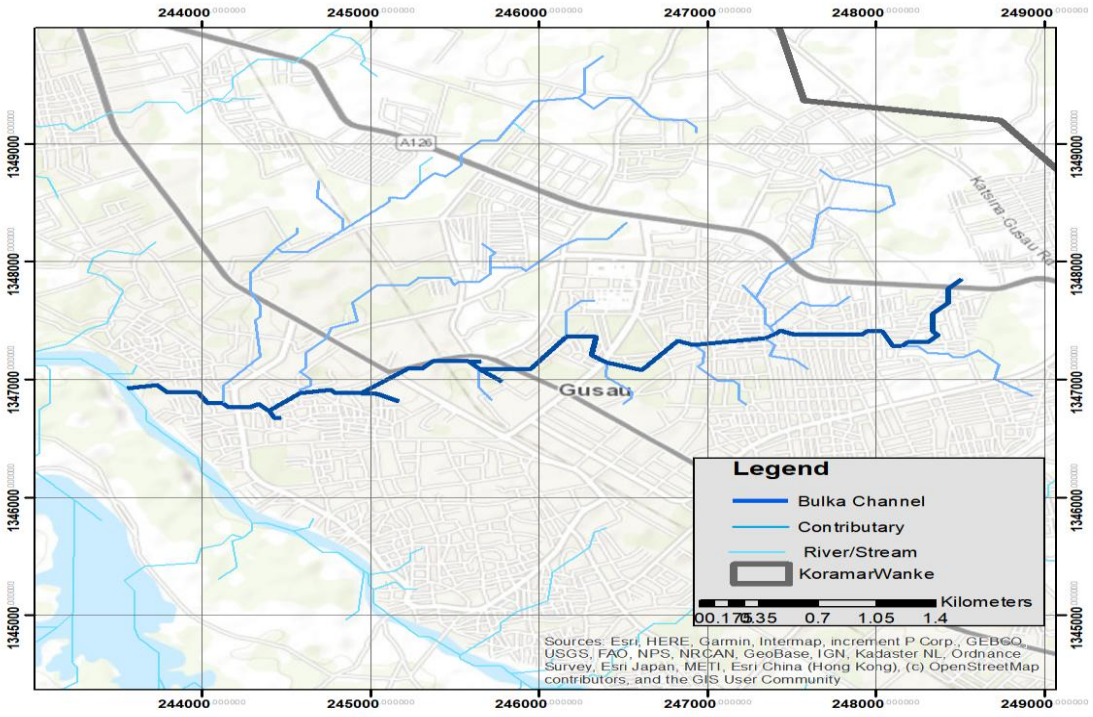



**Figure Shows Bulka Intervention Route Map**

### 2.1.2 Hydraulic Design Equations

The detailed engineering design integrates multiple technical elements into a cohesive storm-water management system. The trapezoidal channel configuration (7m top width, 4m Bottom width, 1.5m depth) optimizes hydraulic efficiency while minimizing excavation volumes sophisticated structural components—including inlet/outlet structures, drop structures, energy dissipation mechanisms, sediment traps, and bridge interfaces—create a comprehensive water management network. Hydraulic features such as detention basins and retention ponds provide critical flow regulation while offering ecological benefits. Together, these design elements transform traditional drainage infrastructure into a dynamic, resilient system capable of addressing the complex environmental challenges of the Gusau urban landscape.

### 2.1.3 Design Equation

Open Channels

The hydraulic design for the Bulka Stormwater & Erosion Control Project incorporates a dual approach:

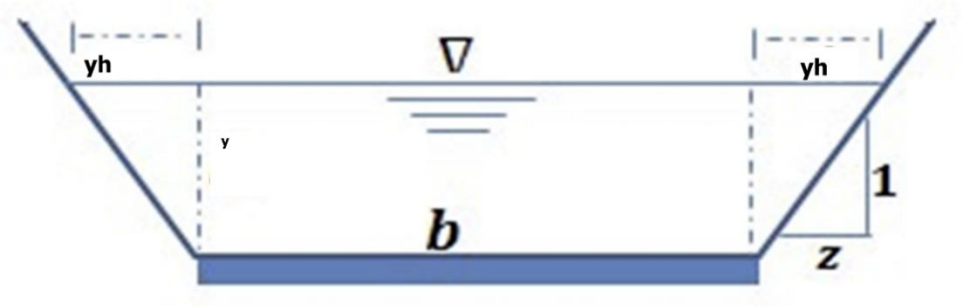
1. Reinforced concrete channels for high-velocity flow areas and urban sections

Sizing of reinforced concrete drains follows the Manning equation:

Q = (1/n) AR^(2/3)S^(1/2)

Where:

- Q = Discharge ($m^3/s$)
- n = Manning's coefficient (0.015 for concrete)
- A = Flow Area ($m^2$)
- R = Hydraulic Radius (m)
- S = Channel longitudinal slope (m/m)




**Prismatic Open channel parameters**

**Normal Depth Formulae**

| Formula | Description |
|---|---|
| A = y(b + zy) | Cross-sectional area |
| P = b + 2y(1 + z^2)^{1/2}$ | Wetted perimeter |
| T = b + 2zy | Top width |
| R = A/P | Hydraulic radius |
| D = A/T | Hydraulic depth |
| Q = (K/n) AR^{2/3}S^{1/2} | Discharge (Manning's equation) |
| V = Q/A | Average velocity |
| F = V/(gD)^{1/2} | Froude number |

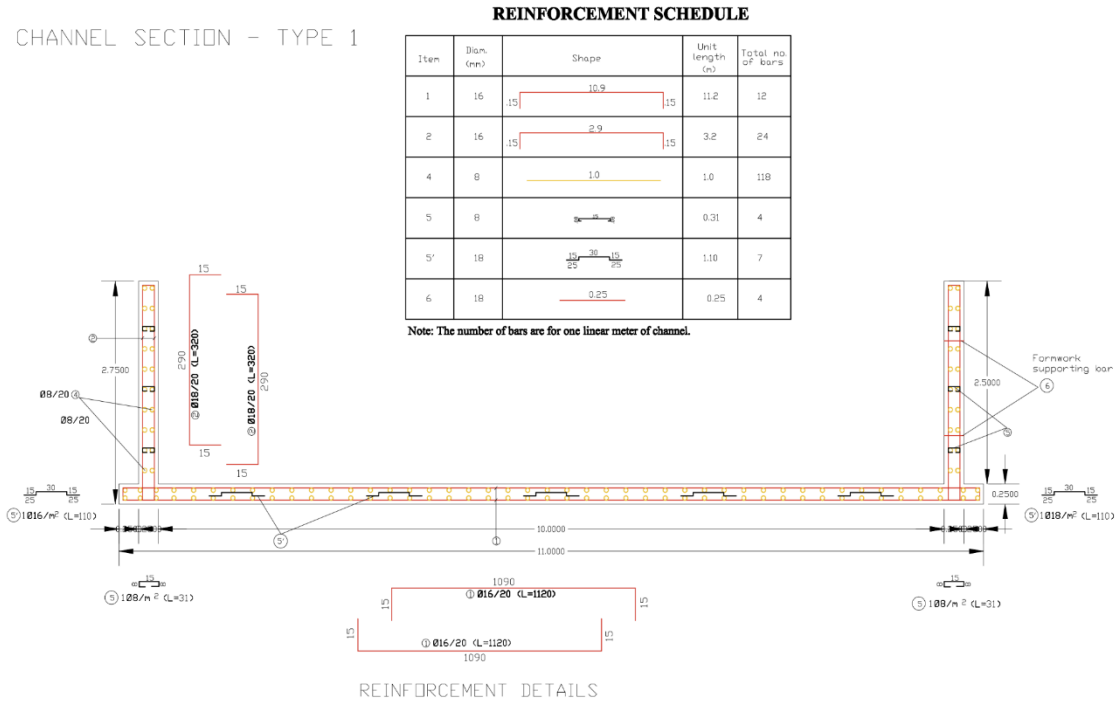
**Critical Depth Formulas**

| Formula | Description |
|---|---|
| F^2 = (Q^2T)/(gA^3) | Square of Froude number |
| F = 1 | Critical flow condition |
| (Q^2/g)T - A^3 = 0 | Critical depth equation |
| A = y(b + zy) | Cross-sectional area |
| T = b + 2zy | Top width |
| V = Q/A$ | Average velocity |
| D = A/T | Hydraulic depth |

**These formulas are fundamental for open channel Cross-Sectional Design**

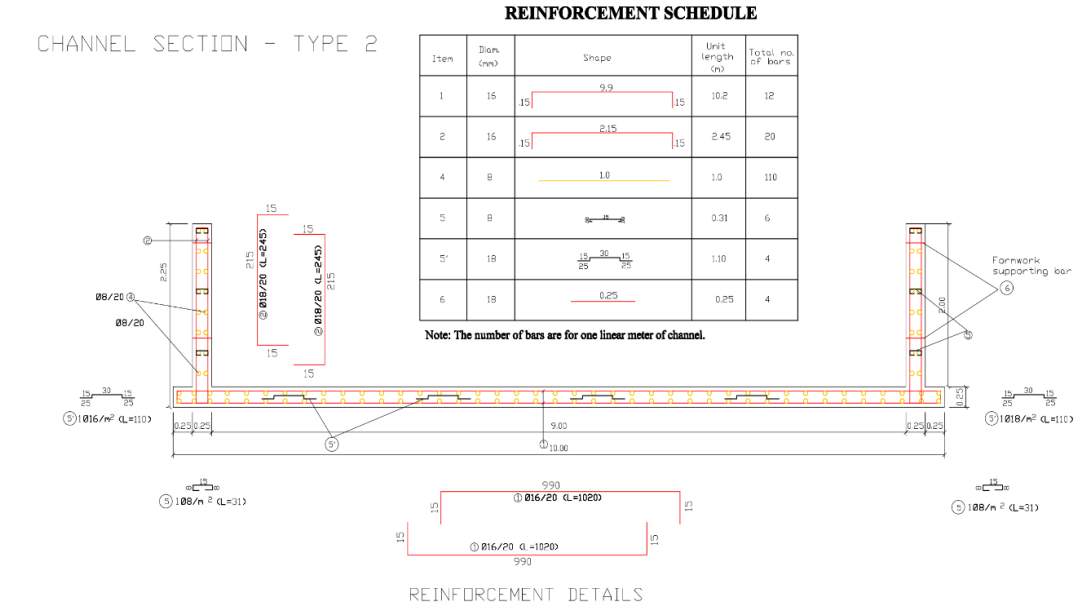
**Geometric Specifications**

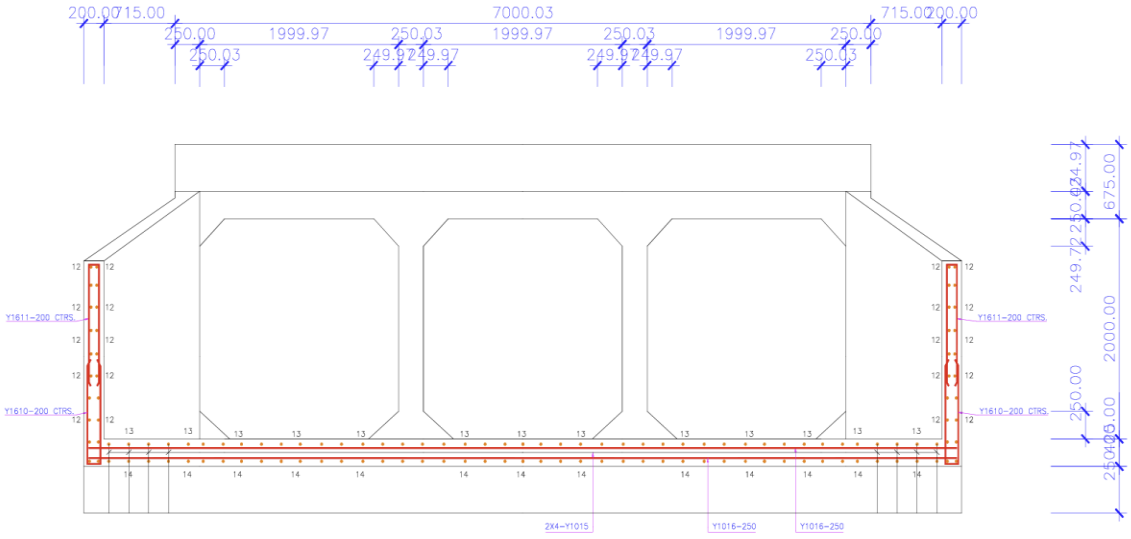
- **Total Channel Length: 5.527 kilometers**
- **Channel Type: Rectangular**
- **Bottom Width: 10 meters**
- **Vertical Depth: 2.5 meters**



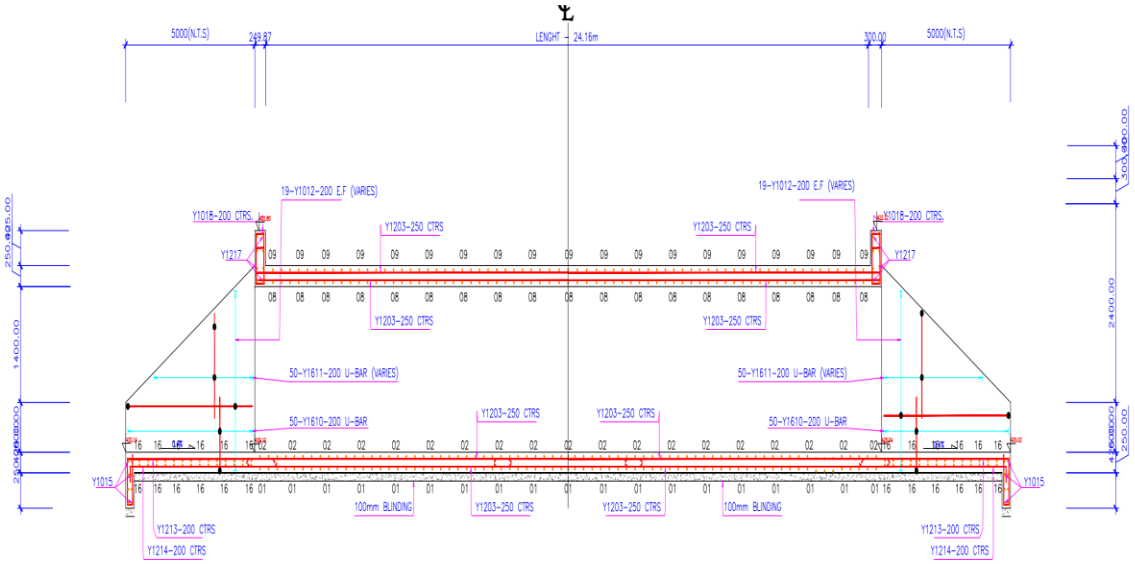

**Geometric Specifications**

- **Channel Type: Rectangular**
- **Bottom Width: 9 meters**
- **Vertical Depth: 2 meters**



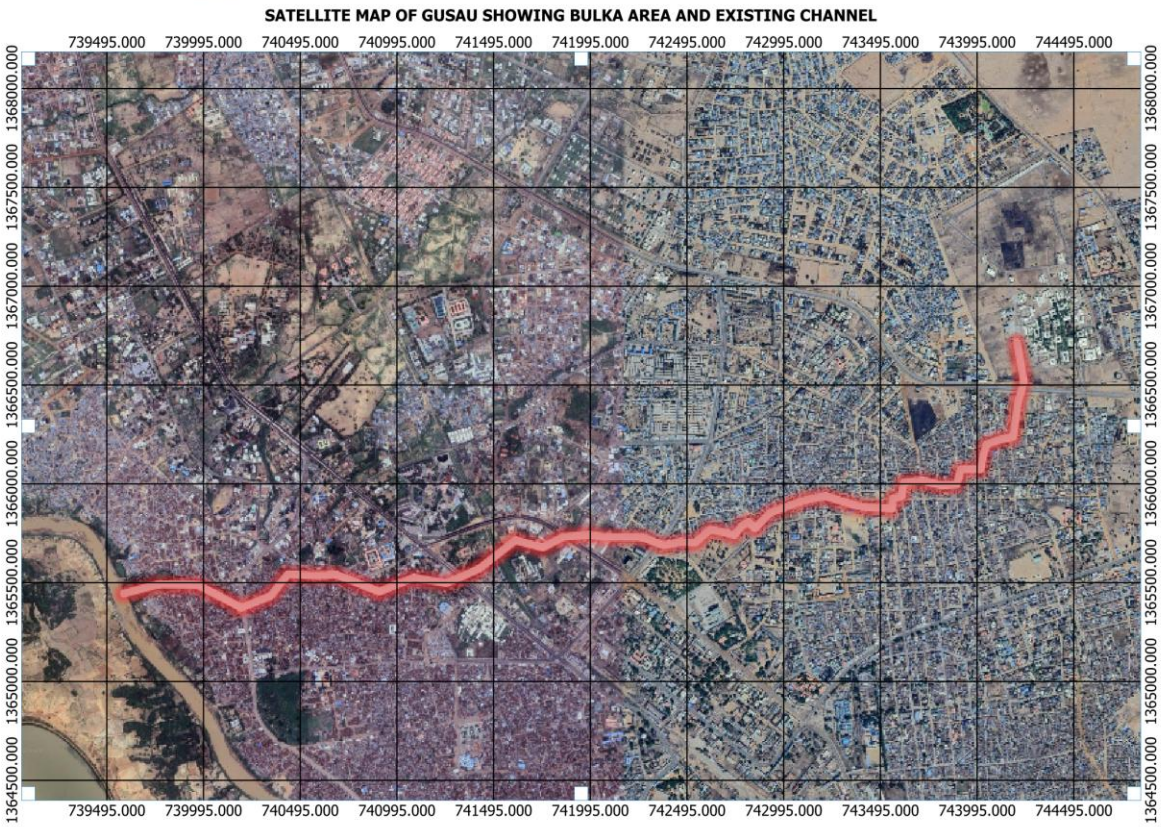




**Inlet Structures – Approach View**




**Inlet Structures – Side View**

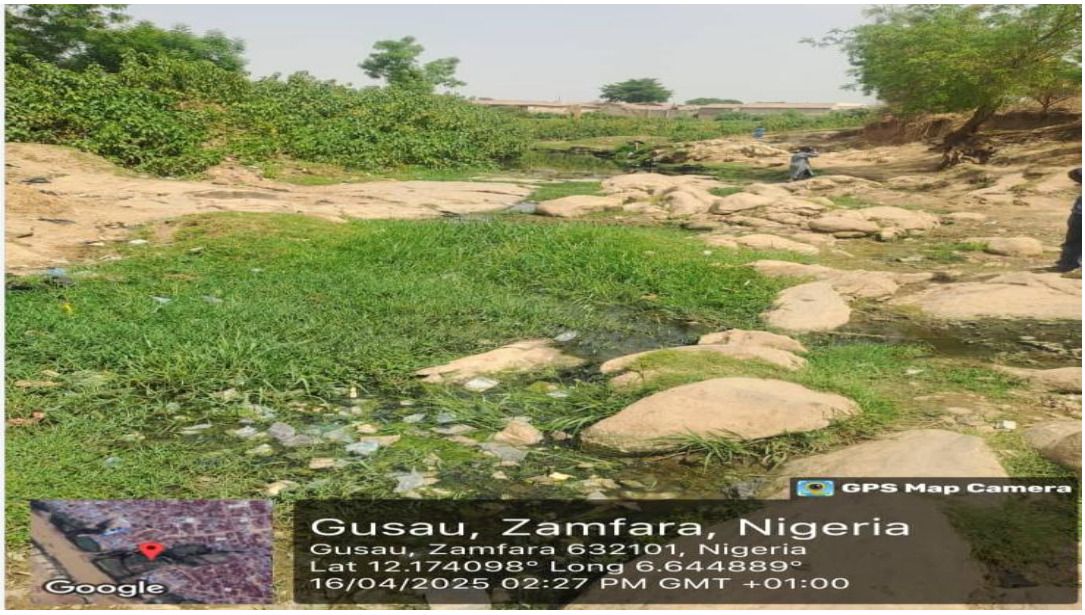
The Bulka erosion site is one of the most critical environmental challenges facing Gusau Local Government Area of Zamfara State. Over the past few decades, it has developed into a deep gully threatening residential structures, farmlands, and local infrastructure. The site is situated in the semi-arid zone of northern Nigeria, an area already vulnerable to land degradation due to both climatic and anthropogenic pressures. The Bulka area was originally covered with native vegetation and supported small-scale agriculture and settlements. Land was relatively stable due to vegetative cover and natural water drainage patterns. Increased human activities, such as deforestation, overgrazing, and farming on marginal land, began to disturb the natural land balance. Removal of vegetation exposed the topsoil to heavy rainfall impact, causing initial surface runoff and rill erosion. With annual rainfall runoff and lack of erosion control, small rills deepened and widened. Construction of roads and footpaths without proper culverts or drainage worsened the problem, concentrating runoff into specific channels. A gully system began to form, cutting across community paths and farmland. The gully has progressively grown in length, width, and depth, now threatening buildings and critical access routes in the community. Erosion has undermined farmlands, increased sedimentation in nearby streams, and raised public safety concerns, particularly during the rainy season.




**Satellite image of Bulka erosion site and its drains**



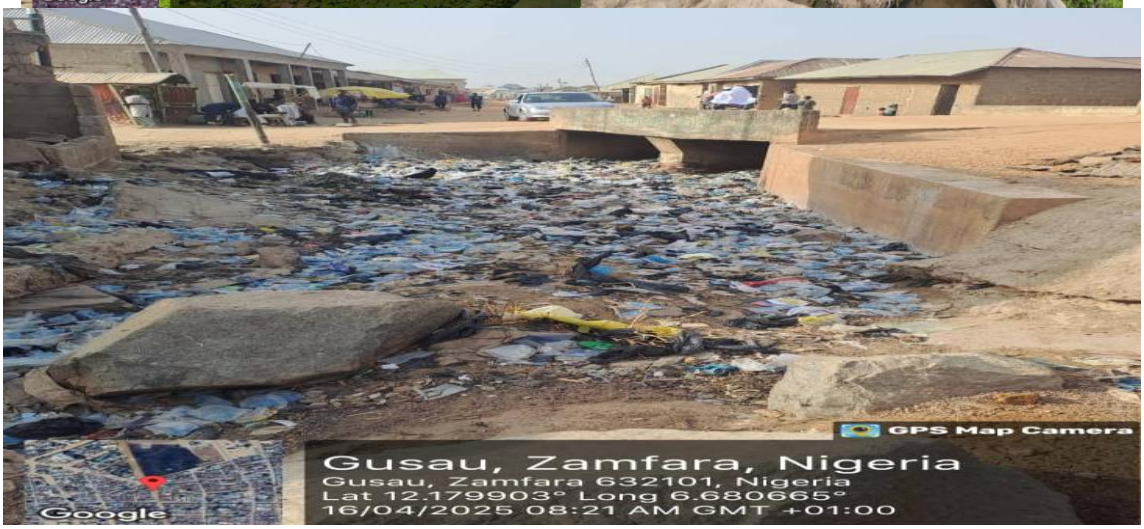


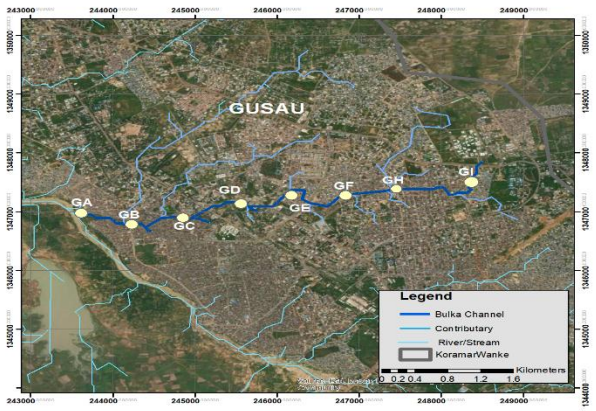


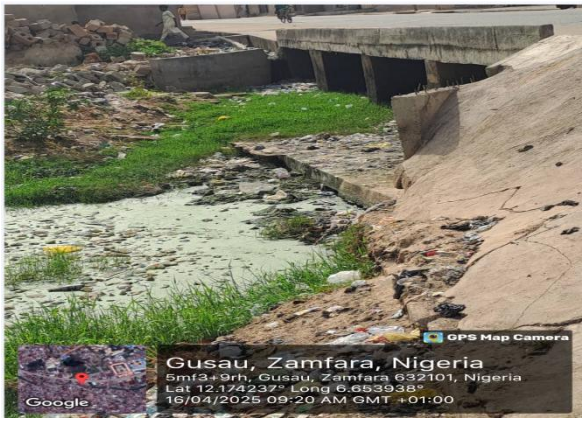

**Silted selection of the channel**




GPS Map Camera
Gusau, Zamfara, Nigeria
Gusau, Zamfara 632101, Nigeria
Lat 12.174289° Long 6.653619°
16/04/2025 09:20 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
Gusau, Zamfara 632101, Nigeria
Lat 12.179903° Long 6.680665°
16/04/2025 08:21 AM GMT +01:00
Google


GUSAU
GA
GB
GC
GD
GE
GF
GH
GI
Legend
Bulka Channel
Contributary
River/Stream
KoramarWanke
Kilometers
0 0.2 0.4 0.8 1.2 1.6


GPS Map Camera
Gusau, Zamfara, Nigeria
5mf3+9rh, Gusau, Zamfara 832101, Nigeria
Lat 12.17423° Long 6.653938°
16/04/2025 09:20 AM GMT +01:00
Google

## 3.0 SCOPE OF SERVICE

To achieve the core objectives of this assignment, the consultant will develop a work plan to ensure the completion of the tasks listed below in a manner consistent with the international best practice and in accordance with the project agreement and World Bank/IDA procurement guidelines. The Tasks of the consultant shall include the following:

- Detailed description of each subproject identifying the specific environmental and social issues related to each subproject site, including all risks and health and safety aspects.
- The description shall include proposed design layout of each subproject and details of construction works, materials sourcing and management/efficiency measures. Traffic impact highlighting specific sensitive receptor mapping in the project site
  - ✓ Detailed description of each subproject identifying the specific environmental and social issues related to each, including all risks and health and safety aspects.
  - ✓ Description of each subproject location and sensitive environmental and social features.
  - ✓ The description shall include a sufficiently detailed map showing each subproject site and the area that may be affected by the project's direct, indirect, and cumulative impacts. (i.e. area of influence).
  - ✓ The description shall include proposed design layout of each subproject and details of construction works, materials sourcing and management/efficiency measures.

Traffic impact highlighting specific sensitive receptor mapping in the project site

- ✓ Identification of policy, legal and administrative framework relevant to the project. Review the local material/labour availability, operational and policy/legal requirements, etc
- Describe relevant World Bank Environmental and Social policy for the assignment, identify gaps and provide comparison where applicable relative to the national legal and institutional framework.
- The consultant will provide a description of the existing status/ baseline conditions of the sub-watershed and gullies, which will cover the biophysical, socioeconomic, and climatical context of the project area, including the existing vulnerability to climate chocs. The baseline conditions should cover the direct and indirect areas within the scope of the project including the area covering i.e.
- The activities inherent to the project,
- The areas potentially threatened by the direct impacts of the project's implementation and operation (downstream zone) as well as
- aThe area that could potentially constitute a threat to the project's implementation and operation, because of its actual degradation or vulnerability to extreme climate events (upstream zone).
  - ✓ Identify the environmental and social issues/risks associated with the existing conditions.
  - ✓ Select and measure appropriate baseline indicators (for example, $m^3$/sec of runoff collected in the sub-watershed during heavy hour-long rainfall).

- ✓ Develop a plan for mitigating environmental and social risks associated with construction and operation in the gully in consultation with the relevant public and government agencies; Identify feasible and cost-effective measures that may reduce potentially significant adverse environmental and social impacts to acceptable levels.
- ✓ Develop a time-bound plan for mitigating environmental and social risks associated with sub-watershed management in consultation with the relevant public and government agencies; Identify feasible and cost-effective measures that may reduce potentially significant adverse environmental and social impacts to acceptable levels.
- ✓ Identify monitoring objectives and specify the type of monitoring, with linkages to the impacts assessed and the mitigation measures described above (in a-e).
- ✓ Provide a specific description of institutional arrangements: the agencies responsible for carrying out the mitigation and monitoring measures (e.g., for operation, supervision, enforcement, monitoring of implementation, remedial action, financing, reporting, and staff training) and the contractual arrangements for assuring the performance of each implementing agency.
- ✓ Define technical assistance programs that could strengthen environmental management capability in the agencies responsible for implementation.
- ✓ Provide an implementation schedule for measures that must be carried out as part of the project, showing phasing and coordination with overall project implementation plans; and
- ✓ Provide the expected capital and recurrent cost estimates and sources of funds for implementing the ESMP and inform accordingly the design consultants so that these costs are duly taken into consideration in the designs.

The consultant shall also document how to manage risks related to Gender Based Violence (GBV) particularly Sexual Exploitation and Abuse (SEA) taking cognisance of (i) labour influx implications (ii) Security issues, etc.

***The following socio-economic issues shall be addressed in the ESMP:***

- A summary of the impacted communities for the project: location, access, population (number, demographic and social characteristics); economy (employment rate, income distribution); services (types, capacity, and adequacy) and housing. Concern is the ability to provide work force, service new development and absorb and adjust to growth (worker/family).
- A summary of the views of the population including vulnerable groups, determined through thoroughly documented discussions with local communities. These meetings and discussions must be documented and should show how issues and problems raised are or will be resolved (note that a Resettlement Action Plan (RAP) could be developed for the Site, and this is covered under separate TORs).
- Cultural: Summarize the possible effects of the project on historical/archaeological sites, heritage/artifacts, native religious or harvest sites of the affected communities and identification or development of mechanisms for handling chance findings.

- Issues related to environment, health and Safety, community safety, climate change, threat to the protection, conservation, maintenance, and restoration of natural habitats and biodiversity, ecosystem services, and use of natural resources e.g., fisheries and forest etc.,
- nformation will be gathered from field surveys and secondary data sources (interviews, structured questionnaires, in-depth interviews and focus group discussions).

*Other Tasks:*

The consultant shall assist the SPMU to: (i) Register the ESMP with the Environmental Assessment (EA) Departments at Federal and State levels; and (ii) Disclose the finalized ESMP at National, State, LGA and Community levels. Information of the disclosure of the ESMP report shall be published in one local and one national newspapers. Evidence of newspaper publications will be used to disclose the ESMP in World Bank Infoshop.

## 4.0 INSTITUTIONAL FRAMEWORK

The Consultant is to report to the Zamfara State Project Management Unit (SPMU). The SPMU will interface with the Consultant in addition to the corresponding federal-level institutions, the World Bank, and several key state institutions involved in land degradation and watershed management. These include: (a) the State Ministry of Environment (SMEnv); (b) the State Ministry of Water Resources (SMWR), with the River Basin Development Authorities (RBDAs), the State Integrated Water Resources Management Commission, the State Water Resources Ministry; (c) the State Ministry of Agriculture and Rural Development (SMARD), with the multi-sector Federal Sustainable Land Management Committee and (e) State Ministry of Works. Additional Federal institutions are also involved including Nigeria Meteorological Agency (NIMET) and the Nigerian Space Research and Development Agency (NASRDA).

## 5.0 REPORTING AND DELIVERABLES

- Inception Report: An Inception Report describing the procedures, methodology and timetable for completion of the ESMP preparation process must be prepared. This shall be submitted one (1) week after signing of the contract. The SPMU shall check to ensure that the Consultant has commenced the work and has a good understanding of the TOR and the tasks. The Consultant shall also participate in periodic review meetings with the SPMU on the progress of the assignment.
- Week 6: A draft ESMP will be submitted to SPMU for comments within six (6) weeks from the date of signing the contract. Prior to that, a brief weekly report will be submitted to SPMU on the progress of the work, potential delays which may affect the deliverables and identify any assistance required.
- Week 8: The draft final ESMP Report with all comments covered will be submitted to the SPMU.
- Week 10: Submit the Final ESMP Report acceptable to Zamfara State and to the World Bank. Include a comprehensive database of relevant information collected in Excel format. Number of Copies:

**a.** The Consultant undertakes to submit a soft copy of the draft reports for each of the abovementioned deliverables via the SPMU's e-mail address.

**b.** For the purpose of completing the services in time, the Client shall respond to and provide comments on the draft Reports within 1 week of their submission.

**c.** The Consultant shall deliver a soft copy of the final reports within one (1) week of the receipt of the comments on the draft reports.

The draft and final reports submitted to the Client and all relevant data and information contained therein, compiled by the Consultant while providing the services, shall be the property of the Client. The Client shall be free to make full use of the draft and final reports, data and information received pursuant to this Contract at its own discretion.

## 6.0 CONSULTANT QUALIFICATIONS

- The Consultant(s) must have an advanced degree (M.Sc., PhD) earned in relevant fields including but not limited to Civil/Environmental Engineering, Environmental Sciences, or the Social Sciences. The Consultancy Team should include an Environmental Specialist, a Socio-economic Specialist, a Botanist/Ecologist Specialist, a Civil Engineer, Hydrologist, a GIS Specialist, and an Analytical Chemist.
- Each Team Member must have an advanced degree and a minimum of six (6) years of experience in preparation of Environmental and Social Impact Assessment and ESMP.
- The Team Leader must have a minimum experience of eight (8) years, of which, at least four (4) years should be in preparing ESIAs/ESMPs, preferably for the World Bank projects.
- The Team must have experience in the design and preparation of an Environmental and Social Management Plan (ESMP) for infrastructure projects and must have competency and documented experience in analysis of social and environmental data and development of operational action plans.
- The Team Leader, the Environmental Specialist and the Social scientist must have wrought knowledge of the World Bank Environmental and Social Framework (ESF) gained through hands-on experience in the preparation and implementation of Environmental and Social Management Plans.

## 7.0 REMUNERATION:

Remuneration for the consultant will be commensurate with those offered by international bodies for similar assignments.

## 8.0 PAYMENT SCHEDULE

30% of Contract Sum on Successful Submission of Inception Report
40% of Contract Sum on Submission of Draft Report
20% of Contract Sum on Submission of Draft Final Report and PowerPoint Presentation. 10% of Contract Sum on Submission, Presentation and Acceptance of Final Report and Disclosure.

## 9.0 CLIENT'S OBLIGATION

The client shall provide the following facilities and project-specific background documents:

(i) Office accommodation, Office equipment, furniture, ICT facilities, logistics for field visits etc.

(ii) Relevant available published information

(iii) Environmental and Social Management Framework (ESMF)

(iv) Resettlement Policy Framework (RPF)

(v) ACRESAL Project Appraisal Document (PAD)

(vi) ACRESAL Project Implementation Manual (PIM)World Bank Environmental and Social Framework (ESF)

(vii) Intervention design

(viii) Stakeholder Engagement Plan (SEP)

(ix) Environmental and Social commitment plan (ESCP)

## 10.0 CONDUCT OF THE CONSULTANT

i. The Consultant will, always, be expected to carry out the assignment with the highest degree of professionalism and integrity. The Consultant will be expected to conduct his or her duties in an open and transparent manner.

ii. The Consultant will not, under any circumstance, take any actions or be seen to be taking any actions, which may hinder or prevent the Zamfara State ACReSAL from executing this assignment.

iii. The Consultant will familiarize him or herself with all applicable Zamfara State ACReSAL guidelines and policies and will be expected to ensure that the assignment is concluded with the strictest adherence to all such policies and regulations.

iv. The Consultant will not, under any circumstances, take any material decision pertinent to this assignment without the express permission and written consent of the Project Coordinator or of an authorized representative of the Zamfara State ACReSAL Project.

v. The Consultant will not, under any circumstances, discuss, divulge, or use any information regarding this assignment or any other transaction conducted without the express written permission of an authorized representative of Zamfara State ACReSAL Project.

vi. The Consultant must not have a conflicting assignment with government agencies, development partners etc. If a conflict of interest is discovered, the contract shall be terminated.

vii. The Consultant must avoid all potential conflict of interest situations.

## 11.0 DURATION

The duration of the assignment shall be for a period of 10 (Ten) Weeks.

Project-specific Background Documents Available to the Consultant on Request

a. Environmental and Social Management Framework (ESMF) Report 2021

b. Resettlement Policy Framework (RPF)

c. ACReSAL Project Appraisal Document (PAD)

d. ACReSAL Project Implementation Manual (PIM)

e. World Bank Environmental and Social Framework (ESF)
f. Intervention design
g. Stakeholder Engagement Plan (SEP)
h. Environmental and Social commitment plan (ESCP)

Annex 1: Outline and Substance of the ESMP report
The ESMP Report shall be presented in a concise format containing all studies, processes, analyses, tests, and recommendations for the proposed intervention. The report shall focus on the findings, conclusions, and any recommended actions, supported by summaries of the data collected and citations for any references used. The ESMP report will include the following topics and other sub-topics organized in a suggested outline that can be adjusted for local needs:

Cover page o Table of Contents
- List of Acronyms and their definitions
- Executive Summary
- List of Tables

1.0 Chapter 1: Introduction o Project description: The project description should clearly define and describe in details the proposed project activities, their locations, typical designs, material requirements (e.g. borrow materials, sand, water, aggregates, etc.), labour requirements, location of Contractor's camps and facilities, waste disposal areas, completion schedule.
- Rationale for the ESMP and the methodology followed to prepare the ESMP. o Detailed location maps, plans, layouts, et.c

2.0 Chapter 2: Institutional and Legal Framework for Environmental and Social Management
- Discussion of the World Bank Environmental and Social Standards triggered by ACReSAL and their relevance to the proposed project activities. Description of the requirements of the World Bank and how they are addressed in this ESMP.
- A summary of Local, State, and Federal regulations, international conventions, and administrative frameworks relevant to the proposed project activities and how they are addressed in the ESMP.
- Applicable regulatory standards for air quality, noise, water quality and other contamination.

3.0 Chapter 3: Baseline Environment A chapter on baseline environment including social baseline o Description of the area of influence with a map
- Description of environmental baseline conditions, including physical (e.g., terrain, land use, climate, geomorphological) and biological (e.g. flora and fauna, sensitive areas, etc.)
- Description of socioeconomic baseline conditions. Analysis of existing livelihoods opportunities, income, gender characteristics, age profile, health, transport access, existing community structures – at watershed, community, household, and individual levels

- Other topics as relevant (e.g., Gender Based Violence, Sexual Exploitation and Abuse, Child Labour, Gender Discrimination, Security issues, etc.)

4.0 Chapter 4: Stakeholder Consultations o List of the relevant stakeholders relevant to the proposed subproject activities.

- Details of the first round of consultations during the preparation of the ESMP and on the second round of consultations on the draft ESMP with the stakeholders and affected communities (dates of consultations, location, list of participations, photographs, etc.)
- Feedback from the first round of consultations and actions taken or responses provided to address their concerns
- Feedback from the second round of consultations and actions taken or responses provided to address their concerns
- Analysis of existing formal and informal grievance redress mechanisms in and around the intervention area
- Proposed grievance mechanism for the subproject in alignment with the ESMF, RPF, RAP, and Project Implementation Manual) to address situations of conflicts or disagreements about some of the project activities

5.0 Chapter 5: Assessment of Potential Impacts and Analysis of Alternatives

- Discussion on 'no subproject' scenario, including a brief description of likely future scenario without the intervention.
- Discussion of the alternative locations considered for the proposed interventions, and a brief E&S impacts and risks associated with each location and the rationale for recommending the chosen location and rejecting the others.
- Discussion on the alternatives considered in the engineering designs (civil engineering only vs. a combination of civil engineering and biological settings) and the rationale for selecting the chosen option.

6.0 Chapter 6: Environmental and Social Management Plan (ESMP), including:

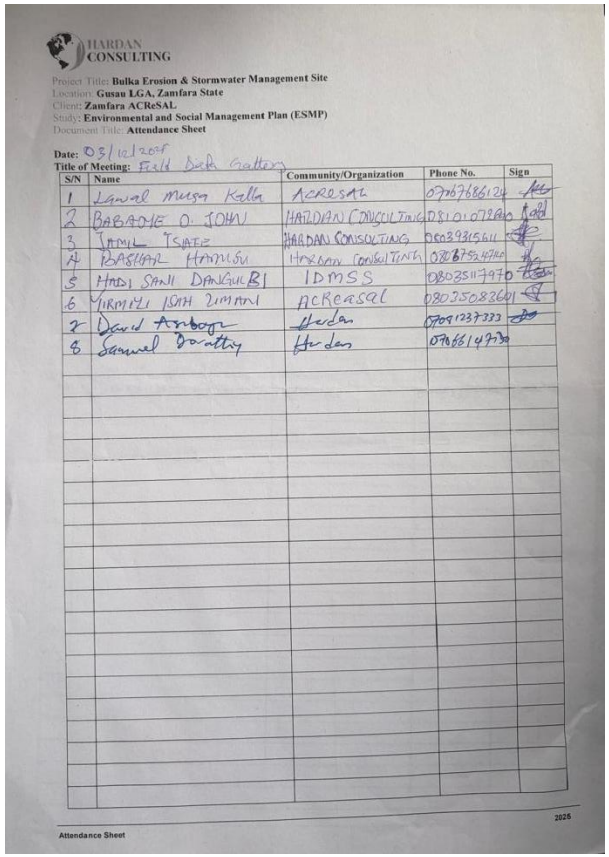
- Identification of potential E&S impacts and mitigation measures and risks associated with the proposed interventions.
- Description of the proposed mitigation measures to address the above risks – To include all prevalent emerging issues and their Management Plans
- Institutional responsibilities and accountabilities – describe the role of the contractor, supervision engineer, and project implementation unit.
- Capacity building plan on strengthening of E&S capacity of the implementing agencies. o Costs of implementing the ESMP – with BOQ items to be included in the contract.

7.0 Chapter 7: Summary, Recommendations and Conclusion

- Annex 1: Provide the names of the participants in each consultation meeting.
- Annex 2: General Environmental Management Conditions for Construction Contracts/Civil works.
- Annex 3: References
- Annex 4: Photos

# ANNEX 2

## Attendance



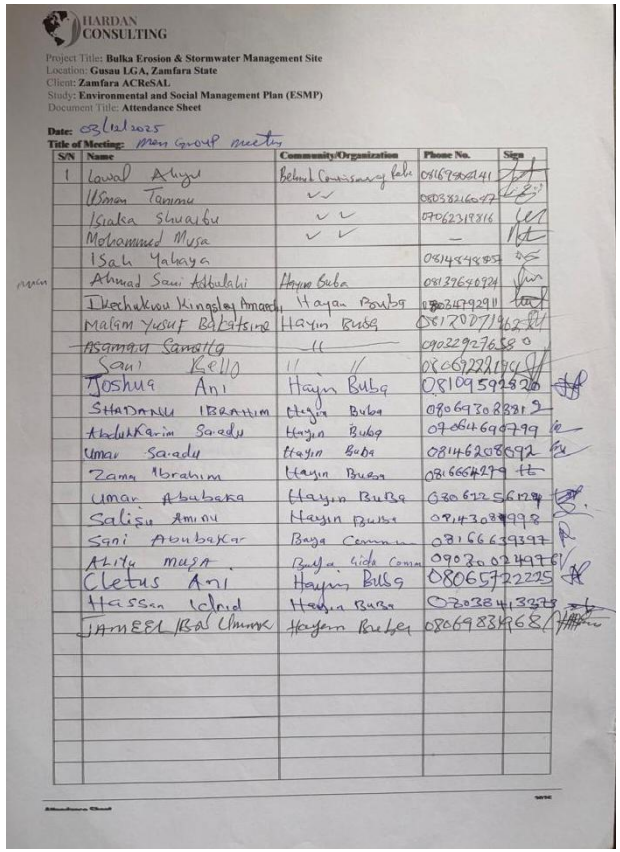
HARDAN CONSULTING

Project Title: **Bulka Erosion & Stormwater Management Site**
Location: **Gusau LGA, Zamfara State**
Client: **Zamfara ACReSAL**
Study: **Environmental and Social Management Plan (ESMP)**
Document Title: **Attendance Sheet**

Date: 03/12/2025
Title of Meeting: Field Data Gathering

| S/N | Name | Community/Organization | Phone No. | Sign |
|---|---|---|---|---|
| 1 | Lawal Musa Kalla | ACReSAL | 07067686124 | |
| 2 | BABAOJE O. JOHN | HARDAN CONSULTING | 08101072666 | |
| 3 | Jamil Isaiz | HARDAN CONSULTING | 08039315611 | |
| 4 | BASHAR HAMMAN | HARDAN CONSULTING | 08187524740 | |
| 5 | HADI SANI DANGULBI | IDMSS | 08035117970 | |
| 6 | YIRMIYI ISAH ZIMAN | ACReasal | 08035083261 | |
| 7 | David Arbogo | Hardan | 07061237333 | |
| 8 | Samuel Dorathy | Hardan | 07066147730 | |

Attendance Sheet 2025

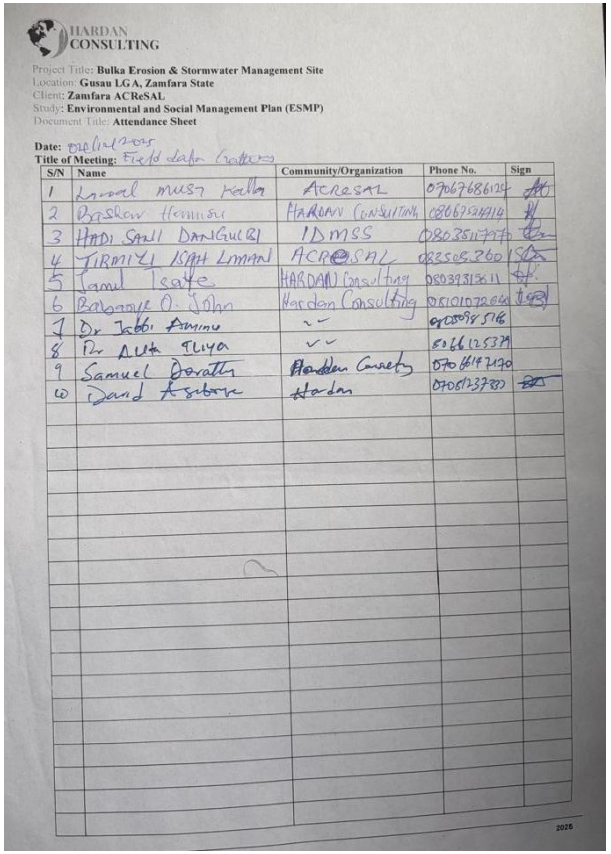


HARDAN CONSULTING

Project Title: **Bulka Erosion & Stormwater Management Site**
Location: **Gusau LGA, Zamfara State**
Client: **Zamfara ACReSAL**
Study: **Environmental and Social Management Plan (ESMP)**
Document Title: **Attendance Sheet**

Date: 03/12/2025
Title of Meeting: Mass Group meeting

| S/N | Name | Community/Organization | Phone No. | Sign |
|---|---|---|---|---|
| 1 | Lawal Aliyu | Behind Commissioner's Lodge | 08167424141 | |
| | Usman Tanimu | " " | 08038216647 | |
| | Isiaka Shuaibu | " " | 07062319816 | |
| | Mohammed Musa | " " | - | |
| | Isah Yahaya | | 08145485855 | |
| | Ahmad Sani Abdulahi | Hayin Buba | 08129646924 | |
| | Ekechukwu Kingsley Amaechi | Hayin Buba | 08024579291 | |
| | Malam Yusuf Babatsine | Hayin Buba | 08170771962 | |
| | Asamaki Samaila | " " | 09022927658 | |
| | Sani Kello | " " | 08069222104 | |
| 1 | Joshua Ani | Hayin Buba | 08109594826 | |
| | Shadrach Ibrahim | Hayin Buba | 08069308381 | |
| | Abdulkarim Saadu | Hayin Buba | 07061469799 | |
| | Umar Saadu | Hayin Buba | 08146208692 | |
| | Zama Ibrahim | Hayin Buba | 08166479 | |
| | Umar Abubakar | Hayin Buba | 08067225619 | |
| | Salisu Aminu | Hayin Buba | 08143089998 | |
| | Sani Abubakar | Baya Commun | 08166679397 | |
| | Aliyu Musa | Baya Side Comm | 09030274976 | |
| | Cletus Ani | Hayin Buba | 08065722225 | |
| | Hassan Idris | Hayin Buba | 08038413273 | |
| | JAMEEL Bal Ummuk | Hayin Buba | 08069838168 | |



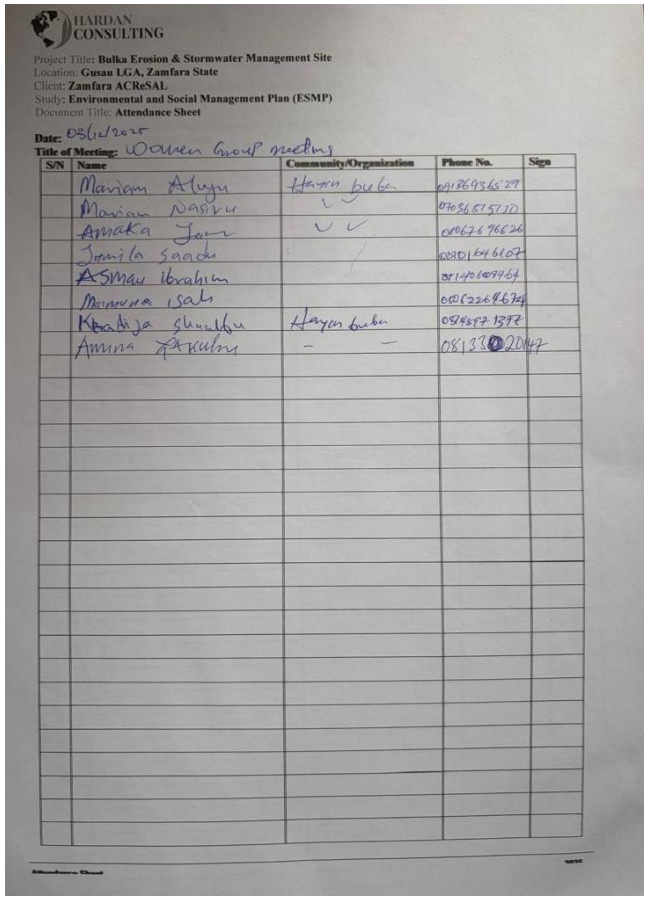
HARDAN CONSULTING

Project Title: **Bulka Erosion & Stormwater Management Site**
Location: **Gusau LGA, Zamfara State**
Client: **Zamfara ACReSAL**
Study: **Environmental and Social Management Plan (ESMP)**
Document Title: **Attendance Sheet**

Date: 03/12/2025
Title of Meeting: Field data Gathering

| S/N | Name | Community/Organization | Phone No. | Sign |
|---|---|---|---|---|
| 1 | Lawal Musa Kalla | ACReSAL | 07067686124 | |
| 2 | Babaoje Hermisu | HARDAN CONSULTING | 08067524740 | |
| 3 | Hadi Sani Dangulbi | IDMSS | 08035117970 | |
| 4 | Yirmiyi Isah Liman | ACReSAL | 08035083260 | |
| 5 | Jamil Isaiz | HARDAN Consulting | 08039315611 | |
| 6 | Babaoje O. John | Hardan Consulting | 08101072666 | |
| 7 | Dr Jabbi Amina | " " | 07038985146 | |
| 8 | Dr Alka Eliya | " " | 08066125379 | |
| 9 | Samuel Dorathy | Hardan Consulty | 07066147730 | |
| 10 | David Arbogo | Hardan | 07061237333 | |

2025

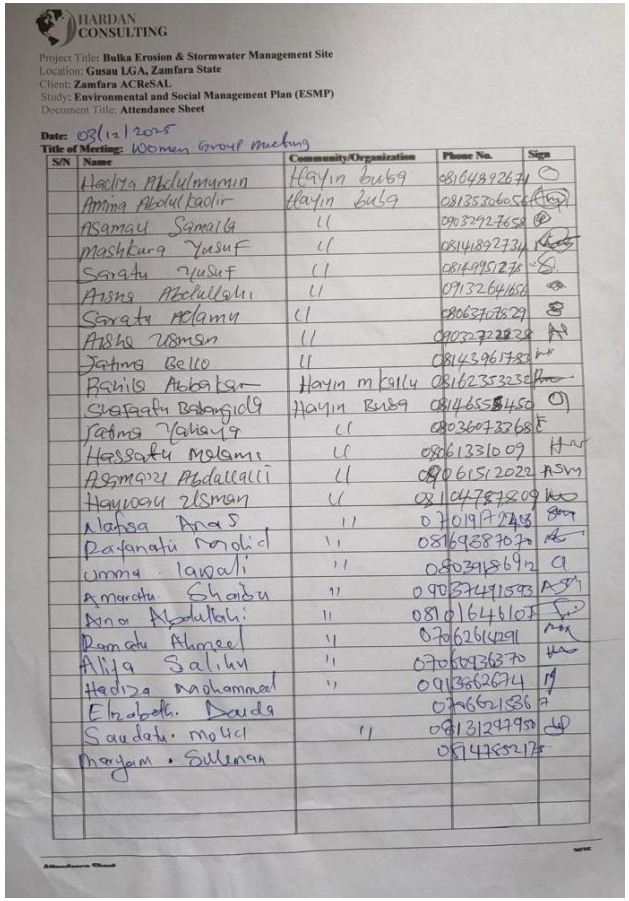


HARDAN CONSULTING

Project Title: **Bulka Erosion & Stormwater Management Site**
Location: **Gusau LGA, Zamfara State**
Client: **Zamfara ACReSAL**
Study: **Environmental and Social Management Plan (ESMP)**
Document Title: **Attendance Sheet**

**Date:** 03/12/2025
**Title of Meeting:** Women Group meeting

| S/N | Name | Community/Organization | Phone No. | Sign |
|---|---|---|---|---|
| | Mariam Aliyu | Hayin buba | 09186936529 | |
| | Mariam Nasiru | " | 07036875120 | |
| | Amaka Jam | " | 08067696626 | |
| | Jamila Saadu | | 08101646107 | |
| | Asmau Ibrahim | | 08140607464 | |
| | Maimuna Isah | | 08032268674 | |
| | Khadija Shuaibu | Hayin buba | 0548877378 | |
| | Amina Abdulmu | - | 08133[illegible]20147 | |

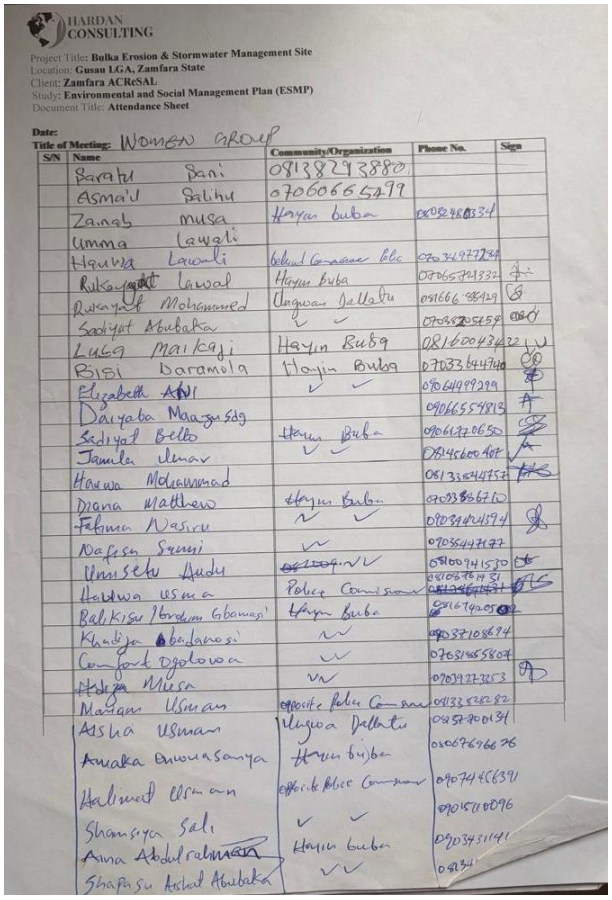


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**Date:** 03/12/2025
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| S/N | Name | Community/Organization | Phone No. | Sign |
|---|---|---|---|---|
| | Hadiza Abdulmumin | Hayin buba | 08164892674 | |
| | Amma Abdulkadir | Hayin Buba | 08135306056 | |
| | Asmau Samaila | " | 09032927658 | |
| | Mashkura Yusuf | " | 08141892734 | |
| | Saratu Yusuf | " | 08149952?? | |
| | Aisha Abdullahi | " | 07132641656 | |
| | Saratu Aliyu | " | 08063705829 | |
| | Aisha Usman | " | 09032722228 | |
| | Fatima Bello | " | 08143961783 | |
| | Rabilu Abubakar | Hayin mkailu | 08162353230 | |
| | Safiyatu Babangida | Hayin Buba | 08146558450 | |
| | Fatima Yahaya | " | 08036732685 | |
| | Hassatu Malami | " | 08061331609 | |
| | Asmau Abdullahi | " | 08061512022 | |
| | Hauwa Usman | " | 08104787809 | |
| | Nafisa Anas | " | 07019172485 | |
| | Rafanatu Rashid | " | 08169887070 | |
| | Umma Lawali | " | 08039185692 | |
| | Amaratu Shaibu | " | 09037491593 | |
| | Ana Abdullahi | " | 08101646107 | |
| | Ramatu Ahmeed | " | 07062614291 | |
| | Aliya Salihu | " | 07068093670 | |
| | Hadiza Mohammed | " | 09136626?4 | |
| | Elizabeth David | | 07066211586 | |
| | Saudatu Malci | " | 08131277950 | |
| | Maryam Sulaiman | | 08147552175 | |

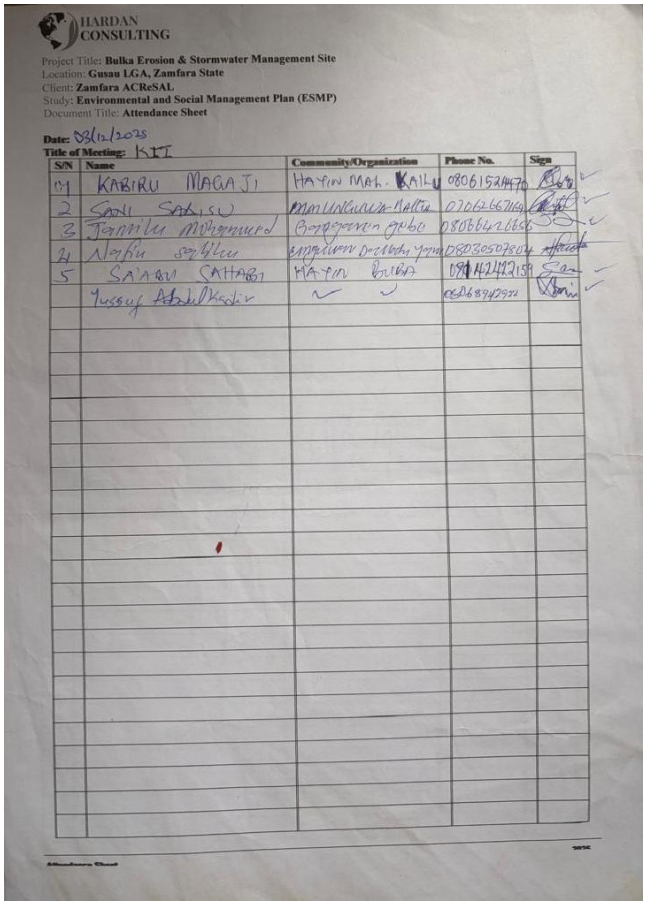


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Document Title: **Attendance Sheet**

**Date:**
**Title of Meeting:** WOMEN GROUP

| S/N | Name | Community/Organization | Phone No. | Sign |
|---|---|---|---|---|
| | Saratu Sani | | 08138273880 | |
| | Asma'u Salihu | | 07060665479 | |
| | Zainab Musa | Hayin Buba | 08082480334 | |
| | Umma Lawali | | | |
| | Hauwa Lawali | Behind Comprehensive Clinic | 08034977274 | |
| | Rukayyat Lawal | Hayin Buba | 07065741332 | |
| | Ruqayyat Mohammed | Unguwar Dallatu | 091666[illegible]429 | |
| | Sadiyat Abubakar | | 07032205459 | |
| | Laka Maikaji | Hayin Buba | 08160043432 | |
| | Bibi Daramola | Hayin Buba | 07033644740 | |
| | Elizabeth [illegible] | | 07064999299 | |
| | Daryaba Maaganag | | 09066554813 | |
| | Sadiyat Bello | Hayin Buba | 07061720650 | |
| | Jamila Umar | | 08146604[illegible] | |
| | Hauwa Mohammad | | 08133544752 | |
| | Diana Matthew | Hayin Buba | 07033866710 | |
| | Fatima Nasiru | | 08034404394 | |
| | Nafisa Sani | | 07035447177 | |
| | Umusetu Audu | | 08100741530 | |
| | Hauwa Usman | Police Commissioner | 08156[illegible]31 | |
| | Bala Kisu Ibrahim Gbamaji | Hayin Buba | 08167420502 | |
| | Khadija Abdulwasi | | 08037108894 | |
| | Comfort Ogolowa | | 07031655807 | |
| | Hadiza Musa | | 07039773253 | |
| | Mariam Usman | opposite Police Commissioner | 08135285282 | |
| | Aisha Usman | Unguwa Dallatu | 09057001034 | |
| | Amaka Emmanuel | Hayin Buba | 08069769676 | |
| | Halimat Usman | opposite Police Commissioner | 09074456391 | |
| | Shamsiya Sali | | 09015110096 | |
| | Ana Abdulrahman | Hayin Buba | 09034731141 | |
| | Shafasu Ashat Abubaka | | 0834 | |

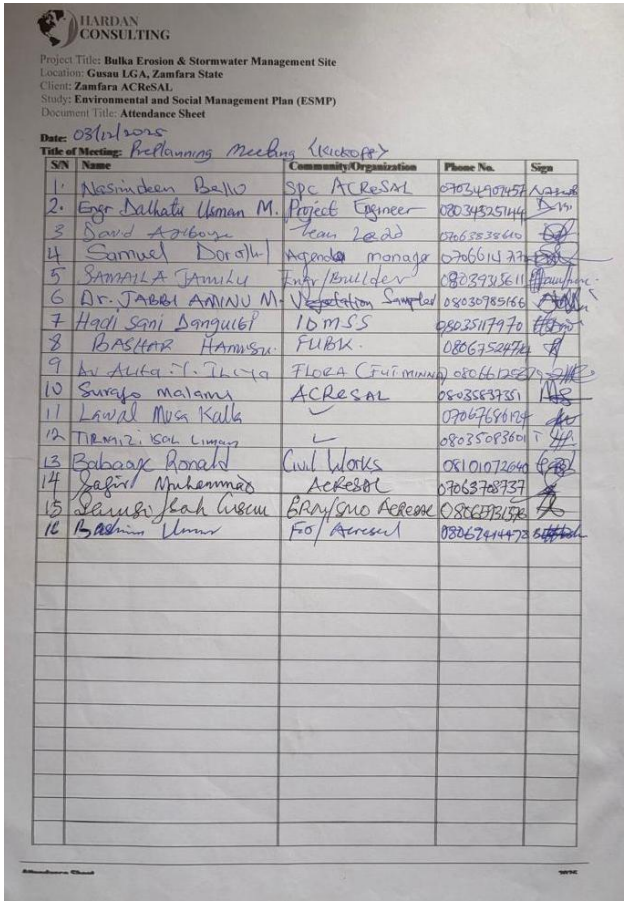


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Client: **Zamfara ACReSAL**
Study: **Environmental and Social Management Plan (ESMP)**
Document Title: **Attendance Sheet**

Date: 08/12/2025
Title of Meeting: KII

| S/N | Name | Community/Organization | Phone No. | Sign |
|---|---|---|---|---|
| 1 | KABIRU MAGAJI | HAYIN MAH. KAILU | 08061524470 | |
| 2 | SANI SAIDU | MAI UNGUWA-NATTA | 07062667169 | |
| 3 | Jamilu Muhammed | Bogopawa gobo | 08066426656 | |
| 4 | Nasiru Ibrahim | Engineer Director, yarn | 08030507804 | |
| 5 | SA'ADU SATTARI | HAYIN BULKA | 08142922158 | |
| | Yusuf Abdulkadir | ~ ~ | 08068942930 | |

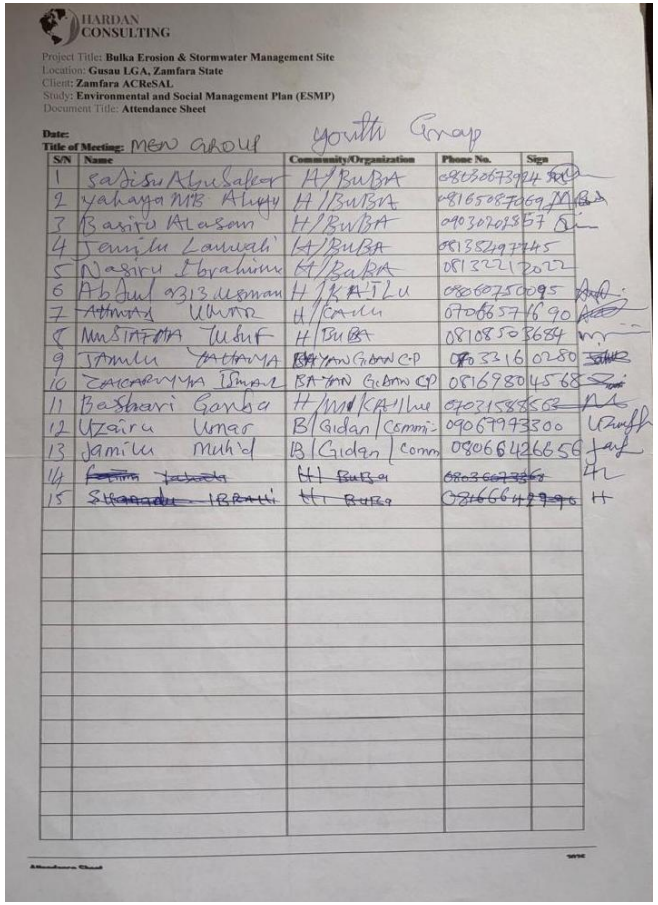


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Study: **Environmental and Social Management Plan (ESMP)**
Document Title: **Attendance Sheet**

Date: 08/12/2025
Title of Meeting: Preplanning Meeting (Kickoff)

| S/N | Name | Community/Organization | Phone No. | Sign |
|---|---|---|---|---|
| 1. | Nasimdeen Bello | Spc ACReSAL | 07024908458 | |
| 2. | Engr. Dalhatu Usman M. | Project Engineer | 08034325144 | |
| 3 | David Agbonye | Team Lead | 07068838440 | |
| 4 | Samuel Dorothy | Agronomy manager | 07066147 | |
| 5 | SANAILA JAMILU | Entr/Builder | 08039385611 | |
| 6 | Dr. JABBI AMINU N. | Vegetation Sampler | 08030785166 | |
| 7 | Hadi Sani Danguli | IDMSS | 08035117970 | |
| 8 | BASHAR HAMISU | FUBK | 08067524 | |
| 9 | Ar Aliyu I. Iliya | FLORA CIVIL MINING | 08066125 | |
| 10 | Suraja Malami | ACReSAL | 08035837351 | |
| 11 | Lawal Musa Kalla | | 07067686 | |
| 12 | Tijjani Isah Limam | | 08035083601 | |
| 13 | Babaak Ronald | Civil Works | 08101072640 | |
| 14 | Jafiri Muhammad | ACReSAL | 07063708737 | |
| 15 | Ibrahim Isah Lucem | ESMP/SMO ACReSAL | 08067781526 | |
| 16 | Bashir Umar | FO/ Accountant | 08062944473 | |



HARDAN CONSULTING

Project Title: **Bulka Erosion & Stormwater Management Site**
Location: **Gusau LGA, Zamfara State**
Client: **Zamfara ACReSAL**
Study: **Environmental and Social Management Plan (ESMP)**
Document Title: **Attendance Sheet**

Date:
Title of Meeting: MEN GROUP Youth Group

| S/N | Name | Community/Organization | Phone No. | Sign |
|---|---|---|---|---|
| 1 | Sadisu Abusakar | H/BuBA | 08130673924 | |
| 2 | Yahaya MB Aliyu | H/BuBA | 08165087069 | |
| 3 | Basiru Alasan | H/BuBA | 09030703857 | |
| 4 | Jamilu Lawali | H/BuBA | 08135249745 | |
| 5 | Nasiru Ibrahim | H/BuBA | 08132712022 | |
| 6 | Abdul 0313 Usman | H/KAILU | 08060750095 | |
| 7 | Ahmad Umar | H/Gandu | 07086576 90 | |
| 8 | Mustapha Yusuf | H/BuBA | 08108503684 | |
| 9 | Jamilu Dahamya | BA/Yan Gidan CP | 08033160280 | |
| 10 | Zakariyya Ismail | BA/Yan Gidan CP | 08169804568 | |
| 11 | Basheri Ganda | H/MA/KAILU | 07031588568 | |
| 12 | Uzairu Umar | B/Gidan/Comm. | 09067993300 | |
| 13 | Jamilu Muh'd | B/Gidan/Comm | 08066426656 | |
| 14 | ~~Fatima Yakubu~~ | ~~H/ BuBA~~ | ~~08036073562~~ | |
| 15 | ~~Shamsudeen Ibrahim~~ | ~~H/ BuBA~~ | ~~08166642796~~ | |

# ANNEX 3

## Social / GBV Assessment Tools

- **Socio-economics Questionnaire**
- **GBV Questionnaire**
- **Minutes of Meeting / Summary of Engagement**

# Socio-economics Questionnaire

**QUESTIONAIRE IDENTIFICATION**
**Socioeconomic & Health Assessment**
**Project:** Bulka Stormwater & Erosion Management (ACReSAL)
**Instrument type:** Household/Individual (head or adult household representative)
**Enumerator:** _____ **Date:** ____ / ____ / 20__
**Location:** Community: _____ Ward/Street: _____
**GPS coordinates (household):** Lat _____ Long _____
**Respondent name (optional):** _____ **Phone (optional):** _____

**INFORMATION & CONSENT (Read aloud to the respondent)**
Hello. We are conducting a socioeconomic and health survey for the Bulka Stormwater & Erosion Management Project. The survey will take ~30–45 minutes. Your answers are confidential and will only be used to prepare the project assessment. You may refuse any question or stop at any time. Do you consent to participate?
- 1 = Yes → continue
- 2 = No → END INTERVIEW

If respondent is a child/minor, obtain consent from parent/guardian; do not ask sensitive GBV questions to minors.

**ENUMERATOR NOTES / ETHICS**
- Observe privacy for sensitive questions (health, gender-based violence).
- Do not probe for identifiable health or GBV details in public — follow referral protocol if disclosure indicates immediate danger.
- Record responses exactly; use codes for structured fields.
- If household absent, make up to 3 revisit attempts.

**SECTION A: HOUSEHOLD IDENTIFICATION & DEMOGRAPHICS**
A1. Household code: _____
A2. Type of dwelling (observe & ask):
- 1 = Permanent (concrete/masonry)
- 2 = Semi-permanent (partially improved)
- 3 = Temporary (makeshift)
- 4 = Other (specify) _____

A3. Number of people normally living in household: ____
A4. Household roster — list all usual members (including visitors staying >1 month). Start with head. For each person, record: Name / Sex (M=1 F=2) / Age / Relationship to head / Education level / Main occupation. (Use a separate table or tablet roster.)
Example columns & codes:
- Sex: 1=M, 2=F
- Relationship: 1=Head, 2=Spouse, 3=Child, 4=Parent, 5=Sibling, 6=Other
- Education level: 0=None, 1=Primary, 2=Secondary, 3=Vocational, 4=Tertiary, 5=Adult literacy
- Occupation: 0=None, 1=Farmer, 2=Trader, 3=Formal employee, 4=Self-employed, 5=Casual labor, 6=Student, 7=Housewife, 8=Unemployed, 9=Other(specify)

A5. Head of household: Name/initials _____ Sex: 1/2 Age: __
A6. Ethnicity / language(s) spoken in home (specify): _____
A7. Religion (specify): _____
A8. Is any household member a person with disability?
- 0 = No
- 1 = Yes → specify type: 1=Mobility, 2=Visual, 3=Hearing, 4=Mental, 5=Other _____

A9. Is any household member elderly (65+)?
- 0 = No
- 1 = Yes → how many? ____

A10. Does anyone in the household belong to a minority or vulnerable group (e.g., internally displaced person (IDP), migrant, single female-headed household, chronically ill)? Specify and indicate vulnerability type. _____

**SECTION B: EDUCATION**
B1. Highest education level attained by head of household (code as A4): __
B2. For each household member aged 5–24: are they currently attending school?
- 1 = Yes
- 2 = No (skip to B4)

B3. If no, main reason for not attending (select one):
- 1 = Too expensive
- 2 = No school nearby
- 3 = Work at home/farm
- 4 = Safety/security concerns
- 5 = Other (specify) _____

B4. Are there primary and secondary schools within 30 minutes walking distance from this community?
- 1 = Yes, both
- 2 = Only primary
- 3 = Only secondary
- 4 = None within 30 minutes

B5. Quality/availability perception of education services: (1=Poor, 2=Fair, 3=Good, 4=Very good) ____

**SECTION C: LAND USE, HOUSING & PROPERTY**
C1. Land tenure of the household home plot:
- 1 = Owned with title
- 2 = Owned without title
- 3 = Rented
- 4 = Occupied free / customary
- 5 = Other (specify) _____

C2. Do you or the household own other land or property?
- 0 = No
- 1 = Yes → type(s): 1=Farmland, 2=Commercial plot, 3=House, 4=Other ___

C3. Primary land use around the household (within 100m): (tick all that apply)
- 1 = Residential
- 2 = Commercial/market
- 3 = Floodplain/wetland
- 4 = Farmland/gardens
- 5 = Road/transport corridor
- 6 = Empty/unused
- 7 = Other _____

C4. Has this household or your land been affected by flooding or erosion in the past 5 years?
- 1 = Yes — frequency: 1=Once, 2=Occasional, 3=Every year, 4=Multiple times/year
- 2 = No

C5. If Yes, what impacts were experienced? (tick all)
- 1 = Crop loss
- 2 = House damage
- 3 = Income loss/business disruption
- 4 = Displacement/temporary relocation
- 5 = Health impacts (illness/injuries)
- 6 = Other (specify) _____

**SECTION D: LIVELIHOODS & INCOME**
D1. Main source(s) of household income (rank top 3):
- 1 = Farming/agriculture
- 2 = Trading/retail
- 3 = Formal employment (govt/private)
- 4 = Casual labor/daily wage
- 5 = Petty services (motorbike/taxi)
- 6 = Remittances
- 7 = Small-scale manufacturing/processing
- 8 = Other (specify) _____

D2. Approximate total household monthly income (select range):
- 1 = < NGN 10,000
- 2 = NGN 10,000–29,999
- 3 = NGN 30,000–49,999
- 4 = NGN 50,000–99,999
- 5 = NGN 100,000–199,999
- 6 = >= NGN 200,000
- 7 = Prefer not to say

D3. Does any household member engage in flood-related livelihoods (e.g., sand winning, river transport, fishing)?
- 0 = No
- 1 = Yes → specify: _____

D4. Have you experienced loss of income or assets due to past floods/erosion?
- 1 = Yes — describe briefly: _____
- 2 = No

D5. Do you have savings or access to credit?
- 1 = Yes, regular savings (bank/ROSCA)
- 2 = Yes, occasional (informal)
- 3 = Yes, formal credit/ loan
- 4 = No

**SECTION E: GENDER & HOUSEHOLD CHARACTERISTICS**
E1. Is the household head:
- 1 = Male
- 2 = Female
- 3 = Other/Prefer not to say

E2. Who makes primary decisions in the household on: (select one for each)

# Socio-economics Questionnaire

- Food purchases: 1=Male, 2=Female, 3=Both jointly, 4=Other
- Farm/business decisions: 1=Male, 2=Female, 3=Both, 4=Other
- Children's education: 1=Male, 2=Female, 3=Both, 4=Other
- Use of household income: 1=Male, 2=Female, 3=Both, 4=Other

E3. Are there women's groups, cooperatives, or community organizations active here?
- 1 = Yes → list: _____
- 2 = No

E4. Does the household experience any gender-based safety concerns (e.g., unsafe paths, harassment) due to drainage/flooding or during transit?
- 1 = Yes → describe: _____
- 2 = No

E5. Pregnancy and maternal health: Are there any pregnant women in the household?
- 1 = Yes — how many? __
- 2 = No

**SECTION F: TRANSPORTATION & ACCESS**

F1. Main mode(s) of transport household members use regularly (rank 1–3):
- 1 = Walking
- 2 = Bicycle
- 3 = Motorcycle (okada)
- 4 = Private car
- 5 = Public minibus/transport
- 6 = Other _____

F2. Typical travel time to nearest market (one way): __ minutes

F3. Typical travel time to nearest primary health centre: __ minutes

F4. Are roads/passages frequently impassable during rainy season?
- 1 = Yes — for how long on average (weeks/months)? _____
- 2 = No

F5. How would you rate transport accessibility for livelihoods and health access during rainy season? (1=Very poor, 2=Poor, 3=Fair, 4=Good) __

**SECTION G: OCCUPATION & EMPLOYMENT STRUCTURE**

G1. For each working-age household member, list main occupation and whether formal or informal. (From roster)
- Formal = pays taxes/has contract; Informal = casual/self-employed without formal contract.

G2. Is unemployment a major problem in this household?
- 1 = Yes — number unemployed: __
- 2 = No

G3. Are livelihoods expected to be affected by the proposed channel construction (e.g., business disruption, temporary loss of access)?
- 1 = Yes — anticipated impacts: _____
- 2 = No
- 3 = Don't know

**SECTION H: HEALTH STATUS, DISEASE PREVALENCE & MORTALITY**

H1. In the past 12 months, has any household member suffered from any of the following? (tick all that apply)
- 1 = Malaria/fever
- 2 = Diarrheal diseases
- 3 = Respiratory infections (cough, pneumonia)
- 4 = Water-borne diseases (cholera, typhoid)
- 5 = Skin infections
- 6 = Injuries from accidents/floods/erosion
- 7 = Chronic conditions (hypertension/diabetes)
- 8 = Other (specify) _____

H2. Have there been any deaths in the household in the past 5 years?
- 0 = No → skip H3
- 1 = Yes → number of deaths: __ → causes (if known): _____ → Year(s): _____

H3. Childbirth & maternal care: In the past 2 years, where were births attended?
- 1 = Health facility with skilled attendant
- 2 = Home with skilled attendant
- 3 = Home without skilled attendant / traditional birth attendant
- 4 = Other (specify)

H4. Do household members have regular access to immunisation and child health services?
- 1 = Yes
- 2 = No
- 3 = Sometimes

H5. Are there common seasonal health issues during rainy season (e.g., malaria, diarrhea)? Describe: _____

**SECTION I: HEALTH PRACTICES (ORTHODOX & TRADITIONAL)**

I1. When household members are ill, where do they FIRST seek care? (select one)
- 1 = Public clinic/health center
- 2 = Private clinic/hospital
- 3 = Pharmacy/Chemist shop
- 4 = Traditional healer / herbalist
- 5 = Home remedies / self-medication
- 6 = Other (specify) _____

I2. Is traditional medicine widely used in this community?
- 1 = Yes — common conditions treated: _____
- 2 = No

I3. Are there traditional healers within the community?
- 1 = Yes — number approx. __
- 2 = No

I4. Perception of quality of public health services (1=Very poor, 2=Poor, 3=Fair, 4=Good, 5=Very good): __

**SECTION J: WATER, SANITATION, HYGIENE (WASH) & WASTE MANAGEMENT**

J1. Main drinking water source for household:
- 1 = Piped to dwelling
- 2 = Piped to compound/yard
- 3 = Public tap/standpipe
- 4 = Borehole/handpump
- 5 = Dug well (protected)
- 6 = Dug well (unprotected)
- 7 = Surface water (river/stream)
- 8 = Purchased water (tankers/jerrycans)
- 9 = Other _____

J2. Is the main water source affected by flooding or contamination during rainy season?
- 1 = Yes — often
- 2 = Sometimes
- 3 = No

J3. Type of sanitation facility used by household:
- 1 = Flush toilet (connected to sewer/septic)
- 2 = VIP latrine / improved pit latrine
- 3 = Shared public latrine
- 4 = Pit latrine without slab
- 5 = Open defecation
- 6 = Other _____

J4. Where does household waste go? (tick all that apply)
- 1 = Collected by municipal service
- 2 = Dumped on community open site
- 3 = Burned on site
- 4 = Buried
- 5 = Dumped into drainage/river
- 6 = Other _____

J5. Are there problems with solid waste blocking drains or causing flooding?
- 1 = Yes — often
- 2 = Sometimes
- 3 = No

J6. Does the household treat drinking water (boil, filter, chlorinate)?
- 1 = Yes (specify method) _____
- 2 = No

**SECTION K: PUBLIC HEALTH INFRASTRUCTURE & SERVICES**

K1. Name nearest health facility type and approximated distance/time:
- Facility name: _____ Type: 1=Primary Health Centre, 2=Health Post, 3=Clinic, 4=Hospital
- Travel time (mins): __

K2. Does the nearest facility provide: (tick all that apply)
- 1 = Maternal & child health services
- 2 = Immunisations
- 3 = Emergency services (24/7)
- 4 = Laboratory services
- 5 = Pharmacy / medicines
- 6 = None of the above

K3. In your opinion, what are the main barriers to using health services? (rank top 3)
- 1 = Cost of services
- 2 = Distance/transport difficulty
- 3 = Poor quality / lack of staff
- 4 = Cultural/religious reasons
- 5 = Opening hours / availability

# Socio-economics Questionnaire

- 6 = Other _____

K4. Have there been disease outbreaks in the community in last 5 years (e.g., cholera, measles)?

- 0 = No
- 1 = Yes — specify disease & year: _____

**SECTION L: COMMUNITY PERCEPTIONS OF THE ACReSAL / BULKA PROJECT**

(Explain: ACReSAL = name of the proponent/project)

L1. Have you heard about the Bulka Stormwater / ACReSAL project?

- 1 = Yes → source of information: 1=Community meeting, 2=Radio, 3=Local leader, 4=NGO, 5=Other _____
- 2 = No

L2. How well do you understand the purpose of the project? (1=Not at all, 2=Little, 3=Somewhat, 4=Well) __

L3. Do you think the project will benefit your household/community?

- 1 = Yes — major expected benefits (tick): 1=Less flooding, 2=Better sanitation, 3=Improved health, 4=Better roads/access, 5=More livelihoods, 6=Other _____
- 2 = No — why? _____
- 3 = Don't know

L4. Do you have concerns about negative impacts from the project? (tick all that apply)

- 1 = Loss of land/property
- 2 = Temporary loss of business/income during construction
- 3 = Risk to health from construction (dust, accidents)
- 4 = Increased flooding elsewhere
- 5 = Exclusion of vulnerable groups from benefits
- 6 = Other _____

L5. Are you aware of any compensation or grievance mechanism related to the project?

- 1 = Yes — specify: _____
- 2 = No

L6. Would you or your household want to be consulted / engaged about project activities that affect you?

- 1 = Yes — preferred method: 1=Community meeting, 2=Household visit, 3=Radio announcement, 4=Local leader, 5=Other _____
- 2 = No

L7. What would you like the project to prioritise? (rank top 3)

- 1 = Flood control/structural works
- 2 = Improved drainage & sanitation
- 3 = Job opportunities for locals
- 4 = Compensation or alternative livelihoods
- 5 = Health interventions / clinics
- 6 = Environment / tree planting
- 7 = Other _____

**SECTION M: COMMUNITY ASSETS & SOCIAL ORGANIZATIONS**

M1. List active community organizations (e.g., youth groups, women groups, religious organisations): _____

M2. Are there formal mechanisms for community representation (e.g., community development committee)?

- 1 = Yes — name: _____
- 2 = No

M3. Do marginalized groups have representation in community structures?

- 1 = Yes
- 2 = No
- 3 = Don't know

**SECTION N: FINAL OBSERVATIONS (Enumerator to record)**

N1. Observed hazards around household (tick):

- 1 = Eroded banks / gullies within 50m
- 2 = Blocked drains
- 3 = Standing water / stagnant pools
- 4 = Waste dumps near drainage
- 5 = Cracks/damage to foundations
- 6 = Other _____

N2. Notes on coping strategies used by household during floods (brief): _____

N3. Immediate needs indicated by household (brief): _____

# GBV/SEA Questionnaire

**Environmental and Social Management Plan (ESMP) for Bulka Erosion & Stormwater Management site in Zamfara state under the ACReSAL Project.**

**FOCUS GROUP DISCUSSION GUIDE (FOR WOMEN)**

*Before beginning the group discussion, read the **consent form** and obtain the participants' consent to proceed with the group discussion. **DO NOT** proceed without consent. Inform the participant that you would like to start recording the interview & taking notes and start the audio recorder.*

***Oral Consent***

Hello, my name is _____representing the Hardan consulting services for preparing an Environmental and Social Management Plan (ESMP) for Bulka erosion & stormwater management site in Zamfara state under the ACReSAL Project. ACReSAL project is a multi-sectoral and multi-institutional scheme, covering Environment, Agriculture and Water. It was designed by the Federal Government to combat desertification, restore degraded lands, and special ecosystems for agriculture and biodiversity conservation. Having said this, we are interested in learning about some of the needs and concerns of people in this community. This we will help us understand some of the issues related to violence against women and girls, men and boys. I hope that your answers to my questions will help improve services for people in this community. I expect our discussion to last about 30-60 minutes.

This assessment aims to understand local gender issues, particularly those arising from the project's labour influx. We are specifically identifying the support services available to survivors of gender-based violence (GBV) within this community. Please note that I am not asking about your personal experiences with GBV. GBV is defined as an umbrella term for any harmful, non-consensual act based on socially ascribed gender differences. This includes sexual violence, domestic/intimate partner violence, threats, controlling behaviour, and harmful practices like trafficking, FGM, or child/forced marriage. Women and girls are most vulnerable by GBV across the globe. We are focused solely on community issues and concerns, and not personal experiences or survivor status.

During the interview, audio recording will be done as I take notes in order not to miss all the important points we will discuss. You do not have to mention your name or something you may be identified by. However, if you do not wish that the interview be recorded, we will not. You may feel uncomfortable talking about some of the topics or your experiences. You are free not to answer any of the questions we ask, and you can stop your participation in the study at any time. Although we would appreciate your participation, you are free to decide not to participate. The findings may contribute to efforts to improve GBV services in this community.

You may call the lead local Consultant, David Ajiboye (07063838610), if you have questions or complaints about being in this study. If you have any questions about your rights as a research participant, you may also contact the consultant about any problems or concerns via email: hardanconsulting@hotmail.com

**ASK PARTICIPANT:** Do I have your permission to continue with this discussion?
Yes, consent is given → go to question 1
No, consent is not given → Discussion with the participant must END.
Interviewer's Signature and date: _____ (indicates respondent's willingness to participate)

**ESSENTIAL RULES FOR THE GROUP DISCUSSION**

- Be respectful when others speak
- Keep all discussions confidential
- Do not share details of the discussion later, whether with people who are present or not

***Ice breakers:***

***What do you understand by the term Gender Based Violence? What type of violence occurs here?***

***Kindly describe how men and women in this community spend their time***

**SECTION A (information regarding safety for women and girls, men and boys with respect to labour influx)**

1. How safe is this community? Are there any safety and security measures available for women and girls in this community? Examples?
2. What are the situations that pre-dispose people to Gender based violence (GBV) in this community? (Probe for example, poverty, culture, social status, etc.?)
3. Which group of women/girls are most at risk of violence? Why?
4. Are there specific times of day or specific locations (e.g., markets, paths, water points, project site boundaries, worker accommodation) where women/girls feel more unsafe when workers from outside this community come in to work? Give examples of previous project examples to further explain this point. Why?
5. Do the workers from outside the community affect the stability of the community? (Probe for changes in social norms, public harassment, or feeling watched).
6. What do individuals in this community do to protect themselves from gender-based violence? What does the community as a whole do to protect people from GBV? (Probe for activities by community institutions such as churches, mosques etc.)
7. How are women/girls protected in this community? What about men and boys in the community? Who are usually the perpetrators of GBV (Probe for when and where IPV, forced marriage, sexual abuse etc. occurs)
8. What actions are taken against perpetrators of violence in this community?
9. From other projects, are there situations where women are forced against their wishes to gain employment, grants or favours?
10. Any suggestion(s) on ways to improve the safety of women/girls in the community?

**SECTION B Help-seeking Behaviours and community attitudes**

1. Are there any support groups available to women, girls, men or boys in this community?
2. Any existing cultural practices in this community that may be considered harmful to women or young girls? Is the practice on the rise or decreasing? What motivates people to practice it/them?
3. At what age do men and women get married in this community? Are there cases of early and forced marriages? How often does it happen? Is it increasing or decreasing? What factors are responsible for parents marrying their child/children out early?
4. When there is family crisis who do women report to?
5. Are women in this community allowed to work?
6. While the woman works. Who cares for the child/children? Any issues on child labour?
7. Are women/girls sometimes responsible for violence done to them?
8. Are these victims to be blamed when violence occurs? What are the consequences of being a victim of violence?

**SECTION C (Access to services and quality of these services)**

1. Where do women go when they have medical issues? (health centre, traditional healer or faith healer)
2. What is the quality of these services? How effective are they? Are there any issues that one may face accessing these services?
3. Are there community structures that support survivors of GBV? (Probe: If yes, please describe the structures vis a vis functionality, accessibility)
4. Do existing services to prevent or respond to GBV employ a survivors-centered approach? For example, addressing the needs of survivors who are living with disability?? (Please explain)
5. Are there women groups in this community? Any women centres? Where do women gather? How safe is the place? (ask for description of the locations)
6. What is the quality and accessibility of services to prevent or respond to GBV survivors? What are the gaps in the GBV services these organizations or facilities provide?
7. What do you think needs to be done to break the barriers of women and girls or men and boys face to report violence and access post-GBV services?
8. What services do you think need to be available to help address GBV? What should be done to help GBV survivors in this community? (Probe: How could these efforts be improved?

**Additional questions**

1. Considering this project, what do you think about the impacts of this project on the lives of women and girls? How do you think these fears and concerns can be addressed?
2. What do you think needs to be done to break the barriers women and girls or men and boys face to report GBV and access post-GBV services in this community/LGA?
3. Are there new economic opportunities available due to the project? Who (men/women, boys, girls are most able to a, etc) access these? What are the barriers?

**End the Interview**

*Do you have questions for me? Thank you all for your time and ideas. This has been extremely helpful. Please remember that you agreed to keep this discussion confidential. Please do not share with others what was said here.*

**COMMUNITY SENSITIZATION MEETING HELD AT BULKA AREA GUSAU LOCAL GOVERNMENT AREA OF ZAMFARA STATE ON WEDNESDAY 5st DECEMBER, 2025.**

| ITEMS | DESCRIPTION |
|---|---|
| 1. Project: | Zamfara State ACReSAL: Environmental and Social Management Plan for Bulka Storm water & Erosion Management Site – Men |
| 2. Name of Community: | Bulka |
| 3. Date: | December, 5 2025 |
| 4. Language of Communication: | Hausa and English |
| 5. Protocols and Introductions: | • The community consultation meeting was held at the Bulka Community Central Gathering Ground near District Head's Palace. The meeting commenced at approximately 11:00 am with an opening prayer led by a respected community elder. The Consultant's representative introduced the project team and informed the community that they were engaged by the Zamfara State ACReSAL Project to carry out an Environmental and Social Management Plan for the proposed stormwater and erosion control intervention in the Bulka area. The purpose of the meeting was clearly explained as part of the stakeholder engagement process to ensure community participation, collect relevant socioeconomic and health data, and understand local concerns regarding flooding, erosion, and public health. |
| 6. Remarks of the Lead Consultant: | • The representative of the Lead Consultant provided a comprehensive overview of the assignment and emphasized the importance of ESMP in World Bank-supported projects. He explained that:<br>➢ The ESMP is designed to assess the social, economic, and health conditions of the community.<br>➢ The exercise will identify how the proposed stormwater and erosion intervention may impact:<br>• livelihoods<br>• health conditions<br>• infrastructure<br>• vulnerable populations<br>• He further stated that:<br>➢ The study involves household surveys, FGDs, and stakeholder consultations.<br>➢ Community members are encouraged to cooperate fully and provide accurate information.<br>➢ The findings will guide the design of mitigation measures to reduce negative impacts and enhance benefits.<br>• He also highlighted that:<br>➢ The proposed project will help reduce flooding, improve drainage, and minimize disease outbreaks.<br>➢ There may be temporary inconveniences during construction, but these will be properly managed.<br>• The Consultant assured the community that all information provided will be treated confidentially and used strictly for project planning. |
| 7. Remarks of the Community Representative | • The District Head (or representative) welcomed the Consultant team and appreciated the initiative by ACReSAL and the Zamfara State Government. He noted that:<br>➢ Flooding and erosion have caused serious damage to houses, farmlands, and access roads.<br>➢ The community has long awaited intervention to address these challenges.<br>• He emphasized that:<br>➢ The community supports the project fully.<br>➢ The engagement process should be transparent and inclusive.<br>➢ Youths and vulnerable groups should benefit from employment opportunities.<br>• He encouraged all residents to:<br>➢ Participate actively in the survey<br>➢ Provide accurate and honest information |

| | |
|---|---|
| | ➢ Cooperate with the project team |
| 8. Questions/Concerns of the Community: | Participants raised the following questions and questions and concerns:<br>1. When will the project implementation commence?<br>2. Will affected houses and farmlands be compensated?<br>3. How will flooding be controlled during construction?<br>4. Will local youths be employed during the project?<br>5. What measures will be put in place to protect children from construction hazards?<br>6. Will the project address stagnant water that causes malaria?<br>7. How will access roads be managed during construction activities?<br>8. What are the requirements for the socioeconomics and verification survey? |
| 9. Responses to the Questions and Concern: | The Consultant responded as follows:<br>1. The project will commence after completion of necessary assessments and approvals.<br>2. Any affected assets will be addressed in line with appropriate safeguards instruments (where applicable).<br>3. Temporary drainage measures will be put in place during construction to prevent flooding.<br>4. Local youths will be considered for employment opportunities where possible.<br>5. Safety measures such as fencing, signage, and community awareness will be implemented.<br>6. The project is designed to reduce stagnant water, thereby minimizing malaria risks.<br>7. Traffic and access management plans will be developed to minimize disruption.<br>8. The specific requirements for the survey is for residents located within the 8m and 25m radius of the gully corridor. |
| 10. Community Perceptions about the Project: | • The overall perception of the proposed project by the Bulka community was highly positive. Community members expressed that:<br>➢ The project is urgently needed due to recurring flooding and erosion.<br>➢ It will improve safety, health conditions, and infrastructure.<br>➢ It will enhance livelihoods and reduce environmental hazards.<br>• The community pledged full cooperation and support for the successful implementation of the project. |
| 11.Vote of Thanks: | • The Consultant's representative thanked the community leaders and members for their active participation, valuable contributions, and cooperation.<br>• He assured them that:<br>➢ All concerns raised would be documented and considered<br>➢ Continuous engagement will be maintained throughout the project lifecycle. |
| 12.Closing/ Attendees: | • The meeting ended at approximately 3:30 pm.<br>• A total of 125 participants attended, including:<br>• Community leaders<br>• Men, women, and youth representatives<br>• Vulnerable group representatives |

| ITEMS | DESCRIPTION |
|---|---|
| 1. Project: | Zamfara State ACReSAL: Environmental and Social Management Plan for Bulka Storm water & Erosion Management Site – Women |
| 2. Name of Community: | Bulka |
| 3. Date: | December, 5 2025 |
| 4. Language of Communication: | Hausa and English |
| 5. Protocols and Introductions: | • The community consultation meeting was held at the Bulka Community Central Gathering Ground near District Head's Palace. The meeting commenced at approximately 11:05 am after the opening prayer led by the respected community elder. The Consultant's representative introduced the project team and informed the women that they were engaged by the Zamfara State ACReSAL Project to carry out an Environmental and Social Management Plan for the proposed stormwater and erosion control intervention in the Bulka area. The purpose of the meeting was clearly explained as part of the stakeholder engagement process to ensure community participation, collect relevant socioeconomic and health data, and understand local concerns regarding flooding, erosion, and public health. |
| 6. Remarks of the Lead Consultant: | • The representative of the Lead Consultant provided a comprehensive overview of the assignment and emphasized the importance of ESMP in World Bank-supported projects. He explained that:<br>➢ The ESMP is designed to assess the social, economic, and health conditions of the community.<br>➢ The exercise will identify how the proposed stormwater and erosion intervention may impact:<br>• livelihoods<br>• health conditions<br>• infrastructure<br>• vulnerable populations<br>• She further stated that:<br>➢ The study involves household surveys, FGDs, and stakeholder consultations.<br>➢ Community members are encouraged to cooperate fully and provide accurate information.<br>➢ The findings will guide the design of mitigation measures to reduce negative impacts and enhance benefits.<br>• She also highlighted that:<br>➢ The proposed project will help reduce flooding, improve drainage, and minimize disease outbreaks.<br>➢ There may be temporary inconveniences during construction, but these will be properly managed.<br>• She also asked the women<br>➢ Challenges they face in the community<br>➢ Vulnerabilities for women in the community<br>➢ Ability or enablement to work and school for girls<br>➢ Issues concerning marriage<br>• The Consultant assured the women that all information provided will be treated confidentially and used strictly for project planning. |
| 7. Remarks of the Community Representative | • Some of the women responded by noting that:<br>➢ Flooding and erosion have caused serious damage to houses, farmlands, and access roads.<br>➢ The community has long awaited intervention to address these challenges.<br>➢ Women in this community are allowed to work and also do businesses to support their families.<br>➢ They have easy access to healthcare facilities because there is a primary health care within the community.<br>➢ Women in the community faces domestic violence due to majority of the men in that community marries more than 3wives. s an issue involving relations of power |

| | |
|---|---|
| | ➢ Early marriage for girls is supported by poor families. Young girls are pulled out of education for marriage, to help with domestic tasks and to generate an income.<br>• The women emphasized that:<br>➢ They support the project fully and are expectant as the project will reduce loss of live and properties.<br>➢ The engagement process should be transparent and inclusive.<br>➢ Women, Youths and vulnerable groups should benefit from employment opportunities.<br>➢ They will ensure they provide accurate and honest information<br>➢ Fully cooperate with the project team |
| 8. Questions/Concerns of the Community: | Participants raised the following questions and questions and concerns:<br>• When will the project implementation commence?<br>• Will Women be given employment opportunities?<br>• Will affected houses and farmlands be compensated?<br>• How will flooding be controlled during construction?<br>• Will local youths be employed during the project?<br>• What measures will be put in place to protect children from construction hazards?<br>• Will the project address stagnant water that causes malaria?<br>• How will access roads be managed during construction activities?<br>• What are the requirements for the socioeconomics and verification survey? |
| 9. Responses to the Questions and Concern: | The Consultant responded as follows:<br>• The project will commence after completion of necessary assessments and approvals.<br>• Any affected assets will be addressed in line with appropriate safeguards instruments (where applicable).<br>• Women will be considered as the project sponsor fully encourages equal gender opportunities in work environments<br>• Temporary drainage measures will be put in place during construction to prevent flooding.<br>• Local youths will be considered for employment opportunities where possible.<br>• Safety measures such as fencing, signage, and community awareness will be implemented.<br>• The project is designed to reduce stagnant water, thereby minimizing malaria risks.<br>• Traffic and access management plans will be developed to minimize disruption.<br>• The specific requirements for the survey is for residents located within the 8m and 25m radius of the gully corridor. |
| 10. Community Perceptions about the Project: | • The overall perception of the proposed project by the Bulka community was highly positive. Community members expressed that:<br>➢ The project is urgently needed due to recurring flooding and erosion.<br>➢ It will improve safety, health conditions, and infrastructure.<br>➢ It will enhance livelihoods and reduce environmental hazards.<br>• The community pledged full cooperation and support for the successful implementation of the project. |
| 11.Vote of Thanks: | • The Consultant's representative thanked the community leaders and members for their active participation, valuable contributions, and cooperation.<br>• He assured them that:<br>➢ All concerns raised would be documented and considered<br>➢ Continuous engagement will be maintained throughout the project lifecycle. |
| 12.Closing/ Attendees: | • The meeting ended at approximately 3:55 pm.<br>• A total of 125 participants attended, including: Community leaders, Men, women, and youth representatives and Vulnerable group representatives |

## ANNEX 4

## GBV CONTEXT WITHIN BULKA PROJECT AREA

***What is GBV?***

Gender Based Violence is defined as an umbrella term for any harmful act perpetrated against a person's will based on a person's gender. It ranges from physical, sexual, mental harm to but not limited to coercion and other deprivation of liberty. These acts can occur in private or public spaces (IASC 2015).

All over the world, women and girls are mostly affected by GBV. One out of three women has experienced any form of GBV at one point or the other of their lives. GBV also referred to as violence against women and girls is a manifestation of historical power imbalance between men and women giving rise to domination over and discrimination against women resulting to the limitation of women's advancement (UN Declaration on the Elimination of Violence Against Women 1993). Despite the numerous drivers of GBV, the presence of power imbalance between males and females is the major driver of GBV. This is responsible for the discrimination against men and women as well as the domination of women by men. GBV affects women and girls such that it limits and prevents their full advancement throughout their lives.

**What is SEA and SH?**

**Sexual Exploitation and Abuse** can be defined as an actual or attempted abuse of a position of vulnerability, differential power or trust for sexual purposes including but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another.

**Sexual Harassment** refers to unwelcome sexual advances, requests for sexual favours and other unwanted verbal or physical conduct of a sexual nature. Our focus regarding this project is restricted to sexual exploitation and abuse (SEA) and workplace sexual harassment (SH). Both men and women can experience SH. The difference between SH and SEA is that SH occurs between workers (staffs) on the project while SEA can be between workers on the project or between workers and members of the project affected communities. Projects such as NETAP can increase the risks of GBV by the range of perpetrators for example;

Projects with labour influx tend to exacerbate existing GBV risks and equally create new GBV risks. The NETAP is one which requires influx of workers: this in turn can create new GBV risks and exacerbate existing GBV risks. Child/forced marriage (which is the common type of GBV in Northern Nigeria), Increased transactional sex, sexual abuse to minors by project workers may occur as a result of income raise of the project workers in the community.

In cases of relocation of project affected persons (PAPs) whose structures are either along the right of way (ROW) or under the transmission lines, women are most likely to be vulnerable to GBV especially in parts of the country where women are not recognised as land owners.

**GBV AND CONSENT**

In SEA and SH cases, consent is usually a key consideration. Consent must be voluntary given otherwise, GBV arises. Free Prior Informed Consent (FPIC) on an action is said to be given when the individual concerned is informed, has a clear appreciation, understanding, implications and future consequences of the action. The individual concerned must be aware of the right to refuse to engage in the action. Individuals with cognitive impairments and developmental disabilities

(sensory/physical) may not be able to give consent. Children (individuals below the age of 18) are unable to give consent as they are unable to understand the implication, facts and future consequences of an action.

## LEGAL AND REGULATORY FRAMEWORK ON GENDER

### International Laws On Gender-Based Violence

**The Convention on the Elimination of All Form of Discrimination against Women (CEDAW) (1984):** Discourages the discrimination against women by any distinction, exclusion or restriction made on the basis of sex which has the effect or purpose of impairing or nullifying the recognition, enjoyment or exercise by women, irrespective of their marital status, on a basis of equality of men and women, of human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field.

**The International Covenant on Civil and Political Rights (ICCPR) (2004):** Pursues the promotion of self-realization by upholding the right of self-determination. By virtue of that right, they freely determine their political status and freely pursue their economic, social and cultural development. Also, all peoples may, for their own ends, freely dispose of their natural wealth and resources without prejudice to any obligations arising out of international economic co-operation, based upon the principle of mutual benefit, and international law. In no case may a people be deprived of its own means of subsistence.

**The Convention on the Rights of Persons with Disabilities (CRPD) (2012):** Adopts a broad categorization of persons with disabilities and reaffirms that all persons with all types of disabilities must enjoy all human rights and fundamental freedoms. It clarifies and qualifies how all categories of rights apply to persons with disabilities and identifies areas where adaptations have to be made for persons with disabilities to effectively exercise their rights and areas where their rights have been violated, and where protection of rights must be reinforced.

**The Convention on the Rights of the Child (CRC) (1990):** outlines in 41 articles the human rights to be respected and protected for every child under the age of eighteen years.

### Other Regional Treaties Relevant to GBV

- The African Charter on Human and Peoples' Rights (ACHPR) (1982);
- The African Charter on the Rights and Welfare of the Child (ACRWC) (2007);
- The Protocol to the ACHPR on the Rights of Women in Africa (the "Maputo Protocol") (2007).
- UNESCO 1970 Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Cultural Property.
- The Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (CAT) (1993)
- The National Action Plan for the Implementation of United Nations Security Council Resolution 1325 (2009);

### RELEVANT NATIONAL LAWS, ACTS AND REGULATIONS

- **Nigeria Land Use Act of 1978 (Now Cap 202 LFN 1990) and Resettlement Procedures:** The Land Use Act Cap 202, 1990 Laws of the Federation of Nigeria is the key legislation that has direct relevance to the project. Relevant sections of these laws as may relate to this project

with respect to land ownership and property rights, resettlement and compensation are summarized in this section. The Land Use Act is the applicable law regarding ownership, transfer, acquisition and all such dealings on Land. The provisions of the Act vest every Parcel of Land in every State of the Federation in the Executive Governor of the State. He holds such parcel of land in trust for the people and government of the State. The Act categorized the land in a state to urban and non-urban or local areas. The administration of the urban land is vested in the Governor, while the latter is vested in the Local Government Councils. At any rate, all land irrespective of the category belongs to the State while individuals only enjoy a right of occupancy as contained in the certificate of occupancy, or where the grants are "deemed".

- **Child's Rights Act (2003):** An act providing for the best interest of the child as the paramount consideration for any activity involving children.
- **National Gender Policy (2006):** It substitutes the Women's Policy adopted in 2000. The goal includes the elimination of cultural/ religions gender-based biases and harmful cultural and religious practices which rise to inequalities in gender-role relations in the Nigerian society, by ensuring: ensure equal access to women, boys and girls to both formal and informal education; ensure that women have access to critical resources and invest in their human capital as a means of reducing extreme poverty in families; and eliminate the high risks linked to many harmful traditional cultural practices, which still put threaten the health of women
- **Administration of Criminal Justice Act/Law (ACJA (2015) /ACJL) (Varies by state)** The ACJA is a national law and provides for the administration of the criminal justice system which promotes efficient management of criminal justice institutions, speedy dispensation of justice, protection of the society from crimes and protection of the rights and interest of the suspect, the defendant and victims in Nigeria. While the ACJL upon domestication in the various states in Nigeria, provides for the administration of criminal justice on the state level in Nigeria.
- **Violence Against Persons (prohibition) Act (VAAP) 2015:** The VAPP is a national law providing for the protection from violence of persons in Private and Public Life. The Act also prohibits all forms of violence against persons and provides maximum protection and effective remedies for victims as well as punishment for offenders. This Act has been domesticated by thirteen (13) states in Nigeria.

**RELEVANT STATE LAWS, POLICIES AND REGULATIONS**

- **The Penal Code (Northern States) Federal Provisions Act of 1959 ('the Penal Code')** (applies to all states under its jurisdiction in northern Nigeria): The Penal Code makes specific provision in relation to children under the age of 16 years who are sexually assaulted by those in positions of authority.
- **Criminal Procedure Code Cap 81 Laws of the Federation 1990 (CPC)** (applies to all states under its jurisdiction in northern Nigeria)
- **Sharia Penal Codes:** rape is criminalized in the Sharia penal laws which were introduced from 1999 and are now in force in 12 states in the north – Zamfara, Kano, Sokoto, Katsina, Bauchi, Borno, Jigawa, Kebbi, Yobe, Kaduna, Niger and Gombe. The definitions of rape however, does not conform to the principles underlying the Rome Statute definition, does not provide sufficient protection or redress for women and girls who have been raped, and also discriminate against married women and girls. Understanding that these states have not adopted the Child's Rights Act, VAPP and other laws which they deem contrary to Sharia law will form part of a better understanding of the legal framework and legislation on GBV and child protection.

**Other Legal Considerations**

- **Consent and maturity under National and State Laws:** The Constitution of Nigeria (1999) and the Child Rights Act (2003) both considers 18 years as the age of maturity and consent. However, Sharia law, which is practised in Kano, Jigawa, Gombe, Borno, Katsina, Zamfara and Sokoto States hold that the age when a person reaches *taklif* is flexible under Sharia penal law, and is defined as the age at which a person attains legal and religious responsibility. This is commonly regarded as being the age of puberty and is therefore widely variable.

**MANDATORY REPORTING**

According to the World Health Organization's (WHO) Guidelines for Gender-Based Violence Interventions in Humanitarian Settings: Focusing on Prevention of and Response to Sexual Violence in Emergencies (2005), all health care providers must be aware of relevant laws and policies governing health care providers in cases of sexual violence. Similarly, the United Nations have set policies for mandatory reporting that are adopted for all humanitarian workers, where incidents of Sexual Exploitation and Abuse involving humanitarian workers must be reported according to the SEA General Bulletin of the UN Secretary General 2003.

Additionally, some countries have laws mandating health care providers to report cases of sexual violence to police or other authorities, often highlighted in the Criminal Procedure Code of that country (in many countries, there are police forms that must be completed by the health care provider to report issues of Sexual violence). Conversely, the Criminal Procedure Code of Nigeria does not include such provisions. Furthermore, the Zamfara State Criminal Produce Act does not capture or provide any procedure for mandatory reporting of SEA/GBV**.** Regardless, a survivor is given the freedom to exercise his/her prerogative to choose not to report (in which case, the survivor's refusal to report should not result in cessation of necessary support). Consideration should also be given to the safety of the individual concerned, as well as the wider community. The VAPP and ACJA also have provisions concerning accessories to crimes and punishment for persons found concealing information about the existence of a crime committed to their knowledge.

**<u>Gender Assessments and reports from the study area</u>**

Gender based violence is a common social problem in Nigeria especially in the Northern parts of Nigeria. Types of GBV issues prevalent in Zamfara state ranges from domestic violence, sexual exploitation to forced and early marriage, child labour and deprivation of resources.

The most common type of GBV in the state is early/child and forced marriage. The major drivers of these forms of GBV as experienced in the state are the religious and cultural norms and values governing this part of the country. Despite the United Nations measures (Article 1 of the United Nations Convention on the Rights of the Child which considers a child as anyone below 18) set out to protect the interest of young girls regarding child marriage and child sexual abuse, the historical practise of child/forced marriage is still in existence in some communities in Zamfara as well as some other northern states. The Summary of consultations with various groups from the six communities of the project site (Hayin Buba, Hayin Danhausa, Sabon Fegi, Unguwar Dallatu) and other stakeholders (community heads, women leader, etc) are summarized in the following tables below;

**FOCUS GROUP DISCUSSIONS WITH WOMEN/ FEMALE YOUTH GROUPS OF BULKA AREA**

These discussions took place 3rd to 4th December, 2025 in Bulka local government (each meeting lasted for approximately 1hour 30minutes per community) in which 10 women above 35 years of age participated and formed the women's group, 10 youth females between 18 and 34 years constituted the female youth group and a group of 10 men in the men group. Before the group discussions began, the **consent form** was read and consent was obtained from the participants before proceeding with the group discussion. A focus group discussion guide of 29 questions was used to facilitate the meeting for the various groups.

The groups were disaggregated by gender and age to ensure confidentiality and protection of all participants (age 18 to 35 for the youths and above 35 years for the older group). The participants were generally responsive. They also understood the meaning of GBV, its types and forms (child abuse, rape, early marriage, forced marriage and domestic violence). As regarding the safety of their community, they stated that their community is not very safe especially for young girls (9 to 17 years). They have police stations and service providers at the local government secretariat they report security and gender issues respectively. According to the participants, female children from age 9 and above are at risk of GBV and this is so because they move around the community freely. There are no NGOs in this community to the best of their knowledge. Women in this community get married from the age of 15 while men get married from the age of 25 and this is dependent on their educational background; the lower the level of education, the earlier it is for them to get married but for the women; educational level is immaterial. Most parents marry off their young girls due to poverty.

Women report family crisis to her family members or village heads when they occur depending on nature of the crisis. Medical issues are reported to the primary health care centres. These health centres are accessible and the qualities of the services they render are satisfactory. When asked if women are sometimes responsible for violence done to them, a participant from Unguwar Dallatu said 'Domestic violence sometimes occur in our community; as a result of polygamy (she said it in Hausa language)'. They also stated that survivors of GBV should not be blamed for their ordeal. The consequence of being a victim /survivor of violence is victim shaming from both family and members in these communities especially in the case of rape or sexual violence. This in turn affects the victim's social life, marital life and throughout her life cycle as a whole. The perpetrators of GBV in the community are often reported to the community heads, this is to ensure the safety of the victims in case of reprisal attack from perpetrators or anyone associated with them. The community head escalates to the police and further take them to court (this is done with the victim's consent). Sexual violence in this community can be stopped by creating awareness and counselling victims and survivors.

To improve the safety of young girls and women, proper sensitisation should be done in the community. Women should look after their children, advice their young boys to desist from drug abuse and the support groups should continue to sensitise the community members. When asked about the past projects in their community and if women have been forced against their wishes to gain employment, grants or favours, they said there have never been such situations. The women groups in these communities ensure that women are treated well and they hold their meetings in safe spaces. The summary of consultations from each community is below:

**1, Hayin Buba: (Female youth group, 10 participants)**

Participants stated that life in the community is difficult as a result of lack of employment and lack of capital to startup businesses and limited access to funds and grants further strengthens this barrier to financial assistance. They identified the most vulnerable age group in this community as girls between the ages of 9 to 17years old. This particular group of concern which are usually vulnerable to risks of sexual violence such as rape, unwanted kissing and touching, unwanted advances from men in the community. They also explained that teen girls are raped mostly in the evening when they are sent to sell food or drinks in the market.

***GBV issues and drivers identified in Hayin Buba***

- ✓ High unemployment and lack of capital limit women's ability to start small businesses.
- ✓ Adolescent girls (ages 9–17) are identified as the *most vulnerable group*.
- ✓ Teen girls are especially at risk in the evening when they are sent to markets to sell food or drinks, where attacks commonly occur.

**2. Hayin Danhausa (women group, 10 participants)**

Participants in this community stated that poor families usually engage in harmful practices of child and forced marriage. Young girls are pulled out of education for marriage, to help with domestic tasks and to generate an income. They discussed how these families live in poor environment with high number of female children and the girls are being forced to marry between the age of 15 and 17 because their families cannot fend for them.

***GBV issues and drivers identified in Hayin Danhausa***

- ✓ Extreme poverty continues to fuel harmful cultural practices:
- ✓ Increase in child marriages among economically disadvantaged families.
- ✓ Girls are withdrawn from school to get married, assist with household responsibilities and support income-generating activities
- ✓ Girls are often forced into marriage between ages 15–17, mostly to older men, due to their parents' inability to provide for them.

**3. Sabo Fegi (Women Group)**

In this group, participants stated that women in this community are allowed to work and also own businesses in order to support their families. They stated that women have access to healthcare facilities establishing that there is a primary health care within the community. There is also a challenge with child marriage in this community.

***GBV issues and drivers identified in Sabo Fegi***

- ✓ Increase in child marriages among economically disadvantaged families.
- ✓ Girls are often forced into marriage between ages 15–17, mostly to older men, due to their parents' inability to provide for them.

**4. Angwar Dalhatu. (Female Youth Group)**

Participants here explained thar women in the community faces domestic violence due to the men in that community marrying several wives i.e engaging in polygamy. There is a perception that this issue is associated with relations of power. The women discussed that It is based on the men feeling of superior, and exerting that superiority in their family. They also stated that there are occasions

where the wives fight with each other or the man beats one of his wives if she refuses his sexual advances.

***GBV issues and drivers identified in Angwar Dalhatu***

- ✓ Domestic violence is common, often linked to men having multiple wives (up to 3 or more).
- ✓ Violent incidents arise due to power imbalance within marriage, men asserting dominance and control and conflicts among co-wives
- ✓ Some men physically assault their wives, especially when a wife refuses sexual access or disagreements occur among co-wives
- ✓ Gender inequality continues to shape women's vulnerability in the family structure.

**List of available service providers within the Bulka LGA secretariat**

The following women at the local government secretariat provide essential support services to community members:

1. Saratu Abubakar
2. Hadiza Jafar
3. Balkisu Aliyu

These service providers offer emergency services and its aftermath, access to lifesaving care and support systems that protect women and girls, including family, community and state structures. Empowering women and girls across their lifetime by Keeping girls in school, empowering women economically, using feminist approaches to tackle gender inequality, including in the home; Providing women and girls with safe spaces.

**GENDER ASSESSMENT REPORT FROM KEY INFORMANT INTERVIEWS WITH COMMUNITY HEAD AND WOMEN LEADER OF HAYIN DANHAUSA COMMUNITY**

| Community | Key Questions by Consultant | Designation of Stakeholder in the community | Response/Comments by Stakeholder |
|---|---|---|---|
| Hayin Dahausa | Have you ever heard of the term GBV (what does GBV mean to you)? | Village head | Yes, I have. GBV is abuse of women and girls. There times where they girls where the girls meet the men in their homes or incomplete buildings where they are raped. |
| | hat are the situations that pre-se people to Gender based nce (GBV) in this community? e for example, poverty, culture, status, etc.?) | | Poverty is the main situation. Gender based violence happens to teen girls more especially when they are sent on errands or out for business like selling of food, drinks or bean curd which is a popular food in the community. |
| | Which group of women/girls are most at risk of violence? Why | | Young children and teenage girls. There are instances where they girls are been sent out to men by their mothers to men for favor or money and there are times where the mothers also meet men for |

| Community | Key Questions by Consultant | Designation of Stakeholder in the community | Response/Comments by Stakeholder |
|---|---|---|---|
| | | | money or favors this is mostly due to financial constraints. |
| | Vhen there is family crisis who o women report to? | | They report to the women leader or community leader depending on the nature of the crisis. |
| | Are there any family and traditions that contribute to the vulnerability of women? | | Early marriage in the communities are decreasing but few people marry their daughters out to Politicians due to poverty or for political positions, such girls suffer from domestic violence and sexual abuse by their partners. |
| | Are there barriers in the community determined by gender (are women allowed to work in this community? | | This depends on their husband's choice. |
| | actions are taken against trators of violence in this unity? | | When individuals are caught with rape they are reported to the village heads then taken to the police station for proper punishment. |
| | What is currently being done in this community/LGA to prevent gender- based violence? | | . The village heads and have unions within these communities where teen girls and boys between the age of 13 to 17years are educated about sex |

| Community | Key Questions by Consultant | Designation of Stakeholder in the community | Response/Comments by Stakeholder |
|---|---|---|---|
| Hayin Dahausa | Have you ever heard of the term GBV (what does GBV mean to you)? | Community women leader | Yes, I have. GBV is an act against a person's will either male or female. Some forms of GBV are rape, child marriage and confining women at home. |
| | hat are the situations that pre- se people to Gender based nce (GBV) in this community? e for example, poverty, culture, status, etc.?) | | lack of education and poverty expose people to GBV |

| Community | Key Questions by Consultant | Designation of Stakeholder in the community | Response/Comments by Stakeholder |
|---|---|---|---|
| | Are there existing laws to protect women and young girls in your community? | | There are no laws except for the community responsibility in ensuring peace and order |
| | Which group of women/girls are most at risk of violence? Why | | Teenage girls and children.for example, sometimes, girls are been sent out to men by their parents and guardians to men for favor or money and due to financial challenges. |
| | hen there is family crisis who o women report to? | | They report to the women leader union |
| | Are there any family and traditions that contribute to the vulnerability of women? | | Early marriage in the communities are decreasing but few people marry their daughters out to Politicians due to poverty or for political positions, such girls suffer from domestic violence and sexual abuse by their partners. Some men beat their wives too. |
| | Are there barriers in the community determined by gender (are women allowed to work in this community? | | No. women are allowed to work |
| | actions are taken against trators of violence in this unity? | | When individuals are caught, they are reported to the village heads then taken to the police station for proper punishment. |
| | What is currently being done in this community/LGA to prevent gender- based violence? | | . The village heads and women leaders have unions within these communities where teen girls and boys between the age of 13 to 17years are educated about sex education and also dangers of unprotected sexual relationships, They also have an organization called Solidarity which helps in rape cases within the community. |

From the table above, the Key Informant Interview (KII) was conducted with the village head and women leader in order to gain insights into the prevailing patterns, drivers, and community responses to Gender-Based Violence (GBV) within the area. The perspectives of these community leaders provide valuable context for understanding cultural norms, social dynamics, and existing mechanisms for addressing GBV.

**Perceptions of Gender-Based Violence in the Community**

These stakeholders described GBV as a persistent and multifaceted problem, disproportionately affecting adolescent girls between the ages of 13 and 17 years. According to them, teenage girls often face heightened vulnerability due to their involvement in daily household errands, petty trading, and movement across various locations within the community. Such activities frequently expose them to interactions with adult men, some of whom exploit these encounters.

**Common Contexts Where GBV Occurs**

The village head and women leader noted that many cases of rape and sexual exploitation occur in:

- Private residences, where perpetrators invite girls under the guise of assistance or errands.
- Abandoned or incomplete buildings, which provide secluded environments that increase the risk of sexual assault.

**Drivers of GBV within the community**

A prominent theme identified by the informants is the role of economic hardship in perpetuating GBV. The community is characterized by limited financial opportunities, which influences the behavior of both adolescents and parents. Some mothers, due to extreme financial pressure, reportedly:

- Send their daughters to adult men in exchange for money, food items, or other forms of support.
- Sometimes engage personally in relationships with men for economic benefit, inadvertently reinforcing exploitative gender norms.

**Early Marriage and Associated Risks**

While the informants acknowledged a gradual decline in early marriage, they highlighted that the practice persists in isolated households. A specific concern is the trend of marrying off young girls to wealthy individuals or political figures. This is often motivated by:

- Poverty alleviation,
- Expectations of political patronage,
- Desire for social or economic elevation.

**Community Mechanisms for Preventing GBV**

The village head and women leader described several community-led initiatives aimed at preventing and responding to GBV. These strategies reflect an emerging awareness of the importance of safeguarding adolescents and promoting collective responsibility

**GBV DETECTION AND MANAGEMENT STRATEGY.**

In order to prevent occurrence of GBV on any project, certain measures are to be undertaken. During project preparation, there should be identification and assessment of the risks that can emerge as a result of the project's presence, most times, projects often give rise to new GBV and social risks or exacerbate existing risks in and around the project areas. The ability and response capacity of the client to these risks should be reviewed and assessed. Project risk rating should be carried out using appropriate World Bank risk rating tools (GBV risk assessment tool) and inclusion of mitigation measures into the project design. The GBV risks identified on the ACRESAL project field visits to Bulka LGA erosion sites are through the consultations and stakeholders engagement made with the women groups, district heads in the 6 communities within the LGA.

Throughout the project implementation stage, the risks identified during the project preparation stage will be addressed; mitigation measures will be identified, established, implemented and monitored to ensure effective implementation of these measures and adaptation where necessary. In a situation where GBV has occurred, the project will need to actively respond to the GBV case, provide appropriate services for the survivor, report the case through the GRM in a survivor centred manner ensuring the confidentiality of the survivor, the GRM documents the case and closes it. Regarding ACRESAL, Stakeholders engagement and community consultations should be continuous throughout the project's life cycle not only during project preparation stage.

**LABOUR INFLUX, GBV RISKS AND MANAGEMENT MECHANISMS**

The project will involve construction which will require labour force, as it may be difficult to source especially skilled workers from the communities due to lack of technical skills and capacity. Thus, the labour force (total or partial) may be brought in from outside the project area. In many cases, this influx is compounded by an influx of other people ("followers") who follow the incoming workforce with the aim of selling them goods and services, or in pursuit of job or business opportunities. The influx of workers and followers can lead to adverse social and environmental impacts which may include increased demand and competition for local social and health services, as well as for goods and services, which can lead to price hikes and crowding out of local consumers, increased volume of traffic and higher risk of accidents, increased demands on the ecosystem and natural resources, social conflicts within and between communities, increased risk of spread of communicable diseases such as HIV/AIDS, , increased rates of illicit behaviour and crime and risks of GBV/SEA/SH.

**Gender-based violence (GBV)** which include sexual harassment, exploitation and abuse is a prevalent feature in settings across countries where the World Bank operates. In order to understand and address more effectively key drivers that contribute to incidence of GBV, the recently released report by the Global GBV Task Force emphasizes the need to improve social risk assessment and specific assessment and identification of key risks of Sexual Exploitation and Abuse (SEA) and GBV. In particular, the report highlights the extent to which existing World Bank-supported projects may compound broader contextual risks of GBV in a society, community or relationship that already contribute to prevalence of gender-based violence.

**RECOMMENDED ACTIONS TO PREVENT AND MITIGATE GBV/SEA/SH RISKS ON THE PROJECT**

As part of the initiative to integrate GBV/SEA mitigation measures in the project, a stand-alone GBV assessment report with defined action plan on mitigating these risks has been recommended for the project. Key actions to be implemented by the PIU include the following:

1. institutionalize mitigation measures in the GBV Assessment Report into a state /SPIU specific costed GBV Action Plan
2. The GBV officer or social safeguards specialist with adequate knowledge on GBV/SEA/SH, they will need to conduct trainings on survivor centered approach and how to refer cases to the appropriate GBV service providers for SPIU team, contractors, consultants, etc.
3. The SPIU to liaise with the state and local government secretariat GBV focal persons at the state to identify identify mapped service providers or where this is not feasible, the SPIU should engage a GBV expert to conduct a mapping of service providers. The SPIU should

further, collaborate with the identified service providers through MoU for response and management of GBV related issues during the project. Capacity building for service providers where needed should be conducted in collaboration with other state-based invention providing and supporting organisations and agencies such as the USAID, UNDP, etc.

4. After the identification has been conducted, a GBV referral directory should be produced and distributed within the state.
5. Ensure the inclusion of qualified GBV officer on the supervision consultant team and contractor's team respectively
6. Ensure availability of an effective GBV grievance redress mechanism (GRM) contained) is operationalized. The GBV focal persons will also be trained by the project on handling cases in line with the GRM manual to ensure confidentiality, survivor-centred and referral of cases.
7. The project will produce GBV Code of Conducts for all actors on the project and conduct training, GBV referral manuals will also be produced and distributed to all actors on the project.
8. Mandatory Codes of conduct on GBV prevention will be signed by all workers and managers, and trainings and refreshers will take place on an ongoing basis, including focus on SEA and sexual harassment
9. Assess and ensure appropriate living conditions for workers' and ensure appropriate location for their camps a safe distance outside the communities
10. The contractor shall provide separate toilet and hygiene facilities functional for men and women working on the site, including inside-locking doors and appropriate lighting
11. Display of Zero tolerance to GBV signages around project sites.
12. The Supervision Consultant or GBV Specialist shall be responsible for daily monitoring of the contractor performance and adherence to the labour influx guideline and that of its Sexual Exploitation and Abuse (SEA) obligations, while the SPIU will conduct periodic monitoring to ensure the project is implemented in accordance with the GBV Action Plan, C-ESMP, and other relevant SEA/SH preventive contractual provisions.

## ANNEX 5

## SECURITY MANAGEMENT PLAN

### Introduction

A security management plan is a strategic document that outlines the policies, procedures, and resources required to manage and reduce security risks. It identifies potential threats, assesses vulnerabilities, and implements measures to protect against those threats. Moreover, it serves as a roadmap for responding to security incidents and ensuring the safety of personnel and property.

### Objectives of the Security Management Framework

- To provide and maintain a safe physical environment and manage staff activities to reduce the risk of personal injury and property loss during the construction and operation of the Project.
- The Security Management Plan provides details and outlines measures to minimise the potential for criminal activity and ensure the safety and security of the residents and visitors to the site.
- To provide an obvious uniformed security presence to prevent crime and increase security to workers, contractors, communities and other road users.
- To assess risks and identify potential problems in an effort to lessen crime, injury, and other incidents.
- Analyse security events and other data to envisage and avoid crime, injury, and other incidents.
- Train all workers to identify and report potential or actual security occurrences to ensure a timely response. Workers in sensitive areas are trained about the protective measures designed for those areas and their responsibilities to assist in protection of workers, contractors, communities, other road users and property.
- Workers will be educated on workplace violence and the appropriate response, reporting, and available resources.

### Scope of Security Management Framework

The Security Program is designed to manage the security risks to individuals, businesses, and communities along the project corridor. The program is designed to assure identification of general and high security risks and to develop effective response procedures. The safety and security of all employees, communities, property and other road users is important and essential in providing safe environment as part during all phases of the project. The potential for the occurrence of incidents which can impact the safety and security of an workers should be identified and appropriate response measures be implemented to prevent or reduce the impact.

- Interface by relevant project stakeholders/focal points, with local stakeholders in the project space.
- Interface with project host communities, this will involve community engagements and sensing
- Frequent trips through and from the project sites.
- Construction and occupation of project sites.
- Survey and mapping of project sites. In addition, other ACReSAL project activities identified as having risk exposure relates to community and household level investment intervention such as agricultural / irrigation support, community level infrastructure / household intervention in water harvesting etc. including landscape restoration/ micro watershed and community development plans activities.

**Security Risk Assessment**

Security risk posed to the communities, people, workers and other road users along the project RoW varies and can have various forms of impacts on the proposed project. A proper chain of communication to address such security lags must be implemented to ensure safety of the people and of the longevity of the proposed project. During security risk assessment, it is pertinent to understand the following specific conditions:

1. **Security Risk Pattern in the Project Areas**: The security situation in most part of the Northern States remains fragile as revealed by intelligence analysis of data from ACLED and various official data as made available by the state security agencies and open sources including the media both conventional and social media.

   The Security Risk Assessment (SRA) prepared for ACReSAL identified threats and the vulnerability of the project to these threats, their likely impact and the drivers of insecurity including terrorism and insurgency, farmers herders' clashes, banditry, kidnapping and opportunistic and violent crimes such as break ins, mugging, road blockage, attack on travel routes, armed robbery and gang violence, etc.

2. **Insurgency and Terrorism**: This relates to the activities of groups such as Jama'atul Ahlis Sunna lil Dawatil wal Jihad (JAS) or Boko Haram and the Islamic State in West Africa Province (ISWAP) seek to establish a Sharia caliphate in the Lake Chad Basin. These groups attempt to take over territories and impose their own version of Islamic doctrines on their victims. Their main areas of influence are in Taraba, its borders with Yobe and Adamawa States.

3. **Armed Banditry**: Banditry is carried out by assailants who are popularly described as "unknown gunmen". These group rustle cattle, displace communities and engage in kidnap for ransom. The bandits operate in most part of north central and northwest states, especially in Katsina, Zamfara, Niger, Kaduna and Kebbi.

4. **Kidnapping**: This involves forceful adoption (abduction) and taking away of people by criminals or terrorist groups to raise money through ransom payment to buy weapons and equipment to further their operations. The most affected states including Kaduna, Katsina, Niger and Zamfara, where communities have informants and suppliers feeding in on the industry

5. **Opportunistic Crime**: These are opportunistic crimes resulting from limited job and high unemployment rates.

6. **Farmers and Herders Violence**: These are clashes between farmers and herders which is becoming frequent and attackers more emboldened. The situation is particularly worsened by emerging ethnic and religious dimensions the crisis has adopted. This threat remains one of the most severe challenges in Nigeria security space particularly around the middle belt.

7. **Road Travel Risk**: Road travel remains porous to attacks by criminal gangs who engage in robbery, extortion, and kidnap for ransom. Mostly driven by financial benefits, these attacks

target persons perceived to be wealthy, including business and government officials due to the believe that they have high "ransom" value.

8. **Gang Violence**: This category involves violence committed by criminal gangs involved in large-scale cattle rustling, kidnapping for ransom, armed robbery, pillage, and attacks on gold miners and traders. The authorities sometimes also refer to these gangs as "bandits" although this report describes them as "criminal" groups, gangs or organizations.

The assessment categorised the locations according to the assessed threat and risk levels namely:

| |
|---|
| **High Risk**: These are areas with high security threat resulting from the activities of terrorist groups and insurgency. Taraba, Yobe, Adamawa, Zamfara, Kaduna, Kastina, Niger, Sokoto, Benue. |
| **Medium Risk**: These are areas where the risk is not as high as obtained in situation of terrorist/ insurgent activities, however, there are prevalence of banditry and kidnapping activities. Plateau, Nasarawa, FCT, Bauchi, Kebbi. |
| **Low Risk**: These are areas with occasional kidnapping and farmers / herder clashes Kogi, Kwara, Gombe, Kano, Taraba, Jigawa. Furthermore, the assessment identified the following activities as having the most potential risks and requiring enhanced mitigation measures: |

**Proposed Security Risk Mitigation Principle**

Having identified the risk and possible impact on the project in the event of any breach of security and attack, this security risk assessment framework provides the guideline for the development of appropriate state level security assessments and management plans prior to the start of any activities in the relevant State. State Level Security Management Plan will also include clear escalation protocol and responsibility in the event that security situation worsens in any site.

To address identified risk at state level, public and private security forces may be used to provide protection for the project. The use of these security forces will be guided by the following principles:

- Adherence to the Voluntary Principles of Security and Human Rights abuses and Code of Conduct. In addition,
  a) Any private and public security forces to be deployed or dedicated to the project must be subjected to screening for any past human rights violations and be trained on SEA/SH and GBV prevention, human rights and international humanitarian law, etc.
  b) Any private and public security force to be deployed must be trained on conduct of conduct on the use of force and must have signed the required code of conduct before deployment to the project.

- Institutional Arrangement
  a) Setting up of a security management structure / forum at the federal and state levels. This structure will be an inter-agency security committee or forum that will be responsible for coordinating the operation of all security forces (private and public security) and for sharing security information and incident reports. The security focal person at the Federal level under the guidance of the National Project Coordinators will be in charge of facilitating the set up / collaboration and keeping records including those of stakeholders.

b) The security focal person at the federal level will be responsible for the security of the project throughout the project's life. The federal security focal person and state level security officers who will oversee the day-to-day activities (including supervising the deployment of security officer - public and private) shall ensure coordination of all security requirements /activities with the relevant office/officer in charge of the state Government Security Agency/Agencies (GSAs).
c) Effective communications system is vital for personal safety and security of project personnel. In order to monitor staff movements more effectively, and to alert others or to be alerted in the event of potential insecurity and to avoid incident, the state level SMP will include an effective communication system such as cellular phones (with consideration for service providers with reliable coverage in the state) including computer enabled communication capability, land line and radio phones.
d) The state security focal persons will report all security, safety, and serious health incidences to the State project coordinator who will report to the relevant state security agency and National Project Coordinator at the Federal level, where appropriate. The confidentiality of the reporting will ultimately be the responsibility of the state security focal person. The basic principle will be to convey the required information quickly and efficiently to those responsible to provide help including escalation process if situation worsens. Reports must be kept in a secure location and only accessible to the appropriate authorities to ensure confidentiality.

- The adoption of the 4Ds security strategy namely –
  - deterrence,
  - detection,
  - delay (Any security measures / device put in place to limit security threat before calling for help), and
  - denial (Any security measure / Action put in place to avoid any security breach) against all hostile activities throughout the project lifecycle. To be ensured by deployed security forces.
- Escort security protocol of lead (the team of security officers responsible for leading a convoy movement from point A to Point B or from one location to another) and chase (the team of security officers responsible for deterring any potential threat during convoy movement from one location to another), to reduce risks associated with road travels in recent day Nigeria
- Continuous threat forecast and appraisal through an intelligence risk management program.
- Leveraging on the public and private security to provide protection and timely / actionable intelligence but ensuring strict observance of relevant human rights, limited use of force and personnel non-lethal requirements e.g., batons, pepper spray, hand cuffs, whistles etc.
- Constant engagements with the local communities and other relevant stakeholders if and when the need arises on any of the project sites as documented in the project SEP.
- State level SMP will include a system to receive and address security / security force personnel related allegations / complaints such as abuse of power, excessive use of force, retaliation, sexual harassment and exploitation, gender-based violence etc. Allegations or incidents related to security personnel must be documented and reported to the Bank through the federal level security focal persons within 48 hours of the incident occurring.

**State Level Security Risk Assessment**

Prior to commencement of state level SMP, the Borrower through the security management structure / forum will conduct a security risk assessment (which will be on-going and the SMP revised accordingly) with all relevant stakeholders including community members, youth, traditional rulers and all relevant state security institution involved in security matters to determine the threat level of the security of the state. All developed security management plan by each state will be reviewed and cleared by the state / federal security focal persons

# ANNEX 6

# TRAFFIC MANAGEMENT PLAN

## Introduction

A traffic management plan template is used when planning safe traffic and work zones during roadside construction activities. It is used to keep workers safe from vehicles and equipment both outside and within roadside worksites. Traffic management plan templates can be used to assess workers' compliance with safety precautions to improve traffic controls, the security of the work area, and general protection of all workers.

To ensure safety, efficiency, and proper implementation in each traffic control situation, a basic traffic management plan template should include a comprehensive review of the following items:

- General information (e.g., project description, speed limit, traffic conditions)
- Project representatives
- Advance warning signs
- Channelizing devices
- Pavement markings
- Flagging
- Roadside safety
- Internal traffic control
- Other project-specific items

A traffic management plan also supports workers by determining what safety equipment is needed to protect the affected people such as safety cones, fences, barricades, traffic lights, closed road signs, and other equipment to ensure that work zones are properly and distinctively established. By doing so, traffic management teams will be able to create a protective zone to organize traffic alongside the work being done simultaneously. Lastly, a traffic management plan is vital to ensure that road construction plans and projects are being done safely without disrupting the normal traffic flow.

## Effective Traffic Management Plans.

The objectives of the TMP are to clearly define how the contractor will:

- Provide a safe environment for all persons working on, and traffic travelling along, roads through the work zone by adopting appropriate measures
- Minimize the impact of the works on traffic and adjacent communities;
- Minimize delays and access to public transport operations;
- Cater for the needs of all road users (including pedestrians, persons with disabilities, cyclists, motor-cyclists, heavy vehicles etc.); and,
- Communicate the arrangements for, and impacts of, any activities affecting traffic and road safety.

Given the peculiarity of the Bulka gully corridor, Extra care needs to be taken for increased levels of hazards, for example:

- Activities at or near intersections or areas with many turning and maneuvering movements;
- Where there are many vulnerable users (i.e. pedestrians, cyclists and motorcyclists);

- On or off ramps to motorways;
- Roads with hills and corners;
- At locations where contractors vehicles enter or exit the construction zone from or to the main road network;
- Where normal traffic conditions change as a result of the temporary roadworks (eg, constrained carriageway or lane width; where traffic converges from multiple lanes into a lesser number of lanes; or on carriageways where there is un-separated contra-flow)

**Design and layout of Road Systems**

The contractor in conjunction with the community, SPMU and FRSC must: -

a) Plan traffic routes to give the safest route between places within the project route

b) Make traffic routes wide enough for safe movement of the largest vehicle using them.

c) Ensure all drops and falls are adequately protected.

d) Avoid traffic routes passing close to vulnerable areas such as fuel tanks.

e) Ensure there are designated safe areas for loading, unloading and plant maintenance.

f) Avoid sharp corners or blind bends, if these cannot be avoided install mirrors.

g) Road crossings and junctions should be clearly signed and marked.

h) Make entrances and gates wide enough.

i) Set speed limits and clearly mark on traffic routes; (5mph).

j) Give prominent warning of limited headroom and overhead cables.

**Liaisons with Government Traffic Agencies**

The TMP will ensure liaisons with the FRSC at the State level. In situations where heavy traffic impacts are envisaged, the Contractor will liaise with the FRSC to ensure traffic coordination and mitigate adverse traffic impacts.

**Pedestrians**

a) Provide separate routes for pedestrians and where needed provide suitable barriers.

b) If traffic routes are used by both pedestrians and vehicles they should be wide enough.

c) Provide suitable well marked crossing points.

## Traffic Situation and Responsibilities for Management

| S/N | Aspects | Descriptions | Responsible Party |
|---|---|---|---|
| 1 | Traffic/Safety Signage | • Safety signage should be put at strategic locations to warn road users of the ongoing construction activities.<br>• Signages should also be located along engineering yards and workers' camp. | Contractor |
| 2 | Movement of Vehicles and Equipment | • Mobilization of equipment and materials should be done at off-peak period (between 10am & 4pm), mainly on weekends, holidays<br>• Enforce speed limit.<br>• Ensure vehicles and equipment are parked at designated areas ONLY.<br>• Untarred access roads shall be sprinkled with water frequently to suppress dust emissions.<br>• The contractor must ensure that trucks carrying sand/soil to and from the sites are well covered in order not to cause injury to the public.<br>• Station flagmen at junctions, diversion points, near public crossings such as schools and speed bumps will be installed in built up areas and near public facilities such as schools, mosques, churches to reduce speed and dust<br>• During peak periods, such as market days FRSC will also be involved in assisting traffic and road safety management. Furthermore, the contractor will engage the services of FRSC to train all project drivers. | Contractor |
| 3 | Training | • Hire drivers with appropriate driver's license.<br>• Liaise with FRSC to train drivers<br>• As part of refresher course for construction workers, train drivers on defensive driving and enforce speed limits | Contractor |
| 4 | Communication | • All Traffic and Safety signages should be boldly written in English & local languages.<br>• Any incident/ accidents should be reported immediately to the SPMU within 24hrs. The SPMU will also report to the NPCU/WB within 48hrs including immediate action taken | Contractor<br><br>SPMU<br><br>Contractor |
| | **Cost** | **All actions and costs have been embedded in the ESMP Matrix Table** | |

## ANNEX 7

## LABOUR MANAGEMENT PLAN

**Purpose**

This Labor Management Plan (LMP) is intended to set out responsibilities and the management practices associated with the management of labor during operation of the Projects. This LMP is developed to Ensure that the Project comply with applicable environmental, health and safety, and social (E&S) requirements Ensure that all personnel involved in the Project, contractors, and subcontractors fully comply Financiers labor management requirements; and Implement applicable Good International Industry Practices (GIIPs) to manage labor related issues in an appropriate manner.

According to the World Bank Environmental and Social Safeguards, the objectives of the LMP are:

- To promote safety and health at work.
- To promote the fair treatment, non-discrimination, and equal opportunity of project workers.
- To protect project workers, including vulnerable workers such as women, persons with disabilities, children (of working age, following this ESS) and migrant workers, contracted workers, community workers, and primary supply workers, as appropriate.
- To prevent the use of all forms of forced Labor and child Labor.
- To support the principles of freedom of association and collective bargaining of project workers in a manner consistent with national law.
- To provide project workers with accessible means to raise workplace concerns.

**Introduction of Workers**

As per ESS2, project workers can be defined in the following four areas:

- Direct workers: people employed or engaged directly by the project (including project proponent and project implementing agencies) to work specifically concerning the project.
- Contracted workers: people employed or engaged through third parties to perform work related to the core functions of the project regardless of the location.
- Primary supply workers: people employed or engaged by SPMU's primary suppliers.
- Community workers: people engaged and employed in providing community Labor.

**Legal And Regulatory Requirements**

There are national laws, policies, systems, standards and international good practice codes that govern labour and working conditions associated with projects. Such requirements are outlined in this section.

***Policies and Acts***

Labour Act, Chapter 198, Laws of the Federation of Nigeria (LFN) 2004:

The Act covers general provisions including:

- Protection of wages
- Contracts of employment and terms and conditions of employment
- Fair treatment and equal opportunities for project workers.
- Hours of work and overtime
- Employment of women
- Labour health matters
- Prohibition of forced labour

Labour complaints Factories Act, 1990: The Factories decree 1990 is a landmark in legislation in occupational health in Nigeria. It provides a substantial revision of the colonial legislation, Factories Act 1958, in which the definition of a factory was changed from an enterprise with 10 or more workers to a premise with one or more workers thereby providing oversight for the numerous small-scale enterprises that engage the majority of the workforce in Nigeria. It stipulates the enforcement of compliance on factories, industries and organizations that employ labour on the protection of the right of workers to friendly environment, health and safety including provisions for prevention and protection from hazards, safety training and supervision, notification and investigation of accidents amongst others.

Factories Act, Cap F1, LFN 2004: The Act –

- Provides a legal framework for the regulation of safety standards for the operation of factories in Nigeria; and
- Sets out minimum standards for clean and conducive working environments Employees's

Compensation Act (2010): The Act provides compensation to employees who suffer from occupational diseases or sustain injuries arising from accidents at the workplace or in the course of employment. Payment of compensation (to the worker or his dependents in case of death) by the employer is rooted in the accepted principle that the employer has a duty of care to protect the health, welfare and safety of workers at work.

Trade Unions (Amended) Act, 2005: Relevant provisions include:

- Membership of a trade union by employees shall be voluntary and no employee shall be forced to join any trade union or be victimized for refusing to join or remain a member.
- For the purposes of collective bargaining all registered Unions in the employment of an employer shall constitute an electoral college to elect members who will represent them in negotiations with the employer.
- The right to strike is an integral part of the freedom of every citizen to associate with others particularly to form or join a trade union of his choice for the protection of his interests, which is entrenched in section 40 of the Constitution of the Federal Republic of Nigeria 1999.
- No person shall subject any other person to any kind of constraint or restriction of this personal freedom in the course of persuasion.

National Minimum Wage Act, 2010: National minimum wage in Nigeria is determined by the Government. Government is empowered to set up "industrial wages boards" for specific sectors or geographical areas where it considers wages to be "unreasonably low" or where there is no adequate collective bargaining machinery for the effective regulation of wages or other conditions of employment of those workers. Generally, wage rate is determined by the applicable collective agreement or the agreement between the worker and the employer. Section 15 of the Labour Act states that "wages shall become due and payable at the end of each period for which the contract is expressed to subsist (daily, weekly or at such other period as may be agreed upon) provided that where the period is more than one month, the wages become due and payable at intervals not exceeding one month". The Act applies across the all sectors/employers, with the exception of an establishment in which workers are employed or paid on part-time and/or on a commission or piece-rate basis: this implies that such supply and transport workers are bound by their contractual agreements

The Occupational Safety and Health Act 2005: this act states that every employer shall, so far as is reasonably practicable, ensure the safety, health and welfare at work of all his employees. Other special provisions relevant to this LMP include:

- Prohibitions regarding young persons
- Duties of employer regarding Safety and Health Officers

- Risk assessment by employer and Record of risk assessments
- Exposure to serious and imminent danger
- Duties of Safety and Health officers, Establishment of Safety and Health Committees
- Health and welfare: Structure of building, Overcrowding, Ventilation and temperature, Lighting, Sanitary conveniences, Supply of drinking water, Washing facilities, Provisions for first-aid
- Safety (Machinery): Training and supervision, use of equipment and machinery
- Safety (general provision): Safe means of access and safe place of employment, Substances hazardous to health, Prevention of fire, Safety provisions in case of fire.

***International Regulations*** The following international regulations are also relevant to the project:
1. International Labour Organization (ILO) International Labour Organization has maintained and developed a system of international labour standards aimed at promoting opportunities for women and men to obtain decent and productive work, in conditions of freedom, equity, security and dignity. International labour standards are legal instruments drawn up by the ILO's constituents (governments, employers and workers) and setting out basic principles and rights at work. The standards provide a comprehensive system of instruments on work and social policy, backed by a supervisory system designed to address all sorts of problems in their application at the national level of member-countries including Nigeria.

Specifically, Nigeria is a signatory to the following agreements relevant to this project:

- Freedom of Association and Protection of the Right to Organise, 1948 (No. 87)
- Right to Organise and Collective Bargaining, 1949 (No. 98)
- Discrimination (Employment and Occupation), 1958 (No. 111)
- Equal Remuneration, 1951 (No. 100)
- Child Labour, 1999 (No. 182)
- Abolition of Forced Labour, 1957 (No. 105)
- Occupational Safety and Health, 1981 (No. 155)

2. Africa Regional Labour Administration Centre (ARLAC) The African Regional Labour Administration Centre was jointly established by the ILO and UNDP in 1974 as a project for the development of labour administration issues, then referred to as public administration activities in the field of national labour policy in ratified member states including Nigeria. The following areas are covered:
   - Labour Administration
   - Labour Inspection
   - Occupational Safety and Health
   - Employment Issues
   - Training of Trainers
   - Social Dialogue

   3. Organization of African Trade Union Unity (OATUU) OATUU, which Nigeria is a party to, performs its functions of coordinating trade union actions in Africa, defending the moral and material interest of African workers including migrant workers; harmonizing labour legislation and the principles of collective bargaining; working for African unity and economic integration; working for social and economic justice etc.

International Finance Institution requirements In relation to this LMP, the most pertinent applicable requirement is

The World Bank Environmental and Social Standard 2 (ESS 2): Labour and working conditions (The World Bank, 2017)

Other important requirements include:

- Performance Standard 2: Labour and Working Conditions (International Finance Corporation, 2006)
- Workers' accommodation: processes and standards (European Bank for Reconstruction and Development and International Finance Corporation, 2009)
- Universal Declaration of Human Rights (United Nations, 1948)
- International Labour Organization Core Conventions
- United Nations Human Rights Council: Report of the Special Representative of the Secretary General on the issue of human rights and transnational corporations

## ANNEX 8

## BIODIVERSITY MANAGEMENT PLAN

***Purpose, Scope and Mitigation Hierarchy***

The purpose of the BMP is to set out the practical measures, responsibilities, schedules, and monitoring systems required to **avoid, minimize, restore, and—if needed—offset** adverse environmental and social impacts arising from erosion control and stormwater works at Bulka, while enhancing biodiversity and ecosystem services. It operationalizes the ESMP commitments across **design, construction, and operation/maintenance** phases. The EMP scope applies to the **Direct Impact Zone (DIZ)—**drainage channels, gully stabilization footprints, access routes, material lay-down zones—and the **Indirect Impact Zone (IIZ)** within ~500 m of the footprint where secondary effects (hydrology, sedimentation, noise, dust, access changes) may occur. It covers all ten mapped transects: **FMC, Masjid Kanoma, CP, Hayin Buba, Eid Masjid, Jifatu, Yardole, Hayin Mal. Ibrahim, Gusau River A, and Gusau River B.**

**Mitigation hierarchy m**easures follow the project's stated approach aligned to **IFC PS6**: **avoidance** of sensitive habitats/cultural sites; **minimization** via good engineering and construction practices; **restoration** of riparian/terrestrial vegetation; and **offsets** only if residual impacts remain.

**Baseline and Key Environmental Risks**

The baseline shows a mosaic **of shrub/grass-dominated riparian corridors, sparse tree cover, seasonal streams** that dry outside rains**, year-round irrigation** reaches (Gusau A/B; Hayin Mal. Ibrahim), and **heavy settlement/commercial encroachment** (housing, mosques, plazas, supermarkets, filling stations, rail). Biodiversity records include **844 plants (16 spp., 12 families)** with dominance of ruderal/invasive herbs (e.g., *Ageratum conyzoides*, *Chromolaena odorata*), small mammals (e.g., *Cricetomys*), amphibians in ephemeral pools, reptiles typical of Sudan Savanna, and a **Vulnerable** raptor (**Lesser Kestrel,** *Falco naumanni*). Cultural features include **graveyards** and **sacred trees/groves** near drains. Principal risk drivers are **habitat loss/fragmentation, vegetation degradation, hydrological alteration and erosion, pollution from fuels/solid waste/agrochemicals, declining animal diversity,** and **erosion of cultural ecosystem services.**

**BMP Objectives and Performance Standards**

**Objectives**

1. Prevent further habitat loss/fragmentation in mapped sensitive riparian and cultural sites.
2. Restore low diversity reaches toward **mixed shrub–tree** structure; suppress invasive spp population.
3. Maintain base-flow connectivity and aquatic refuge during works; protect water quality.
4. Reduce pollution risks from filling stations, markets, and agrochemical use.
5. Safeguard seasonal habitats for amphibians/reptiles and foraging habitat for **Lesser Kestrel.**
6. Protect cultural ecosystem services (graveyards, sacred trees/groves) via co-management.

**Performance Standards (BMP KPIs)**

1. **Riparian buffers established and fenced** on all channels; **no works** inside no go polygons.
2. **Native planting survival ≥60% at 12 months; ≥80% at 24 months** (with infill).
3. **Downstream water quality incidents = 0** (no concrete washout, fuel/oil discharge).
4. **Invasive cover (*Ageratum/Chromolaena*)** reduced **>75%** in treated plots within 18 months.

5. **Wildlife protection:** no fauna entrapments; amphibian presence at restored pools; seasonal **Lesser Kestrel** detections maintained/improved.
6. **Cultural sites:** 0 disturbances; fences/signage intact.

**Legal, Policy, and Institutional Framework (Project Application)**

Project's BMP is framed to meet Nigerian regulatory expectations and **international best practice** noted in the report (especially **IFC PS6**), emphasizing biodiversity conservation and **No Net Loss** intent where feasible. Roles for state/local authorities include enforcement of **planning/setbacks** and waste/fuel management compliance; project institutions (Client, Contractor, Biodiversity Consultant, Community) implement and co-monitor measures.

**BMP Measures by Project Phase**

***Design and PreConstruction***

***1.*** **GIS Constraints Mapping & No-Go Zones**
- Digitize riparian edges, seasonal pools, amphibian calling sites, wildlife use areas, and **cultural sites** per transect; stake and fence before mobilization; include on IFC drawings and method statements.

***2.*** **Buffers & Setbacks**
- Establish channel-specific vegetated buffers; install signage; coordinate with local planning to prevent encroachment (houses, plazas, filling stations) into buffers.

*3.* **Ecology-Sensitive Hydraulic Design**
- Culverts/bridges sized to maintain **baseflow connectivity**, roughened beds, and **faunal shelves**; prioritize **bioengineered banks** (live staking, brush layering, coir rolls) before hard armoring; add **offline retention ponds/wet cells** near high-runoff commercial nodes.

4. **Native Planting Specification (Site Palette)**
- Trees/shrubs: *Faidherbia albida, Parkia biglobosa, Balanites aegyptiaca, Combretum* spp., *Dichrostachys cinerea*; grasses: *Andropogon gayanus, Hyparrhenia* spp., *Setaria* spp. Exclude *Chromolaena* and *Ageratum* from any supply.

*5.* **Seasonal Activity Windows**
- Schedule clearing, loud works and in-channel interventions away from **peak amphibian breeding** and **Lesser Kestrel** foraging periods; require ecologist sign-off.

*6.* **Cultural Site Protocols**
- Buffer and fence **graveyards** and sacred trees/groves; co-monitor with community; install interpretive signage; chance-find procedure in method statements.

**Construction**

1. **Riparian Protection and Access Control**
   - Fence and flag no-go areas; use mats/temporary crossings on soft banks; control access routes to avoid rutting and turbidity plumes.
2. **Erosion and Sediment Control (ESCP)**
   - Silt fences, straw bales/check dams, sediment basins, staged earthworks; **stabilize exposed soils within 72 hours** via mulching/hydroseeding (native grasses). Trigger stop-work ahead of heavy rain.
3. **Pollution Prevention**
   - Bunded fuel storage with spill kits; **designated concrete washout pits** away from drains; **zero solid-waste dumping**; vendor supervision near markets/filling stations.
4. **Watercourse Work Methods**
   - Temporary bypasses to preserve downstream aquatic refuge; limit in-channel time; use turbidity curtains where required.

5. **Wildlife Safeguards**
   - **Fauna rescue/relocation** for amphibians/reptiles/fish; **trench covers or fencing** each night; **escape ramps**; daily checks; control lighting/noise (orient away from riparian edges; minimize night works).
6. **Invasive Species Hygiene**
   - Clean machinery before site entry; prohibit contaminated fill; **hand-pull/cut** *Ageratum/Chromolaena* regrowth before seeding; immediate re-vegetation with natives.
7. **Community Safety & Access**
   - Maintain farmer access (Gusau A/B), coordinate working hours with markets to reduce nuisance; active liaison.

**Operation and Maintenance**

1. **Buffer Stewardship**
   - Infill planting, selective thinning/pruning; **ban grazing/fuelwood collection** within buffers via community agreements; establish **community woodlots** outside buffers.
2. **Hydraulic Asset Care**
   - Quarterly inspection/cleaning of culverts, check structures and bioengineered banks; repair scours using bio-methods first; keep **low-flow pathways** open.
3. **Pollution & Runoff Controls**
   - Regular audits of filling stations/markets; incident logs; engage farmers on **integrated pest management** to reduce agrochemical loads to streams.
4. **Habitat Enhancement**
   - Manage offline ponds/wet cells to retain emergent vegetation; install **nest boxes, perch poles, brush piles** in tree-scarce corridors; maintain hedgerows.
5. **Cultural Co-Management**
   - Maintain fences/signage; joint patrols; record and address any grievances or near-misses.

**Table 1 Management Matrix (BMP Action Plan)**

| Impact/Risk | Locations (Transects) | Mitigation/Control | Timing | Responsible Parties | Resources/ Inputs | KPIs | Verification |
|---|---|---|---|---|---|---|---|
| Habitat loss/encroachment | All riparian corridors; **FMC, CP, Hayin Buba, Masjid Kanoma** | Map/fence **no-go buffers**; signage; access rerouting | Design → Pre-constr. | Client/Designer; Contractor | Fencing, signage, GIS | 100% buffers fenced; 0 intrusions | Daily checks; photo/ GPS logs |
| Vegetation degradation | Low-tree sites; disturbed banks | **Native enrichment planting; invasive suppression**; rapid grass cover | Constr. → O\&M | Contractor; Ecologist; Community | Seedlings, mulch, hydroseeding | Survival ≥60% (12 mo); invasives ↓ >75% | Survival counts; invasive transects |
| Erosion/hydrological alteration | Gullies; **Gusau A/B** | Bioengineered banks; grade controls; culvert baseflow continuity | Design → Constr. | Designer; Contractor | Coir, stakes, brush; culvert specs | Stable banks; connected flows | Bank surveys; as-built review |
| Pollution (fuels, waste, concrete, agrochem.) | Markets, filling stations, | Bunds/spill kits; washout pits; waste | Constr. → O\&M | Contractor; Market/St | Bunds, kits, bins; training | 0 spills to drains; | Spill logs; |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | irrigated fields | segregation/haulage; IPM outreach | | ation Mgmt.; Community | | compliant waste handling | ESCP audits |
| Fauna disturbance/entrapment | All works; trenches/crossings | Fauna rescue; trench covers/ramps; light/noise controls; timing windows | Constr. | Contractor; Ecologist | PPE, boxes, ramps | 0 entrapments; window compliance | Incident register; toolbox talks [[Biodiversity Report |
| Cultural site impacts | **Eid Masjid graveyard**, sacred trees | Buffers/fencing; signage; co-monitoring; chance-find protocol | Pre-constr. → O\&M | Client; Community; Contractor | Fencing; signs | 0 disturbances; positive community feedback | Patrol logs; grievance records |

**Monitoring Programme and Adaptive Management**

**Baseline & indicators.** Use the established transect baselines (Chap. 4) and diversity indices (Shannon H′, Simpson 1–D, Evenness) for **plot-based comparison** over time. Monitor invasive cover; riparian integrity; fauna presence (amphibians, birds incl. **Lesser Kestrel**); pollution controls; and cultural site status.

**Frequency & methods.**

1. **Construction:** monthly ESCP audits; weekly buffer integrity checks; **daily fauna incident log**.
2. **Operation:** quarterly riparian/structure inspections; **biannual wet/dry biodiversity surveys** (transects, quadrats, point counts, amphibian night surveys).

**Adaptive triggers.**

1. Invasive cover **>10%** post-treatment → repeat removal + infill planting.
2. Decline in H′ or 1–D vs. baseline for two cycles → revise species mix; strengthen mulching/watering; enforce grazing exclusion.
3. Repeated fauna incidents → add ramps/fencing; adjust hours/lighting.
4. Cultural near-miss → expand buffer; intensify patrols/community liaison.
5. **Reporting.** Produce **quarterly EMP reports** with GIS-linked dashboards (photo-points, GPS coordinates, KPI graphs) and **annual EMP reviews** to update measures and budgets.

**Training, Awareness and Capacity Building**

1. **Induction for all workers:** biodiversity values, buffer/no-go rules, spill response, fauna rescue, waste handling.
2. **Target trainings:** equipment operators (ESCP deployment), site supervisors (incident reporting), vendors/filling stations (pollution control), farmers (IPM & buffer-friendly practices).
3. **Community sessions:** pollinators, seed dispersers, riparian functions; guardianship of graveyards/sacred trees; grievance channels.
4. **Frequency:** at mobilization, then **6-monthly refreshers**; keep attendance logs.

**Emergency Preparedness and Response**

**Spills (fuel/oil):** Immediate containment (booms/absorbents); isolate source; notify site lead; recover contaminated soils for licensed disposal; incident report within 24 h; root-cause and corrective action. **Concrete washout:** use lined pits; zero discharge to channels; stop-work if uncontrolled washout occurs**. Flood/storm events:** secure materials; stabilize vulnerable banks; activate stop-work; re-inspect ESCPs post-event. **Fauna emergencies:** trained handler relocation; notify ecologist; record data (species, numbers, coordinates).

**Roles, Responsibilities and Governance**

1. **Client/Project Owner:** overall EMP accountability; budget allocation; coordination with authorities; quarterly and annual reporting.
2. **Designer/Engineer:** integrate buffers/passages/bioengineering into drawings and BoQ; supervise compliance in construction packages.
3. **Contractor:** implement ESCP, planting, invasive control, pollution prevention, fauna rescue; maintain logs and housekeeping; ensure worker training.
4. **Biodiversity Consultant/Ecologist:** supervise sensitive works; lead monitoring; verify data; advise adaptive changes; certify seasonal windows.
5. **Community Stewardship Committee:** co-monitor buffers/cultural sites; report infractions; assist in awareness programs.

**BMP Checklists**

**Daily Construction Checklist**

- Buffers fenced and intact?
- ESCPs (silt fence, traps, basins) functioning; any turbidity plumes?
- Fuel/oil storage bunded; spill kits stocked?
- Trenches covered/fenced; escape ramps placed?
- Waste segregated; zero dumping near water?
- Night lighting directed away from riparian zones?

**Weekly Ecologist Checklist**

- Fauna incidents recorded and resolved?
- Invasive regrowth detected/removed?
- Sensitive habitat integrity maintained; any incursions?
- Works comply with seasonal windows?
- Cultural sites undisturbed; fence/signage status?

## ANNEX 9

## EMERGENCY PREPAREDNESS AND RESPONSE PLAN

### Introduction

This Emergency Preparedness and Response Plan (EPRP) has been prepared for the Bulka Sub-Project. Possible emergencies that could arise during the operation phase and construction phase of the project encompass a range of situations. These include emergencies stemming from natural disasters, potential fires within the work area and surrounding forests, traffic accidents, incidents involving hazardous materials, acts of sabotage, and more. To effectively address these potential challenges, EPRP has been developed.

### Objective

The main objective of the EPRP is to establish effective and prompt responses to potential emergency situations that could arise during the construction phase and operation phase of the Project. EPRP has been carefully developed to provide a clear framework for taking specific actions and following established protocols when emergencies arise. The plan has a dual purpose: first, it aims to proactively prevent emergencies during both the construction and operation phases of the project; second, it aims to minimize potential damages that might occur due to unexpected emergencies.

The key performance indicators determined in this context are as follows.

| Key Performance indicator | Timeframe | Records | Responsibility |
|---|---|---|---|
| Number of emergency drills | Twice a year | Emergency Response Audit Reports | SPIU/Contractor |
| Having appropriate spill response equipment at site | weekly | Weekly Monitoring Report | SPIU/Contractor |
| Emergency announcement system established | monthly | Monthly Monitoring Report | SPIU/Contractor |
| Training records on emergency response | Twice a year | Monthly Monitoring Report | SPIU/Contractor |
| Communications records on potential/actual emergencies | Monthly | Monthly Monitoring Report | SPIU/Contractor |

### Component of an Effective Emergency Preparedness and Response Plan

Planning shall begin before any work commences on the project. Although there may be little time between the award of the contract and the start of the project, a good emergency response plan can be generic and, with some minor changes, can be easily adapted to specific sites and readily implemented. This is especially the case where a constructor specializes in similar types of projects.

The plan shall include the following considerations:

1) hazard identification/assessment
2) emergency resources
3) communication systems
4) administration of the plan
5) emergency response procedure
6) communication of the procedure
7) debriefing and post-traumatic stress procedure.

**Hazard Identification/Assessment**

The process of hazard identification and assessment involves a thorough review that should include, but not be limited to, the following points:

- ❖ transportation, materials handling, hoisting, equipment or product installation, temporary structures, material storage, start-up, and commissioning activities
- ❖ environmental concerns
- ❖ consultation with the client regarding potential hazards when working in or adjacent to operating facilities
- ❖ resources such as material safety data sheets (MSDSs) to determine potential hazards from on-site materials
- ❖ proximity to traffic and public ways. Because construction sites are frequently fast-changing, the process of hazard assessment must be ongoing to accommodate the dynamic environment. Once hazards are identified, the next task is to assess the potential or risk involved in each. For each hazard identified, ask:
- ❖ What can go wrong and their consequences?

**Different Emergency Scenario and Response Process**

| S/N | Scenario | Response to Emergency Scenario |
|---|---|---|
| 1 | Fire | • Do not panic.<br>• If the fire is small,<br>• extinguish any visible flames with a portable fire extinguisher and notify your first supervisor and Project environmental, health, and safety (EHS) Manager/emergency coordinator.<br>• If the fire is too big for you to fight or is behind a closed door;<br>• Raise an alarm verbally.<br>• If there is a fire alarm button in your location, press this button, if not, inform your first supervisor to make the emergency horn sound.<br>• Notify your supervisor and the Project EHS Manager/emergency coordinator.<br>• Cut off the energy of the Machine-Equipment you are working with.<br>• Never open the door if the door handle is hot.<br>• If you have a first aid certificate, give first aid to the injured,<br>• If there is no loss of life, go safely to the assembly area using the emergency exit route (if there is an item to be rescued first in a fire, take it with you).<br>• Do not pass through a completely smoke-covered area on the emergency escape route.<br>• Move as close to the ground as possible.<br>• notify your first supervisor when you come to the assembly area about missing colleagues.<br>In the meantime, the teams intervene with the team leaders according to the situation within their job descriptions. From the moment the fire brigade arrives, they become the assistant of the extinguishing team. |
| 2 | Flood | In the event of flood, the emergency chief within the knowledge of the Emergency coordinator will manage the necessary coordination. The activities will be supported by team leader.<br>Electrical lines will be cut off by the instruction of the team leader.<br>Employees who are stuck will be rescued by the rescue team.<br>The first aid team will respond to the injured employees.<br>The accumulated water will be evacuated by the emergency team. The employees should take the actions below. ▪ Wait in a safe and elevated position. ▪ If there are missing personnel in your team, inform the regional supervisor and the emergency coordinator. ▪ Assist the teams when needed. |

| | | |
|---|---|---|
| 3 | Insecurity / Insurgency | In the event of an insurgency, it is necessary for the contractor should provide:<br>**Early warning signs and preparedness:**<br>• Establish a Site Emergency Response Team with clear roles (Incident Commander, Security Officer, Communications Officer, Medical/First Aid Lead)<br>• Set up a 3-level alert system: Green (Safe) → Yellow (elevated risk) → Red (active /danger)<br>• Maintain contact list: Police, Army (Operation Fansan Yamma), DSS, NSCDC, local vigilante/Community Protection Guard, nearest hospital<br>• Identify muster points on site and evacuation routes off-site<br>• Equip site with radios and a backup satellite phone (GSM networks can go down during security operations)<br>• Monitor for bandit sightings, notices to nearby communities, and sudden or unusual troop/security movement/changes in community movement patterns<br>• Maintain daily liaison with local village heads and vigilante groups for intelligence<br>• Restrict travel to daylight hours only; avoid dawn/dusk movement on rural roads<br>**In the event of an Active Attack / Raid on Site**<br>• Sound the alarm (agreed code word/signal)<br>• All personnel move immediately to the muster area/take cover and do not confront attackers<br>• Site Security Officer contacts Police/Army emergency line immediately<br>• Maintain silence, stay low-profile, no phone lights or noise<br>• Conduct headcount once safe<br>• Wait for official "All Clear" before moving |

**Emergency Response Procedure**

An emergency can be reported from any source—a worker on site, an outside agency, or the public. Note that circumstances may change during the course of an emergency. Any procedures you develop must be able to respond to the ongoing situation. The following list covers basic actions to take in an emergency.

These steps apply to almost any emergency and should be followed in sequence.

- Stay calm – Your example can influence others and thereby aid the emergency response.
- Assess the situation – Determine what happened and what the emergency is. Look at the big picture. What has happened to whom and what will continue to happen if no action is taken? Try to identify the cause that must be controlled to eliminate immediate, ongoing, or further danger.
- Take command – The most senior person on the scene should take charge and call, or delegate someone to call, emergency services and explain the situation. Assign tasks for controlling the emergency. This action also helps to maintain order and prevent panic.
- Provide protection – Eliminate further losses and safeguard the area. Control the energy source causing the emergency. Protect victims, equipment, materials, environment, and accident scene from continuing damage or further hazards. Divert traffic, suppress fire, prevent objects from falling, shut down equipment or utilities, and take other necessary measures. Preserve the

accident scene; only disturb what is essential to maintain life or relieve human suffering and prevent immediate or further losses.

- Aid and manage – Provide first aid or help those already doing so. Manage personnel at the scene. Organize the workforce for both a headcount and emergency assignments. Direct all workers to a safe location or command post. This makes it easier to identify the missing, control panic, and assign people to emergency duties. Dispatch personnel to guide emergency services on arrival.
- Maintain contacts – Keep emergency services informed of situation. Contact Fire service and NERMA where required. Alert management and keep them informed. Exercise increasing control over the emergency until immediate hazards are controlled or eliminated and causes can be identified.
- Guide emergency services – Meet services on site. Lead them to emergency scene. Explain ongoing and potential hazards and cause(s), if known.

**Communication of the Procedure**

For a procedure to be effective, the Emergency Response Procedure must be clearly communicated to all site personnel and visitors. The following activities should be considered:

Review the procedure with new site subcontractors and new workers to ensure that it covers their activities adequately.

Review the procedure with suppliers to ensure that it covers any hazards that the storage or delivery of their materials might create.

Review new work areas in operating plants with owner/client to ensure that new hazards are identified and covered in the procedure.

Review the procedure with the Joint Health and Safety Committee or Health and Safety Representative on a regular basis to address new hazards or significant changes in site conditions.

Post the procedure in a conspicuous location.

*The Emergency Response Procedure for a construction project (Bulka Intervention Project) must continually undergo review and revision to meet changing conditions.*

**Debriefing and Post-Traumatic Stress Procedure**

The recovery process, or what happens after the emergency response has been completed, is a critical step in the plan. Many emergency tasks may be handled by people who are not accustomed to dealing with emergencies. People may have seen their work partners and friends badly injured and suffering great pain. Once the emergency is over, the attitude should not be “Okay, let’s get back to work” or “Let’s go home.” Some of the people involved may need assistance in order to recover. In some cases professional counselling may be needed. As part of site emergency planning, construction companies should have measures in place to deal with post-traumatic stress.

Debriefing is necessary to review how well the plan worked in the emergency and to correct any deficiencies that were identified. Debriefing is critical to the success of future emergency response planning.

**ANNEX 10**

**DETAILED ENGINEERING CONTEXT FOR BULKA STORMWATER DRAINAGE PROJECT**




**Drainage at FMC Gusau (Starting Point)**

**The assessment covers:**

- Technical feasibility of the proposed drainage system
- Structural stability and hydraulic adequacy
- Environmental and social impacts
- Presence of rock formations along the drainage alignment and the need for controlled blasting
- Community participation and long-term maintenance requirements
- Detailed drainage geometry and engineering design specifications

The report recommends a hybrid engineering approach, combining reinforced concrete drains, riprap, gabions, vegetative stabilization, and controlled rock excavation, to ensure durability, safety, and long-term sustainability of the project.

## INTRODUCTION

### Background

The Bulka drainage corridor at Yanmangorora – Unguwar Malam Ibrahim has experienced progressive and severe erosion, primarily driven by:

- High-intensity rainfall events
- Uncontrolled surface runoff
- Inadequate and undersized drainage infrastructure

These conditions have resulted in active gully expansion, posing serious risks to:

- Residential buildings

- Agricultural lands
- Road networks
- Public safety and mobility

Site inspections further revealed that several sections of the drainage alignment intersect zones of shallow bedrock and exposed rock outcrops, which restrict conventional excavation methods and necessitate specialized engineering and blasting solutions. Failure to adequately address these geological constraints would compromise structural integrity, hydraulic performance, construction safety, and long-term serviceability of the drainage system.

**Objectives**

The key objectives of this study are to:

- Assess the feasibility and sustainability of proposed stormwater drainage and erosion control measures
- Evaluate hydraulic capacity and structural stability of the proposed designs
- Integrate environmental and social safeguards into project planning
- Identify rock presence along the drainage corridor and outline professional and safe blasting procedures

**Scope of Study**

The scope of this assessment includes:

- Structural drainage design and sizing
- Runoff diversion feasibility analysis
- Rock excavation and blasting assessment
- Environmental and social impact evaluation
- Maintenance and sustainability planning

**METHODOLOGY**

The methodology adopted for this study includes:

- Site Survey: Physical inspection of gully dimensions, slopes, soil conditions, exposed rock formations, and hydrological patterns
- Engineering Review: Evaluation of drainage geometry, channel capacity, and structural stability requirements
- Environmental Assessment: Identification of potential construction and operational impacts
- Community Consultation: Engagement with residents regarding setbacks, safety concerns, and maintenance responsibilities

**STRUCTURAL MITIGATION MEASURES**

Technical Suitability

Based on site conditions and hydraulic requirements, the following structural mitigation measures are recommended along the project alignment:

- Reinforced concrete drains for high-flow and urban sections
- Riprap and gabion linings for energy dissipation and erosion protection
- Limited use of check dams (not recommended within the main channel)
- Vegetative stabilization of embankments and disturbed areas

**WASTE MANAGEMENT AS A CONTRIBUTING FACTOR TO EROSION**

**Background and Observations**

Field inspections conducted along the Bulka stormwater drainage corridor revealed that poor solid waste management practices constitute one of the primary drivers of erosion and flooding within the project area. Large quantities of domestic refuse, construction debris, plastics, and organic waste were observed being indiscriminately dumped within natural waterways, gully channels, and along drainage paths.

These practices significantly interfere with the natural flow of stormwater and undermine the effectiveness of existing and proposed drainage infrastructure.

**Impact of Poor Waste Management on Erosion Development**

Improper waste disposal contributes to erosion through the following mechanisms:

1. Drainage Blockage
   Accumulated waste obstructs stormwater flow within natural channels and drains.
   Blockages cause water to overflow onto unprotected soil surfaces, leading to rapid surface erosion.
2. Flow Diversion and Concentration
   Refuse deposits redirect water away from designed flow paths.
   Concentrated runoff increases flow velocity and erosive force at unintended locations.
3. Undermining of Structural Works
   Trapped waste increases hydraulic pressure against drain walls and embankments.
   This accelerates structural deterioration, cracking, and eventual collapse of drainage systems.
4. Sedimentation and Reduced Channel Capacity
   Solid waste traps sediment, reducing the effective carrying capacity of the drainage channel.
   Reduced capacity results in overtopping during peak rainfall events.
5. Environmental Degradation
   Decomposing waste contaminates soil and water.
   Vegetation loss caused by pollution further exposes soil to erosion.

**Implications for the Proposed Drainage Project**

If solid waste management issues are not addressed, the following risks remain:

- Premature failure of newly constructed drains
- Increased maintenance costs due to frequent desilting and debris removal
- Reoccurrence of erosion even after structural intervention
- Reduced lifespan of hydraulic structures
- Public health hazards and environmental pollution

Therefore, drainage construction alone will not achieve long-term erosion control without effective waste management interventions.

**Recommended Waste Management Measures**

To complement the proposed stormwater drainage works, the following measures are strongly recommended:

**Waste Control Along Drainage Corridors**

- Prohibit refuse dumping within a minimum 10-meter setback from the drainage channel.

- Install waste barriers, trash racks, and debris traps at strategic inlet locations.
- Provide designated refuse collection points away from drainage paths.

**Community Sensitization and Engagement**

- Conduct public awareness campaigns on the link between waste disposal, flooding, and erosion.
- Engage community leaders and residents in drainage protection initiatives.
- Encourage community-based monitoring of drainage corridors.

**Institutional and Regulatory Support**

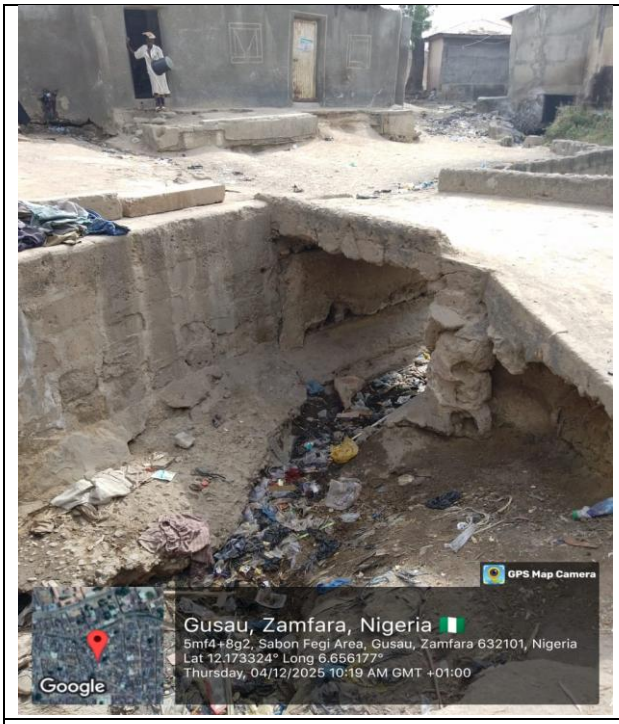
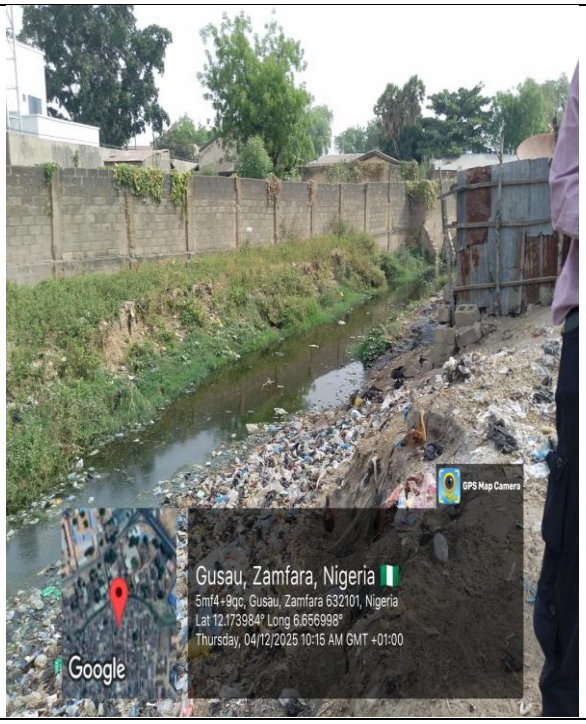
- Strengthen enforcement of existing environmental sanitation laws.
- Coordinate with local waste management authorities for routine waste evacuation.
- Introduce penalties for illegal dumping within drainage and erosion-prone areas.

**Routine Maintenance and Monitoring**

- Establish a community-based maintenance committee responsible for:
  - Regular debris removal
  - Reporting illegal dumping
  - Monitoring blockages during the rainy season

Poor waste management has been identified as a major underlying cause of erosion and drainage failure within the Bulka project area. Addressing this issue is essential to ensuring the effectiveness, durability, and sustainability of the proposed stormwater drainage and erosion control measures. An integrated approach combining engineering works, waste management, community participation, and regulatory enforcement is therefore critical for long-term success.

| | |
|---|---|
|  |  |
| Unorganised refuse disposal in water way | Unorganised refuse disposal in water way |

| | |
|---|---|
|  |  |
| Unorganised refuse disposal in water way | Unorganised refuse disposal in water way |

## PROPOSED DRAINAGE DESIGN SPECIFICATIONS

### General Drainage Parameters

| Parameter | Specification |
|---|---|
| **Total Channel Length** | **5.527 km** |
| **Channel Type** | **Rectangular** |
| **Design Storm** | **1 in 50-year return period** |
| **Freeboard** | **0.3 – 0.5 m** |
| **Minimum Structural Setback** | **10 m on both sides** |
| **Lining Type** | **Concrete / Riprap / Gabion (location-dependent)** |

### Hydraulic and Geometric Design Table

| Section | Location | Width B (m) | Depth D (m) | Area A ($m^2$) | Wetted Perimeter P (m) | Hydraulic Radius R (m) | Discharge Q ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| 1 | Malam Kanoma Mosque (Upstream) | 10.0 | 2.5 | 25.00 | 15.0 | 1.667 | **≈ 245 $m^3/s$** |
| 2 | Before Fadama Plaza | 9.0 | 2.0 | 18.00 | 13.0 | 1.385 | **≈ 159 $m^3/s$** |
| 3 | Mid–Downstream | 8.0 | 2.0 | 16.00 | 12.0 | 1.333 | **≈ 136 $m^3/s$** |
| 4 | Sabon Fegin Maigadaje | 7.0 | 1.5 | 10.50 | 10.0 | 1.050 | **≈ 79 $m^3/s$** |

The formula used to achieve this result is Manning Equation, below is the formula used.

$$Q = \frac{1}{n} A R^{2/3} S^{1/2}$$

**Where:**

- $Q$= **Discharge (m³/s)**
- $A$= **Cross-sectional area (m²)**
- $R$= **Hydraulic radius =** $\frac{A}{P}$
- $P$= **Wetted perimeter (m)**
- $S$= **Channel slope**
- $n$= **Manning's roughness coefficient**

**SECTION-BY-SECTION CALCULATIONS**

**Geometric Formulae for Rectangular Channel**

- **Area:**

$$A = B \times D$$

- **Wetted perimeter:**

$$P = B + 2D$$

- **Hydraulic radius:**

$$R = \frac{A}{P}$$

**TECHNICAL INTERPRETATION**

The water-flow calculations done using Manning's formula show that the proposed concrete drainage channel at Bulka can carry stormwater well along its entire length without overflowing.

At the upper part of the channel, the drain can carry up to about 245 cubic metres of water every second, while at the downstream end, it can safely carry about 79 cubic metres per second. The drain becomes smaller as it moves downstream on purpose. This helps to slow down the water, reduce its force, and control erosion, so that the land and nearby houses are protected.

The slope of the channel (0.01086) and the smooth concrete surface used in the design allow water to flow freely without staying back or causing blockages. At the same time, the design prevents water from moving too fast and damaging the drain.

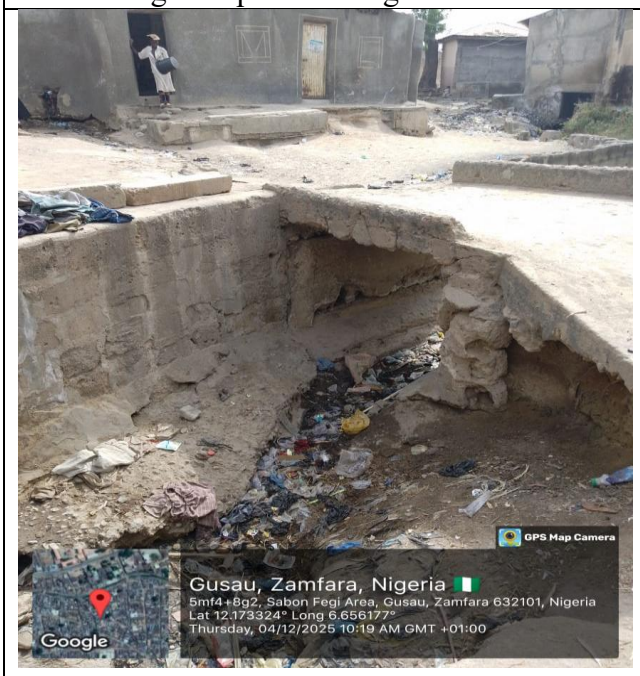
In summary, the drainage system is strong and well designed. It can handle heavy rainfall safely, and the smallest part of the drain at the downstream end controls how much water the whole channel can carry, which is normal and acceptable in drainage design.

**Structural Construction Specifications**

| Component | Specification |
|---|---|
| Concrete Grade | C25/30 |
| Base Slab Thickness | 300 mm |
| Wall Thickness | 250 – 350 mm |
| Reinforcement | Epoxy-coated high-yield steel |
| Expansion Joints | 20 – 25 m intervals |

**Engineering Notes:**

- Channel dimensions vary to match hydraulic demand and erosion intensity
- Rock excavation sections must be completed prior to lining works
- Concrete lining is mandatory in high-velocity and urban sections
- Riprap and gabions are suitable for lower-velocity downstream reaches
- All works shall comply with Nigerian engineering, environmental, and safety regulations

| | |
|---|---|
|  |  |
| An existing collapsed drainage | Pre-cast rectangular box drainage |
|  |  |
| A bridge built by community effort | Underground water path-way (Bridge) |

## ROCK EXISTENCE AND BLASTING REQUIREMENTS

### Rock Presence Along Drainage Alignment

Site investigations confirm the presence of weathered to hard rock formations along several portions of the drainage corridor, particularly within midstream and downstream sections. These formations obstruct excavation to the required design depth and width and must be removed to ensure proper hydraulic performance.

**Need for Blasting**

Mechanical excavation alone is inadequate in rock-dominated sections. Controlled blasting is therefore required to:

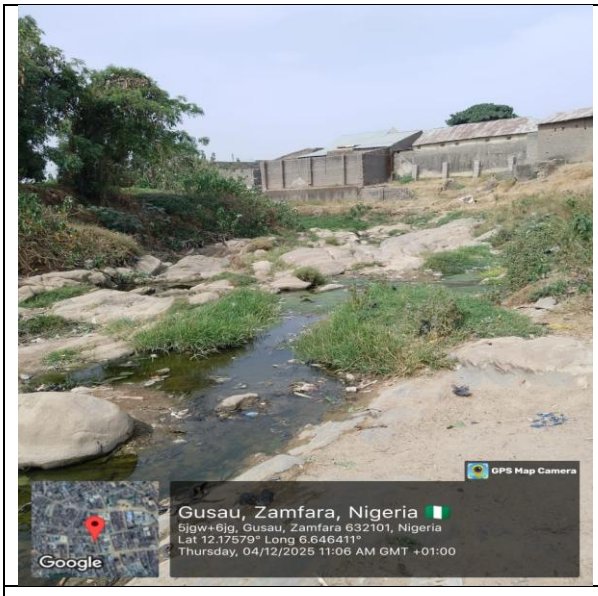
- Achieve the specified channel depth and width
- Prevent irregular excavation profiles
- Ensure proper seating and bonding of concrete linings

**Professional and Safe Blasting Measures**

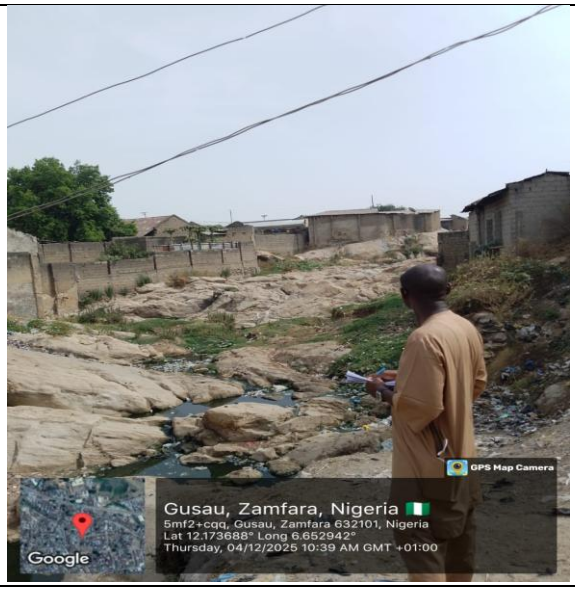
| Safety Aspect | Specification |
|---|---|
| Blasting Type | Controlled low-charge blasting |
| Detonation Method | Delay detonators |
| Vibration Limit | ≤ 5 mm/s at nearest structure |
| Fly-rock Control | Blast mats and protective coverings |
| Safety Buffer | Minimum 10 m exclusion zone |
| Personnel | Licensed blasting engineer only |
| Warning System | Sirens and clearly marked exclusion zones |
| Monitoring | Pre- and post-blast structural inspection |

**Reuse of Blasted Rock:**

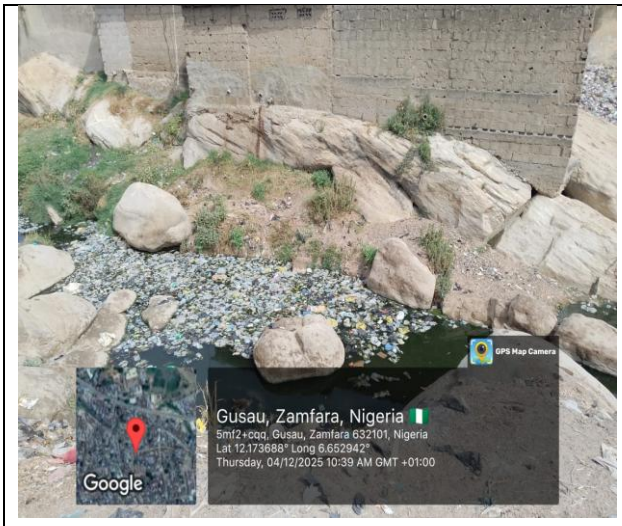
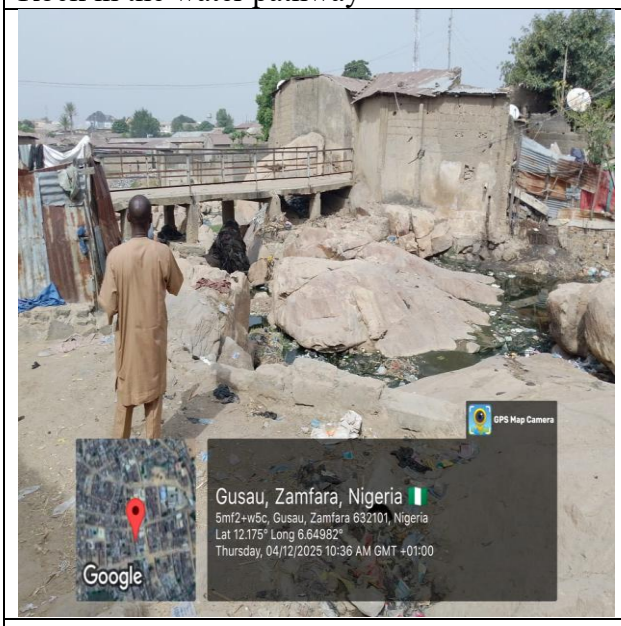
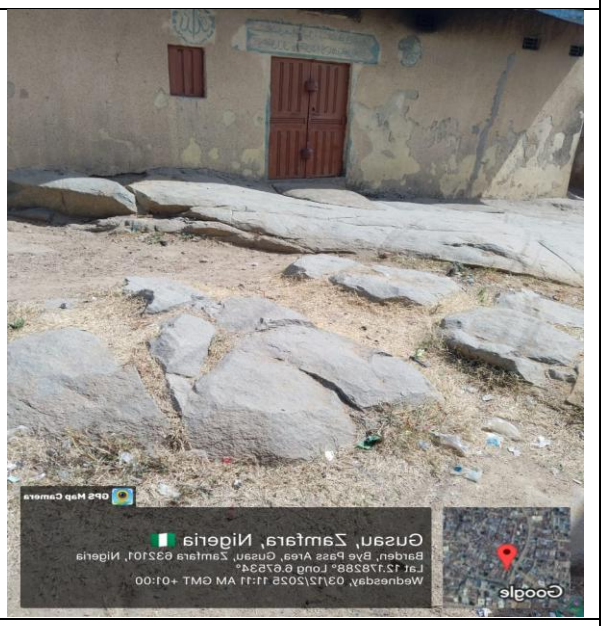
Recovered rock materials shall be reused as riprap and gabion fill, thereby reducing construction costs and minimizing environmental impact**.**




High concentration of rock in Gulbi corridor




High concentration of rock in Gulbi corridor

| | |
|---|---|
|  |  |
| Rock in the water pathway | |
|  |  |
| Presence of rock in sabo Pegi area | House built on rock in sabo pegi |

## INLET, OUTLET, AND DROP STRUCTURES

### Inlet Structures

- Reinforced concrete headwalls
- Maximum intake capacity: 50 $m^3/s$
- Trash racks and sediment traps incorporated

### Outlet Structures

- Energy dissipation basins
- Riprap aprons
- Vegetative stabilization of outlet zones

### Drop Structures

- Number: 1
- Height: 0.5 – 2.0 m
- Function: Velocity reduction and scour prevention

## RUNOFF DIVERSION FEASIBILITY

### Technical Possibility

- Diversion channels are feasible from Malam Kanoma Mosque to Fadama Plaza
- Alignments should follow natural slopes
- Excessive zigzag alignment should be avoided for efficiency

## SIGNIFICANCE OF ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

### Environmental Protection

- Significant reduction in erosion severity
- Improved vegetation recovery
- Temporary construction-related disturbances

### Social Protection

- Protection of residential buildings and farmlands
- Enforcement of 10 m setbacks enhances public safety

### Economic Impacts

- High initial capital investment
- Long-term savings through reduced damage and maintenance

## SUSTAINABILITY AND MAINTENANCE

- Establishment of community-led maintenance committees
- Routine debris and waste removal
- Vegetation management along embankments
- Quarterly structural inspections

## CONCLUSIONS

**The proposed Bulka Stormwater Drainage Project is technically feasible, environmentally sound, and socially beneficial, provided that:**

- Approved drainage geometry is strictly adhered to
- Rock excavation and blasting are professionally executed
- Mandatory setbacks and safety measures are enforced
- Community participation is sustained

## RECOMMENDATIONS

1. Adopt hybrid concrete–riprap–vegetative erosion control solutions
2. Enforce a 10 m mandatory setback along the entire drainage corridor
3. Implement controlled and professionally supervised blasting
4. Strictly follow staged drainage geometry and design specifications
5. Allocate dedicated funding for long-term maintenance and monitoring

## ANNEX 11

## WASTE MANAGEMENT PLAN

**Waste Management Guideline**

Wastes generated as a result of the project activities shall be managed in accordance with regulatory waste management rules and procedures. Waste disposal operations can cause significant impacts when uncontrolled, therefore mitigation measures will seek to reduce, recycle and reuse waste as far as practicable.




*Source: cerlex.com*

***Figure 1: Waste Management Process***

Personnel shall be educated on how to utilize and handle hazardous products safely. All hazardous materials on site shall be documented, and a Material Safety Data Sheet (MSDS) shall be maintained. Hazardous materials shall be stored exclusively in authorized storage facilities and according to established procedures (e.g. bonding, impermeable surface, secure drainage, limited access, labelling).

Designated waste storage sites will be set up in designated areas away from watercourses and drains. The uncontrolled burning or burial of debris will be prohibited. Domestic waste from construction sites will be collected and disposed of in government-approved landfills. Littering along the walkways will be completely prohibited as waste collection bins will be provided.

The waste management will also include consideration of all matters related to solid and liquid waste disposal including the following:

- likely types of waste and quantities of waste generated;
- waste reduction, reuse and recycling methods to be employed;
- approved options and locations for disposal following approval from local groups and authority;
- procedures for treatment and disposal of all solid and liquid wastes;
- process of transportation to minimize interference with normal traffic; and
- establishment of regular disposal schedule.

The mitigation measures should include but not necessarily limited to the measures below:

- Disposal areas will be agreed upon with local authorities and leaders, and will be reviewed, recorded, and monitored by the contractor (save for oil waste, which will be taken to approved sites).
- Prohibit the burning of waste related to the Project or its supporting activities. Waste burning should be prohibited throughout the Project.
- Waste segregation is required, and cleared foliage, bushes, and grasses may be provided to local farmers for fodder and fuel. Organics (biodegradables) must be collected and disposed of on-site (burning waste is not permitted anywhere on the Project site or in the camps).
- Recyclable wastes must be recovered and sold to a recycling company. Garbage containers must be provided in construction camps. Residual general wastes must be disposed of at landfills approved by local authorities.
- Strictly prohibit the disposal of soil waste into waterways, rivers, other watercourses, farms, forest, places of worship, or other culturally sensitive or livelihood-producing sites such as canals, agricultural fields, and public areas.
- The Contractor will not build any site-specific landfills.
- All solid waste from construction site will be collected and removed, and disposed of in local authority designated waste disposal sites; and
- All waste generated during construction and maintenance activities must be separated, with quantities estimated and recorded. Waste that can be reused or recycled should be reused or recycled wherever possible.
- Materials and products with recyclable content shall be proposed for works wherever these are environmentally preferable to the unrecyclable alternative.

***Expected Waste Stream and Disposal options***

Basic information that must be provided, as a minimum, for adequate definition of wastes include:

- Waste type identification
- Proper waste categorization
- Waste segregation information
- Recommended Management practices

***Waste collection***

Waste segregated at source and well contained in appropriate waste receptacle shall be manually handled or trucked to designated collection points before it is taken to appropriate disposal facilities.

***Waste Segregation***

This is the physical separation of different waste streams and is a pre-requisite for implementing minimization options. Waste segregation shall be done at source through the provision of colour and/or text coded bins. Only containers in good condition and with properly fitting lids shall be used for waste containment. Plastic bin liners shall also be used for temporary containment, this is essential for effective implementation of appropriate waste disposal.

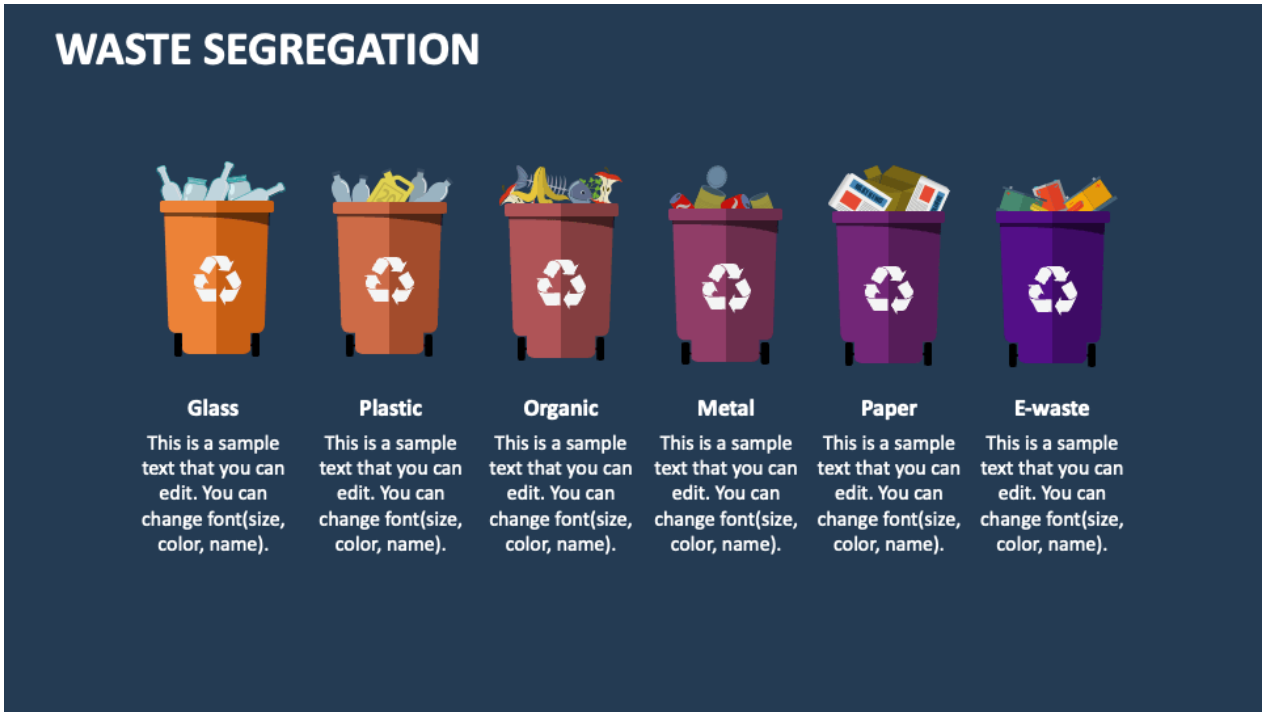



**Figure 2: Waste Segregation Strategy**

Waste inventory of typical waste types, sources, and planned management practices are presented in **Table 1.**

It is important to note that the handling, storage and disposal of wastes and the waste management guidelines take into consideration standards of national and international environmental agencies.

**Table 1: General Guidelines for Waste Management**

| Waste / Emissions Streams | Category | Origin | Disposal Option(s) |
|---|---|---|---|
| ***Domestic waste*** | | | |
| Empty food containers, food waste, aluminum or iron cans, cartons, papers, plastic bags, office wastes | Non-hazardous | Staff, workers and visitor's consumption | • Manually sort plastics and metals for recycling<br>• Segregate waste appropriately and contain for evacuation to approved sites for composting<br>• Papers should be shredded, collected and stored for recycling by certified contractors |
| Cardboard and Paper | Hazardous (combustible) | Paper recovered from construction materials | Paper can easily be packed and recycled properly. |
| ***C&D / Industrial waste*** | | | |
| Vegetation cuttings, trees stumps and Trees | Non-hazardous | Preconstruction activities such as site preparation and earthworks | • Remove and reuse (ensile) as organic manure on farmlands or transport offsite by an approved waste management contractor for further use or disposal |
| Plastic Polyethylene terephthalate (PET) | Hazardous (combustible) | Packaging from construction materials, tools. Plastic components from demolition (plastic piping, Cable ducking). | • Collect in properly labelled plastic drums placed at designated strategic locations.<br>• Store in sealed, properly labelled plastic drums placed in a closed container located within the designated hazardous waste storage area for evacuation to incineration facilities |
| Metal / Wood scraps | Hazardous | Construction waste segregated in skids | • Re-use, Recycle or sell to other end users<br>• Collection by TEPA approved waste off-takers |
| Concrete, Rocks and sand | Non-hazardous | Remains of Rocks and concrete and dredge remain | • Rock and cement pieces can be crushed, screened, and separated to produce useful aggregates of various dimensions<br>• Collected sand can be repurposed into other construction needs. |
| Glass | Non-hazardous | Broken bottles, remains of glass packing of other materials | • Collect in properly labelled waste collection bin<br>• Transfer or collection by TEPA / FMEnv approved waste collectors |
| Gravel, aggregate and fines | Non-hazardous | Gravel, small stones, concrete chips | • concrete chips and similar materials can be shredded and converted into building materials |
| Liquid Waste | | | |
| Vehicles and machineries fuel spill/leaks | Hazardous (combustible) | Fuel tanks, leaking pipes, equipment, etc. | • Quickly mop up and store in sealed drums for recycling.<br>• Label sealed drums with a Hazardous waste label (showing ":Danger or Hazardous Waste")<br>• Reuse for oiling and greasing of joints where necessary<br>• Collection by TEPA approved waste collectors |
| Contaminated topsoil affected by grease and oily spills/leak | Hazardous (combustible) | Topsoil removed from spill/leak site | • Safely contained in sealed designated containers subsequent thermal desorption at approved FMEnv facility<br>• Label sealed Containers with a Hazardous waste label (showing ":Caution or Medical Waste") |

| | | | |
|---|---|---|---|
| Medical Waste | | | |
| Clinical Waste, syringes, cuts and injury management kits | Hazardous | Clinic (Medic) | • Collected by TEPA approved waste collectors<br>• Cradle to grave management clinical waste<br>• Incinerated at very high temperature |
| Electronic Waste | | | |
| Used Batteries, Bad E-Panels, Bad phones, used or bad cable | Hazardous | Release of toxicants from damage electronics | • Designated Collection Areas and labelled containers<br>• Sorting and Segregation to categorize various electronic waste types.<br>• Reuse where applicable<br>• Engage with suppliers or manufacturers to trade off old electronics or to recycle old electronics<br>• When disposing, engage with TEPA or regulatory approved waste collectors |

# ANNEX 12

# CERTIFICATE OF ANALYSIS

## Sediment Analysis

countrylab UP TO STANDARD — ISO 17025 Accredited

### CERTIFICATE OF ANALYSIS

*Certificate No.: 03971 – 03975*

| FIELD | DETAILS | FIELD | DETAILS |
|---|---|---|---|
| Client | HARDAN CONSULTING LTD | Submitted By | Mr. David Ajiboye |
| Client Address | 22 Gnassingbe Eyadema Street, Asokoro, Abuja, Nigeria | Project Location | Gusau, Zamfara State, Nigeria |
| Sample Type / Matrix | Sediment | Number of Samples | Five (5) |
| Reference Standard | Not Applicable (Baseline Environmental Assessment) | Sampling Date | 03 December 2025 |
| Receiving Date | 04 December 2025 | Date of Analysis | 15 December 2025 |
| Lab Reference Numbers | CL/753 – 757/25/SD | Certificate Numbers | 03971 – 03975 |
| Sampling Conducted By | Countrylab Ltd | Sample Condition | Good |
| Sample Containers | Sealed Ziplock Pouches | Sample Volume | 250 g Each |
| Field Environmental Condition | 24–25°C / 33–40% RH | Sample Matrix Status | Sediment |
| Remarks | Samples received intact and in good physical condition | | |

I hereby certify that the above sediment samples were analyzed in the condition received, using appropriate standard analytical procedures. The results presented reflect the sediment quality status at the time of sampling.

### TEST RESULTS

### TABLE A: CONSOLIDATED LABORATORY RESULTS

| Category | S/N | Parameter | Unit | 03971 | 03972 | 03973 | 03974 | 03975 |
|---|---|---|---|---|---|---|---|---|
| **Physicochemical Parameters** | | | | | | | | |
| | 1 | pH | — | 5.9 | 6.4 | 6.2 | 6.2 | 6.3 |
| | 2 | Texture | — | Sandy | Sandy | Sandy | Clay Loam | Sandy |
| | 3 | Grain Size | mm | 0.05–2.0 | 0.05–2.0 | 0.05–2.0 | 0.002–2.0 | 0.05–2.0 |
| | 4 | Porosity | % | 41.0 | 53.6 | 26.6 | 31.0 | 26.6 |
| | 5 | Permeability | cm/s | $5.5\times10^{-4}$ | $6.2\times10^{-4}$ | $1.2\times10^{-4}$ | $1.5\times10^{-4}$ | $2.1\times10^{-4}$ |
| | 6 | Bulk Density | kg/m³ | 1550 | 1220 | 1936 | 1828 | 1910 |
| | 7 | Particle Size 0.356 | % | 5.2 | 4.4 | 6.3 | 41.3 | 3.4 |
| | | Particle Size 0.25 | % | 6.3 | 6.1 | 7.7 | 5.3 | 4.7 |
| | | Particle Size 0.15 | % | 9.5 | 7.6 | 10.0 | 6.1 | 7.1 |
| | | Particle Size 0.063 | % | 67.0 | 64.5 | 60.3 | 72.0 | 59.0 |
| | 8 | Moisture Content | % | — | — | — | — | — |
| | 9 | Colour | — | Brown | Brown | Brown | Dark Brown | Brown |
| | 10 | Total Nitrogen | mg/kg | 70 | 300 | 90 | 400 | 150 |
| | 11 | Total Organic Compounds | mg/kg | 840.0 | 3600.0 | 1080.0 | 4800.0 | 1800.0 |
| | 12 | Oil & Grease | mg/kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Exchangeable Cations** | | | | | | | | |
| | 13 | Calcium ($Ca^{2+}$) | mg/kg | 31.00 | 28.40 | 22.40 | 18.50 | 24.10 |
| | 14 | Magnesium ($Mg^{2+}$) | mg/kg | 12.40 | 10.15 | 8.10 | 7.20 | 9.40 |
| | 15 | Ammonium ($NH_4^+$) | mg/kg | 0.65 | 0.88 | 0.52 | 0.42 | 0.48 |
| | 16 | Potassium ($K^+$) | mg/kg | 18.50 | 22.10 | 14.60 | 11.80 | 16.20 |
| | 17 | Manganese ($Mn^{2+}$) | mg/kg | 9.40 | 8.20 | 6.15 | 4.10 | 6.55 |
| | 18 | Sodium ($Na^+$) | mg/kg | 31.00 | 26.50 | 21.80 | 15.40 | 22.30 |
| **Exchangeable Anions** | | | | | | | | |
| | 19 | Chloride ($Cl^-$) | mg/kg | 48.20 | 44.20 | 36.50 | 32.10 | 38.40 |
| | 20 | Sulphate ($SO_4^{2-}$) | mg/kg | 45.50 | 41.80 | 34.20 | 24.50 | 36.10 |
| | 21 | Nitrate ($NO_3^-$) | mg/kg | 18.50 | 18.20 | 14.80 | 12.60 | 15.50 |
| | 22 | Phosphate ($PO_4^{3-}$) | mg/kg | 4.20 | 4.80 | 2.10 | 1.85 | 2.45 |
| | 23 | Carbonate ($CO_3^{2-}$) | mg/kg | 0.04 | 0.02 | <0.01 | <0.01 | <0.01 |
| **Heavy Metals** | | | | | | | | |
| | 24 | Manganese (Mn) | mg/kg | 9.40 | 8.20 | 6.15 | 4.10 | 6.55 |
| | 25 | Iron (Fe) | mg/kg | 94.47 | 94.31 | 71.63 | 180.7 | 120.4 |
| | 26 | Copper (Cu) | mg/kg | 0.733 | 0.736 | 0.644 | 0.867 | 0.565 |
| | 27 | Zinc (Zn) | mg/kg | 2.133 | 1.034 | 0.823 | 3.667 | 1.890 |
| | 28 | Mercury (Hg) | mg/kg | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | 29 | Lead (Pb) | mg/kg | 0.012 | 0.010 | 0.008 | 0.018 | 0.012 |
| | 30 | Nickel (Ni) | mg/kg | 0.844 | 0.132 | 0.000 | 0.821 | 0.425 |
| | 31 | Cadmium (Cd) | mg/kg | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | 32 | Chromium (Cr) | mg/kg | 0.065 | 0.045 | 0.032 | 0.038 | 0.035 |
| | 33 | Vanadium (V) | mg/kg | 0.022 | 0.018 | 0.010 | 0.012 | 0.014 |
| | 34 | Arsenic (As) | mg/kg | 0.004 | 0.002 | 0.001 | 0.001 | 0.002 |
| | 35 | Barium (Ba) | mg/kg | 0.410 | 0.365 | 0.285 | 0.295 | 0.315 |

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*Certificate No.: 03971 – 03975(Cont'd)*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Microbial Contaminants** | | | | | | | | |
| | 36 | Total Plate Count | cfu/g | $0.10\times10^3$ | $0.015\times10^3$ | $0.005\times10^3$ | $0.015\times10^3$ | $0.033\times10^3$ |
| | 37 | Total Coliform | cfu/g | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 38 | *E. coli* | — | Absent | Present | Present | Present | Present |
| | 39 | *Salmonella* | — | Absent | Absent | Absent | Absent | Absent |
| | 40 | *Vibrio cholerae* | — | Absent | Absent | Absent | Absent | Absent |
| | 41 | *Pseudomonas aeruginosa* | — | Absent | Absent | Absent | Absent | Absent |
| | 42 | *Clostridium spp.* | — | Absent | Absent | Absent | Absent | Absent |
| | 43 | Yeast & Mould | cfu/g | 1 | 0 | 0 | 4 | 3 |

### TABLE B : SEDIMENT SAMPLE IDENTIFICATION KEY

| Certificate No. | Lab Reference No. | Sample Label / Name | Sampling Location |
|---|---|---|---|
| 03971 | CL/753/25/SD | Gulbi Yar Kwana | Gusau, Zamfara State |
| 03972 | CL/754/25/SD | Gulbi Hayin Malam Ibrahim | Gusau, Zamfara State |
| 03973 | CL/755/25/SD | Gulbi Hayin Na Okele | Gusau, Zamfara State |
| 03974 | CL/756/25/SD | Control 1 | Gusau, Zamfara State |
| 03975 | CL/757/25/SD | Control 2 | Gusau, Zamfara State |

**COMMENT**

Sediment quality is generally within normal environmental ranges; however, E. coli detected in four samples indicates localized faecal-associated contamination influence.

Signature of Public Analyst

**Jamilu Habu** (MIPAN) Reg. No. 00603
Laboratory Manager

INSTITUTE OF PUBLIC ANALYSTS OF NIGERIA — JAMILU HABU — P/L No.:00603 — No 000747

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**Soil Analyses**

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## CERTIFICATE OF ANALYSIS

*Certificate No.: 03960 – 03970*

| FIELD | DETAILS | FIELD | DETAILS |
|---|---|---|---|
| Client | HARDAN CONSULTING LTD | Submitted By | Mr. David Ajiboye |
| Client Address | 22 Gnassingbe Eyadema Street, Asokoro, Abuja, Nigeria | Project Location | Gusau, Zamfara State, Nigeria |
| Sample Type / Matrix | Soil (Topsoil) | Number of Samples | Eleven (11) |
| Reference Standard | Not Applicable | Sampling Date | 03 December 2025 |
| Receiving Date | 04 December 2025 | Date of Analysis | 15 December 2025 |
| Lab Reference Numbers | CL/742 – 752/25/SL | Certificate Numbers | 03960 – 03970 |
| Sampling Conducted By | Countrylab Ltd | Sample Condition | Good |
| Sample Containers | Sealed Ziplock Pouches | Sample Quantity | 250 g Each |
| Field Environmental Condition | 25°C / 33% RH | Sample Matrix Status | Soil |
| Remarks | Samples received intact and in good condition | | |

I hereby certify that the above soil samples were analyzed in the condition received, using appropriate standard analytical procedures. The results presented reflect the soil quality status at the time of sampling.

## TEST RESULTS

### TABLE A: CONSOLIDATED LABORATORY RESULTS

*(SOIL – 0 – 15cm /15–30 cm Composite)*

| Category | S/N | Parameter | Unit | 03960 | 03961 | 03962 | 03963 | 03964 | 03965 | 03966 | 03967 | 03968 | 03969 | 03970 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Physicochemical | 1 | pH | — | 6.2 | 7.0 | 7.0 | 6.23 | 6.2 | 6.3 | 6.2 | 7.0 | 6.6 | 6.8 | 6.1 |
| | 2 | Texture | — | Clay Loam | Loamy | Sandy | Sandy-Loam | Loam | Loam | Silt Loam | Sandy-Loam | Loam | Loam | Clay Loam |
| | 3 | Grain Size | mm | 0.02–2.0 | 0.05–2.0 | 0.1–2.0 | 0.05–2.0 | 0.02–2.0 | 0.02–2.0 | 0.01–2.0 | 0.05–2.0 | 0.02–2.0 | 0.02–2.0 | 0.02–2.0 |
| | 4 | Porosity | % | 64.2 | 48.8 | 75.6 | 58.1 | 55.8 | 69.8 | 66.6 | 43.4 | 68.7 | 70.0 | 51.6 |
| | 5 | Permeability | cm/s | 1.2E-06 | 4.5E-05 | 8.2E-03 | 3.1E-05 | 2.8E-05 | 3.3E-05 | 9.5E-06 | 5.1E-04 | 4.1E-05 | 3.8E-05 | 1.8E-06 |
| | 6 | Bulk Density | kg/m³ | 945.9 | 1352.7 | 639.6 | 1101.4 | 1162.3 | 800.0 | 880.0 | 1501 | 830.0 | 794.6 | 1270 |
| | 7 | Particle Size 0.356 | % | 45.1 | 42.1 | 4.1 | 23.9 | 16.3 | 17.8 | 14.1 | 21.9 | 19.2 | 18.5 | 38.3 |
| | | Particle Size 0.25 | % | 4.28 | 5.65 | 5.4 | 8.7 | 12.0 | 15.0 | 4.61 | 11.0 | 13.0 | 14.1 | 4.7 |
| | | Particle Size 0.15 | % | 5.8 | 7.7 | 8.9 | 15.0 | 15.0 | 17.7 | 9.3 | 14.0 | 17.0 | 16.8 | 8.1 |
| | | Particle Size 0.063 | % | 30.6 | 31.8 | 62.0 | 48.5 | 45.9 | 50.6 | 62.6 | 46.2 | 52.1 | 50.6 | 42.0 |
| | 8 | Moisture Content | % | 9.48 | 1.14 | 1.26 | 12.49 | 16.4 | 16.2 | 7.9 | 1.38 | 5.84 | 6.42 | 18.62 |
| | 9 | Colour | — | Brown | Brown | Grey | Dark Brown | Dark Brown | Brown | Grey-Brown | Red | Dark Brown | Brown | Brown |
| | 10 | Total Nitrogen | mg/kg | 80 | 160 | 185 | 70 | 65 | 150 | 70 | 200 | 150 | 120 | 130 |
| | 11 | Total Organic Compounds | mg/kg | 960 | 1920 | 2220 | 840 | 780 | 1800 | 840 | 2400 | 1800 | 1440 | 1560 |
| | 12 | Oil & Grease | mg/kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Exchangeable Cations | 13 | Calcium ($Ca^{2+}$) | mg/kg | 14.20 | 18.50 | 12.10 | 15.60 | 14.80 | 16.20 | 11.40 | 22.10 | 17.40 | 13.50 | 15.80 |
| | 14 | Magnesium ($Mg^{2+}$) | mg/kg | 5.80 | 7.20 | 4.40 | 6.10 | 5.50 | 6.80 | 3.90 | 8.40 | 7.10 | 5.20 | 6.45 |
| | 15 | Ammonium ($NH_4^+$) | mg/kg | 0.22 | 0.38 | 0.12 | 0.28 | 0.25 | 0.31 | 0.20 | 0.45 | 0.35 | 0.29 | 0.29 |
| | 16 | Potassium ($K^+$) | mg/kg | 8.40 | 12.10 | 9.50 | 7.70 | 6.90 | 10.50 | 5.80 | 14.20 | 11.30 | 9.10 | 9.20 |
| | 17 | $Mn^{2+}$ ion | mg/kg | 4.15 | 5.80 | 1.05 | 3.44 | 3.10 | 4.22 | 2.85 | 7.60 | 5.12 | 3.90 | 3.85 |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 18 | Sodium ($Na^+$) | mg/kg | 14.20 | 18.60 | 6.40 | 11.80 | 10.50 | 15.40 | 9.20 | 24.50 | 19.80 | 13.50 | 13.40 |
| Exchangeable Anions | 19 | Chloride ($Cl^-$) | mg/kg | 22.50 | 31.00 | 18.40 | 25.20 | 20.10 | 28.40 | 15.20 | 42.50 | 33.40 | 26.80 | 28.50 |
| | 20 | Sulphate ($SO_4^{2-}$) | mg/kg | 18.50 | 24.10 | 8.20 | 15.60 | 14.80 | 20.10 | 12.40 | 38.20 | 28.50 | 17.40 | 19.10 |
| | 21 | Nitrate ($NO_3^-$) | mg/kg | 9.40 | 14.20 | 4.10 | 8.80 | 7.90 | 11.50 | 6.50 | 22.10 | 16.20 | 10.10 | 10.50 |
| | 22 | Phosphate ($PO_4^{2-}$) | mg/kg | 1.12 | 1.85 | 0.42 | 0.95 | 0.82 | 1.34 | 0.68 | 3.10 | 2.15 | 1.08 | 1.15 |
| | 23 | Carbonate ($CO_3^{2-}$) | mg/kg | <0.01 | 0.05 | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 | 0.08 | <0.01 | <0.01 | <0.01 |
| Heavy Metals | 24 | Mn | mg/kg | 4.15 | 5.80 | 1.05 | 3.44 | 3.10 | 4.22 | 2.85 | 7.60 | 5.12 | 3.90 | 3.85 |
| | 25 | Iron (Fe) | mg/kg | 235.1 | 218.5 | 214.8 | 181.0 | 195.6 | 178.4 | 136.3 | 271.3 | 191.7 | 204.6 | 150.1 |
| | 26 | Copper (Cu) | mg/kg | 0.572 | 0.654 | 0.609 | 0.316 | 0.316 | 0.323 | 0.552 | 1.759 | 0.902 | 0.428 | 0.832 |
| | 27 | Zinc (Zn) | mg/kg | 2.294 | 2.184 | 1.763 | 0.654 | 0.892 | 0.731 | 0.376 | 1.650 | 3.383 | 2.155 | 6.422 |
| | 28 | Mercury (Hg) | mg/kg | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | 29 | Lead (Pb) | mg/kg | 0.012 | 0.008 | 0.015 | 0.009 | 0.010 | 0.011 | 0.007 | 0.024 | 0.018 | 0.014 | 0.014 |
| | 30 | Nickel (Ni) | mg/kg | 1.723 | 1.142 | 3.069 | 0.616 | 1.407 | 0.772 | 0.772 | 0.155 | 2.710 | 1.250 | 0.440 |
| | 31 | Cadmium (Cd) | mg/kg | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | 32 | Chromium (Cr) | mg/kg | 0.042 | 0.038 | 0.015 | 0.029 | 0.031 | 0.035 | 0.022 | 0.055 | 0.048 | 0.033 | 0.025 |
| | 33 | Vanadium (V) | mg/kg | 0.011 | 0.015 | 0.006 | 0.010 | 0.009 | 0.012 | 0.008 | 0.018 | 0.014 | 0.011 | 0.009 |
| | 34 | Arsenic (As) | mg/kg | 0.002 | 0.001 | <0.001 | 0.002 | 0.001 | 0.002 | 0.001 | 0.003 | 0.002 | 0.001 | 0.001 |
| | 35 | Barium (Ba) | mg/kg | 0.245 | 0.312 | 0.188 | 0.220 | 0.215 | 0.260 | 0.195 | 0.380 | 0.335 | 0.240 | 0.230 |
| Microbiology | 36 | Total Plate Count | cfu/g | $2.3\times10^2$ | $0.033\times10^3$ | $0.026\times10^3$ | $0.032\times10^3$ | $0.030\times10^3$ | $0.027\times10^3$ | $0.039\times10^3$ | $0.036\times10^3$ | $0.035\times10^3$ | $0.029\times10^3$ | $0.031\times10^3$ |
| | 37 | Total Coliform | cfu/g | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 38 | E. coli | cfu/g | Present | Present | Present | Present | Present | Present | Present | Present | Present | Present | Present |
| | 39 | Salmonella | cfu/g | Absent | Absent | Present | Present | Present | Present | Absent | Absent | Present | Absent | Absent |
| | 40 | Vibrio cholerae | cfu/g | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| | 41 | Pseudomonas aeruginosa | cfu/g | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| | 42 | Clostridium spp. | cfu/g | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| | 43 | Yeast & Mould | cfu/g | 27 | 15 | 16 | 6 | 4 | 13 | 23 | 0 | 36 | 21 | 20 |

## TABLE B – SOIL SAMPLE IDENTIFICATION KEY

| Certificate No. | Lab Ref. No. | Sample Label / Name | Sampling Location |
|---|---|---|---|
| 03960 | CL/742/25/SL | FMC Gusau | Gusau, Zamfara State |
| 03961 | CL/743/25/SL | Masallaci | Gusau, Zamfara State |
| 03962 | CL/744/25/SL | Behind Masallaci | Gusau, Zamfara State |
| 03963 | CL/745/25/SL | Kongo | Gusau, Zamfara State |
| 03964 | CL/746/25/SL | Gulbi Yar Kwana – Control | Gusau, Zamfara State |
| 03965 | CL/747/25/SL | Gulbi Hayin Malam Ibrahim | Gusau, Zamfara State |
| 03966 | CL/748/25/SL | Hayin Na Okele | Gusau, Zamfara State |
| 03967 | CL/749/25/SL | Fadama Plaza by Taj Bank | Gusau, Zamfara State |
| 03968 | CL/750/25/SL | Unguwar Dallatu | Gusau, Zamfara State |
| 03969 | CL/751/25/SL | Behind Taj Bank | Gusau, Zamfara State |
| 03970 | CL/752/25/SL | Control | Gusau, Zamfara State |

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**COMMENT**

The soil samples exhibit generally normal physicochemical properties and heavy metal concentrations within expected environmental baseline ranges. However, microbial indicators including E. coli and, in several locations, Salmonella were detected, suggesting faecal-associated contamination in parts of the study area.

Signature of Public Analyst

**Jamilu Habu** (MIPAN) Reg. No. 00603
Laboratory Manager

INSTITUTE OF PUBLIC ANALYSTS OF NIGERIA
JAMILU HABU
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No 000744

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# Surface and Ground Water Analysis

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## CERTIFICATE OF ANALYSIS

*Certificate No.: 03940 – 03946*

| FIELD | DETAILS | FIELD | DETAILS |
|---|---|---|---|
| Client | HARDAN CONSULTING LTD | Submitted By | Mr. David Ajiboye |
| Client Address | 22 Gnassingbe Eyadema Street, Asokoro, Abuja, Nigeria | Project Location | Gusau, Zamfara State, Nigeria |
| Sample Type / Matrix | Groundwater and Surface Water | Number of Samples | Seven (7) |
| Reference Standard | NIS 554:2015 | Sampling Date | 03 December 2025 |
| Receiving Date | 04 December 2025 | Date of Analysis | 08 December 2025 |
| Lab Reference Numbers | CL/735 – 741/25/BH | Certificate Numbers | 03940 – 03946 |
| Sampling Conducted By | Countrylab Ltd | Sample Condition | Good |
| Sample Containers | PET Bottles | Sample Volume | 1 Litre Each |
| Field Environmental Condition | 24–25°C / 33–40% RH | Sample Matrix Status | Groundwater and Surface Water |
| Remarks | Samples received intact and in good condition | | |

I hereby certify that the above samples were analyzed in the condition received, using appropriate analytical procedures. The results presented herein reflect the quality of the samples at the time of testing.

## TEST RESULT

### TABLE A : IN-SITU FIELD MEASUREMENTS

| S/N | Parameter | Unit | 03940 | 03941 | 03942 | 03943 | 03944 | 03945 | 03946 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Temperature | °C | 24 | 24 | 24 | 24 | 25 | 25 | 24 |
| 2 | pH | — | 9.0 | 7.0 | 8.8 | 8.7 | 7.9 | 7.8 | 7.7 |
| 3 | Dissolved Oxygen | mg/L | 6.12 | 9.06 | 6.52 | 8.63 | 8.26 | 8.50 | 6.80 |
| 4 | Conductivity | µS/cm | 374 | 3,850 | 391 | 366 | 369 | 2,340 | 2,346 |
| 5 | Salinity | mg/L | 188 | 1,930 | 197 | 184 | 188 | 1,170 | 1,210 |

### TABLE B : LABORATORY RESULTS

*(Excludes the 5 in-situ parameters already separated in Table A)*

| Category | S/N | Parameter | Unit | 03940 | 03941 | 03942 | 03943 | 03944 | 03945 | 03946 |
|---|---|---|---|---|---|---|---|---|---|---|
| Physicochemical | 1 | Colour | TCU | <5 | 11 | <5 | <5 | <5 | <5 | <5 |
| | 2 | Alkalinity | mg/L | 70 | 252 | 71 | 78 | 78 | 86 | 354 |
| | 3 | Total Hardness | mg/L | 111 | 112 | 129 | 83 | 181 | 103 | >300 |
| | 4 | COD | mg/L | 100 | 10 | 480 | 1,122 | 1,126 | 1,120 | 15 |
| | 5 | BOD | mg/L | 14.2 | 1.8 | 160 | 375 | 377 | 373 | 3.5 |
| | 6 | TSS | mg/L | 0.06 | 0.11 | 0.05 | 4.29 | 4.29 | 0.12 | 0.04 |
| | 7 | TDS | mg/L | 200 | 1,915 | 208 | 192 | 190 | 216 | 1,185 |
| | 8 | Turbidity | NTU | <1 | <1 | 3 | 2 | 27 | 21 | <1 |
| | 9 | Oil & Grease | mg/L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 10 | Redox Potential | mV | −142 | +210 | −112 | −105 | +145 | +162 | +182 |
| | 11 | Total Organic Carbon | mg/L | 3.5 | 0.85 | 144 | 336 | 336 | 336 | 4.8 |
| Exchangeable Cations | 12 | Calcium ($Ca^{2+}$) | mg/L | 26.36 | 2.80 | 34.8 | 22.4 | 41.2 | 18 | 82.4 |
| | 13 | Magnesium ($Mg^{2+}$) | mg/L | 11 | >50 | 24 | 25 | 19 | 13.8 | >50 |
| | 14 | Ammonium ($NH_4^+$) | mg/L | 0.02 | <0.01 | 0.08 | 0.12 | 0.15 | 0.09 | 0.05 |
| | 15 | Potassium ($K^+$) | mg/L | 4.10 | 6.40 | 4.1 | 3.8 | 4.2 | 4.6 | 6.2 |
| | 16 | Manganese ($Mn^{2+}$ ion) | mg/L | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | 0.34 | 0.23 |
| | 17 | Sodium ($Na^+$) | mg/L | 19 | 32 | 23.2 | 18 | 16.8 | 27.4 | 27.4 |
| Exchangeable Anions | 18 | Chloride ($Cl^-$) | mg/L | 19.9 | 33.6 | 24.9 | 19.7 | 18.2 | 28.2 | 44.1 |
| | 19 | Sulphate ($SO_4^{2-}$) | mg/L | 18 | >200 | 3 | 22 | 14 | 20 | >200 |
| | 20 | Nitrate ($NO_3^-$) | mg/L | >20 | >20 | >20 | >20 | >20 | >20 | >20 |
| | 21 | Phosphate ($PO_4^{3-}$) | mg/L | 0.12 | 0.08 | 0.12 | 0.14 | 0.16 | 0.11 | 0.15 |
| | 22 | Carbonate ($CO_3^{2-}$) | mg/L | 6.4 | 12.4 | 14.2 | 15.6 | 15.6 | 17.2 | 18.4 |
| Heavy Metals | 23 | Manganese (Mn) | mg/L | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | 0.34 | 0.23 |
| | 24 | Iron (Fe) | mg/L | 0.05 | <0.01 | <0.01 | <0.01 | <0.01 | <0.04 | <0.01 |
| | 25 | Copper (Cu) | mg/L | <0.07 | 0.08 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 |
| | 26 | Zinc (Zn) | mg/L | <0.03 | <0.03 | <0.03 | 0.04 | 0.04 | <0.03 | 0.48 |
| | 27 | Mercury (Hg) | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | 28 | Lead (Pb) | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |



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*Certificate No.: 03940 – 03946 (Cont'd)*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 29 | Nickel (Ni) | mg/L | 0.93 | 0.42 | 0.77 | 0.94 | 1.08 | 0.41 | 0.94 |
| | 30 | Cadmium (Cd) | mg/L | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| | 31 | Chromium (Cr) | mg/L | 0.07 | 0.07 | 0.05 | 0.07 | 0.07 | 0.09 | 0.05 |
| | 32 | Vanadium (V) | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | 33 | Arsenic (As) | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | 34 | Barium (Ba) | mg/L | 0.02 | 0.05 | 0.02 | 0.03 | 0.04 | 0.04 | 0.05 |
| | 35 | Fluoride ($F^-$) | mg/L | 0.38 | 0.88 | 0.41 | 0.38 | 0.42 | 0.45 | 0.51 |
| Microbiology | 36 | Total Plate Count | cfu/ml | 357 | 375 | 351 | 395 | 301 | 421 | 150 |
| | 37 | Total Coliform | cfu/ml | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 38 | *E. coli* | cfu/ml | Present | Present | Present | Absent | Present | Present | Present |
| | 39 | *Salmonella* | cfu/ml | Absent | Absent | Absent | Absent | Absent | Absent | Present |
| | 40 | *Vibrio cholerae* | cfu/ml | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| | 41 | *Pseudomonas aeruginosa* | cfu/ml | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| | 42 | *Clostridium* | cfu/ml | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| | 43 | Yeast & Mould | cfu/ml | Absent | Absent | 3 | 10 | 3 | 7 | 0 |

### TABLE C : SAMPLE IDENTIFICATION KEY

| Certificate No. | Lab Reference No. | Sample Label / Name | Sampling Location |
|---|---|---|---|
| 03940 | CL/735/25/BH | Gulbi Yar Kwana (Surface Water) | Gusau, Zamfara State |
| 03941 | CL/736/25/BH | GW1 Kongo (Ground Water) | Gusau, Zamfara State |
| 03942 | CL/737/25/BH | Gulbi Yar Kwana – Control 1 (Surface Water) | Gusau, Zamfara State |
| 03943 | CL/738/25/BH | Gulbi Hayin Na'Okele (Surface Water) | Gusau, Zamfara State |
| 03944 | CL/739/25/BH | Gulbi Hayin Malam Ibrahim (Surface Water) | Gusau, Zamfara State |
| 03945 | CL/740/25/BH | Gulbi Yar Kwana - Control 2 (Surface Water) | Gusau, Zamfara State |
| 03946 | CL/741/25/BH | Hayin Dan Hausa (Ground Water) | Gusau, Zamfara State |

### GENERAL COMMENT

The results indicate varying water quality conditions across the seven sampling locations. While most physicochemical and heavy metal parameters are generally within acceptable limits, elevated nitrate levels, high organic load (COD/BOD), and widespread microbial contamination—including *E. coli* and, in one case, *Salmonella*—were observed.

Signature of Public Analyst

INSTITUTE OF PUBLIC ANALYSTS OF NIGERIA
JAMILU HABU
P/L No.: 00603
No. 000746

THE INSTITUTE OF PUBLIC ANALYSTS OF NIGERIA (IPAN)
Act Cap 1. 16 LFN 2004
(Formally Decree No. 100 of 1992)
212425
IPAN REGISTERED LABORATORY

**Jamilu Habu** (MIPAN) Reg. No. 00603
Laboratory Manager



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+234 (703) 166 8522
info@countrylab.com.ng
www.countrylab.com.ng

# ANNEX 13
# GLOSSARY OF PICTURES ON SITE



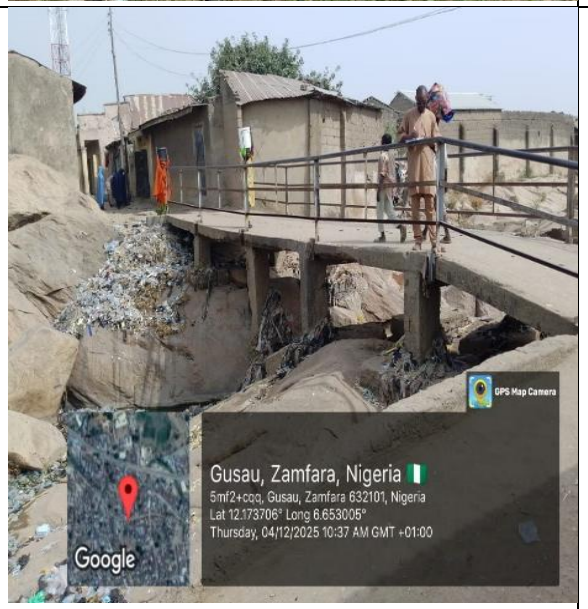




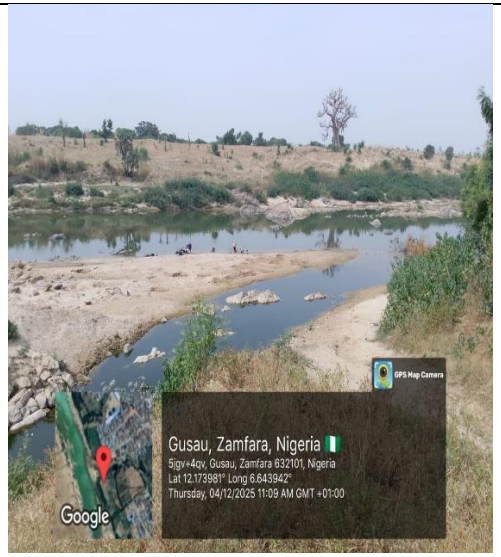


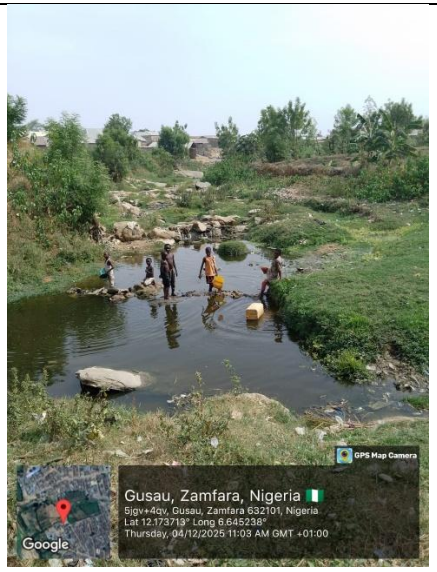


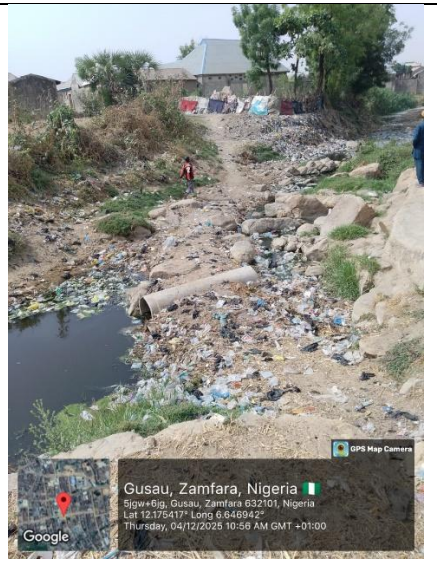




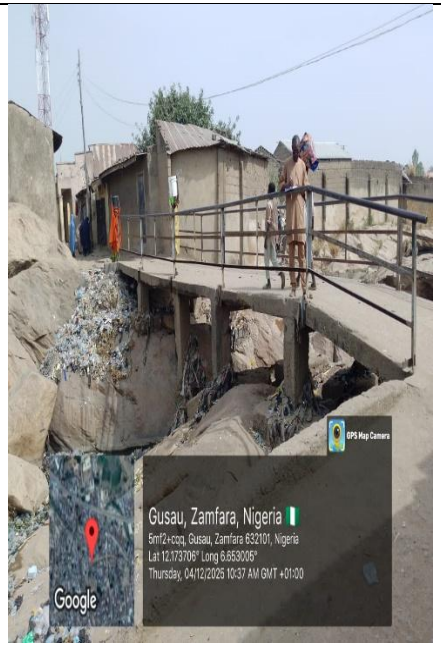




GPS Map Camera
Gusau, Zamfara, Nigeria
5jgv+4qv, Gusau, Zamfara 632101, Nigeria
Lat 12.173981° Long 6.643942°
Thursday, 04/12/2025 11:09 AM GMT +01:00
Google

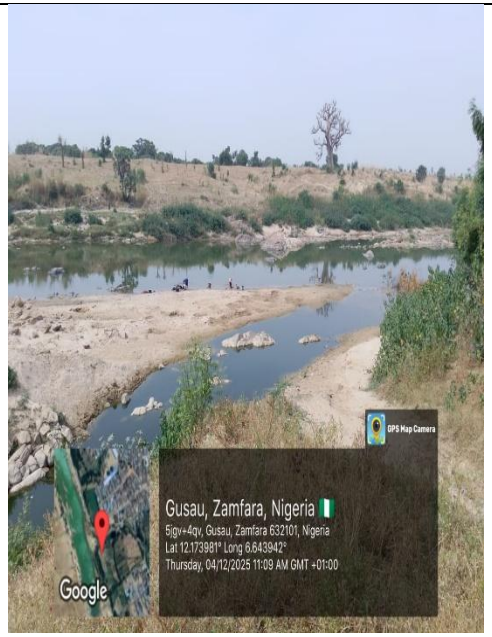

GPS Map Camera
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5jgv+4qv, Gusau, Zamfara 632101, Nigeria
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Google

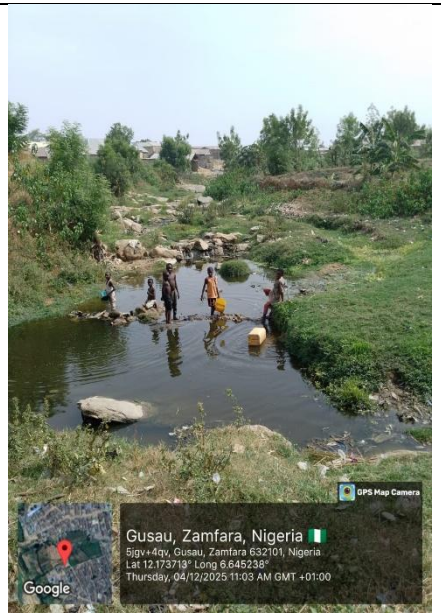

GPS Map Camera
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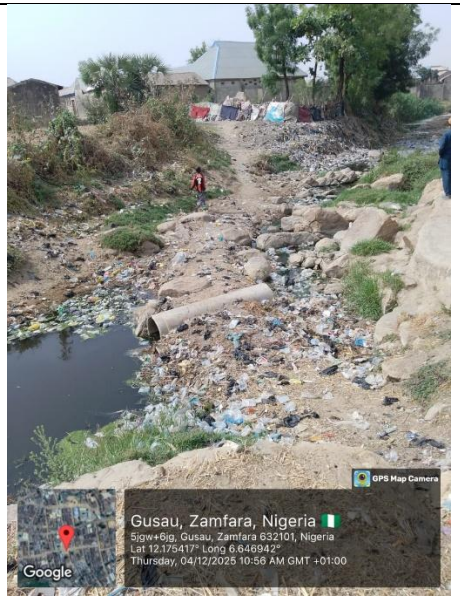

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Google


GPS Map Camera
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5mf2+cqq, Gusau, Zamfara 632101, Nigeria
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Google

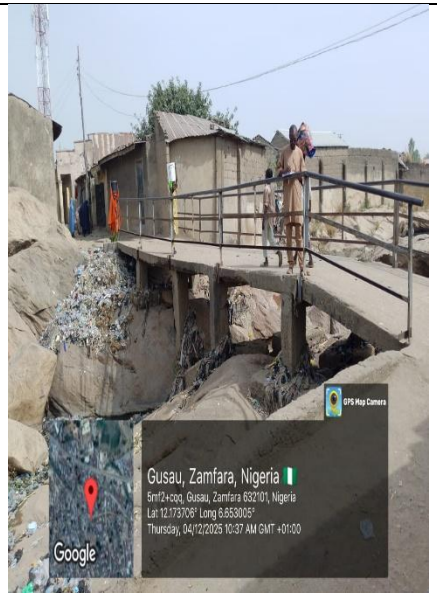

GPS Map Camera
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Thursday, 04/12/2025 10:28 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
5jgv+4qv, Gusau, Zamfara 632101, Nigeria
Lat 12.173981° Long 6.643942°
Thursday, 04/12/2025 11:09 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
5jgv+4qv, Gusau, Zamfara 632101, Nigeria
Lat 12.173713° Long 6.645238°
Thursday, 04/12/2025 11:03 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
5jgw+6jg, Gusau, Zamfara 632101, Nigeria
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Google


GPS Map Camera
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5mf2+cqq, Gusau, Zamfara 632101, Nigeria
Lat 12.173545° Long 6.651545°
Thursday, 04/12/2025 10:45 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
5mf2+cpq, Gusau, Zamfara 632101, Nigeria
Lat 12.173706° Long 6.653005°
Thursday, 04/12/2025 10:37 AM GMT +01:00
Google


GPS Map Camera
Gusau, Zamfara, Nigeria
5mf3+9rh, Gusau, Zamfara 632101, Nigeria
Lat 12.173394° Long 6.653904°
Thursday, 04/12/2025 10:28 AM GMT +01:00
Google