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Amandi Investments Ltd

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TAKORADI TO HUNI VALLEY RAILWAY, GHANA
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

RAMBOLL

This document is a first draft of the Environmental and Social Impact Assessment (ESIA) for the Takoradi Port to Huni Valley Railway Line (the Project), the redevelopment of a 102 km stretch of railway in Ghana to accommodate standard gauge rail lines and realignments to allow for higher speeds.

This document contains a number of [HOLDS]. Impact mitigation references and other details contained within the ESIA may change as part of this review process.

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1. INTRODUCTION

1.1 Introduction

This document is the Environmental and Social Impact Assessment (ESIA) of the Takoradi Port to Huni Valley Railway Line (the Project), the redevelopment of a 102 km stretch of railway in Ghana to accommodate standard gauge rail lines and realignments to allow for higher speeds. It describes the ESIA process, the outcomes and approach to the environmental and social management for the Project. Construction of the Project will be managed by Amandi Investment Limited (Amandi). The Project will be owned and ultimately operated by Ghana Railways Development Authority (GRDA). Ramboll UK Ltd (Ramboll) has been appointed by Amandi to conduct the ESIA to meet international standards to support financing.

This ESIA has been undertaken in alignment with the International Finance Corporation (IFC) IFC Performance Standards (2012), applicable IFC Environmental, Health and Safety (EHS) guidelines, the Equator Principles IV (2020) (EPIV), and the OECD Common Approaches, and in accordance with the laws and regulations of the Republic of Ghana. All IFC Performance Standards are relevant to the Project with the exception of Performance Standard 7: Indigenous People. Further details can be found in Legislation and Standards (Chapter 2).

1.2 Project Overview

Ghana aims to establish itself as the transport hub of West Africa[1]. The Railway Master Plan of Ghana (2013)[2] sets out plans to rehabilitate and expand the existing rail network within Ghana. The current network is comprised of three sections, the Western, Eastern and Central Lines. Phase 1 of the Railway Master Plan focuses on the rehabilitation of the Western and Eastern lines (Figure 1-1).

The proposed redevelopment of the Takoradi Port to Huni Valley Railway Line forms part of the wider rehabilitation of the Western line identified in the Railway Master Plan, with rehabilitation of the line from Huni Valley to Kumasi considered as a separate project. The rehabilitation of the line from Takoradi Port to Huni Valley will involve upgrading the line to standard gauge, as well as realignment of sections to allow an increase in train speeds up to 120 km/hr. Rehabilitation of the line commenced in 2017, with some aspects of the rail upgrades funded through the government including the upgrade to the track between Takoradi Station and Kojokrom including the installation of dual gauge sleepers to facilitate the subsequent upgrade to standard gauge. As a result, only the laying of the standard gauge rails on the existing dual gauge sleepers in this area is required as part of the Project construction.

In addition, the track upgrades between Kojokrom and Manso are also currently in construction, with some 40-50% of the construction work completed. In this section, only the construction of the Eshiem realignment, or 'offline' route section, is within the scope of the Project.

North of Manso to north of Tarkwa the route will be upgraded to a twin track standard gauge network with construction/upgrade of six stations (Amantin, Benso, Esuaso, Bonsawire, Nsuta and Tarwa). The Project also includes a number of realignment sections, the most significant of which is located at Tarkwa and which comprises decommissioning the line which currently runs through the centre of Tarkwa and relocating it to the east of Tarkwa. The Project also includes the construction of a heavy maintenance facility at Tarkwa. North of Tarkwa to Huni Valley the line will consist of single line standard gauge track. The Project includes construction of two

[1] AfricaWatch (2014), Transporting Ghana into the Future, http://www.mot.gov.gh/files/2.pdf accessed 17 September 2020
[2] Ghana Railway Development Authority (GRDA) of the Ministry of Transport (2013), Railway Master Plan of Ghana, https://new-ndpc-static1.s3.amazonaws.com/CACHES/PUBLICATIONS/2016/05/03/1-MASTER+PLAN+GHANA+FINAL+REPORT+-+Fin4.pdf accessed 16 September 2020

stations in this section (Bompieso and Huni Valley) and straightening realignments. For the purposes of the ESIA, the route has been divided into five sections as illustrated in Figure 1-2.

Further details can be found in *Chapter 3: Project Description*.

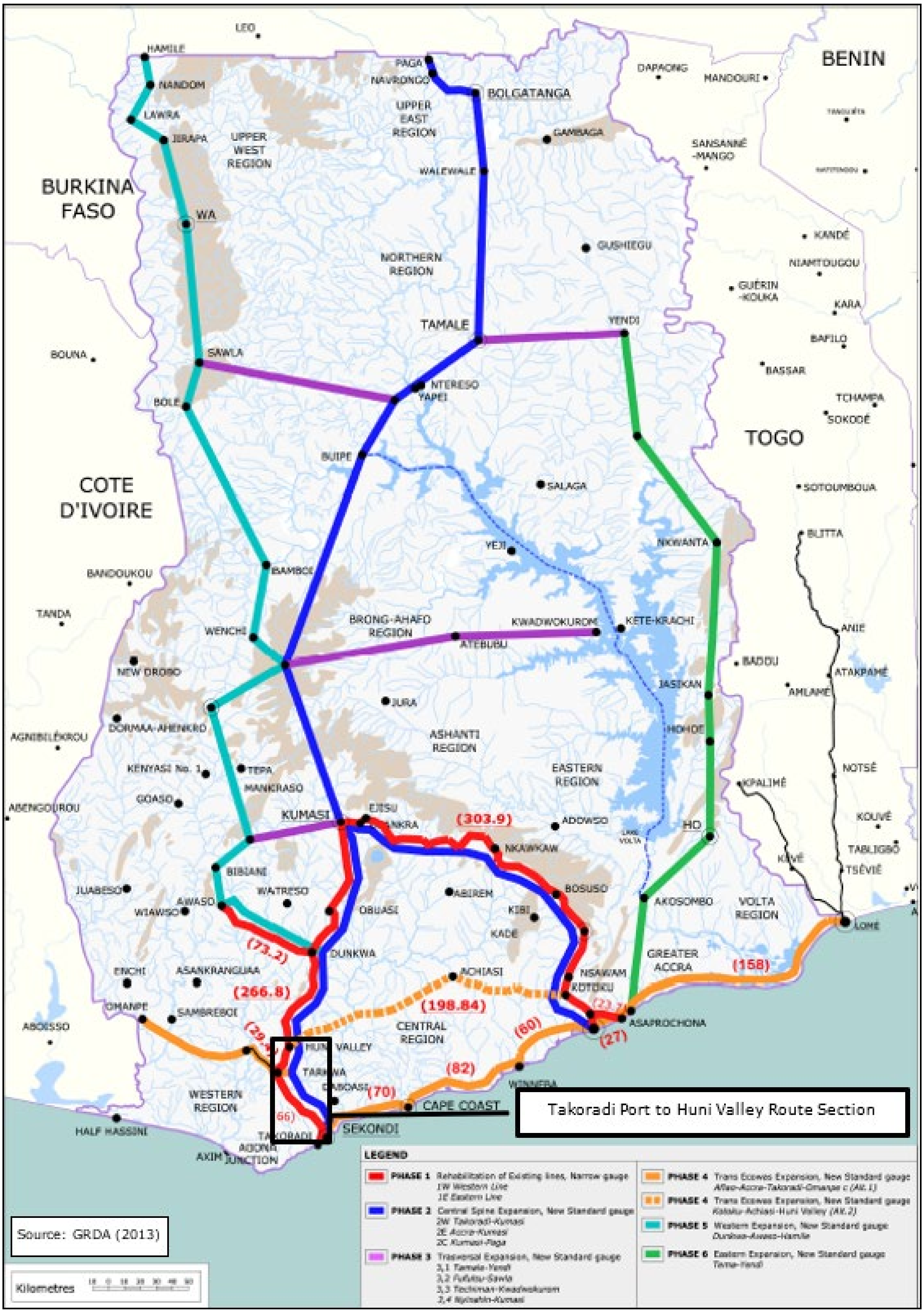


Figure 1.1: Railway Master Plan Ghana

Legend

- City
- Town
- Village
- Hamlet
- Train Station

Route Sections

- 1
- 2
- 3
- 4
- 5
- Eshiem Bypass
- Existing Train Track

Figure Title Project Route Sections	
Project Name ESIA Ghana	
Project Number 1620010291	Figure No. 1.2
Date October 2020	Prepared By AB
Scale 1:250,000 @A3	Issue 1
Client Amandi Investments Ltd	

1.3 Scope of the ESIA

This ESIA has been developed to identify and assess potential environmental and social impacts of the Project on the biophysical and human environments, and to set out measures to avoid, minimise, mitigate and manage potential significant adverse impacts to acceptable levels (as defined by Ghanaian regulatory requirements and the applicable requirements of the IFC Performance Standards and EHS guidelines, and EPIV).

The ESIA assesses the potential impacts across the lifetime of the Project, assessing the impacts due to construction (including site preparation, construction and commissioning), operation, closure and decommissioning.

The Project Area of Influence (AoI) has been defined in accordance with IFC Performance Standard 1 and includes the railway track and realignment sections, railway infrastructure (including bridges, culverts, underpasses and level crossings), railway stations and Associated Facilities such as the light rail maintenance facility (see Chapter 5: Methodology and Chapter 21: Cumulative Impacts for further details).

1.4 Structure of the ESIA

The ESIA is structured as follows:

Table 1.1: ESIA Structure

Chapter	Title	Description
2	Legislation and Standards	Describes the national and international legal frameworks and agreements that form the legislative constraints of the Project. Also defines the applicable international lender standards for the Project.
3	Project Description	Describes the component parts of the Project, proposed Project route alignment, and associated infrastructure.
4	Assessment of Alternatives	The analysis of alternatives considered for the Project including a no Project scenario, technology and material alternatives (such as fuel source, materials) and routing alternatives.
5	Methodology	Outlines the proposed methodology for undertaking the ESIA.
6	Stakeholder Engagement	Summarises the approach to stakeholder engagement.
7	Baseline	Detailed environmental and social baseline characterisation and data of the Project area of influence.
8	Air Quality	The identification and assessment of potential environmental and social impacts, both adverse and beneficial, associated with the Project and measures adopted to mitigate and manage these alongside enhancement measures for opportunities for improved environmental and social performance where beneficial effects are identified for each topic scoped in to the assessment.
9	Climate Change	
10	Noise and Vibration	
11	Soils, Geology, Topography and Landscape	
12	Water Resources	
13	Biodiversity and Ecosystem Services	
14	Socio-Economics, Employment & Livelihoods	

Chapter	Title	Description
15	Community Health, Safety and Security (CHSS)	
16	Cultural Heritage	
17	Labour & Working Conditions	
18	Transport	
19	Waste	
20	Major Hazards	Assessment of unplanned events.
21	Cumulative Impacts	Assessment of cumulative impacts that may result when the Project is considered alongside other existing and future developments.
22	Environmental and Social Management	Outlines the Project approach to environmental and social (E&S) management, performance monitoring and evaluation processes to demonstrate how E&S performance will be improved.

The main ESIA report is supported by a series of technical annexes for each of the topic disciplines assessed (*Annexes A-J*).

2. LEGISLATION AND STANDARDS

2.1 Introduction

This section of the ESIA Report details the relevant legislation and standards for the Project, covering national requirements as well as applicable international conventions and standards, and internal guidelines and standards voluntarily committed to by the Lenders EKN, Serv and Deutsche Bank. The intent of this section is to lay out the regulatory and non-regulatory performance requirements for all stages of the Project. When identifying and assessing the applicable standards and requirements for the Project, the most stringent requirements have been adopted as the project standards and applied in the ESIA.

2.2 National Environmental Impact Statement

An Environmental Impact Statement (EIS) was undertaken for the Western Railway Line Infrastructure Project in 2015 on behalf of the Ministry of Transport Ghana Railways Authority. In June 2020, the Ghana Environmental Protection Agency (EPA) granted an environmental permit for the 360km Western Railway Infrastructure Project valid until December 2021.

In August 2020, a commercial contract agreement was signed between the Republic of Ghana (represented by the Ministry of Transport - Ghana Railways Authority) and Amandi Investments Limited for the construction of the Western Railway Line from Takoradi Port to Huni Valley.

2.3 Government Administration

An overview of Ghanaian government ministries and the key administrative bodies (i.e. authorities, agencies and commissions) with responsibilities related to the Project is provided in Figure 2.1. The duties and authorities of the relevant administrative bodies within these key Ministries are discussed further below.

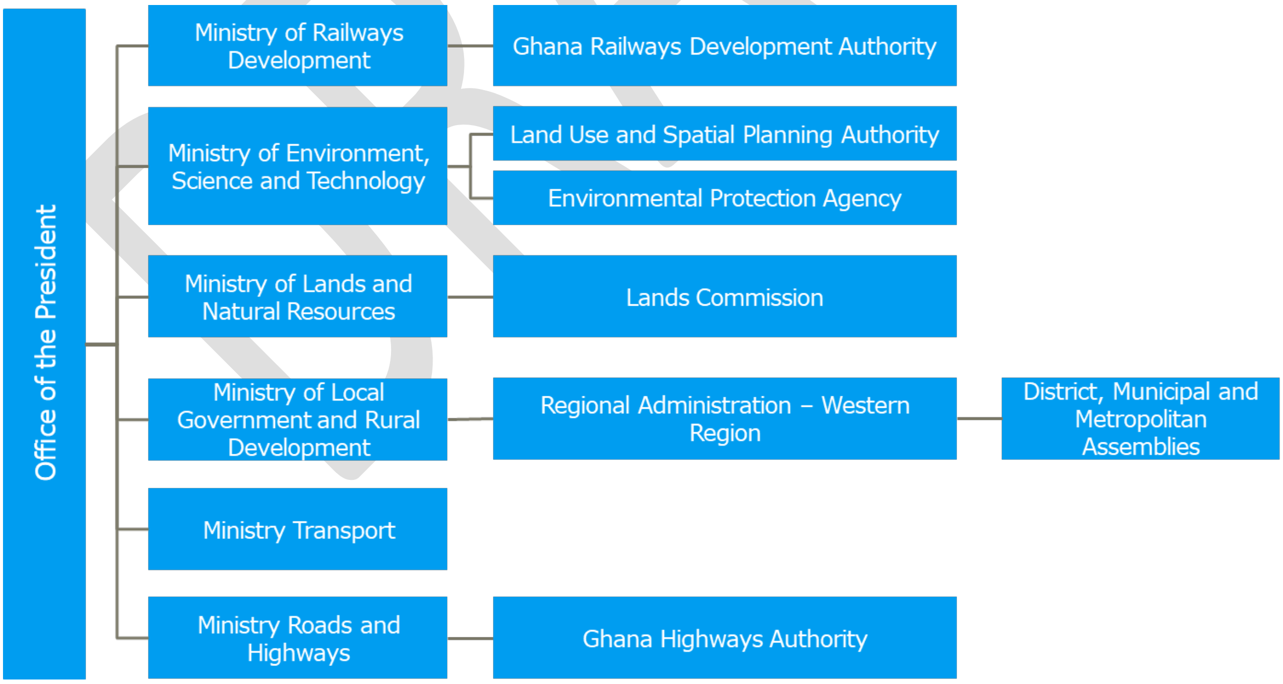


Figure 2.1: Relevant Ghanaian Ministries and Agencies

2.3.1 Ministry of Railways Development

The Ministry of Railways Development was created to manage infrastructural development and service delivery specifically for rail transportation. It exists to provide leadership and guidance for the development and modernisation of Ghana's railways system and associated socio-economic infrastructure.

Ghana Railways Development Agency (GRDA)

The Ghana Railway Development Authority was established under the Railways Act 2008, (Act 779) to promote the development of railways and railways services, administer and improve the railway assets, and promote the development and management of suburban railway. Ghana Railways Development Authority will be responsible for the operation of the railway line from Takoradi Port to Huni Valley once construction works are completed.

Ghana Railways Company Limited (GRCL)

GRCL was established in 2001 under the Companies Code 1963 (Act 179) to provide freight and passenger train services in Ghana.

2.3.2 Ministry of Environment, Science, Technology and Innovation

The Ministry of Environment, Science, Technology and Innovation (MESTI) exists to establish a strong national scientific and technology base for accelerated sustainable development of the country to enhance the quality of life for all. The EPA is part of this Ministry.

The Environmental Protection Agency

The EPA is responsible for the protection and improvement of the environment in Ghana. It is responsible for enforcing environmental policy and legislation, prescribing standards and guidelines, inspecting and regulating businesses and responding to emergency incidents.

The EPA is responsible for issuing environmental permits and pollution abatement notices for controlling waste discharges, emissions, deposits or other source of pollutants and issuing directives, procedures or warnings for the purpose of controlling noise. The EPA has the authority to require an EIA, is responsible for ensuring compliance with EIA procedures and is the lead EIA decision-maker.

Land Use and Spatial Planning Authority

The Land Use and Spatial Planning Authority was established to promote inter sectoral collaboration, plan and ensure easy identification and adequate access to services. It has regulatory powers to ensure conformity and compliance with spatial plans, zoning regulations and planning standards at the national, regional and district levels. It is responsible for overseeing the implementation of approved policies regarding spatial planning and physical development.

2.3.3 Ministry of Transport

The Ministry of Transport was created to manage infrastructural development and service delivery for maritime and rail transport subsectors and to complement the other modes of transport for the socio-economic development of the country.

2.3.4 Ministry of Lands and Natural Resources

The Ministry of Lands and Natural Resources is mandated to ensure the sustainable management and utilisation of the Ghana's lands, forests and wildlife resources. The Ministry consists of three subsectors: lands, forestry and mining. In terms of the Project, their role is executed through the Lands Commission as detailed below.

Lands Commission

The Lands Commission is comprised of four divisions: Land Valuation; Land Registration; Survey and Mapping; and the Public and Vested Land Management. Responsibilities of the Lands Commission include allocation of public lands for use by individuals, private and state institutions and the management of such lands; a comprehensive programme for the registration of title to land throughout the country; providing land administration advisory services; monitoring developments on public lands; and executing consents on all stool land transactions.

The Project will work closely with the Lands Commission in the acquisition of the land required for the Project and to ensure that both acquisition and compensation is undertaken to meet both legal requirements and international standards.

2.3.5 Ministry of Local Government and Rural Development

The Ministry of Local Government and Rural Development is responsible for the Regional Administrations in Ghana. These regions each have a Regional Coordinating Council and are sub-divided into 216 metropolitan, municipal and district areas each with an administrative assembly. The Districts of Secondi Takoradi, Tarkwa Nsuaem and Prestea / Huni Valley cover the area where the Project is located.

2.3.6 Ministry of Roads and Highways

The Ministry of Roads and Highways is responsible for road construction and road maintenance. It comprises two departments, the Department of Feeder Roads and the Department of Urban Roads.

Ghana Highways Authority (GHA)

The GHA is in charge of administration, control, development and maintenance of the trunk road network in Ghana.

2.4 National Legislation

An overview of key relevant Ghanaian legislation is summarised in Table 2.1, covering environmental protection, worker health and safety, labour management, and property rights.

Table 2.1: Ghanaian Legal Framework

Legislation	Key Legal Requirements
Constitution of Ghana (1992 as amended 1996)	Article 41(k) in Chapter 6 of the constitution of Ghana requires that all citizens (employees and employers) protect and safeguard the natural environment of the Republic of Ghana.
Environmental Protection Agency Act 1994, Act 490	The Environmental Protection Act (Act No. 490 of 1994) establishes the authority, responsibility, structure and funding of the EPA. In Part I of the Act, the EPA is mandated with the formulation of environmental policy, issuing of environmental permits and pollution abatement notices, and prescribing standards and guidelines. Requirements and responsibilities of the Environmental Protection Inspectors are defined, and the Act empowers the EPA to request that an EIA process be undertaken.
Environmental Assessment Regulations (LI 1652, 1999)	The Environmental Assessment Regulations (LI 1652, 1999) legislate the EIA process, the principal enactment within the Environmental Protection Act (Act No. 490 of 1994). The Regulations require that all activities likely to have an adverse effect on the environment are subject to environmental assessment and issuance of a permit before commencement of activity. They define the EIA process, what should be addressed in the EIA, and stakeholder engagement within the process. Schedules 1 and 2 of the Regulations provide lists of activities for which an environmental permit is required and EIA is mandatory, respectively. Railway developments are included under Schedule 2 and therefore an EIA is required for the Project.

Legislation	Key Legal Requirements
EPA Environmental Guidelines	The EPA has issued formal guidance on regulatory requirements and the EIA process, such as *Environmental Assessment in Ghana, a Guide to Environmental Impact Assessment Procedures (EPA, 1996)*.
Fees and Charges (Amendment) Instrument 2019, LI 2386	The Fees and Charges (Amendment) Instrument 2019 (LI 2386) provides regulation to the fees and charges (Miscellaneous Provision) Act 2009, Act 793. The Act provides a comprehensive list of rates, fees and charges collectable by Ministries, Departments and Agencies for goods and services delivered to the public. The Project will be required to comply with this legislation with regards to fees and charges to be paid by the Project proponent with respect to processing, environmental permits and certificates.
Local Governance Act, 2016 (Act 936)	This Act establishes and regulates the local government system and gives authority to the Regional Co-ordinating Councils and the District Assembly to exercise political and administrative power in the Regions and District. The Act sets out the planning functions of the District Assemblies, provision of emergency, disaster and relief, and financial matters including rates and budgets.
State Lands Act 1962, Act 125 and Amendments	The State Lands Act 1962 (Act 125) and its amendments establish the principles for compulsory acquisition of land. Following an application to acquire land, a Site Advisory Committee is set up to assess the application. The application is then assessed by the Lands Commission, which prepares an executive instrument. Once this is accepted and endorsed by the Ministry of Lands and Natural Resources, it is published and claims can be submitted by property owners. Land users affected by the land acquisition process will be considered in the assessment of eligibility and entitlements in a Resettlement Action Plan. Under the Act, the affected person or responsible group can register a claim against land acquisition. Claims for compensation must be made to the Minister no more than three months after the date of declaration made by the President. Claims must be reviewed and approved by the Minister. The Act identifies a number of eligibility requirements for obtaining compensation.
Land Bill, 2019	The bill has been developed to consolidate the laws relating to land, including administration, management, land tenure and surveying/mapping. Section 256 of the Act states that where compulsory acquisition or possession of land involves displacement suitable alternative land "*with due regard for their economic well-being and the social and cultural values of the inhabitants*" should be provided. It also states that a Land Acquisition and Resettlement Plan (LARP) should be developed.
Stool Lands Act, 1994 Act 481	The Stool Lands Act (Act No. 481 of 1994) puts in place a mechanism to ensure equal distribution of the benefits accruing from stool land resources. Stool lands are defined as those which belong to or are controlled by a stool or skin (the head of a particular community/ family) that have an allodial title for the benefit of the subjects of that stool or the members of that community. The Project is located in an area of family owned lands, held in trust under customary ownership by the traditional titleholders, typically the paramount chiefs or traditional council members.
Administration of Lands Act, 1962, Act 123	The Act consolidates the amendments relating to the administration of Stool and other lands Acts. However, the Act states that the management of stool lands shall be exercised in accordance with article 267 of the Constitution of the Republic of Ghana (Lands and Natural Resources) and where there is a conflict between a provision of this Act and a provision of Chapter 21 of the Constitution, the provision of the Constitution prevails. The Act states that Subject to Article 20 of the Constitution, the President may authorise the occupation and use of a land to which this Act applies for a purpose which, in the opinion of the President is conducive to the public welfare or the interests of the State. In the case that land is acquired, the President shall publish a notice in the Gazette giving

Legislation	Key Legal Requirements
	particulars of the land, of the use to which it is intended to be put, and of the payments that will be made in respect of that use of the land.
Wild Animals Preservation Act 1961, Act 43	The Wild Animals Preservation Act makes provisions for the preservation of birds and fish, as well as other wild animals. The Act is implemented through the Wildlife Conservation Regulations.
Wildlife Conservation Regulations, 1971 (LI 685) as amended	The regulations provide rules for hunting, the commercialization of dead or alive wild animals or trophies and various other matters for purposes of conservation and protection of wild animals. They are divided into four sections: restrictions on hunting; game licences; game and trophy export permits ; and general.
Fisheries Act, 2002, Act 625	The Act consolidates amendments the law on fisheries; and outlines regulation and management of fisheries; provides for the development of the fishing industry and the sustainable exploitation of fishery resources and to provide for connected matters. It outlines fines for pollution of fishery water and the need to undertake an impact assessment for activities likely to have a substantial impact on the fishery resource of other aquatic resources of Ghana.
Fisheries Regulations, 2010 (L.I. 1968) as amended	The Fisheries Regulations implement the Fisheries Act making provision with respect to a wide variety of matters regarding fisheries management and conservation, aquaculture and trade in fish products.
Forestry Commission Act, 1999, Act 571	The Act established the responsibilities of the Forestry Commission and implementing agencies with respect to the protection, development, management, and regulation of forests and wildlife resources and to provide for related matters. The objectives and functions of the commission include regulation of the utilization of forest and timber resources of Ghana, management of the nation's forest reserves and protected areas, assistance to the private sector and other bodies in relation with implementation of forest and wildlife policies and development of forest plantations, restoration of degraded forests, and afforestation for industrial purposes.
Ghana Forest and Wildlife Policy, 2012	The Policy sets out the laws, institutions, systems, organizations and individuals and how they interact for the conservation and sustainable development of forest and wildlife resources. It includes provisions for forest ecosystem services and the conservation of flora and fauna.
National Climate Change Policy, 2013	The National Climate Change Policy is an integrated response to climate change. It has three objectives: (i) effective adaptation, (ii) social development and (iii) mitigation and is divided into four thematic areas, which include Energy and Infrastructure.
National Building Regulations 1996, (LI 1630)	The regulations establish a common set of baseline requirements for all structures erected in Ghana. The regulations also provide the District Planning Authority with the power to include conditions on building regulations as part of building permits and outline the need to inform the District Planning Authority of demolition works, as well as requirements to manage dust and public health related to demolition activities.
Water Resources Commission Act 1996, Act 522	The Water Resources Commission Act 1996 (Act 522) establishes and mandates the Water Resources Commission with responsibility for the regulation and management of water resources and for the co-ordination of any policy in relation to them.
Water Use Regulations 2001, LI 1692	Under the Water Use Regulations 2001 (LI 1692) persons may obtain Water Use Permits from the Water Resources Commission for various uses including domestic, industrial, and municipal water use. The Commission, in consultation with the EPA, may identify water uses for which an environmental impact

Legislation	**Key Legal Requirements**
	assessment or an environmental management plan is required. These should be approved by the EPA before issuance of the Water Use Permit.
Land Use and Spatial Planning Act, 2016, Act 925	The Land Use and Spatial Planning Act consolidates existing laws on spatial planning to provide for sustainable development of land and human settlements through a decentralised planning system and ensures judicious use of land. It aims to improve the quality of life, promote health and safety in respect of human settlements, and regulate national, regional, district and local spatial planning. Under Article 113 of the Act, physical development of land within a district is prohibited unless that person has been issued with a permit by the relevant District Assembly. Article 116 identifies that fees shall be required for granting of a permit for a physical development unless the purpose of the development is compliance with an approved local plan, in which case the District Assembly shall impose a time limit for compliance.
Lands Commission Act, 2008, Act 767	Lands Commission Act (Act No. 767 of 2008) established the Lands Commission, which merged the land sector agencies. These became the four divisions of the Lands Commission: Land Valuation; Land Registration; Survey and Mapping; and the Public and Vested Land Management.
Forests Protection (Amendment) Act, 1986 (PNDCL 142)	The Act defines offences with regards to forests which includes activities such as felling of trees, cultivation, building of farms, obstructing of streams, fishing, grazing of cattle or hunting carried out without written consent of the competent authorities.
Public Lands (Protection) Act, 1974 (NRCD 240)	The Act provides for the protection of public land from unlawful deeds, occupation, trespass or other illegal encroachment or interference. It also prescribes penalties for unlawful sale or occupation of public land and provides for the ejection of trespassers.
Farm Lands (Protection) Act, 1962 (Act 107)	The Farm Lands Act upholds the principles that where a person, in this Act referred to as a farmer, acquires land after the commencement of this Act for the purposes of farming and does not farm a part or the whole of that land for a period of eight years from the date of the acquisition, his title to the whole of the land or that portion that has not been farmed shall be deemed for all purposes to have been extinguished.
The Lands (Statutory Wayleaves) Act, 1963	The Act details the process involved in occupation of land for the purpose of the construction, installation and maintenance of works of public utility, and for the creation of right-of-ways for such works.
Statutory Wayleave Regulations, 1964	The Regulations provide procedural details and address grievance mechanisms to enact the Lands (Statutory Wayleaves) Act.
Ghana National Fire Service Act 1997 and the Fire Precaution (Premises) Regulations 2003, LI 1724	The Act outlines the National Fire Service mandate to provide for the management of undesired fires and to make provision for related matters. The Fire Precaution (Premises) Regulations 2003 (LI 1724) require all premises intended for use as workplaces to have Fire Certificates.
Labour Act 2003 (Act 651)	The Labour Act consolidates and updates former legislation, and includes provisions reflecting the International Labour Organisation (ILO) Conventions ratified by Ghana. It covers conditions of employments, including hours of work and leave, occupational health and safety, and includes specific provisions for persons with disabilities, women and young persons.

Legislation	Key Legal Requirements
Workmen's Compensation Law, 1987	Under this law, employers must compensate any workers who suffer personal injuries caused by accidents arising out and in the course of their employment.
Public Health Act 2012, (Act 851)	The Act provides for the prevention of disease and pollution dangerous to human health and to any water supply for domestic use. It also empowers the District Assemblies to control drainage, latrine and disposal of sewerage and treatment systems.
Persons with Disability Act 2006, (Act 715)	The Act requires owners or occupiers of public structures to provide appropriate facilities to make them easily accessible by persons with a disability and outlines the penalty for failure to comply with the requirement.
Hazardous and Electronic Waste and Control Act, 2016 (Act 917) and Hazardous, Electronic and Other Wastes (Classification), Control and Management Regulations, 2016 (LI 2250)	The Act provides list of hazardous and other waste and identifies control, management and disposal methods of electrical and electronic waste. The Act aims to ensure safe management and disposal of harmful elements associated with hazardous and other waste products to preserve critical ecological components such as the soil, groundwater, flora and fauna.
Commission on Human Rights and Administrative Justice Act, 1993 (Act 456)	The Act is the national institution for the protection and promotion of fundamental rights and freedoms and administrative justice in Ghana. It establishes a Commission on Human Rights and Administrative Justice to investigate complaints of violations of fundamental human rights and freedoms, injustice and corruption, with power to seek remedy in respect of such acts or omissions.
Railways Act 2008 (Act 779)	Part one of the Railways Act establishes the Ghana Railways Development Authority (GRDA) and its responsibilities. Part two of the Act covers operation, licencing and regulation of railways. This includes the need for approval by the Authority prior to railway construction, the need to limit the amount of and make good any damage during railway construction, compensation requirements and conditions that must be met in order to enable land acquisition under the State Lands Act. The Act also identifies that the minimum right of way required for a railway shall be 30 m.
Minerals and Mining Act, 2006 (Act 703)	The Act outlines ownership of minerals and cadastral system requirements, mining leases and prospecting licences for mining activities, including licences and leases for industrial minerals such as laterite.
Minerals and Mining (General) Regulations, 2012 (L.I. 2173)	The Minerals and Mining (General) Regulations implement the Minerals and Mining Act. The regulations cover exportation, sale and disposal of minerals, record keeping, prospecting and mining lease requirements.
National Museum Decree, 1969 (NLCD 387)	The National Museum Decree outlines the requirements by which antiquities are to be exported, excavated or sold and procedures for managing chance finds.

2.5 International Conventions

Ghana has signed and ratified a number of international conventions and treaties that commit the country to the conservation and protection of biological and environmental resources, and people. In certain cases, conventions and agreements have influenced policy, guidelines and regulations, and therefore are relevant to planning, construction and operation of the Project. Table 2.2 sets out some of the key international conventions and protocols that are relevant to the Project.

Table 2.2: Key International Treaties Applicable to the Project

Name	Date Ratified by Ghana	Objective	How it Relates to the Project
Labour Relations and Workers' Rights			
Ghana has ratified 51 of the International Labour Organization (ILO) conventions, of which 37 are currently in force, including all eight fundamental conventions: • Forced Labour Convention, 1930 • Freedom of Association and Protection of the Right to Organise Convention, 1948 • Right to Organise and Collective Bargaining Convention, 1949 • Equal Remuneration Convention, 1951 • Abolition of Forced Labour Convention, 1957 • Discrimination (Employment and Occupation) Convention, 1958 • Minimum Age Convention, 1973 • Worst Forms of Child Labour Convention, 1999			Working conditions and regulation on site during construction and operation of the Project.
Energy, Climate Change and Air Quality			
The United Nations Convention Framework on Climate Change, 1992	6 Sept 1995	To achieve stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.	GHG emissions during the construction and operation of the Project
Paris Climate Agreement, 2015	22 Apr 2016	To respond to the global climate change threat by keeping a global temperature rise below 2ºC above pre-industrial levels and to pursue efforts to limit the increase to 1.5ºC.	GHG emissions during the construction and operation of the Project
The Montreal Protocol on Substances that Deplete the Ozone Layer, 1987	24 Jul 1989	To protect the stratospheric ozone layer by phasing out the production and consumption of Ozone Depleting Substances (ODS). Implemented in Ghana by the National Ozone Office within the EPA.	ODS use during the construction and operation of the Project
The Stockholm Convention on Persistent Organic Pollutants, 2001	30 May 2003	To eliminate or restrict the production and use of persistent organic pollutants (POPs). Ghana's National	POP use during the construction and operation of the Project

Name	Date Ratified by Ghana	Objective	How it Relates to the Project
		Implementation Plan was developed in 2007.	
Waste Management			
Basel Convention on the control of transboundary movements of hazardous wastes and their disposal, March 22, 1989	24 Nov 1992	To reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries.	Waste management during the construction and operation of the Project
Bamako Convention on the Ban of the import into Africa and the control of transboundary movement and management of hazardous wastes within Africa, January 31, 1991	26 Nov 1992	Rules concerning waste imports and movements, which have to be authorised by the authorities of each country and prohibiting the import of any hazardous (including radioactive) waste.	Waste management during the construction and operation of the Project
Biodiversity			
United Nations Convention on Biological Diversity (CBD), June 1992	27 Nov 1994	To develop national strategies for the conservation and sustainable use of biological diversity and a fair and equitable sharing of benefits arising from genetic resources. Implementation mechanisms for the Convention in Ghana include the National Biodiversity Strategy and Action Plan (NBSAP) and Shared Growth Development Agenda (SGDA).	Protection of the biodiversity in the surrounding area of the Project.
The Convention on the Conservation of Migratory Species of Wild Animals (The Bonn Convention), 1979	19 Jan 1988	To conserve migratory species within their migratory ranges	
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), also known as the Washington Convention, March 3, 1973	28 Apr 1975	To ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species.	
International Union for Conservation of Nature and Natural Resources (IUCN)	2003	The IUCN is the world's main authority on the conservation status of species. IUCN established a	

Name	Date Ratified by Ghana	Objective	How it Relates to the Project
		red list set upon precise criteria to evaluate the extinction risk of thousands of species and subspecies.	
African Convention on the Conservation of Nature and Natural Resources (known also as Algiers Convention)		The Algiers Convention is a continent-wide agreement that supersedes the Convention Relative to the Preservation of Fauna and Flora in their Natural State.	

2.6 International Standards

2.6.1 IFC Performance Standards

The IFC Policy on Environmental and Social Sustainability[1] defines the IFC's commitments to environmental and social (E&S) sustainability. The requirements for Projects in managing environmental and social risks are defined in the IFC Performance Standards (PS)[2].

Table 2.3: IFC Performance Standards

Performance Standard	Scope	Applicability	Addressed in ESIA
1. Assessment and Management of Social and Environmental Risks and Impacts.	Outlines the importance of managing E&S performance throughout the life of a project by using a dynamic environmental and social management system (ESMS). Defines requirements for ensuring appropriate E&S management, policy implementation and accountability, including ESIA requirements, emergency response, and stakeholder engagement.	✓	Ch6 Stakeholder Engagement, Topic Impact Assessment Chapters 8-19, Ch20 Major Hazards, Ch21 Cumulative Impacts, Ch22 E&S Management
2. Labour and Working Conditions	The requirements set out in PS2 have been in part guided by a number of international conventions negotiated through the UN and ILO. PS2 includes requirements for ensuring definition and implementation of fair recruitment and workforce management policies and safe and healthy working conditions.	✓	Ch 17: Labour and Working Conditions, Ch22 E&S Management
3. Resource Efficiency and Pollution Prevention	Defines requirements for ensuring an appropriate level of pollution prevention and abatement in line with international available technologies	✓	Ch8: Air Quality, Ch9: Climate Change, Ch10: Noise and Vibration, Ch11: Water Resources,

[1] IFC (2012) Environmental and Social Sustainability Policy https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/sustainability-policy/sustainability-policy Accessed 17 September 2020
[2] IFC (2012) Performance Standards, https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/Performance-Standards/ Accessed 17 September 2020

Performance Standard	Scope	Applicability	Addressed in ESIA
	and practices, including consideration of technical and financial feasibility.		Ch19: Waste and Ch20: Major Hazards, Ch22 E&S Management
4. Community, Health, Safety and Security (CHSS)	Defines requirements for ensuring that adverse impacts from the Project on the receiving community are managed and controlled.	✓	Ch15: CHSS
5. Land Acquisition and Involuntary Resettlement	Defines requirements for land tenure management and community resettlement as part of Project development including the need to improve, or restore, the livelihoods and standards of living of displaced persons.	✓	Ch14: Socio-Economic and Employment and Livelihoods A separate Resettlement Action Plan is also being developed for the Project
6. Biodiversity Conservation and Sustainable Management of Living Resource	Defines requirements for ensuring that the Project's impacts on nature, ecosystems, habitats and biodiversity are appropriately managed. Outlines requirements to maintain the benefits from ecosystem services.	✓	Ch13: Biodiversity and Ecosystem Services
7. Indigenous Peoples	Defines requirements for ensuring that the rights of Indigenous Peoples are respected and that they may benefit from the Project.	✕	N/A - No groups falling within the definition of 'Indigenous People' are affected
8. Cultural Heritage	Defines requirements for managing the Project's impacts on replicable and non-replicable cultural heritage.	✓	Ch16: Cultural Heritage

2.6.2 World Bank Environmental Health and Safety Guidelines

In addition to the IFC PSs, the IFC and World Bank Group have also developed general and sector-specific environmental health and safety guidelines. The EHS guidelines are designed to be used in conjunction with the IFC PSs, and provide guidance to users on common EHS issues potentially applicable to various industry sectors. The applicability of these guidelines should be tailored to the hazards and risks of a project based on the site-specific variables of host country context, assimilative capacity of the environment, and other project factors as deemed relevant by qualified and experience assessors. The key guideline documents applicable to the Project include:

- General Environmental, Health and Safety Guidelines, 2012;
- Environmental, Health and Safety Guidelines for Railways, 2007;
- Environmental, Health and Safety Guidelines for Retail Petroleum Networks[3], 2007;
- Environmental, Health and Safety Guidelines for Water and Sanitation[4], 2007; and
- Environmental, Health and Safety Guidelines for Construction Materials Extractions, 2007.

[3] For measures related to underground fuel storage tanks
[4] For measures related to water treatment

The IFC EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice. The industry sector EHS Guidelines incorporate information relevant to the specific facility/development and provide guidance on environmental, occupational health and safety (H&S) and community H&S aspects, as well as performance indicators and monitoring.

2.6.3 Project Categorisation

Both the OECD Common Approaches (Section 2.6.4) and Equator Principles (EP) IV (Section 2.6.5) classify projects as Category A, B or C based on the project risk level. EP IV defines Category A projects as those "*with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented*" whilst the OECD Common Approaches, expands on this to note that "*These impacts may affect an area broader than the sites or facilities subject to physical works.*"

Based on the likely impacts of the Project, it has been assumed for the purposes of this ESIA that the Takoradi Port to Huni Valley Railway Line rehabilitation be classified as a Category A project. This is in line with the illustrative list of Category A Projects provided in Annex 1 of the Common Approaches and which includes "*construction of railway lines that go beyond urban areas and of long-distance railway lines*".

2.6.4 OECD Recommendations (Common Approaches)

The OECD Common Approaches[5] are a series of recommendations for addressing environmental and social aspects and are applied by export credit agencies (ECAs) operating in OECD countries. The OECD Common Approaches promote good practices, application of international standards, and are designed to contribute to sustainable development through the consideration of international environmental, climate change, social and human rights policies, and commitments under relevant international agreements and conventions.

2.6.5 Equator Principles IV

The Equator Principles (EPs) are a voluntary set of standards for determining, assessing and managing social and environmental risk in projecting financing. The EPs are considered the financial industry 'gold standard' for sustainable project finance. EP Financial Institutions (EPFIs) will only provide loans to projects that comply with Principles 1-10 (Figure 2-2).

[5] Organisation for Economic Co-operation and Development (OECD), 2016. Recommendation of the Council on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence (the "Common Approaches"), April 2016, http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/ECG%282016%293&doclanguage=en Accessed 18 September 2020

Equator Principles IV (2020)
EP 1: Review and Categorisation - Requires that a project proposed for financing be categorised based on the magnitude of potential impacts and risks in accordance with the E&S screening criteria of the IFC
EP 2: Environmental and Social Assessment - Requires that for Category A or B projects, the relevant E&S impacts and risks be addressed through an E&S Assessment process, to include assessments of potential adverse Human Rights impacts and climate change risks as part of the ESIA or other assessment
EP 3: Applicable Environmental and Social Standards - Requires projects in non-designated countries, such as Ghana, to be in compliance with the IFC Performance Standards and the World Bank EHS Guidelines
EP 4: Environment and Social Management System and Equator Principles Action Plan - Requires that all Category A and Category B projects to develop and maintain an ESMS as well as prepare an MP to address the findings of the Assessment. This will describe and prioritise actions necessary to manage the impacts and risks identified by the Assessment
EP 5: Stakeholder Engagement - Requires that all Category A and Category B projects to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, Other Stakeholders
EP 6: Grievance Mechanism - Requires that all Category A and, as appropriate, Category B projects to establish a grievance mechanism as a component of their management system
EP 7: Independent Review - Requires that for all Category A projects and, as appropriate, Category B projects, an Independent Environmental and Social Consultant, must review the management plans, ESMS and Stakeholder Engagement process and assess compliance with Equator Principles
EP 8: Covenants - Requires that for all Category A and Category B projects the borrower ensures that all financial documentation will be compliant with the set covenant agreement. If compliance is not achieved, the EPFI will work with the borrower on remedial actions to bring the Project back into compliance. If unsuccessful, the EPFI reserves the right to exercise remedies, including calling an event of default, as considered appropriate
EP 9: Independent Monitoring and Reporting - Requires that for all Category A projects and, as appropriate, Category B projects, an independent expert will verify all monitoring and reporting information that is shared with EPFIs
EP 10: Reporting and Transparency - Requires that each EPFI commits to report publicly at least annually about its Equator Principles implementation processes and experience

Figure 2.2: The Equator Principles

The Equator Principles IV also require a human rights due diligence in accordance with the United Nations Guiding Principles on Business and Human Rights (UNGPs).[6]The EPs serve as a common framework for each adopting institution for its own internal social and environmental policies, procedures and standards. EPFIs commit to not providing loans to projects where the borrower will not or is unable to comply with their respective social and environmental policies and procedures that implement the EPs.

2.7 Lender Specific Standards

This ESIA is required to satisfy the requirements of the project lenders (EKN and Deutsche Bank). Deutsche Bank became a signatory of the Equator Principles in July 2020[7], and EKN as the Swedish Export Credit Agency applies the OECD Common Approaches. Both EKN and Deutsche Bank require the use of the IFC Performance Standards and World Bank EHS Guidelines when assessing the environmental and social risks and impacts of a project. EKN also applies the UNGPs[8].

In accordance with the OECD Recommendation on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence, EKN will disclose an ESIA for a Category A project for at least 30 days before final decision is made.

[6] United Nations, 2011. Guiding Principles of Business and Human Rights: Implementing the United Nations "Protect, Respect and Remedy" Framework. New York and Geneva, 2011.
[7] Equator Principles, EP Association Members & Reporting, https://equator-principles.com/members-reporting/ accessed 21 September 2020
[8] Human Rights, https://www.ekn.se/en/what-we-do/sustainability/human-rights/

2.8 Project Design Standards

The internationally recognised Eurocodes have been adopted as the main Design Standards the Project for structural analysis. The main standards adopted include:

- BS EN 1991-1-1: Eurocode 1 - Design Loads: General Loads – Dead Loads.
- BS EN 1991-1-4: Eurocode 1 - Design Loads: General Loads – Wind Loads.
- BS EN 1991-1-5: Eurocode 1 - Design Loads: General Loads – Therm. Actions.
- BS EN 1991-1-6: Eurocode 1 - Design Loads: General Loads – Erection Loads.
- BS EN 1991-2: Eurocode 1 - Design Loads: Live Loads.
- BS EN 1992-2: Eurocode 2 - Design of Concrete Structures – Concrete Bridges
- BS EN 1992-3: Eurocode 2 - Design of Conc. Structures – Concrete foundations
- BS EN 1993-1: Eurocode 3 - Design of steel structures – General Rules
- BS EN 1993-2: Eurocode 3 - Design of steel structures – Steel bridges
- BS EN 1993-3: Eurocode 3 - Design of steel structures - Piling
- BS EN 1994: Eurocode 4 - Design and composite steel and concrete structures
- BS EN 1997-1: Eurocode 7 - Part 1 Geotechnical Design – General Rules
- BS EN 1997-2: Eurocode 7 - Part 2 Geotechnical Design – Ground invest. and test.
- BS EN 1998-1: Eurocode 8 - Part 1 Design of structures for earthquake - general
- BS EN 1998-2: Eurocode 8 - Part 2 Design of structures for earthquake - bridges
- BS EN 206:2000 Concrete Specifications
- BS EN 445:2007 Grout for prestressing tendons. Test methods
- BS EN 446:2007 Grout for prestressing tendons. Grouting procedures
- BS EN 447:2007 Grout for prestressing tendons. Basic requirements
- BS 5896:1980 Prestressing cables specifications
- BS 4449:2005 Specification for carbon steel bars for reinforcement of concrete
- BS 4483:2005 Steel fabric for the reinforcement of concrete. Specification
- BS EN 1536:2000 Execution of special geotechnical work. Bored piles
- BS EN 13450: Aggregates for railway ballast
- BS EN 933: Tests for geometrical properties of aggregates

The stations shall be constructed/rehabilitated in line with the adopted European Railway Standards for the station facilities (e.g. waiting rooms, toilets etc) and operational requirements (e.g. ticket office, staff areas, and technical facilities/control rooms), including design standards for hardstanding areas, and sustainable drainage.

3. PROJECT DESCRIPTION

This chapter describes the redevelopment of the Takoradi Port to Huni Valley Railway located in the Western region of Ghana. The chapter is set out as follows:

- Section 3.1 provides an overview of the Project including location and key design requirements.
- Section 3.2 describes the rail alignment, proposed route including defined sections of the rail and alterations to the existing rail network, right of way and rail design, and the infrastructure required in each section including bridges, culverts, crossings and other key infrastructure.
- Section 3.3 provides details on the operational facilities required for the Project, including an overview of the locomotives using the rail, stations along the route, central control centre, and rail maintenance facilities including maintenance roads.
- Section 3.4 details the associated facilities for the Project including the Central Control Facility, Light Rail Maintenance Facility at Takoradi Port and the existing track between Takoradi and Manso that has already been constructed.
- Section 3.5 provides information on the operational timetable for the railway.
- Section 3.6 describes the construction methods and requirements including site preparation and earthworks, equipment, methods for constructing the required infrastructure, and temporary facilities required to complete the construction including logistics centre, accommodation requirements, access roads and any likely borrow pits.
- Section 3.7 outlines the resources required and expected waste during both construction and operation, including energy, utilities, water, materials and likely waste types and management.
- Section 3.8 provides an estimate of the workforce needs for the Project during both construction and operation.
- Section 3.9 provides an overview of the Project Schedule including detailed design, construction, commissioning and operation.
- Section 3.10 describes the lifetime and expected decommissioning requirements.
- Section 3.11 describes the mitigation measures that have already been incorporated into the Project, including both embedded design measures and Good International Industry Practice (GIIP). These are the measures the Project has agreed to incorporate either within the design itself, or as part of the construction and operation management to reduce potential significant effects to environmental and social receptors. As such these measures are taken into consideration during the impact assessment and in the identification of significant effects. The measures are also provided in the Environmental and Social Management Plan accompanying this ESIA.
- An overview of the alternatives considered during the development of the Project is provided in Chapter 4: Alternatives Assessment.

3.1 Project Overview

The Takoradi Port to Huni Valley Railway Project comprises upgrades to approximately 102 km of existing rail infrastructure. The project forms part of the wider Western Railway Line development being developed and ultimately operated by the Ghana Rail Authority (GRA), a major 340 km rail line which aims to connect the port of Takoradi to Kumasi (267km) with a branch route to Awaso (73km). The ultimate aim of this branch line is to be extended an additional 58km to connect to Nyinhan. The Project and its connection to the western railway line is shown in Figure 3.1.

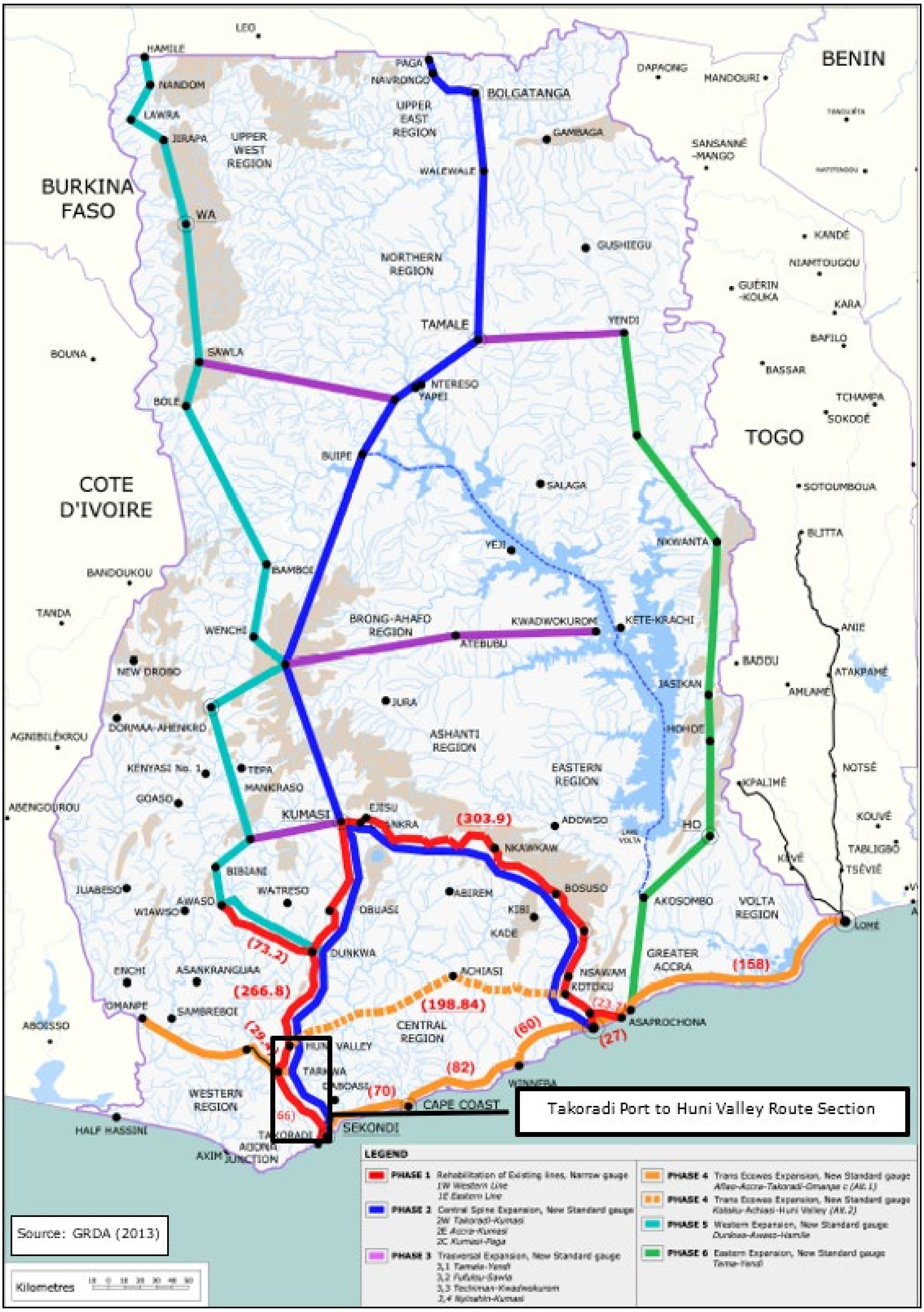


Figure 3-1: Railway Master Plan of Ghana

The Western Railway Line is expected to connect to two major existing manganese and bauxite mines and will support the delivery of essential cargo including cocoa, timber, cement, flour and other materials. In addition, the rail line would serve areas of Ghana with the 2nd and 4th largest populations, through the provision of a passenger service.

Amandi Infrastructure has been contracted by GRA to undertake the following works as part of the first section of the Western Railway Line between Takoradi Port and Huni Valley (Figure 3-2):

- Construction of the Takoradi Port rail lines
- Conversion of the existing rail to standard gauge between Takoradi Station and Kojokrom and replacement of the standard turnouts.
- Redevelopment of the Manso – Tarkwa – Huni Valley Standard Gauge Rail line.
- Construction of alignment bypasses including Eshiem, Manso and Tarkwa.
- Construction of eight stations at Amantin, Benso, Esuaso, Bonsawire, Nsuta, Tarkwa Bompieso and Huni Valley.
- Upgrades to/reconstruction of rail infrastructure including bridges, culverts, level crossings etc.
- Construction of workshop infrastructure and fit out.
- Supply of signalling and telecoms equipment and rolling stock.
- Temporary works and tracks for construction.

The rail is designed to carry both freight and passenger services, up to maximum speeds of 160 km/hr.

As part of the Project, some aspects of the rail upgrades have been funded through the government. These include the upgrade to the track in 2017 between Takoradi Station and Kojokrom which included installation of dual gauge sleepers to facilitate the subsequent upgrade to standard gauge. As a result, only the laying of the standard gauge rails on the previously installed sleepers in this area is required as part of the Project construction. The impact of the project in-combination with the existing operation of the track will be assessed as part of the cumulative impact assessment.

In addition, the track upgrades between Kojokrom and Manso are also currently in construction, with some 40-50% of the construction work completed. In this section, only the construction of the Eshiem offline section is within the Project. However, as the rail would not be able to operate without these upgrades, this section excluding the Eshiem offline section (which is part of the Project) is considered to be an Associated Facility (as defined under IFC Performance Standard 1[1]).

3.2 Railway Alignment

3.2.1 Proposed Route

For the purposes of the ESIA the 102 km Route has been broken down into five sections based on the type of upgrades required, and the environmental and social context the route will traverse. These sections are described in Table 3-1 and Figure 3.2. The environmental and social baseline associated with these sections is described in Chapter 7 of this ESIA. Infrastructure associated with each section is described in Section 3.2.3.

[1] IFC Performance Standard 1 defines associated facilities as "*facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable*".

Table 3-1: Sections of the Proposed Takoradi Port to Huni Valley Railway

Section	Route Chainage Section	Description
1	0 -10.2	This section runs from Takoradi Port to Kojokrom. The Project work comprises the lay down of the standard gauge rails onto the existing dual gauge sleepers between Takoradi Station and Kojokrom and development of the Port rail lines. The existing rail runs through a predominantly urban environment. Upgrades to the port rail lines require upgrade to standard gauge. This section also contains the light rail maintenance facility which has already been constructed close to the port, and is considered to be an Associated Facility as it will provide maintenance for the fleet during operation.
2	10.2-32.6	This section runs from Kojokrom to Manso. The Project work in this section comprises only the offline section around Eshiem. The track upgrades to the existing route have been funded via the government and are currently in construction with the majority of the earthworks completed; these upgrade works are not part of the funded Project, but are considered to be Associated Facilities. The line runs through a predominantly forested environment, and in close proximity to the towns of Angu and Manso
3	32.6 – 59.8	This section runs from north of Manso to south of Nsuta and comprises upgrade of the existing rail to a twin track standard gauge network, and the construction/upgrade of 4 stations (Amantin, Benso, Esuaso, Bonsawire). The line runs through predominantly forested environment. The route includes three main offline sections: to the south of Amantin, to the south of Esuaso, and to the east of Bonsawire.
4	59.8 – 67.3	This section runs from Nsuta to north of Tarkwa and requires upgrade to a twin track standard gauge network. The section includes the most significant route realignment. Works include the decommissioning of the line which currently runs through the centre of Tarkwa and relocating it to the east of Tarkwa. This section also includes the construction of the Nsuta and Tarkwa stations as well as the construction and initial set up of the Heavy Rail Maintenance Facility including the fuel storage area at the new Tarkwa Station. The route runs through a typical forest/crop matrix habitat with some settlements. .
5	67.3 – 85.8	This is the remaining stretch from the north of Tarkwa to the Huni Valley station and is a single line standard gauge track. This stretch contains two main straightening realignments and construction of 2 stations (Bompieso and Huni Valley) and is predominantly forested. This section requires the reestablishment of the railway following disuse, and may include one passing loop, with the location and exact design to be determined during detailed design.

The proposed route has been developed using the existing rail line as far as practicable. A total of seven main offline sections have been developed to reduce curvature and allow for the safe running of training at 160 km/hr. These are shown in Figure 3-3 and Figure 3-4. Some smaller straightening of the route may be required in specific areas, however, these are likely to remain within the footprint of the temporary construction boundary.

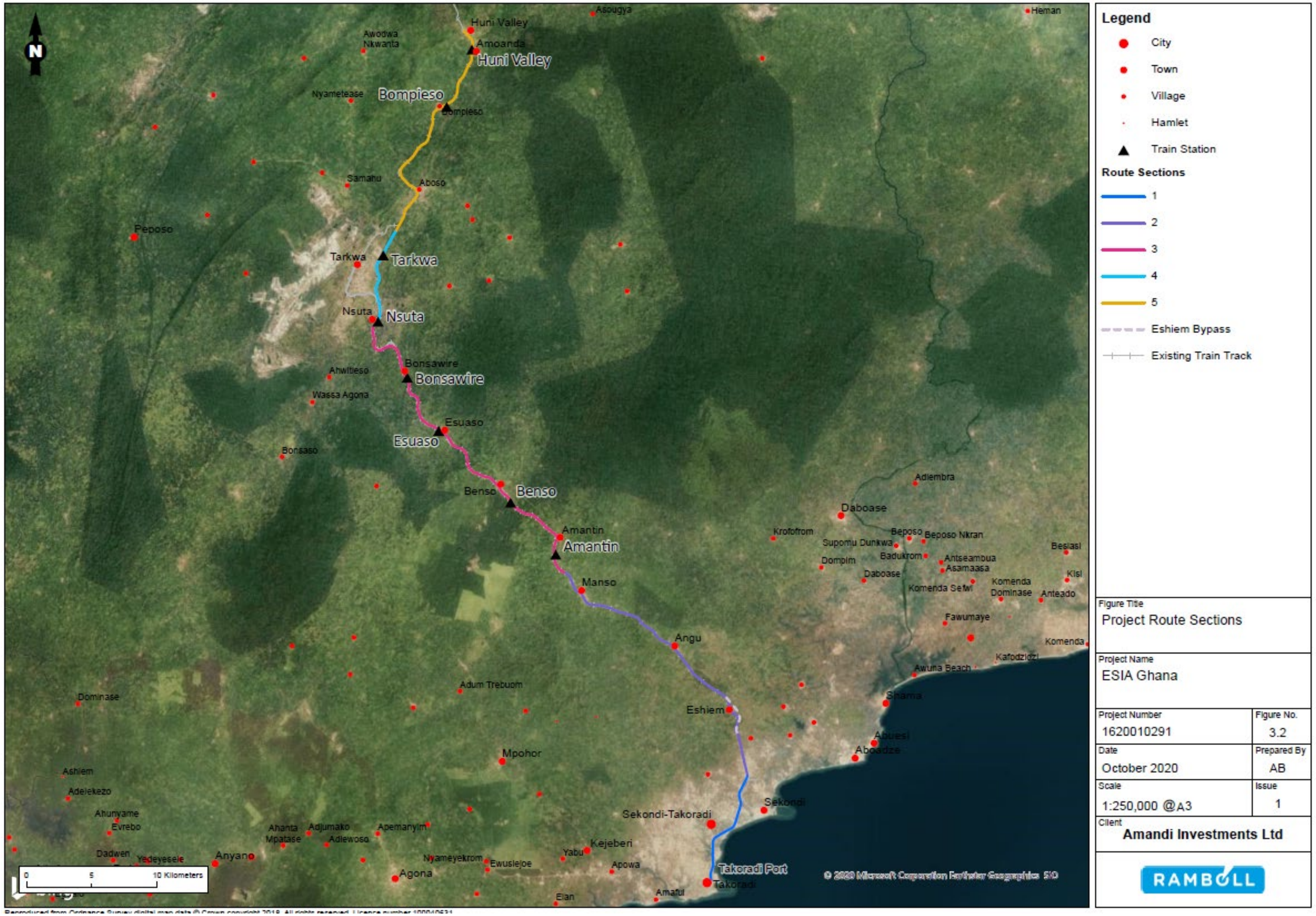


Figure 3-2: Project Route Sections

These seven offline sections are described in more detail below.

Eshiem

The track at Eshiem will require a realignment of approximately 3km to provide a safer curvature to the east of the current alignment and closer to an existing fuel storage area at Eshiem. The realignment starts at approximately KM 13.0 and re-joins the existing track at approximately KM 15.5. The rail will be standard gauge and twin track in this area.

An indicative alignment has been provided, which will be finalised during detailed design and prior to construction to avoid any critical natural habitat and sensitive receptors. In particular, the alignment will need to avoid fuel tanks and storage areas at the nearby existing facility, and a safe distance away from this will need to be maintained.

The new alignment runs through predominantly pre-disturbed areas, comprising existing compacted land for the fuel storage facility, or compacted roads, with some natural unforested habitat surrounding the cleared areas. The realignment will require an additional 9 hectares of land to be acquired.

Amantin

The offline section at Amantin requires a short distance (1km) of realignment to allow for a safer curvature to the east of the existing alignment and closer to the settlement. The realignment runs from KM 35 to KM 36. The rail will be standard gauge and twin track in this area.

The straighter alignment runs through a predominantly semi forested area and brings the rail to the edge of the settlement. An additional 9.63 hectares of land will be required for the permanent RoW.

Esuaso

The original alignment to the south of Esuaso will be straightened at KM 47 and re-join at approximately KM 47.5. This section will therefore move east slightly and closer to the settlement.

There are two other small realignments at KM 44 and KM 46. Both of these are to reduce the curvature over a short distance (circa 100-200m). The realignment is adjoining the existing permanent RoW. The rail will comprise standard gauge twin tracks in this area. The straighter alignments run through predominantly mixed forested/plantation areas and will require an additional 2.87 hectares of land to be acquired.

Bonsawire

The original narrow gauge track at Bonsawire includes a high curvature alignment. To improve the track alignment a new standard gauge track will commence at KM 55.4 and continue on a straighter alignment for 2.2km until it re-joins the existing alignment at KM 57.5 (see Figure 3-4). There are currently two options for the alignment. Option 1 provides for a new single track section with the existing narrow gauge track remaining in place for future redevelopment to a second standard gauge line. The alignment will take the route closer to the settlement and at the point of re-joining the existing alignment is likely to require some resettlement/relocation of property.

In addition, there are two small realignments between KM51 and KM52, and two between KM 52 and KM 53. All of these smaller realignments are to reduce the curvature over a short distance (circa 100-200m). The realignments adjoin the existing permanent RoW.

The shorter and straighter alignments will be located in mixed forested and farmed area with a typical matrix of cleared and wooded patches. The realignments will require an additional 8.72 Ha of land acquisition.

Tarkwa

This section represents the most significant variation to the existing route. The original rail runs on a narrow gauge for 10.8 km through the town of Tarkwa, with the station to the west of the town. The proposed offline section starts at KM 60.8 and follows a 7.2 km route to the east of Tarkwa away from the centre of the town and sensitive receptors with a new station at the north east of the town near existing road links. The offline section re-joins the existing route at KM 68.

The section will require an additional 26.6 Ha of additional land. The new route will run through predominantly semi urban land with some properties, crops and existing industry (e.g. mining/quarrying). A new station will be constructed along the new route at around KM 65 (see section 3.3.2), as well as the heavy rail maintenance facility (Section 3.3.3).

The shortening and straightening of the track alignment, combined with a new single standard gauge track, allows for significant improvements in the geometry reducing risk of accidents and unplanned events.

Abooso

The original alignment to the north of Tarkwa will be straightened at approximately KM 70.5 and re-join the track at KM 71. The rail in this location will be single track and standard gauge. The realignment moves the rail away from a significant number of properties in the main settlement, but closer to a few properties located on the western side.

The straighter alignment runs through predominantly semi urban area and will require an additional 1.64 hectares of land to be acquired.

Bompieso

The track at Bompieso will require minor realignment in two areas between KM 72 and KM73 and at KM 78 to provide a safer curvature in the area. The rail will be a single track standard gauge.

The straighter alignment runs through predominantly forested/mixed semi natural habitat area and will require an additional 7.71 hectares of land to be acquired.

Figure 3-3: Offline Route Sections (Amantin to Bonsawire)

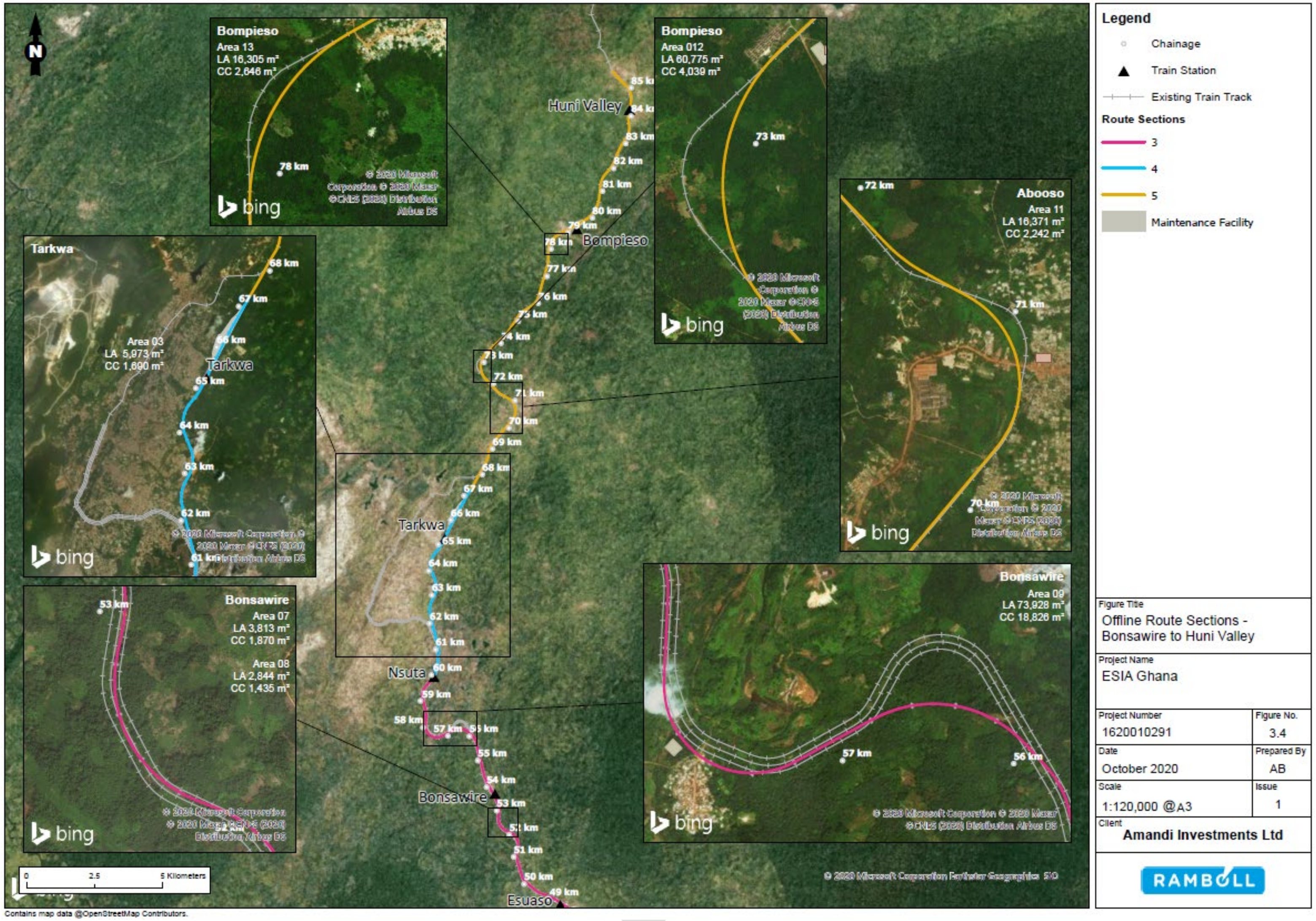


Figure 3-4: Offline Route Sections (Bonsawire to Huni Valley)

3.2.2 Rail Width and Permanent Right of Way

The permanent right of way (RoW) for the standard gauge rail will generally be 30m either side of the centre line of the track, except for locations such as stations, sidings and turnouts, where the permanent RoW will need to be wider to accommodate the infrastructure.

Where the rail is single track in section 6, passing loops will generally be provided within the stations within the permanent footprint.

Construction will occur within the permanent RoW for the majority of the Project. Where laydown areas are required to support construction, these will generally be confined to a 7m wide x 60m long bay located adjacent to the working area and likely to be outside of the RoW. It is anticipated these will only be in-situ for a few weeks during the construction of the section, and will be rehabilitated once the construction has been completed. It is expected that temporary laydown areas will be required every 2 km, to be opened and closed as construction progresses along the route.

A permanent maintenance road will not be required as most maintenance activities will conducted using the new rail infrastructure, however, access points to the rail using existing road crossing points will be provided to ensure access to the rail can be maintained especially in case of emergency works.

The proposed route overall width exceeds the present Right of Way (RoW) for 15% of the total length from Manso to Huni Valley. For the stretch out route from Kojokrom to Manso, which is already under construction, 6km of the 22km route fall outside the existing RoW.

3.2.3 Track Design

Track design will follow GIIP with the use of specified layers of ballast, precast concrete sleepers and track. An example schematic layout is presented in Figure 3-5.

In general, ballast will be laid along the full length of the main route (including any loops) to a depth of 30cm. The depth will be reduced to 25cm for any bridges, and to 20-25 cm for loops, sidings and service tracks. The total quantity of ballast required for the Project will be approximately 160,000 cubic metres. Ballast will vary in size between 26mm and 63mm but 80% of the material will be at the coarser 63mm size. The material will be sourced from waste material from an existing manganese mine in the area (the waste fraction from the mining activity is currently stored for disposal at the end of the lifetime of the mine, but is of the right grade and quality for use on the rail). The local mine has sufficient waste fraction capacity to supply the full ballast requirement for the Project and thus removes the requirement for sourcing of new ballast material.

Following the laying of the ballast, pre-stressed concrete sleepers will be laid at intervals of 60cm along the main route and any loops. The spacing between the sleepers will be modified to 66.6cm for turnouts, stations and sidings as appropriate, and at 75cm spacing for all other station tracks.

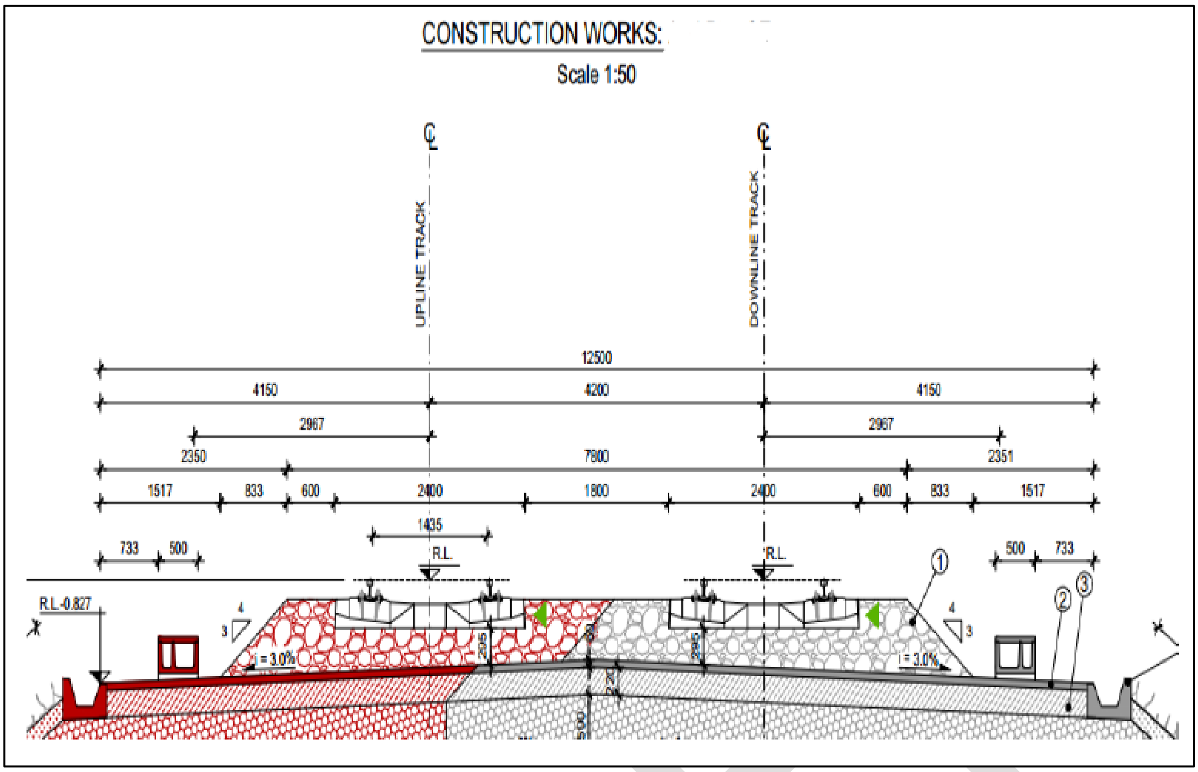


Figure 3-5: Example Schematic Layout

The sleepers will be prefabricated in Sweden to the following approximate dimensions:

- 2,600mm long
- 220mm at the bottom level increasing to 300mm wide at the ends.
- 175mm to 180mm high increasing to 210mm under the rail.
- 240 – 280kg in weight

The total number of sleepers required will be approximately 127.5 thousand. These will be shipped from Sweden to Takoradi Port, and from there transported to the required location via flatbed trucks.

The sleepers are stabilised underneath through packing ballast and using a special tamping machine.

Once the sleepers have been laid the rails will be laid on top of the sleepers and fixed using special Vossloh fasteners (elastic steel fastened with spring clip and screw). The rails will be prefabricated using Grade 275 pre-stressed steel with a design life of 50 years and capable of withstanding current and future variations in temperature from 20ºC to 70ºC. Each rail will be approximately 18m long. Rails will be shipped to the Project site from Sweden via Takoradi port and installed using specialist rail-based track installation equipment. 8,300 tons of rails are estimated to be required.

Once the rails are in place, the joints will be arc welded using specialist machines (e.g. ARS-4 device) which raises the rail to the required temperature and using hydraulic pressure produces a homogenous rail joint with minimal additional profile work. The joints are designed to reduce train resistance and prolongs the lifetime of the rail.

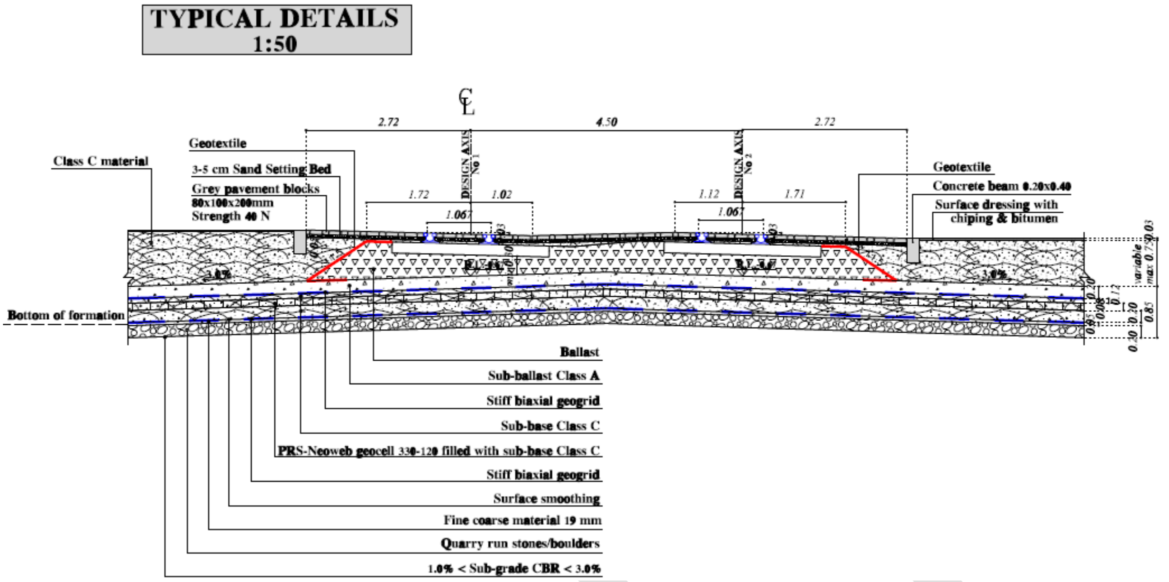
3.2.4 Rail Infrastructure

Bridges and Crossings

Where road crossings are required these will generally be grade separated with the rail constructed over the top and perpendicular to the road or, as a minimum, at 45 degrees to allow safe transit for vehicles passing underneath. The road leading into and out of the crossing will be rehabilitated and the surface dressed with chipping and bitumen to ensure stability of the structure. The rail will be constructed to allow for a maximum of 6% slopes into and out of the crossing. The crossing itself will be a minimum of 9m above the road surface, rising to 11m in the centre. The design of the rail on the crossing is shown in Figure 3.6a. Ballast on the crossings will be reduced to 25mm depth. Pedestrian access will be provided as underpasses adjacent to the road to ensure vehicles and pedestrians are segregated. Safety fencing will be installed to prevent pedestrian access to the rail.

Where at-grade crossings are required, these will be designed to be fully automated, but can be operated semi-automatically or manually if required. The barriers will be full width across the road to ensure vehicles are prevented from crossing. The crossing will be perpendicular to the rail (or as close as possible to this) to ensure safe crossing. The road will be rehabilitated and surface dressed with chipping and bitumen to ensure stability, and the rail constructed through the centre using the formation shown in Figure 3.6b.

(a) Raised Level Crossing



(b) At Grade Level Crossing

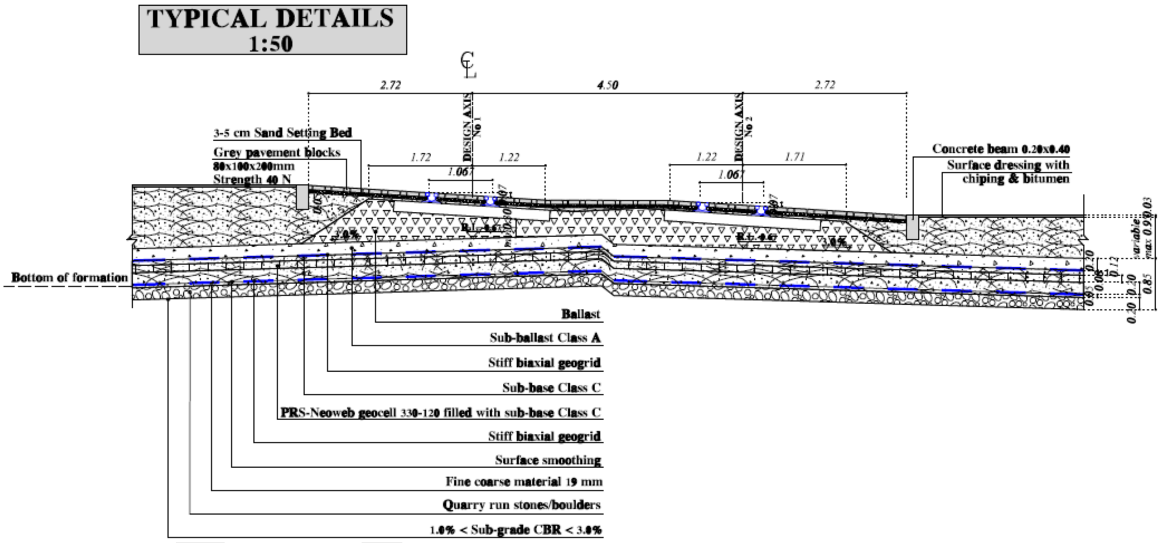


Figure 3-6: Typical Level Crossing Cross Section (a) Raised and (b) At Grade

Pedestrians will be able to cross with the vehicles along the existing road and pavement. Security fencing will be installed to prevent pedestrian trespass onto the rail. In addition, drainage will be installed parallel to the rail to ensure flooding from surface waters is controlled at the crossing.

Locations for three new level crossings have been identified in Route Section 5:

- Located north of Tarkwa between New Atuabo and Abooso at KM 67.8;
- Southwest of Bompieso at chainage KM 78.6; and
- In Huni Valley at chainage KM 85.6.

Where possible, existing bridges will be retrofitted to reinforce the footings/foundations by casting concrete around them. Weakened decks and parapets will be replaced using the standard design formation described for grade separated crossings.

Where new bridges are required these will be constructed as far as practicable to be single span with the same design formation described for grade separated crossings. Where multiple spans are required, these will be supported using piers, and designed specifically for the type of crossing required.

Four road over bridges, eight rail bridges, one rail overpass, one rail viaduct and twelve underpasses are identified in sections 3 to 5 of the propose route(see Table 3-2):

Table 3-2: Railway Bridges

Section	Chainage	Type	No. lanes / tracks	Structure Type
3	37.1	Road over bridge	2 lanes	R.C. Deck Girder
	41.1	Road over bridge	2 lanes	R.C. Deck Girder
	47.6	Rail Bridge	2 tracks	R.C. Deck Girder
	47.9	Underpass	2 lanes	R.C. Box Frame
	48.5	Rail Viaduct	2 tracks	R.C. Deck Girder
	50.5	Underpass	2 lanes	R.C. Box Frame
	52.9	Road over bridge	2 lanes	R.C. Deck Girder
	53.7	Rail Bridge	2 tracks	R.C. Deck Girder
	54.2	Underpass	2 lanes	R.C. Box Frame
	55.1	Rail overpass	2 tracks	R.C. Box Frame
	57.1	Underpass	2 lanes	R.C. Box Frame
	57.3	Rail Bridge	2 tracks	R.C. Deck Girder
	59.3	Underpass	2 lanes	R.C. Box Frame
	59.6	Rail Bridge	2 tracks	Steel Truss
4	60.2	Rail Bridge	2 tracks	R.C. Deck Girder
	60.7	Road over bridge	2 lanes	R.C. Deck Girder
	61.6	Underpass	2 lanes	R.C. Box Frame
	62.0	Underpass	2 lanes	R.C. Box Frame
	63.1	Underpass	2 lanes	R.C. Box Frame
	64.0	Underpass	2 lanes	R.C. Box Frame
5	69.9	Underpass (3.0x3.0m)	2 lanes	R.C. Box Frame
	70.7	Underpass (10.0x5.0m)	2 lanes	R.C. Box Frame
	71.8	Rail Bridge	18m span	R.C. Deck Girder
	73.5	Underpass (10.0x5.0m)	2 lanes	R.C. Box Frame
	82.2	Rail Bridge	18m span	R.C. Deck Girder
	84.55	Rail Bridge/Viaduct	12+12+12m span	R.C. Deck Girder

Culverts and Drainage

The rail, stations and other infrastructure will be designed to allow for sustainable drainage of the track. Run off from the track will be managed through a series of channels and collected for discharge. Drainage channels will be pre-cast and placed in-situ before the sub-ballast is laid for the track. The drain will be placed within a concrete blinding, which is cast in-situ using cement to a length of 1m and 100mm thick. The pre-cast drain is then laid on the concrete blinding and jointed using cement grout to be true to line and levels.

Oil interceptors will be fitted to discharge points to ensure any drainage water is free from primary run-off pollutants prior to discharge to land or watercourses.

Drainage under the track to allow for free flow movement of rainfall will be provided through a series of land drains and culverts sized according to the water conveyance requirements.

Land drains typically comprise trapezoidal, V or U-shaped drainage ditches. These are cast in-situ. The trench is excavated and then stabilised with 250mm rocks/boulders compacted to the level of the concrete liner (blinding). The concrete liner is then cast and lined with wire mesh before a final concrete layer is added. The concrete drain is allowed to harden and cure for seven days before use. Oil interceptors will be fitted to discharge points to ensure any drainage water is free from primary run-off pollutants prior to discharge to land or watercourses.

Culverts will typically be either pipe or box culverts. Locations and dimensions for the culverts are provided in Table 3-3.

Most culverts will be constructed in-situ, especially for land drainage. Where in-situ casting is not appropriate, the culverts will be cast at the concrete batching plants located in the logistics camps to the required dimensions and transported to the construction location via truck.

Culverts will typically comprise an excavated area to allow for the required size of culvert. To provide uniform and appropriate support to the culvert, the culvert bottom will be supported by a 1.5m thick layer of compacted boulders and cobbles (0/250mm) onto which the lining for the culvert (blinding) can be cast from concrete. The culvert will be cast in-situ (or installed if prefabricated off site) onto the concrete lining and then coated with a waterproof membrane. Reinforcement at either end of the culvert to provide protection from erosion and undercutting will be installed. Culverts on watercourses will be installed such that the base of the culvert is sufficiently below the bed level of river/stream so that a natural bed can reform. Backfilling of the natural bed to a thickness of 250mm will be undertaken.

Culverts required to allow the passage of water courses will be constructed to allow the free passage of fish and aquatic species by using clear span bridges or open bottom culverts that allow for natural bed materials and natural flow to be maintained.

Table 3-3: Proposed Box Culverts

Section	No. culvert locations	Box Culverts	Number proposed
3 (32-59.8)	46	1.5x1.5m	20
		2.0x1.0m	20
		2.0x1.5m	15
		2.0x2.5m	23
		3.0x2.5m	1
		3.0x3.0m	5
		Section 3 Total	84

Section	No. culvert locations	Box Culverts	Number proposed
4 (59.8-67.3)	14	1.5x1.5m	11
		2.0x1.5m	1
		2.0x2.5m	2
		3.0x2.5m	12
		Section 4 Total	26
5 (67.3-85.8)	32	1.5x1.5m	28
		2.0x2.0m	8
		3.0x2.5m	7
		3.0x3.0m	3
		Dimensions still to be confirmed	2
		Section 5 Total	51
Total (all sections)	82		161

Sidings/loops/turnouts

Sidings and turnouts will only be required at the stations and at the maintenance facility. These will be relatively small and be contained within the permanent RoW for the facilities. These are shown in Figure 3-7 and Figure 3-8.

Passing loops will also largely be provided in the station area for the single track in Section 5. It is expected that only one passing loop outside of the stations will be required. This will require an area of 0.06 km^2 (approx. dimensions are 60m x 1000m), and once designed will be located within the permanent RoW.

3.3 Rail Operational Facilities

The rail will be designed to operate at speeds of 120 km/h, although for safety reasons in some sections speeds will be restricted to 110km/h. Freight trains are to run at maximum speeds of 80 to 100 km/hour depending on the load.

To ensure the safe running of the trains along the route, each station will be equipped with a light home signal and related distant signal with two superimposed lights at both sides to allow movement into the station at speeds no more than 30 km/h. Departure signals can clear only with authorization of the automatic block system that carries out a comparison between train axle number at input of block section and same number at output of the block section. All these light signals and the powered turnouts will be controlled and commanded by the Station Master through the safety electromechanical interlocking located in the station building.

Other non-powered turnouts at the stations will be individually remotely controlled which will send its position (normal or reverse) to the interlocking control at the station building.

All at grade crossings will be designed to be fully automated and linked to the Central Control Facility. However, the design will allow these crossings to be used manually or semi-automatically if required to ensure safe running of the rail.

Long distance data transmission for all communication types will be based on Synchronous Digital Hierarchy technology. Fibre-optic cables along the railway line will be installed with signal regenerators in each station. Digital Mobile Radio communication systems will be reserved for land-train service communication with a frequency band dedicated for use on the railway network. The system is simple and efficient, using Base Station repeaters installed at 60-80km distances depending on the topography of the terrain along the route.

3.3.1 Trains

Freight rolling stock for the Standard gauge rail will initially comprise two diesel locomotives at 3500 HP or more, with 64 Kiruna bottom dumper mineral wagons. Each wagon is between 10-12m long (depending on specification) and with an axle load of 25 tonnes per wagon. The wagons are designed to operate at temperatures between -40 degrees to +60 degrees Celsius. The initial provision will provide greater capacity for the mines than currently served by the narrow gauge rail. The modular construction of the wagon simplifies maintenance requirements, allowing full maintenance to be achieved with a team of two trained personnel. Typical average annual wagon speed will be between 17 and 25km/hour.

The wagons will be pulled by the Bombardier TRAXX 3500 hp diesel locomotive, built in India or Indonesia and shipped to Takoradi port. The locomotives are designed to perform to the full operation speed for the rail (i.e. 120km/hour) and can be used for both freight and passenger wagons. The locomotives meet the EU emission standard level IIIB and are fuel-efficient and quiet. The locomotive’s multi-engine concept of four diesel engines means the engines can be switched on and off individually as required so the locomotive only uses the energy it actually needs.

According to the Ghana Rail Masterplan[2], the passenger service will comprise a diesel locomotive with a 12-carriage formation. The formation would carry between 800-1200 passengers. The exact specification for the carriages has not been defined, however, the locomotives will be designed to meet the EU level IIIB or equivalent emission standards.

3.3.2 Stations

A total of eight stations will be constructed along the route. Many of the existing stations are no longer in use or unable to support the new railway configuration. The stations shall be constructed/rehabilitated in line with the adopted European Railway Standards for the station facilities (e.g. waiting rooms, toilets etc) and operational requirements (e.g. ticket office, staff areas, and technical facilities/control rooms), including design standards for hardstanding areas, and sustainable drainage. Station design shall be inclusive and designed for physical and sensory disabilities. Pedestrian under/overpasses for twin platform stations will be installed as well as elevators for access to the train platforms where required.

Where possible, rehabilitation of existing station buildings will be undertaken. New stations shall be located on flat, straight stretches of the line where practicable to allow for easy access, boarding and disembarkation from the trains. The general concept design is shown in Figure 3-7.

Each station shall comprise as a minimum the following:

- Parking facilities for cars, motorcycles and bicycles sized dependent on location and future demand.[3] For most standard station configurations with two platforms this will equate to an area sufficient for approximately 35 parking spaces with 80% dedicated to cars and the remaining 20% for motorcycles and bicycles.

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[2] GRDA (2013) Railway Master Plan of Ghana, https://new-ndpc-static1.s3.amazonaws.com/CACHES/PUBLICATIONS/2016/05/03/1-MASTER+PLAN+GHANA+FINAL+REPORT+-+Fin4.pdf accessed 22 September 2020

[3] Calculation defined in the Railway Masterplan of Ghana 2013 where 40 m^2 of parking area for every 100 m^2 of gross built up paved area is recommended, with each parking space for a car occupying 27 m^2. In addition, $1m^2$ parking area per $30m^3$ construction is to be added.

- Pick up and drop off facilities for Park and Ride vehicles, designated taxi routes and waiting areas.
- Green areas and street furniture including lighting for the main areas.
- At least one route that is completely accessible to passengers with motor or sensory disabilities from the entrance to all main services of the station. This route must have a minimum width of 1.6m and minimum height of 2.3m which is free from all obstacles.
- All routes designed to be in full compliance with fire regulations for escape.
- Passenger building/terminal incorporating:
  - Ticket office;
  - Toilets;
  - Waiting areas (and separate VIP waiting area);
  - Service office for the rail operations staff;
  - Commercial and catering areas including luggage facility; and
  - Facilities for Currency exchange and ATMs.
- One or two platforms depending on track layouts.
- Signage and notice boards including tactile routes and maps for the blind.
- Underpasses where crossing to other platforms is required.
- Bicycle racks.
- CCTV.
- Fencing around the stations.
- Access gates for out of hours and emergency access.
- Generator and associated fuel storage.

Further information on the exact requirements for each of these aspects is provided in the Railway Masterplan of Ghana (GRDA 2013).

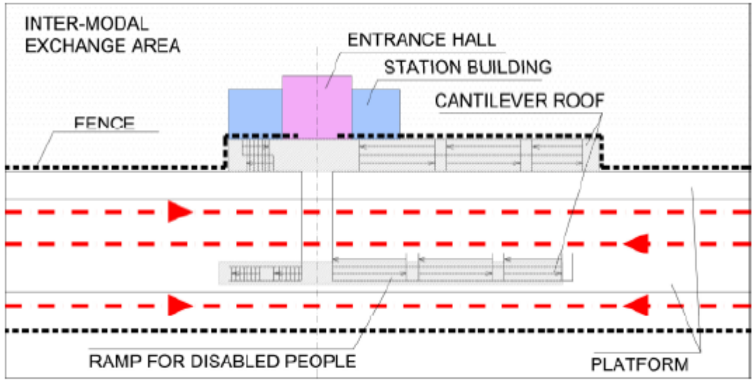
Figure 3.4 Typical Station Layouts

New stations shall be located on flat, straight stretches of the line where practicable to allow for easy access, boarding and disembarkation from the trains. Each station shall comprise the following:

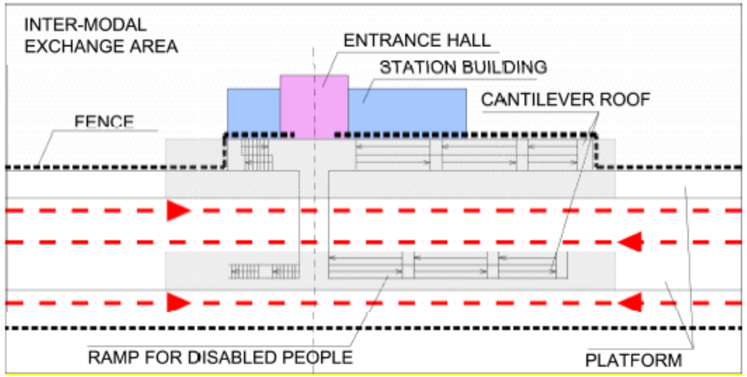
- Parking facilities for cars, motorcycles and bicycles sized dependent on location and future demand.
- Pick up and drop off facilities for Park and Ride vehicles, designated taxi routes and waiting areas.
- Green areas and street furniture including lighting for the main areas.

The Railway Master Plan for Ghana identifies two main station configuration based on forecasted passenger traffic: Type 1 (for lower passenger numbers, typically less than 2-400 passengers per weekday) and Type 2, for over 2-400 passengers per weekday.

Type 1:

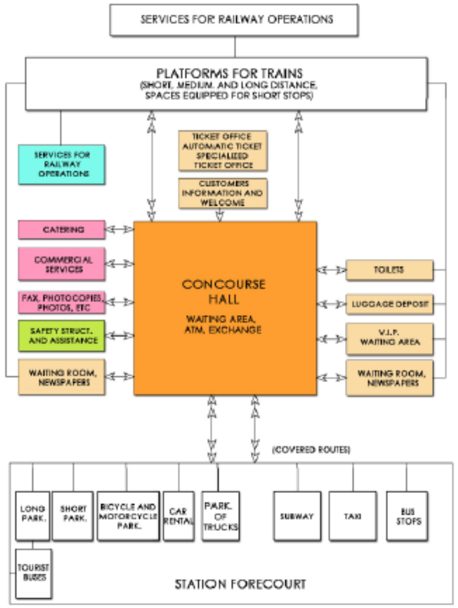


Type 2:



The Railway Master Plan also identifies two main concours hall types, based on analysis of compatible activities, as illustrated below.

Scheme A:



Scheme B:

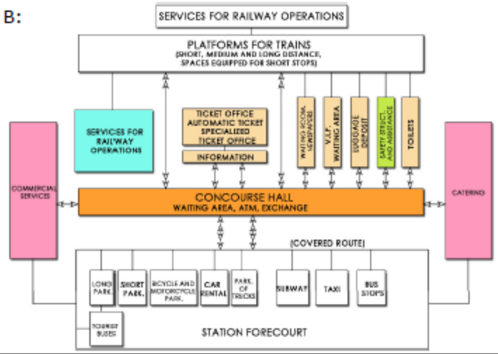


Figure 3-7: Typical Station Layout

Platforms

Platforms will be constructed taking into account the final level of the station building and the trains using the station. The exact height of the platform above the rail will be determined in the detailed design phase and prior to construction. The general dimensions for the platforms will be 250 m long x 4 m wide for single sided platforms and 350 m long x 10 m wide for double sided platforms respectively.

Platforms will be constructed using concrete paving blocks with the main surface having a 1 to 1.5% slope to allow for drainage. Each end of the platform will be designed with ramps at 8% slope to provide access from the ground level to platforms.

In addition to the station building, platforms will be designed to provide shelter from inclement weather conditions. The shelters will be at least 4.8m above the track level. Shelters will be located both on the platforms at the station entrances. Cantilever rooves will be provided at key areas on the platforms including over stairs and pedestrian routes, and along the platform waiting areas.

Signage will be provided at all stations. Where signage is to be hung below the shelters the bottom of signs and associated equipment will be at least 2.5m above the platform level. All signage must be designed to be inclusive of physical and sensory disabilities.

Floor signage and safety zones will also be provided including a yellow line between the platform waiting area and the platform edge to protect passengers from oncoming and through trains.

Footbridges or underpasses will be installed at main stations to provide passage between platforms. These will be designed with ramps to assist disabled passengers.

3.3.3 Heavy Rail Maintenance Facility

The main heavy rail maintenance facility will be provided adjacent to Tarkwa Station. This facility is designed to undertake all maintenance on the locomotives and wagons, including spares fitting, cleaning, washing, refuelling, and maintaining the locomotives themselves in terms of spares and routine checks (brakes, electronic controls, driving equipment etc.).

The facility will comprise:

- Access road to the facility for staff and goods;
- Gate house for security staff and access control;
- Segregated tracks for moving locomotives;
- Goods shed;
- Stockpiling area (primarily for minerals);
- Loading area;
- Civil works and Permanent RoW maintenance area;
- External inspection pits;
- Depot for locomotives to be maintained and serviced;
- Washing facilities for the locomotives and wagons;
- Power generation building (housing diesel generators);
- Water treatment facility including potable water tower and pumping facility;
- Signalling building;
- Staff canteen, offices and first aid centre;
- Fuel storage area comprising two 50,000 litre tanks; and
- Shunting locomotive storage shed.

The site will include wastewater and stormwater systems for:

- Collection and treatment of workshop area drainage and process effluents by sediment and oil interceptors;
- Sewage collection in cesspits; and
- Collection of storm drainage.

Train washes, process water and toilets will be supplied from the treated potable water supplies.

The fuel storage area will comprise two storage tanks each containing 50,000 litres. These will be located either above ground (ASTs) or underground (USTs). ASTs would be installed as the preferred option where practicable.

The design of any underground storage area will be in line with *European Standard EN 122855 – 1 ed 2 Workshop fabricated steel tanks - Part 1* or equivalent. This standard presents the design requirements for horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and non-flammable water polluting liquids.

In general, the design will include:

- Locating tanks away from areas with potential for vehicle collisions and damage;
- Installation of a secondary containment systems to prevent the uncontrolled release of fuel (e.g. double wall construction);
- Installation of impermeable liners or structures under and around tanks (e.g. concrete vaults);
- Inclusion of a leak detection systems to detect the presence of liquid or petroleum vapor within the interstitial space;
- Use of corrosion protection in steel tanks and piping (e.g. dielectric coating or cathodic protection);
- Inclusion of automatic shut-off devices and catch basins around fill pipes;
- The use of unjointed polyethylene piping and continuous, flexible composite piping rather than metal pipes; and
- Secondary containment for any pressurised piping system.

Where fuel storage is located in ASTs, these will be designed to incorporate secondary containment measures including:

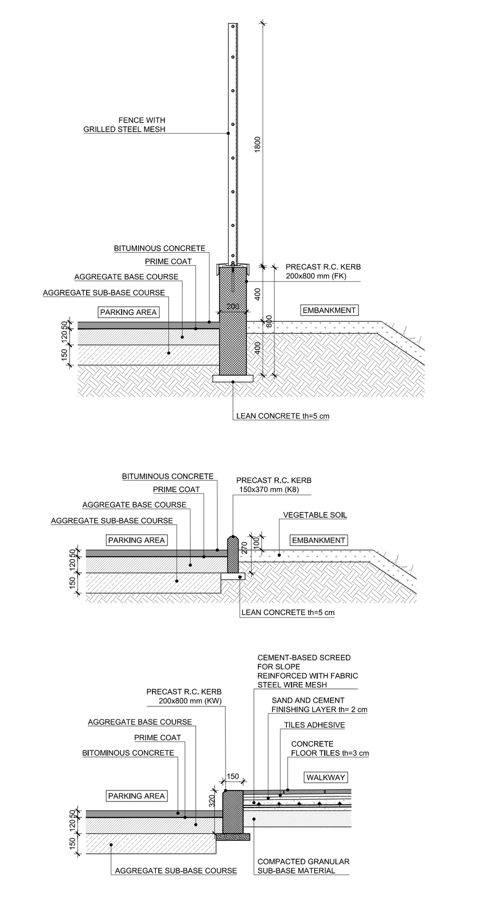
- Installation of berms/or walls to contain 110% of the largest tank or 25% of the combined tank volume whichever is larger;
- Impervious, chemically resistant hardstanding in the containment area;
- Dedicated runoff/drainage area not connected to a municipal facility to allow storage and transfer to a special hazardous waste facility as required, and incorporation of shutoff valves with oil separators where segregation is not possible; and
- Installation of leak detection equipment for the tanks.

A borehole for the supply of water will be required at the facility. Water will be abstracted and pumped to a water tower for use. Testing of the water will be conducted prior to construction to identify the water quality of the supply. Where this does not meet the applicable national and/or international requirements, a small water treatment plant will be installed at the facility to treat the abstracted water prior to supply.

The operation of the water treatment plant will incorporate a leak detection and repair programme, and a small pumping station will ensure water pressure is maintained for consistent supply. The design of this facility, if required, will be completed prior to construction and following any borehole water testing.

Wastewater during construction and operation will be collected in septic tanks and collected for off-site disposal at registered facilities.

R.C. KERB DETAILS
Scale 1:20



LEGEND

FUTURE URBAN RAIL LINE
MAIN LINE TRACKS
SIDING TRACKS

HYDRAULIC

Concrete shells as gutter
Water flow
Grilled drain channel

GENERAL NOTE:	
1	FOR ARCHITECTURAL AND STRUCTURAL DETAILS SEE RELEVANT DRAWING
2	FOR CIVIL PLANT AND TECNICAL INSTALLATION DETAILS SEE RELEVANT DRAWING
3	FOR HYDRAULIC AND RAIN WATER COLLECTION NETWORK DETAILS SEE RELEVANT DRAWING
4	FOR ACCESS ROAD SEE RELEVANT DRAWING

REPUBLIC OF GHANA

MINISTRY OF TRANSPORT

CLIENT: GHANA RAILWAY DEVELOPMENT AUTHORITY

PROJECT:

FINAL DESIGN OF WESTERN RAILWAY LINE INFRASTRUCTURE

CONSULTANT: TEAM group; TEAM Engineering SpA

SITE: **KOJOKROM - TARKWA SECTION**

DOCUMENT TITLE:

TARKWA STATION FACILITIES AREA

PLAN

DOCUMENT CODE:	REV.	SCALE: 1:500	DRAWN	FC
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REV.	DESCRIPTION	DATE	DRAWN	CHECKED	PASSED

NOTES

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3.3.4 Maintenance Regime

Light maintenance (cleaning, refuelling etc.) of the trains will be undertaken daily at the light or heavy rail maintenance facilities.

A train maintenance programme will be developed prior to operation which sets out the planned maintenance for all locomotives and rolling stock, including the type of maintenance to be carried out, frequency, locations and manpower requirements. Fleet maintenance is likely to be carried out at the Heavy Rail Maintenance Facility in Tarkwa.

The Permanent RoW will need to be maintained to ensure the track remains free of vegetation encroachment and rail damage. A track maintenance programme will be developed prior to operation which sets out the type of maintenance required, frequency, equipment and methods. The track maintenance programme shall include (but not be limited to):

- Roles and responsibilities for Track and Permanent RoW maintenance
- Schedule of Planned Maintenance;
- Overview of the type of maintenance including:
  - Drainage and culvert inspections and clearance;
  - Track inspections for ballast defects and compactness;
  - Inspection of Rails Sleepers and fastenings for wear and tear, cracks corrosion sleeper condition and alignment at the rail seats and loose fastenings/fittings;
  - Sleeper replacement regime;
  - Track alignment inspections;
  - Bridge and structure condition inspections (including embankments as appropriate);
  - Track replacement regime; and
  - Vegetation clearance requirements
- Method statements for maintenance activities including equipment, staffing requirements and techniques.

All planned track maintenance will be carried out using specialist equipment. Road access via road to the track will be provided primarily for emergency access, however, some maintenance activities can be carried out via these points (e.g. vegetation clearance). This will be set out in the track Maintenance Programme and associated method statements.

3.4 **Associated Facilities**

3.4.1 Section 2: Kojokrom to Manso rail upgrades.

As part of the construction of the Western Railway, some aspects of the track upgrades have been funded via the government and priorities for early completion. The track upgrades in Section 2 of this project between Kojokrom and Manso have commenced construction, with the earthworks approximately 50% complete. The earthworks for Manso Station have also been completed. The track is being upgraded to standard gauge twin track to the same design and construction requirements set out in this Project description and is required to enable the trains to run between Takoradi Port and the remaining sections of the railway to Huni Valley.

The upgrade works along section 2 are considered to be Associated Facilities. The offline section at Eshiem, however, is part of the Project.

The construction of track upgrades in section 2 form part of the Project's overall AoI both as Associated Facilities and as part of cumulative impacts, and hence have been considered within the ESIA.

3.4.2 Light Rail Facility Takoradi

A light rail facility near to Takoradi Port has been constructed as part of the early phases of the upgrade work for the western rail. This rail facility will handle general maintenance such as cleaning, washing down of wagons etc., for rolling stock located at the port end of the facility. All technical maintenance of the rolling stock and locomotives will be conducted at the Heavy Rail Maintenance facility in Tarkwa.

The light rail maintenance facility will also provide some storage for track and rail maintenance, locomotive storage and shunting locomotive garages, as well as some goods storage. The facility also houses office and site operation facilities.

The use of the facility will be required during operation as part of the maintenance regime for the Project, and therefore is considered to be an Associated Facility.

3.4.3 Central Control Facility

The Central Control Facility is vital to the safe operation of the network. It houses the central facility for the monitoring of signals, communications, crossings, emergency shutdowns, and train and track monitoring.

The main Central Control Facility for the Western Rail will be located at Kumasi and has been assessed as part of the National EIA for the Western Rail Programme. However, this facility may not be available at the start of operation for the Takoradi port to Huni Valley rail.

All signalling and communications equipment to facilitate connection to the Central Control Facility at Kumasi will be installed as part of the Project.

To ensure safe running of the trains, a temporary Central Control Facility at Takoradi Station can be set up. This facility is already constructed and only requires connection to be able to operate for the full length of the Project.

The temporary and permanent Central Control Facilities are considered to be an Associated Facilities for the Project.

Operation of the rail and connection to the facility will be achieved through each station and each Station Master being provided with one selective desk phone that will be able to communicate directly without any telephone exchange to adjacent stations on the route and the Central Traffic Controller. The Controller can call any Station Master directly and will have supervision of all the line under his jurisdiction. Outside phones will be installed near home light signals, departure light signals and powered turnouts. These outside phones can call the Station Master for maintenance control and service. This selective phone system will require the installation of buried copper telephonic cable from the Central Traffic location to each station on the line or one optical cable and related digital transmission SDH system at 155 Mb/s.

3.5 **Operational Timetable**

Current narrow gauge movements along the operational section of the rail comprise passenger trains between Takoradi and Secondi operating on alternate days, once in the morning and once in the evening. Freight movements operate between the manganese mine near Manso and Takoradi. Freight movements occur on an as needed basis using four locomotives with 20 wagons each carrying 40 tonnes (i.e. 800 tonnes per train). Peak freight movements are estimated to involve eight journeys by each train per day (eight movements northbound and eight southbound).

The Railway Master Plan of Ghana estimates that by 2030, the 1161km western line railway could be used to transport 3,660,000 tonnes of freight per year and 10,600 passengers per day. The

Master Plan assumes an average freight movement of 1800 tonnes per train and between 800 and 1500 passengers per train. This equates to an average of 12 freight movements and between 7 and 13 passenger movements per day along the full length of the route.

In assessing operational movements along the 102 km stretch of the western railway between Takoradi and Huni Valley, a reasonable worst case of up to six passenger trains per day and continued peak or up to 16 freight trains per day has been assumed (see Table 3-4).

The Project line capacity analysis assumes train operations of 20 hours per day with 4 hours for night maintenance, with freight trains operating 300 days per year and passenger trains operating 365 days per year.

Table 3-4: Estimated Operational Rail Movements

	Train type	**Rail movements**				**Movements per day**
		North	**South**			
Current movements – Takoradi to Nsuta	Freight	Four locomotives with 20 wagons each carrying 40 tonnes (i.e. 800 tonnes per train)				16 (peak)
	Passengers	Trains between Takoradi and Secondi operating on alternate days, once in the morning and once in the evening				1
Railway Master Plan Phase 2 [(a)]	Freight (ave. mil/ton/yr)	0.95	2.7	3.66	1800ton / train	6
	Passengers (000 PAX)	5.3	5.3			
Estimated daily movements Takoradi – Huni Valley	Freight	Two locomotives, 64 wagons with axle load of 30 tonnes (i.e. up to 960 tonnes per train)				**16** (peak)
	Passengers	Two movements in the morning, two in the evening and two during the day (e.g. dependent on timing of shift patterns at Takoradi Port)				6

Note:

(a) Estimated freight and passenger transport by 2030 along the 1161km Western Railway following Phase 2 (conversion to standard gauge)

3.6 Construction

3.6.1 Overview

Construction of the main track shall be undertaken on the project using two simultaneous workfronts (Teams A and B). Team A commences construction at KM 32.6 and works up the route to KM 59.8. Team B commences at KM 59.8 and works up the track to the end point at KM 85.8. Team A will also construct the Eshiem Bypass in Section 2 and undertake the track upgrades in Section 1. (Figure 3-9).

The team will be based primarily on the rail tracks, and will complete works in a staged linear fashion. Construction of the track is completed on the rail itself. At each stage the main logistics camp will service the respective workfronts with materials, equipment and support, and will move with the workfronts as required.

Construction will be undertaken 6 days per week (Monday to Saturday) and nominally between the hours of 7.30am and 9.30pm in two shifts. This will enable staff from the local communities to be collected and transported to the workfronts and back again each day using dedicated buses. Some staff will be on site on rest days and public holidays for security and administration duties.

Construction work will avoid major national holidays and festivals (e.g. Easter, Eid and Christmas), but will continue through other public holidays.

Whilst construction in total will take up to three years, for the main track it is expected that construction works for a team in one area will only be for a period of one to three weeks depending on the complexity of the work required. In Section 1 for example, where all track work has already been completed and only the rails need to be laid, construction will move more quickly, whereas at the offline areas, construction is expected to remain in the area for longer (four to six weeks). It is expected that the workfronts will move an average of two to three times per month along the track.

Construction of the Stations and Heavy Rail Maintenance Facility is expected to take longer. On average the station construction will take approximately 12 months depending on the size and location. Construction of the Heavy Rail Maintenance Facility is expected to last for a period of 18 months. Since Tarkwa Station and the Heavy Rail Maintenance Facility are adjacent to each other, construction in this area will be protracted. The construction of the two facilities will overlap, however the total duration for the works is expected to last for approximately 18 to 20 months.

No accommodation camps will be required for the construction of the Project (see Section 3.8).

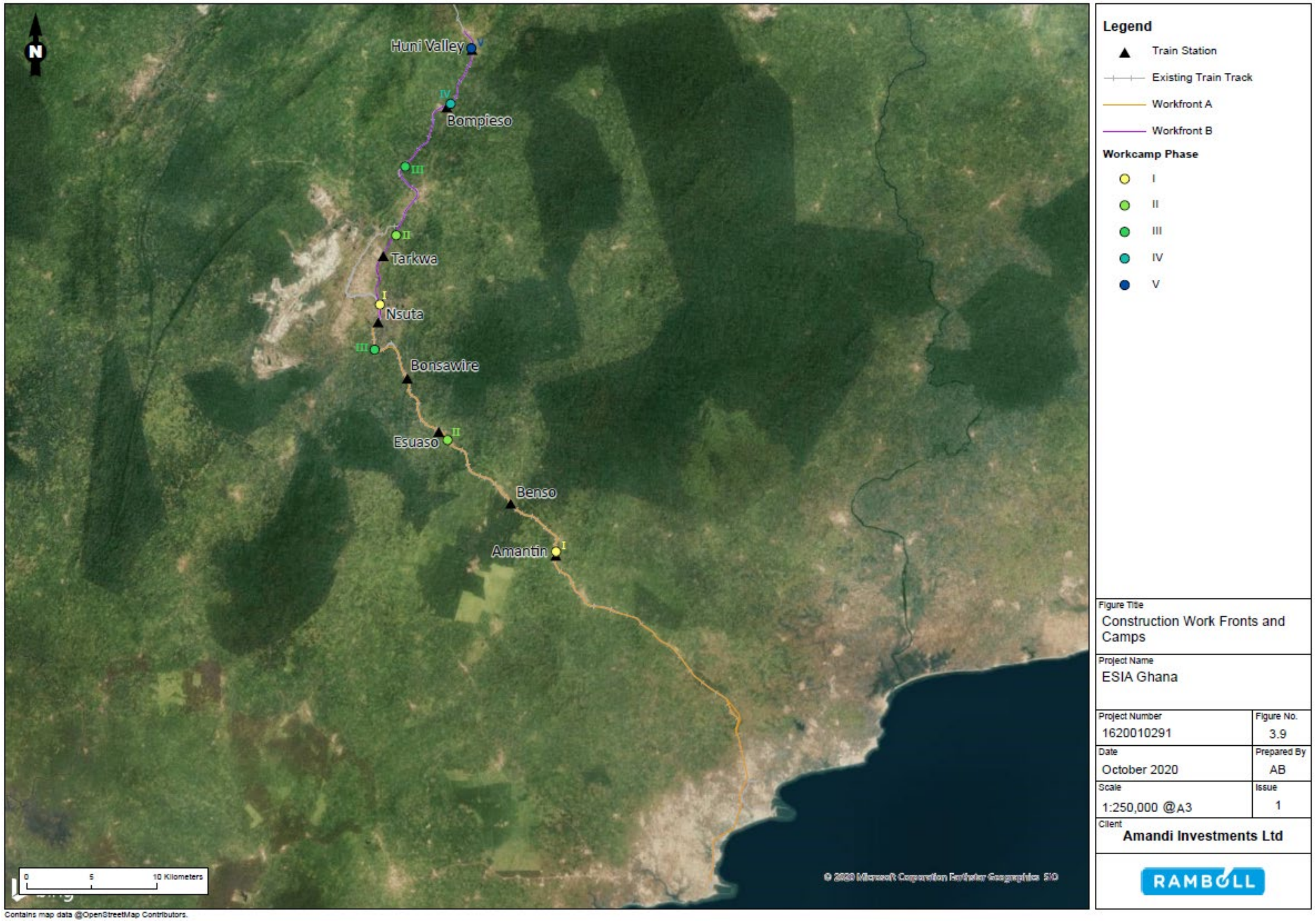


Figure 3-9: Construction Work Fronts and Central Construction Camps

3.6.2 Equipment

Table 3-5 provides details of the equipment required for the construction of the rail and associated works.

Table 3-5: Construction Equipment

Equipment Type	Quantity	Use	Fuel Source
SUV	10	Construction	Diesel
Bus	2	Worker transport	Diesel
Backhoe	10	Excavation	Diesel
Truck water tanker	3	Water supply	Diesel
Truck with crane	3	Construction	Diesel
Fuel doser	3	Construction	
Excavators (30 and 45 tons)	21	Excavation	Diesel
Generators (various 29- 120KW)	40	Power supply	Diesel
Wheel Loader	10	Movement of materials	Diesel
Articulated Dump Truck	15	Movement of materials	Diesel
Compactors	8	Soil compaction	Diesel
Tandem Compactor	4	Soil compaction	Diesel
Pneumatic wheel compactor	4	Soil compaction	Diesel
Motor Grader	8	Construction	Diesel
Asphalt paver	2	Paving	Diesel
Tipper Trucks	40	Movement of materials	Diesel
Tractor head	20	Movement of materials	Diesel
Semi Trailers	20	Movement of materials	
Jaw Crusher	2	Crushing plant	Diesel
Cone Crusher	2	Crushing plant	Diesel
Screen	2	Crushing plant	Diesel
Rock drilling rig	2	Drilling	Diesel
Concrete Batching Plant	2	Concrete batching	

3.6.3 Site Preparation

Site Preparation required the clearance and stripping of topsoil ready for the next phases of construction. In advance of the works the area to be prepared will be marked using wooden pegs and coloured tapes/ribbons. Areas for storage of topsoil storage and other special areas will be designated and marked out using tape/ribbons of different colours. The exact colour coding will be defined in the method statement to be developed prior to and clearance or construction work commencing.

The area to be cleared will be defined, set out and cleared one kilometre in advance of the excavation/earthworks in a rolling progression of construction along the track. Clearance works on the tracks will be extend 5m beyond the start and end points to ensure that continuous construction can be maintained.

For stations and other facilities, sites will be marked out according to the detailed design layout to be agreed prior to any works being undertaken. Areas to be cleared will be set out using wooden pegs and coloured tapes/ribbons to identify different areas. All colour coding will be defined in the method statement.

Site clearance will comprise clearance of any obstructions, trees and shrubs, including root systems and stumps using mechanical excavators or manpower as appropriate. Any pits from the removal tree stumps and roots will be backfilled using suitable material (e.g. topsoil) prior to any construction works being completed.

Topsoil will be stripped to a thickness of 300mm using a dozer or other suitable equipment and stored in designated areas for rehabilitation of the area once construction has been completed.

Topsoil stockpiles will be designed to be stable, with slopes of not more than 2m high with 45-degree slopes. Stockpiles being stored for longer durations (over 4 months) will be stabilised as appropriate (using technical or vegetative means) to prevent erosion and degradation of the resource.

Once topsoil has been stripped, a vibratory roller will be used to compact the soils in defined areas as required. These areas will be defined in the site layouts and method statements. Other areas will be left free from compaction.

3.6.4 Earthworks

Once site clearance works have been completed, the survey team will set out the required level profiles and colour coded batter rails and boards for all earthworks. These reduce the area being excavated to a minimum (e.g. for drainage and for cuttings). Excavation and embankment levels will be calculated to include the need for any base materials (e.g. for drainage channels, structure foundations or subgrade etc. for the tracks).

Excavations

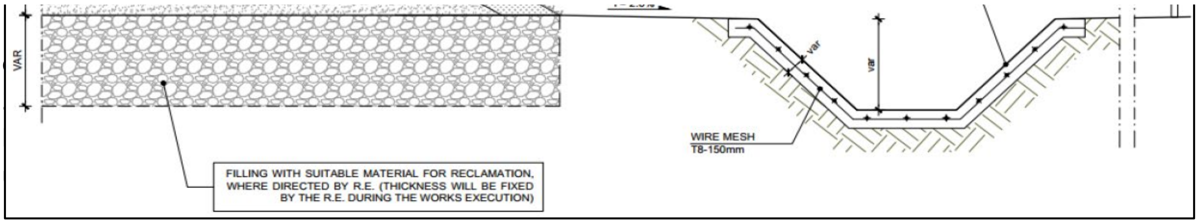
Excavations of material will commence following layout using 360-degree excavator and other equipment (back hoes, tippers etc.). Material will be excavated to the line and levels defined during the survey and inspected by the responsible staff (defined in the method statement for excavations and earthworks) and all formations recorded by the survey team. Excavations will be filled and compacted to a depth of 20mm per m^2 with stabilisation materials with the exact grade and material defined in the detail design information and method statement.

Excavated material will be stored in designated areas and segregated from topsoil stockpiles. As much of the track and station work will be undertaken on pre-disturbed areas, all excavated material will checked for potential contaminants. Where materials are identified as unsuitable for reuse these will be stored in designated waste areas for disposal.

Suitable excavated material will be reused on the project for backfilling of any areas (e.g. borrow pits), and for ground restoration.

Excavated material (excluding topsoils) will be stored in stockpiles up to 3 m high at 45-degree slopes where stockpiles need to be higher, at 30-degree slopes for piles 3 m to 6 m high. Where the height of the stockpiles exceeds 6 m, breaks will be added into the slopes to prevent stockpile collapse. For longer term storage of excavated materials (more than 4 months) temporary drainage will be provided.

Embankments



Once the core has been constructed and inspected the subgrade layer will be constructed in two 25cm layers using a mix of 50% crushed rock (max size 40mm) and 50% laterite to 50cm depth. Each layer will be laid and compacted before the next layer is added.

The sub-ballast will then be laid using coarse crush rock (max size 40mm) and compacted to a uniform depth of 22 cm. The embankment slope will then be covered with 15cm of topsoil.

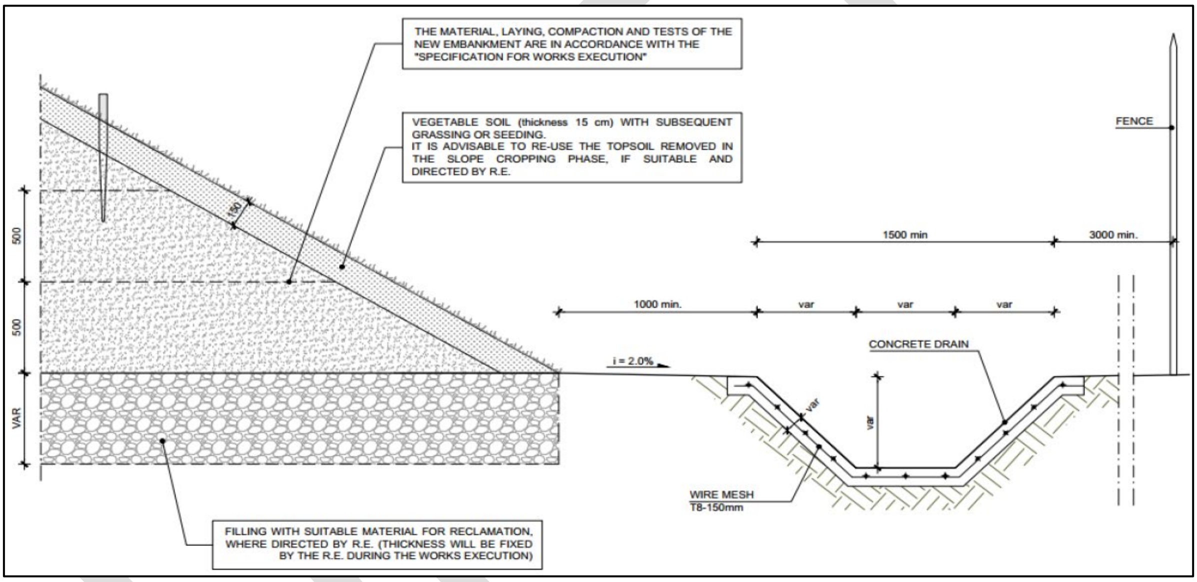


Figure 3-10: Typical Embankment Cross Section

3.6.5 Structures

Culverts

The majority of culverts will be constructed in-situ. Where this is not possible, culverts will be cast at the central construction camp (see Section 3.6.7) and transported to the required location for installation.

Prior to casting and/or installation in watercourses, a coffer dam will be constructed. The dam will typically be an earthen construction using suitable compacted materials (typically a mix of sands gravels and clays) to allow dewatering of the construction area. Water will be pumped from the construction area to the downstream end, and a bypass flow for the water course around the site installed (typically piped around the area). Once dewatering has been completed the site will be cleared from debris and other materials.

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[4] Compaction will be to 95% AASHTO (American Association of State Highway and Transportation Officials) standard of the maximum dry density of the standard proctor test.

The survey team will set out the required levels (depths, blinding levels etc.) for the construction team prior to any excavations.

Any trenches for pipe culverts will then be excavated to the required depth according to the detailed design using mechanical diggers. The support for the culvert will then be installed and compacted in layers to a depth of 1.5m as per the design requirements. Exchange materials will be installed and compacted in the culvert base to the level of the blinding.

Once the support and exchange materials have been laid and compacted, the blinding will be cast at the required height and to the required standard as defined in the detailed design. A supporting beam for the expansion joints of the culverts will be cast 300mm thick x 700mm wide and the water stopper for the joints installed. A framework will be constructed according to the required dimensions for the culvert, and the concrete culvert cast within the framework with the required mix, vibrated to ensure structural integrity and left to set for a period of 48 hours. Once the culvert is cast the framework will be removed and the waterproof bitumen coating added.

Once the culvert is in place, the framework will be laid for the entrance and exit end walls and spacer blocks installed to achieve the required cover. The concrete will be mixed to the required standard according to the detailed design requirements and the end walls cast in place, vibrated and left for 24 hours to harden and achieve maximum strength. The framework will be removed and the joints grouted.

Once the end walls have been grouted the culvert will be backfilled with the appropriate bed material to a depth of 250mm.

Bank reinforcement at either end of the culvert will be installed to protect the structure from erosion where appropriate using, rip rap, gabions or suitable vegetative mat.

Once the installation is complete the dam and bypass will be removed, and the watercourse reinstated.

Drainage

The drainage channels will be constructed using a similar method to the culverts. Following clearance of the area, levels will be set out by the survey team and excavation to the required depth completed. The soil will be stabilised using 250mm boulders and the concrete blinding cast. The framework will then be installed, and the channel constructed in 1m lengths using the required cement specification to a depth of 100m, vibrated and left to harder for 24 to 48 hours to harden. The framework will be removed, and the channel allowed to cure for seven days.

Asphalt works.

Following site clearance, all asphalt works (e.g. for roads, crossings etc.,) will ensure the non-bituminous sub-base layer is free from dust and other materials using air jetting or other mechanical means. The layer will then be wetted and the priming coat laid. The priming coat consists of a bituminous spray applied at between 50 to 70ºC to all surfaces of the sub-base layer using a bitumen distributor. This will be left to cure for at least 48 hours before laying the permanent pavement.

Once the priming coat has been cured, the asphalt layer will be laid at a depth of 6cm in adjacent strips working from the centreline outwards for standard flat areas or from the high side to the low side on one-way slopes. For flat areas, a slope outward to the drainage channels at the edge will be maintained.

The layer will be compacted and finished with a bituminous layer.

3.6.6 Track Laying

Once the sub-ballast for the track has been laid during earthworks, 300mm of ballast will be placed in a layer to form the foundation for the track construction. Concrete sleepers will be placed using a front-end loader with a sleeper grab attachment which picks up the sleeper and lays them in the correct configuration. The equipment moves along the right of way from one of the track to the other in a continuous manner.

The steel rail is then placed on top of the sleepers and clipped into place using a track mountable machine. The rails are then welded together to form a seamless track. The equipment runs along the laid track to lay the next piece of the rail in a continuous manner.

Once the rails have been welded the ballast machine using the rails adds the specified grade of material over the sleepers and between the rails to keep the track in place. The tamping machine then follows and lifts the rails to vibrate the ballast underneath and set the track in its final position. This is repeated several times to ensure the track is stable and ready for use.

Masts and overhead equipment are then installed within the permanent RoW to ensure signalling and train operations can be maintained.

3.6.7 Temporary Facilities

Central Construction Camp

The Central Construction Camps (one for each workfront) will be set up in advance of construction and move along the track to specific locations in line with construction progress. The indicative locations are provided in Figure 3-9.

The camps are designed to be mobile and will require no hardstanding to be laid although some site clearance may be required. An indicative layout has been provided in Figure 3-11.

Each camp will comprise:

- Project Management Team Office – 400m^2;
- Client and Supervision Office – 200m^2;
- Workshop and Replacements Part Shop - 350m^2;
- Iron and Welding Shop – 150m^2;
- 2 – Storage Containers – 150m^2;
- Fuel Container (Above Ground Storage Tank) 30,000 litres – 100m^2;
- Mobile Concrete Plant – 600m^2;
- Internal Navigation Routes and Open Storage – 1,150m^2;
- Manager Container – 20m^2; and
- Storage Container – 40m^2.

Site offices (including first aid facilities, changing rooms and sanitary facilities), stores and workshops will be housed within converted shipping containers, which are easily transportable and require no specific foundation with minimal set up requirements. The facility will be controlled through fencing and a secure check point at the main entrance. The camp locations will be sited to ensure access via road is available from existing infrastructure.

Figure 3-11 Typical Construction Central Camp Layout

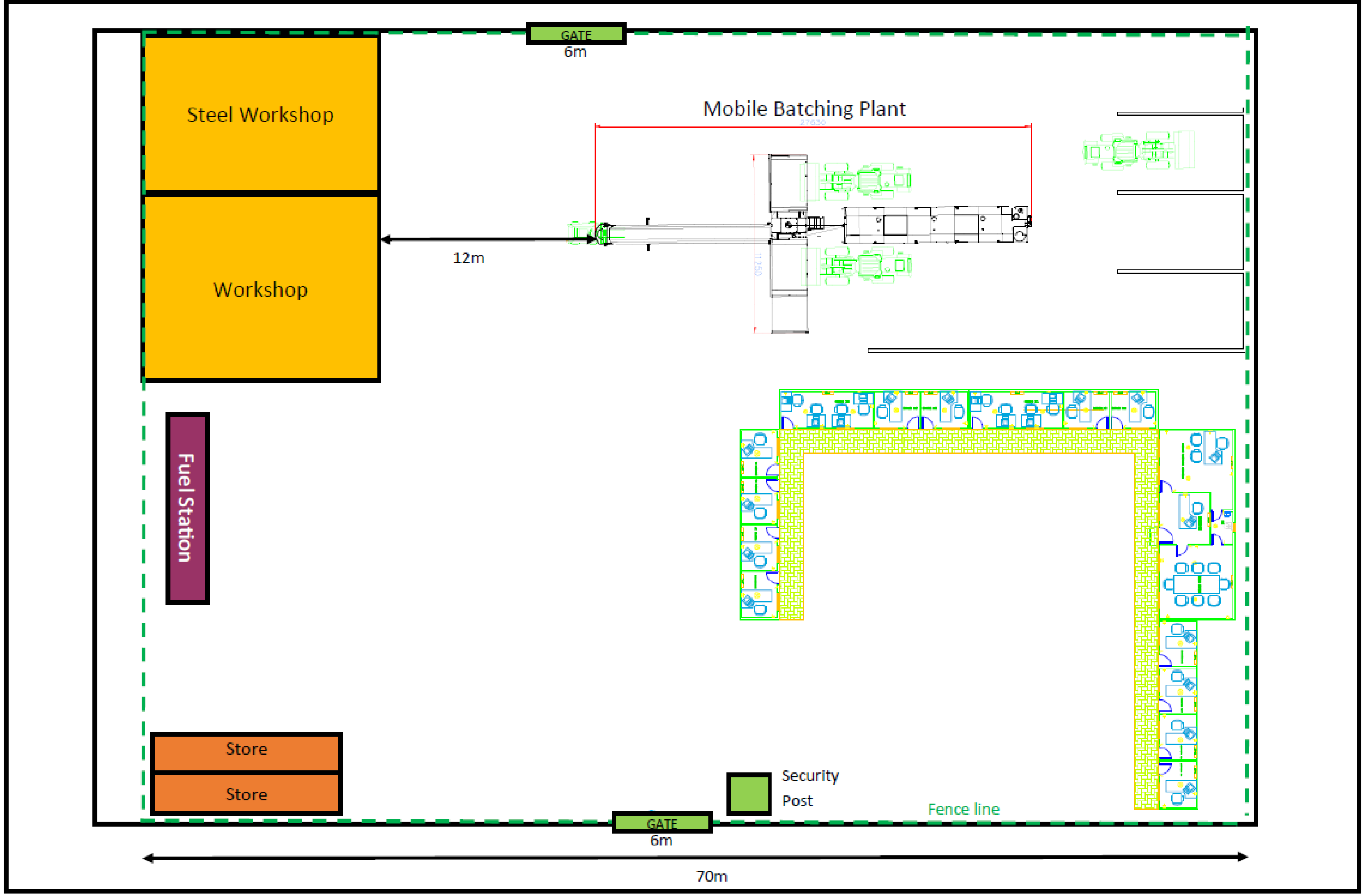


Figure 3-11: Typical Central Construction Camp Layout

The concrete batching plant will be of a model and specification designed for mobile construction, which already incorporates design features to prevent spills and leakage and requires no hardstanding to be developed. Materials will be stockpiled in close proximity to the plant to reduce potential spillage and ensure any adverse incidents can be contained. The materials will be loaded into the plant via mechanical means and once the concrete has been produced will be fed directly into the transport vehicles through special fittings to minimise leakage and pollution incidents.

The fuel storage will be in an above ground storage tank, double skinned to reduce the potential for spills, and will use special fittings and hoses for secured filling of vehicles and plant.

In addition, an on-track working station with first aid facilities (comprising a converted shipping container) will be on mobile trailers that will be parked in working area of the Permanent RoW and will be moved 2-3 times per month. Septic tank or chemical toilets will be used for sanitary facilities at the workfronts.

No catering facilities will be provided as it is expected that staff will bring food with them, however, a mess facility/canteen to eat food will be provided.

For stations and the Heavy Rail Maintenance Facility, construction camp facilities will be provided at each one and located on the hardstanding areas being set up as part of those facilities. The exact layout and design for these will be defined in the detailed design phase and prior to construction.

Borrow Pits

Whilst many of the materials required for the construction of the Project can be sourced via supply chain, some borrow pits may be required to supply construction materials such as crushed rock or laterite and in particular for the offline sections and sections which require more extensive rehabilitation (e.g. Section 6).

The location, extent and design of the borrow pits will be determined prior to construction once detailed design has been completed, however, these will be located within the Permanent RoW and will be managed by the EPC Contractor. If borrow pits cannot be located within the RoW they will need to be subject to an assessment under Design Change Control Process and permitted as per Ghanaian legal requirements.

The opening and operation of any Borrow Pits will be detailed in a Borrow Pit Management Plan which will include details included in Table 3-6.

Table 3-6: Borrow Pit Management Plan Measures

Borrow Pit Phase	Activities	Measures
Site definition	Selection of site Material Quality Testing Site layout	Minimum setback of 100m from environmentally sensitive areas and residences; Inclusion of adequate space for all activities; Estimated quantity and type of resources to be extracted Defined Sequence of Operation Location and definition of stockpile locations Location and procedures for waste management Type and quantity of water required for operation Site operating procedures; and Consultation requirements with the adjacent communities and stakeholders.

Borrow Pit Phase	Activities	Measures
Site Preparation	Vegetation clearance Soil and overburden removal Access roads and paths	Retain vegetation to maintain slope stability; Construct ditches to divert water runoff away from site; Define the stockpile management practices. Optimise of internal-traffic routing to maximise distances to the closest sensitive receptors Design separate footpaths to segregate pedestrians and vehicles
Operations	Material exploration Access roads maintenance Stockpiling	Limit the drop height of falling materials to 10 metres; Ensure that internal roads are adequately compacted and periodically graded and maintained; Limit Vehicle speeds to 25 km/h in the borrow pit areas Limit the sediment from runoff by using sand traps or sediment ponds; Limit pit depth above the water table Limit the formation of ponds and accumulation of standing water to avoid breeding mosquito larvae Only conduct refuelling at designated areas Install natural barriers or fencing/railing for areas with steep includes or drop heights of more than 2m above ground level.
Closure	Degraded area Management	Use the overburden for area recovery and revegetation; Use non-conforming material for backfilling Re-grade perimeter berms and stockpiles Reuse on top of the overburden for restoration purposes. Restore natural drainage; Remove all waste materials, temporary structures and equipment.

Access Roads

Access roads for construction will be developed from existing infrastructure to site locations where required. Following site clearance, the ground will be levelled and compacted to ensure a stable surface. Speed limits will be implemented to ensure dust is reduced, and the surface will be damped down using water tankers.

Once the construction has been completed access routes will be reinstated using the stored topsoil.

3.6.8 Logistics Route

Key supplies for the construction of the rail (e.g. sleepers, rails etc.) will arrive at Takoradi Port and will primarily be moved to the work fronts by the existing train line where possible.

Where movement by rail is not possible, materials and equipment will be moved to site by road. The key logistics route to Tarkwa and Section 6 to Huni valley will comprise the new Takoradi Port via the Cape Coast Road to the main asphalt Takoradi-Agona Road which runs from Takoradi City to Agona in the east, before travelling north via Mufriso and Dompem to Tarkwa. From Tarkwa, the principal logistics route for Section 6 will be via the gravel Tarkwa-Agyempoma Road which runs via Abooso to the end point at Huni Valley.

For the construction of the Eshiem Bypass, there is an existing road serving the fuel storage facility at Eshiem, which runs from the N1 near Mpintsin northwards. The Eshiem Bypass will run in close proximity to this facility (see Chapter 7: Baseline Figure 7.9 Transport).

For any road transport to the Manso area of the Project, the key route would comprise the N1 to Apowa and then the Apowa-Mpohor road to Manso. Other smaller routes to this area exist, however, it is unlikely these would be able to carry significant truck or heavy goods movements, or any special loads.

3.7 Resource Requirements and Waste

3.7.1 Energy Use

Electricity supply for the construction and operation of the permanent facilities (stations and Heavy Rail Maintenance Facility will be via generator. A total of 40 generators will be required, each with an average 120kw rating.

Fuel will be purchased according to the National Ghana Standards for Petroleum and Petroleum Products with a maximum sulphur content of 50mg/kg. Testing on shipments of the expected fuel to be used on the Project by the Inspectorate Ghana Ltd, detailed total sulphur content at 26mg/kg.

Expected fuel use during construction across workfronts A and B will be approximately 320,000-360,000 litres of diesel per month for trucks and heavy machinery and 4,000 litres of fuel oil per month per site for the passenger vehicles (SUVs etc). This gives annual totals of approximately 3,840,000 to 4,320,000 litres of diesel and 28,000 litres of fuel oil.

During operation, the majority of diesel consumption will be for the train operation with smaller volumes required for maintenance activities and for use of the diesel generators at station facilities, estimated at 100-200 litres per month. It has been assumed that the annual usage would be 768,000-864,000 litres of diesel and 800 litres of fuel oil.

3.7.2 Utilities

Water for construction will be supplied by the Ghana Water Authority and trucked to the camps. Water will be stored in special water storage tanks to ensure supplies are maintained. Approximately 60,000 cubic litres per annum is required for construction.

Operational water at the Heavy Rail Maintenance Facility will be provided by borehole at the facility. This will be pumped directly to a water storage tank for supply to the workshops, washing areas, and offices.

In the event that the quality of the water from the borehole does not meet the required standards a small potable water treatment facility will be installed close to the borehole to ensure the national and WHO standards are met.

Telecommunications will be provided by existing satellite and cell phone providers in the area; MTN for cell phones and SuperTetch for internet and data supply either by radio communication or satellite VSAT depending on the coverage in each location. Dedicated fibre optic telecommunications for operations will be installed during construction and will form part of the operational Project. In addition, within the site, mobile radio will be utilised between the Forman and workers to allow fast and efficient communication for short distances up to 2.5 km.

3.7.3 Materials

A summary of the likely materials requirements to complete the rail project is provided in Table 3-7.

Table 3-7: Material Requirements

Material Type	Quantity/Volume	Grade/Design spec	Source	Phase

Concrete sleepers	132,627	B70	Sweden	Construction
Ballast	2 m^3 per km for new track (approx. 3.2 ton per m^3)	26 to 63mm	Source (s) e.g. local mines etc	Construction

3.7.4 Waste

An estimate of waste quantities and types for the construction of the rail is provided in Table 3-8 and Table 3-9.

Table 3-8: Waste Quantities and Types - Construction

Waste Type	Source	Quantity/ Volume	Destination	Waste management/ disposal
Sanitary waste solids	Wastewater treatment plant	15-20 litres per person for 800 peak workforce (16,000 litres per day)	Septic tank and soakaway/ filtration pit	Disposal Government approved landfill
Excavated materials	Excavation	2,000,000 m^3	Reuse as fill where possible, disposal to inert construction landfill or, if contaminated, disposal	60% to re-use, 40% to be filed in areas next to the rail line .
Vegetation waste	RoW clearance	Unknown	Community reuse OR disposal to landfill where contaminated with herbicides?	Wood waste not treated with herbicides to be recycled/reused in communities
Top soil	RoW clearance	180,000 m3		80% to be used for topsoil on slopes
Concrete and gypsum	Demolition of structures	15,000 m3	Municipal/District Landfill Site	All reinforced concrete foundations should be demolished by use of excavators
Asbestos Containing Materials	Demolition of stations	Unknown	Approved hazardous waste disposal site	Disposal as hazardous waste
Scrap wood / decommissioned wood sleepers	Demolition of structures, railway sleepers	30,000 wood & 40,000 steel	Return to GRDA	Reuse By Railway for Maintainance
Glass	Demolition of structures	Unknown	Recycling facilities	Recycling
Waste lubricating oil (from machinery)	Construction and demolition	3000 litres per month	Approved hazardous waste disposal site	Disposal as hazardous waste

	equipment maintenance			
Packaging wastes (plastics, styro-foam, cardboard, paper)	Packaging	Unknown	Municipal/District Landfill Site or recycling where possible (plastics etc)	Disposal or recycling
Fluorescent tubes	Stations	Unknown		Disposal as hazardous waste
Contaminated rags	Construction and demolition activities	Unknown	Approved hazardous waste disposal site	Disposal as hazardous waste
Oil/diesel/herbicide contaminated materials from any spillages	Spillages, machinery breakdown	1,000 litres per year	Approved hazardous waste disposal site	Disposal as hazardous waste
Waste batteries	Machinery maintenance	20 per month		Disposal as hazardous waste
Electronic waste	Stations, existing infrastructure to be removed	Unknown		Recycling or disposal at an e-waste disposal facility
Waste paints and solvents	Site office construction	Approx. 100 litres	Approved hazardous waste disposal site	Disposal as hazardous waste
Scrap metal (steel cuttings, metal wires, pipe cuttings)	From on site equipment maintainance and reinforcement works	120 tons	Recycling facilities / Tema recycling steel mills	Aluminium should be sent for recycling. Steel materials should be sent to recycling steel mills in Tema
Domestic refuse from the workforce	Workforce	500 litres per month	Municipal/District Landfill Site	Disposal

Table 3-9: Waste Quantities and Types- Operation

Waste Type	**Source**	**Quantity/ Volume**	**Destination**	**Waste management/ disposal**
General domestic/office waste – paper, food, packaging (plastic, scrap wood etc.)		Unknown	Municipal/District Landfill Site or recycling where possible (plastics etc)	Glass and aluminium materials should be transported out of the construction site for recycling
Vegetation waste	RoW clearance	Unknown	Community reuse OR disposal to landfill where	Wood waste not treated with herbicides to be

			contaminated with herbicides?	recycled/reused in communities
Vegetation waste	Drain maintenance	400m^3 per month	Municipal/District Landfill Site	Disposal
Maintenance wastes – paints, solvents, rags, old fluorescent tubes	Maintenance activities	Unknown	Approved hazardous waste disposal site	Disposal as hazardous waste
Oil/diesel/herbicide contaminated materials from any spillages	Rolling stock maintenance, Spillages	400 litres per month	Approved hazardous waste disposal site	Disposal as hazardous waste
Waste lubricating oil (from machinery)	Maintenance activities & operation	Unknown	Approved hazardous waste disposal site	Disposal as hazardous waste
Contaminated rags	Maintenance activities & operation	Unknown	Approved hazardous waste disposal site	Disposal as hazardous waste
Waste batteries	Maintenance activities & operation	10 per year	Approved hazardous waste disposal site	Disposal as hazardous waste
Electronic waste	Maintenance activities & operation	Unknown		Recycling or disposal at an e-waste disposal facility
Domestic wastewater from stations	W/C in stations	3,000 litres per day	Septic tanks	Station waste water treatment

Waste management

The Project is committed to managing and disposing of wastes in accordance with good international practice and Ghana EPA and District/Municipal Assemblies requirements, including following the internationally recognised waste management hierarchy. Waste generation will be reduced where possible, for example by limiting vegetation clearance in the RoW and restricting excavations to only areas required. Materials will be reused or recycled where possible. Where excavated material is deemed suitable for reuse, it will be stored in designated areas segregated from topsoil stockpiles, and used for backfilling and ground restoration. Where possible existing infrastructure will be reused and recycled for the replacement rail and facilities if they are in an acceptable condition.

Waste streams will be separated and segregated at the source and collected in specific types of waste containers or skips at designated locations at worksites. The contractor will be responsible for providing a sufficient number of the different types of waste containers at each construction site. Waste will be collected by licenced waste management companies on a regular basis and transported to licenced facilities for recycling or disposal as appropriate.

Hazardous wastes will be stored in closed containers located away from the elements (direct sunlight, wind and rain) and shall not be stored onsite for more than 180 days. Temporary hazardous waste storage areas will be identified during construction with permanent locations identified during operation (e.g. at the heavy rail maintenance facility), and access to these locations restricted to trained personnel. A Waste Management Plan will be developed which will provide the basis for all the waste management arrangements and act as a central point of reference for how wastes will be managed by the Project.

An accredited company with expertise in asbestos analysis and management will be engaged to determine whether the buildings slated for demolition contain asbestos. If asbestos containing materials (ACM) are identified, an Asbestos Management Plan will be developed which identifies the location and condition of and the ACM present (e.g. whether it is in friable form with the potential to release fibres). For structures remaining in place procedures for monitoring ACM condition will be developed. The removal of ACMs should be undertaken only by specially trained personnel following Ghana Standards requirements. Following removal, ACMs shall be stored at the hazardous waste storage area prior to disposal at an approved hazardous waste landfill in accordance with the Schedule to the Environmental Permit for the Western Railway Line Infrastructure Project.

3.8 Workforce

Construction workforce will comprise 200 employees at the start of construction rising to 800 at peak distributed along all workfronts. An additional 60 contract staff will be required. The Workforce will comprise of approximately 97% local workers from the surrounding areas with only 25 expatriates expected to make up the construction workforce.

The Workforce will live and work in the surrounding villages and will be collected and taken to the workfronts via a dedicated Project bus service.

3.9 Schedule

Early Construction for the rail is due to commence in February 2021 with main construction commencing in May 2021 for a period of approximately three years.

Commissioning and fit out is due to commence in October 2023 through to December 2024 with handover to the operator due to be completed in January 2025.

A summary schedule is provided in Figure 3-12.

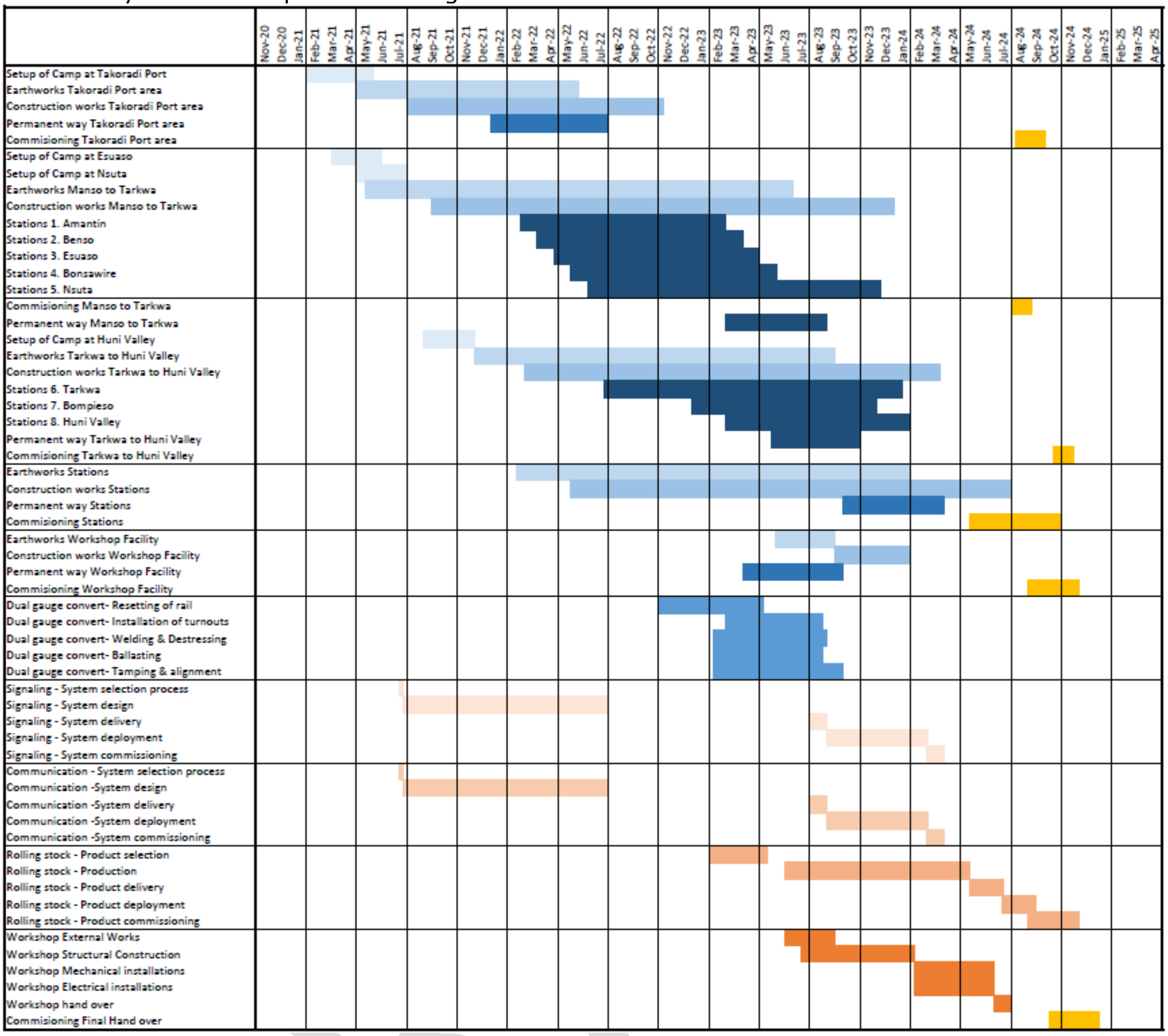


Figure 3-12 Construction Schedule

3.10 Decommissioning

Decommissioning of some of the existing infrastructure will be required to allow redevelopment of the railway. This includes existing rails, sleepers, ballast, station buildings, bridges, signalling and telecommunication equipment.

A Buildings and Structures Demolition Plan will be implemented for decommissioning of the existing infrastructure. The Plan will define:

- Sequence of operation;
- Requirements for site mobilisation including equipment and layouts;
- Full description of pre-demolition activities;
- Measures to manage asbestos, including safe removal and disposal;
- Methods for determining hazardous materials and full description of methods for treatment, removal and disposal;
- Definition of and methods for preparing buildings for building preparations;
- Demolition activities;
- Dust control;
- Stockpiling and segregation;
- Surface water/pollution prevention; and
- Post demolition activities.

Method statements for demolition works will be developed covering the following issues: (i) Façade Works (ii) Roof Works (iii) Floor Coverings (iv) Suspended Ceiling Coverings (v) Internal Partitions (vi) Structural Steel Elements (vii) Reinforced Concrete Slabs and Beams (viii) Reinforced Concrete Foundations.

Where possible existing infrastructure will be reused and recycled for the replacement rail and facilities if they are in an acceptable condition. Where soil contamination of the existing alignment exists, this will be manually removed from the track and disposed of appropriately according to the waste management plans. Sections where the formation is contaminated with vegetation would be stripped to remove all traces of grass, weed, roots and other unacceptable material before they are refilled with formation material and compacted to the required level.

The lifetime of the rail has been designed to be 50 years. Maintenance requirements have been described in section 3.3.4.

All temporary construction areas, including borrow pits will be subject to full reinstatement prior to operation.

Decommissioning of the new rail track and infrastructure, if required, will be subject to a full decommissioning plan to be approved by the relevant authorities, and in line with the requirements of the National legislation and international good practice at the time of decommissioning.

3.11 Incorporated Mitigation Measures

3.11.1 Embedded Mitigation

Table 3-10 presents the embedded design mitigation measures whilst Table 3-11 presents the Project ESIA Good International Industry Practice (GIIP) Mitigation Measures.

Table 3-10 ESIA Embedded Design Mitigation Measures

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
PDM1	Air Quality	All small combustion facilities (e.g. generators) shall comply with the required emissions guidelines set out in the IFC EHS general guidelines (table 1.1.2).	X	X	X	X
PDM2	Air Quality	Where multiple small combustion facilities are required the cumulative emissions shall be evaluated to ensure compliance with the required emissions guidelines set out in the IFC EHS general guidelines (table 1.1.2).	X	X		X
PDM3	Design	All Project facilities and main components shall be located to avoid or minimise adverse impacts to Critical Natural Habitat, Communities and other sensitive receptors.	X	X		X
PDM4	Design	Safety fencing will be installed at the stations, crossings and Heavy Rail Maintenance Facility to prevent pedestrian access to the rail.	X		X	
PDM5	Design	All Project facilities and main components shall comply with the relevant Project design standards as set out in the Chapter 2: Legislation and Standards.	X	X	X	
PDM6	Design	The proposed route will use the existing rail line and permanent RoW as far as practicable.	X	X	X	
PDM7	Design	The road will be rehabilitated and surface dressed with chipping and bitumen.	X	X		
PDM8	Design	Platforms will be designed to provide shelter from inclement weather conditions.	X		X	
PDM9	Design	Site access to all construction sites and camps will be restricted through the use of fencing and a secure check point. Warning signs will be installed.	X	X		
PDM10	Design	The concrete batching plant will incorporate design features to prevent spills and leakage.	X	X		
PDM11	Design	All temporary site offices will be converted shipping containers which do not require specific foundation.	X	X		
PDM12	Design	Trash screens and silt traps shall be provided to prevent rubbish and soils entering water courses and drains	X			

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
PDM13	Design	Pedestrian access will be provided as underpasses adjacent to the road crossing to ensure vehicles and pedestrians are segregated.	X		X	
PDM14	Design	All at grade crossings will be designed to be fully automated and linked to the Central Control Facility. The barriers will be full width across the road and perpendicular to the rail (or as close as possible to this).	X		X	
PDM15	Design	Culverts required to allow the passage of water courses will be constructed to allow the free passage of fish and aquatic species where practicable, using clear span bridges, or open bottom culverts which allow for natural bed materials and natural flow to be maintained. Backfilling of the natural bed to a thickness of 250mm will be undertaken.	X		X	
PDM16	Design	Prior to casting and/or installation of culverts in a watercourse, a coffer dam will be constructed. Coffer dams will typically be of earthen construction using suitable compacted materials (typically a mix of sands gravels and clays).	X	X		
PDM17	Design	Following the installation of culverts the dam and bypass installed during construction will be removed and the watercourse reinstated.	X	X		
PDM18	Water	Reinforcement at either end of the culvert to provide protection from erosion and undercutting will be installed using, rip rap, gabions or suitable vegetative mat.	X		X	
PDM19	Design	Stormwater flow channels and collection ponds installed as part of the open drainage system will be fitted with oil/water separators at permanent facility locations. Separators will be able to achieve an oil and grease concentration of 10mg/l.	X	X	X	X
PDM20	Design	Separate drainage systems for wastewater from areas that could be contaminated (e.g. with oil) will be developed and implemented at all permanent facilities.	X		X	
PDM21	Design	The rail, stations and other infrastructure will be designed to allow for sustainable drainage of the track. Run off from the track will be managed through a series of channels and collected for discharge. Drainage under the track to allow for free flow movement of rainfall will be provided through a	X		X	

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		series of land drains and culverts sized according to the water conveyance requirements. Drainage will be installed parallel to the rail to ensure flooding from surface waters is controlled at level crossings.				
PDM22	Design	All construction fuel storage areas will be bunded.	X	X		
PDM23	Design	All permanent fuel storage areas will be lined and bunded to ensure drainage water flows into the closed drainage system and that uncontrolled surface runoff is avoided.	X		X	
PDM24	Design	Permanent UST fuel storage tanks shall, as a minimum: • Be located away from areas with potential for vehicle collisions and damage; • Include installation of a secondary containment systems to prevent the uncontrolled release of fuel (e.g. double wall construction); • Include installation of impermeable liners or structures under and around tanks (e.g. concrete vaults); • Include a leak detection systems to detect the presence of liquid or petroleum vapor within the interstitial space; • Use corrosion protection in steel tanks and piping (e.g. dielectric coating or cathodic protection); • Include automatic shut-off devices and catch basins around fill pipes; • Use unjointed polyethylene piping and continuous, flexible composite piping rather than metal pipes; and • Include provision of secondary containment for any pressurised piping system.	X		X	
PDM25	Design	Where fuel storage is located in ASTs, these shall be designed to incorporate secondary containment measures including (but not limited to): • Installation of berms/or walls to contain 110% of the largest tank or 25% of the combined tank volume whichever is larger; • Impervious, chemically resistant hardstanding in the containment area; • Dedicated runoff/drainage area not connected to a municipal facility to allow storage and transfer to a special hazardous waste facility as required, and incorporation of shutoff valves with oil separators where segregation is not possible; and • Installation of leak detection equipment for the tanks.	X		X	

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
PDM26	Air Quality	Locomotives procured will meet EU emission standard level IIIB or equivalent	X		X	
PDM27	Design	Platforms will be constructed using concrete paving blocks with the main surface having a 1 to 1.5% slope to allow for drainage.	X		X	
PDM28	Design	Signage at all stations will be designed to be inclusive of physical and sensory disabilities. Footbridges or underpasses will be installed at main stations to provide passage between platforms. These will be designed with ramps to assist disabled passengers.	X		X	
PDM29	Water	Rainwater harvesting facilities will be installed to trap and store water for landscape irrigation and horticultural purposes.	X		X	
PDM30	Water	Toilets with water economy flush features will be installed at the permenant operational facilities	X		X	
PDM31	Design	Ballast material will be sourced from the waste fraction from the existing mines in the area, reducing the requirement for new materials to be sourced.	X	X		
PDM32	Design	Track design will follow GIIP with the use of specified layers of ballast, precast concrete sleepers and track.	X	X		

3.11.2 Good Practice Mitigation

Table 3-11 ESIA GIIP Mitigation Measures

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
GPM1	Air Quality	Open burning for clearance or of solid wastes shall be prohibited.		X	X	X
GPM2	Air Quality	Site access roads for construction will be damped down using water tankers.		X		
GPM3	Air Quality	Fuel will be purchased according to the National Ghana Standards for Petroleum and Petroleum Products with a maximum sulphur content of 50mg/kg. Testing on shipments of the expected fuel to be used on the Project by the Inspectorate Ghana Ltd, detailed total sulphur content at 26mg/kg.		X	X	
GPM4	Biodiversity	An Integrated Vegetation Management Plan (IVMP) shall be developed which outlines measures for the regular maintenance of the RoW to control vegetation such as: • the use of mechanical methods (e.g. mowing), manual methods (e.g. hand pruning), and use of herbicides; • chemical herbicides on the bank beyond the transition area will be avoided (approximately 5 meters from the track); • revegetation from the edge of the track area to the boundary of the RoW, will be structured such that smaller plants will be located near the railway line with larger trees further away from the line to provide habitats for a wide variety of flora and fauna species; • maintenance clearing in riparian areas will be avoided or minimised.	X	X	X	
GPM5	Biodiversity	An Invasive Species Management Plan shall be developed which outlines measures for the management of invasive and alien species including (but not limited to): • Use of good soil management practices to prevent potential import of weed and invasive alien plant species to/from the sites on materials, personnel, and machinery. • Vehicle wheel washing and machinery washing to ensure weed and invasive alien plant species free. • Use machine wash-down facilities for the importing and exporting of machinery/equipment.	X	X	X	X

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		• Training of personnel on invasive alien species and associated management measures.				
GPM6	Community Health, Safety and Security	Safe distances to sensitive receptors and communities shall be clearly demarcated. The Construction Method Statement shall define the purpose for the safe distance area, Where safe distances cannot be free from all activity, the Method Statement shall clearly define the activities that are and are not allowed within the zone.		X		
GPM7	Community Health, Safety and Security	All work sites will have access to sanitary facilities for use by Project workers and open urination and defecation will be prohibited. Project workers will be provided with hand washing facilities with training on the importance of hand washing. Hand washing or hand sanitising facilities shall be provided at site entrances in accordance with the Conditions of the Environmental Permit.		X		X
GPM8	Community Health, Safety and Security	All Project Staff, including direct subcontractors and supply chain working at sites must be informed of the nearest medical facilities during induction and must be able to access medical facilities when suffering from illness.		X	X	
GPM9	Community Health, Safety and Security	A Security Management Plan will be developed to include (but not limited to): • A detailed assessment of security risks and determination of proportional security arrangements. • A process for ensuring the use of security personnel and any decisions to provide firearms or other weapons (e.g. batons) is proportional to the security risk. Commitments shall include (but not limited to): • When employing any security personnel or engaging a security contractor, the Project will make reasonable enquiries to investigate the employment and criminal record of individuals or firms. The Project will not employ or use any individuals or companies that are known to have abused or violated human rights in the past. • The Project will verify that security personnel have been adequately trained for their role. • The Project will provide direction to security providers on the appropriate use of force and conduct towards Project workers and local communities. If security		X	X	X

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		personnel will be armed then the appropriate use of arms must be clearly defined by the Project to the security provider and / or security personnel. • The Project will state in contracts with security providers and as part of the induction of security personnel that they will not sanction any use of force except when used for preventive and defensive purposes in proportion to the nature and extent of the threat. • The Project will ensure that all security incidents are reported to Company and are investigated. Security incidents include any alleged or actual trespass, threat or use of violence, theft or damage to property, harassment or intimidation, and includes incidents (a) caused by Project Workers or (b) caused by community members when the victim is a Project Worker or it affects Project property. Security incidents also include any situation when security personnel have used force. Investigations must describe the situation leading to the incident, identify those involved, assess whether the response and use of force (if applicable) were appropriate, and define any corrective actions. Investigations must include reporting to the police when there is evidence of a criminal act. • Any allegations of unlawful or inappropriate acts by security personnel must be treated as grievances and investigated according to the Community Grievance Mechanism. Allegations and / or evidence of unlawful acts must be reported to the public authorities.				
GPM10	Construction	A Borrow Pit Management Plan will be developed which outlines the Project approach to borrow pit site selection, usage and rehabilitation. Mitigation measures may include (but are not limited to): For site definition: • Minimum setback of 100m from environmentally sensitive areas and residences; • Inclusion of adequate space for all activities; • Estimated quantity and type of resources to be extracted • Defined Sequence of Operation • Location and definition of stockpile locations • Location and procedures for waste management • Type and quantity of water required for operation • Site operating procedures; and • Consultation requirements with the adjacent communities and stakeholders.	X	X		

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		For site preparation: • Retain vegetation to maintain slope stability; • Construct ditches to divert water runoff away from site; • Define the stockpile management practices. • Optimise of internal-traffic routing to maximise distances to the closest sensitive receptors • Design separate footpaths to segregate pedestrians and vehicles For operation: • Limit the drop height of falling materials to 10 metres; • Ensure that internal roads are adequately compacted and periodically graded and maintained; • Limit Vehicle speeds to 25 km/h in the borrow pit areas • Limit the sediment from runoff by using sand traps or sediment ponds; • Limit pit depth above the water table • Limit the formation of ponds and accumulation of standing water to avoid breeding mosquito larvae • Only conduct refuelling at designated areas • Install natural barriers or fencing/railing for areas with steep includes or drop heights of more than 2m above ground level. For closure: • Use the overburden for area recovery and revegetation; • Use non-conforming material for backfilling • Re-grade perimeter berms and stockpiles • Reuse on top of the overburden for restoration purposes. • Restore natural drainage; • Remove all waste materials, temporary structures and equipment.				
GPM11	Construction (General)	Construction method statements will be developed. These will include (but not limited to): • Sequence of Operation • Requirements for Site Mobilisation including equipment • Full description of Construction activities • Layouts including laydown areas, stockpiles, offices areas, storage and waste areas etc.,		X		

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		• Location of sensitive receptors • Detailed construction methods for the permanent facilities including topsoil stripping etc. • Definition and method for Drainage requirements • Waste Management requirements and details on waste disposal, supply chain and disposal locations for different waste streams • Method for provision of potable water supplies • Wastewater disposal requirements. • Closure and rehabilitation methods including regrading, replanting and any restoration works. To comply with the conditions of the Environmental Permit, the construction method statement shall ensure disturbed soils are levelled and seeded or replanted on site closure.				
GPM12	Construction (General)	A Buildings and Structures Demolition Plan will be developed which shall define: • Sequence of Operation • Requirements for Site Mobilisation including equipment and layouts • Full description of Pre-Demolition Activities • Measures to manage asbestos, including safe removal and disposal. • Methods for determining Hazardous Materials and full description of methods for treatment, removal and disposal. • Definition of and methods for preparing buildings for Building Preparations • Demolition Activities • Dust Control • Stockpiling and Segregation • Surface Water/Pollution Prevention • Post Demolition Activities		X		X
GPM13	Construction (General)	In advance of construction works the area to be prepared will be marked using wooden pegs and coloured tapes/ribbons. Areas for storage of topsoil storage and other special areas will be designated and marked out using tape/ribbons of different colours. For stations and other facilities, sites will be marked out according to the detailed design layout to be agreed prior to any works being undertaken. The	X	X		

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		exact colour coding will be defined in the Construction Method statement to be developed prior to any clearance or construction work commencing.				
GPM14	Construction (General)	Construction will be undertaken 6 days per week (Monday to Saturday) and nominally between the hours of 7.30am and 9.30pm.		X		
GPM15	Construction (General)	A stockpile management plan shall be developed which outlines the approach to management of temporary stockpiles of topsoil and subsoil.		X		X
GPM16	Construction (General)	Topsoil stockpiles will be designed to be stable, with slopes of not more than 2m high with 45-degree slopes. Stockpiles being stored for longer durations (over 4 months) will be stabilised as appropriate (using technical or vegetative means) to prevent erosion and degradation of the resource. Stockpiles of construction materials shall not be located within 500m of a waterbody, as far as practicable.		X		X
GPM17	Construction (General)	Once topsoil has been stripped, a vibratory roller will be used to compact the soils in defined areas as required. These areas will be defined in the site layouts and method statements. Other areas will be left free from compaction.		X		
GPM18	Construction (General)	Excavated material will be checked for potential contaminants. Where materials are identified as unsuitable for reuse these will be stored in designated waste areas for disposal. Suitable material will be stored in designated areas, segregated from topsoil stockpiles, and used for backfilling and ground restoration.		X		X
GPM19	Cultural Heritage	Construction works shall commence only once all relevant permits have been received from the responsible institution, the Administration for protection of the cultural heritage of the Ministry of Tourism, Culture and Creative Arts.		X		
GPM20	Cultural Heritage	A Chance Finds Procedure shall be developed which sets out the approach to be taken should any physical cultural resources be discovered (e.g. archaeological sites, historical sites, human remains, cemeteries, graves or other objects) in accordance with Ghanaian Law on Protection of Cultural Heritage and IFC PS 8 requirements. Procedures for managing chance finds shall be in line with procedures of the National Museum Decree 1969 (NLCD 387). Steps to be included in the chance finds procedure may include: • Stop all works in the vicinity of the find, until a solution is found for the preservation of these artefacts, or advice from the relevant authorities is obtained.		X		

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		• Notify the relevant authorities of the find. • Implement measures to protect or remove the find in accordance with Ghanaian requirements and IFC PS8. • Document and record any chance finds which may occur. The Chance Finds Procedure shall form part of the Cultural Heritage Management Plan.				
GPM21	Cultural Heritage	Cultural Heritage training shall be provided to construction workers prior to commencement of earthworks to increase awareness and educate on how to identify artefacts and the importance of protecting Ghanaian cultural heritage, including existing cultural monuments and archaeological sites and chance finds.		X		
GPM22	Emergency Response	A HAZOP or other risk assessment process shall be followed to identify and assess Project risks during the different Project phases and used to inform the development of an Emergency Preparedness and Response Plan (EPRP).		X	X	X
GPM23	Hazardous Materials	A Hazardous Materials Management Plan (HMMP) shall be developed and implemented which includes measures related to the production, handling, storage, and use of hazardous materials. The HMMP shall: • Describe the process for purchasing including requirements and audit of purchase inventories, • Identify substitutions to less hazardous materials where practicable, • Set out the requirements for Standard Operating Procedures (SOPs) for the management of secondary containment structures, including integrity inspections an the removal of any accumulated fluid, such as rainfall, to ensure that the containment capacity Set out the method for ensuring access to hazardous materials storage areas shall be restricted. • Set out the design requirements for secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids which is at least 110% of the largest container or 25% of the total volumes of fuel and fluids stored (whichever is greater). • set out the procedures for ensuring refuelling and other fluid transfer only in		X	X	X

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		areas with impervious surfaces or where this is not possible (e.g. temporary construction camps) monitor refuelling activities to avoid spills • Develop procedures for transfer and handling of fuels and chemicals and the response to spills including use of spill kits. This should include specific procedures in response to herbicide spills which should be managed through removal of the contaminated soil or neutralization with activated charcoal, or both (water should not be used to wash down herbicide spills). • set out the training and awareness for transfer and handling of fuels and chemicals and the response to spills for workers involved in the handling of fuels and chemicals. • Detail any specific personal protective equipment (PPE) required to respond to an emergency and training on its use. • Detail the siting for spill kits, portable spill containment and clean up equipment where fuel and chemical handling and takes place. • Identify hazardous materials and petroleum-based products in building systems (e.g. polychlorinated biphenyls (PCB) containing electrical equipment, asbestos-containing building materials) and process equipment and, if present, set out the requirements for the development of a specific plan/procedure for their removal and disposal prior to initiation of decommissioning activities. • Identify any hazardous substances present in or on building materials (e.g., PCBs, asbestos containing flooring or insulation, electrical components containing mercury). If present, ensure contaminated building materials are decontaminated or properly managed and disposed of in line with the waste management plan. • Identify training requirements for personnel to remove potentially hazardous materials in building elements. Such materials should only be removed by specially trained personnel. The HMMP should cover all hazardous materials expected to be encountered including hazardous wastes and herbicides. Herbicide use will follow requirements as set out in the World Bank EHS Guidelines for Railways.				
GPM24	Hazardous Materials	A Spill Response Plan will be developed and implemented as part of the EPRP, specifically to address, minimise and control potential for oil, chemical and fuel spills from the facilities, transport vehicles, loading and unloading operations. The		X	X	X

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		Plan will include (but not limited to): • Clear description of design features for containment, • Labelling, storage and disposal requirements for each substance • Description of specific work practises for each substance including PPE requirements are required; • Procedures for maintaining material inventories and MSDS (Material Safety Data Sheets) • Response and clean up measures based on the type of spill (oil, herbicide, other chemical etc) and extent of the spill (bioremediation, floating booms and adsorbents, solid materials that capture the soil, chemical oxidation). The Plan shall identify links to other related plans and procedures such as the Hazardous Materials Management Plan, Emergency Response Plan and Standard Operating Procedures for chemical use.				
GPM25	Hazardous Materials	Use of Ozone Depleting Substances will be avoided.		X	X	X
GPM26	Hazardous Materials	Use of asbestos containing materials (ACM) will be avoided.		X		
GPM27	Hazardous Materials	Where existing facilities are identified to have ACM present, an Asbestos Management Plan shall be developed which includes: • the locations where the ACM is present; • the condition of the ACM present (e.g. whether it is in friable form with the potential to release fibres); • procedures for monitoring ACM condition; • procedures to access the locations where ACM is present to avoid damage; • measure related to the removal of ACMs including the requirement that ACMS should be removed only by specially trained personnel following Ghana Standards requirements; and • training of staff who can potentially come into contact with the material to avoid damage and prevent exposure. The plan will be made available to all persons involved in operations and maintenance activities.		X		X

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
GPM28	Hazardous Materials	Standard Operating Procedures will be developed for the storage and use of specific chemicals including herbicides as part of the HMMP.		X	X	X
GPM29	Hazardous Materials	Herbicides to be used will be manufactured under license, registered, and approved by an appropriate authority such as Ghana EPA, MoH, MoFA, FAO and WHO.		X	X	
GPM30	Hazardous Materials	Records of herbicide use shall be kept for five (5) years. Maintenance personnel shall record: • Application date number of units treated. • Name/address of treated location and completion time. • Brand name used and name of maintenance worker. • License number of maintenance worker. • Dosage and registration (serial) number of herbicide product used or applied. • Temperature of the environment. • Wind speed and direction in the environment. • Size of area treated per acre or meters. • Start and completion dates. • Name and signature of maintenance worker. • Name and address of maintenance division or department.		X	X	
GPM31	Labour management	Human Resources Management Plan shall be developed. The plan shall: •Define the HR Policy for the Project; •Set out the HR Roles and Responsibilities for the Project; •Set out the Procedures and Rules to be required under the plan; •Outline the provisions to support maximisation of local content; •Set out the need for and outline contents of the Recruitment Plan: •Set out the need for and outline content of the Worker Code of Conduct; •Define the requirements for the Contractor Management Process. •Define the requirements for the Influx Management Plan.		X	X	
GPM32	Labour management	The Project shall develop an Influx Management Plan identify the risks associated with the movemnet of workers into the area as a result of construction and operations of the new rail, and ensuring recruitement of local labour		X	X	

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
GPM33	Labour management	No person under the age of 15 shall be employed on the Project. No person under the age of 18 will be employed as a Project Worker if their work is potentially hazardous, including all construction activity that: • Is underground, under water, at dangerous heights or in confined spaces; involves dangerous machinery, equipment and tools; • Involves the manual handling or transport of heavy loads; • Is in an unhealthy environment which may, for example, expose children to hazardous substances, agents or processes, or to temperatures, noise levels, or vibrations damaging to their health; • Requires working for long hours or during the night. The age of all Project Workers must be verified and recorded through a check of worker documentation. Working hours for all employees under the age of 18 must be risk assessed for worker fatigue and hours adjusted accordingly.		X	X	X
GPM34	Labour management	The Project will not use any forced labour or people who have been trafficked. Project Workers will not be employed based on any of the following practices that may be classed as forced labour: •'bonded' labour where the worker is forced to work in order to pay off a debt that is so large that it is impossible or very difficult to ever pay off; •the provision of excessive monetary deposits by the worker; •excessive limitations on the freedom of movement of the worker; •excessive notice periods such that they cannot leave employment when they wish; •substantial or inappropriate fines; •loss or delay of wages that prevent workers from voluntarily ending employment within their legal rights; •retention of worker's identity documents, such as passports, or personal belongings so that the worker cannot access them in a timely manner; •charging recruitment fees to the worker or excessive amounts for travel, housing and meals that create unpayable debt obligations.		X	X	X
GPM35	Life and Fire Safety	Design certification shall be obtained from a third party life and fire safety consultant. Certification shall be against the following standards as a minimum: • Ghana National Fire Service (GNFS) fire codes guidelines, and legal requirements;		X		

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		• Ghana EPA compliance requirements • IFC EHS General Guidelines.				
GPM36	Life and Fire Safety	A Life and Fire Safety Plan shall be developed and implemented which identifies major fire risks, applicable codes, standards and regulations, and mitigation measures. The plan shall identify all links to other relevant plans including the EPRP.		X		
GPM37	Occupational Health and Safety	An Occupational Health and Safety (OHS) Management Plan for construction will be developed. The plan shall identify measures using the hierarchy of control to prevent accident or injury from: • physical hazards, such as equipment, noise and working at height; • chemical hazards, including air quality, chemical use, fire and explosives; and • biological hazards. The OHS Plan shall be updated for each phase of the Project. The plan shall define: • the role and responsibilities for OHS management • set out and define the requirements for associated procedures including the OHS risk assessment, job/task risk assessments, and permit to work system. • Set out the training and awareness requirements • Define the audit and inspection requirements to ensure implementation and compliance with the Plan. Specific measures may include but are not limited to: • installation of barriers, warning tape/ net, signage, watchman, and proper lighting; • use of appropriate PPE by site personnel at all times during construction activities; • provision of adequate cool drinking water for construction workforce; • provision of back-up alarms, lights, and all other applicable safety devices for plant and equipment; • workforce induction on the project site safety requirements prior to commencement of activities covering activity safety issues and general safety requirements.	X	X	X	X

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
GPM38	Occupational Health and Safety	An overall OHS risk assessment will be developed for each phase of the Project as part of the OHS Plan. This assessment must follow an appropriate risk assessment methodology and result in the identification of hazards, risks and appropriate means of control, applying the hierarchy of controls . The overall OHS risk assessment will be supplemented with more detailed job / task risk assessments. These assessments must be updated each time a job or task changes, or when an accident, incident or near miss has occurred.	X	X	X	X
GPM39	Occupational Health and Safety	A Permit to Work system will be implemented for high risk tasks that require these controls (to be identified as part of the OHS risk assessment). Authorized work permits will be required before work can begin on any such tasks.	X	X	X	X
GPM40	Occupational Health and Safety	An OHS Plan shall include the define the reporting system that must be developed and implemented to enable workers to report immediately to their supervisor any situation they believe presents a risk of injury or hazard to life or health.	X	X	X	X
GPM41	Occupational Health and Safety	The OHS Plan shall identify and define programs for medical screening and medical surveillance of workers will be developed to help ensure that employees are fit for duty and any injuries or illnesses are identified in a timely manner.	X	X	X	X
GPM42	Occupational Health and Safety	The OHS plan shall define the number and requirements for First aid equipment, First aid personnel, and supplies to be kept at all active Project sites to help support first response to any injuries. The need for and specific details of the First aid requirements shall be based on the risk profile of the activities undertaken at each site.	X	X	X	X
GPM43	Occupational Health and Safety	The OHS Plan shall define the Audit and Inspection programme to ensure appropriate implementation of the Plan at each site. The Plan shall define the Key Performance Indicators to be audited against, and a clear corrective action feed back loop described.	X	X	X	X
GPM44	Occupational Health and Safety	The Project will implement regular maintenance of vehicles/machines, use manufacturer approved parts, and ensure that the manufacturer recommended maintenance programs are implemented.	X	X	X	X

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
GPM45	Resettlement	A Resettlement Action Plan (RAP) will be developed to guide the resettlement process, including identification of Project Affected Peoples, consideration of baseline conditions, eligibility requirements, entitlements, grievance mechanism and consultation / disclosure activities.		X		
GPM46	Traffic / Community Health and Safety	A Traffic Management Plan (TMP) shall be developed and implemented that evaluates potential routes for the main Project related vehicle movements, such as deliveries of goods and services, worker transport, and waste removal vehicles. The TMP should prioritise routes that, where possible, avoid sensitive areas included but not limited to schools and residential areas. If avoidance is not possible, the TMP will consider alternative minimisation measures such as timing of vehicle movements, speed restrictions, staff training etc. The TMP should include management measures to control traffic safety at the construction sites and along routes used by the project. It will also detail who will be responsible for implementing these controls. The implementation of these measures shall be verified on an on-going basis. Specific measures may include: • Training on safety aspects to be provided to drivers. • Only trained and authorised operatives will operate site plant / vehicles. Drivers to have a valid driving licence if operating on public roads. • Speed limits will be complied with. • Routine inspections and periodic maintenance of vehicles. This may include daily safety checks carried out by drivers and regular maintenance inspections based on time or mileage. • Vehicles to include safety measures such as seatbelts, mirrors, reversing alarms and safety signals. • Sites will be designed to include pedestrian - vehicle segregation. Where complete segregation is not possible, pedestrian and vehicle traffic routes should be clearly marked. • Vehicle entrances to the site should will be clearly marked and located where there is good visibility (i.e. not close to sharp bends). Where this is not possible, mirrors shall be installed. There should be separate entrances and exits for vehicles and pedestrians. • Traffic and pedestrian safety training will be provided to local communities (e.g. through school education campaigns).		X		X

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		• Traffic wardens to coordinate vehicle movements entering / leaving site locations. • Notification provided to the general public and appropriate authorities where line stringing will cross public roads.				
GPM47	Waste Management	A Waste Management Plan shall be developed and implemented following the waste hierarchy which defines how wastes will be reduced, re-used, collected, managed, recycled and disposed of in an appropriate manner and in accordance with good international practice and Ghana EPA, District/Municipal Assemblies requirements. In accordance with the Conditions of the Environmental Permit granted by the EPA, construction wastes shall be reused or recycled as far as practicable. The WMP will provide the basis for all the waste management arrangements and act as a central point of reference for how wastes will be managed by the Project. Specific measures may include: • use of only approved / licenced companies for undertaking waste transport • use of only approved / licenced facilities, treatment and disposal • submission of an Annual Report for non-hazardous and hazardous waste management generation and disposal to Ghana EPA/District and Municipal Assemblies and Project Financiers. • review / audit of the main waste disposal facilities. • dissemination of the WMP and training of staff responsible for managing the construction sites and central construction camp and to all sub-contractors working on the Project. Personnel at an appropriate level of seniority will be nominated to be responsible for good site practices and arrangements for collection and effective disposal of all wastes generated by the Project. • inert waste landfills shall be constructed according to specifications set by Ghana EPA/District and Municipal Assemblies and IFC EHS Guidelines requirements and closure plan developed for the closure of any inert landfills established. The waste management plan should identify measures for the storage and handling of hazardous wastes. These may include: • Segregation of hazardous and incompatible wastes to prevent commingling or contact between wastes. Inspection of containers should be undertaken to monitor leaks or spills. Segregation may be through physical separation such as walls or		X	X	X

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		containment curbs. • Hazardous waste should be stored in closed containers located away from direct sunlight, wind and rain. • Hazardous waste shall not be stored onsite for more than 180 days. • Secondary containment systems should be designed and constructed using materials appropriate for the wastes being contained with the volume of secondary containment at least 110% of the largest storage container, or 25% of the total storage capacity (whichever is greater) • Where volatile wastes are stored ventilation should be provided. • Chemical compatibility should be considered when storing hazardous wastes. Information on chemical compatibility should be provided to employees and containers should be labelled with contents. • Access to hazardous waste storage areas should be restricted. • The hazardous waste storage area should be clearly identified and labelled and indicated on the site plan. • Periodic inspections of waste storage areas should be conducted and any findings documented and actioned. • Spill response and emergency plans should include scenarios for the accidental release of hazardous wastes. • Hazardous waste should be stored above ground. No underground storage tanks or underground piping of hazardous waste will be undertaken.				
GPM48	Waste Management	Where possible existing infrastructure will be reused and recycled for the replacement rail and facilities if they are in an acceptable condition		X		X
GPM49	Wastewater Management	In accordance with the Conditions of the Environmental Permit for construction, the existing piping system (both public and internal) shall be identified and re-located in the project area to prevent spillages through breakages during excavation works		X		
GPM50	Wastewater Management	Sewage, domestic grey and black water will be treated in line with the General EHS Guidelines, to meet discharge requirements set out in Table 1.3.1 of the IFC EHS General Guidelines.		X	X	X
GPM51	Wastewater Management	A Waste Water Management Plan shall be developed, or measures included within the Waste Management Plan, such as:		X	X	X

Ref No	Aspect / Topic	Mitigation Measure	Phase			
			Design	Construction	Operation	Decommissioning
		• measures to avoid or reduce the generation of wastewater such as use of drip trays, regular maintenance of oil/water separators, regular discharge of domestic wastewater into sewage septic tanks; • measures related to the treatment and disposal of wastewater; • spill prevention and control measures; and • treatment and discharge requirements.				
GPM52	Water Resources	A Construction Water Consumption Plan (CWCP) shall be developed in consultation with officials from GWRC, GWCL and District/Municipal Assemblies. This plan will: • include details on water supply locations within the project area of influence; • detail measures to ensure water usage for Project construction activities such as undertaking regular leak checks, repair or replacement of faulty plumbing encountered and monitoring of construction water usage; • requirements to investigate groundwater from borehole(s) and surface water utilization and obtain consent from Ghana Water Company Limited (GWCL) and Ghana Water Resources Commission (GWRC) and the District/Municipal Assemblies officials for any additional water required beyond the agreed usage limit; and • reflect the community consumption profile mandated by GWCL.		X		
GPM53	Water Resources	Testing of the water supply from the borehole will be conducted prior to construction to identify the water quality. Where this does not meet the applicable national and/or international requirements, a small water treatment plant will be installed at the facility to treat the abstracted water prior to supply. The operation of the water treatment plant will incorporate a leak detection and repair programme.		X		
GPM54	Water Resources	Wastewater during construction and operation will be collected in septic tanks and collected for off-site disposal at registered facilities		X	X	
GPM55	Water Resources	In accordance with the Conditions of the Environmental Permit Utility Company and other relevant bodies shall be informed of the construction works where relevant.		X		

4. ASSESSMENT OF ALTERNATIVES

4.1 Introduction

The assessment of alternatives (or alternatives analysis) is an important step in the management of environmental and social risks of a project through a robust analysis of technically and financially feasible alternatives to reducing potentially significant impacts.

The need for an alternatives analysis is defined in International Finance Corporation (IFC) Performance Standard (PS) 1 (2012) (footnote 11):

> *"For greenfield developments or large expansions with specifically identified physical elements, aspects, and facilities that are likely to generate potential significant environmental or social impacts, the client will conduct a comprehensive Environmental and Social Impact Assessment, including an examination of alternatives, where appropriate"*

In addition, IFC PS 3 (2012) requires the assessment of technically and financially feasible alternatives for eliminating, reducing or managing impacts associated with resource efficiency and emissions, including water use, greenhouse gases (GHGs), air emissions and emissions to land (including waste streams).

This chapter analyses the project alternatives in terms of the 'no project' alternative, road alternative, routing options and technology and materials alternatives.

4.2 The 'No Project' Alternative

The 'no project' alternative for the purposes of this ESIA is the situation where the Project (i.e. redevelopment of the Takoradi Port to Huni Valley Railway) does not proceed. Under this scenario, there are no adverse or beneficial environmental or social impacts, as there would be no construction or operation of the railway redevelopment.

Ghana's existing rail network is located mainly in the south of the country, which is more densely populated and affluent. The need for the overall wider Western Railway Line Development and therefore the first section, defined as the Project, is driven by Ghana's requirement to connect two major existing manganese and bauxite mines and support the delivery of essential cargo including cocoa, timber, cement, flour and other materials. In addition, the Western Railway Line Development would serve areas of Ghana with the second and fourth largest populations, through the provision of a passenger service.

The existing Western Railway Line is characterised by old tracks and inadequate stations and platforms. Therefore the redevelopment of the Takoradi Port to Huni Valley Railway would be the first stage in modernising the Western Railway Line to create a sustainable and efficient mode of transport that would help contribute to the economy, support the new oil and gas industry and ease the pressure of congestion on local roads and highways.

The 'no project' alternative will likely cause the further deterioration of the existing railway infrastructure in Western Ghana, further increase the pressure on the existing road network, including wear and tear from heavy freight and add to the economic disparity between the west and the south of the country.

4.3 Road Transportation Alternative

Another alternative to the project that was considered was the expansion/improvement of the road network. The main advantages of rail over road, are the following:

- dependable transportation that is less affected by weather and traffic;
- timetabled service with fixed routes that can be relied upon;
- greater speed over longer distances;

- low operating costs in terms of personnel;
- safety for passengers (in terms of accidents and breakdowns);
- affordability for a wide range of the population;
- carrying capacity of passengers and goods (which can be increased with the addition of carriages where required);
- reduction in external costs (such as noise, pollution, congestion, accidents) compared to the use of private vehicles; and
- lower GHG emissions that other forms of transport.

Rail is an energy efficient means of land transportation, with consumption of energy per unit load per kilometre lower than road travel. In addition, CO_2 emissions from rail are significantly lower than from road travel, therefore rail is considered a low carbon transport mode and important in the fight against climate change. The main disadvantages of rail over road, are the following:

- requires large investment of capital with the costs of construction and maintenance being high compared to road travel;
- inflexibility due to set routes and scheduled timings compared to road travel;
- less suitable for short distance travel; and
- must run at full (or close to full) capacity to be economically successful.

Finally, given the Western Railway Line already exists (but requires redevelopment and upgrade), this option provides most economical method to transport goods and people in western Ghana.

4.4 Routing Alternatives

4.4.1 Existing Railway Alignment versus Tarkwa Variant Alignment

Two routing options were considered for the project, the first being the existing railway alignment and the second includes variants to the alignment (see Chapter 3 Project Description Figure 3.3 and 3.4). It was decided by project engineers that given the existing railway alignment curvature and the fact that it passes through Tarkwa centre, it would be unsuitable to accommodate the safe running of 160 km/hr trains. Therefore, the Tarkwa variant alignment was developed using the existing railway alignment where possible, with the development of seven offline sections to avoid Tarkwa centre and reduce curvature of the alignment to allow for the safe running of faster trains.

The seven sections of the existing railway alignment which were amended by project engineers to form the Tarkwa variant alignment include:

- Eshiem- minor realignment of 3m which currently runs through Eshiem to route to the east of the settlement.
- South of Amantin – minor realignment of 1 km to the east of the existing alignment, through predominantly semi forested area, closer to the edge of Amantin.
- South of Esuaso – existing alignment to the south of Esuaso to be straightened and moved east, slightly closer to the settlement. Two other small realignments will run through predominantly mixed forested/plantation areas.
- East of Bonsawire- straightening of alignment for 2.2 km, to take the route closer to Bonsawire. Two other small realignments will run through mixed forested and farmed area with a typical matrix of cleared and wooded patches.
- East of Tarkwa- significant realignment of 10.8 km of rail which currently runs through the town of Tarkwa to route to the east of the town. The realignment will run through predominantly semi urban land with some properties, crops and existing industry (e.g. mining/quarrying). A new station will be constructed to the north east of the town, as well as the heavy rail maintenance facility.

- Abooso- straightening of alignment to north of Tarkwa and away from a significant number of properties in the main settlement but closer to a smaller number located to the west of Tarkwa. The new route will run through a predominantly semi urban area.
- Bompieso- minor realignment in two areas which will run through a predominantly forested/mixed semi natural habitat.

In addition to the main offline sections of the Tarkwa variant alignment detailed above there may be some smaller straightening of the route required in specific areas, however, these are likely to remain within the footprint of the temporary construction boundary.

4.4.2 Station Locations

Eight stations are proposed as part of the project at Amantin, Benso, Esuaso, Bonsawire, Nsuta, Tarkwa Bompieso and Huni Valley, which are considered the main communities along the route. Existing stations will be upgraded and used where possible, however new stations will be required where existing stations are no longer in use or are no longer located on the route due to the realignment of some parts of the route (as described in Section 4.4.1).

4.5 Technological and Material Alternatives

4.5.1 Locomotive Choice: Diesel or Electric Power

Two alternatives were considered in relation to locomotive choice for the project, diesel and eclectic power. Diesel locomotives are self-powered whilst electric powered locomotives require an overhead line to distribute power.

There are positives and negatives when comparing performance, cost and environmental impacts associated with both options.

Electric power locomotives generally perform better than diesel when it comes to acceleration, travel speed and pollution emissions (particulate, air and noise emissions) when close to stations. They are also are generally considered a lower carbon alternative compared with diesel powered locomotives, but only if the power generation mix is not dependent on fuels with high carbon content, such as coal. In Ghana 59.8% of the energy mix is from thermal power stations mainly powered by natural gas, with the remainder generated from renewable sources including hydropower. As a result, emissions associated with electricity usage will be lower than those for diesel usage.

Ghana Railway Development Authority do not currently have any electric locomotives in their system and none of the Western Railway corridor is electrified. Therefore, the cost for the project to consider electric powered locomotives without any of the appropriate existing infrastructure would far exceed that of using diesel locomotives. This coupled with an inadequate existing electricity infrastructure in the region has meant electric power locomotives have not been considered further.

4.5.2 Material Choice: Concrete or Wooden Sleepers

Two alternative materials were considered for sleepers, concrete and wood, both which have advantages and disadvantages.

In terms of safety, concrete sleepers have the advantage of being heavier (up to 300lbs heavier) and therefore more stable and less susceptible to temperature change which can affect timber. In addition, concrete sleepers are safer in relation to fire hazard. However, during train derailment timber sleepers can absorb the impact from wheels better than concrete sleepers which can shatter and need replacement.

In relation to cost, concrete sleepers are more expensive to initially produce but generally have a longer life compared to timber sleepers and require less maintenance (they do not rot), resulting in lower costs and fewer track closures. However concrete sleepers do not absorb vibrations from passing trains as well as wooden sleepers and small cracks can form in the concrete which can cause failure. This can occur when concrete sleepers are located next to a joint.

In terms of the environment impacts both options have their disadvantages. Wooden sleepers are usually soaked in creosote and the manufacturing of cement used in concrete sleepers produces high levels of greenhouse gas emissions. Concrete sleepers have been chosen for the project based on their safety characteristics over wooden sleepers.

5. METHODOLOGY

5.1 Introduction

The ESIA methodology provided within this Chapter sets out the standard approach used to characterise and evaluate the potential environmental and social (including community health and safety) effects of the Project.

The ESIA process is a systematic approach to identifying, describing and evaluating the potential environmental and social effects of a Project, and developing measures that will be implemented to manage these effects. These measures include ones that avoid or reduce the significance of adverse effects to an acceptable level and enhance beneficial effects.

The typical ESIA process is presented in Figure 5.1.

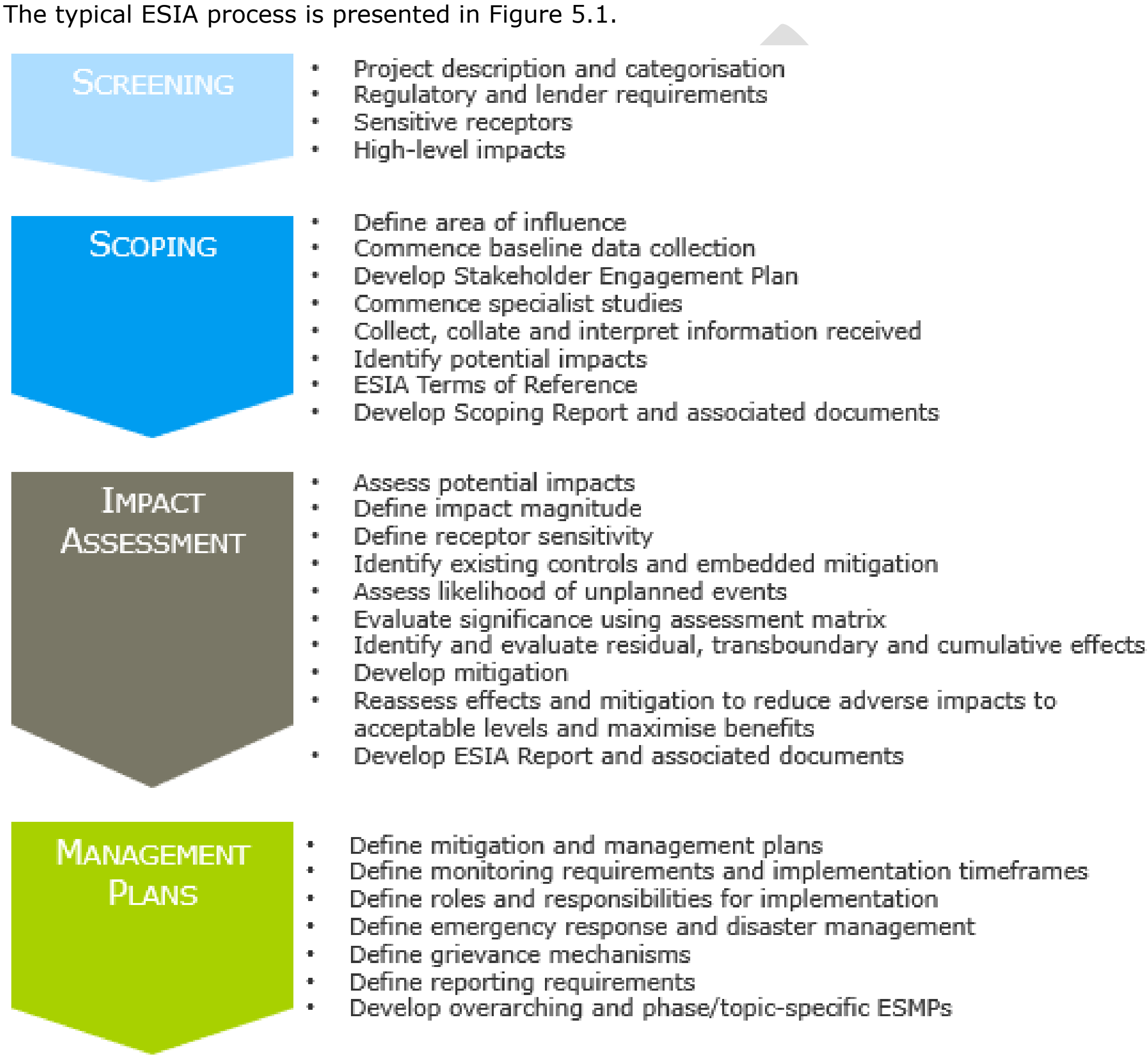


Figure 5.1: Key ESIA Phases

5.2 Screening

The first stage in the international ESIA process typically involves 'screening' or categorisation of the Project in line with the environmental risk (as required by Equator Principle 1 and IFC screening criteria). A traditional screening exercise was not undertaken for this Project, further details of the approach followed are provided in the following ESIA Scoping section.

It has been assumed that the Project should be categorised as Category A per the OECD Common Approaches and the Equator Principles, and hence is subject to a comprehensive ESIA process.

5.3 ESIA Scoping

The purpose of the scoping phase is to:

- identify key sensitivities and those activities with the potential to contribute to, or cause, potentially significant effects to environmental and socio-economic receptors and resources;
- obtain stakeholder views through consultation;
- evaluate siting, layout and technology alternatives for the Project; and
- develop the Terms of Reference (ToR) for the ESIA through consultation to ensure that the ESIA process and associated reporting output are focussed on the key issues.

Scoping was undertaken in 2015 for the national EIA process and a Scoping Report, incorporating the draft terms of reference for the EIA, was submitted to the EPA.

In 2020, an independent Environmental and Social Due Diligence (ESDD) assessment was undertaken on behalf of potential lenders to the Project. The ESDD was based on review of the national EIA and other relevant project materials, and identified relevant gaps with international requirements. Taking into account the scope of the national EIA, the findings of the ESDD was used to inform the scope of the ESIA, in place of a separate scoping exercise. As such, the ESDD aided in:

- defining the Project Area of Influence (AoI) and Study Area in accordance with IFC Performance Standard 1 (PS1);
- identifying the types of environmental and social impacts to be assessed and reported in this ESIA Report, and in doing so scope out 'insignificant impacts' that do not warrant further consideration at the ESIA stage;
- identifying gaps in baseline data and the requirements for further surveying; and
- determining the assessment techniques.

The following environmental and social impacts have been scoped into the Project ESIA:

- Air Quality;
- Climate Change;
- Noise and Vibration;
- Soils and Geology;
- Water Resources;
- Biodiversity and Ecosystem Services;
- Socio-Economics, Employment and Livelihoods;
- Community Health Safety and Security;
- Cultural Heritage;
- Labour and Working Conditions;
- Transport;
- Waste;
- Major Hazards; and
- Cumulative Impacts.

5.4 Impact Assessment

5.4.1 Scope of the ESIA

Temporal Scope

For the purposes of the ESIA, the Project has been divided into the following phases:

- **Construction** including pre-construction and site preparation, construction and commissioning activities: land clearance, gauge widening and construction activities, construction of stations and associated infrastructure (water pipeline, power line, access roads, waste facilities);
- **Operations** including operation of the railway rolling stock and stations, maintenance, utilities use and waste management. Note, environment and social aspects associated with the transport of various freight types, such as dangerous goods, have not been assessed as part of this ESIA and would be subject to risk assessment by GRDA as part of operations; and
- **Closure and decommissioning** i.e. once the Project has reached the end of its service life.

Spatial Scope - Project Area of Influence

In line with IFC PS1, the Area of Influence is considered to comprise:

- The areas directly and indirectly impacted by the funded Project;
- Associated Facilities (defined under IFC PS1 as facilities that are not funded as part of the Project and that would not have been constructed or expanded if the Project did not exist and without which the Project would not be viable); and
- Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the Project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

A description of the spatial extent of the direct and indirect impacts of the funded Project is provided below. Further details on Associated Facilities are described in Chapter 3 (Project Description) and cumulative impacts are further described in Section 5.4.5 below and Chapter 21 (Cumulative Impacts).

For the construction phase, the spatial extent of the Project's direct AoI includes:

- **Section 1 (KM0-10.2) -** the laying of the new standard gauge rails to be a core project component for the ESIA. The impact of the project in-combination with the existing operation of the track in this section will be assessed as part of the cumulative impact assessment.
- **Section 2 (KM10.2-32.6) -** construction of the Eshiem bypass is considered a core component project component, with remainder of works between KM10.2-32.6 considered as associated facilities.
- **Sections 3-5 (KM32.6-85.8) -** the Project AoI includes the construction activities and laying of the railway track (twin track standard gauge from KM32.6 to 67.3 and single track standard gauge from KM67.3-85.8), various realignment sections, railway infrastructure (including bridges, culverts, underpasses and level crossings), and railway stations.

The operational phase direct spatial AoI covers operation of Sections 1-5 of the railway, from Takoradi Port to Huni Valley (KM0-85.5).

Transport infrastructure which will be shared with the Project construction and operation logistics on the main logistics routes (see Chapter 3 Project Description) are not planned to be funded/managed as part of the Project, but which are part of the overall Project development or could be impacted by the development, were considered to be within the indirect AoI.

The AoI is presented in each of the topic specific chapters reflecting the specific nature of potential impacts and types of receptors. The composite Project AoI is presented in Figure 5.2 for construction and Figure 5.3 for operation.

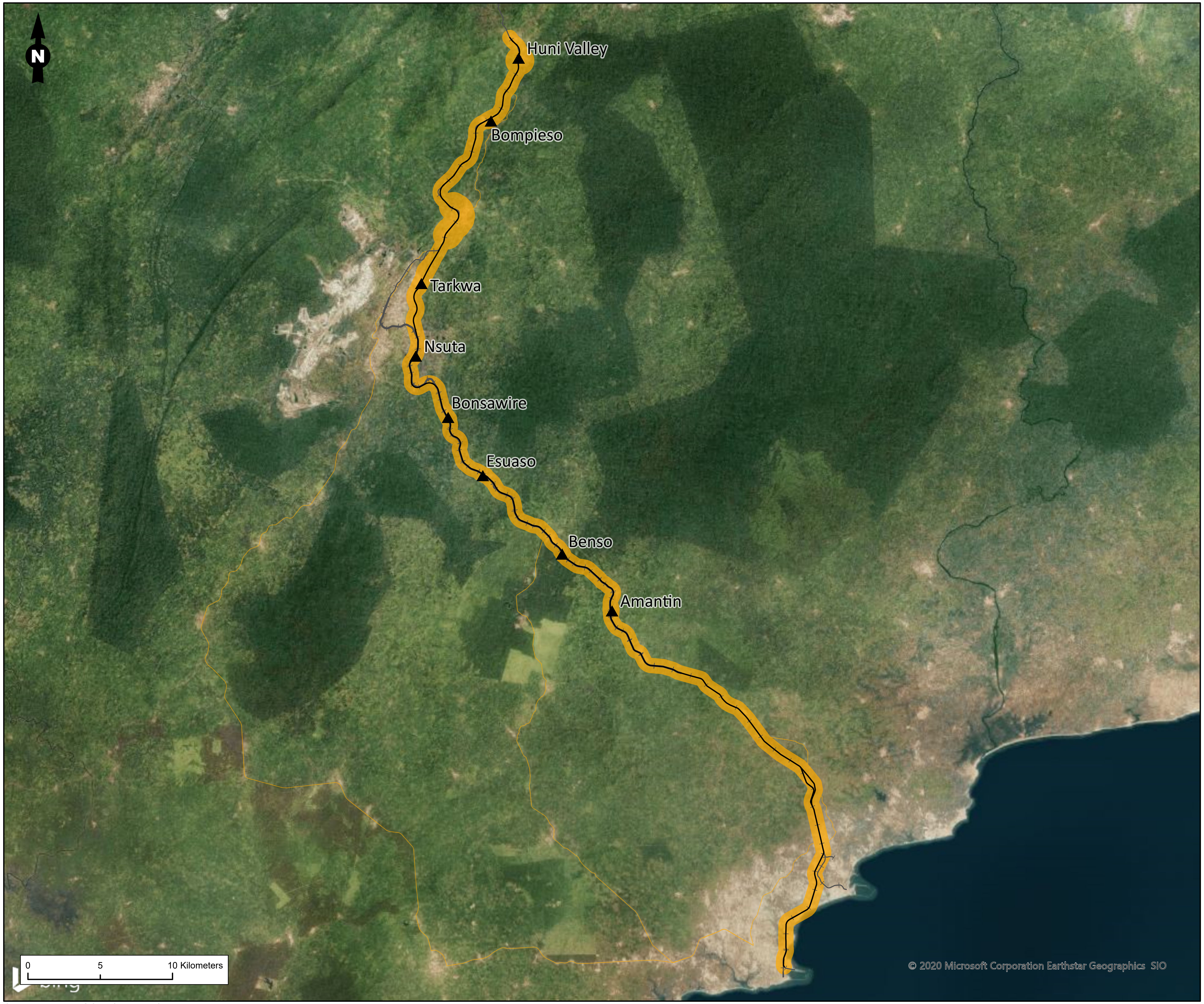
Contains map data @OpenStreetMap Contributors.

Legend

- ▲ Train Station
- Route
- Existing Train Track
- Project AOI - Construction

Figure Title Area of Influence - Construction	
Project Name ESIA Ghana	
Project Number 1620010291	Figure No. 5.2.1
Date October 2020	Prepared By AB
Scale 1:250,000 @A3	Issue 1
Client **Amandi Investments Ltd**	

RAMBOLL



Contains map data @OpenStreetMap Contributors.

Legend

- Train Station
- Route
- Existing Train Track
- Project AOI - Operation

Figure Title: Area of Influence - Operation	
Project Name: ESIA Ghana	
Project Number: 1620010291	Figure No.: 5.2.2
Date: October 2020	Prepared By: AB
Scale: 1:249,303 @A3	Issue: 1
Client: **Amandi Investments Ltd**	

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5.4.2 Baseline Studies

Baseline data collected to inform the previous EIA undertaken to national standards have been supplemented with additional baseline data gathered through desk top studies (secondary baseline data) to inform the ESIA. Where existing baseline data were not available or not sufficient, additional baseline data have been collected via surveys (primary baseline data).

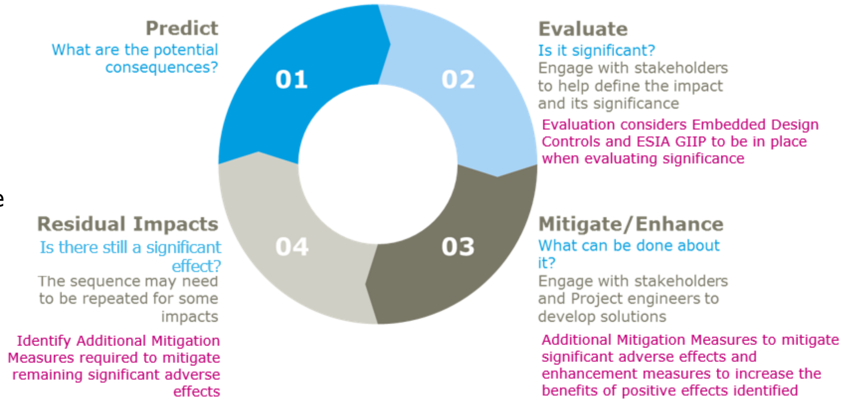
5.4.3 Assessing Planned Activities

The actions undertaken to determine the significance of potential effects from impacts associated with planned Project activities are described in Figure 5.3.

A range of qualitative and quantitative methods have been used within the ESIA. Quantitative methods have been used to predict measurable changes as a result of the Project and rely on measuring baseline conditions to make predictions for the different stages of the Project. Qualitative assessment techniques have relied on expert judgment and have been exercised with a structured framework to ensure consistency of the conclusions drawn. Where assumptions have been made, degrees of confidence and areas of uncertainty have been clearly stated.

Assessing Planned Activities

The ESIA process is a systematic approach to identifying, describing and evaluating the potential environmental and social effects of a Project, and developing measures that will be implemented to manage these effects. These measures include ones that avoid or reduce the significance of adverse effects to an acceptable level and enhance beneficial effects. The actions undertaken to determine the significance of potential impacts associated with planned Project activities involves four key steps:



1. Predict

The first step was to determine impact magnitude. The magnitude of an impact is a measure of the scale of a change from baseline conditions for a receptor. This measure of change can be described by considering the following factors in combination:

- **Extent:** Spatial extent (e.g. habitat impacted) or population extent (e.g. proportion of the population/community affected);
- **Duration:** Period over which an impact will interact with a receptor;
- **Frequency:** How often the impact will occur; and
- **Reversibility:** Restoration of the pre-impact status of a receptor.

Consideration of impact magnitude has taken into account embedded design controls and ESIA Good International Industry Practice (GIIP) measures.

Once the respective magnitudes of each impact were allocated, the next step was to determine receptor sensitivity, or vulnerability, which is based on:

- the degree to which a receptor is resilient to a change; and
- the value attributed to the receptor by stakeholders or applicable regulations/policies.

Topic specific criteria have been defined for impact magnitude and receptor sensitivity/vulnerability and are presented in the individual topic impact assessment chapters/technical annexes.

2. Evaluate

The impact magnitude and receptor sensitivity results were combined to determine significance of the effect. This was done using a significance matrix, whereby effect significance was determined by finding the cell where the impact magnitude and receptor sensitivity results intersect.

Impact Magnitude	**Receptor Sensitivity**		
	Low	Medium	High
Beneficial	Positive	Positive	Positive
Very Small	Negligible	Negligible	Minor
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

3. Mitigate / Enhance

Where adverse impacts were identified (the effects of which cannot be managed via design controls/incorporated mitigation), additional mitigation measures were developed (including avoiding, management and monitoring actions). The process of identifying design controls and mitigation measures followed the sequence of the mitigation hierarchy as specified in IFC PS1, which is widely regarded as the best practice approach to managing impacts. First, efforts were made to avoid or prevent, then minimise or reduce adverse impacts through the application of design controls. These efforts were supplemented by additional design controls and mitigation measures during Project construction, operation and decommissioning. For positive impacts, enhancement measures to increase the positive benefits generated by the Project were also considered.

4. Residual Impacts

Impacts were reassessed following the identification of mitigation measures to determine the magnitude and significance of any residual impacts. Any remaining significant residual effects (typically of Moderate or Major significance) were then addressed via consideration of mitigation measures such as offsetting and compensation.

Types of Mitigation Measure

Embedded mitigation measures have been taken into account when determining the impact magnitude and resultant effect as these are considered to be part of the Project (Step 2 of Figure 5.2). Two types of embedded mitigation measure are identified: **embedded design control** and **ESIA GIIP**, which are detailed in Chapter 3: Project Description of this ESIA. Mitigation measures that are inherent to the Project design and require only a one-time verification are referred to as embedded design controls. Mitigation measures that are generally consistent with good international industry practice, are classified as ESIA GIIP mitigation measures.

Where significant adverse effects have been identified (Step 3 of Figure 5.2), **additional mitigation measures** have been developed to mitigate these. **Enhancement measures** have been developed to increase benefits where positive effects have been identified.

In identifying mitigation measures, the mitigation hierarchy has been applied:

- **Avoid:** designing-out impacts by adopting a design that avoids impacts;
- **Reduce:** assessing alternatives and, where feasible, adopting those with less or lower impacts;
- **Mitigate:** applying mitigation measures to manage remaining impacts; or
- **Compensate or Offset:** establishing fair compensatory measures to address residual impacts that remain after implementation of the above steps.

5.4.4 Assessing Unplanned Events

To assess unplanned events, a risk-based approach has been used considering the likelihood of the potential event, and potential consequence of the hazard. Unplanned events were assessed using the methodology set out in Figure 5.4.

5.4.5 Cumulative Impacts

This ESIA addresses cumulative impacts defined by the IFC (2012) as *"those that result from the incremental impact of the project when added to other existing, planned and reasonably predictable future projects and developments."*

Figure 5.5 sets out the methodology used to assess cumulative impacts based on a six-step rapid cumulative impact assessment (RCIA) process.

Assessing Unplanned Events

An **unplanned event** is a reasonably foreseeable event that is not planned to occur as part of a Project, but which may conceivably occur due to Project activities, even with a low probability. Unplanned events may occur during any phase of a Project. Impacts arising from unplanned events should be evaluated using a combination of likelihood and consequence. Assessment of likelihood and consequence should take a quantitative approach where possible, and in many cases, independent quantitative risk assessments (QRA) will be commissioned for a Project (e.g. for oil and gas facilities and pipelines). Where a QRA is not available, assessment of unplanned events should be based on qualitative assessment involving the professional judgement of the developer and ESIA team.

Impact Likelihood

Likelihood refers to the probability of the unplanned event occurring, not the likelihood of an impact or effect due to the unplanned event.

Likelihood	Definition
Probable	Events that are known to occur within the industry and likely to occur on multiple occasions during the lifetime of the Project. The probability of occurrence is greater than 50% over the Project lifetime.
Possible	Events that are known to occur periodically within the industry and are reasonably foreseeable to occur at least once during the lifetime of the Project. The probability of an occurrence is less than 50% but greater than 10% over the Project lifetime.
Unlikely	Events that are known to occur rarely in the industry. They are realistically feasible, but unlikely to occur during the lifetime of the Project. The probability of an occurrence is less than 10% but greater than 1% over the Project lifetime.
Improbable	Events that are extremely unlikely to occur during the lifetime of the Project. The probability of an occurrence is less than 1% over the Project lifetime.

Impact Consequence

Consequence in unplanned events is similar to the impact magnitude of planned activities

	Environment	Social	H&S
High	Severe environmental damage that will require extensive measures to restore beneficial use of the environment, and will lead to loss of commercial, recreational use or natural resources over a wide area (regional to international). Recovery will only be possible in the long term with significant remediation effort.	Lasting or irreversible effects on socio-economics, community H&S, or cultural heritage assets. Mitigation is costly, complex or protracted, and of limited effectiveness. Effects are serious and/or over a large geographic area or population.	Permanent total disability or fatalities in communities and/or the Project workforce.
Medium	Limited environmental damage that will persist or require remediation over a local to regional area. Receptors can recover in the short to medium term.	Lasting or persistent nuisance with effects on socio-economics, community health and safety, or cultural heritage assets at a community level.	Major injury or health impact that requires hospitalisation.
Low	Minor environmental damage, that may extend beyond the Project footprint, but no lasting effect. Receptors can readily recover in the short term.	Temporary and/or reversible impact with limited short-term effect on socio-economics, community health and safety, or cultural heritage assets at a local level.	Minor injury or health impact that requires medical treatment.
Very Low	Slight environmental damage that is contained within the Project footprint.	Slight nuisance, and /or no measurable adverse effect on socio-economics, community health and safety, or cultural heritage assets.	Slight injury or health impact that requires first aid only.

Risk Assessment Matrix

Likelihood and Consequence are combined using a risk assessment matrix to determine impact significance ratings. Unplanned events will often result in an impact of Major significance, even with mitigation/remedial measures in place. In such cases, measures must be in place to manage an unplanned event, and the likelihood must be minimised to levels representing Good International Industry Practice. Unplanned events with a High residual impact significance should have sufficient mitigation to be categorised as improbable.

Consequence	Likelihood			
	Improbable	Unlikely	Possible	Probable
Very Low	Negligible	Negligible	Negligible	Minor
Low	Negligible	Minor	Minor	Moderate
Medium	Minor	Moderate	Moderate	Major
High	Moderate	Major	Major	Major

Cumulative Impacts

Cumulative impacts are those that arises due to an impact from the Project interacting with an impact from another activity to create an additional impact. For example, a residential property positioned between a railway project and an airport would result in the residential receptors experiencing the combined effect of the two noise sources. Cumulative impacts should consider existing, planned, and/or reasonably anticipated future Projects.

Cumulative impacts consider what impacts the Project will have on valued environmental and social components (VECs) in term of existing or future developments and how to avoid or minimise these impacts to the greater extent possible. Cumulative impact assessment can be challenging, particularly in emerging markets. A six-step rapid cumulative impact assessment (RCIA) entails a desk review that, in consultation with the affected communities and other stakeholders, enables the developer to determine whether its activities are likely to significantly affect the viability or sustainability of identified receptors. This approach recognises the many challenges associated with managing a good cumulative impact assessment (CIA) process in emerging markets, such as limited baseline data, uncertainty associated with anticipated developments, limited government capacity, and absence of strategic regional, sectoral, or integrated resource planning schemes.

1. • Determine spatial and temporal boundaries, e.g. the Project Area of Influence
2. • Identify receptors in consultation with affected communities and stakeholders, and identify all developments and external natural and social stressors affecting the receptors
3. • Determine the present condition (baseline) of receptors
4. • Assessment of the contribution of the Project under evaluation to the predicted cumulative impacts
5. • Evaluation of the significance of predicted cumulative impacts to the viability or sustainability of the affected receptors
6. • Design and implementation of mitigation measures to manage the Project's contribution to the cumulative impacts and risks

The initial screening results of the RCIA can identify several potential scenarios:

Significant Risk for Cumulative Impacts, with Significant Leverage	**Significant Risk for Cumulative Impacts, with Limited Leverage**	**Limited to No Contribution to Cumulative Impacts**
The Project under consideration represents a significant contributor to the expected cumulative impacts or will be the first of several future reasonably anticipated developments that will use the same resource and/or potentially affect the same receptors.	The Project under consideration is immersed in an environment where the cumulative impacts are evident but the issues are complex, many actors are already involved, and the solution is clearly beyond any individual Project sponsor.	The RCIA determines that even though there are clear cumulative impacts, the Project's contribution to the cumulative impacts over the affected receptors are negligible or nil.
Through consultation with stakeholders, the RCIA will help assess potential cumulative impacts that could be expected over time, and guide the developer in defining the required mitigation measures.	The RCIA will help developers to: • Determine the significance of the overall cumulative impacts and its contribution to these cumulative impacts; and • Design environmental and social management plans and procedures to appropriately mitigate hose contributions.	No measures other than the ones resulting from the ESIA process are necessary.
A developer could design a strategy to appropriately manage cumulative impacts and provide advice to the government on the appropriate governance structure to ensure other developers will follow suit. This is an ideal case, where the developer can capitalise on the ESIA process, and the RCIA may organically evolve into a more robust CIA process and contribute to leveraging governments by outlining a strategic approach to managing cumulative impacts.	Developers should be accountable only for the design and implementation of mitigation measures commensurate with the magnitude and significance of its contribution to the cumulative impacts. They should also use best efforts to engage other developers, governments, and other stakeholders in acknowledging the cumulative impacts and risks and in designing coherent management strategies to mitigate them.	***Note:*** If there are cumulative impacts from other sources that are not being addressed, developers may consider it pertinent to draw this to the attention of the government or other stakeholders, and assess whether its Project may be at risk from the unmanaged cumulative effect.

6. STAKEHOLDER ENAGEMENT

6.1 Introduction

This chapter describes the stakeholder engagement activities undertaken as part of the ESIA process. It provides a summary of consultation with regulatory authorities, local communities and other key stakeholders; full details are presented in the Stakeholder Engagement Plan (SEP). The engagement activities undertaken were designed to share information and knowledge in a timely manner, whilst also seeking to understand and respond to the concerns of potentially impacted or affected stakeholders; thereby building relationships based on trust. For the purposes of this assessment, a stakeholder is defined as 'persons, groups, organisations or communities who may be directly or indirectly affected (positively or negatively) by the Project, or who have an interest in it'.

Stakeholder engagement activities for the Project have been planned and implemented in line with the requirements of the Ghanaian Environmental Assessment Regulations (1999), the IFC Performance Standards (2012).[1], the Equator Principles, and the OECD Recommendation on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence ('OECD Common Approaches'). Stakeholder engagement has also been informed by the practices outlined in the IFC guidance on stakeholder engagement[2]

6.2 Overview of Stakeholder Engagement Undertaken

6.2.1 Stakeholder Identification and Analysis

Prior to undertaking engagement activities, stakeholders were identified and subsequently categorised according to their interests and interaction with the Project. This analysis was used to ensure engagement activities were tailored appropriately to the needs and interests of different stakeholder groups.

In order to ensure that the engagement process was as inclusive as possible, the ESIA team identified individuals and groups that could be deemed as 'vulnerable' i.e. those who may find it more difficult to participate and those who may be differentially or disproportionately affected by the Project because of their marginalised or vulnerable status.

The stakeholder analysis also looked to identify those stakeholders that are likely to be affected by Project impacts (actual or perceived) to ensure that stakeholder engagement and planned communication are appropriately tailored.

The stakeholders identified are presented in Table 6.1. Details of individual stakeholders were compiled in a stakeholder register and further details are provided in the SEP. This was periodically updated throughout the ESIA engagement process.

[1] The relevant World Bank Environment, Health and Safety (EHS) Guidelines are also Applicable Standards but do not directly provide specific requirements for stakeholder engagement.
[2] IFC, 2007. Stakeholder engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets.

Table 6.1: Stakeholders and their potential interest in or influence on the Project

Stakeholder type	Area of responsibility and potential interest in or influence on the Project
National government authorities	
Environmental Protection Agency (EPA)	The EPA has a mandate to guide the conduct of EIAs, to grant approvals for projects that are subject to EIA and to monitor the construction and operation phases of projects to ensure compliance with approval conditions, mitigation measures, and other environmental commitments and quality standards. The EPA has an Environmental Assessment and Audit Department. The EPA has Regional/ District Offices that would be involved in the monitoring of the Project.
Ghana Railway Development Authority (GRDA)	The GRDA established under the Railways Act, 2008 (Act 779) has the responsibility to promote the development of railways and railway services, hold, administer and improve the railway assets and promote the development and management of sub-urban railway. GRDA under the Act is required to regulate the railway industry in Ghana, to operate as the railway landlord, to develop the rail systems in Ghana, including the development of master plans, to expand the railway systems, to link the railway systems to neighbouring countries and to exercise ownership rights over the infrastructure and all assets.
Department of Urban Roads (DUR)	The DUR is responsible for the provision of roads other than trunk roads in the metropolitan areas. It was established in 1989 as an implementing agency within the then Ministry of Roads and Highways. Where there is any crossing of urban roads by the railway there will be the need for collaboration between GRDA and DUR to discuss the likely adverse impacts of the Project on the level crossing sections of the road and mitigation issues like separation. Ghana Railway Master Plan ESMF has a procedure to follow with DUR to consult on and plan road-rail crossings, including during construction for Joint Site meeting to review progress of implementation, etc
Ghana Highway Authority (GHA)	The GHA is a semi-autonomous body which is responsible for the provision and management of trunk roads Where there is any crossing of trunk roads by the railway there will be the need for collaboration between GRDA and GHA to discuss the likely adverse impacts of the Project on the trunk road and mitigation issues like separation. Ghana Railway Master Plan ESMF has a procedure to follow with GHA to consult on and plan road-rail crossings, including during construction for Joint Site meeting to review progress of implementation

Stakeholder type	**Area of responsibility and potential interest in or influence on the Project**
Department of Feeder Roads (DFR)	The DFR is a civil service institution responsible for rural roads. It was set up under Government instrument in 1981 to have the sole responsibility for the planning, development and maintenance of rural roads. Where there is any crossing of feeder roads by the railway there will be the need for collaboration between GRDA and DFR to discuss the likely adverse impacts of the Project on the feeder road and mitigation issues. Ghana Railway Master Plan ESMF has a procedure to follow with DFR to consult on and plan road-rail crossings, including during construction for Joint Site meeting to review progress of implementation
Forestry Commission: • Wildlife Division (WD) • -Forest Services Division (FSD)	The Forestry Commission Act, 1999 (Act 571) establishes the Commission to be responsible for the regulation of the utilisation of forest and wildlife resources, the conservation and management of those resources and the co-ordination of policies related to them. Some portions of the railway may impact negatively on wildlife and forest resources and therefore there is a need for consultation with the WD and FSD. As stated in the RMP ESMF: • WD considered areas declared by law as wildlife reserves as 'no go areas' for railway infrastructure and network development. • The position of FSD is that railway lines could pass through forest reserves in principle. Stringent conditions are, however, required. to allow routing railway lines through reserves, including consulting with FSD.
Water Resources Commission (WRC);	The Water Resources Commission Act, 1996 (Act 522) and the Water Use Regulations, 2001 provide for the regulation and management of all water resources and related matters, including the different types of water use that require water use permit. The Commission should be consulted and notified on any plans to divert water bodies if required.
Lands Commission (LC)	The LC is a government authority that provides various land-related services including surveying and mapping, registering title to land and other interests in land, and assessing compensation upon compulsory acquisition. The LC is a key partner in the preparation and implementation of the RAP, and their roles and responsibilities are detailed in the RAP document.
Ghana Museums and Monuments Board (GMMB)	The GMMB is the legal custodian of Ghana's material cultural heritage, both movable and immovable heritage. The GMMB would need to coordinate with GRDA and the client in the event of any significant chance finds of archaeological material.
Regional / district authorities and representatives	

Stakeholder type	Area of responsibility and potential interest in or influence on the Project
Metropolitan, Municipal and District Assemblies (MMDA) (see section below table for list of applicable MMDA)	The Local Governance Act, 2016 (Act 936) establishes and regulates the local government system and gives authority to the District (or Municipal / Metropolitan) Assembly to exercise political and administrative power in the District, provide guidance, give direction to, and supervise all other administrative authorities in the District. An Assembly’s responsibilities include: responsibility for overall development of the district; to promote and support productive activity and social development in the district; initiate programmes for the development of basic infrastructure and provide municipal works and services in the district; be responsible for the development, improvement and management of human settlements and the environment in the district; maintenance of security and public safety in the district; and, preserve and promote the cultural heritage within the district. The Land Use and Spatial Planning Act, 2016 (Act 925) seeks to provide sustainable development of land and human settlements through a decentralised planning system and ensures judicious use of land. This is to improve the quality of life, promote health and safety in respect of human settlements. It further regulates national, regional, district and local spatial planning and generally provides for spatial aspects of socio-economic development and related matters. Section 113 on permits outlines the following function of Assemblies: *A person shall not undertake any physical development of land within a district unless that person has been issued with a permit by the District Assembly within the jurisdiction in which the land is situated.* As noted in the RMP ESMF, “*MMDAs are therefore expected to integrate the RoW of railway corridors into their planning schemes, and take necessary enforcement action against encroachers and unauthorised development on railway land. Waste management and waste infrastructure planning are primary mandates of MMDAs. GRDA must liaise with MMDAs to address the misuse and abuse of railway land for waste disposal.”* The Assembly therefore has an interest in all aspects of the Project and its impact on their communities and its residents, including addressing any requirements for permitting of the Project and its ancillary facilities.
Paramount Chiefs within the Project Area	The Paramount Chief is the traditional authority at the district level. Community chiefs report to the Paramount Chief. The Paramount Chief will have an interest in the Project and for each phase of activity will be consulted prior to consultation with the individual community chiefs unless they express an alternative preference. .
Community stakeholders(see section below table for list of communities)	

Stakeholder type	Area of responsibility and potential interest in or influence on the Project
All residents, business operators and land users within the communities	Interest in all aspects of the Project, its impact on lives and livelihoods, and the mitigation measures that will be applied to avoid and manage impacts.
People directly affected by physical or economic displacement.	Specific interest in the measures that will be applied to avoid and mitigate displacement.
Chiefs and sub-chiefs for each community	Interest in all aspects of the Project, its impact on the community and its residents, and the mitigation measures that will be applied to avoid and manage impacts.
Religious leaders of the communities.	Wellbeing of the residents and protection of any religious buildings and sites.
Women's Association of the communities	Wellbeing and protection of women.
Youth Association of the communities	Wellbeing and protection of young people, including job opportunities created by the Project.
Associations representing vulnerable people in the community(disabled, widows, orphans and old people, etc.)	Wellbeing and protection of vulnerable people.
Utility Companies	
Ghana Water Company Limited (GWCL)	GWCL is a utility company, fully owned by the state and is responsible for potable water supply to all urban communities in Ghana. GWCL will have an interest in any requirement to move existing or planned water supply assets as a result of the Project. Ghana Railway Master Plan ESMF has a procedure to follow to consult on and plan interaction with water assets.
Electricity Company of Ghana (ECG)	ECG is a company wholly owned by the Government of Ghana and provides electricity distribution and supply. ECG will have an interest in any requirement to move existing or planned electricity assets as a result of the Project. Ghana Railway Master Plan ESMF has a procedure to follow to consult on and plan relocation of electricity lines.
Ghana Chamber of Telecommunications (GCT)	These stakeholders will have an interest in any requirement to move existing or planned telecommunications assets as a result of the Project. Ghana Railway Master Plan ESMF has a procedure to follow to ensure smooth relocation and alignment of telecommunication lines and fibre deployment in relation to railway infrastructure (e.g. rail track) development.
Telecommunications companies that may have assets at or close to Project footprint, including MTN, Tigo, Vodafone Ghana Limited	
Bulk Oil Storage & Transportation Company (BOST).	BOST is a private limited liability company with the Government of Ghana as the sole shareholder, and its mandate includes developing a network of storage tanks, pipelines and other bulk transportation infrastructure throughout the country. BOST will have an interest in any requirement to move existing or planned assets (such as pipelines) as a result of the Project.
Other	

Stakeholder type	Area of responsibility and potential interest in or influence on the Project
Mines: • Ghana Manganese Company - Nsuta manganese mine. • Goldfields – Tarkwa gold mine	Mine companies will have a general interest in the Project and will expect consultation and joint planning on any potential impacts to their operations, including any disruption to road access that could be caused during the construction phase.
Commercial farms and other large businesses	Large farms and other businesses operating close to the railway will have a general interest in the Project and will expect consultation and joint planning on any potential impacts to their operations, including any disruption to road access that could be caused during the construction phase.
Commanding officer of the police at each police station along the Project route	Local police commanding officers will benefit from general awareness of the Project as well as specific information about the timing of construction in each area, the location and size of construction camps, and any security incidents that occur.
Non-Governmental Organisations (NGOs) operating in the Affected Communities	Various responsibilities depending on the area of the NGO's work. Interests will be in potential interaction between the Project and their area of work.
Media	
Regional / local newspapers	Interest in reporting on the Project to their local audience, including an overview of the Project and reporting on any material changes and milestones.
Regional / local radio	
Regional / local television	

6.2.2 Stakeholder Engagement Activities

Stakeholder engagement activities throughout the ESIA are summarised below and a full list of meetings undertaken as part of the ESIA is presented in Table 6.2.

Draft ESIA Engagement

Stakeholder engagement on the draft ESIA report was undertaken in August and September 2020 to:

- introduce the Project to stakeholders and inform them of the ESIA process;
- present the findings of the draft ESIA Report;
- discuss potential environmental and social impacts associated with the Project and seek feedback on proposed management and mitigation/enhancement measures;
- identify and discuss any issues of concern;
- explain the grievance mechanism for the Project; and
- provide stakeholders with an opportunity to ask questions.

Table 6.2: Social baseline FGDs and KIIs undertaken during the ESIA studies[3]

Date	Meeting	Location	Number of Participants
24/08/2020	Manso Market woman FGD	Roman Catholic MA Basic School - Manso	21

[3] Note that engagement on the draft ESIA will incorporate NGOs, government departments as well as communities and PAPs

Date	Meeting	Location	Number of Participants
25/08/2020	Manso Market Men FGD	Roman Catholic MA Basic School- Manso	21
25/08/2020	Manso Woman FGD	Roman Catholic MA Basic School - Manso	5
24/08/2020	Manso Youth FGD	Roman Catholic M/A Basic School - Manso	8
25/08/2020	Manso Health Health KII	Health Center - Manso	1
26/08/2020	Manso Small Business KII	Shop Premises - Manso	1
24/08/2020	Manso Community/Village leaders KII	Chief's Palace - Manso	1
26/08/2020	Amantin Men FGD	Chief's Palace - Amantin	16
26/08/2020	Amantin Woman FGD	Chief's Palace - Amantin	11
25/08/2020	Amantin Youth FGD	Chief's Palace - Amantin	11
27/08/2020	Amantin Community/Village Leaders	Chief's Palace - Amantin	1
28/08/2020	Amantin small business KII	Aminu Abubakr Store – Amantin	1
28/08/2020	Benso Men FGD	Methodist Church- Benso	23
28/08/2020	Benso Women FGD	Methodist Church- Benso	8
28/08/2020	Benso Youth FGD	Methodist Church- Benso	7
27/08/2020	Benso Community/Village leaders KII	Chief's Palace - Benso	3
28/08/2020	Benso Small Business KII	Fa wo ho bo Awurade, ma wo ho nto wo- Benso	1
02/09/2020	Benso Health KII	Health Center - Benso	1
30/08/2020	Esuaso Men FGD	Community Centre - Esuaso	40
30/08/2020	Esauso Women FGD	Market - Esuaso	10
30/08/2020	Esauso Youth FGD	Esuaso	8
30/08/2020	Esuaso Community/Village leaders KII	Chief's Palace - Esuaso	TBC
30/08/2020	Esuaso Health KII	Opposite the Information Centre - Esuaso	TBC
30/08/2020	Esuaso Small Business KII	Eusaso	TBC
31/08/2020	Bonsawire Men FGD	Bonsawire	14
31/08/2020	Bonsawire Women FGD	Community Centre - Bonsawire	14

Date	Meeting	Location	Number of Participants
31/08/2020	Bonsawire Youth FGD	Bonsawire	32
29/08/2020	Bonsawire Community/Village leaders KII	Chiefs residence - Bonsawire	3
29/08/2020	Bonsawire Small Business KII	Nothing I get - Bonsawire	1
27/08/2020	Bonsawire Health KII	CHPS - Bonsawire	1
31/08/2020	Nsuta Women FGD	New Compound Methodist School - Nsuta	16
31/08/2020	Nsuta Youth FGD	Nsuta	12
31/08/2020	Nsuta Community / Village Leaders KII	Community Basic School - Nsuta	3
31/08/2020	Nsuta Health KII	Nsuta	TBC
04/09/2020	Brahabebom Men FGD	Brahabebom	8
05/09/2020	Brahabebom Woman FGD	Brahabebom	12
04/09/2020	Brahabebom Community / Village Leaders KII	Brahabebom	TBC
04/09/2020	Brahabebom Health KII	Brahabebom	1
04/09/2020	Brahabebom Small Business KII	It takes two drinking spot - Brahabebom	1
01/09/2020	Aboso Men FGD	Aboso	14
01/09/2020	Aboso Women FGD	Aboso	15
01/09/2020	Aboso Youth FGD	Aboso	36
01/09/2020	Aboso Health KII	Health Centre - Aboso	1
01/09/2020	Aboso Opinion Leader KII	Aboso	TBC
01/09/2020	Aboso Small Business KII	My Redeemer Lives Enterprise - Aboso	1
02/09/2020	Amoanda Men FGD	Amoanda	6
02/09/2020	Amoanda Women FGD	Amoanda	13
02/09/2020	Amoanda Small Businesses KII	Amoanda	1
02/09/2020	Amoanda Youth FGD	Social Grounds - Amoanda	18
02/09/2020	Amoanda Community / Village Leaders KII	Chief’s Palace - Amoanda	3
03/09/2020	Huni Valley Men FGD	Huni Valley	19
03/09/2020	Huni Valley Youth FGD	Huni Valley	5

Date	Meeting	Location	Number of Participants
03/09/2020	Huni Valley Women FGD	Nana Kwabena Amponsah Social Grounds – Huni Valley	16
03/09/2020	Huni Valley Small Businesses KII	Benja Enterprise- Huni Valley	1
03/09/2020	Huni Valley Health KII	Health Centre- Huni Valley	1
03/09/2020	Huni Valley Community / Village Leaders KII	Huni Valley	TBC
09/09/2020	Ministry of Food and Agriculture (MOFA)- Prestea-Huni Valley Municipal Assembly KII	MoFA office - Huni Valley	TBC
09/09/2020	Department of Agriculture KII	Tarkwa-Nsuaem Municipal Assembly	TBC

Table 6.3: General stakeholder engagement meetings introducing the Project

Date	Location	Participants	Details of the Meeting
22/08/20	Manso	32	A general stakeholder meeting was held with representatives from four project communities in Manso. These representatives were community/opinion leaders and community members. These communities were Manso, Angu, Amantin and Benso. The meeting commenced at 11:30 am with a prayer said by Mr Silas Danquah. This was followed by an introduction from representatives of Associated Consultants (ACON) and Ghana Railway Development Authority (GRDA). The various representatives from the four communities present also introduced themselves
24/08/20	Tarkwa-Brahabobom Community Centre	32	A general stakeholder meeting was held with representatives from four project communities in Tarkwa. These were the chiefs and leaders of the Brahabebom, Nsuta, Bonsawire and Esuoso communities. The meeting started at 2:45 pm with a prayer by an Assembly Member and was followed by an introduction of all persons gathered. The meeting began with 6 representatives from Brahabobom, 11 from Esuaso and 9 from Bonsawire.
26/08/20	Huni Valley-Community Centre	25	A general stakeholder meeting was held with representatives from four project communities in Huni Valley. This was a meeting with chiefs and leaders along of Huni Valley, Amoanda, Bompieso, Brigade and Aboso. The meeting started at 4pm with the introduction of persons gathered.

Date	Location	Participants	Details of the Meeting
20/08/20	Mpohor Municipal Assembly	20	The meeting with the Mpohor District Assembly Officials commenced with a brief prayer said by a volunteer of the assembly at about 10:38 am. Introduction was done by both representatives from the Ghana Railway Development Authority (GRDA), the consultants from the Associated Consultants (ACON) and the Municipal Assembly.
20/08/20	Prestea-Huni Municipal Assembly	22	The meeting with the Prestea-Huni Valley Municipal Officials commenced with a brief prayer said by Ing. Osei at about 17:05pm. Introduction was done by both representatives from the Ghana Railway Development Authority (GRDA) and the Municipal Assembly.
24/08/20	Tarkwa – Nsuaem Municipal Assembly	15	The meeting with the Tarkwa – Nsuaem Municipal Officials the meeting commenced at exactly 10:47 am with a prayer. This was followed with a welcome address together with the purpose of the meeting by the District Coordinating Officer (DCO).
25/08/20	EPA Office (The EPA's jurisdiction covers TNMA as well as Mpohor District Assembly on the ROW	5	The meeting with the Environmental Protection Agency started at 9:18 am with an introduction of personnel on the Project Team and EPA respectively. The EPA in Tarkwa is responsible for activities in the following Districts/Municipality: Tarkwa-Nsuaem; Prestea- Huni Valley; Wassa-Amenfi East; Wassa-Amenfi Central; and Wassa-Amenfi West.
25/08/20	Forestry Commission Office	4	A meeting with the forest services division of the Forestry Commission and Ministry of Food and Agriculture (MOFA) began at 2:15 pm. A presentation on the Project was given and details of the ESIA and RAP was given by the Team.
24/08/20	Tarkwa – Nsuaem Municipal Assembly (the municipal planning officer, municipal health officer)	TBC	The meeting with the Tarkwa - Nsuaem municipal planning officer, municipal health officer commenced at exactly 10:47 am with a prayer. This was followed with a welcome address together with the purpose of the meeting by the District Coordinating Officer (DCO).

6.3 Outcomes of Engagement

The response to the Project has provided some positive thoughts on the impacts on local communities. Perceived positive impacts of the Project include:

- Increase trading with new methods of movement of people and goods. This is in turn, would decrease in the cost of food and transportation, providing financial gains.
- New and faster connections to other towns and remote communities.
- Sustainable job creation/employment (including through the GRDA) and increase in income generation.
- Improvement in the quality of life for local communities.
- Reduction in damage caused to roads by the haulage of minerals and timber by reducing the stress on the roads.
- Safer and faster means of transportation by reducing highway robberies and motor vehicle accidents.
- Regeneration of communities and improvements in infrastructure.

Perceived negative impacts of the Project include:

- Safety concerns due to people climbing onto the trains, train-human collisions and vehicular-train collisions due to the Project not having adequate safety features.
- Loss of livelihood resulting from the acquisition of farmlands and properties without enough compensation, increasing poverty and leading to the displacement of people.
- Potential to cause health and wellbeing issues, i.e. emotional and mental trauma due to the loss of properties and land.
- Increase in social issues due to the influx of traders/travellers/migrants/foreigners arriving from other towns.
- Introduction of infections and diseases.
- Lower quality of life for those who live near the railway due to vibrations from train movement. Damage to farmland and structures.
- New jobs brought by the railway not going to the local communities / local people.
- The youth may no longer be interested in attending school as a result of employment opportunities associated with the Project.

During the public meetings, stakeholders also had questions about the specific plans for the Project. These included:

- Will there be compensation for those who will be affected by land acquisition in the AoI?
- Will there be any special support for businessmen and women in the community?
- Will those who are impacted be given prior notice to relocate? Is there available land to purchase for relocation?
- What will be the nature of the compensation? How will this be determined?
- Will the new line be for passengers or goods only?
- Will, there be any engagements with the PAPs and how will they be compensated?
- Can you provide more detail on the Project, i.e. what exactly is the Project about, when will it start etc?
- Will local people of all ages be employed in the construction and operation of the railway?
- Will the Project provide skills training for the youth?
- The current train station is too far from the community. Will new train stations be close enough to allow for more accessibility for the community?
- In terms of safety, will there be a buffer zone created around the track?
- Is it possible for the AoI to be re-routed?

Table 6.4 provides a summary of stakeholder engagement questions and answers from the meeting minutes with the MMDA officials, chiefs, opinion leaders and community members.

Table 6.4: Summary of responses to key questions

Question	Answers
Project Programme	
When is the Project starting?	The Project had already started from Takoradi Port to Eshiem and it's the same link. It is considered that the Project has already started as engagement has begun.
How many years is the Project going to span to completion?	The start date of the construction cannot be confirmed, but when it starts, it is expected to take four years to complete. Stakeholder engagements, ESIA and RAP, are the preliminary exercises that are precedent to the finalisation of the contract. The commencement date is contingent on some conditions precedence such as the ESIA and RAP.
Construction and Operation	
Will the Project make use of the existing railway and expand on this? or will a new one be constructed?	There is going to be an expansion of the existing rail lines. However, during this expansion, an effort will be made to avoid areas such as cemeteries, etc.
Will the old lines be abolished?	The old lines will continue to be used to haul manganese from Nsuta until the new one is commissioned.
Will the stations be maintained?	There will be new stations built along the route; however, the engineers will need to confirm the specifics.
How can residents know that they are encroaching on the said land (operational safety width)?	The railway operational limit for safety/ buffer zone is 30 m on both sides of the railway line. Most encroachers already know about the statuses of their lands. The RAP team will also contact all affected persons.
Is a 60 m ROW too big for a railway?	There is going to be a double lane and that the new lanes will have speed trains plying it and hence needs more area.
How will the GRDA maximise income through the redesign of the terminals?	In terms of structure, the medium railway terminals will be adopted as well as a signaling system to help maximise income through the redesign of the terminals.
Where the railway crosses the road, what interventions will have been put into place?	Level crossing design will be adapted during the implementation of the Project
Compensation	
How will the Project Affected Persons be compensated?	The MA will be involved in the compensation/resettlement process. The process for compensation of affected persons is as follows:

Question	Answers
	• Project Affected Persons (PAPs) will need to demonstrate ownership of affected properties. • The Land Valuation team of the Lands Commission together with Consultant's will assess properties • Resettlement Action Plan (RAP) team will value all affected properties. • The compensation details will be presented to the Client organisation for payment. • The client organisation will serve letters to all PAPs with regards to compensation packages. The PAPs will be provided to opportunity to accept or reject the compensation sums. • If the PAP rejects the sum, he/she has to begin another set of processes with the Valuation Team until a consensus is reached.
For those who acquired the land from the railway authority, what are the arrangements for those claiming ownership of affected assets/land?	The lands were leased and not sold. Therefore, the railway authority has access to it after the lease period. Lands belonging to GRDA are leased out for the construction of only temporary structures.
What will the valuation of the farm be if there is no produce or inadequate crop spacing on the farm during its valuation?	The farm will be valued based on its exact state at the time of the exercise. If the farm has poor crop spacing, it is likely to affect the crop yield, and this is a critical factor that is considered during valuation. Planting arrangements will be analysed during the valuation process
Does the GRDA pay royalties to the stool on the existing line?	Royalties being paid to the stool is something the Project is not aware of and does not believe something like that happens.
Whose name will be on the legal claim document, the landowner or the person cultivating on the and especially in the "abusa" or "abuno" sharecropping agreement which is common in the area?	In the existence of a sharecropping agreement between two parties, there will be a different claim document for the parties involved.
Will photographs of the actual landowners be taken especially in the case of the sharecropping arrangement where the farmer owns only the crops on the land?	Photographs of the parties involved will also be taken.
Crop compensation rates are renewed every year by the mining companies. The rates for mining companies are different from that of the Lands Commission, is the need to assess this?	The mining companies usually take vast portions or all of peoples lands, but there is the tendency for the Project to affect linear bits of some lands. The law also permits PAPs to salvage some part of their structures.
Stakeholder Engagement	

Question	Answers
There have been some works at Angu whereby no stakeholder engagement was carried out with community leaders. Will officials have some engagements with the community later on?	This was a mistake on the side of GRDA. However, no engagement will be carried out in Angu.
Communities	
What will be the social and corporate responsibility of the contractor on this Project?	Usually goodwill, the contractor chooses to do some things for the communities. This cannot be confirmed in the current time.
Government	
Will a change of government affect the Project at any stage?	The Railway Master Plan was published in 2013 and has seen changes of governments but the development of railway lines has nonetheless been done over the years. A change of government therefore has no bearing on the upgrading of existing railway lines as well as the construction of new lines. The railway master plan was previously initiated by the previous administration, and as of now, the current government will continue with its implementation.
Is there funding available to construct the railway line and procure all the items	Yes, the government has funding for the Project.
Jobs	
What are the plans regarding the employment of locals for the Project?	According to Ghana's Local Content law, 60 percent of workers should be Ghanaians and the Authority will ensure that this is duly followed.
Will there be an emphasis on youth employment and training opportunities?	Youth Employment is one of the most critical components considered in the cause of executing projects in the country. The Project will seek to provide local content to locals where the Project is being carried out. The implementing agency will ensure that the local content clause is enshrined in the contractor's bidding document to minimise the issue of unemployment among the youth.
Other	
Has a Moratorium been declared?	Opportunistic/ speculative development may occur if a moratorium is not declared immediately. According to the Law, people own their lands until an executive instrument is publicised for land acquisition. Drone images have been taken, and affected properties have already been outlined. Subsequent to this exercise, another drone image will be captured to identify any new development. The stakeholder engagement, ESIA and RAP exercise serves as a mean to notify people and the end of the exercise marks the cut-off date.

6.4 Grievance Mechanism

The mechanism for affected people to raise grievances is given in the Community Grievance Mechanism (CGM), which is part of the Project ESMS and is not repeated here. The key interfaces between the CGM and the SEP are that:

- As part of each engagement activity, information should be given to stakeholders about the CGM.
- Investigations and corrective actions identified through the CGM may create the need to revise or enhance the engagement programme. For example, a corrective action may be identified to enhance communication on specific issues to help avoid the conditions leading to grievances.

7. BASELINE

7.1 Introduction

This chapter provides a summary of the environmental and social baseline conditions, supported by survey reports presented in Annexes A-J.

In preparing the baseline chapter, a wide range of public domain data and independent studies were drawn upon. The existing information has been reviewed and assessed for accuracy, consistency and validity and these studies are referenced where relevant.

Baseline surveys were undertaken in August 2020 to supplement existing available secondary baseline sources. Baseline surveys were undertaken in relation to air quality, noise, hydrology, biodiversity, and social aspects. Further details are included in the Annexes.

The baseline data summarised in this chapter, was used to inform the impact assessment process, the results of which are presented by topic in Chapters 8 to 19.

7.2 Sources of Data

Principle sources of data are presented in Table 7.1. Further baseline data sources can be found in the relevant technical annexes (Annexes A-J).

Table 7.1: Baseline Data Sources

Baseline Data Source	Relevant Topic
• Ghana Railway Development Authority (GRDA) of the Ministry of Transport, 2013, Railway Master Plan of Ghana https://new-ndpc-static1.s3.amazonaws.com/CACHES/PUBLICATIONS/2016/05/03/1-MASTER+PLAN+GHANA+FINAL+REPORT+-+Fin4.pdf • Centre for Environment, Health, Research and Training, on behalf of Ghana Railways Development Authority (GRDA), Republic of Ghana Ministry of Transport, 2015, Final Environmental Impact Statement: Western Railway Line Infrastructure Project • Team Engineering SpA, 2020, Ghana Western railway Line Infrastructure Final Design. Geotechnical Design Report. Lot 2 Kojokrom-Tarkwa km21+000 - km27 +000Section.Doc374 2 P 00 GG RE 005 Rev 1. Prepared for Ghana Railway Development Authority	Various

• Baseline survey results:
  • Diffusion Tube monitoring of NO_2 and SO_2
  • PM_{10} and $PM_{2.5}$ monitoring carried out using a 'MiniVol' sampler
	Air Quality

• World Bank Group Climate Knowledge Portal https://climateknowledgeportal.worldbank.org/country/ghana/climate-data-historical [Accessed 03/09/2020] • Asante, F.A. and Amuakwa-Mensah, F., 2015, Climate change and variability in Ghana: Stocktaking. Climate, 3(1), pp.78-99. • Climate Change Synthesis Report. Available at https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf [Accessed 03/09/2020] • Ghana UNFCCC National Report (2020). Available at: https://unfccc.int/documents?search2=&search3=ghana [Accessed 03/09/2020]	Climate
• Baseline survey results: • Takoradi Port - Huni Valley Railway Project, ESIA And Rap Studies: Environmental Quality Data Collection [and raw data files]	Noise and Vibration

Baseline Data Source	Relevant Topic
• Perrouty et al, 2012. Revised Eburnean geodynamic evolution of the gold-rich southern Ashanti Belt, Ghana, with new field and geophysical evidence of pre-Tarkwaian deformations. Precambrian Research 204-205 (2012) 12-39. Elsevier. • F. Owusu-Nimo,J. Mantey, K. B. Nyarko,Eugene Appiah-Effah,A. Aubynn. 2018, F. Owusu-Nimo,J. Mantey, K. B. Nyarko,Eugene Appiah-Effah,A. Aubynn. 2018 • Pure Earth, 2018, Toxic Sites Identification Program (TSIP) in Ghana. Prepared for UNIDO • Dickson, KB., Benneh, G. and Essah RR.(1988), A new geography of Ghana, Published by Longman, London	Soils, Geology, Topography and Landscape
• ECOWAS Centre for Renewable Energy and Energy Efficiency, Praia, Cabo Verde March 2017. GIS Hydropower resource Mapping and Climate Chance Scenarios for the ECOWAS Region – Country Report for Ghana. • Ghana Maritime, Profile of Major Rivers in Ghana https://www.ghanamaritime.org/uploads/39536-profile-of-major-rivers-in-ghana.pdf#: ~:text=PROFILE%20OF%20MAJOR%20RIVERS%20IN%20 GHANA%20Ghana%20is,comprises%20the%20Bia%2C%20Tano%2C% 20Ankobra%20 and%20Pra%20Rivers. • Water Resources Commission, Basins, https://www.wrc-gh.org/basins/ankobra/ • Water Resources Commission (2009), Ankobra Integrated Water Resource Management Plan, https://www.wrc-gh.org/documents/reports/ • Kuma, J. S. and Ewusi, A., (2009), Water Resources Issues in Tarkwa Municipality, Southwest Ghana, Ghana Mining Journal, Vol. 11, pp. 37 - 46.	Water

• Baseline Biodiversity Surveys:
  ◦ Fauna: Avifauna, Fish, Herpetofauna, Mammals
  ◦ Flora
• Integrated Biodiversity Assessment Tool (IBAT)
• IUCN Red List of Threatened Species
	Biodiversity and Ecosystem Services

• RAP, Social Baseline and ESIA Stakeholder:
  ◦ RAP census and socio-economic survey of affected households
  ◦ Focus Groups conducted with: community men, women and youth in Benso, Manso and Amantin.
  ◦ Key Informant Interviews conducted with community leaders and business owners in Benso, Manso and Amantin.
  ◦ Stakeholder engagement undertaken during the preparation of the ESIA
	Social & Cultural Heritage

• Amandi Investment Limited (2020) Western Railway Line Project From Takoradi Port to Huni Valley (100km) – Project Lenders Demand for Specific IFC Performance Standards Requirements	Cultural Heritage
• Ministry of Finance and Economic Planning (2010), Integrated Transport Plan for Ghana Volume 9: The Road Transport Sector in Ghana https://new-ndpc-static1.s3.amazonaws.com/CACHES/PUBLICATIONS/ 2016/05/03/ITPGhana_Vol+09+ Road+Transport.pdf	Transport
• Agyepong, K.A. (2018), Waste Management Options in Ghana, Future Strategy, https://imaniafrica.org/2018/04/12/waste-management-options-ghana-future-strategy/	Waste

Baseline Data Source	Relevant Topic
• Anarfi, W.S. (2013), Solid Waste Management in Ghana, https://www.d-waste.com/new-infographics/item/169-solid_waste_management_ghana.html • Fei-Baffoe, B., Atta Nyankson, E., Gorkeh-Miah, J. (2014), Municipal Solid Waste Management in Sekondi-Takoradi Metropolis, Ghana, Journal of Waste Management, https://www.hindawi.com/journals/jwm/2014/823752/ • Mensah, S.I, Arhin, R.N., Tumi Acquah, F. (2016) A Heuristic Approach to Locating a Landfill Site in the Sekondi Takoradi Metropolis of Ghana, Mathematical Theory and Modelling, Vol 6(2) https://core.ac.uk/download/pdf/234680352.pdf	

The following figures present baseline condition summaries for:

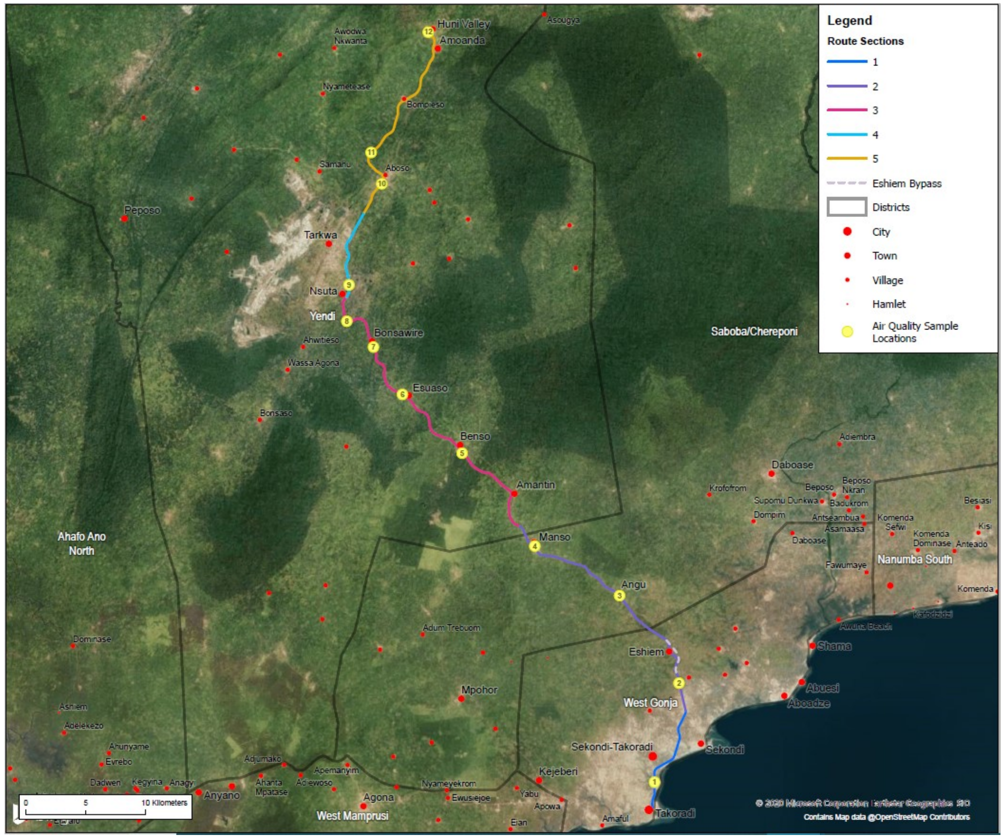
- Figure 7-1: Air Quality Baseline Summary
- Figure 7-2: Climate Baseline Summary
- Figure 7-3: Noise and Vibration Baseline Summary
- Figure 7-4: Soils, Geology, Topography and Landscape Baseline Summary
- Figure 7-5: Water Baseline Summary
- Figure 7-6a-d Biodiversity Baseline Summary
- Figure 7-7a-c Social Baseline Summary
- Figure 7-8: Cultural Heritage Baseline Summary
- Figure 7-9: Transport Baseline Summary
- Figure 7-10: Waste Baseline Summary

Figure 7.1 Air Quality Baseline Summary

Pollutants of Interest

The key pollutants of interest in relation to construction and operation of a railway are emissions of nitrogen dioxide (NO_2) and sulphur oxides (SO_x) associated with combustion emissions, most notably from the diesel run trains during operation and vehicles and construction equipment during construction; and emissions of dust, in particular particulate matter (PM_{10} and $PM_{2.5}$) during the construction phase, arising from both general site activities (including site clearance) and construction and operational phase combustion sources. Baseline monitoring of NO_2, SO_2, PM_{10} and $PM_{2.5}$ air pollutants was undertaken at 12 locations (see map). NO_2 and SO_2 were monitored using diffusion tubes exposed for 14 days and a hand held MiniVol monitor was used to sample dust (PM_{10} and $PM_{2.5}$) concentrations over a 24hr period. Further details can be found in Annex A.

Baseline Survey Locations



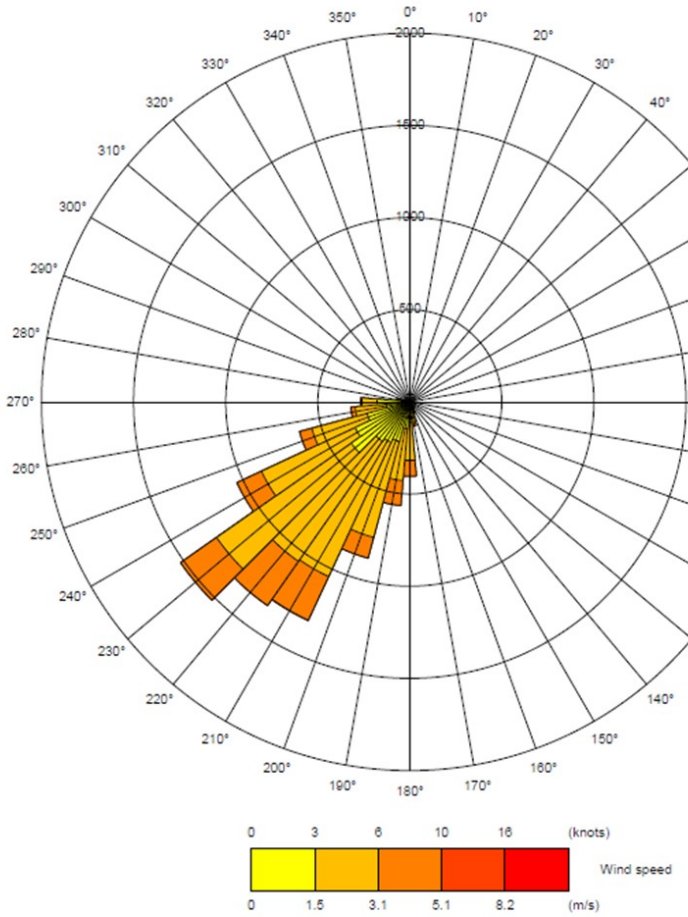
Baseline Survey Results

Pollutant	Summary	Above/below standard
NO_x	Generally NO_2 concentrations were low at all sites. The maximum concentration was recorded at Site 1 where the average of the two tubes was 17.3 μg/m³. The next highest was site 12 with an average of 11.1 μg/m³. The lowest concentration was recorded at Site 3a with a 14 day average of 5.5 μg/m³	Direct comparison with WHO and Ghanaian ambient air quality standards is not possible due to the limited period of monitoring, however the data indicates that at all locations concentrations of NO_2 are generally low and are well below the WHO annual guideline value of 40 μg/m³.
SO_x	Concentrations of SO_2 were below the level of detection (<2.54μg/m³) at all except Location 1, within Takoradi, where concentrations of 2.64μg/m³ were recorded.	Direct comparison with WHO and Ghanaian ambient air quality standards is not possible due to the limited period of monitoring, however the data indicates that at all locations concentrations of SO_2 are low or negligible and well below the Ghanaian annual guideline value of 80 μg/m³.
PM_{10}	This highest monitored concentration was at Site 3 where the average was 83.3 μg/m³. The average for all sites was 60.7 μg/m³. The lowest concentration was 27.7 μg/m³ at site 10.	The results indicate that particulate concentrations in the vicinity of the rail line are already elevated resulting in a degraded air shed. Comparison with the 24 hour limits indicates that all sites meet the WHO Interim Target 2. However, 3 sites (Loc#3,5,9) exceed both the WHO Interim Target 3 (75 μg/m³) and the Ghanaian standard 70 μg/m³). Only4 sites meet the WHO guideline value (50 μg/m³), Site#1, 8, 10 and 12.
$PM_{2.5}$	The highest recorded concentrations was 69.4 μg/m³ at site 9. The average for all sites was 34.3 μg/m³. The lowest concentration was 13.8 μg/m³ recorded at site 8. There are no annual Ghanaian standards for $PM_{2.5}$.	The results indicate that particulate concentrations in the vicinity of the rail line are already elevated resulting in a degraded air shed. Comparison with the 24 hour limits indicates that all sites meet the WHO Interim Target 1 (75 μg/m³). Sites#3, 4, 5 and 9 exceed both the Ghanaian Standard (35μg/m³) and Interim Target 3 (37.5μg/m³). Only 5 sites meet the WHO Guideline Target of 25 μg/m³ (Sites#1,6,7,8 and 11).

Figure 7.1 Air Quality Baseline Summary (Continued)

Meteorological Data Used for Dispersion Modelling and Wind Roses

Reliable recorded meteorological data was not available from a recording weather station that was considered representative of the study area. Instead data was sourced from a Numerical Weather Prediction (NWP) model. The NWP data is based on the NMM (Non-hydrostatic Mesoscale Model) and NEMS (NOAA Environment Monitoring System) technology and has been extensively verified against observed data.



Sensitive Receptors

A summary of the key sensitive receptors present in the Project Area of Influence is presented below.

Sensitivity	Receptor	Comment
High	Particulate matter, including PM_{10} and $PM_{2.5}$	Baseline concentrations recorded above the WHO guideline concentrations at a number of locations
Medium	None identified	
Low	NO_2 and SO_2	Baseline concentrations well within the AAQS

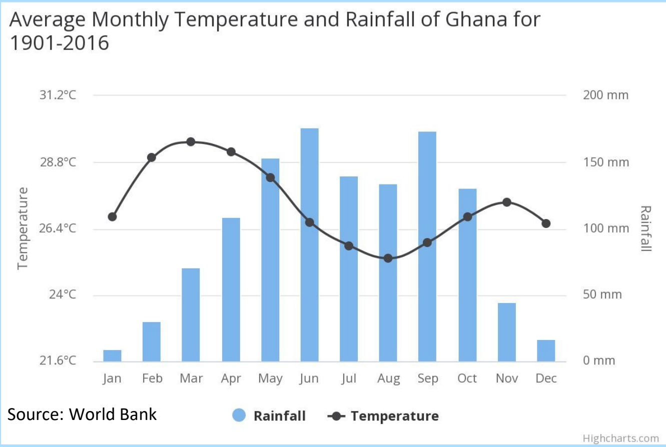
Figure 7.2 Climate Baseline Summary

Existing Baseline Conditions

Ghana has a tropical climate, strongly influenced by the West African monsoon, with a mean annual temperature of 27.26˚C (1901-2016), and mean annual precipitation of c.1190mm (1901-2016) (World Bank).

Ghana has three hydro-climatic zones. The South-Western system, where the Project is located, is known to be the most humid part of the country, with a mean annual rainfall between 1500 mm and 2000 mm, and lower temperatures (22-25˚C June, August, September) compared with the north (27-30˚C April, May, June).

Ghana frequently experiences include flooding, windstorm, rainstorm, drought and bushfires (MESTI, 2015).



Source: World Bank

Historic Climatic Trends

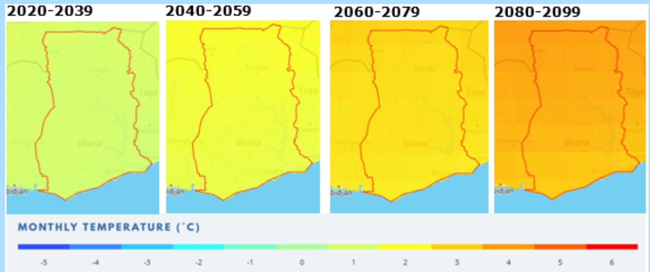
Temperatures across Ghana have risen at an average of 0.21˚C per decade since 1960, with the increase in temperature lower in the southwest where the project is located than in northern Ghana. The average number of 'hot' days[(1)] per year have increased by 4 days over the period 1961-2003, whilst the number of 'cold' days[(2)] reduced by 12 days during the same period.

Annual rainfall in Ghana is highly variable on inter-annual and inter-decadal timescales and long-term trends are difficult to identify. Despite his variability, there is a decreasing trend for the period 1960 to 2006, with an average precipitation reduction of 2.3 mm per month (2.4%) per decade There is no evidence that the proportion of rainfall during heavy events has increased since 1960.

Future Baseline

Climate projections consider uncertainty due to natural variability and an incomplete understanding of the climate system and its imperfect representation in models. They can be used to determine the likely future climate conditions in the locality of the proposed development through its operational life.

Climate projections can be presented via individual models or through multi-model ensembles.



Source: World Bank

Projected change in monthly temperature of Ghana.
All scenarios are compared to 1986-2005 dataset. These projections are based on an RCP 8.5 emission scenario, using an ensembled model.

Using a multi-model ensemble and an RCP (Representative Concentration Pathway) 8.5 high emission scenario, mean annual temperature is projected to increase by 1.0-3.0°C by the 2060's, and 1.5-5.2°C by the 2090's, with warming more rapid in the northern regions of Ghana. Substantial increases in the frequency of hot days and nights are also predicted across all models.

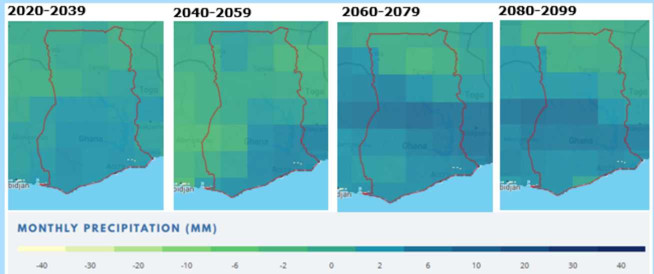
Warming of more than 1.5°C is indicated to increase the risk of aridity for Southern Africa. Desertification in Ghana is estimated to be proceeding at a rate of 20,000 hectares per annum.

Climate projections indicate that total annual rainfall will decline by 1.1%, and 20.5% in 2020 and 2080, respectively.

The proportion of total annual rainfall that falls in 'heavy' events is projected to increase. There is a trend in the projections toward a decrease in rainfall during the dry season (January-June) with an increase in wet season rainfall (July-August).

Projected changes also suggest an increase in 1-day and 5-day rainfall maxima.

Global sea levels are predicted to rise 1 m by 2100 (UNEP, UNDP 2011), with sea-surface temperatures predicted to increase in Ghanaian waters (Stanturf *et al*., 2011).



Source: World Bank

Projected change in monthly precipitation of Ghana.
All scenarios are compared to 1986-2005 dataset. These projections are based on an RCP 8.5 emission scenario, using an ensembled model.

The Project design life is 50 years, with a three-year construction period. A slight increase in monthly precipitation is anticipated in the Western region of Ghana over this period, with an increase in rainfall by the 2070s of 1-2mm per month and temperature of 2-3ºC.

References

World Bank, Ghana Climate Data, https://climateknowledgeportal.worldbank.org/country/ghana/climate-data-historical, accessed 14 September 2020

The Ministry of Environment, Science, Technology and Innovation (MESTI), 2015, Ghana National Climate Change Master Plan Action Programmes for Implementation 2015-2020, Accra, https://www.preventionweb.net/english/policies/v.php?id=59575&cid=67, accessed 14 September 2020

Stanturf, J.A.; Warren, M.L.; Charnley, S.; Polasky, S.C.; Goodrick, S.L.; Armah, F.; Nyako, Y.A. (2011) Ghana Climate Change Vulnerability and Adaptation Assessment; United States Agency for International Development, https://www.climatelinks.org/file/2113/download?token=Q2oNtsPe, accessed 21 September 2020

UNEP and UNDP, Climate Change and Development Reducing Vulnerability (2011) National Adaptation Strategy. Ghana, National Adaptation Plan, https://www.adaptation-undp.org/sites/default/files/downloads/ghana_national_climate_change_adaptation_strategy_nccas.pdf accessed 21 September 2020

(1) 'Hot' days - are defined as the temperature above which 10% of days or nights are recorded in current climate of that region/season.

(2) 'Cold' days - are defined as the temperature below which 10% of days or nights are recorded in current climate of that region/season.

Figure 7.3 Noise and Vibration Baseline Summary

Existing Noise and Vibration Sources

Existing sources of noise and vibration present along the Takoradi to Huni Valley proposed railway include: human activities in settlements (e.g. markets, movement of people outdoors), vehicle movements and rail noise from trains along the existing operational railways.

The southern end of the railway is located at Takoradi Port, an industrial area. It then passes through the urban areas of Takoradi and Sekondi, mixed use residential and industrial areas. The Eshiem bypass is located close to Eshiem, and an industrial area believed to include fuel storage and chemical processing.

As the route progresses northwards, the area becomes more rural with a number of small settlements located along the route before it reaches the more urban areas of Nsuta and Tarkwa, passing close to existing mining operations. The final stretch of the route, north of Tarkwa to Huni Valley is predominantly rural, with a few settlements located along the existing rail line.

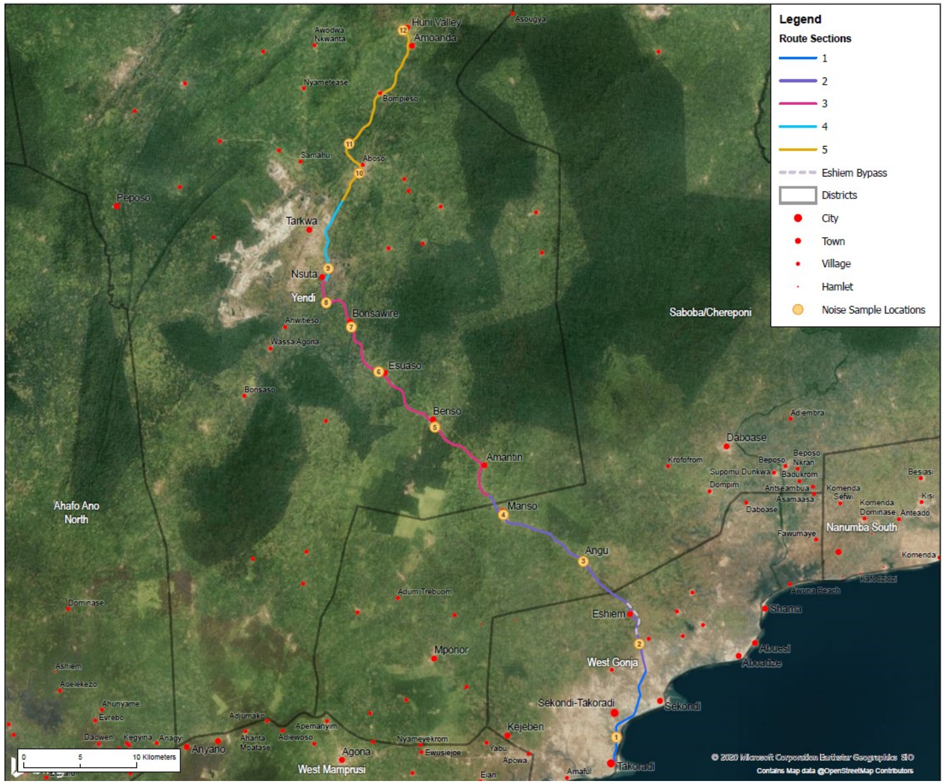
Along the majority of the route significant sources of vibration in the environment baseline are uncommon and are typically only found during temporary construction or close to existing railway lines.

Baseline Survey Results

Daytime and night time baseline noise monitoring was undertaken at 12 locations (see map), focussed on settlements . Monitoring was undertaken for 24 hours at each location using an unattended noise monitor. Further details can be found in Annex C.

#	Ambient Noise Level (dB $L_{Aeq,T}$)		Summary
	Daytime (0600-2200)	Night-time (2200-0600)	
1	69	64	The highest noise levels were recorded at Location 1 (69dBA daytime / 64dBA nightime) and lowest at Location 10 (58dBA daytime / 48dBA nightime). The high noise levels near Takoradi Port (Location 1) reflect the industrial nature of the area. The noise baseline monitoring results at all locations exceed both the IFC Noise Level Guidelines (55dBA daytime / 45dBA nightime) for residential receptors and Ghanaian standards (55dBA daytime / 48dBA nightime). Noise levels fall below the IFC Noise Level guidelines for industrial and commercial locations (70dBA daytime/nightime). Noise levels generally meet the Zone D Ghanaian noise level standards (areas with some light industry) (60dBA daytime / 55dBA nightime), whilst Location 1 meets the limits for a heavy industrial area (70dBA daytime/ nightime).
2	59	55	
3	57	52	
4	63	58	
5	66	49	
6	62	51	
7	63	54	
8	61	60	
9	62	62	
10	58	48	
11	64	52	
12	63	53	

Baseline Survey Locations



Sensitive Receptors

A summary of the key sensitive receptors present in the Project AoI is presented below.

Sensitivity	Receptor	Comment
High	Residential areas	Residential premises and dwellings located in the communities located close to the rail line.
Medium	Offices/ commercial areas	Offices, commercial and light industry located in mixed use areas alongside residential receptors
Low	Industrial areas	Areas within Takoradi Port

Figure 7.4 Soils, Geology, Topography and Landscape Baseline Summary

Geology & Seismicity

The bedrock in the region comprises Palaeoproterozoic metavolcanics and metasediments of the Sefwi Group, Birimian and Tarkwaian, intruded by granitoids. The geology of region varies over the length of the route. Of note, route sections 3, 4, and 5 traverse through large scale mining areas. Some of these areas are know to contain include small scale illegal gold mining, known as galamsey, particularly evident around Esuaso. The route does not affect any current know mining operations.

Southern Ghana is not a highly active seismic area. Despite this there is some activity along the coast. With the exception of a minor increase in risk near the coast the majority of the project is located within a lower risk zone.

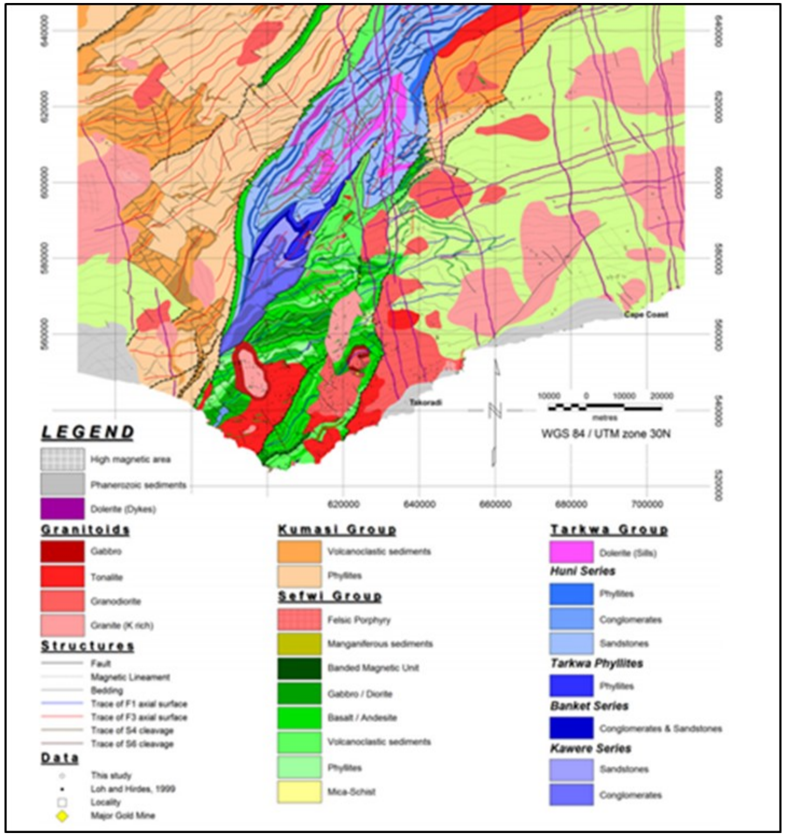


Figure 1 Regional Geology. Source: Perrouty et al, 2012.

Perrouty et al, 2012.Revised Eburnean geodynamic evolution of the gold-rich southern Ashanti Belt, Ghana, with new field and geophysical evidence of pre-Tarkwaian deformations. Precambrian Research 204-205 (2012) 12-39. Elsevier.

Soils

Section 1 (Takoradi Port to Takoradi) of the route passes though an area which is urban in nature and is therefore likely to comprise made ground with underlying natural soils. From Takoradi to Kojokrom, Section 2 passes through an urban landscape. The remainder of the route consists of a mixture of farmland, forest and mining areas with number of intermittent settlements. These land uses are likely to create and reflect variances in the composition of the soil. Surveys have indicated that topsoils contain variable organic content and lateritic soil deposits. The majority of superficial soils are derived from in situ weathering of the bedrock with alluvial sediments anticipated in the locality of water courses. The soils in the region support farming, including palm oil plantations. A report on the Benso oil palm plantations indicates the soil types are forest ochrosol-oxysol intergrades, which is not considered to be fragile.

The land within the existing railway right of way and under the existing railway track is likely to have suffered disturbance and may have experienced contamination as a result of rail operations. The northern section of the scheme (Manso to Huni Valley) contains some realignment sections, the majority of which is routed though agricultural land. Soils within these sections may have suffered contamination due to the existing rail operations, and contamination from historic large scale mining operations and galamsey.

Topography

The Western Region of Ghana is typically low lying. The coastal area around Takoradi is generally flat and low lying, located in the coastal plain where the general elevations is below 100m above sea level with isolated hills. Further inland the route near Huni Valley passes through Forest Dissected Plateau, an area in southwest Ghana characterised by undulating topography, comprising gently rolling hills and broad flat valleys.

Landscape

The coastal plateau is relatively flat, although a number of hills are present. The Forest Dissected Plateau comprises hills dissected by flat valleys. Outside of settlements, the area is generally forested (see Annex F: Biodiversity and Ecosystem Services for further details) with an area of palm-oil plantation near Benso. The landscape around Nsuta and Tarkwa is more industrial, due to the presence of mining activities including the Nsuta Manganese Mine and Gold Fields Tarkwa Mine. The rail begins at Takoradi Port, passing through an industrial area followed by urban city environment. Other settlements are smaller and less urbanised.

Sensitive Receptors

A summary of the key sensitive receptors present in the Project AoI is presented below.

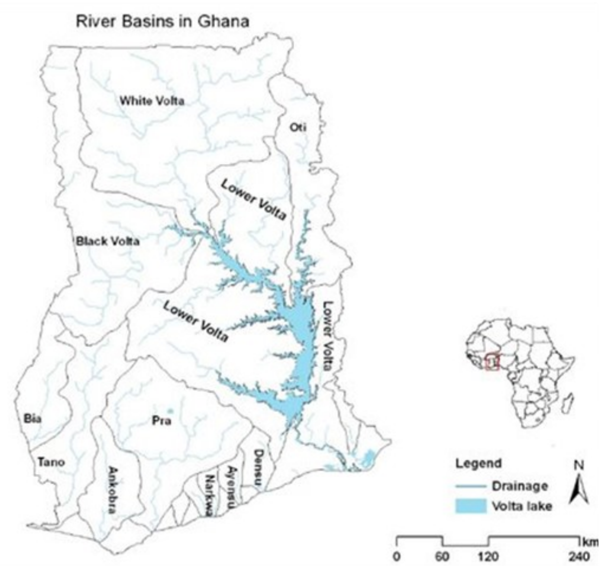
Sensitivity	Receptor	Comment
High	Mineral resources (Section 3-5)	Route passes through mining concession areas. It is likely to run through areas of mineral resources not yet exploited.
Medium	Agricultural & forest soils, topography, landscape (unscreened views, topographic highs)	Soils with the potential to support subsistence farming. Unscreened views of the railway and associated infrastructure from residential areas and topographic highs
Low	Landscape (screened views), soils within existing RoW and urban areas	Degraded soils within urban areas and existing railway RoW. Screened views from residential areas and topographic highs associated with mining activities.

Figure 7.5 Surface Water and Groundwater Baseline Summary

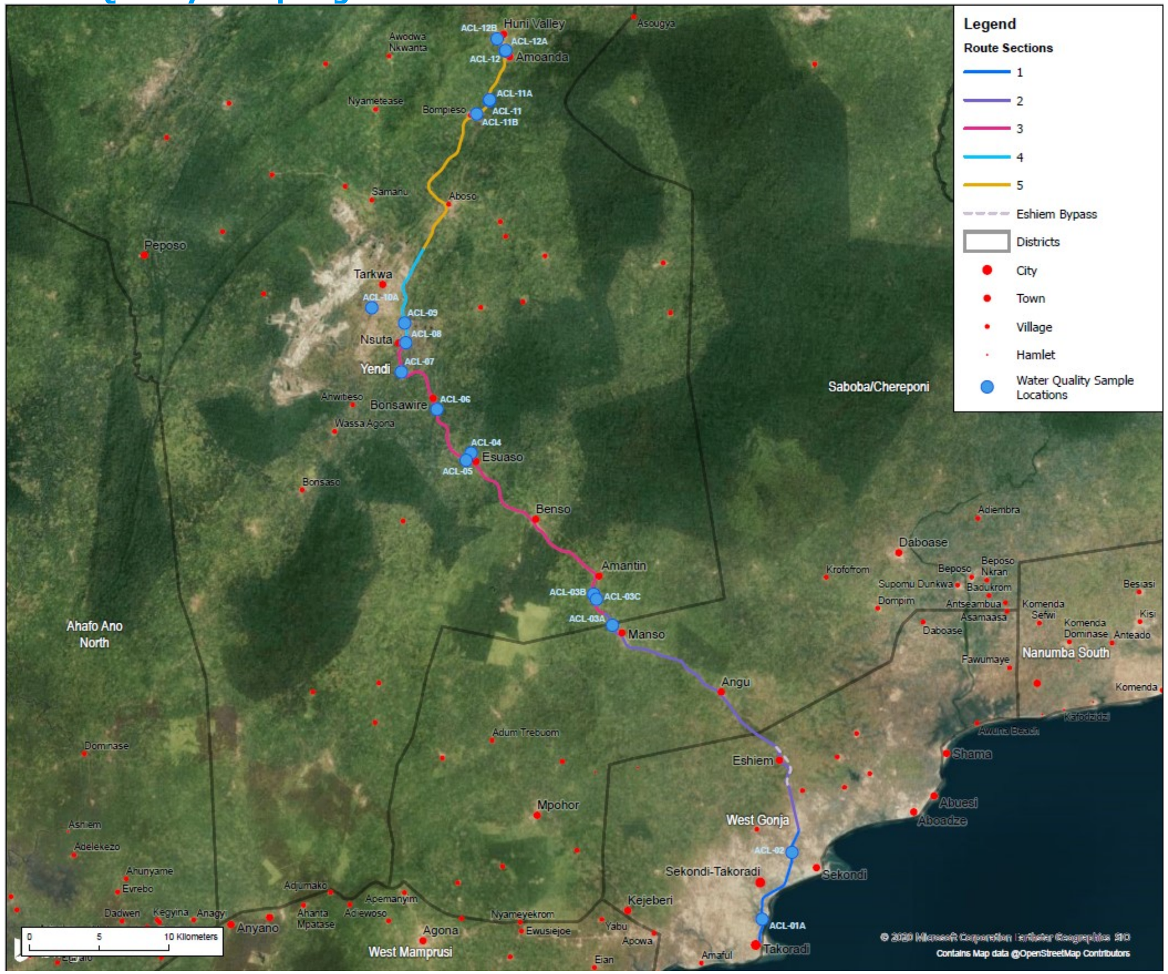
Surface Water

The majority of the Project lies within the Western River System and in Ankobra River Basin. The Ankobra catchment drains an area of approximately 8,460 km^2 and flows from the source near Bibiani for approximately 260 km south where it discharges to the Gulf of Guinea at Asanta. Section 1 of the Project (Takoradi Port to Takoradi) lies within the Sekondi-Takoradi Basin. A small catchment between the Pra River Basin to the north east and the Ankobra Basin to the North West. The Ankobra basin is bounded to the East by the Pra Basin, on the west by the Tano Basin and in the South by the Gulf of Guinea.

A general analysis of flow records for the basin for the Integrated Water Resource Management Plan (WRC 2009) suggest a marked seasonal variation in flows in the main Ankobra river and its tributaries, and statistical analysis of the all the flow records suggest a mean annual flow in the main river of 30.5m3/sec and an annual flow volume of 962 million m^3, which is comparable to the predicted basin water balance of 1,160 million m^3.



Water Quality Sampling Locations



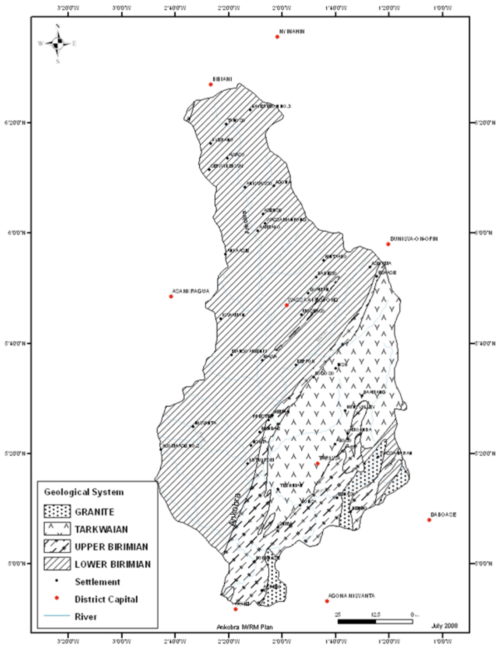
Water Quality Baseline Survey

Surface water quality in the basin is generally good with a trend towards increasing pollution from human activities (WRC 2009). The water Quality index for the main Ankobra River upstream and downstream of the Project Area is classed as II or fairly good quality. Water quality samples from the main Ankobra river show most metals being below the detection limits with the exception of Iron, Manganese and Zinc. Suspended sediments typically range between 10 and 120mg/l.

Samples taken downstream of mining areas demonstrated high levels of Arsenic and mercury. It is reasonable to assume that tributaries flowing through the mining concession areas and into the main river are therefore at a similar quality or higher. Poor land use practices, artisanal mining and illegal logging have increased the erosion of topsoil and consequently turbidity in the surface waters is also increasing. Exposure of arsenic bearing rocks due to mining coupled with poor management of waste materials and leaching from old waste dumps and unregulated artisanal mining is an increasing threat to the quality of surface and groundwaters. The rivers are also increasingly used by communities for the disposal of solid and liquid wastes. Sanitary facilities are generally poor for the rural communities in the region.

Surface Water and Groundwater Baseline Summary

Groundwater Aquifers



There are four principal geological formations within the Ankobra basin. The Project lies primarily within the Upper Birimian and Tarkwaian formations. The Upper Birimian is comprised of metamorphosed lavas and pyroclastic rocks. The Tarkwaian formation also includes quartzites phyllites, grit and other conglomerate materials. Both formations each comprise approximately 18% of the basin area. The other formations in the basin are the Lower Birimian and the Granite formations.

Groundwater resource potential in the basin is high. In particular, the areas of Wassa West (which includes the main towns of Esuaso, Benso, Tarkwa and the Huni Valley Area), Wassa Amenfi East and Nzema East can support high levels of abstraction for industrial and domestics use. Boreholes within the region have been analysed and average yields are found to be 2.6m^3/hour and 6.6m^3/hour for the Tarkawaian and Upper Birimian formations respectively.

Groundwater abstractions are an important source of water in the area, with pipe water supply schemes for domestic use in communities as well as for mining and mineral processing, industrial usage and domestic water supply to industry. Estimates of demand suggest that only 27% of the population in the basin is currently supplied through piped abstractions and substantial unmet demand exists within the region. Rural water supply is typically sourced via community boreholes and hand dug wells.

Formation	Composition	Basin Coverage	Borehole Depth (m)	Depth to Aquifer Top (m)
Tarkwaian	Metamorphosed lavas & pyroclastic rocks with quartzites phyllites, grit & other conglomerates	18%	22-61	9-40
Upper Birimian	Metamorphosed lavas & pyroclastic rocks	18%	18-48	13-52
Lower Birimian	Phyllites, schists, tuffs & greywackes	50%	23-75	13-52
Granites	Granites, granodiorites & granite-gneisses.	14%	18-65	6-52

Groundwater

Groundwater quality is generally found to be high across the region, although some groundwater samples taken in 2007 suggested that some areas have high metal concentrations that exceed WHO standards. In general groundwater quality was found to be:

- mildly acidic (pH 4.5-6.9);
- possess chloride levels below the WHO permissible limits;
- have high turbidity and colour due to high concentrations of iron (>300µg/l); and
- have low nitrate levels.

In addition to the high iron concentrations, some samples were found to have high levels of Aluminium, Manganese and Mercury exceeding WHO standards for drinking water which low pH levels would exacerbate due to increased dissolution of trace metals, low buffering capacity of the aquifer formations.

In Tarkwa, 208 of the additional boreholes have been constructed in areas known to be used for groundwater discharge. As a result, they are likely to be highly turbid during the rainy season, and prone to pollution. In addition, 43 wells are in close proximity to waste dumps, and septic tanks, and preliminary studies on five wells showed high levels of faecal coliforms in the samples (Kuma and Ewusi, 2009).

Sensitive Receptors

Key sensitive receptors present in the Project AoI are summarised below.

Sensitivity	Receptor	Comment
High	Tarkwaiain and Upper Birimian Hydrogeological formations	High quality potable groundwater resource.
High	Groundwater Dependent Terrestrial Ecosystem.	High sensitivity habitat type possibly supporting Critical
Medium	All other watercourses	Water courses are subject to human pressure showing some modifications and failing some water quality parame-
Low	Water courses in the Takoradi /Sekondi Area at the port end of Section 1.	High saline intrusion and modification to the watercourse.

References

Water Resources Comission (WRC) (2009) Ankobra Integrated Water Resource Management Plan, https://www.wrc-gh.org/basins/ankobra/

Kuma, J. S. and Ewusi, A., (2009), Water Resources Issues in Tarkwa Municipality, Southwest Ghana, *Ghana Mining Journal*, Vol. 11, pp. 37 - 46.

Figure 7.6a Biodiversity and Ecosystem Services Summary

Ecoregional Setting

Ghana's natural landscape comprises two major ecological zones. The southwestern part of the country within which the Project is located is the High Forest Zone. Considerable areas of forestland have been converted to farmlands. Topography undulates between 50 and 300m, and soil fertility is generally low. Temperatures in the forested south range between 22°C and 34°C, whereas in the north temperatures are more extreme and can reach a maximum of 43°C and fall to 10°C on cold nights. In the southwestern zone of Ghana, there is an average rainfall of 1,000 mm to 2,100 mm per year.

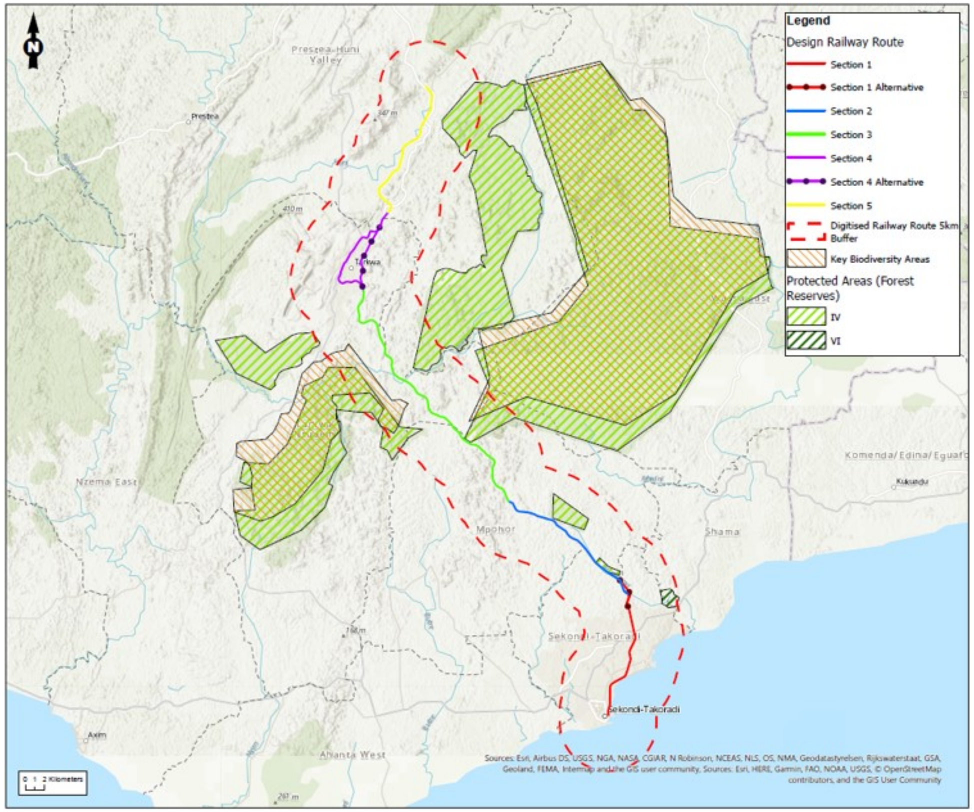
The Project is located within the Eastern Guinean Forest Terrestrial Ecoregion, consisting primarily of lowland forest. Seven vegetation types with unique plant associations have been identified in the forest zone. The ecoregion is rich in animal and plant life, with the Eastern Guinean Lowland Forest supporting a number of endemic and near-endemic species, though primate diversity has for some time been threatened by habitat loss and bushmeat hunting. The species richness of birds in this ecoregion is also high. The combined ecoregions of the Eastern Guinean Lowland Forest and western portion of the Upper Guinea forest are together considered an Endemic Bird Area, which contains 15 unique bird species.

The Project is located in the Ashanti freshwater ecoregion. The main habitat type is Tropical and Sub-tropical Coastal Rivers. The Project is situated almost entirely within the Bonsa sub-catchment of the Ankobra River, the exception of the southern length of line in the Takoradi area, which is located in a small unnamed coastal catchment draining directly to the Atlantic Ocean. There are several fish with highly restricted distributions within the ecoregion, associated primarily with the Pra River.

Habitats

The route of the proposal traverses three major vegetation zones; Moist evergreen forest, Moist semi-deciduous Forest and Dry semi-deciduous forest. Within these vegetation zones there are a number of habitat types. Closed canopy forest degraded forest, agriculture and semi-natural habitats, freshwater swap forest, mangrove swamp forest and settlements. Survey results indicate that proposed route passes through generally modified habitats, with conversion of natural habitats to agricultural lands predominantly farming food and cash crops. The project is located within the Bonsa River sub catchment of the Ankobre River. The proposed route crosses the Bonsa River and a number of its tributaries. The Bonsa River and some larger tributaries have perennial flow, whilst some tributaries crossed by the railway RoW have seasonal flow. Aquatic habitats are categorised as permanent or seasonal watercourses. Within Takoradi the RoW also crosses a smaller coastal catchment of a short, unnamed watercourse.

Figure 7.6b Biodiversity and Ecosystem Services Summary



Protected Areas

There are 6 protected areas located within 5km of the Project area:

- Bonsa River- Forest Reserve 1.7km - IUCN Management Category: IV
- Inchaban- Forest Reserve 3.7 km- IUCN Management Category: VI
- Neung North- Forest Reserve- 3 km IUCN Management Category: IV
- Sekondi Waterworks (Blocks II and III)- Forest Reserve- Adjacent IUCN Management Category: IV
- Neung South- Forest Reserve- Key Biodiversity Area (KBA) 2 km IUCN Management Category: IV
- Subri River Forest Reserve- KBA- International Bird and Biodiversity Area (IBA) - 0.5 km IUCN Management Category: IV, IBA Criteria Met: A1, A2, A3

Flora

Baseline surveys included 19 representative transects, each 100 m long, which surveyed in each natural/semi-natural vegetation type present. All plant species within 1 m either side of the transect were identified and scored according to abundance.

A total of 176 Species in 60 Families and 157 Genera were encountered along the proposed route. These are predominantly comprised of species which are either of Least Concern (LC) or Not Evaluated by IUCN. The Family Fabaceae (Legumes) dominated the flora with 24 species followed by the Poaceae (10 species), Malvaceae (9 species) and the Rubiaceae and Asteraceae with 8 species each. The Araceae, Euphorbiaceae and Moraceae had 7 species each while the Apocynaceae had 6 Species. These 9 families accounted for almost 49% of the species recorded. All other families had fewer than 6 species in the flora.

The life form composition showed a dominance of the herb (30.1%) and tree (33.5%) life forms. This abundance of trees is in part due to the prevalence of coco farming in the area. Additionally, secondary forests and thickets are common where farms and agricultural land are in fallow. This is likely why there are so many climber and shrub life forms present. The vegetation is considered secondary to tertiary in development.

Threatened botanical species known or potentially occurring in the Project area are presented below. Those confirmed to be present during surveys are shaded in blue.

Species	Conservation Status	Vulnerable
African oak *Afzelia Africana*	Vulnerable	Dry forest and woodland. No distribution data available. A widespread species which has declined in population numbers.
Aframomum at ewae	Endangered	Poorly known species with a constricted range in West Africa. There are a number of threats to forest habitat in West Africa, particularly logging and clearance for agricultural expansion.
Garcinia epunctata	Vulnerable	A species of evergreen Guineo-Congolian forests. Found in evergreen and demi-deciduous forests, rainforests, swampy, riverine and gallery forests; at elevations from around 200 - 1,000 m. It is threatened by logging and wood harvesting.
Mitragyna ledermannii	Vulnerable	Gregarious forest tree species restricted to swampy areas, rivers and coastal regions. Regeneration is good in wet areas
Njayei tree *Omphalocarpum ahia*	Endangered	This species is known to occur in Southern Ghana, Ivory Coast, Liberia, Sierra Leone and Guinea. It is found in dense forests on damp areas, river margins and swamps.
Black Afara *Terminalia ivorensis*	Vulnerable	West African Timber species found scattered at low densities in remnant forest areas. Apparently adult trees are common along roadsides. Considered to be moderately exploited for logging and wood harvesting, with poor regeneration.

Figure 7.6c Biodiversity and Ecosystem Services Summary

Fauna—Mammals

Evidence of mammal species observed was recorded, with a focus was on primates and pangolins, as several species of conservation concern have known ranges which overlap the Study Area. Suitable habitat along the route was evaluated using the diurnal line transect census method within the most suitable habitat, or thorough searches in areas where habitat was less suitable, with recce walks conducted between the fixed transects/ search areas to gather additional information. Direct sightings and indirect evidence of mammal presence (e.g. footprints, feeding signs, droppings etc) were recorded. Community consultation was also undertaken at selected communities along the route.

11 species of mammal were recorded during baseline surveys as occurring within the AoI, with a further eight reportedly present based on community consultations. These primarily comprised species of 'Least Concern'. The highest number of mammals encountered was recorded in the Sekondi Waterworks Forest Reserve, with relatively low encounters along the existing railway line. The table below summarises the IUCN Threatened Species and Nationally Protected Mammal Species with confirmed presence or reported during community consultation. A number of other Threatened Species and Nationally Protected Mammal Species may be present however their presence is unconfirmed.

Species	Conservation Classification	Presence
Spot-nosed monkey *Cercopithecus petaurista*	Near Threatened	Directly surveyed
Bosman's potto *Perodicticus potto*	Near Threatened Schedule 1 Ghana Wildlife Conservation Regulation, 1971 (L.I. 685)	Reported during community consultation
Johnston's genet *Genetta johnstoni*	Near Threatened	Reported during community consultation
White-bellied pangolin *Phataginus tricuspis*	Endangered Schedule 1 Ghana Wildlife Conservation Regulation, 1971 (L.I. 685)	Reported during community consultation
Lowe's monkey *Cercopithecus lowei*	Vulnerable	Reported during community consultation
Northern Lesser Galago (Senegal bush baby) Galago senegalensis	Least Concern Schedule 1 Ghana Wildlife Conservation Regulation, 1971 (L.I. 685)	Reported during community consultation

IUCN classifications: IUCN Red List 'Threatened' classifications: Critically Endangered (CE), Endangered (EN), Vulnerable (VU). Other classifications: Near Threatened (NT), Least Concern (LC), Data Deficient (DD), Not Evaluated (NE)

Fauna—Reptiles, Amphibians and Invertebrates

Active searches using time-constrained transect surveys of 80 to 250m in length were undertaken for reptiles and amphibians within the most suitable/ representative natural and semi-natural habitat along the route. Four species of frog were recorded all of which are listed as LC on the IUCN Red List. The Ivory Coast running frog *Kassina arboricola* is known to potentially occur within the range of the proposed route and is categorised VU on the IUCN Red List.

14 species of reptile were recorded the majority of which were snake species, two skink and two lizard species, all of which are listed as LC or NE on the IUCN Red List. Based on species ranges, two species of turtle and the African dwarf crocodile classified as VU and the critically endangered slender-snouted crocodile could occur within the AoI however their presence is unconfirmed.

There are no threatened invertebrate species known to have ranges within the project area.

Fauna—Birds

Bird counts were undertaken at 16 stations to cover Bird the most suitable/ representative natural and semi-natural habitat types along the route. Identification was done visually using Birds of Ghana keys developed by Borrow and Demey (2010) and by their calls using the bird sounding technique. Both point count and transect methods were employed, depending on the field conditions.

Approximately 102 species of bird were recorded. This included three IUCN NT species: copper-tailed starling (*Hylopsar cupreocauda), Eurasian curlew (Numenius arquata) and Eurasian oystercatcher (Haematopus ostralegus),* and one globally threatened species the hooded vulture (*Necrosyrtes monachus*). The highest diversity of bird species was located in the Essiam Forest Reserve (30 species) with both New Takoradi Lagoon and Monkey Hill forest also recording an appreciable number of species (28 species).

The African harrier hawk (*Polyboroides typus*), Hooded vulture (*Necrosyrtes monachus*) are IUCN Threatened Species and Nationally Protected Bird Species with a confirmed presence in the development area. In addition, a further 19 globally threatened and nationally protected bird species have been identified with potential to occur within the development area and with known ranges overlapping the Study zone.

Fauna—Fish

Fish sampling surveys were conducted at representative waterbodies along the railway route. Sampling techniques included cast nets and hook and line as appropriate. Sampling techniques included dip nets, seine nets and fish traps as appropriate. At least one hour of active fishing effort was spent at each sample site, covering a minimum 50 m length of watercourse.

The route encompasses a number of permanent and seasonal watercourses. Surveys for fish across the study area indicated low species diversity. Six species of fish listed as Least Concern on the IUCN Red List: blackchin tilapia *Sarotherodon melanotheron*, elongated turkana robber *Micralestes elongatus*, silla *Coptodon dageti*, Guinean tilapia *Coptodon guineensis* and redbelly tilapia *Coptodon zilla alongside* oine catfish *Clarius sp.* which was not identified to species level. Fish were most abundant in the Kawire River located near the Nsuta railway station. This watercourse was the largest and deepest of all the water bodies sampled and appeared cleaner than the rest, which was attributed to the railway company restricting access to the river at this point. Overall, the fish catch was dominated by tilapia species, likely due to poor quality in the area as a result of community mining activities, which introduce sediment into the system.

Two IUCN Threatened species and nationally protected fish species were identified with known extant ranges overlapping the study zone, *Epiplatys chaperi ssp. schreiberi* (EN) and *Epiplatys chaperi ssp. schreiberi* (VU) however their presence in the study area is unconfirmed.

Figure 7.6 Biodiversity and Ecosystem Services Summary

Invasive Species

Two invasive flora species were identified along the RoW. Siam weed *Chromolaena odorata* is by far the most widespread invasive species encountered, present in 11 out of the 17 samples sites surveyed (i.e. about 65% of samples). *Leucaena leucocephala* was recorded in only one sample location, which was the thicket along the margins of the lagoon at New Takoradi.

Survey Limitations

The habitat and faunal surveys provide a snapshot of ecological conditions and do not record plants or animals that may be present in the Project site at different times of the year. The absence of a particular species cannot definitely be confirmed by a lack of field signs and only concludes that an indication of its presence was not located during the survey effort. Where the Project AoI has the potential to support certain species that were not observed during the surveys their presence will be further investigated in future surveys.

Ecosystem Services

Ecosystem services are classified into four categories: provisioning, regulating, cultural and supporting. Priority ecosystem services identified in the Project AoI are summarised below.

Service	Type	Comment
Surface Water	Provisioning	**Importance:** Critical for habitat maintenance, in particular freshwater swamp forest and other riparian vegetation. It is also critical that surface water is maintained for fish and other aquatic species. **Replaceability:** Difficult
Groundwater	Provisioning	**Importance:** Amongst vulnerable households affected by land take, only 12% had a tap in their house, however 41% used a borehole, 30% used a public standpipe and 10% used a hand dug well. also important for habitats and flora. **Replaceability:** Difficult
Crops	Provisioning	**Importance:** Agriculture is a primary economic activity for 22% of all PAPs affected by land acquisition. 52.5% of households rely on farming to support their livelihoods. **Replaceability:** Moderate
Fuelwood	Provisioning	**Importance:** Fuelwood is commonly collected from forests and woodland surrounding villages and from farms. **Replaceability:** Moderate
Sand, natural gravel and ballast	Provisioning	**Importance:** Sand and natural gravel are harvested and sold by communities and is a source of livelihood for only a limited number of PAPs. The materials are required for track construction. R **Replaceability:** Easy
Rivers and streams	Cultural	Importance: Rivers and streams are closely associated with rituals, sacred sites and taboos and several sacred streams cross the Project RoW. **Replaceability:** Moderate
Sacred forests	Cultural	**Importance:** Forests are important for medicines and closely associated sacred sites. **Replaceability:** Moderate

Sensitive Receptors

Key sensitive receptors present in the Project AoI are presented below.

Sensitivity	Receptor	Comment
High	• Internationally Recognised Areas and IUCN Category IV Legally Protected Areas • Mangrove Swamp Forest • Freshwater Swamp Forest • Closed Canopy Forest • Endangered Primates • Endangered Plants	Internationally recognised and legally protected areas have been designated on their importance to biodiversity Critical habitat and critical and or natural habitat with the potential to support endangered species is considered to be of high sensitivity. The Subri River KBA listing includes a number of primate species triggering KBA criteria. If these species persist on the area, they trigger a critical habitat classification for the KBA. Endangered plants are known from the area and trigger a critical habitat classification.
Medium	• IUCN Category VI Legally Protected Area • Secondary Forest • Permanent and Seasonal Rivers and Streams • Vulnerable plant species including *Garcinia epunctata, Mitragyna ledermanni* and *Terminalia ivorensis* • Birds • Reptiles • Non-primate ground mammals and non-endangered primates • Fish	The Inchaban Forest Reserve is and IUCN Category VI Legally Protected Area. Natural habitats that do not meet the criteria for Critical habitat. Vulnerable plant species present which given their sparse distribution could be considered to represent regionally important concentrations. Widespread least concern and near threatened species Threatened species which exist, or have the potential to exist, in low levels representing populations of local importance only.
Low	• Agricultural Lands and Semi-Natural Regrowth • Settlements • Amphibians • Bats • Invertebrates	Modified habitats Species where no threatened invertebrate species are known from the Project AoI, and are likely to support an assemblage of species which are primarily non-threatened and not range-restricted. Only one threatened amphibian species is considered to be potentially present in the Project AoI and was not found during surveys and is unlikely to be present at more than locally important populations

Figure 7.7a Social Baseline Summary—Demographics

General Demographics

The Population of Ghana in 2019 was 30,280,000 of which 2,165,000 live in the Western Region. The population of the MMDAs crossed by the AoI ranges from 727,915 in Sekondi Takoradi Metropolis to 55,829 in Mpohor District. The Project will directly affect a population of approximately 5,800 people, including 1,253 Project Affected People (PAPs). The average household size for the affected population is 5. The largest households have between 10—15 members however the majority have 5 members or less.

Throughout the Western region, the gender ratio of men and women in the MMDA crossed by the AoI is approximately equal. Amongst the PAPs, there are 190 women headed households.

In the past decade Western Region has seen the second-largest increase in population in Ghana behind that of the Western North Region, with over half the population living in a rural area.

Within the Western region, the 2020 population was projected to be approximately 59% under the age of 25, with 38% of this below the age of 15. The regional population is predominantly children and youth, with few (4%) people over the age of 64.

The primary ethnicity of the people in the western region is Akan (78%) with all other ethnicity's below 10% including Mole-Dagbon, Ewe, Ga-Dangme, Gurma, Grusi, Mande and Guan. The Wassa (a sub-group of the Akan) is the dominant ethnic group in the Project Area. There are no identified indigenous peoples in the Project Area.

There are considered to be two major religions in the western region that are Christianity and Islam, making up 81% and 8.5% respectively. Focus Group Discussions with community groups indicated that within the Project area, approximately 75% of community members were Christian, 20% Muslim and between 1—5% following traditional religions.

By the year-end in 2017, Ghana hosted 11,865 refugees and 1,371 refugees with approximately half coming from neighbouring Cote d'Ivoire (6,453 refugees; 504 asylum seekers). Other significant contributors to refugees and asylum seekers include Togo and Liberia. However migrants within the Project area are largely from other areas of Ghana, migrating to the region for job opportunities in the mining and oil and gas sectors.

At a regional level, the literacy rates in the Western region (Female 69.4%: Male 81.8%) are slightly above that of national level (Female 79.4%: Male 79.4%). Amongst PAPs, literacy levels reflect these trends, with high levels of literacy amongst heads of households (100% for women and 79.8% for men.

Gender

In the Western region men in the community are generally considered as the breadwinners and decision-makers both at home and community level. In comparison, women are generally seen to cater to the family with little representation in the decision making in the community. This has been highlighted with approximately a quarter of women believing that there is justification for a husband to beat his wife. Despite this, women's roles are changing with women sometimes providing more of the financial support than the men. Furthermore, Female-headed households in the communities indicate that they are not treated any differently by other residents. In terms of education, men are more likely to go to a higher level of education. In contrast, local women have fewer opportunities to further their education. Potential reasons are due to early marriage/pregnancies and financial challenges.

Human Rights

On a national level, there is a concern for human rights in Ghana from international governments and non-government organisations. Areas of concern include law enforcement, government officials and policies, freedom of speech and women's rights. Some examples of concern include, but are not limited to:

- Overcrowding and low-quality living standards in prisons;
- Discrimination towards women, or people who are disabled, HIV-positive, or LGBT;
- Violence against women with a lack of government legislative for protection;
- Censorship of a free press and violence towards journalists; and
- Corruption in governmental officials.

Vulnerable Receptors

A summary of the key sensitive receptors present in the Project Area of Influence is presented below.

Vulnerability	Receptor	Comment
High	Large households	Financial insecurity
High	Women and girls	Limited opportunities and rights
Medium	Farmers and Labourers	Loss of land and exposure to health

Figure 7.7b Social Baseline Summary—Community Health and Safety

Community Health

Regarding community health in the Western region, the social baseline has focused on access to good quality health facilities and diseases such as Malaria and HIV.

In terms of access to health facilities in the Western region, access for communities is slightly below the national average on the percentage of those who have health insurance. The Western region has also seen a decline in people consulted by a healthcare provider or who used a healthcare facility. Those who can access local health facilities consider some local health services to have limited services. The local health services tend to lack equipment, staff, emergency vehicles and have limited medical supplies.

In terms of diseases, Malaria is a principal issue of concern, especially in children under five, and pregnant women. One factor is the lack of treated mosquito nets used. The use of mosquito nets in the Western region has a similar usage rate to that at a national level; however, the prevalence of Malaria amongst children aged up to 59 months is high in the Western region relative to the Ghana average. An associated issue is that health facilities in the Western region may not have laboratory services or rapid testing kits to help in malaria diagnosis. Despite this over the past five years, there have years due been a decrease in malaria cases with improvements in case management practices and methods.

In terms of HIV, the prevalence amongst both men and women is high in the Western region relative to Ghana. In turn, the percentage of men paying for sexual intercourse is approximately twice as high in the Western region as it is for Ghana as a whole.

Other medical concerns include upper respiratory tract infections, Diarrhoea, Hypertension, Diabetes, Menstrual disorders, sexually transmitted diseases such as gonorrhoea and accidents occurring at work such as mining sites.

Disability

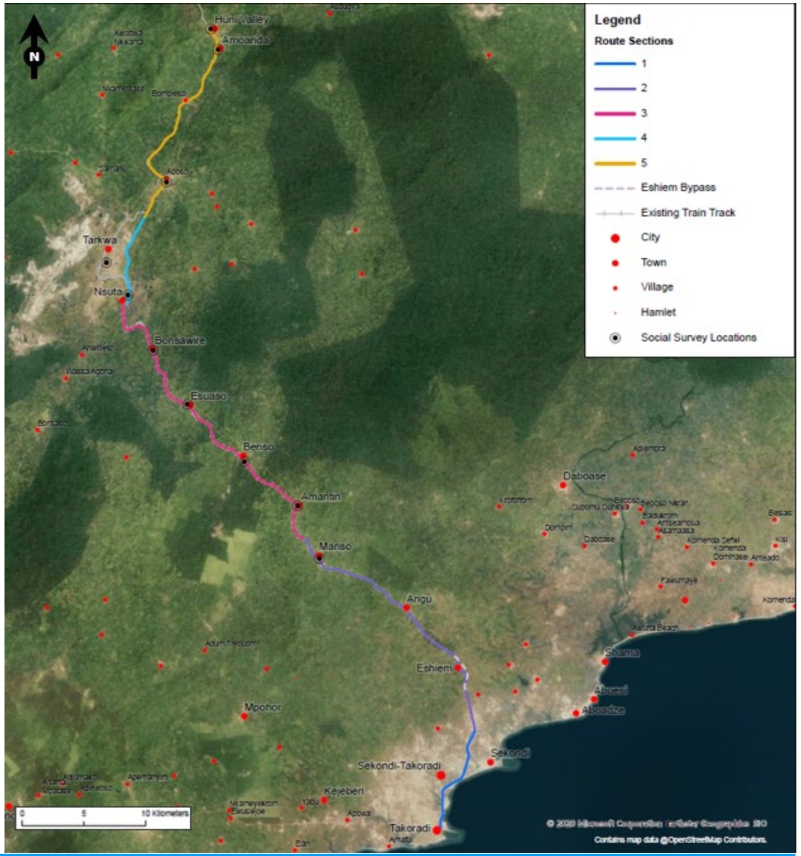
Across Ghana in the percentage of people with functional difficulties in at least one domain (from seeing, hearing, walking, self-care, communication or remembering) was estimated at 9.3% of women and 7.1% of men. Within the Western region there are small numbers of disabled people resident in the community, including those with visual, mobility, learning and hearing impairments. Amongst heads of households, only 3% had some form of disability.

Infrastructure and Services

In the Western region, in terms of sanitation systems, 66% of the household population used improved sanitation systems, 18% unimproved pit latrine without slab and 16% use open defecation. It is deemed that rural areas rely on traditional latrine methods than those seen in urban areas. Household surveys indicate that the majority of PAPs access toilet facilities within 20 m of their home however 20% did not have close access to toilet facilities (distances was more than 40 m).

In terms of grid electricity, 85.8% of households in the Western region have access to interconnected grid electricity and amongst PAPs, 90% used electricity for lighting. Less than 1 % had no access to any form of power.

Approximately 82.1% of the household population in the Western region have access to improved water sources. These are principally public tap/stand-pipe (24%), sachet water (22.2%) or a tube-well / bore -hole (20.6%). Only 4.1% of people in the Western region have to travel for more than 30 minutes to access water.



Receptor Vulnerability

A summary of the key sensitive receptors present in the Project AoI is presented below.

Sensitivity	Receptor	Comment
High	Residents of buildings located within or adjacent to the Project footprint. Children resident in communities located within the Project AoI.	Residents that live adjacent to the rail line may do so because they have limited resources and so are reliant on the marginal land within or adjacent to the rail line right of way. They may also have no or limited occupancy rights for their residence. This group of receptors includes squatters using the rail stations. Not all households within this receptor grouping will necessarily be highly vulnerable but within this group vulnerability will be particularly heightened for the elderly, female headed households and the disabled.
Medium	Men and women resident in communities located within the Project AoI	The communities within the Project AoI include a mix of residents, including some that may be vulnerable due to poverty, age or disability, as well as many others who have access to a range of economic, social and political resources to help them adapt to any Project impacts. On balance this group is classed as having moderate vulnerability.

Figure 7.7c Social Baseline Summary—Employment and Livelihoods (economic activity)

Economic Activity

The main economic activities in the Western region are farming, small scale mine/ community mining, trading. Other economic activities include ventures such as masonry, carpentry and farming. It is estimated that 90% of men are engaged in some kind of economic activity. Key economic issues noted include:

- lack of funds to buy seedlings and implements such as tools and pesticides, fluctuating market prices, changes in rainfall patterns, and longer drought seasons affect harvest, pests, high prices of fertilizers.
- No banks in the community and access to bank accounts, or formal savings accounts is limited no funds to develop these lands.
- Opportunities to develop trade and supply partnerships with industries that need raw materials, as lands are available for mass cultivation but there are no funds to develop these lands.

Income, assets and expenditure

Nearly a quarter of Ghana's population was classed as being in poverty, and 8.2% were classed as being in extreme poverty. For the Western region, there was a lower incidence of poverty and extreme poverty were substantially lower compared to Ghana as a whole, at just 2.3%. Between 2005/6 to 2016/17, the western region has seen a decline in its levels of poverty.

Within communities some are reasonably wealthy (especially those with large cocoa or oil palm farms), some are average (i.e. not wealthy but not poor either), and some are poor.

The average household finances in the communities tend to are affected on the coco seasons and school terms.

The cost of living index for Western region in 2017 was 1.00 for food and 1.04 for non-food, indicating that food costs are the same as in Greater Accra and slightly higher than Greater Accra for non-food items.

There are very few employment opportunities for the youth that exist in the community, forcing youth to engage in social vices and illegal activities. Many of the youth have completed secondary and tertiary education or have various skills including carpentry, masonry, driving etc but are not employed due to lack of employment opportunities.

Land Use and Ownership

The western region is a producer of cocoa, rubber, coconut and oil palm. In addition, the recent discovery of oil has led to off-shore commercial oil drilling.

The lands in the Western region are typically family-owned. To acquire land, a person must see his family head and make known his intention to acquire land.

Land related conflicts are quite frequent in the community and often result from disputes over boundaries. The community elders usually resolve these issues

There is a land-use system called sharecropping which is used in some areas. In this system, the landowner shares the land with a tenant farmer.

Around the AoI the dormancy of the railway has lead to land being cultivated for farming and mined and used for timber processing and industry.

Labour and working conditions

In Ghana, the minimum age for admission of a child to employment is 15 years, although children are to be involved in light work at the age of 13 years under the Children's Act, 1998 (Act, 560)

Children are further prohibited from being engaged in night work or hazardous work. Despite these legal provisions that it is common to see children engaged in some form of child labour in the Western region.

In Ghana, there are issues with labour and working conditions through forced labour and People trafficking. Exploitation includes domestic and foreign victims, including children. Ghana does not have any national occupational health and safety policy.

Sensitive Receptors

Key sensitive receptors in the Project AoI are summarised below.

Sensitivity	Receptor	Comment
Medium	Local residents that cultivate or harvest resources from land within or adjacent to the Project footprint Local labourers and tradespeople who are seeking em-	These residents have reliance on land for cultivation for livelihoods and food consumption There are some risks of forced and child labour in Ghana, but rail construction and operation were not identified to be sectors at
Low	Skilled and semi-skilled workers employed in long-term roles during the operation	Long-term employment in a reputable business means lower risk of exploitation and greater opportunity for workers to raise con-

Figure 7.8 Cultural Heritage Baseline Summary

Geographical and Topographical Context

The physical and human geography along the proposed route varies considerably from city / densely populated urban communities to rural communities, productive farms and forest. The Western Region contrasts physical heritage including historic forts, castles and beaches with villages and small towns with rich cultural heritage. Sekondi-Takoradi is the region's capital and where the rail route begins. The city has a population of approximately 728,000. Sekondi was the site of a 17th century Dutch Fort Orange and the English Fort Sekondi. The railway was constructed in 1901. Ghana's first Deepwater seaport was built in Takoradi in 1928. Nzulezu, an ancient village built over 500 years ago and overlooking Lake Tadane, is also located in Western Region and is one of the few stilted settlements remaining in the world. It was declared a UNESCO World Heritage Site in 2000.

At the other end of the Project route, Tarkwa is the centre of the Western Region mining industry, where mining has been in operation since the late 19th century. Some mining companies allow visitors and are a tourism attraction in the area.

The Project route passes through a series of modern settlements. The rail route itself is an historic feature. Construction commenced in 1898 on the Sekondi to Tarkwa route and opened in 1901, making it the oldest rail route in Ghana.

Tangible Cultural Heritage

Understanding of archaeological resources is growing rapidly in West Africa, with the knowledge that the region contains the remains of settlements dating back for many hundreds of thousands of years. However, no significant archaeological fieldwork is known to have been carried out along the proposed route and records of any archaeological finds during the construction of the original track are not known. There have been no recent excavations related to the Project and therefore there have not been any recent archaeological / cultural heritage finds.

Site reconnaissance visits undertaken in July 2020 identified several cemeteries including one in Angu Township, Manso, Esuaso and Benso. Community leaders in Esuaso were particularly concerned about the impact of the Project on their cemetery, and field studies confirm that the cemetery will be directly impacted.

Intangible Cultural Heritage

While Focus Group Discussions (FGDs) revealed that less than five percent of the population follows traditional beliefs, the Asafo still remains an important institution within affected communities along the route including, Huni Valley, Benso, Bonsawire, Nsuta and Amoanda. In the Project area, villages have Asafo units and the Asafo still have a role to play and perform during rituals and festivals as well as during emergency situations in the community. They beat their drums to inform the community of serious or emergency situations and to call the community together for meetings or for communal labour and for other activities. They are also responsible for searching for missing persons.

Although traditional festivals are declining in importance in the area, FGDs indicate that several festivals still take place. These include the Apam festival in Bonsawire, the Edim or Adim festival in Huni Valley, Tarkwa Brahabehom and Amantin communities., the Amankoma festival in Tarkwa Brahabehom, they Ayim festival in Esuaso, and the Odwira and Edidikese festivals in Benso. Taboo days are common throughout the Project area and often fall on Wednesdays, Fridays, Tuesdays or Sundays, depending on the community and time of year.

Rivers are closely associated with rituals, sacred sites and taboos. Sacred sites include the Huni, Dituo, Twena, Baasin and Atta rivers, which cross the rail track in Huni Valley. In many communities, it is taboo for women to cross certain rivers, particularly while menstruating or when pregnant.

Sacred sites and rivers / streams near the railway include the Huni, Dituo, Twena, Baasin and Atta rivers in Huni Valley, the Huni, Esukokoo and Esuoben Bansa in Amoanda, and a sacred river in Bonsawire. There is also a shrine near the rail line in Amoanda.

Sensitive Receptors

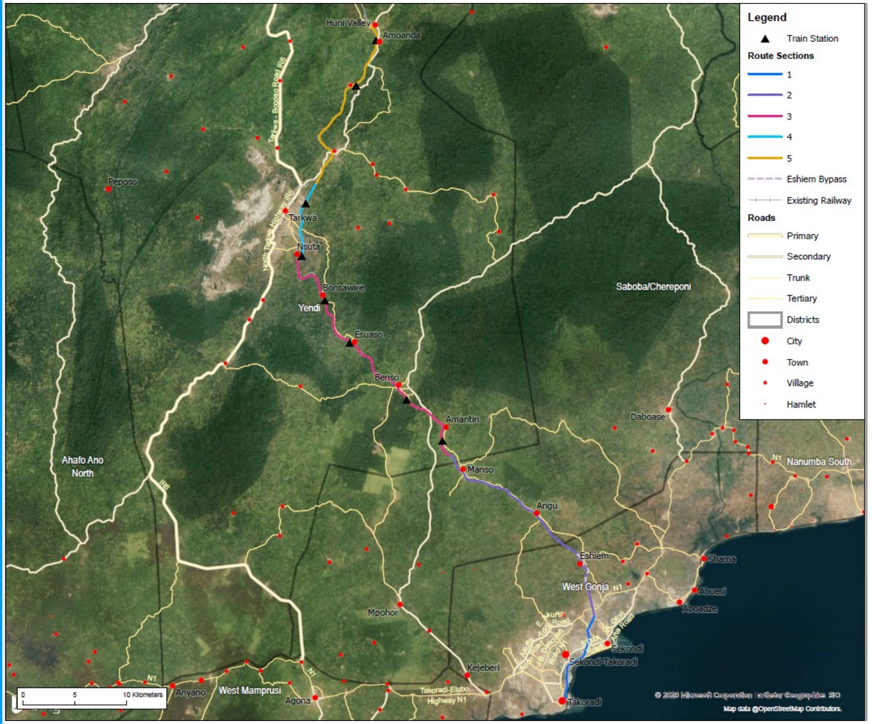
A summary of the key sensitive receptors present in the Project AoI is presented below.

Sensitivity	Receptor	Comment
High	Cemeteries	Esuoso cemetery falls within the Project area
High	Sacred sites	Associated with rivers in the Project area
High	Archaeological sites	Can be damaged through earthworks

Figure 7.9 Transport Baseline Summary

Road Transport

Transport in Ghana currently depends predominantly on the road network, comprised up of approximately 67,000km of main and secondary roads, of which approximately 12,800km are main arteries but only 3,800km of which are paved[1]. It is estimated that 90% of people and goods in Ghana are transported by road. Traffic densities are generally low, outside of large cities.



The road network in the Project AoI is limited, with access to a number of communities along the proposed route alignment between Eshiem and Manso dependent upon a single main access road which runs parallel to the railway, stretches of which was found to be in poor condition during the site reconnaissance visit. For travel between Takoradi to settlements north of Manso, alternative routes are possible, involving travel along the Tarkwa-Agona Road, Tarkwa-Esiama Road and Tarkwa- Agyempoma Road.

Port of Takoradi

Work on the Takoradi Port Expansion Project is currently underway. This involves the development and operation of a container and multi-purpose terminal within the existing Port of Takoradi. The new facilities will allow for increased port traffic, increased efficiency and reduced ship waiting times. In 2019, the Port handled 38% of Ghana's seaborne traffic, 75% of Ghana's seaborne exports and 17% of Ghana's seaborne imports[2].

Rail Network

The existing railway network comprised three lines: Western, Eastern and Central. The railway network, including branch lines, extends for approximately 940km. The railway lines are narrow gauge, single track lines and are used for both freight and passenger transport. Due to a lack of maintenance of both the track and rolling stock, the existing rail network is in a state of disrepair; it is unreliable and safe transport is not guaranteed[1].

Much of the Western Line has fallen into disuse and disrepair, with freight trains operating between Takoradi and the manganese mine near Nsuta. Freight movements occur on an as needed basis using four locomotives with 20 wagons each carrying 40 tonnes (i.e. 800 tonnes per train). Peak freight movements are estimated to involve eight journeys by each train per day (eight movements northbound and eight southbound). Current narrow gauge passenger train rail movements occur between Takoradi and Secondi, operating on alternate days, once in the morning and once in the evening (see Chapter 3: Project Description Section 3.5).

Sensitive Receptors

A summary of the key sensitive receptors present in the Project AoI is presented below.

Sensitivity	Receptor	Comment
Medium	Communities located along rail alignment between Eshiem and Manso	Access to these communities is dependent on a single road or the existing rail operations. The rail network is physically capable of accommodating Project traffic.
	Road network from Takoradi to route sections north of Manso Railway from Takoradi to Nsuta	Transport infrastructure is physically capable of accommodating Project traffic by road, although limited route options are available.

References

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(2) Ghana Ports (2020) Takoradi Port https://www.ghanaports.gov.gh/page/index/15/EXKGB1KA/Welcome-Message accessed 16 October 2020

Figure 7.10 Waste Baseline Summary

Waste Generation and Management

In 2010, the Sekondi-Takoradi area was responsible for generating almost a quarter of Ghana's total waste. Per capita waste output in the city was estimated to be 0.6 kg per person by the Waste Department of Sekondi-Takoradi, which equated to 335,728.8 kg or approximately 336 tonnes per day based on 2010 population census figures[1]. By 2013, it was estimated that Ghana produced over 13,000 tonnes of waste daily. As population levels in Ghana have continued to rise, so too has waste generation and the demands on waste management infrastructure.

Waste Collection and Transport

Historically, poor road infrastructure has made it difficult for conventional waste collection vehicles to be used in Ghana. Recent trends towards decentralisation and privatisation of waste management operations have resulted in an increase in solid waste collection services, with a number of licenced companies providing services across the Western region. Poor road infrastructure and quality remains an issue in Sekondi-Takoradi, especially the roads used to access the municipal landfill at Sofokrom, which affects collection frequency and results in the dumping of waste along the access road[2].

References

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(6) Nhounou, B. (2020) Ghana: Switzerland invests €6.1million for sustainable recycling of electronic waste https://www.afrik21.africa/en/ghana-switzerland-invests-e6-1-million-for-sustainable-recycling-of-electronic-waste/ accessed 15 October 2020

Existing Waste Management and Disposal Infrastructure

Within Ghana, solid waste is collected and disposed of at designated landfill and waste dump sites by public and private waste management firms, with bio-medical and other hazardous waste often managed through landfill. Landfills are used to dispose of both household and commercial wastes. Historically, weak enforcement of environmental regulations allowed local authorities to breach environmental regulations, resulting in poor management of landfill sites and refuse dumps. Landfill sites in Ghana are often open pit waste dumps lacking leachate control linings, and accessible by rodents and other scavenging animals.

Rapid urbanisation and population increase have acted to exacerbate the waste management challenges experienced in Ghana, particularly in urban and peri-urban areas including Sekondi-Takoradi. Resource constrained authorities have been left unable to deliver effective and efficient sanitation services, this has led to an increase in private and public-private partnership waste management. Construction of the Sofokrom engineered landfill was funded by a number of international finance institutions including the World Bank[3]. The landfill site became operational in 2015, replacing the previous municipal dumpsite which engaged in open burning of waste.

Waste collections in Sekondi-Takoradi are generally undertaken by Zoomlion Ghana Ltd and disposed of at the Sofokrom landfill site, managed by Zoomlion until 2017 and subsequently by another waste management company. In 2019 the site was described as poorly managed and left inaccessible to waste management vehicles during the rainy season due to the steep nature of the road[2]. As a result the company responsible for managing the site was changed.

There has been an increased focus on waste management in recent years, particularly following the development of the Hazardous and Electronic Waste and Control Act (2016). In 2019, commissioning of the first of several planned waste recycling plants in Ghana was completed by the Ghanaian waste company Zoomlion[4], capable of recovering 100 tonnes of organic waste and 100 tonnes of plastic waste per day. The future plant located in Takoradi is not yet operational, but was due to be constructed in 2020[5]. Currently recycling facilities within Ghana are capable of recovering and recycling wastes such as organic compost, plastics, metals, paper and refuse derived fuel. Substantial investment has also been made to improve the recycling of electronic wastes[6].

Sensitive Receptors

A summary of the key sensitive receptors present in the Project AoI is presented below.

Sensitivity	Receptor	Comment
Low	Sofokrom landfill facility Waste transport	Sofokrom engineered landfill was constructed in 2012 to take waste from Sekondi-Takoradi and surrounding environs. A number of commercial waste management companies exist (e.g. Zoomlion Ghana Ltd, Zeal Environmental Technologies Ltd) with the capabilities to treat and dispose of inert and hazardous waste streams

8. AIR QUALITY IMPACT ASSESSMENT

8.1 Introduction

This chapter presents an over of the air quality impact assessment for the Project and is based on the detailed assessment provided in Annex A. Air quality impacts are described in sections 8.2 through to 8.4 using the assessment methodology described in Chapter 5 and air quality magnitude criteria provided in Annex A. A summary of the results of the impact assessment is also presented below in Table 8.1 for construction (impact AQ1-AQ3 as described in Section 8.2) and Table 8.2 for operation (impacts AQ5-AQ7 as described in Section 8.3).

Table 8.1: Air Quality Construction Impact Summary

Impact #	**AQ1**	**AQ2**	**AQ3**
Receptor importance/ sensitivity	High	High	Low
Frequency	Periodic	Periodic	Periodic
Likelihood	Likely	Likely	Likely
Extent	Local	Local	Local
Duration	Short-Medium	Short	Short-Medium
Magnitude	High	Low - Medium	Low
Effect	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct
Significance	Moderate to Major	Minor	Minor
Additional mitigation? (Y/N)	Y	N	N
Residual Significance	Minor	Minor	Minor

Table 8.2: Air Quality Operation Impact Summary

Impact #	**AQ4**	**AQ5**	**AQ6**	**AQ7**
Receptor importance/ sensitivity	High	Low	Low	Low
Frequency	Continuous	Continuous	Continuous	Continuous
Likelihood	Likely	Likely	Likely	Likely
Extent	Regional	Regional	Regional	Regional
Duration	Long term	Long term	Long term	Long term
Magnitude	Low to Very Low	Low to High	Very Low	Low to Very Low
Effect	Adverse	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct	Direct
Significance	Minor	Minor	Minor	Minor
Additional mitigation? (Y/N)	N	N	N	N
Residual Significance	Minor	Minor	Minor	Minor

8.2 Direct Construction Impacts

Impacts introduced by the scheme are summarised below. Each impact is given an impact code (e.g. AQ1, AQ2, etc.) for ease of reference. The impact assessment for each impact is summarised in Table 5.3 for construction and Table 5.4 for operation.

8.2.1 Construction Impact CODE AQ1

Dust and Particulate Emissions from High Magnitude Areas

The main air quality impact arising during the construction phase is considered to be the potential for increased dust and particulate emissions from construction activity. The potential for impacts will depend on dust emission magnitude which is related to the construction activities being carried out.

The main sources of dust impacts have been identified in Table 5.3. Those with a high dust emission magnitude are considered in AQ1.

Table 8.3: Dust Emission Magnitude

Code	Typical Location	Dust Emission Magnitude	Duration	Justification
AQ1	Construction compounds	High	Short term as camp is mobile	There are two mobile construction camps, one for each workfront, no hardstanding is to be provided and each camp will contain potentially dusty activities including concrete plant and stone crushing plant
AQ1	Heavy Rail Maintenance Facility	High	Medium term	To be located adjacent to Tarkwa Station. Work to take approximately 14 months. Construction activity at this location will be extensive and include earthworks and building works to construct the buildings, goods sheds, storage areas, washing facilities, water treatment works, fuel storage and other facilities required in this location.
AQ1	Station	High	Medium term	Work anticipated to last for up to 12 months at each station. Track work will be increased to allow for passing loops. A station building will be constructed to include ticket office, toilets, waiting areas, service office, commercial and catering areas. One or two platforms will require construction. Car parking areas and pick up and drop off facilities will be provided.
AQ2	Track Realignment works	Medium	Short term	Additional earthworks will be required and stockpiling of material
AQ2	Bridges and crossings	Medium	Short term	Additional earthworks and construction works will be required over a longer period to allow for the construction of required bridges or crossings
AQ2	Track Construction on pre-existing train-line	Low	Short term	All work to be carried out within permanent RoW. Ballast material is generally coarse. Sleepers will be

Code	Typical Location	Dust Emission Magnitude	Duration	Justification
				prefabricated off-site. Laying of rails will not generate dust
AQ2	Temporary Laydown Areas	Low	Short term	Will be located close to the permanent RoW and anticipated to only be required for a short period of time

Impact Assessment

PM_{10} and $PM_{2.5}$ concentrations have been recorded in excess of the WHO guidelines and Ghanaian AAQS. The sensitivity of the air shed to increased dust and particulate emissions is therefore considered to be high. Impacts will vary in length depending on location, for example at the stations and heavy rail maintenance facility construction activity is likely to occur for periods of 12 months or greater. At the construction camps the duration will be shorter, but there are significant dust generating activities included within these areas. Impacts would be predominantly confined to within 500m of the RoW and are therefore local in nature, although in the event that there are significant emissions of fine dust such as PM_{10} and $PM_{2.5}$ this could be dispersed more widely.

The magnitude of the impact is largely dependent on the activities being carried out and the duration. For example, dust generating activities such as concrete batching, and crushing of stone may be carried out at the construction camps; at the stations and at the Heavy Rail Maintenance Facility there will larger scale construction which will have a greater potential for dust emissions.

The significance of the potential effect is **Moderate to Major**.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM3, PDM6, PDM7, PDM10, PDM32
Relevant ESIA GIIP: GPM1, GPM2, GPM12, GPM15, GPM16, GPM46

Additional Mitigation and Enhancement Measures

In addition to the requirements set out in the embedded design controls and good practise measures outlined above a dust management plan should be provided for each of the high dust magnitude locations identified in Table 5.3. The plans should focus on both minimising emissions at source and preventing the dust blow-off through the use of hoardings and screens.

Residual Impact

Implementation of the additional measures will reduce AQ1 to **Minor**.

8.2.2 Construction Impact CODE AQ2

Dust and Particulate Emissions from Medium to Low Magnitude Activities

The main air quality impact arising during the construction phase is considered to be the potential for increased dust and particulate emissions from construction activity. The potential for impacts will depend on dust emission magnitude which is related to the construction activities being carried out.

The main sources of dust impacts have been identified in Table 4.3. Those with a medium to low dust emission magnitude are considered in AQ2.

Impact Assessment

PM_{10} and $PM_{2.5}$ concentrations have been recorded in excess of the WHO guidelines and Ghanaian AAQS. The sensitivity of the air shed to increased dust and particulate emissions is therefore considered to be high. Due to the nature of the rail construction, activities will vary in length from short (one to two weeks) to medium (up to several months) Impacts will be predominantly confined to within 500m of the permanent RoW, and are therefore local in nature, although in the event that there are significant emissions of fine dust such as PM_{10} and $PM_{2.5}$ this could be dispersed more widely.

The magnitude of the impact is low to medium as detailed in Table 5.3.

The significance of the potential effect is considered to be **Minor.**

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM3, PDM6, PDM7, PDM10, PDM32
Relevant ESIA GIIP: GPM1, GPM2, GPM12, GPM15, GPM16, GPM46

8.2.3 Construction Impact CODE AQ3

NO_2 and SO_2 Emissions from Combustion Plant during Construction

NO_2 and SO_2 emissions would be generated during the construction phase from the following activities:

- Transport of construction materials by road or rail to the construction sites;
- Movement of heavy plant used within the construction activities such as excavators, dump trucks, compactors;
- Use of generators to provide a local power source;
- Use of mobile plant such as crushing and drilling plant.

Impact Assessment

Existing concentrations of NO_2 and SO_2 have been found to be low within the study area and therefore the sensitivity of the airshed as a receptor is considered to be low. Impacts will be either short to medium as the maximum length of the construction works is anticipated to be 14 months for construction of the Heavy Rail Maintenance Facility. Where materials are to be transported by road or rail impacts will occur over a wider area, whereas impacts from generators and mobile plant would be of a more local nature.

Emissions of SO_2 are primarily controlled through limiting the sulphur content of fuel which is mitigated through GPM3. NO_2 emissions from generators will be controlled by adhering to the emission limits set by PDM1. Mitigation of road traffic sources would be achieved through GPM46 which relates to traffic management.

The significance of the potential effect is therefore considered to be **Minor.**

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM1, PDM2, PDM3
Relevant ESIA GIIP: GPM3, GPM46

A summary of all additional mitigation measures for construction are provided in Table 5.4 below.

Table 8.4: Construction Additional Mitigation Measures

Mitigation ID	Mitigation Measure
ADM1	Site specific dust management plans shall be developed and implemented to minimise emissions and spread of dust from construction activities. Separate management plans should be generated for the following: • Heavy rail maintenance facility; • Construction compounds, taking into account the use of dust generating equipment such as crushers; and • Stations.

8.3 Direct Operational Impacts

8.3.1 Operational Impact CODE AQ4

Impact to PM_{10} and $PM_{2.5}$ from Operations

The operation of the trains will generate emissions of PM_{10} and $PM_{2.5}$. As detailed in Section 2 and Section 4, it is anticipated that the maximum increase in emissions would arise at the stations where the airshed would be impacted by both moving trains and those idling in the station.

Other potential sources of PM_{10} and $PM_{2.5}$ during the operation of the project include;

- use of generators and operation of plant within the Heavy Rail Maintenance Facility;
- road traffic accessing the Heavy Rail Maintenance Facility;
- plant movements associated with track maintenance operations;
- traffic dropping off passengers and accessing station car parks.

However, these sources will be more widespread and are not expected to give rise to significant impacts on PM_{10} or $PM_{2.5}$ concentrations.

Impact Assessment

Given the existing high concentrations of PM_{10} and $PM_{2.5}$ recorded during the baseline assessment the sensitivity of the receptor to increased concentrations of these pollutants is considered high. The frequency and duration of the events would be continuous and long term. An increase in concentrations could extend over a large area into adjacent towns and countryside.

The locomotives used on the railway are to meet EU emission limit IIIb or equivalent (PDM26). The modelling results presented in Section 4, has indicated that the maximum increase in 24 hour average PM_{10} concentrations is 0.5 $\mu g/m^3$ and that of $PM_{2.5}$ is 0.5 $\mu g/m^3$. On this basis the magnitude of impact is low.

The significance of effect is therefore considered to be **Minor**.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM 1, PDM2, PDM4, PDM26
Relevant ESIA GIIP: GPM1, GPM46

8.3.2 Operational Impact CODE AQ5

Impact to NO_2 from Operations

The operation of the trains will generate emissions of NO_x which will be converted to NO_2. As detailed in Section 2 and Section 4, it is anticipated that the maximum increase in emissions will arise at the stations where the airshed would be impacted by both moving trains and those idling in the station.

Other potential sources of NO_2 during the operation of the project include;

- use of generators and operation of plant within the Heavy Rail Maintenance Facility;
- road traffic accessing the Heavy Rail Maintenance Facility;
- plant movements associated with track maintenance operations;
- traffic dropping off passengers and accessing station car parks.

Other sources of NO_2 emissions will be spread over a wider area and are unlikely to result in significant impacts.

Impact Assessment

Existing NO_2 concentrations recorded during the baseline assessment are relatively low indicating that the air shed is not degraded for this pollutant. The results of the modelling of emissions from the train operations are provided in Section 4. The frequency and duration of the events is likely to be continuous and long term. An increase in concentrations could extend over a large area into adjacent towns and countryside. The magnitude of impact is considered high for one hour and 24-hour standards, but low for the annual average standard. The potential for an exceedance of the AAQS taking into account background concentrations is considered low for all averaging standards.

The locomotives used on the railway are to meet EU emission limit IIIb or equivalent (PDM26). Generators will meet the required emission standards set out in the IFC guidelines (PDM1). Traffic emissions will be minimised through the adherence to a traffic management plan (GPM46).

The significance of effect is therefore considered to be **Minor.**

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM 1, PDM2, PDM4, PDM26
Relevant ESIA GIIP: GPM46

8.3.3 Operational Impact CODE AQ6

Impact to SO_2 from Operations

The operation of the trains will generate emissions of SO_2.

Other potential sources of SO_2 during the operation of the project include;

- use of generators and operation of plant within the Heavy Rail Maintenance Facility;
- road traffic accessing the Heavy Rail Maintenance Facility;
- plant movements associated with track maintenance operations;
- traffic dropping off passengers and accessing station car parks.

As detailed in Section 2 and Section 4, it is anticipated that the maximum increase in emissions would arise at the stations where the airshed would be impacted by both moving trains and those idling in the station. The emissions of SO_2 are largely controlled by the sulphur content within the diesel and gas oil used to fuel road vehicles, trains and generators.

Impact Assessment

Existing SO_2 concentrations are very low and therefore the existing air shed is not considered to be degraded for this pollutant and the sensitivity of the receptor is Low. The frequency and duration of the events would be continuous and long term. An increase in concentrations could extend over a large area into adjacent towns and countryside.

The locomotives used on the railway are to meet EU emission limit IIIb or equivalent (PDM26). The sulphur content of the fuel will be limited to less than 50 mg/kg (GPM3). The modelling results presented in Section 4, has indicated that the maximum increase in SO_2 is very low for all averaging periods and the likelihood of an exceedance of a relevant AAQS including background concentrations is considered low.

The significance of effect is therefore considered to be Minor.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM 1, PDM2, PDM26
Relevant ESIA GIIP: GPM3

8.3.4 Operational Impact CODE AQ7

Impact to NO_x and SO_x from Operations

The operation of the trains will generate emissions of NO_x and SO_x. Other potential sources of these pollutants during the operation of the project include;

- use of generators and operation of plant within the Heavy Rail Maintenance Facility;
- road traffic accessing the Heavy Rail Maintenance Facility;
- plant movements associated with track maintenance operations;
- traffic dropping off passengers and accessing station car parks.

As detailed in Section 2 and Section 4, it is anticipated that the maximum increase in emissions will arise at the stations where the airshed would be impacted by both moving trains and those idling in the station

Impact Assessment

Existing concentrations of both pollutants is relatively low indicating an undegraded air shed of low sensitivity. The frequency and duration of the events would be continuous and long term. An increase in concentrations could extend over a large area into adjacent towns and countryside.

The locomotives used on the railway are to meet EU emission limit IIIb or equivalent (PDM26). Sulphur emissions are to be controlled by limiting the sulphur content within the fuel (GPM3). The modelling results presented in Section 4, has indicated that the magnitude of impact is low for NO_x and very low for SO_x. When background concentrations are also included the likelihood of an exceedance of the objectives for the protection of vegetation and ecosystems is considered low.

The significance of effect is therefore considered to be **Minor.**

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM 1, PDM2, PDM26
Relevant ESIA GIIP: GPM1, GP3, GPM46

No additional mitigation measures have been identified for the operational phase.

8.4 Indirect Impacts

No indirect impacts have been identified.

9. CLIMATE IMAPCT ASSESSMENT

9.1 GHG Impact Assessment

9.1.1 Introduction

This chapter presents an overview of the climate impact assessment for the Project and is based on the detailed assessment provided in Annex B. Climate impacts are described in sections 9.1.2 and 9.1.3 using the assessment methodology described in Chapter 5 and climate assessment criteria provided in Annex B. A summary of the results of the impact assessment is also presented below in Table 9.1 for construction and operation (impacts CC1 and CC2). A climate risk assessment is also presented in Section 9.2.

Table 9.1: GHG Impact Summary

Impact	CC1: Construction Stage Greenhouse Gas Emissions	CC2: Operation Stage Greenhouse Gas Emissions
Scope 1 Emissions: Direct	Fuel use during construction of the proposed development. Comprising predominantly diesel fuel. Emissions associated with land use conversion – clearance of forest vegetation within permanent RoW. **Scoped in**	Fuel use during operation of the proposed development. Comprising predominantly diesel fuel used to fuel locomotives and diesel generators at stations. **Scoped in**
Scope 2 Emissions: Electricity	No grid electricity usage is planned during construction phase. **Scoped out**	At this time insufficient information is available to confirm whether electricity at stations will be provided via diesel generators or using grid electricity. If during detailed design it is determined that grid electricity will be used to supply stations and the maintenance facilities, the GHG calculations should be revised to reflect the associated emissions.
Scope 3 Emissions: Indirect	In accordance with the Applicable Project Standards, reporting of Scope 3 emissions is optional. At this time insufficient information is available to provide a robust assessment of Scope 3 emissions therefore they have been excluded from this assessment. Although scoped out, it should be noted that in line with GMP44 existing infrastructure will be reused and recycled for the replacement rail and facilities where possible if they are in an acceptable condition.	

9.1.2 Direct Construction Impacts - Impact CC1: Construction Stage GHG Emissions

Impact Description

The construction GHG emissions are reported in tonnes of carbon dioxide equivalent emissions (CO_2e) for the duration of the 3-year construction period. The GHG emissions have been calculated using client supplied data on anticipated fuel consumption and IPCC GHG emissions conversion factors[1]. Monthly diesel usage during the construction period is anticipated to comprise 160,000-180,000 litres of diesel and 2,000 litres of fuel oil at each worksite, giving an overall monthly usage of 320,000-360,000 litres of diesel and 4,000 litres of fuel oil. A carbon emissions factor (tCO_2e) of 0.00268526916 was used to calculate the GHG emissions.

The construction of the proposed development is anticipated to lead to land use change. Land use change as a result of the permanent RoW encompasses the following existing land use categories, closed canopy forest, degraded forest, freshwater swamp forest, agricultural lands semi-natural regrowth and settlements. A total of 382 hectares of land is expected to permanently change, excluding settlements which are not included in the GHG assessment as they are not typically a carbon sink. The majority of this area (76.5%) is comprised of agricultural lands and semi-natural regrowth, with the remainder forested (degraded, freshwater swamp and closed canopy forest). See Annex E: Biodiversity and Ecosystem Services for further details on land use change. For the purpose of the GHG emissions calculations, the existing land uses have all been assumed to comprise high growth forest habitats which represent a worst case scenario. This precautionary approach is taken due to a lack of site specific data on carbon intake for the land uses present. The land use change conversion has been calculated in line with the IFC PS3 Guidance Note Annex A[2].

The results of the GHG assessment are summarised in Table 9.2.

Table 9.2: Construction Green House Gas Assessment Summary

Item	**Estimated GHG Emissions (tCO_2e)**
On-site emissions from diesel and fuel usage (total over 3 year construction period)	35,187.77
Land use conversion within permanent RoW (total)	8,679.77
Construction Annual On-site emissions [(a)]	**20,409.03**
Note: (a) Assumes all emissions associated with land use conversion occur during a single (worst case) construction year. As noted above the conversion factor has assumed all land is forested resulting in an overestimate of emissions.	

Impact Assessment

Construction GHG emissions are below 25,000 tonnes per annum and therefore are considered not significant.

Additional Mitigation and Enhancement Measures

The impact during construction is assessed to be not significant and therefore no additional mitigation measures are required.

Enhancement measures could be adopted during construction to further reduce GHG emissions. As a resource efficiency measure, which would reduce Scope 3 GHG emissions, the Project should consider sourcing materials with low embodied carbon where possible; for example, steel with a high recycled content and concrete with a high percentage of cement replacement (ENH1).

Residual Impact

No significant effect is anticipated as a result of Scope 1 and Scope 2 construction emissions.

1 IPCC (2014) IPCC 5th Assessment Report: https://www.ipcc.ch/assessment-report/ar5/

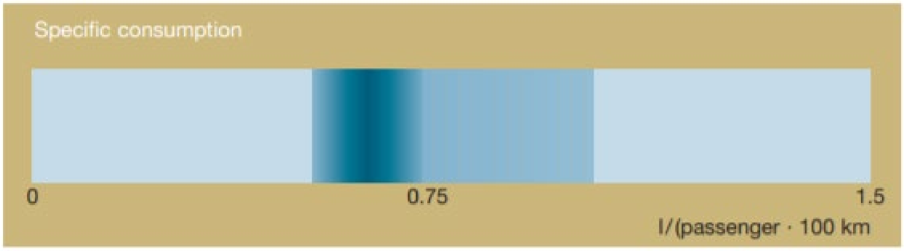
2 IFC (2012) Guidance Note 3 Resource Efficiency and Pollution Prevention https://www.ifc.org/wps/wcm/connect/9fc3aaef-14c3-4489-acf1-a1c43d7f86ec/GN_English_2012_Full-Document_updated_June-27-2019.pdf?MOD=AJPERES&CVID=mRQmrEJ

9.1.3 Direct Operational Impacts - Impact CC2: Operation Stage GHG Emissions

Impact Description

The proposed development will result in an increase in the peak movement of passenger trains from 1 to 6 per day. The peak movements per day for freight trains is expected to remain as per the baseline at 16 per day. The GHG emissions have been calculated using client supplied data on anticipated fuel consumption and IPCC GHG emissions conversion factors. Operational diesel and fuel oil usage is estimated to be 64,000-72,000 litres of diesel and 800 litres of fuel oil per month, or 786,000 to 864,000 litres of diesel and 9,600 litres of fuel oil per year.

A comparison of this estimated diesel usage was made against the range of fuel consumption quoted within the specifications for TRAXX locomotives (Figure 9-1).[3]. Recognising fuel consumption may vary under practical operating conditions depending on operating parameters, fuel consumption values of 0.75 l and 1.25 l were considered, which resulted in an estimate of 614,295 to 837,675 litres of diesel per year by the locomotives. The Project estimated diesel usage falls within this range and is therefore considered to be appropriate.



Source: Bombardier

Figure 9-1 TRAXX Range of Fuel Consumption

The operational GHG emissions are reported in tonnes of CO_2e per year. The results of the GHG assessment are summarised in Table 9.3.

Table 9.3: Operational Greenhouse Gas Assessment Summary

Item	Estimated GHG Emissions (tCO_2e) per year
Operational emissions	2,345.85
TOTAL	**2,345.85**

Impact Assessment

The operational GHG emissions are below 25,000 tonnes per annum and therefore are considered not significant.

Additional Mitigation and Enhancement Measures

The impact during operation is assessed to be not significant and therefore no mitigation measures are required.

Residual Impact

No significant effect is anticipated as a result of Scope 1 and Scope 2 operational emissions.

[3] Bombardier, TRAXX 4 Environment Environmental Product Declaration: TRAXX P160 DE http://www.bombardier.at/content/dam/Websites/bombardiercom/supporting-documents/Sustainability/Reports/BT/Bombardier-Transportation-EPD-TRAXX-P160DE-en.pdf accessed 26/10/20

9.2 Climate Change Risk Assessment

9.2.1 Construction Stage Climate Change Risk Assessment

Construction activities will occur over a three-year construction period. Construction activities at a single location will typically have a duration of 2-3 months, with construction durations of 12 months at station locations. The climate change projections identified focus on change between 2020 and 2099. The shortest timescale projections identified by the World Bank Group Climate Knowledge Portal focus on the period 2020-2039. Within this time period, the climate trends summarised in Chapter 7: Baseline will still be relevant, with extreme weather events such as heavy rainfall events, heatwaves and drought events potentially having an impact on construction activities. A precautionary approach therefore has been taken, and mitigation measures relevant to the potential changes that may occur have been identified. For this particular assessment, we have assumed that the additional mitigation measures identified in Chapters 8, 10-20 as part of this ESIA will be in place and implemented. The relevant embedded deign measures and relevant additional mitigation measures are documented in Table 9.4.

Table 9.4: Construction Stage Climate Change Risk Assessment

Climate Change Trend	Climate (change) Impact on Receptor	Existing Design and Mitigation Measures
Increased frequency of hot days and heatwaves	**Receptor:** Human health receptors Heatwaves and higher temperatures could result in site personnel welfare impacts including heat stress and unsafe working conditions.	**ESIA GIIP:** • **GPM14:** Construction will be undertaken 6 days per week (Monday to Saturday) and nominally between the hours of 7.30am and 9.30pm. • **GMP36:** An Occupational Health and Safety (OHS) Management Plan for construction will be developed. The plan shall identify measures using the hierarchy of control to prevent accident or injury from: • physical hazards, such as equipment, noise and working at height; • chemical hazards, including air quality, chemical use, fire and explosives; and • biological hazards. • The OHS Plan shall be updated for each phase of the Project. The plan shall define: • the role and responsibilities for OHS management • set out and define the requirements for associated procedures including the OHS risk assessment, job/task risk assessments, and permit to work system. • Set out the training and awareness requirements • Define the audit and inspection requirements to ensure implementation and compliance with the Plan. • Specific measures may include but are not limited to: • installation of barriers, warning tape/ net, signage, watchman, and proper lighting; • use of appropriate PPE by site personnel at all times during construction activities;

Climate Change Trend	Climate (change) Impact on Receptor	Existing Design and Mitigation Measures
		• provision of adequate cool drinking water for construction workforce; • provision of back-up alarms, lights, and all other applicable safety devices for plant and equipment; • workforce induction on the project site safety requirements prior to commencement of activities covering activity safety issues and general safety requirements. • GPM37: An Occupational Health and Safety (OHS) Management Plan for construction will be developed. The plan shall identify measures using the hierarchy of control to prevent accident or injury. Specific measures may include but are not limited to provision of adequate cool drinking water for construction workforce. • **GPM38:** An overall OHS risk assessment will be developed for each phase of the Project as part of the OHS Plan. This assessment must follow an appropriate risk assessment methodology and result in the identification of hazards, risks and appropriate means of control, applying the hierarchy of controls . The overall OHS risk assessment will be supplemented with more detailed job / task risk assessments. These assessments must be updated each time a job or task changes, or when an accident, incident or near miss has occurred. • **GPM42:** The OHS Plan shall identify and define programs for medical screening and medical surveillance of workers will be developed to help ensure that employees are fit for duty and any injuries or illnesses are identified in a timely manner. • **GPM42:** The OHS plan shall define the number and requirements for First aid equipment, First aid personnel, and supplies to be kept at all active Project sites to help support first response to any injuries. The need for and specific details of the First aid requirements shall be based on the risk profile of the activities undertaken at each site. • **GPM43:** The OHS Plan shall define the Audit and Inspection programme to ensure appropriate implementation of the Plan at each site. The Plan shall define the Key Performance Indicators to be audited against, and a clear corrective action feedback loop described. **Additional mitigation:** • **ADM62:** Independent OHS specialists with experience in OHS management at the required International Standards shall be employed. These specialists shall review the OHS Plan

Climate Change Trend	Climate (change) Impact on Receptor	Existing Design and Mitigation Measures
		prior to construction and monitor implementation of the OHS Plan during construction. The OHS specialists will be separate to the Project’s OHS management personnel and will take an independent advisory role with the objective to help ensure compliance of the Project to the OHS requirements of the Applicable Standards.
Increased frequency of intense rainfall events	**Receptor:** Buildings and infrastructure receptors; Human health receptors Extreme rainfall could pose a safety risk and also affect the ability to undertake certain construction activities leading to programme delays and potential damage to construction materials.	**GPM12:** A Buildings and Structures Demolition Plan will be developed which shall define surface water/pollution prevention measures.
Increased frequency and intensity of droughts and increased frequency of hot days and heatwaves	**Receptor:** Human health receptors and environmental receptors Heatwaves and drought conditions could increase dust generated during construction activities which could affect human and environmental receptors	**GPM12:** A Buildings and Structures Demolition Plan will be developed which shall define dust control and surface water/pollution prevention measures.
Extreme weather events: Storm surge in Takoradi Port region	**Receptor:** Infrastructure receptors and human health receptors Storm surges could lead to flooding within the vicinity of the site which could affect the ability to undertake construction activities and damage construction materials and present a safety risk.	The construction locations at Takoradi Port and along the coastal section of the route to Essamen are at least 50m inland. Construction within this section of the route includes laying of rails on dual sleepers and rail line at Takoradi Port, with an anticipated duration of only a few months.

9.2.2 Operational Stage Climate Change Risk Assessment

A summary of the climate risk assessment for the operational stage is provided in Table 9.5.

Table 9.5: Operational Stage Climate Change Risk Assessment

Climate Change Trend	Climate (change) Impact on Receptor	Existing Design and Mitigation Measures	Impact Magnitude	Additional Mitigation Required
Increased mean temperatures and frequency of heatwaves	**Receptor:** Buildings and Infrastructure and human health receptors Higher temperatures and heatwaves could result in overheating of mechanical and electrical equipment.	Stations to be built to European Standards (see Chapter 2, Section2.8 Project Design Standards). Stations will have cantilever roofs, providing shading for passengers, drinking water facilities, and waiting rooms with air conditioning provided (PDM9). Wagons purchased have an operating temperature of wagons -40 to +60ºC Grade 275 pre-stressed steel with a design life of 50 years and capable of withstanding current and future variations in temperature from 20ºC to 70ºC.	**Likelihood level**: Possible **Consequence level:** Low **Impact Magnitude**: Low	None required – Existing design and mitigation measures are considered appropriate.
Increased mean temperatures and frequency of heatwaves	**Receptor:** Infrastructure (Track) Higher temperatures and heatwaves could cause track buckling and/or associated misalignment problems, damaging the infrastructure and posing a safety risk.	Grade 275 pre-stressed steel with a design life of 50 years and capable of withstanding current and future variations in temperature from 20ºC to 70ºC.	**Likelihood level**: Possible **Consequence level:** Low **Impact Magnitude**: Low	None required – Existing design and mitigation measures are considered appropriate.
Increased frequency of heatwaves and droughts	**Receptor:** Infrastructure, Environmental and human health receptors Hotter and drier conditions could increase the risk of fire in the region. Fires accidentally started as a result of train operation could be exacerbated by hotter and drier weather.	Planned measures include: • **GPM35:** Design certification shall be obtained from a third party life and fire safety consultant. • **GPM36:** A Life and Fire Safety Plan shall be developed and implemented which identifies major fire risks, applicable codes, standards and regulations, and mitigation measures. The plan shall identify all links to other relevant plans including the EPRP.	**Likelihood level**: Unlikely **Consequence level:** Medium **Impact Magnitude**: Low	None required – Existing design and mitigation measures are considered appropriate.

Climate Change Trend	Climate (change) Impact on Receptor	Existing Design and Mitigation Measures	Impact Magnitude	Additional Mitigation Required
Increased frequency of intense rainfall events	**Receptor:** Buildings and infrastructure receptors Extreme rainfall could result in the overwhelming of drainage assets and culverts. This could result in secondary impacts such as localised flooding which could disrupt rail operations and damage rail infrastructure.	• **PDM19:** Stormwater flow channels and collection ponds installed as part of the open drainage system will be fitted with oil/water separators at permanent facility locations. Separators will be able to achieve an oil and grease concentration of 10mg/l. • **PDM21:** The rail, stations and other infrastructure will be designed to allow for sustainable drainage of the track. Run off from the track will be managed through a series of channels and collected for discharge. Drainage under the track to allow for free flow movement of rainfall will be provided through a series of land drains and culverts sized according to the water conveyance requirements. Drainage will be installed parallel to the rail to ensure flooding from surface waters is controlled at level crossings. • **PDM27:** Platforms will be constructed using concrete paving blocks with the main surface having a 1 to 1.5% slope to allow for drainage. As outlined in the Ghana Western Railway Line Infrastructure Final Design: Hydraulic Report Lot 2 KM10.6 to KM67.6, design measures include provision of adequate numbers of culverts, to discharge the maximum expected flood levels to avoid overtopping (PDM21).	**Likelihood level**: Unlikely **Consequence level:** Low **Impact Magnitude**: Low	**ADM96:** During detailed design, hydraulic assessment shall be undertaken to ensure sizing of culverts includes both the existing flow requirements and future changes under climate change. This shall include consideration of hydraulics, morphological change, and requirements for maintenance of habitats.

<table>
<tr><th>Climate Change Trend</th><th>Climate (change) Impact on Receptor</th><th>Existing Design and Mitigation Measures</th><th>Impact Magnitude</th><th>Additional Mitigation Required</th></tr>
<tr><td>Increased frequency of intense rainfall events</td><td>Receptor: Infrastructure receptors
Extreme rainfall could cause embankment failure and landslides.</td><td>As outlined in the Ghana Western Railway Line Infrastructure: Hydraulic Report:
Where the watercourse is very close to the railway, a channel dedicated to water regulation and/or protection of the embankment will be provided by means of Reno type mattresses and/or gabions based on the extent of the flows involved;
The drainage network for the railway includes top drains for collecting the flow coming from the railway formation at the embankments, tile gutters, side drains, external ditches, and culverts. Modelling has been undertaken as part of the hydraulic report to confirm the adequacy of drainage. Rainfall intensity adopted for top drain checks was as follows:<table><tr><td>Return time</td><td>Tr[years]</td><td>50</td></tr><tr><td>Rainfall duration</td><td>t_c[h]</td><td>0.2</td></tr><tr><td>Rainfall intensity</td><td>i(t_c,Tr)</td><td>299.9</td></tr></table></td><td>Likelihood level: Possible

Consequence level: Low

Impact Magnitude:
Low</td><td>None required – Existing design and mitigation measures are considered appropriate.</td></tr>
<tr><td>Increased frequency of intense rainfall events</td><td>Receptor: Infrastructure receptors (Bridges)
Extreme rainfall could cause flooding, which could damage or destabilise bridges.</td><td>As outlined in the Ghana Western Railway Line Infrastructure: Hydraulic Report, design measures include choosing the most suitable bridge type depending on whether the location is in a depressed or flooding area. In addition, a minimum vertical freeboard of 1.0 metres between water surface and the bridge structure bottom level will be adopted for all proposed bridges along the railway line.</td><td>Likelihood level: Unlikely

Consequence level: Medium

Impact Magnitude:
Low</td><td>None required – Existing design and mitigation measures are considered appropriate.</td></tr>
</table>

Climate Change Trend	Climate (change) Impact on Receptor	Existing Design and Mitigation Measures	Impact Magnitude	Additional Mitigation Required
Increased frequency of intense rainfall events	**Receptor:** Environmental and human health receptors Extreme rainfall could overwhelm drainage capacity and cause run-off, potentially spreading contamination and polluting nearby environmental receptors.	• **PDM19:** Stormwater flow channels and collection ponds installed as part of the open drainage system will be fitted with oil/water separators at permanent facility locations. Separators will be able to achieve an oil and grease concentration of 10mg/l. • **PDM20:** Separate drainage systems for wastewater from areas that could be contaminated (e.g. with oil) will be developed and implemented at all permanent facilities. • **PDM21:** The rail, stations and other infrastructure will be designed to allow for sustainable drainage of the track. Run off from the track will be managed through a series of channels and collected for discharge. Drainage under the track to allow for free flow movement of rainfall will be provided through a series of land drains and culverts sized according to the water conveyance requirements. Drainage will be installed parallel to the rail to ensure flooding from surface waters is controlled at level crossings. • **PDM27:** Platforms will be constructed using concrete paving blocks with the main surface having a 1 to 1.5% slope to allow for drainage. As outlined in the Ghana Western Railway Line Infrastructure: Hydraulic Report, design measures include provision of adequate numbers of culverts, to discharge the maximum expected flood levels to avoid overtopping (PDM21).	**Likelihood level**: Possible **Consequence level:** Low **Impact Magnitude**: Low	None required – Existing design and mitigation measures are considered appropriate. **ADM96:** During detailed design, hydraulic assessment shall be undertaken to ensure sizing of culverts includes both the existing flow requirements and future changes under climate change. This shall include consideration of hydraulics, morphological change, and requirements for maintenance of habitats.

Climate Change Trend	Climate (change) Impact on Receptor	Existing Design and Mitigation Measures	Impact Magnitude	Additional Mitigation Required
Sea level rise in Takoradi Port region	**Receptor:** Infrastructure receptors and Human health receptors Increased sea levels could lead to flooding within the vicinity of the site which could pose safety risks and damage infrastructure, causing delays to rail operations. Given land availability, the route alignment within Takoradi is relatively fixed, and the coastal area is generally low lying. The railway is located approximately 50m inland at the closest point to the sea. The section of the railway near Essamen is approximately 100m inland, and separate from the coast by road infrastructure.	**PDM6:** The proposed route will use the existing rail line and permanent RoW as far as practicable. It should be noted works to upgrade the operations at Takoradi Port are in progress. Information on consideration of sea level in design was not available.	**Likelihood level**: Possible **Consequence level:** Medium **Impact Magnitude**: Medium	

9.2.3 Indirect Impacts

The Project is not anticipated to result in an increase in vulnerability of receptors to climatic change therefore no indirect impacts are anticipated.

10. NOISE AND VIBRATION IMPACT ASSESSMENT

10.1 Introduction

This chapter presents an over of the noise and vibration impact assessment for the Project and is based on the detailed assessment provided in Annex C. Noise and vibration impacts are described in sections 10.2 through to 10.4 using the assessment methodology described in Chapter 5 and noise and vibration magnitude criteria provided in Annex C. A summary of the results of the impact assessment is also presented below in Table 10-1 for construction (NV1 denoting noise impacts and NV2 vibration impacts as described in Section 10.3) and Table 10-2 for operation (NV3 a denoting noise impacts and NV4 vibration impacts as described in Section 10.3).

and presents a summary of the noise and vibration impacts.

Table 10-1: Noise and Vibration Construction Impact Summary

Impact #	**NV1**	**NV2**
Receptor importance/ sensitivity	High	High
Frequency	Periodic	
Likelihood	Certain	Certain
Extent	Local	Local
Duration	Short to Medium term (at station locations)	Short-term
Magnitude	Medium – Large	Large
Effect	Adverse	Adverse
Direct/ indirect	Direct	Direct
Significance	Moderate – Major	Moderate- Minor
Additional mitigation? (Y/N)	Y	Y
Residual Significance	Minor - Moderate	Minor - Negligible

Table 10-2: Noise Operation Impact Summary

Impact #	**NV3**	**NV4**
Receptor importance/ sensitivity	High	High
Frequency	Periodic- up to 22 trains per 24 hrs	
Likelihood	Certain	Certain
Extent	Local	Local
Duration	Permanent	Permanent
Magnitude	Medium-Small	Very Small
Effect	Adverse	Adverse
Direct/ indirect	Direct	Direct
Significance	Moderate - Major	Minor
Additional mitigation? (Y/N)	N	N

Impact #	NV3	NV4
Residual Significance	Minor - Moderate	Minor

10.2 Direct Construction Impacts

10.2.1 Construction Impact NV1: Noise Impacts from Construction Works

Impact Description

Noise resulting from construction plant associated with construction works and earthworks may impact on sensitive receptors located along the proposed route. The sensitive receptors that have the potential to be affected by noise from construction activities include residential areas, as well as non-residential receptors such as hospitals and schools that are sensitive to noise. Other industrial or commercial receptors are considered to have a lower sensitivity.

The construction activities and durations will vary by route section. Construction will be undertaken 6 days per week (Monday to Saturday) and nominally between the hours of 7.30am and 9.30pm, avoiding major national holidays and festivals. In total construction activities will last for 3 years, however given the linear nature of the project, construction activities will move along the route with workfronts moving on average two to three times a month, with longer construction durations at stations and the heavy rail maintenance facility.

Impact Assessment

The assessment has focussed on residential receptors as the highest sensitivity receptor (High sensitivity). It should be noted that baseline noise levels at all locations sampled as part of the baseline survey exceed both the IFC Noise Level Guidelines (55dBA daytime / 45dBA nighttime) for residential receptors and Ghanaian standards (55dBA daytime / 48dBA nighttime). Given the moving workfronts during construction, this assessment has focused on a number of representative receptor locations.

Broadly, construction activities in each of the proposed rote sections will include:

- Section 1- construction and development of the Port rail lines in the industrial area at Takoradi Port. The remainder of the construction activities in this section comprises the lay down of the standard gauge rails onto the existing dual gauge sleepers already installed between Takoradi Station and Kojokrom. Construction activities are expected to last for a period of one to three weeks.
- Section 2- construction of the 3km Eshiem bypass, relocating the track away from the residential area and closer to the existing industrial facility. Construction is expected to remain in the area for four to six weeks. The exact alignment for the Eshiem bypass has yet to be confirmed, therefore the location of the nearest sensitive receptors is approximate only.
- Sections 3 – comprises upgrade of the existing rail to a twin track standard gauge network, and the construction/upgrade of 4 stations. Construction is expected to remain in the area for four to six weeks. It is expected that the workfronts will move an average of two to three times per month along the track. Construction of the Stations is expected to take longer, on average station construction will take approximately 12 months.
- Section 4 – this section requires upgrade to a twin track standard gauge network and construction of Nsuta and Tarwka Stations and the Heavy Rail Maintenance Facility. The most significant realignment of the existing track will occur at Tarkwa. Construction of Construction at Tarkwa Station and the adjacent Heavy Rail Maintenance Facility is expected to have a total duration of approximately 18 to 20 months.
- Section 5 - the remaining stretch from the north of Tarkwa to the Huni Valley station and is a single line standard gauge track. This stretch contains two main straightening realignments

and construction of 2 stations, with construction durations likely similar to those noted for section 3.

Noise resulting from construction plant associated with construction works and earthworks will generate noise in proximity to noise sensitive receptors (settlements) located along the railway route are summarised in Table 10.3. The construction noise magnitude criteria take into consideration the existing baseline activities with urban areas near main roads and industrial areas able to tolerate a higher noise levels before significant effects are felt. Areas considered rural, suburban or urban located away from main roads or industry have a lower tolerance (see Annex C: Noise Impact Magnitude Criteria).

Table 10.3 NV1 Noise Assessment Results

Receptor Location	Applicable Construction Noise Magnitude Criteria	Predicted Construction Noise (dB $L_{Aeq,T}$)		
		Laying of Track	Track upgrade	Station Construction
Noise levels are colour coded based on resultant effect significance:				
Major	Moderate	Minor	Negligible	Positive

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: N/A
Relevant ESIA GIIP: GPM12 (Construction Working Hours)

Additional Mitigation and Enhancement Measures

Given the temporary nature of the construction activities, it may not be feasible to install source abatement (e.g. the use of cladding/sound barriers) at all locations, however the following additional noise mitigation measures are proposed (Table 10.4):

Table 10.4 Impact NV1 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM#	As part of the land disturbance process, assess the potential for noise and vibration on receptors in the specific locations in order to develop detailed mitigation for impacts at the specific locations. Measures could include but are not limited to micrositing of noisiest activities away from sensitive receptors where practicable, installation of temporary noise barriers between receptors and noise generating activities.
ADM#	A noise and vibration management plan shall be developed which includes the approach to management of noise and vibration at project construction sites including specific measures to be implemented. The noise management plan should identify requirements for noise monitoring of construction noise levels at receptor locations to confirm the effectiveness of measures implemented. The plan shall incorporate feedback mechanisms to improve or manage noise levels where actual effects are different to those predicted.
ADM#	Monitoring of community grievances reported to determine whether noise levels experienced are resulting in disturbance or nuisance to local residents. If grievances are reported, additional noise screening shall be installed (e.g. fencing/hoarding).
ADM#	For long-term construction activities (e.g. station and heavy rail maintenance facility), screening such as fencing, hoarding or earthbund shall be installed around the site, or as a minimum between the sensitive receptors and construction activity locations.
ADM#	Prior to procurement of construction equipment, an evaluation of planned noisy construction activities should be undertaken (e.g. tamping machines, ballast crushers) and for these activities equipment that has the lowest noise level feasible from cost and technology perspective should be selected.

Residual Impact

Taking into consideration the additional embedded mitigation identified, the following residual significant effects are anticipated:

Table 10.5: NV1 Noise Assessment Results

Receptor Location	Track upgrade	Laying of Track	Station Construction
Noise levels are colour coded based on residual effect significance:			
Major	Moderate	Minor	Negligible

10.2.2 Construction Impact NV2: Vibration Impacts from Construction Works

Impact Description

Vibration resulting from construction plant. The sensitive receptors that have the potential to be affected by vibration from construction activities include residential areas, as well as non-residential receptors such as hospitals and schools that are sensitive to vibration. Other industrial or commercial receptors are considered to have a lower sensitivity.

Impact Assessment

Compaction is considered to be the main potential vibration source, primarily associated with construction of stations and the heavy rail maintenance facility. Although construction activities at the station and heavy rail maintenance facility will occur over medium term durations (12 months for most stations, 18-20 months for the Tarkwa Station and Heavy Rail Maintenance Facility), compaction activities during construction will be of a much short duration during this period. Following topsoil stripping, areas requiring compaction will be defined and the areas marked to avoid unnecessary soil compaction by vibratory rollers.

Groundborne vibrations travel through soil, and different types of soil have different properties and transmission loss of vibrations. Soil properties are dependent on the nature of the parent rock from which the soil is derived, and indirectly dependent on geology through its influence on relief. The geology in the area is predominantly sandstone, the properties of which reduce the propagation of vibration as it travels through the ground with sandy soils having higher vibration transmission losses that other soils as distance from the source increases[1].

Vibration levels arising from vibratory compaction have been calculated based on BS5228:2014 which gives an equation for the empirical predictors for groundborne vibration (Table 10.6).

Table 10.6: NV2 Construction Vibration Impacts

Receptor	Predicted Construction Vibration (mms^{-1})	Impact Magnitude	Effect Significance
Residents of Amantin			
Residents of Benso			
Residents of Esuaso			
Residents of Bonsawire (east)			
Residents of Nsuta			
Residents of Tarkwa			
Residents of Bompieso			
Residents of Huni Valley			

[1] Astrauskas, T. and Grubliauskas, R. (2017) Modelling of Ground Borne Vibration Induced by Road Transport, Environmental Protection Engineering, 9 (4), p.376-380 https://www.researchgate.net/publication/320202266_Modelling_of_Ground_Borne_Vibration_Induced_by_Road_Transport accessed 27/10/20

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: N/A
Relevant ESIA GIIP: GPM14 (definition of compaction areas)

Additional Mitigation and Enhancement Measures

The vibration levels experienced at receptor locations are dependent on the ground conditions. Given the short-term, temporary nature of the compaction activities it may not be feasible to install abatement measures. Given the potential for significant adverse impacts, the following additional noise mitigation measures are proposed (Table 10.7):

Table 10.7: Impact NV2 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM#	Monitoring of community grievances reported to determine whether vibration levels experienced are resulting in disturbance or nuisance to local residents. If grievances are reported, a review of activities shall be undertaken to consider potential measures to reduce vibration impacts, such as: • Scheduling of compaction activities to limit the amount of disturbance in vibration sensitive areas at times that are considered of greatest sensitivity. • If compaction activities are being undertaken alongside other construction activities which themselves generate vibration, determine if it is possible to phase the work programme to avoid unacceptable levels of disturbance.
ADM#	Prior to procurement of construction equipment, undertake an evaluation to determine the most appropriate compaction equipment, considering ground conditions, cost and technological feasibility.
ADM#	A noise and vibration management plan shall be developed which includes the approach to management of noise and vibration at project construction sites including specific measures to be implemented.

Residual Impact

Taking into consideration the above additional mitigation measures, the residual effect at the sensitive receptor locations is summarised in Table 10.8.

Table 10.8: NV2 Construction Vibration Residual Effect

Receptor	Residual Effect Significance
Residents of Amantin	
Residents of Benso	
Residents of Esuaso	
Residents of Bonsawire (east)	
Residents of Nsuta	
Residents of Tarkwa	
Residents of Bompieso	

Receptor	Residual Effect Significance
Residents of Huni Valley	

10.3 Direct Operational Impacts

10.3.1 Operational Impact NV3: Noise Impacts from Operational Activities

Impact Description

Operational impacts due to noise from proposed railway. The receptors that have the potential to be affected by noise from the operation of the railway include residential areas, as well as non-residential receptors such as hospitals and schools that are particularly sensitive to noise. Other industrial and commercial receptors are considered to be of lower sensitivity.

Impact Assessment

The impact significance is based on the noise from the Project activities. In order to establish this change it is necessary to calculate the noise from the railway and the existing baseline noise levels at receptors. The calculations of the railway noise have been based on the 6 passenger trains per day operating with 12 cars and 16 freight trains with 32 wagons operating at peak travelling at its full speed (160 km/h). In reality, the railway will operate at slower speeds, with passenger trains operating at 120km/hr with some sections restricted to 110km/hr and freight trains operating at speeds of 80-100km/hr. Trains will operate at reduced speeds approaching and leaving stations, and will reduce speed around corners as part of its normal operation. Operating at these slower speeds will produce noise levels lower than those used in this assessment. Figure 10.1 presents the operational noise contour, showing the predicted noise daytime noise level and Figure 10.2 the nighttime noise level.

Figure 10.1: Operational Noise Contour Day

Figure 10.2: Operational Noise Contour Night

It should also be noted that a large stretch of the existing railway is operational, with freight trains transporting material from the mining operations near Nsuta to Takoradi. Peak freight movements are currently up to 16 trains per day. Currently passenger trains only operate between Takoradi and Kojokrom on alternate days. The increase in noise compared to the baseline experienced by residents as a result of the upgraded railway operations in these areas is therefore likely to be lower than that predicted.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM11 (alignment developed using the existing rail line as far as practicable)
Relevant ESIA GIIP: N/A

As evidenced in Figure 10.1 and Figure 10.2, significant effects (effects of moderate and major significance) are predicted at a number of receptor locations along the proposed route as a result of operational train movements.

Additional Mitigation and Enhancement Measures

In order to reduce the significance at receptor locations where Major and Moderate effects have been identified the following mitigation measures are proposed:

Table 10.9: Impact NV3 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM#	A noise and vibration management plan shall be developed which includes the approach to management of noise and vibration at project construction sites including specific measures to be implemented.
ADM#	Monitoring of community grievances reported to determine whether noise levels experienced are resulting in disturbance or nuisance to local residents. If grievances are reported, additional noise screening shall be installed (e.g. noise barriers/ fencing/hoarding).
ADM#	Screening such as noise barriers/fencing, hoarding or earthbund shall be installed between the sensitive receptors and permanent RoW in areas where significant (Moderate/Major) effects are predicted.

Residual Impact

Following the implementation of the additional mitigation measures, residual effects shall be reduced as follows:

Table 10.10: NV3 Operational Noise Residual Effect

Receptor	Residual Effect Significance

Receptor	Residual Effect Significance

10.3.2 Operational Impact NV3: Vibration Impacts from Operational Activities

Impact Description

The sensitive receptors that have the potential to be affected by vibration from train operations include residential areas, as well as non-residential receptors such as hospitals and schools that are sensitive to vibration. Other industrial or commercial receptors are considered to have a lower sensitivity.

Impact Assessment

Noise sources associated with train operations include rolling noise generated by the contact between wheel and rail during normal movement and braking and aerodynamic noise generated by the train pushing air.

The calculations of vibration from trains have been based on the 6 passenger trains per day operating with 12 cars and 16 freight trains with 32 wagons operating at peak travelling at its full speed (160 km/h). In reality, the railway will operate at slower speeds, with passenger trains operating at 120km/hr with some sections restricted to 110km/hr and freight trains operating at speeds of 80-100km/hr. Trains will operate at reduced speeds approaching and leaving stations, and will reduce speed around corners as part of its normal operation. Operating at these slower speeds will produce vibration levels lower than those predicted in this assessment.

A large stretch of the existing railway is currently operational, with up to 16 freight trains transporting material from the mining operations near Nsuta to Takoradi at peak. Currently passenger trains only operate between Takoradi and Kojokrom on alternate days. The increase in vibration compared to the baseline experienced by residents as a result of the upgraded railway operations in these areas is therefore likely to be lower than that predicted.

The geology in the area is predominantly sandstone, the properties of which reduce the propagation of vibration as it travels through the ground through transmission loss.

Operation impacts from vibration at sensitive receptor locations are summarised in Table 10.11.

Table 10.11: NV4 Operation Vibration Impacts

Receptor	Predicted Operation Vibration (mms^{-1})	Impact Magnitude	Effect Significance

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: N/A
Relevant ESIA GIIP: N/A

Additional Mitigation and Enhancement Measures

The vibration levels experienced at receptor locations are dependent on the ground conditions. Geology in the area is predominantly sandstone, which does not promote propagation of groundborne vibration. The following additional mitigation measures are proposed to reduce vibration impacts:

Table 10.12: Impact NV4 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM#	An operational maintenance and inspection regime shall be developed which should specify the minimum frequency of maintenance checks and inspections including track inspections and locomotive maintenance to reduce the roughness of running surfaces
ADM#	A noise and vibration management plan shall be developed which includes the approach to management of noise and vibration during project operation including specific measures to be implemented.

Residual Impact

Taking into consideration the above additional mitigation measures, the residual effect at the sensitive receptor locations is summarised in Table 10.8.

Table 10-13 NV4 Operational Vibration Residual Effect

Receptor	Residual Effect Significance
Residents of Amantin	
Residents of Benso	
Residents of Esuaso	
Residents of Bonsawire (east)	
Residents of Nsuta	
Residents of Tarkwa	
Residents of Bompieso	
Residents of Huni Valley	

10.4 Indirect Impacts

HOLD - Vibration impacts on cultural heritage – TBC – monitoring of community grievances

11. SOILS, GEOLOGY, TOPOGRAPHY AND LANDSCAPE IMPACT ASSESSMENT

11.1 Introduction

Impacts introduced by the scheme that may affect the receptors identified in the previous section are summarised below. Each impact is given an impact code (e.g. SG1, SG2, etc.) for ease of reference; sub codes (e.g. 'a', 'b' etc.) are used for each receptor or activity potentially affected by that impact. The impact assessment for each impact is summarised in Table 4.1 for construction and Table 4.2 for operation.

Construction impacts:

SG1: Construction of railway infrastructure - excavation and removal of soils along the route, degradation of soils. Permanent works all anticipated to be contained within the permanent RoW, approximately 30m either side of the centre line within the 50m width area of influence along the route.

a. Agricultural and forest soils in Section 3, 4, and 5 beneath new sections of track and new infrastructure.
b. Soils within the existing rail route alignment in Sections 1-5.
c. Soils within Section 1 and 2 urban area – new sections of track and new infrastructure.

SG2: Temporary construction infrastructure may result in compaction of soils of areas used for temporary facilities, potential for low level contamination as a result of spills during construction activities and excavation and removal of soil associated with borrow pit construction and usage:

a. Compaction and contamination from spills in land used for construction camps and laydown areas.
b. Excavation and removal of soils associated with borrow pit usage.

SG3: Impacts to topography due to construction activities

a. Sections 1-5 (excluding main realignments at Tarkwa)
b. Tarkwa realignment

SG4: Impacts to landscape due to construction activities

a. Landscape (topographic highs, unscreened residential viewpoints), primarily residential areas in Nsuta and Tarkwa.
b. Landscape (screened residential viewpoints, mining/industrial topographic highs), residential receptors located along the majority of the route with the exception of those in Nsuta and Tarkwa.

SG5: Construction of railway infrastructure - permanent occupation of land. Anticipated to include the right of way for the railway extending 30m either side of the centre line plus additional footprint areas for facilities such as stations and maintenance facilities.

a. Mineral resources in Sections 3, 4 and 5.
b. Potential for mineral resources in Sections 1 and 2.

Operational impacts:

SG6: Impacts to landscape from operation of Project facilities

a. Landscape (topographic highs, unscreened residential viewpoints), primarily residential areas in Nsuta and Tarkwa.

b. Landscape (screened residential viewpoints, mining/industrial topographic highs), residential receptors located along the majority of the route with the exception of those in Nsuta and Tarkwa.

SG7: Potential contamination due to spills during operation of the railway

a. Agricultural and forest soils

b. Urban soils

Table 11.1: Soils, Geology, Topography and Landscape Construction Impact Summary

Impact #	SG1 a	SG1 b	SG1 c	SG2 a	SG2 b	SG3 a	SG3 b	SG4a	SG4b	SG5a	SG5b
Receptor importance/ sensitivity	Medium	Low	Low	Medium-Low	Medium-Low	Medium	Medium	Low	Medium	High	Low
Frequency	Constant			Constant		Single event		Infrequent		Constant	
Likelihood	Certain			Likely	Certain	Certain		Certain		Certain	
Extent	Local, area >100ha affected. Large change from baseline condition	Local, area >100ha affected. Small change in comparison to baseline condition		Local		Local, minimal changes to topography	Local, small changes to topography associated with realignment sections	Local, no impact to landscape in Section 1&2 (exc. Eshiem), small changes around Eshiem and Section 3-5	Local, moderate change to landscape associated with Nsuta and Tarkwa realignment and RMF	Local, no change to integrity or viability of underlying mineral resources	
Duration	Construction area - Short Term Permanent RoW- Long Term			Short term	Medium term	Permanent		Short Term	Short Term	Short Term	
Magnitude	Large	Medium	Medium	Very Small	Small	Very Small	Small	Very Small	Small	Very Small	
Effect	Adverse			Adverse		Adverse	Adverse	Adverse		Adverse	
Direct/ indirect	Direct			Direct		Direct	Direct	Direct		Direct	
Significance	Moderate	Minor	Minor	Negligible	Minor - Negligible	Negligible	Minor	Minor - Negligible	Minor	Minor	Negligible
Additional mitigation? (Y/N)	Yes – closure and rehabilitation/restoration plans			No		No		No		No	
Residual Significance	Minor	Negligible	Negligible	Negligible	Minor - Negligible	Negligible	Minor	Minor - Negligible	Minor	Minor	Negligible

Table 11.2: Soils, Geology, Topography and Landscape Operation Impact Summary

Impact #	SG6a	SG6b	SG7
Receptor importance/ sensitivity	Low-Medium	Low-Medium	Medium
Frequency	Constant railway presence, periodic train movements		Intermittent
Likelihood	Certain		Possible
Extent	Local		Local
Duration	Medium-Long Term		Single events
Magnitude	Small	Medium	Very Small
Effect	Adverse		Degradation of soils
Direct/ indirect	Direct		Direct
Significance	Minor - Negligible	Moderate	Negligible
Additional mitigation? (Y/N)	Yes – planting of vegetation		N
Residual Significance	Negligible	Minor	Negligible

11.2 Direct Construction Impacts

11.2.1 SG1: Soil Degradation from Construction Activities

Impact Description

Construction of permanent railway infrastructure will involve excavation and removal of soils along the route as well as import of ballast material to form suitable development platform. This will degrade the soils and reduce potential for affected soils to sustain agriculture or forests in the future.

Impact Assessment

The impact is discussed below in relation to the relevant receptors identified.

a. Section 3, 4, 5 soils – new sections of track and new infrastructure: Soils in the proposed new sections of track and additional land required for new infrastructure such as stations are capable of supporting essential farmland for local peoples and also supporting forests and forest reserves.

   The impact will be permanent and irreversible and will remove these areas of farmland and forests from existing use. The area of land affected will include all new areas of track and all new land required for new facilities and infrastructure. The effect will not extend beyond the boundary of the land required for construction. Areas not located under the physical footprint of the rail will be restored following construction activities with areas outside the permanent RoW returned back to original ownership following construction activities, with impacts in these locations temporary only. The design life of the project is 50 years, with areas under the physical footprint within the permanent RoW unavailable for use during this time. The impact magnitude is considered Medium.

b. Soils within existing active and disused rail route alignment (Sections 1-5): Soil quality along the existing route will already be degraded due to previous development as a railway.

   The impact will be permanent and irreversible; however soils are likely to be degraded to already due to previous development. The effect will not extend beyond the boundary of the land required for construction. The impact magnitude is considered to be Medium.

c. Section 1 and 2 soils – new sections of track and new infrastructure: There will be a limited area of additional land included within the scheme for track upgrade and additional infrastructure including stations. Section 1 and the southern area of section 2 including the new track at Eshiem are within urban development areas and areas already cleared of forest or agriculture (based on Google Earth images). Soils are likely to be predominantly made ground relating to existing rail infrastructure and urban development. Soils may be contaminated from historical use of the existing railway and local industrial facilities. The impact will be permanent and irreversible, however soils are likely to be degraded to already due to previous development. The effect will not extend beyond the boundary of the land required for construction. Taking into consideration the embedded mitigations identified, the impact magnitude is considered Medium.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: PDM6 – The proposed route will use the existing rail line and permanent RoW as far as practicable.
Relevant ESIA GIIP: GPM15 (stockpile management), **GPM16** (stockpile design), **GPM17** (topsoil stripping), **GPM18** (contaminants), **GPM24** Spill Response Plan

In areas following the existing route alignment and urban areas, there is a potential for a beneficial effect in any areas affected by contamination. The significance of the effect on soils in sections 3-5 is considered to be ***Moderate*** under the permanent RoW and ***Minor*** for the construction areas, with effects along the existing alignment and within Sections 1 and 2 considered to be ***Minor***.

Additional Mitigation and Enhancement Measures

The design life of the project is 50 years, with areas under the permanent RoW unavailable for use during this time. Responsibility for decommissioning of the railway and permanent infrastructure does not lie with Amandi as the construction contractor. Given the length project life, details of decommissioning and rehabilitation of the permanent RoW are not known at this time. It is anticipated that GRDA or the responsible authority will develop closure and rehabilitation plans prior to decommissioning of the permanent infrastructure.

Table 11.3: Impact SG1 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM33	The GRDA, or other responsible party, shall develop decommissioning plans for (i) the decommissioning of existing lines following completion of construction of the standard gauge line and (ii) decommissioning of the Project at the end of the Project operational life. These plans shall include measures related to the rehabilitation of soils within the permanent RoW. Temporary areas required for construction shall be returned to original ownership following completion of construction.

Residual Impact

Following implementation of rehabilitation measures as part of closure plans, it is anticipated that recovery of soils will be possible in the short to medium term. As a result, the residual significance is considered to be ***Minor to Negligible.***

11.2.2 SG2: Soil Degradation from Temporary Construction Facilities

Impact Description

Construction of use of temporary facilities required for construction such as the central construction camps, laydown areas, and of borrow pits will involve compaction of soils under temporary camp and laydown areas and excavation and removal of soils at borrow pit locations. This will degrade the soils and reduce potential for affected soils to sustain agriculture or forests in the future.

Impact Assessment

The impact is discussed below in relation to the relevant receptors and activities identified.

a. Temporary laydown and central construction camp locations – construction activities and temporary facilities have the potential to result in compaction of soils located within the construction temporary RoW. Construction activities in these areas may also result in small spills and localised contamination. Spills will be managed through the implantation of a spill response plan to avoid long term contamination. Soil compaction is likely to result in a temporary reduction in the ability of soils in these areas to support essential farmland for local peoples, forests and forest reserves. The effect will not extend beyond the temporary RoW and laydown areas. As a result the impact magnitude is considered to be Very Small.

b. Borrow pit construction and usage: The number and extent of borrow pits is currently unknown, however it is assumed borrow pits will be located within the permanent RoW. Excavation will result in removal of soils in the area impacting on the ability of these areas to sustain forestry or agriculture on a long term basis. A Borrow Pit Management Plan will be developed which shall include measures related to the selection of sites, site preparation, operation and closure including site restoration. Taking into consideration the embedded mitigation measures, the magnitude of this impact is anticipated to be Small.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: PDM7 (road rehabilitation), **PDM10** (concrete batching design) **PDM11** (temporary site shipping containers)**, PDM6** (The proposed route will use the existing rail line and permanent RoW as far as practicable).
Relevant ESIA GIIP: GPM10 Borrow Pit Management Plan, **GPM11** (Method Statements), **GPM15** (stockpile management), **GPM16** (stockpile design), **GPM17** (topsoil stripping), **GPM24** Spill Response Plan

Soils in Sections 1 and 2 of the route are considered to be of Low sensitivity given the urban nature and potential for contamination. Sections 3-5 are considered to be of Medium sensitivity. When considered alongside the embedded mitigation measures, the significance of the effect is considered to be ***Negligible*** as a result of temporary laydown and construction camp activities and ***Minor-Negligible*** as a result of borrow pit usage.

Additional Mitigation and Enhancement Measures

As the significance of the effects is considered to be Minor to Negligible no additional mitigation measures would typically be required however this assessment is tied to the assumption that all borrow pits would be located within the permanent RoW. Following the precautionary principle it is proposed than an assessment of resources required for construction be undertaken. This should include consideration of the need for new laterite during construction or whether other suitable materials could be located (e.g. use of waste fraction from mining or excavations) reducing the volume of materials required from borrow pits and thereby the potential impact and resultant effects of borrow pit construction and usage.

Table 11.4: Impact SG1 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM74	An assessment of resources required for construction must be undertaken prior to construction. This shall include consideration of the need for new laterite during construction or whether other suitable materials could be located (e.g. use of waste fraction from mining or excavations) reducing the volume of materials required from borrow pits and thereby the potential impact and resultant effects of borrow pit construction and usage.

Residual Impact

On the basis that all borrow pits are located within the permanent RoW the residual significance of the effect remains ***Minor to Negligible***.

11.2.3 SG3: Change to Topography due to Construction Activities

Impact Description

Topographical changes in the Project AoI will occur due to site levelling and earthworks. Aggregate material will be sourced from existing quarries, however, some construction materials (laterite) may be sourced from borrow pits within the Project AoI located within the RoW. The exact location, number and dimensions of these borrow pits will be determined prior to construction. Site levelling and clearance will be completed, and all borrow areas recontoured and rehabilitated prior to operation. Impacts on views from the construction of station buildings, and changes to the railway alignment are considered under landscape. Topographical changes during operation have therefore been scoped out of further assessment.

Impact Assessment

Any change to topography will be of short duration (less than 5 years) with the exception of changes associated with permanent earthworks for operational facilities and route realignment. The level of permanent earthworks varies by route section, directly linked to the level of route realignment. New stations will also be constructed along the route however these are generally located close to the existing towns in relatively flat areas:

a) From Takoradi Port to Takoradi, the Project involves on a change of gauge, from narrow to standard gauge, with no changes to routing. The realignment of the route at Eshiem is located within a relatively flat section. There may be some imperceptible to very minor topographic changes during construction, to enable construction equipment to access the site in this section and to enable the realignment at Eshiem. The impact magnitude in this section is therefore considered to be Very Small.

   From Manso to south of Nsuta and from north of Tarkwa to the Huni Valley, the majority of the route follows the existing alignment with some small areas of realignment, where limited topographic changes may occur. Outside of these realigned sections, very minor topographic changes may occur during construction, to enable construction equipment to access the site in this section. The impact magnitude in this section is therefore considered to be Very Small.

   The section of track realignment to the south of Nsuta is located near the operating manganese mine. Again, the realignment is located within a relatively flat area, therefore topographic changes associated with the construction will be relatively limited however will require some levelling of the proposed route in this section. The impact magnitude in this section is therefore considered to be Very Small.

b) The most significant sections of track realignment occur near Nusta and Tarkwa. At Tarkwa there will be a significant realignment of route section, moving the route to the east of the residential area. The realigned route is located within a relatively flat area, therefore topographic changes due to levelling of the route will be limited, and the impact magnitude is considered to be Small.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: PDM6 (The proposed route will use the existing rail line and permanent RoW as far as practicable)
Relevant ESIA GIIP: GPM10 (borrow pit management plan), **GPM11** (method statements)

The overall significance of effects on topography are considered to be ***Negligible*** for route sections from Takoradi to Manso (Eshiem realignment), Manso to south of Nsuta and from north of Tarkwa to the Huni Valley (SG4a) and ***Minor*** for the section from Nsuta to Tarkwa (SG4b).

Additional Mitigation and Enhancement Measures

As the significance of the effects is considered to be Minor to Negligible no additional mitigation measures are proposed.

Residual Impact

Residual significance of effects to topography remains ***Minor to Negligible***.

11.2.4 SG4: Impacts to Landscape due to Construction Activities

Impact Description

The construction phase will be characterised by loss of vegetation cover, the presence of construction equipment, vehicle movements and associated construction/development activities. The worst-case landscape impacts during construction will therefore be during the peak construction period. As a linear project, construction will occur in phases moving along the length of the route with impacts at any single location lasting only for a short duration, with construction work fronts typically moving every 2-3 months.

Impact Assessment

Construction will occur in phases with work fronts moving along the length of the route, therefore construction impacts at any single location will be of short duration only. The magnitude of impacts to landscape will vary along the length of the route based on the project design:

a) From Takoradi Port to Takoradi, the Project involves a change of gauge, from narrow to standard gauge, with no changes to routing only, with no impacts to landscape anticipated. The Eshiem bypass involves realignment of a short (c. 3km) stretch of track away from the settlement at Eshiem closer to the industrial facility. The area is predominantly urban. With limited clearance of vegetation required to enable construction equipment to access the site, with construction equipment present to complete the change of gauge. In this route section, impact magnitude is considered to be Very Small.

   From Manso to south of Nsuta and from north of Tarkwa to the Huni Valley, the majority of the route follows the existing alignment with some small areas of realignment. Vegetation clearance, increasing visibility of the railway to allow construction equipment to access the site and construction activities to occur will be necessary, alongside the presence of construction equipment. In addition to rehabilitation of the existing railway and realignment sections, construction activities will also occur at station locations adjacent to the railway and at locations identified for temporary construction camps and other supporting infrastructure. Construction camps will move as the work fronts progress along the route. As a result, impact magnitude is considered to be Small.

b) The route section from south of Nsuta to north of Tarkwa includes the most substantial changes from the existing route alignment. At Tarkwa, the route will be moved to the east of the residential area and the heavy rail maintenance facility constructed. The realigned route is located within a relatively flat area, adjacent to the residential area. To the west, the Gold Fields Tarkwa mine represents the local topographic high, beyond which views of the route will be obscured. To the east, a forested undulating landscape exists obscuring long range views of the site.

   The realigned section to the south of Nsuta is located near the operational manganese mine. The landscape to the east is industrial mining, and to the west is residential. The realignment moves the rail closer to the residential area. To the east the topographic high is represented by the manganese mine, which obscures long range views. Beyond the residential area to the east, continuation of the undulating hills also obscures the long range views. Construction activities will be of limited duration.

The impact is anticipated to be of a Small magnitude.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: PDM3 (siting), **PDM6** (The proposed route will use the existing rail line and permanent RoW as far as practicable).
Relevant ESIA GIIP: GPM10 (borrow pit management plan), **GPM11** (Method Statements), **GPM16** (stockpile design)

The overall significance of effects on landscape are considered to be ***Negligible*** for route sections from Takoradi Port to Takoradi, and ***Minor*** for the Eshiem bypass, and route from Manso to Huni Valley during construction.

Additional Mitigation and Enhancement Measures

As the significance of the effects is considered to be Minor to Negligible no additional mitigation measures are proposed.

Residual Impact

Residual significance of effects to topography remains ***Minor to Negligible***.

11.2.5 SG5: Mineral Resource Sterilisation

Impact Description

Construction of railway infrastructure has the potential to result in sterilisation (i.e. prevention of future extraction) of any mineral resources within the boundary of the scheme.

Impact Assessment

The impact is discussed below in relation to the relevant receptors identified.

a. Mineral resources, mining concessions Sections 3, 4, 5: Manso to Huni Valley. The route runs through several mining concession areas. The route is likely to run through areas of mineral resources not yet exploited. The presence of the existing railway line currently prevents access to the underlying mineral resources. The Project permanent RoW will continue to prevent access to any underlying mineral resources. The permanent RoW for the scheme comprises a narrow strip of land with slightly greater areas for stations and associated infrastructure. Although the presence of the railway and associated infrastructure will prevent access to the underlying mineral resources, the railway will not affect the integrity of the resources which remain present in situ, and could be exploited at the end of the Project lifetime following decommissioning. The impact magnitude is therefore considered to be Very Small.

b. Mineral resource potential in Section 1 and 2: The route is currently existing railway land. Additional land required for any route upgrade, stations and maintenance facilities in this area will be limited, primarily associated with the 3km Eshiem bypass. No mineral resources or concessions were identified in this area and any resource in this area is already sterilised due to existing infrastructure and the urban environment through which this section passes. The impact magnitude is therefore considered Very Small.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: PDM6 (The proposed route will use the existing rail line and permanent RoW as far as practicable.)
Relevant ESIA GIIP: N/A

Taking into consideration the receptor sensitivity (High for sections 3-5 and Low for sections 1 and 2), the significance of the effect is considered to be ***Minor*** for sections 3-5 and ***Negligible*** for sections 1 and 2.

Additional Mitigation and Enhancement Measures

As the significance of the effects is considered to be Minor to Negligible no additional mitigation measures are proposed.

Residual Impact

Residual significance of effects to topography remains ***Minor to Negligible***.

11.3 Direct Operational Impacts

11.3.1 SG6 Operational Impact to Landscape

Impact Description

The impacts to landscape can be broadly categorised as those associated with the railway operation and railway infrastructure including the new stations.

Impacts from the presence of the new stations and realigned track sections will be a permanent long term impact, whilst rehabilitation of the existing railway line will result in limited change from the baseline conditions for most receptors following regrowth of vegetation.

The railway line represents a permanent linear feature on the landscape during operation alongside associated infrastructure including stations. The upgrade of the railway will enable an increase in the number of trains passing along the route and the speed at which the trains will travel. The train movements will be periodic and short term as they travel along the length of the route therefore the impact as a result of the presence of the permanent features on the landscape is considered to be the worst-case landscape impact.

Impact Assessment

From Takoradi to Takoradi Port, the Project involves only a change of gauge, from narrow to standard gauge, with no changes to routing. The impact magnitude for this route section is therefore considered to be Very Small. Realignment of a 3km stretch of track at the Eshiem bypass will move the railway further from the town, and closer to the existing industrial facility, resulting in a Small magnitude impact.

From Manso to south of Nsuta and from north of Tarkwa to the Huni Valley, the majority of the route follows the existing alignment with some small areas of realignment. Vegetation is likely to return in the short to medium term, reducing views of the railway from many receptor locations along the route. New stations will represent a permanent change to the views from the residential areas where they are located. The stations will be located close to existing residential areas, in terms of views from topographic highs, these will represent a small change compared to baseline conditions. As a result, the impact magnitude for these sections is considered to be Small.

The route section from south of Nsuta to north of Tarkwa includes the most substantial changes from the existing route alignment and presence and operation of the heavy maintenance facility at Tarkwa. Although vegetation may regrow and obscure views of the railway from long-range viewpoints on topographic highs, the realignment of these sections, the new stations and heavy rail maintenance facility will be a permanent impact, with a larger impact on views from the residential communities in these areas. The impact is therefore considered to be of Medium magnitude on residential receptors in these areas and Small magnitude on topographic highs.

The frequency of train movements along the route will increase from the baseline conditions, representing a very short term, period impact on landscape views.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: PDM6 (The proposed route will use the existing rail line and permanent RoW as far as practicable)
Relevant ESIA GIIP: N/A

The overall significance of effects on landscape are considered to be ***Minor*** for route sections from Takoradi to Manso, Manso to south of Nsuta and from north of Tarkwa to the Huni Valley (SG6a) and ***Minor to Moderate*** for the section from Nsuta to Tarkwa during construction (SG6b).

Additional Mitigation and Enhancement Measures

Table 11.5: Impact SG6 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM75	Vegetation shall be planted to obscure direct views of the heavy maintenance facility and other permanent facilities where necessary.

Residual Impact

Residual significance of effects on landscape remains Minor for route sections from Takoradi to south of Nsuta and north of Tarkwa to Huni Valley. Following application of the additional mitigation measures above, the residual significance of effects on landscape from Nsuta to Takoradi is considered to be ***Moderate*** during the first two years of operation, reducing to ***Minor*** after the regrowth of vegetation.

11.3.2 SG7: Soil Degradation from Spills during Operational Activities

Impact Description

Potential contaminant release to ground during operation resulting in degradation of soils and potential risks to the environment and human health.

Impact Assessment

The operation of the railway will require use of fuels and other potentially contaminative substances which may be toxic and mobile within the environment. There is a potential for release of contaminants to ground which would have an impact on soils and an indirect impact on human health and the local environment. Embedded mitigations include the development of a Hazardous Materials Management Plan, Standard Operating Procedures and Spill Response Plan which will reduce the potential for the occurrence of spills and reduce the impact of any resultant spills. Taking into consideration these embedded mitigation measures, the impact magnitude is considered to be Very Small.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: PDM23 (bunding), **PDM24** (fuel storage - USTs)**, PDM25** (fuel storage ASTs)
Relevant ESIA GIIP: GPM23 (Hazardous Materials Management Plan), **GPM24** (Spill Response), **GPM27** (Asbestos Management Plan), **GPM28** (Standard Operating Procedures for chemical use), **GPM24** (Spill Response Plan), **GPM37** (Occupational Health and Safety Management Plan), GPM47 (Waste Management Plan)

Soils in Sections 1 and 2 of the route are considered to be of Low sensitivity given the urban nature and potential for contamination. Sections 3-5 are considered to be of Medium sensitivity. When considered alongside the embedded mitigation measures, the significance of the effect is considered to be ***Negligible***.

Additional Mitigation and Enhancement Measures

As the significance of the effects is considered to be Negligible no additional mitigation measures are proposed.

Residual Impact

Residual significance of effects to topography remains ***Negligible***.

11.4 Indirect Impacts

The operation of the railway will require use of fuels and other potentially contaminative substances which may be toxic and mobile within the environment. There is a potential for release of contaminants to ground which would have an impact on soils and an indirect impact on human health and the local environment.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: N/A
Relevant ESIA GIIP: GPM23 (Hazardous Materials Management Plan), **GPM24** (Spill Response), **GPM27** (Asbestos Management Plan), **GPM28** (Standard Operating Procedures for chemical use), **GPM37** (OHS Management Plan), GPM47 (Waste Management Plan)

Although potential release of ground contaminants has the potential to result in indirect impacts on human health, taking into consideration the embedded mitigation measures identified, the impact is considered to be Negligible and no further mitigation measures are required.

12. WATER IMPACT ASSESSMENT

12.1 Introduction

This chapter presents an overview of the water impact assessment for the Project and is based on the detailed assessment provided in Annex E. Water impacts are described in sections 12.2 through to 12.3 using the assessment methodology described in Chapter 5 and water magnitude criteria provided in Annex E. A summary of the results of the impact assessment is also presented below in Table 4.1 for construction (impacts WQ1-WQ8 as described in Section 12.2) and Table 4.2 for operation (impact WQ9-WQ12 as described in Section 12.3).

Table 4.1: Water Construction Impact Summary

Impact #	**WQ1**	**WQ2A**	**WQ2B**	**WQ3**	**WQ4A**	**WQ4B**	**WQ5**	**WQ6**	**WQ7A**	**WQ7B**	**WQ8**
Receptor importance/ sensitivity	High	High	Medium	Medium	High	Medium	Medium	Medium	High	Medium	Medium
Frequency	Constant	Periodic	Periodic	Periodic	Periodic	Periodic	Periodic	Periodic	Periodic	Periodic	Periodic
Likelihood	Likely	Likely	Likely	Likely	Likely	Likely	Likely	Likely	Unlikely	Unlikely	Likely
Extent	Local	Local	Local	Local	Local	Local	Local	Local	Local	Local	Local
Duration	Short-Medium term	Short term	Short term	Short-medium term	Short-term	Short – medium term	Short term	Medium term	Short term	Short term	Short-term
Magnitude	Small - Medium	Small	Small	Medium	Small	Small-medium	Small	Medium	Very Small	Small	Small
Effect	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct
Significance	Moderate - Major	Moderate	Minor	Minor - Moderate	Moderate	Minor - Moderate	Minor	Moderate	Minor	Minor	Minor
Additional mitigation? (Y/N)	Y	Y	N	Y	Y	Y	N	Y	Y	N	N
Residual Significance	Minor - Moderate	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor

Table 4.2: Water Operation Impact Summary

Impact #	WQ9	WQ10	WQ11	WQ12
Receptor importance/ sensitivity	High	Medium	High	High
Frequency	Constant	Periodic	Periodic	Constant
Likelihood	Certain	Likely	Likely	Likely
Extent	Local	Local	Local	Local
Duration	Permanent	Short-term	Short-term	Long-term
Magnitude	Medium	Medium	Small	Small
Effect	Adverse	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct	Indirect
Significance	Major	Moderate	Moderate	Moderate
Additional mitigation? (Y/N)	Y	Y	Y	Y
Residual Significance	Minor	Minor	Minor	Minor

12.2 Direct Construction Impacts

Impacts introduced by the scheme that may affect the receptors identified in the previous section are summarised below. Each impact is given an impact code (e.g. WQ1, WQ2, etc.) for ease of reference; sub codes (e.g. 'a', 'b' etc.) are used for each receptor or activity potentially affected by that impact. The impact assessment for each impact is summarised in Table E4.1 for construction and Table E4.2 for operation.

12.2.1 Construction Impact CODE WQ1

Borrow pit excavation

Excavation of borrow pits can impact on groundwater quantity and quality through instruction of pollutants to the aquifer, leaching, and dewatering for extraction. Approximate depths of aquifer types suggest aquifer depths to be from 9m below ground. The exact design, quantity and location of borrow pits is currently unknown, therefore an assessment of potential impact has been made using a worst case scenario, where few borrow pits are excavated but for a longer period of time (2 to 3 years) to support the whole of construction. Typically, these type of borrow pits would be expanded (depth and surface area) throughout construction with progressive backfilling of cells with inert fill and final restoration completed at the end of the construction period.

Siting of the borrow pits is expected to be undertaken based on geology and avoidance of sensitive receptors (e.g. communities, surface water courses, critical habitat). It is therefore assumed that impacts to surface waters would be primarily through any run-off or discharge from dewatering. These impacts are covered under impact WQ4.

Impacts to groundwater, and in particular underlying aquifers, increase where the depth of the borrow pit lies in close proximity to, level or below the top of the aquifer. As the exact depth of the borrow pits is not yet defined, a precautionary approach to the assessment assumes excavations to this level. Embedded mitigation exists to prevent excavation below the water table, however the mechanism for achieving this is not defined and, given the general reliance on groundwater for water supply, the direct impacts on aquifers from this type of construction activity needs to be carefully considered.

Where excavations breach the aquifer or are at a depth to allow free movement of water upwards and downwards into the aquifer, dewatering may be required, which will reduce aquifer capacity for the duration of the excavation and use.

In addition, excavation can mobilise metals and other pollutants within the soils and geological structure, allowing them to leach into the underlying aquifer and potentially reducing resource viability at least in the short to medium term. In particular, there is the potential for Acid Mine or Acid Rock Drainage (AMD or ARD) where minerals containing sulphide or elemental sulphur are exposed.

Impact Assessment

Groundwater aquifers are considered to be high sensitivity. Once the borrow pit has been opened excavation is likely to be constant during construction and likely to be open for 6 months to 3 years, and therefore short to medium-term in duration. Where aquifers are breached and dewatering is required, it is likely to affect the resource at a local scale rather than a regional scale as recharge is relatively high in the basin. The magnitude of the impact is therefore considered to be small to medium depending on the duration of the impact.

The significance of the potential effect is therefore **Moderate to Major.**

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM3
Relevant ESIA GIIP: GPM10, GPM49, GPM55.

Additional Mitigation and Enhancement Measures

In addition to the requirements set out in GMP4 of the ESMP mitigation measures (see Chapter 22 of this ESIA), and Table 3.6 of the Project Description, the Borrow Pit Management Plan should include site-specific definition and assessment of depth to aquifer, and a conceptual groundwater model to ensure extraction activities maintain the required buffer above the aquifer (ADM81).

In the Site operations, where dewatering cannot be avoided, provision shall be made for superficial recharge of treated waters into the aquifer to maintain resource provision (ADM91).

An assessment of the potential for AMD or ARD be made during site definition depending on the likely design and location of the borrow Pit. Where this is identified, management of the potential effects from AMD/ARD shall be in line with the IFC EHS Guidelines for Mining (ADM83).

Residual Impact

Implementation of the additional measures will reduce WQ1 to **Minor - Moderate** significance.

12.2.2 Construction Impact CODE WQ2

Pollution/Accidental Spills from General Construction activities

Accidental release of fuels, chemicals and other materials have the to pollute both surface and groundwaters through direct runoff into watercourses or leaching through to groundwaters.

Potential sources of pollutants include the mobile fuel storage tanks at the construction camps and, in particular, improper connections to vehicles and other transfer mechanisms for refuelling of generators. Leaks from vehicles and poorly maintained equipment at the workfronts, construction camps including trucks, buses are also potential sources of pollutants.

Storage of hazardous materials, including chemicals, pesticides etc., are a further source of pollutants where storage facilities are not maintained, or chemicals are stored improperly.

Direct release of pollutants into watercourses can occur especially where in-situ construction of water crossings, culverts and other structures occurs. Direct release of pollutants could include fuels and oils, chemicals and other hazardous materials, and cause indirect impacts to flora and fauna downstream.

Where construction occurs in high sensitivity locations, such as in groundwater dependent terrestrial ecosystems (GWDTEs), there is the potential for pollutants to accumulate in the system and move freely into the aquifer, potentially transferring impacts to a wider area.

Spills and other releases have the potential to leach into aquifer systems especially where spills are undetected, and where the aquifer is unconfined.

Impact Assessment

WQ2a. Impact to Groundwater and GWDTEs.

Groundwater and GWDTEs are considered to be high sensitivity receptors due to their ability to support potential critical habitat or their use as a potable water supply. During construction, the potential for spills and accidental releases from storage areas, equipment, tanks and vehicles is high, especially due to the construction methodology which requires mobile equipment over short periods of time to be accessible, with movement of workfronts on a rapid basis. The occurrence of such spill is therefore assessed as likely. However, given the embedded and GIIP mitigation using bunds in mobile locations along the track and hardstanding with bunding for construction sites based at stations and other permanent facilities where hardstanding is already required as part of the design, frequency of any spills is likely to be only periodic.

As spills are likely to be cleaned up rapidly, the potential for leaching into the aquifers and into GWDTEs will be reduced and impacts are therefore of short duration. The magnitude of the impact to these systems will be small.

The significance of the potential impact is therefore **Moderate.**

WQ2b Impact to Surface Waters.

Most surface watercourses are considered to be of medium sensitivity, with the exception of the water courses near the port end of Takoradi, which are classed as low sensitivity. During construction, the highest potential for spills and accidental releases to surface waters is from the in-situ construction of water crossings and culverts, where equipment may be needed within the channel of along the banks. Where spillage occurs the potential for rapid transport downstream in watercourses is high. Spills will be able to be cleaned up rapidly and impacts are therefore likely to be of short duration, and the magnitude of the impact small.

The significance of the potential effect is therefore **Minor**

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM3, PDM10, PDM12, PDM19, PDM22.
Relevant ESIA GIIP: GPM23, GPM24, GPM28, GPM51, GPM54.

Additional Mitigation and Enhancement Measures

To reduce impacts further, especially to highly sensitive receptors, it is recommended that the following additional measures are incorporated:

- ADM76: Incorporate and implement an inspection programme for all mobile fuel tanks, generators and other potentially polluting equipment where hardstanding is not provided. The inspection regime should include inspections to maintain the structural integrity and operability of tanks, piping systems, containment infrastructure, emergency shutdown measures for valves and associated equipment.
- ADM77: Microsite all pollution sources as far away as practicable from known water supply boreholes.
- ADM78: Prepare written Standard Operating Procedures (SOPs) for the filling of storage tanks, transfer of materials and description of the pipes and fittings required to be used.
- ADM79: Use only dedicated fitting, pipes and hoses for the transfer of materials.
- ADM80: Incorporate overfill protection measures into the SOPs and Hazardous materials Management Plan, including installation of gauges on tanks, checklists for filling procedures and sign off, automatic shut off valves on storage tanks, provision of overfill vents to allow controlled release.
- MON01: In accordance with the Conditions of the Environmental Permit monitoring of the following shall be undertaken during construction and Quarterly reports submitted to the EPA:

- Air quality and dust
- Noise and vibration
- Waste management
- Erosion and flooding
- Water quality
- Accidents
- Traffic Issues

Residual Impact

With the implementation of the additional measures residual impact of WQ2a will be **Minor** significance.

12.2.3 Construction Impact CODE WQ3

Increased sediment mobilisation from general construction activities.

General construction activities such as removal of vegetation, topsoil stripping and stockpiling, culvert and crossing construction, in-stream works, can increase erosion of sediments in run off and discharges to surface waters. Incorrect construction of culverts and water crossings can cause the mobilisation of bank and bed materials downstream. Drainage around construction camps, facilities and borrow areas, can also increase sediment loads to water courses if improperly installed or maintained. Run-off from the central construction camps, and in particular from the area surrounding the concrete batching plant, can also increase the potential for sediment transport in water courses.

High sediment loads in watercourses can be transported for some distance downstream and reduce dissolved oxygen, smother natural gravel bed materials, and settle out changing flow dynamics in channel morphology.

Impact Assessment

Sediment impacts are most likely to be felt in the most sensitive surface waters, which in the project AoI are those categorised as medium sensitivity. Sediment entering the watercourses from run-off or in-stream works is likely to be periodic and of short to medium term duration, especially during the wet season.

Taking into consideration the Embedded and Good Practice Mitigation including the use of coffer dams, and flow diversion for in-situ construction the magnitude of the impact is likely to be Small to Medium.

The significance of the effect is therefore predicted to be **Minor to Moderate**.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM12, PDM16, PDM17, PDM18, PDM27,.
Relevant ESIA GIIP: GPM15, GPM16, GPM28.

Additional Mitigation and Enhancement Measures

To reduce potential impacts further the following measures will need to be implemented:

- ADM84: A pre-construction survey shall be completed as part of the Land Disturbance Procedure to identify areas of potential vulnerability to run-off and any additional measures included in the ESMP.
- ADM88: Construction of drainage for construction shall be undertaken outside of the wet season where practicable, and especially for dewatering of excavations and instream construction activities
- ADM89: Instream construction of crossings, culverts etc shall be undertaken when water levels are at their lowest, to reduce any effects from sediment mobilisation.
- ADM90: Drainage shall be constructed following topsoil stripping.
- ADM91: Cut-off drains shall be installed parallel to construction lines to control run-off from adjacent areas.
- ADM92: Where drainage cut off drains discharge into local watercourses, discharge points must be microsited in the field to avoid further erosion and fitted with in-line silt traps to minimise sediment run-off at the discharge point.
- ADM93: Topsoil stockpiles must be set back at least 10 m from the banks of any watercourses or drains and, where applicable, designed with openings to ensure the stacks do not prevent flow conveyance..
- ADM94: Stockpile run-off shall be routed away from watercourses, and vegetated strips maintained adjacent to watercourses to impede surface runoff and trap sediment.
- ADM95: Other sediment control measures such as bunds, berms and grips and silt fencing shall be constructed within the construction working width as appropriate and where watercourses may be affected.
- MON01: In accordance with the Conditions of the Environmental Permit monitoring of the following shall be undertaken during construction and Quarterly reports submitted to the EPA:
  - Air quality and dust
  - Noise and vibration
  - Waste management
  - Erosion and flooding
  - Water quality
  - Accidents
  - Traffic Issues

Residual Impact

Implementation of the additional measures will reduce WQ3 to **Minor** significance.

12.2.4 Construction Impact CODE WQ4

Impacts to surface and groundwaters from dewatering and wastewater discharges.

Discharges to both surface and groundwaters from wastewater and discharges from dewatering can occur through pollution and change to surface flow regimes.

Discharges directly to groundwater and, in particular, GWDTEs from dewatering can increase suspended sediments and transfer pollutants from excavations (e.g. metals etc). Pollutants, especially in GWDTEs, are likely to settle and accumulate in the immediate vicinity of the habitat due to low flows moving through this type of system and impacting on the habitats the water body supports. Groundwater aquifers can be impacted by increased metal concentrations and pollutants which, depending on the flow rate in the aquifer and proximity to boreholes, can flow through to neighbouring abstractions. Dewatering discharges to surface waters can change the flow regime of the receiving body, as well as increase pollution and suspected sediments in the immediate downstream environment.

Where wastewater is collected and discharged (particularly sanitary waters and run off from process areas) a variety of pollutants including heavy metals, sulphates, and suspended sediments can be discharged and increase pollution in the immediate downstream area until dilution can occur. Where discharges are from septic tanks, waste dumps etc. this can increase organic pollutants and pathogens including coliforms.

Where these discharges are to watercourses with low or reduced flows, the dilution (assimilative) capacity of the receiving water is reduced, increasing pollution in the immediate discharge area and potentially further downstream. Pollutants, especially those bound to suspended sediments (typically metals), may settle out and accumulate in morphological features (e.g. bars, berms etc) and often then subsequently remobilised in storm flushes.

Impact Assessment

WQ4a Impacts to Groundwaters and GWDTEs.

Groundwater aquifers and GWDTEs are considered to be a high sensitivity receptor. Impacts from dewatering is likely to be periodic and short term over a period of weeks rather than months. Given the embedded mitigation requiring treatment of wastewater to be undertaken to the Applicable Standards prior to discharge, and the implementation of a Wastewater Management plan, the magnitude of the impacts to these receiving bodies is likely to be small.

The significance of the effects to groundwaters and GWDTEs is therefore considered to be **Moderate.**

WQ4b – Impacts to surface waters.

Impacts to surface waters from discharges are likely to be periodic. The likelihood of surface waters being the recipient of these discharges is high. However, the baseline studies indicate that many of the watercourses display existing pollution, and a high level of flow modification either through artisanal mining or through siltation and obstruction. Discharging to surface waters must be considered in relation to the capacity of the receiving water body to absorb or assimilate the discharges from the project. The impact is likely to be local but, depending on the watercourse and level of pollution, could extend further downstream. Accumulation of sediments and pollution could also increase the duration of the impact to the medium term. The embedded mitigation, and in particular the Wastewater Management Plan, treatment of discharges, and fitting of interceptors etc., will support the appropriate management of discharges from the project, but the assimilative capacity of the receptor in relation to discharges has not been assessed. The magnitude of the impact is therefore considered to be small to medium.

The significance of the effects to surface waters is therefore considered to be minor to moderate.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM12, PDM16, PDM17, PDM19, PDM20, PDM21.
Relevant ESIA GIIP: GPM49, GPM50, GPM51, GPM54, GPM55.

Additional Mitigation and Enhancement Measures

- ADM84: A pre-construction survey shall be completed as part of the Land Disturbance Procedure to identify of potential vulnerability to pollution (watercourses) and any additional measures included in the ESMP.
- ADM85: No discharges to water bodies identified as Critical Habitats or as having potential to support Critical habitat features shall be allowed.
- ADM86: The wastewater management shall include pre-discharge review to identify the assimilative capacity of the receiving waterbody.
- MON01: In accordance with the Conditions of the Environmental Permit monitoring of the following shall be undertaken during construction and Quarterly reports submitted to the EPA:
  - Air quality and dust
  - Noise and vibration
  - Waste management
  - Erosion and flooding
  - Water quality
  - Accidents
  - Traffic Issues
- MON12: A wastewater monitoring plan shall be implemented for discharges to the environment to include: Frequency type and location of monitoring, pre discharge testing of the wastewaters and monitoring of the receiving waters for discharges lasting for more than three months. The Wastewater monitoring plan shall incorporate feedback mechanisms to improve or manage discharges where actual effects are different to those predicted.

Residual Impact

Implementation of the additional measures will reduce WQ4a and 4b to **Minor** significance.

12.2.5 Construction Impact CODE WQ5

Impacts to surface waters from flow diversions

Construction of multi-span bridges, viaducts and culverts will require dewatering and diversion of flows to enable construction to take place. Diversion of flows around construction areas can impact water quality, flow dynamics and watercourse functionality for the period of time the diversion is in place.

Short term flow diversions in watercourses (up to 6 months) are typically managed through the use of flow diversion pipes to carry water around the construction area. Coffer dams and impoundments are used to ensure the construction area remains free from water. Long term flow diversions (>12 months) would typically require a new channel to be constructed. For construction periods 6-12 months, the type of diversion required would depend on the type of receptor area for construction and construction methods required and would need to be identified on a case by case basis.

The majority of construction within waterbodies for this project will be <6 months and therefore an assumption has been made that all diversions will be via pipes around the construction area. Where this is not the case, the impacts will need to be re-evaluated prior to construction.

Flow diversions can temporarily impact the upstream and downstream environments through impoundment (upstream), and then local bed or bank erosion downstream where the outlet pipe discharges into the river. In the upstream environment impoundment can increase local erosion of bed and banks at the far upstream end where faster flows join the impounded area, and then behind the coffer dam and in the impounded area settlement of sediment and pollutants can occur. Once the coffer dam is removed, these sediments can be washed out and a pollution/sediment spike transferred downstream.

Downstream during the construction, flow dynamics will be altered since the flow of water is likely to be slower than typically experienced. Water courses are likely to be dry for part of the downstream area, and reduced levels and flows experienced further downstream until construction is complete. At the outlet itself, depending on the speed of the flow local erosion of the bed (scour) can occur and depending on the location of the outlet pipe back erosion may also occur increasing sediment load for a short distance downstream. The reduced flows also reduce the dilution in the downstream area.

Impact Assessment

The majority of flow diversions will occur during culvert construction across watercourses with a medium sensitivity. Diversions of flow are likely to be of short duration (a few weeks) especially for culverts and pipes and will occur only once during construction. The impact will therefore only be short term and of small magnitude especially given the local nature of the impact.

Embedded mitigation includes the reinstatement of the watercourse following construction.

Given the magnitude of the impact, the significance of the effect is likely to be **Minor**.

However, it should be noted that should diversions be required in areas which have the potential to support Critical Habitat or Ecosystem Services, the impact should be revisited to identify additional measures required under the Biodiversity Management Plan.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM 16.
Relevant ESIA GIIP: NONE

12.2.6 Construction Impact CODE WQ6

Impacts to morphology of waterbodies.

Impacts to morphology are most likely to occur through the construction of culverts and bridges across watercourses.

Construction of culverts and other structures in watercourses can change channel morphology through vegetation removal, channel straightening, incorrect sizing of culverts (both over and under sizing), inclusion of hard protection on beds and banks, construction of bridge abutments and piers.

Vegetation removal on the banks of watercourses increases the potential for run-off and bank erosion during construction, and until natural revegetation occurs. Excessive bank erosion can lead to localised collapse of the banks and mobilisation of sediment downstream. Instream vegetation removal and removal of in-channel berms and bars will remove valuable habitats within the channel, potentially destabilises bed materials and increase transfer downstream.

Where culverts are being installed, excavation of the bed can impact on local movement of water between surface and groundwaters.

Permanent impacts typically result from the inclusion of hard protection along the bed and banks. Where culverts are being installed, channels are often narrowed creating a local flume effect, ponding of water upstream creating scour of the upstream bed and banks and the flume effect creating scour downstream at the outlet on the banks and bed. As a result, over time, scouring of the banks and beds can undermine the structural integrity of the culvert leading to collapse. Localised scour of the bed can create nick points which migrate upstream and downstream from the culvert entrance over time which leads to destabilisation of the watercourse and potential to undermine any other structures.

Typically, inclusion of hard protection around abutments and culvert entrance and exits is installed in the form of gabions or rip rap to deflect flows and prevent local scour. Hard protection can be washed out during flooding or can be an over engineered approach to management of scour, where softer forms of protection (e.g. vegetative or geotextiles) may be more appropriate and provide similar protection whilst conferring benefits in terms of habitat development.

Incorrect sizing of culverts can lead to impounding of water upstream (in the case of undersizing) exacerbating local scour potential, settling of sediments upstream and changing downstream flow dynamics. In the case of oversizing, flow through the culvert is reduced leading to local deposition of materials and increasing maintenance.

In-stream piers can create scour around each pier, eroding bed materials and causing local destabilisation of the bed. In addition, depending on the size and number of the piers, deposition occurs both upstream and downstream altering flow dynamics within the channel, often deflecting flow towards the banks, and creating localised scour.

Channel diversions at this time are not expected to be required.

Impact Assessment

The majority of watercourses in the project area are already impacted to some extent in terms of morphology and potential for change and have medium sensitivity. In terms of morphology, any additional impacts from the project may exacerbate any impacts already occurring within the channel.

The frequency of the impact is likely to be periodic (occurring once) during construction and local in nature at least in the short term, however the potential for impacts to occur in the future as a result of construction (and in particular from design rather than installation) means that the impacts can be felt in the medium term, especially where impacts are cumulative within the watercourse with other structures or activities (e.g. artisanal mining, plantations etc.). The magnitude of the impact is therefore considered to be Medium.

Embedded mitigation including the construction of the culvert to be below the bed level and ensure natural materials are retained in the channel, installation of appropriate protection, and minimising vegetation clearance have been included in the assessment.

The significance of the effect is therefore considered to be **Moderate.**

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM15, PDM8.
Relevant ESIA GIIP: GPM4

Additional Mitigation and Enhancement Measures

Additional mitigation measures to reduce the significance of the effect include:

- ADM88: Works shall be scheduled to minimise the amount of time flow diversions are in place.
- ADM96: During detailed design, hydraulic assessment shall be undertaken to ensure sizing of culverts includes both the existing flow requirements and future changes under climate change. This shall include consideration of hydraulics, morphological change, and requirements for maintenance of habitats.
- ADM97: Installation of bed and bank protection shall include an assessment of all types of protection for their appropriateness. Where possible, vegetative or other geotextiles shall be installed in preference to harder engineering materials (e.g. rip rap, gabions, and concrete).
- ADM98: Where channel diversions are identified as being required, channels shall be designed to ensure morphological diversity and channel flow dynamics are sustainable in the long term. Natural bank and bed planforms shall be designed and implemented.
- MON01: In accordance with the Conditions of the Environmental Permit monitoring of the following shall be undertaken during construction and Quarterly reports submitted to the EPA:
  - Air quality and dust
  - Noise and vibration
  - Waste management
  - Erosion and flooding
  - Water quality
  - Accidents
  - Traffic Issues
- MON13: Monitoring of erosion through fixed point photography and river morphological surveys shall be implemented both pre and post construction to ensure long terms potential impacts are identified early and any corrective measures implemented. Monitoring shall be implemented for the first five years following construction, with a review of results annually, and a review of the on-going monitoring requirements prior to the end of year five.

Residual Impacts

Where the additional measures are implemented, the significance of the effects will reduce to **Minor.**

12.2.7 Construction Impact CODE WQ7

Impacts to ground and surface waters from abstractions.

Surface and groundwater abstractions for construction can impact on the wider resource provision and assimilative capacity of surface waters. Where water is abstracted via borehole drawdown on the wider aquifer could impact the aquifer resource, although recharge tends to be high.

For surface water, any abstraction could reduce available water in the watercourse, increasing pollution levels through reduced dilution, or exacerbating low flows with consequential impacts to biodiversity.

Water is expected to be provided via tanker from Ghana Water Company, although there may be a need for direct abstraction during construction, and therefore impacts have been considered in this ESIA as a precautionary approach.

The most likely source of potable/process water for very short term (i.e. weeks) would be via surface water however this may require some pre-treatment and testing would be required prior to use. Groundwater abstraction would be an option for longer periods (>6 months) or greater volumes of higher quality (e.g. potable) water. Understanding the drawdown from the abstraction and then in combination with other abstractions in the area would be required to ensure the abstraction is sustainable.

Impact assessment

Impacts to all water sources (ground and surface waters) are likely to be short term and are likely to only be required for a relatively small proportion of the overall Project construction water demand. Impact magnitude even for the highest sensitivity receptors is likely to be small to very small, when embedded and GIIP mitigation is incorporated into the assessment (permits for abstraction to be obtained prior to use, water consumption management plan). If groundwater abstraction is required, water consumption meters will be installed on all water abstraction points to record on a daily basis the volume of water abstracted for construction activities. Approval for such meters will be obtained from GWRC, GWCL and District/Municipal Assembly officials as necessary.

WQ7a - The significance of effects on Groundwater receptors is considered to be **Minor**

WQ7b – The significance of effects on surface water receptors is considered to be **Minor**.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: NONE.
Relevant ESIA GIIP: GPM48, GPM49, GPM55.

12.2.8 Construction Impact CODE WQ8

Impacts to surface water from flooding.

The climate of Ghana provides some challenges during construction, especially in terms of design for flood risk. Flood risk during construction is primarily a result of run off, especially during the wet season, and for watercourse crossings from flood events during construction with rising water levels and faster flows. The potential for flooding through run-off is increased through temporary and permanent loss of land in areas prone to flooding, increase in hardstanding or compacted areas that reduce infiltration into the soils, and over the long term changes to climatic conditions through increased frequency, duration and/or intensity of rainfall and storm events.

Flooding also increases erosion potential and risk of first flush events causing pollution incidents downstream.

Impact assessment

Surface watercourses are considered to be medium sensitivity receptors. There is a significant level of embedded mitigation to manage run-off during construction which will reduce potential for flooding during construction to a small magnitude. As a result, the significance of the effect will be **Minor**.

Some additional measures already developed to control other impacts, e.g. construction of drainage to be undertaken outside of the wet season (ADM 60) and in-situ construction of culverts and crossings to be undertaken when water levels are at their lowest (ADM61), will also contribute to a further reduction of potential significant effects**.**

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM9, PDM20, PDM21, PDM22, PDM23,
Relevant ESIA GIIP: None

A summary of all additional mitigation measures for construction are provided in Table 4-3 below.

Table 4-3 Construction Additional Mitigation Measures

Mitigation ID	Mitigation Measure
ADM76	Incorporate and implement an inspection programme for all mobile fuel tanks, generators and other potentially polluting equipment where hardstanding is not provided. The inspection regime should include inspections to maintain the structural integrity and operability of tanks, piping systems, containment infrastructure, emergency shutdown measures for valves and associated equipment.
ADM77	Microsite all potential pollution sources as far away as practicable from known water supply boreholes.
ADM78	Prepare written Standard Operating Procedures (SOPs) for the filling of storage tanks, transfer of materials and description of the pipes and fittings required to be used.
ADM79	Use only dedicated fitting, pipes and hoses for the transfer of materials.
ADM80	Incorporate overfill protection measures into the SOPs and Hazardous materials Management Plan, including installation of gauges on tanks, checklists for filling procedures and sign off, automatic shut off valves on storage tanks, provision of overfill vents to allow controlled release.
ADM81	Borrow Pit Management Plan should include in site definition the assessment depth to groundwater and conceptual groundwater model to ensure extraction activities maintain the required buffer above the aquifer.
ADM82	In the Site operations, where dewatering cannot be avoided, provision shall be made for superficial recharge of treated waters into the aquifer to maintain resource provision.
ADM83	An assessment of the potential for AMD or ARD be made during site definition depending on the likely design and location of the borrow Pit. Where this is identified, management of the potential effects from AMD/ARD shall be in line with the IFC EHS Guidelines for Mining
ADM84	A pre-construction survey shall be completed as part of the Land Disturbance Procedure to identify of potential vulnerability to pollution (watercourses) and any additional measures included in the ESMP.
ADM85	No discharges to water bodies identified as Critical Habitats or as having potential to support Critical habitat features shall be allowed.
ADM86	The wastewater management shall include pre-discharge review to identify the assimilative capacity of the receiving waterbody.
ADM87	A pre-construction survey shall be completed as part of the Land Disturbance Procedure to identify areas of potential vulnerability to run-off and any additional measures included in the ESMP.
ADM88	Construction of drainage for construction shall be undertaken outside of the wet season where practicable, and especially for dewatering of excavations and instream construction

Mitigation ID	Mitigation Measure
	activities. Works shall be scheduled to minimise the amount of time flow diversions are in place
ADM89	Instream construction of crossings, culverts etc shall be undertaken when water levels are at their lowest, to reduce any effects from sediment mobilisation.
ADM90	Drainage shall be constructed following topsoil stripping.
ADM91	Cut-off drains shall be installed parallel to construction lines to control run-off from adjacent areas.
ADM92	Where drainage cut off drains discharge into local watercourses, discharge points must be microsited in the field to avoid further erosion and fitted with in-line silt traps to minimise sediment run-off at the discharge point.
ADM93	Topsoil stockpiles must be set back at least 10 m from the banks of any watercourses or drains and, where applicable, designed with openings to ensure the stacks do not prevent flow conveyance.
ADM94	Stockpile run-off shall be routed away from watercourses, and vegetated strips maintained adjacent to watercourses to impede surface runoff and trap sediment.
ADM95	Other sediment control measures such as bunds, berms and grips and silt fencing shall be constructed within the construction working width as appropriate and where watercourses may be affected.
ADM96	During detailed design, hydraulic assessment shall be undertaken to ensure sizing of culverts includes both the existing flow requirements and future changes under climate change. This shall include consideration of hydraulics, morphological change, and requirements for maintenance of habitats.
ADM97	Installation of bed and bank protection shall include an assessment of all types of protection for their appropriateness. Where possible, vegetative or other geotextiles shall be installed in preference to harder engineering materials (e.g. rip rap, gabions, and concrete).
ADM98	Where channel diversions are identified as being required, channels shall be designed to ensure morphological diversity and channel flow dynamics are sustainable in the long term. Natural bank and bed planforms shall be designed and implemented.
MON01	In accordance with the Conditions of the Environmental Permit monitoring of the following shall be undertaken during construction and Quarterly reports submitted to the EPA: • Air quality and dust • Noise and vibration • Waste management • Erosion and flooding • Water quality • Accidents • Traffic Issues
MON12	A wastewater monitoring plan shall be implemented for discharges to the environment to include: Frequency type and location of monitoring, pre discharge testing of the wastewaters and monitoring of the receiving waters for discharges lasting for more than three months. The Wastewater monitoring plan shall incorporate feedback mechanisms to improve or manage discharges where actual effects are different to those predicted.
MON13	Monitoring of erosion through fixed point photography and river morphological surveys shall be implemented both pre and post construction to ensure long terms potential impacts are identified early and any corrective measures implemented.Monitoring shall be implemented for the first five years following construction, with a review of results annually, and a review of the on-going monitoring requirements prior to the end of year five.

12.3 Direct Operational Impacts

12.3.1 Operational Impact WQ9

Impacts to groundwater from permanent abstractions.

Permanent abstraction is likely to be required at the Heavy Rail Maintenance Facility near Tarkwa. Water resources in this area are under pressure as described in the baseline assessment, with numerous unauthorised boreholes and hand dug wells. While aquifer properties suggest the water is of high quality, some evidence of pollution has been identified.

Other abstractions to supply water to permanent Project facilities such as the stations have not been identified at present.

Impacts from groundwater abstractions can lead to a drawdown of the aquifer, resulting in a lowering of aquifer levels, and migration of pollutants towards the abstraction. While recharge is relatively high, a conceptual groundwater model based on a full knowledge of abstraction requirements and locations including stations is not available and therefore locally specific impacts cannot be identified. A precautionary approach to the impact has been taken in the assessment.

Impact Assessment

Groundwater aquifers are considered to be high sensitivity receptors. While the volume of water has not been quantified at this time, the abstraction will be a continuous and permanent impact at the local scale, and therefore the magnitude of the impact is considered to be medium

Embedded mitigation includes measures to reduce water needs, through implementation of efficient water practices (rainwater harvesting and use of water efficient toilets etc.). However, taking the precautionary approach of the abstraction, combined with local water pressures the significance of the effect is likely to be **Major**.

Additional Mitigation and Enhancement Measures

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM29, PDM30,
Relevant ESIA GIIP: GPM49, GPM55.

The following additional mitigation measures shall be incorporated into the ESMP for operation:

- ADM99: Where groundwater abstraction is required, water consumption meters will be installed on all water abstraction points to record on a daily basis the volume of water abstracted for construction activities. Approval for such meters will be obtained from GWRC, GWCL and District/Municipal Assembly officials as necessary.
- ADM100: An operational Water Management Plan shall be developed during the construction phase and prior to finalisation of the design of the permanent facilities (stations and heavy rail maintenance facility), to identify the volume of water required for operation, quality (e.g. potable) required, best practicable means of providing the resource, and opportunities for resource efficiency measures to be incorporated including the use of grey water for washing down of trains, flushing of toilets etc.
- ADM101: A conceptual groundwater model for the aquifers impacted by proposed boreholes shall be developed taking into consideration all boreholes and hand dug wells (both licensed and unlicensed) prior to construction of the borehole.

- ADM102: Drawdown contours for the required abstraction rates shall be developed. Drawdown contours shall identify the drawdown associated with the project abstraction alone, and in-combination with other abstractions in the area.
- ADM103: Where drawdown occurs, indirect impacts to other abstractions shall be considered, including whether well/borehole depths are sufficient to maintain water supplies on which communities/households are reliant.
- ADM104: The operational Water Management Plan shall identify the need and outline requirements for an operational Water Monitoring Programme for all required abstractions.
- MON10: Water abstracted from groundwater shall be stored in water storage tanks (poly-tanks). A water utilization logging system (water consumption registry) shall be developed and water usage from the tanks documented including:
  - date;
  - task or activity;
  - volume of water required;
  - recorded volume of water used,
  - performance target expected and performance target achieved;
  - percentage performance target variation;
  - commentary.
- MON11: Regular checks shall be undertaken to identify and detect any leakage along the main water distribution lines, washrooms, and pantries.

Residual Impacts

With the additional mitigation measures, the significance of the effect is reduced to **Minor**.

12.3.2 Operational Impact W10

Impacts to surface water from flooding.

Permanent infrastructure, land take, and increase in areas of hardstanding in areas prone to flooding can contribute to an increase in run-off (volume, frequency and speed) especially where inadequate drainage or maintenance of drainage systems, or poor/infrequent maintenance of structures such as culverts allowing blockages to occur during storm events. This can be exacerbated where long term climate trends have not been accounted for in the design.

Increasing flooding to surface waters can propagate into downstream impacts such as increased erosion and channel morphological change, potential undermining of other structures (e.g. bridges) downstream, especially where other structures may not have been designed with adequate freeboard, erosion protection or maintenance , and increased risk of flooding to other receptors in the area such as communities.

Impact Assessment

Surface waters are considered to be medium sensitivity receptors. Flood events are likely to occur given the climate in Ghana, especially during the wet season. Embedded mitigation in the design around drainage, sustainable drainage design of track, structures etc., and at the stations incorporation of green space, will all reduce the potential for flooding through slowing of run-off and directing any runoff to appropriate discharge locations at a rate the receiving body can assimilate. All of these will reduce the potential extent and duration of any impact, however, over the lifetime of the project the magnitude is considered to be Medium. The significance of the effect to surface waters is therefore considered to be **Moderate.**

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM21, PDM27, PDM29.
Relevant ESIA GIIP: NONE

Additional Mitigation and Enhancement Measures

Additional measures to be implemented include;

- ADM96: During detailed design, hydraulic assessment shall be undertaken to ensure sizing of culverts includes both the existing flow requirements and future changes under climate change. This shall include consideration of hydraulics, morphological change, and requirements for maintenance of habitats.
- ADM105: All permanent facilities located within areas prone to flooding shall consider installation of local flood storage within the design, or measures to reduce run-off including but not limited to:
  - Minimising the area of impermeable surfaces including the use of permeable pavement as appropriate in areas such as car parks etc.;
  - Drainage should include the use of vegetated swales and retention ponds to reduce peak discharge rates;
  - Contouring of land around the facilities where appropriate to act as temporary flood storage areas (e.g. through landscaping around stations and the heavy rail maintenance facility);
  - Use of flood retention bunds as appropriate around facilities; and
  - Replanting and maintenance of buffer strips around receiving waterbodies.
- MON01: In accordance with the Conditions of the Environmental Permit monitoring of the following shall be undertaken during construction and Quarterly reports submitted to the EPA:
  - Air quality and dust
  - Noise and vibration
  - Waste management
  - Erosion and flooding
  - Water quality
  - Accidents
  - Traffic Issues

Residual Impact

With the additional mitigation measures the significance of the effect will reduce to **Minor.**

12.3.3 Operational Impact WQ11

Impacts to surface and groundwater quality

Impacts to surface and groundwater quality could result from drainage discharges to the water body, especially first flush pollutants from hardstanding and industrial areas, maintenance of bridges and culverts (clearance of blockages etc)., and direct discharges from effluents.

These types of sources typically result in pollutants such as oils and other hydrocarbons from car parks and fuel areas, heavy metals, suspended sediments, and coliforms being discharged into the receiving waters. In the case of culvert maintenance, removing blockages (e.g. trees) from upstream of the culvert and removal of sediment build-up etc, can introduce sediment plumes often contaminated with heavy metals and other pollutants into the downstream environment.

Direct discharge of effluents (e.g. sanitary or process water) to ground or surface waters can also impact through introduction of pathogens, caustic chemicals and other pollutants into potentially pristine or already polluted systems.

Impact Assessment

It is expected that sanitary water from the Heavy Rail Maintenance Facility and Stations will be collected using septic tanks and disposed of at local approved facilities, however, this will need to be confirmed during detailed design and therefore a precautionary approach to the assessment has been taken.

Groundwater and GWDTEs are considered to be high sensitivity receptors. Impacts to these areas are likely to be related to discharges from the heavy rail maintenance facility, and drainage/run off from the station at Esuaso. Discharges to these receptors is considered to be unlikely, infrequent and over a short duration, and local in impact. Given the embedded measures in place at these locations the impact magnitude is considered to be small.

Surface waters are considered to be of medium sensitivity but are the more likely recipient of any discharges and pollutant releases from maintenance of bridges and culverts. Impacts to these receptors is therefore considered to be likely, with potentially medium-term impacts as drainage discharges where present will continue for much of the project operation. The impact magnitude is therefore considered to be Medium for surface waters.

The significance of the impact is therefore considered to be **Moderate** for both surface and groundwaters.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM3, PD12, PDM19, PDM20, PDM21, PDM23, PDM24, PDM25.
Relevant ESIA GIIP: GPM23, GPM24, GPM50, GPM51, GPM54.

Additional Mitigation and Enhancement Measures

Additional Mitigation measures to manage any impacts from pollution during operation include:

- ADM85: No discharges to water bodies identified as Critical Habitats or as having potential to support Critical habitat features shall be allowed.
- ADM86: The Wastewater Management Plan shall include pre-discharge review to identify the assimilative capacity of the receiving waterbody.

- ADM106: A Bridge and Culvert Inspection Plan shall be developed which incorporates the requirements for (but not limited to)
  - Frequency of inspections.
  - Routine culvert and bridge maintenance, frequency and methods.
  - Emergency clearance of structures procedures.
  - Frequency of clearance to consider climate conditions (e.g. wet and dry season) accumulation of pollutants and methods for reducing pollutant plumes.
- MON01: In accordance with the Conditions of the Environmental Permit monitoring of the following shall be undertaken during construction and Quarterly reports submitted to the EPA:
  - Air quality and dust
  - Noise and vibration
  - Waste management
  - Erosion and flooding
  - Water quality
  - Accidents
  - Traffic Issues
- MON12: A wastewater monitoring plan shall be implemented for discharges to the environment to include: Frequency type and location of monitoring, pre discharge testing of the wastewaters and monitoring of the receiving waters for discharges lasting for more than three months. The Wastewater monitoring plan shall incorporate feedback mechanisms to improve or manage discharges where actual effects are different to those predicted.

Residual Impacts

With the additional mitigation measures the residual impact is considered to be **Minor.**

A summary of all additional operational mitigation measures is provided in table 4-4 below.

Table 4-4 Operational Additional Mitigation Measures

Mitigation ID	Mitigation Measure
ADM85	No discharges to water bodies identified as Critical Habitats or as having potential to support Critical habitat features shall be allowed.
ADM86	The Wastewater Management Plan shall include pre-discharge review to identify the assimilative capacity of the receiving waterbody.
ADM96	During detailed design, hydraulic assessment shall be undertaken to ensure sizing of culverts includes both the existing flow requirements and future changes under climate change. This shall include consideration of hydraulics, morphological change, and requirements for maintenance of habitats.
ADM99	If groundwater abstraction is required, water consumption meters will be installed on all water abstraction points to record on a daily basis the volume of water abstracted for construction activities. Approval for such meters will be obtained from GWRC, GWCL and District/Municipal Assembly officials as necessary.
ADM100	An operational Water Management Plan shall be developed during the construction phase and prior to finalisation of the design of the permanent facilities (stations and heavy rail maintenance facility), to identify the volume of water required for operation, quality (e.g. potable) required, best practicable means of providing the resource, and opportunities for resource efficiency measures to be incorporated including the use of grey water for washing down of trains, flushing of toilets etc.

Mitigation ID	Mitigation Measure
ADM101	A conceptual groundwater model for the aquifers impacted by proposed boreholes shall be developed taking into consideration all boreholes and hand dug wells (both licensed and unlicensed) prior to construction of the borehole.
ADM102	Drawdown contours for the required abstraction rates shall be developed. Drawdown contours shall identify the drawdown associated with the project abstraction alone, and in-combination with other abstractions in the area.
ADM103	Where drawdown occurs, indirect impacts to other abstractions shall be considered, including whether well/borehole depths are sufficient to maintain water supplies on which communities/households are reliant.
ADM104	The operational Water Management Plan shall identify the need and outline requirements for an operational Water Monitoring Programme for all required abstractions.
ADM105	All permanent facilities located within areas prone to flooding shall consider installation of local flood storage within the design, or measures to reduce run-off including but not limited to: • Minimising the area of impermeable surfaces including the use of permeable pavement as appropriate in areas such as car parks etc.; • Drainage should include the use of vegetated swales and retention ponds to reduce peak discharge rates; • Contouring of land around the facilities where appropriate to act as temporary flood storage areas (e.g. through landscaping around stations and the heavy rail maintenance facility); • Use of flood retention bunds as appropriate around facilities; and • Replanting and maintenance of buffer strips around receiving waterbodies.
ADM106	A Bridge and Culvert Inspection Plan shall be developed which incorporates the requirements for (but not limited to): • Frequency of inspections. • Routine culvert and bridge maintenance, frequency and methods. • Emergency clearance of structures procedures. • Frequency of clearance to consider climate conditions (e.g. wet and dry season) accumulation of pollutants and methods for reducing pollutant plumes
MON01	In accordance with the Conditions of the Environmental Permit monitoring of the following shall be undertaken during construction and Quarterly reports submitted to the EPA: • Air quality and dust • Noise and vibration • Waste management • Erosion and flooding • Water quality • Accidents • Traffic Issues
MON10	Water abstracted from groundwater shall be stored in water storage tanks (poly-tanks). A water utilisation logging system (water consumption registry) shall be developed and water usage from the tanks documented including: • date; • task or activity; • volume of water required; • recorded volume of water used, performance target expected and performance target achieved;

Mitigation ID	Mitigation Measure
	• percentage performance target variation; • commentary.
MON11	Regular checks shall be undertaken to identify and detect any leakage along the main water distribution lines, washrooms, and pantries.
MON12	A wastewater monitoring plan shall be implemented for discharges to the environment to include: Frequency type and location of monitoring, pre discharge testing of the wastewaters and monitoring of the receiving waters for discharges lasting for more than three months. The Wastewater monitoring plan shall incorporate feedback mechanisms to improve or manage discharges where actual effects are different to those predicted.

12.4 Indirect Impacts

12.4.1 Indirect Impact Code WQ12

Impacts from abstractions and dewatering on local water supplies.

Indirect impacts to local water supplies can occur when drawdown occurs at the abstraction borehole or from dewatering resulting in a lowering of the aquifer level at neighbouring boreholes and wells.

Whilst some licensed borehole locations and volumes are known, evidence from the baseline study suggests numerous unlicensed boreholes exist for communities and residents and that the volumes, quality, depth of borehole/well are currently unknown.

Local residents and communities are highly reliant on these abstractions and therefore any impact of drawdown could indirectly adversely affect these receptors.

Additional mitigation for these abstractions has already been identified (including an assessment of drawdown on the aquifer for neighbouring wells) as part of impact WQ9.

Impact Assessment

Communities and individual households are extremely reliant on abstractions from private boreholes and hand dug wells, many of which are unlicensed or unknown. These receptors are considered to be High sensitivity.

Mitigation already identified for abstractions should reduce any indirect impacts of the abstraction, however, impacts will be long-term and as drawdown increases over time depending on the specific aquifer properties and recharge, impacts may not be identified for several years following construction and opening of the rail. A precautionary approach to the assessment has been taken and a magnitude of the indirect impact is considered to be small based on all of the mitigations already identified.

The significance of the indirect effects is therefore considered to be Moderate

Additional mitigation and enhancement measures

- ADM107. Undertake community engagement during construction to identify the location, depth, use and estimated volumes of water from private boreholes and hand dug wells where abstractions and dewatering are likely to occur for the Project.
- ADM102 and 103. Drawdown contours for the required abstraction rates shall be developed. Drawdown contours shall identify the drawdown associated with the project abstraction alone, and in-combination with other abstractions in the area. Where drawdown occurs, indirect impacts to other abstractions shall be considered, including

whether well/borehole depths are sufficient to maintain water supplies on which communities/households are reliant

- ADM108. Where impacts are predicted, liaise and work with communities to identify potential mitigation for loss of water resources and the timeframes to achieve this. This could include for example potentially deepening existing wells in advance of drawdown impacts being realised or provision of new borehole to ensure continuity of water supply.
- MON14. Undertake monitoring of private boreholes/wells for long term changes in water levels against predicted impacts and feedback and changes in approach into the Water Management Plan as appropriate. This could be earlier provision of mitigations if impacts are more severe than predicted, or where monitoring demonstrates no impact, liaison with communities to understand the results and identify any future work if necessary.

Residual Impacts

With all of the additional mitigations in place the significance of the effect is considered to be **Minor.**

13. BIODIVERSITEY AND ECOSYSTEM SERVICES IMPACT ASSESSMENT

13.1 Introduction

This chapter presents an over of the biodiversity and ecosystem services impact assessment for the Project and is based on the detailed assessment provided in Annex F. Biodiversity and ecosystem services impacts are described in sections 13.2 through to 13.6 using the assessment methodology described in Chapter 5 and magnitude criteria provided in Annex F. A summary of the results of the impact assessment is also presented below in Table 13.1 for direct construction (impact BD1-BD4 as described in Section 13.2), Table13.2 for indirect construction impacts (BD5-6, section 13.3) and Table13.3 for operation al impacts (impacts BD7-11 as described in Sections 13.4 and 13.5).

The ecosystem services assessment is presented in section 13.6.

13-2

Table 13.1: Biodiversity and Ecosystem Services - Direct Construction Impact Summary

Impact #	**BD1a**	**BD1b**	**BD1c**	**BD1d**	**BD1e**	**BD1f**	**BD2**	**BD3**	**BD4**
Receptor importance/ sensitivity	High	High	High	High	Medium	Medium	Medium	Medium to High	Low to High
Frequency	Constant	Constant	Constant	Constant	Constant	Constant	Constant	Periodic	Periodic
Likelihood	Definite	Definite	Possible	Unlikely	Definite	Unlikely	Definite	Likely	Possible
Extent	Local	Local	National - Global	Local	Local	Local	Local	Regional	Regional
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Temporary	Temporary	Permanent
Magnitude	Small	Medium	Medium	Very Small	Small	Small	Medium	Medium	Very Small
Effect	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct
Significance	Minor	Moderate	Major	Minor	Minor	Minor	Moderate	Moderate to Major	Minor
Additional mitigation? (Y/N)	Y	Y	Y	N	N	N	Y	Y	N
Residual Significance	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor

Table 13.2: Biodiversity and Ecosystem Services Indirect Construction Impact Summary

Impact #	**BD5a**	**BD5b**	**BD6a**	**BD6b**
Receptor importance/ sensitivity	Medium to High	Medium to High	High	Medium
Frequency	Constant	Constant	Constant	Constant
Likelihood	Likely	Likely	Likely	Likely
Extent	Local	Local	National	Local
Duration	Temporary	Temporary	Temporary	Temporary
Magnitude	Small	Medium	Medium	Medium
Effect	Adverse	Adverse	Adverse	Adverse
Direct/ indirect	Indirect	Indirect	Indirect	Indirect
Significance	Minor to Moderate	Moderate to Major	Major	Moderate
Additional mitigation? (Y/N)	Y	Y	Y	Y
Residual Significance	Minor	Minor	Minor	Minor

Table 13.3: Biodiversity and Ecosystem Services Operation Impact Summary

Impact #	**BD7a**	**BD7b**	**BD8**	**BD9a**	**BD9b**	**BD10**	**BD11**
Receptor importance/ sensitivity	Medium to High	Medium	Low to High	High	Medium	Medium	High
Frequency	Periodic	Periodic	Periodic	Constant	Constant	Periodic	Constant
Likelihood	Likely	Likely	Possible	Likely	Likely	Likely	Possible
Extent	Local	Local	Regional	National	Local	Local	National
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Temporary	Permanent
Magnitude	Very Small	Medium	Very Small	Small	Very Small to Small	Medium	Medium to Large
Effect	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct	Indirect	Indirect	Indirect	Indirect
Significance	Minor	Moderate	Minor	Minor	Negligible to Minor	Moderate	Major
Additional mitigation? (Y/N)	N	Y	N	N	N	Y	Y
Residual Significance	Minor	Minor	Minor		Minor	Minor	Minor

13.2 Direct Construction Impacts

Impacts introduced by the scheme that may affect the receptors identified in the previous section are summarised below. Each impact is given an impact code (BD1, BD2, etc.) for ease of reference; sub codes (e.g. 'a', 'b' etc.) are used for each receptor or activity potentially affected by that impact. The impact assessment for each impact is summarised in Table 4.1 and 4.2 for construction and Table 4.3 for operation

13.2.1 Construction Impact CODE BD1: Terrestrial Habitat Loss and Fragmentation

Construction activities have the potential to destroy and fragment habitat as a result of vegetation clearance. Preparation of the soil in the area where the new tracks will be installed (and old tracks decommissioned) will require clearing and preparation over a strip 30 m wide on either side of the existing track, though this will be wider in some areas to accommodate stations, turnouts and sidings, and clearance of a new 100 m wide strip in bypass areas where the rail line will deviate from its current route.

Table 4.3 sets out the habitat areas to be lost for each habitat type as a result of construction of the Project, including the widening of the rail tracks, construction of bypass sections and stations, and temporary construction camps, though does not include elements which are not yet fixed, including borrow areas and temporary laydown areas.

Table 4.3 Loss of Terrestrial Habitat Areas in Hectares per Habitat Type

Habitat type	Habitat categorisation	Sensitivity	Total within 1 km buffer (Ha)	Permanent Loss (Ha)	Temporary Loss (Ha)
Closed Canopy Forest	Natural (Possible Critical)	High	145.62	0.7	0
Degraded Forest	Natural	Medium	1527.51	28.47	0.57
Freshwater Swamp Forest	Natural (Possible Critical)	High	118.83	4.66	0
Mangrove Swamp Forest	Natural (Possible Critical)	High	72.2	0	0
Agricultural Lands and Semi-natural Regrowth	Modified	Low	11044.96	354.7	27.77
Settlements/ Industry	Modified	Low	3902.31	120.8	91.8

Impact Assessment BD1a&b: Habitat Loss Impacts Subri River and Sekondi Waterworks Forest Reserves

No fragmentation of Forest Reserve or KBA areas will occur as a result of the Project, which skirts the edge two Forest Reserve areas but does not cut across them. Direct impacts to the Subri River Forest Reserve and KBA/IBA and the Sekondi Waterworks Forest Reserve where it runs adjacent to the rail near Eshiam are, however, expected as a result of construction. The construction works affecting the Sekondi Waterworks reserve are already underway as they are part of the rail upgrade being undertaken by the government (and which is therefore an Associated Facility and not part of the funded Project). The earthworks which form part of the upgrade have been communicated as already completed and as such are expected to have encroached into the periphery of the reserve, given its location immediately next to the existing rail line. In the case of both reserve areas, however, the habitats areas to be lost are those on the periphery, comprising areas which have already been modified (previously cleared areas and secondary forest). The areas to be lost are therefore not considered to represent core, good quality Closed Canopy Forest habitat and although permanent, given the limited extent of the loss this is considered to be of Very Small magnitude for the large Subri River reserve and Small magnitude for Sekondi Waterworks, which covers a very small area.

- BD1a. The significance of the effect is therefore considered to be **Minor** for the Subri River Reserve
- BD1b. The significance of the effect is therefore considered to be **Moderate** for the Sekondi Waterworks reserve.

Impact Assessment BD1c: Loss and Fragmentation of Possible Critical Habitat for Endangered Flora Species

The moist lowland forest herb species *Aframomum atewae* is extremely scarce and known records in the region are limited to the Neung South Forest Reserve. Although the wider region is considered to represent Critical Habitat for this species it is considered unlikely that any individual plants will be affected by the Project and it was not recorded during baseline surveys, which were conducted during a season when the species is expected to be visible (known observations in Ghana have been reported from April through to January) [1]. Since a small area of closed canopy forest will be affected by the Project and the species is poorly known, the possibility that individuals of the species may be permanently lost cannot be ruled out. The loss of even a small number of individuals of this species could be considered significant on an international scale, since it is currently only known from 4-5 locations globally and if an additional location was to be discovered and lost this could lead to a 20% loss of the number of locations recorded for the species globally, and therefore ecologically significant at a global scale.

Similarly, the Njayei tree is also very scarce and it appears unlikely that this conspicuous tree, which occurs in dense forests on damp areas, river margins and swamps is present within such habitats where they occur along the rail RoW and the species was not recorded during baseline surveys. Since a number of small areas of freshwater swamp forest will be affected by the Project and the species is known from Tarkwa and further downstream in the Bonsa River catchment, the possibility that individuals of the species may be permanently lost cannot be ruled out. The loss of even a small number of individuals of this species could be considered significant on a national scale, since it is currently only known from 4 locations in Ghana. If an additional location was to be discovered and lost this could lead to a 20% loss of the number of locations recorded for the species nationally, which would be ecologically significant at a national scale.

The significance of the effect is therefore considered to be **Major**

Impact Assessment BD1d: Loss and Fragmentation of Possible Critical Habitat for Endangered Fauna Species

Subri River and Neung South KBAs were originally listed as supporting populations of species which, if they still persist in the area, would qualify as Critical Habitat features. These comprise Roloway Monkey, white-thighed colobus, Miss Waldron's red colobus and western chimpanzee. On the assumption that these species still exist within the KBAs (itself questionable based on the available evidence), it appears unlikely that they are present within the Project AoI, as hunters no longer report their presence in the area and it has been some years since surveys found direct

[1] https://www.gbif.org/occurrence/search?taxon_key=2758896

evidence that they occur within the KBAs. Significant effects to these possible critical habitat features as a result of habitat loss therefore appear unlikely.

Although the Ankobra catchment as a whole is considered to represent potential critical habitat for the killifish subspecies *Epiplatys chaperi ssp. schreiberi*, the subspecies has not actually been confirmed to occur in the catchment, and if it does occur is likely to be confined to the upper catchment where water quality is better than has been demonstrated in the vicinity of the Project and where streams have more forest cover. In addition, this species was not found during baseline surveys. No significant impact to the subspecies is therefore anticipated as a result of the Project.

The significance of the effect is therefore considered to be **Minor**

BD1e Loss and Fragmentation of Non-Critical Natural Habitat

The majority of habitats traversed by the permanent RoW are modified in nature, however given the type of Project, there will be some unavoidable permanent loss of natural habitat adjacent to the existing rail line where it is to be expanded, and also along sections to be decommissioned, since this will involve a decommissioning footprint for the duration of that activity. It is, however, expected that loss of natural habitat as a result of borrow activity and temporary laydown areas will be largely avoidable during detailed design, given the prevalence of modified habitat along the RoW and the discrete extent of natural habitat areas. Given the limited extent and localised nature of natural habitat loss as a result of the Project, the magnitude of change is considered to be Small.

The significance of the effect is therefore considered to be **Minor.**

BD1f Loss and Fragmentation of Non-Critical Natural Habitat and Associated Impact on Non-Critical Flora and Fauna

For fauna, the clearing of any vegetation, whether modified or natural, reduces opportunities for nesting, foraging and shelter. The impact of fragmentation / reduced connectivity is not, however, expected to be significant as the majority of the RoW runs along a rail line which has already fragmented habitat and those areas where new rail is proposed are localised and run through areas which have already experienced degradation. Vegetation clearance will affect only relatively small areas of habitats which are widespread in the surrounding area; and therefore, is not expected to cause a significant change in the populations of the flora and fauna species present. Impact magnitude associated with the loss of these already fragmented habitat areas is therefore considered to be Small.

The significance of the effect is therefore considered to be **Minor**.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM3; PDM6.
Relevant ESIA GIIP: GPM11, GPM13.

Additional Mitigation and Enhancement Measures

Table 13-4 Impact BD1 Mitigation Measures

Mitigation ID	Mitigation Measure
Minimisation	

<table>
<tr><th>Mitigation ID</th><th>Mitigation Measure</th></tr>
<tr><td>ADM35</td><td>A Land Disturbance Process shall be developed and implemented during the detailed design phase. This shall:

Define the scope and purpose of the LD Process
Outline the roles and responsibilities for implementation and sign off.
Detail the information required from the site construction team required to initiate the process.
Detail the required E&S Surveys required to be undertaken at all sites.
Detail specific biodiversity elements required to be surveys by appropriate specialists (as necessary)
Detail the engagement with communities required to identify sensitive receptors (including heritage, water abstractions, water supply pipework etc).
Detail the Information required from stakeholders including ministries to undertake specific desk studies.
Detail the Liaison requirements with the GRDA to ensure the RoW is clear of any PAP or Assets prior to disturbance.
Detail the Land Disturbance Report contents including the requirements around permits and compensation to PAPs as required by the Resettlement Action Plan.
Outline the approval process required prior to construction including timescales prior to construction required to complete the Land Disturbance process and reports, and review of Construction Method statements and associated plans to ensure all site-specific requirements have been incorporated appropriately.

The output of the Land Disturbance Process is a Land Disturbance Report which shall:

Identify the area required for disturbance, locations of receptors and safe/buffer zones to be incorporated in the Construction Method Statement.
Identify specific areas for stockpiles and laydown
Identify any requirements and method for biodiversity or social management at the site including specific methods for any species translocations, and disturbance to heritage assets.
Identify site specific management and mitigations to manage risks including those to local people surrounding the sites. This can include micrositing of the works to avoid or minimise potential impacts.
Detail the site audit and reporting requirements and any specific tasks for the environmental Clerk of Works
Detail specific monitoring requirements for management of environmental and Social risks.
Detail the site restoration requirements including any specialist planting needs.
Detail the Construction sign-off requirements following restoration,

When identifying receptors, the surveyors must include the walking routes, roads, residences, schools and medical facilities close to the Project site that could be impacted by the works.</td></tr>
<tr><td>ADM2</td><td>Clearance will follow a prescribed Vegetation Clearance Procedure and a thorough survey by an Ecological Specialist will be undertaken immediately prior to all vegetation clearance. Threatened vegetation species will be left in place where possible, and translocation of threatened plants and any fauna species less able to escape the area by themselves will take place. For large tree species that cannot be avoided, seeds or cuttings will be taken for nursery propagation and restoration planting. If any nests of breeding birds are found clearance will not proceed until the young have fledged.</td></tr>
<tr><td>ADM3</td><td>The construction workforce will be trained in biodiversity management requirements, including how to recognise and avoid impacts to sensitive habitats where these are present.</td></tr>
<tr><td colspan="2">Rehabilitation</td></tr>
<tr><td>ADM4</td><td>Temporarily disturbed habitats will be rehabilitated following construction, and planting schemes will include threatened species as appropriate. This will include rehabilitation of the original rail alignment for sections that have been straightened or bypassed, and areas on the outside edge of the RoW. Where construction is outwith the control of the Project (i.e. for Associated Facilities being constructed by the Ghana Railway Development Authority</td></tr>
</table>

Mitigation ID	Mitigation Measure
	(GRDA)), the Project will highlight the requirement for replanting of closed canopy forest species in disturbed habitat at the Sekondi Waterworks Forest Reserve and the need for liaison with the Forestry Commission in discussions with the GRDA.

Residual Impacts

Following the implementation of additional mitigation, significant effects are not expected.

Residual impacts to Critical Habitat for endangered fauna as a result of habitat loss and fragmentation appear unlikely; however since the Project will be operating within KBA boundaries and given the uncertainty regarding the status of the species potentially triggering Critical Habitat within the Subri River KBA it will collect data on the KBA species prior to construction in liaison with the World Database of Key Biodiversity Areas and the Forestry Commission. Depending on findings, this data collection may continue into the construction and operational phases of the Project, though at that stage the responsibility for monitoring would transfer from Amandi to the GDRA. Such data collection will also comply with EP4 guidance on the collection and sharing of biodiversity data as part of the Project's overall data sharing commitments. Pending agreement with the protected area authorities, the data collection could include environmental (eDNA) techniques, which have been demonstrated to be more efficient at species detection than conventional survey methods for some species.

13.2.2 Construction Impact CODE BD2: Aquatic Habitat Loss and Fragmentation

For watercourses where new culverts are installed, small areas of natural bed and bank materials will be lost as a result of culvert installation. Whilst the loss of riverbank habitat will be permanent, natural riverbed material will be restored on completion of culvert installation. For the duration of construction during each culvert (expected to be weeks) and bridge crossing installation where it will be necessary to construct piers in the river bed (expected to be months), aquatic habitat will be effectively lost in the dewatered areas and fragmented as pipes will be used to divert water around construction areas. This will create a barrier to the movement of aquatic fauna. None of the species present are long distance migrants, however, and therefore whilst movement will be limited in the short term, the life cycles of the species present and their ability to maintain viable populations is not expected to be affected.

Impact Assessment

The magnitude of the impact on stream habitat and aquatic species is considered to be Medium, with localised loss that does not threaten the long-term viability of the habitat or the species populations it supports. This impact is likely to be significant at the local scale.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM15, PDM16, PDM17,
Relevant Good Practise Mitigation: None

Additional Mitigation and Enhancement Measures

Table 13-5 Impact BD2 Additional Mitigation Measures

Mitigation ID	Mitigation Measure
Minimisation	
ADM88	Construction of drainage for construction shall be undertaken outside of the wet season where practicable, and especially for dewatering of excavations and instream construction activities. Works shall be scheduled to minimise the amount of time flow diversions are in place
ADM89	Instream construction of crossings, culverts etc shall be undertaken when water levels are at their lowest, to reduce any effects from sediment mobilisation.
ADM96	During detailed design, hydraulic assessment shall be undertaken to ensure sizing of culverts includes both the existing flow requirements and future changes under climate change. This shall include consideration of hydraulics, morphological change, and requirements for maintenance of habitats.
ADM98	Where channel diversions are identified as being required, channels shall be designed to ensure morphological diversity and channel flow dynamics are sustainable in the long term. Natural bank and bed planforms shall be designed and implemented.

Residual Impacts

Following implementation of the additional measures, the significance of the effects will reduce to **Minor** for all receptors.

13.2.3 Construction Impact CODE BD3: Direct Mortality of Fauna During Construction

Description of Impact

Vegetation clearance activity has the potential to cause direct mortality of fauna due to interactions with clearance vehicles and machinery. There is also a risk that hunting in the area will increase as a result of influx of the construction workforce to the area, both by the workforce themselves and as a result of increased demand for bushmeat. This impact is expected to be short term during the construction period and will progressively manifest along the route sections as construction progresses.

Impact Assessment

The magnitude of expected change as a result of both accidental mortality and intentional killing is considered Medium, as it could affect population abundance over one or more generations, and could result in significant effects on a regional scale.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: NONE
Relevant Good Practise Mitigation: GPM46

Additional Mitigation and Enhancement Measures

Table 13-6 Impact BD3 Mitigation Measures

Mitigation ID	Mitigation Measure
Minimisation	
ADM2	Clearance will follow a prescribed Vegetation Clearance Procedure and a thorough survey by an Ecological Specialist will be undertaken immediately prior to all vegetation clearance. Threatened vegetation species will be left in place where possible, and translocation of threatened plants and any fauna species less able to escape the area by themselves will take place. For large tree species that cannot be avoided, seeds or cuttings will be taken for nursery propagation and restoration planting. If any nests of breeding birds are found clearance will not proceed until the young have fledged.
ADM3	The construction workforce will be trained in biodiversity management requirements, including how to recognise and avoid impacts to sensitive habitats where these are present.
ADM6	Construction workforce will be prohibited from hunting or purchasing bushmeat.

Residual impacts

Following the application of additional mitigation, no significant residual effects as a result of faunal mortality are expected.

13.2.4 Construction Impact CODE BD4: Introduction and Spread of Alien Invasive Species

Description of Impact

Linear infrastructure can be a particular risk in spreading invasive plant species. It will be important to prevent this occurring along the areas cleared of vegetation during construction. Currently the most pervasive alien invasive species in the Project AoI is Siam weed, and the spread of this species along disturbed ground is considered to be the greatest risk relating to alien invasive species. Other risks include the introduction of additional alien invasive species on construction vehicles and materials delivered to the Project sites from other regions.

Impact Assessment

With standard good practice mitigation in place for the control of alien invasive species no significant residual effects are predicted.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: NONE
Relevant Good Practise Mitigation: GPM5

13.3 Indirect Construction Impacts

13.3.1 Construction Impact CODE BD5: Habitat Degradation and Disturbance of Terrestrial Fauna

Habitat degradation and faunal disturbance is expected to occur through a number of mechanisms, including potential reductions in air quality and water quality in the vicinity of construction areas, and as a result of noise, vibration, lighting and human presence in the area. Degradation of habitat may also occur through the collection of fuel wood and plants by the construction workforce.

The area affected indirectly by habitat degradation is expected to be localised in nature and is expected to comprise up to a 500 m buffer from construction areas.

BD5a Habitat Degradation during Construction: Flora

Changes in air quality as a result of NO_2 and SO_2 generated by fuel combustion and dust generation can penetrate and block plant cells and cause damage that may be lethal or sublethal. Any contamination of soil, groundwater and surface runoff due to spills and leaks also has the potential to penetrate plant tissues of pollutants into the plants' tissues. This is likely to cause habitat degradation around the construction sites up to 500m from construction works areas, depending on wind speed and direction This degradation will be localised in extent, affecting only a relatively small proportion of habitat areas which are largely modified and widespread in the surrounding area; and impacts are expected to be short term for each individual route section. The impact is considered to be reversible and is not expected to last long enough in any area to cause a significant change in the populations of flora present. Impact magnitude is therefore considered to be Small and effects potentially significant at a local level.

BD5b Habitat Degradation and Disturbance during Construction: Fauna

Fauna within an area of 500 m around construction areas is expected to experience disturbance which may lead to their temporary displacement as a result of noise, vibration, lighting and increased human presence for the duration of the construction period (over a period of weeks for any given area).

Although some species are expected to be more sensitive to disturbance impacts than others, the impact will be localised in extent and temporarily affecting a relatively small proportion of faunal populations which will already be habituated to the disturbance caused by the existing habitat modification and operation of the existing rail line, and for areas where new line is to be installed, these are already in cleared/ built up areas. The magnitude of the impact is therefore considered to be Small.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM1, PDM2, PDM16, PDM17, PDM19, PDM20, PDM21, PDM26, PDM27.

Relevant ESIA GIIP: GPM1, GPM3, GPM16, GPM22, GPM23, GPM24, GPM25, GPM26, GPM27, GPM29, GPM30, GPM47, GPM48, GPM50, GPM51, GPM54.

Additional Mitigation

Table 13-7 Impact BD5 Mitigation Measures

Mitigation ID	Mitigation Measure
Avoidance and Minimisation	
ADM3	The construction workforce will be trained in biodiversity management requirements, including how to recognise and avoid impacts to sensitive species and habitats where these are present.
ADM7	Collection of fuel wood and gathering of plants by the construction workforce will be prohibited.
ADM8	Construction adjacent to forest areas will be avoided during sensitive seasons for threatened species known or suspected to use the site, including the main aggregate breeding season for the threatened birds known or suspected to be present (July to January inclusive).

Residual Impacts

Following the application of additional mitigation, residual effects to flora and fauna due to indirect degradation and disturbance are not expected to be ecologically significant.

13.3.2 Construction Impact CODE BD6: Degradation of Aquatic and Groundwater Dependent Habitats and Disturbance of Aquatic Fauna

Potential indirect effects on aquatic fauna may be as a result of reduced water quality as a result of accidental leaks and spills and sedimentation due to in-channel working, including coffer dam removal, and runoff from construction sites, including borrow areas. Toxic and smothering impacts could lead to mortality and sublethal effects on individuals of aquatic biota. Indirect effects leading to loss of habitat functionality may also occur as a result of water abstraction for construction water supply or as a result of dewatering or hydrological interference during borrow activity. Although construction water supply is expected to be provided via tanker from Ghana Water Company, the possible need for local abstraction to supplement this cannot be ruled out; and is therefore considered on a precautionary basis.

Construction impacts to water quality and quantity on which aquatic and groundwater dependent species depend will be short to medium term in duration (likely to be weeks to months for works at individual water crossings but six months to three years for borrow activity).

BD6a Impact Assessment: Groundwater-dependent habitats and species

Water quality and quantity impacts to groundwater dependent ecosystems will be localised, although could be prolonged, effectively leading to indirect (though likely reversible) loss of habitat on a local scale. The impact has the potential to impact discrete patches of high sensitivity Freshwater Swamp Forest known to support vulnerable flora, and potentially supporting endangered flora species which trigger critical habitat, leading to significant effects at up to national scale.

BD6b Impact Assessment: Stream habitats and species

Water quality and quantity impacts to individual watercourses during construction are expected to be short-term (weeks for culvert crossings, months for more complex bridge crossings) and reversible. The impact is considered to be of Medium magnitude and has the potential to impact localised areas around crossing locations, leading to significant effects at a local scale.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM3, PDM16, PDM17, PDM20, PDM21, PDM24, PDM27.

Relevant ESIA GIIP: GPM10, GPM15, GPM22, GPM23, GPM24, GPM25, GPM26, GPM27, GPM29, GMP30, GPM45, GPM46, GPM47, GPM48

Additional Mitigation Measures

Table 13-8 Impact BD6 Mitigation Measures

Mitigation ID	Mitigation Measure
Avoidance	
ADM13	Groundwater abstraction and borrow activity will be sited to allow a buffer of 250 m from habitats which may be groundwater dependent, including Freshwater Swamp Forest. This buffer can be reduced only if site-specific conceptual groundwater modelling suggests a more localised impact zone.
ADM81	Borrow Pit Management Plan should include in site definition the assessment of aquifer depth and conceptual groundwater model to ensure extraction activities maintain the required buffer above the aquifer.
Minimisation	
ADM9	Unless specifically required for water crossing construction or RoW expansion within an existing area of Freshwater Swamp Forest, no encroachment into watercourses, riparian areas or potentially groundwater dependent ecosystems will be permitted during construction.
ADM10	Abstraction from surface waters will only be considered as a last resort and following a through risk assessment for the watercourse in question, including survey to confirm that no sensitive aquatic species are present in close proximity to the abstraction point. If such species are present the abstraction point will be relocated to a more suitable location, again determined though risk assessment.
ADM76	Incorporate and implement an inspection programme for all mobile fuel tanks, generators and other potentially polluting equipment where hardstanding is not provided. The inspection regime should include inspections to maintain the structural integrity and operability of tanks, piping systems, containment infrastructure, emergency shutdown measures for valves and associated equipment.
ADM77	Microsite all pollution sources as far away as practicable from known water supply boreholes.
ADM78	Prepare written Standard Operating Procedures (SOPs) for the filling of storage tanks, transfer of materials and description of the pipes and fittings required to be used.
ADM79	Use only dedicated fitting, pipes and hoses for the transfer of materials.
ADM80	Incorporate overfill protection measures into the SOPs and Hazardous materials Management Plan, including installation of gauges on tanks, checklists for filling procedures and sign off, automatic shut off valves on storage tanks, provision of overfill vents to allow controlled release.
ADM83	An assessment of the potential for AMD or ARD be made during site definition depending on the likely design and location of the borrow Pit and for any waste fractions being used as ballast. Where this is identified, management of the potential effects from AMD/ARD shall be in line with the IFC EHS Guidelines for Mining.
ADM84	A pre-construction survey shall be completed as part of the Land Disturbance Procedure to identify of potential vulnerability to pollution (watercourses) and any additional measures included in the ESMP.
ADM85	No discharges to water bodies identified as Critical Habitats or as having potential to support Critical habitat features shall be allowed.
ADM86	The wastewater management Plan shall include pre-discharge review to identify the assimilative capacity of the receiving waterbody.
ADM87	A pre-construction survey shall be completed as part of the Land Disturbance Procedure to identify areas of potential vulnerability to run-off and any additional measures included in the ESMP.
ADM88	Construction of drainage for construction shall be undertaken outside of the wet season where practicable, and especially for dewatering of excavations and instream

Mitigation ID	Mitigation Measure
	construction activities. Works shall be scheduled to minimise the amount of time flow diversions are in place
ADM89	Instream construction of crossings, culverts etc shall be undertaken when water levels are at their lowest, to reduce any effects from sediment mobilisation.
ADM90	Drainage shall be constructed following topsoil stripping.
ADM91	Cut-off drains shall be installed parallel to construction lines to control run-off from adjacent areas.
ADM92	Where drainage cut off drains discharge into local watercourses, discharge points must be micrmisited in the field to avoid further erosion and fitted with in-line silt traps to minimise sediment run-off at the discharge point.
ADM93	Topsoil stockpiles must be set back at least 10 m from the banks of any watercourses or drains and, where applicable, designed with openings to ensure the stacks do not prevent flow conveyance.
ADM94	Stockpile run-off shall be routed away from watercourses, and vegetated strips maintained adjacent to watercourses to impede surface runoff and trap sediment.
ADM95	Other sediment control measures such as bunds, berms and grips and silt fencing shall be constructed within the construction working width as appropriate and where watercourses may be affected.

Residual Impact

Following the implementation of additional mitigations, no significant ecological effects on aquatic habitats and biota are expected as a result of indirect degradation and disturbance.

13.4 Direct Operational Impacts

13.4.1 Operational Impact CODE BD7: Accidental Mortality of Fauna During Operation

Impact description

The upgrade of the railway will mean an increase in the frequency and speed of trains using the route, which will mean an associated increased risk of mortality for fauna crossing the rail line. Current train movements involve a maximum of 10 journeys per day and following the upgrade works movements are anticipated to rise to on average of 22 per day. The presence of culvert structures has the potential to create barriers to the movement of species which use stream banks as movement corridors and could therefore result in exposure to collision risk where these animals are forced to cross the rail tracks, for example during periods of high flow. Faunal species most sensitive to noise and vibration may avoid the tracks altogether, however, and may not be affected, particularly as the most vulnerable species are associated with and largely confined to closed canopy forest areas, none of which will be newly fragmented. Accidental mortality during operation is also possible due to interaction with vehicles and machinery during maintenance clearance.

BD7a Collison with Trains

Consultation with the local communities suggested only a low incidence of faunal collisions in the area at present, and whilst there will be the increased speed and frequency (just over twice the amount) of trains the effect will be periodic and considered to represent a Very Small additional magnitude of impact compared to the present, affecting individuals but not populations, and is not expected to be ecologically significant.

BD7b Interaction with Clearance Vehicles and Machinery

This impact may affect fauna which have limited mobility and unable to escape the area, or nesting individuals. This effect will be similar to the potential mortality effects during construction clearance, though likely to affect less dense and younger vegetation, which offers fewer resting places for fauna. Impact magnitude could be Medium for nesting species, affecting up to Medium sensitivity fauna which may be resident next to the operational rail line and could be significant at a local scale.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM4, PDM6, PDM15, PDM13.
Good Practice Mitigations: GPM 46

Additional Mitigation and Enhancement Measures

Table 13-9 Impact BD7 Mitigation Measures

Mitigation ID	Mitigation Measure
Avoidance	
ADM11	Maintenance clearing of culverts to prevent debris building up and acting as a barrier to movement under the rail line for semi-aquatic species which use the riparian area for movement.
ADM14	Maintenance vegetation clearance will be avoided during sensitive seasons for species of conservation concern known or suspected to use the site, including the main aggregate breeding season for the threatened birds known or suspected to be present.
Minimisation	
ADM2	Clearance will follow a prescribed Vegetation Clearance Procedure and a thorough survey by an Ecological Specialist will be undertaken immediately prior to all vegetation clearance. Threatened vegetation species will be left in place where possible, and translocation of threatened plants and any fauna species less able to escape the area by themselves will take place. For large tree species that cannot be avoided, seeds or cuttings will be taken for nursery propagation and restoration planting. If any nests of breeding birds are found clearance will not proceed until the young have fledged..
ADM3	The operational workforce will be trained in biodiversity management requirements, including how to recognise and avoid impacts to sensitive species where these are present.

Residual Impact

Following the application of additional mitigation, no ecologically significant effects are predicted.

13.4.2 Operational Impact CODE BD8: Introduction and Spread of Alien Invasive Species

Impact Description

Continued maintenance vegetation clearance during the operational phase means that the risk of spread of alien invasive plant species will continue into this Project phase. In addition, the turbulence caused by passing trains may pick up seeds of alien invasive plants where they occur along the RoW and carry them to new areas, thus facilitating their spread.

Impact Assessment

With standard good practice mitigation in place for the control of alien invasive species no significant residual effects are predicted.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: NONE.
Good Practice Mitigations: GPM5

13.5 Indirect Operational Impacts

13.5.1 Operational Impact CODE BD9: Degradation of Terrestrial Habitats and Disturbance to Terrestrial Fauna including Barrier Effects

Impact Description

Rail traffic and maintenance clearance along the RoW will result in sustained habitat degradation and disturbance of fauna along the RoW, as a result of continued air quality degradation and noise and visual disturbance, primarily as a result of combustion engine emissions, use of herbicides for ongoing vegetation clearance and the physical presence of trains and maintenance vehicles.

BD9a Operational Habitat Degradation: Flora

Indirect impacts to flora during operation are expected to be limited to exposure to NO_2 and SO_2 emissions from passing trains and maintenance vehicles and potential drift of herbicides used during vegetation clearance. This is expected to be limited to a maximum 200 m buffer of the rail line depending on wind speed and direction and will result in sustained exposure of vegetation to air quality degradation for the duration of operations, though extending to a more limited area than during construction. The impact will be local in scale, and directed away from the closest high value habitat to the rail line (the closed canopy forest within the Sekondi Waterworks Forest Reserve), since this is located to the northeast of the line and the prevailing wind direction is to the southwest. As outlined in Section A of Annex A (Air Quality), taking into account existing background pollutant concentrations, the likelihood of an exceedance of the objectives for the protection of vegetation and ecosystems is considered low. The magnitude of increased impact for all areas, including the reserve, as a result of increased train movements is considered to be Very Small and not expected to result in ecologically significant effects.

BD9b Operational Habitat Degradation and Disturbance: Fauna

On a sustained, long-term basis the accumulation of toxic substances in plants has the potential to lead to accumulation of these toxins up the food chain and may affect the health of faunal individuals, in a worst case resulting in population reduction at a local scale for some species levels of some animal species. Should any plants themselves die as a result of exposure there may also be a localised reduction in food supply. Such impacts will, however, be local in nature and expected to species which have very limited ranges and become habituated to living close to the rail line throughout their life cycle. The magnitude of this impact is expected to be Very Small and not ecologically significant.

A sustained increase in noise and vibration as a result of the passage of trains can result in disturbance displacement and barrier effects, though will be intermittent in nature. Given the decrease in the detectability of noise and vibration with distance, disturbance effects are expected to me limited to a buffer distance of up to 500 m from the rail line. Since the frequency of trains will be higher than under current operations, the frequency of disturbance will also be higher, though the magnitude of change is considered to be Small. The barrier effects associated with linear infrastructure can affect the dispersion and movement capacity of fauna; however, since the rail line deviates very little from its existing route (and where it does this is in already degraded habitat) the additional barrier effect associated with the operation of the rail line is considered to be of Very Small additional magnitude and not ecologically significant.

Lighting during the operational phase is expected to be limited to station and maintenance buildings and passing trains during the hours of darkness. The impact of operational lighting will therefore be localised and intermittent respectively, and since stations will be located in areas which already contain settlements this is not expected to add significantly to existing light levels. Disturbance impacts associated with lighting are therefore considered to be of Very Small additional magnitude and not ecologically significant.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM1, PDM2, PDM16, PDM17, PDM19, PDM20, PDM21, PDM24, PDM26, PDM27.
Good Practice Mitigations: GPM3, GPM4, GPM16, GPM22, GPM23, GPM24, GPM25, GPM26, GPM27, GPM29, GPM30, GPM47, GPM48, GPM50, GPM51, GPM54.

13.5.2 Operational Impact CODE BD10: Degradation of Aquatic Habitats and Disturbance to Aquatic Fauna, Including Barrier Effects

Crossings will be designed to allow the free passage of aquatic and semi-aquatic species during both high and low flows; however, there is a potential for culverts to become blocked with debris which is carried into the area by stream flow. This impact would be temporary and at a local scale and would affect species which make local movements but not long-distance migrations. Localised habitat modification may also occur due to culvert blockage, creating impoundments upstream and erosion pools may be created downstream of culverts due to the force of the water emerging from the culvert structure. Again, this would be localised in nature.

Potential indirect effects on aquatic fauna during operation may also occur as a result of reduced water quality as a result of accidental leaks and spills from trains and during maintenance work, and sedimentation due to runoff from areas cleared of vegetation during maintenance. Erosion caused by structures in the aquatic environment is another potential source of sediment. Such effects would be localised in nature.

Impact Assessment

Pollution and sediment loading can cause mortality and sublethal effects to individuals within the affected zone (expected to be up to 500 m downstream of crossings during operation) and blocking of culverts may cause temporary barrier effects at a local scale. The magnitude of impact on the medium sensitivity fish, reptiles and amphibians present, is considered to be generally small, although culvert blockage on a sustained basis could affect distribution over one or more generations and, in such cases, could be considered to be Medium magnitude and ecologically significant.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM8, PDM16, PDM17, PDM20, PDM21, PDM22, PDM27.
Relevant GIIP Measures: NONE

Table 13-10 Impact BD10 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM11	Maintenance clearing of culverts to prevent debris building up and acting as a barrier to movement under the rail line for semi-aquatic species which use the riparian area for movement.

Residual Impact

Following the application of additional mitigation, no effects relating to this impact are considered to be ecologically significant.

13.5.3 Operational Impact Code BD11: Degradation of Groundwater Dependent Habitats due to Permanent Groundwater Abstraction

Permanent abstraction is likely to be required at the Heavy Rail Maintenance facility near Tarkwa. This has the potential to lead to sustained depletion of water supply to habitats and therefore long-term loss of groundwater dependent habitat on a local scale. The impact has the potential to impact discrete patches of high sensitivity Freshwater Swamp Forest known to support vulnerable flora, and potentially supporting endangered flora species which trigger critical habitat, leading to significant effects at up to national scale.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: PDM3
Relevant ESIA GIIP: NONE

Additional Mitigation

Table 13-11 Impact BD11 Mitigation Measures

Mitigation ID	Mitigation Measure
Avoidance	
ADM13	Groundwater abstraction will be sited to allow a buffer of 250 m from habitats which may be groundwater dependent, including Freshwater Swamp Forest. This buffer can be reduced only if site-specific conceptual groundwater modelling suggests a more localised impact zone.

Mitigation ID	Mitigation Measure
ADM81	Borrow Pit Management Plan should include in site definition the assessment of aquifer depth and conceptual groundwater model to ensure extraction activities maintain the required buffer above the aquifer.

Residual Impacts

Following the application of the additional mitigation no significant ecological effect to groundwater dependent ecosystems is predicted.

13.6 Ecosystem Services Assessment

13.6.1 Introduction

The Ecosystem Services Impact Assessment outlined in this section has been undertaken in line with the method summarised in Section **Error! Reference source not found.**. This Section identifies priority ecosystem services, providing a framework for considering potential impacts, which are often interdependent across various specialist topics such as water, socio-economics and cultural heritage as well as biodiversity. The increased usage or impacts to one service could result in a corresponding reduction in capacity, availability or efficiency of another service.

13.6.2 Types of Ecosystem Services

Ecosystem services are typically classified into one of the following four categories[2]:

- Provisioning services— the goods or products obtained from ecosystems, such as food, fibres, fuel (e.g. wood, biomass), timber, medicine, and freshwater.
- Regulating services— the benefits obtained from an ecosystem's regulation or control of natural processes, such as pollination, climate regulation, disease control, erosion prevention, water purification and flow regulation, and protection from natural hazards.
- Cultural services— the non-material benefits obtained from ecosystems, such as recreation, aesthetic enjoyment, sacred sites and sense of place.
- Supporting services— the natural processes required to maintain all other ecosystem services, such as soil formation, nutrient cycling and primary production.

The ecosystem services identified and assessed through the ESIA largely fall within provisioning and cultural services. These will be the focus of this assessment.

13.6.3 Priority Ecosystem Services

Under IFC PS6, priority ecosystem services are defined as "*(i) those services on which project operations are most likely to have an impact and, therefore, which result in adverse impacts to Affected Communities; and/or (ii) those services on which the project is directly dependent for its operations (e.g., water).*"

Priority ecosystem services can be considered as a function of the importance of the ecosystem service to the beneficiaries and replaceability of the ecosystem service:

- **Replaceability** is dependent upon the existence of alternatives, as well as accessibility, sustainability, cost and appropriateness (for example in relation to cultural views and preferences) of such alternatives.

[2] As defined by the UN Millennium Ecosystem Services Assessment. Website: https://www.millenniumassessment.org/en/index.html (viewed 10 September 2020)

- **Importance** of an ecosystem service can be determined by considering the intensity and scope of use, degree of dependence, and stakeholder, cultural and historical importance.

Priority ecosystem services are assessed according to the framework illustrated in Figure 13-1 below.

			Replaceability of Ecosystem Service		
			Easy (many viable alternatives present in area)	**Moderate** (some viable alternatives present in area)	**Difficult** (irreplaceable or few viable alternatives present in area)
Importance of Ecosystem Service	(i) An ecosystem service upon which vulnerable groups are dependent for their livelihood or wellbeing (e.g. drinking water, fuel for heating), or an ecosystem service identified as a priority service by local communities through stakeholder engagement activities; or (ii) An ecosystem service on which the Project is dependent and cannot function without	**High**	Priority	Priority	Priority
	(i) An ecosystem service upon which over 50% of the local community are dependent for their livelihood or elements of their wellbeing; or (ii) An ecosystem service which is utilised by the Project but upon which the project is not dependent	**Medium**	Medium	Priority	Priority
	(i) An ecosystem service upon which 10-50% of the local community are dependent for their livelihood or elements of their	**Low**	Low	Medium	Priority
	(i) An ecosystem service upon which less than 10% of the local community are dependent for their livelihood or elements of their wellbeing	**Very Low**	Low	Low	Medium

Figure 13-1 Ecosystem Services Assessment Framework

Prioritisation of ecosystem services also considers stakeholder views as the human beneficiaries of the services. Priority ecosystem services have been identified in several chapters in the ESIA. These are analysed in Table 13-12 below.

Table 13-12 Priority Ecosystem Services

Ecosystem Service	ESIA Topic	Importance	Replaceability	Priority
Provisioning Services				
Surface water	Water and Biodiversity	Surface water, either rivers, streams or ponds are of less importance to vulnerable households affected by land acquisition. It was rarely used as a source of domestic water. It is used by artisanal miners, which has impacted on surface water quality for domestic consumption. However, surface water is critical for habitat maintenance and in particular freshwater swamp forest and other riparian vegetation. It is also critical that surface water is maintained for fish and other aquatic species.	While alternatives to surface water are used by communities, it is not replaceable for dependent habitats, flora and fauna within its catchment. Replaceability is therefore considered to be **Difficult**	Yes
Groundwater is an important source of water in the Project area with various pipe water supply schemes for domestic use as well as for mining and mineral processing.	Water	Piped water is more important in larger towns and centres. For example, two thirds of water supply is from groundwater in Wassa West, whether by piped borehole supply or community boreholes and wells. Although estimates suggest only 27% of the Ankobra basin population is suppled through piped abstractions, amongst vulnerable households affected by land take, only 12% had a tap in their house, however 41% used a borehole,	Given the sensitivity of groundwater to abstractions is high, the replaceability of groundwater is considered to be **Difficult**	Yes

Ecosystem Service	ESIA Topic	Importance	Replaceability	Priority
		30% used a public standpipe and 10% used a hand dug well. Groundwater is also important for habitats and flora in particular. Importance of groundwater is considered to be **High**		
Crops	Socio-economic	Agriculture is a primary economic activity for 22% of all PAPs affected by land acquisition. In terms of households, 52.5% rely on farming to support their livelihoods while 47.8% see agriculture as either their primary or secondary livelihood. Importance is considered to be **High** due to the importance of crop farming for both subsistence and income generation.	Although PAPs will receive compensation as specified in the Resettlement Action Plan (RAP), there is no guarantee that land is available for all affected PAPs. Replaceability is considered to be **Moderate**	Yes
Timber	Biodiversity and Socio-economic	Timber was not identified as an important ecosystem service in the Project area. Importance is considered to be **Very Low**	Timber is available outside the RoW around communities and therefore replaceability is considered to be **Easy**	No
Fisheries and aquaculture	Biodiversity	Very few PAPs rely on fishing or fisheries either for recreation or to support their livelihood. Importance is considered to be **Very Low**	Replaceability is considered to be **Easy**	No
Medicinal plants and fruits	Cultural Heritage, Socio-	Focus group discussions indicate that medicinal plants are an important natural resource and often used as a	As this is a linear project and most medicinal plants are not endemic or	No

Ecosystem Service	ESIA Topic	Importance	Replaceability	Priority
	economic and Biodiversity	first choice treatment before more expensive formal medical treatment is sought in clinics and hospitals. Importance is considered to be **Medium**	critically endangered, replaceability is considered to be **Easy**	
Wildlife hunting	Socio-economic and Biodiversity	Community consultation did not indicate that hunting is an important livelihood or activity and only a few focus group discussions highlighted that some people hunt rodents. Importance is considered to be **Low**	Since hunting appears to target rodents replaceability is considered to be **Easy**	No
Fuelwood	Socio-economic	Fuelwood is commonly collected from forests and woodland surrounding villages and from farms. It is estimated that the majority of households use firewood and charcoal for cooking therefore importance is considered to be **Medium**	Forests are coming under greater pressure due to firewood and timber extraction and charcoal production. Replaceability is considered to be **Moderate**	Yes
Sand, natural gravel and ballast	Socio-economic, Soils, Project Description	Sand and natural gravel are harvested and sold by communities and is a source of livelihood for only a limited number of PAPs. However, the Project requires sand, natural gravel and ballast for the construction of the track. Due to this requirement, importance to the Project is considered to be **High**	The Project will be obtaining ballast from waste material from an existing manganese mine. Therefore, replaceability is considered to be **Easy**	Yes

Ecosystem Service	ESIA Topic	Importance	Replaceability	Priority
Gold mining	Socio-Economic	Gold mining was identified as a primary or secondary livelihood natural resource by 143 households (13%) of the census survey while 20.6% stated that artisanal activities play some role in supporting their livelihoods. Artisanal mining is considered to have a **Low** importance to vulnerable PAPs in the Project area.	Only small sections of streams will be crossed by the Project and they will not significantly limit access to the resource once construction is complete. Given the availability of other mining locations, replaceability is considered to be **Easy**	No
Cultural Services				
Rivers and streams	Cultural Heritage and Water	Rivers and streams are closely associated with rituals, sacred sites and taboos and several sacred streams cross the Project RoW. Due to the importance of these sites for all communities along the Project RoW, importance is considered to be **High**	Sacred sites are site specific but with specific rituals, they can be relocated. Replaceability is considered to be **Moderate**	Yes
Sacred forest	Cultural Heritage	Forests are important for medicines and closely associated sacred sites. Due to the importance of sacred sites for all communities along the Project RoW, importance is considered to be **High**	Sacred sites are site specific but with specific rituals, they can be relocated. Replaceability is considered to be **Moderate**	Yes

Based on this analysis, priority ecosystem services for the Project are:

- Groundwater;
- Surface water;
- Crops;
- Fuelwood;
- Sand, natural gravel and ballast;
- Sacred rivers and streams; and
- Sacred forest

The impacts to these ecosystem services are summarised in 13.6.4 below.

13.6.4 Ecosystem Services Impacts

Ground and surface waters

Chapter 12 on Water Impacts and the Water Technical Annex assess the impacts to ground and surface waters, including impacts associated with abstractions during operation and construction. Construction impacts include impacts caused by abstractions from groundwater and surface water, impacts to surface waters from flow diversions and impacts to surface water from flooding. All three impacts are predicted to be **Minor** significance with the application of embedded and additional mitigation.

However, groundwater aquifers are considered to be high sensitivity receptors and while impact significance during construction is predicted to be minor, operational is likely to be major without additional mitigation measures. The application of additional mitigation will reduce this impact significance to **Minor**.

Crops

Chapter 14 on Socio-Economic Impacts and the Social Technical Annex considers economic displacement, including the loss of crops. Important crops include maize, rice, cassava, yam and cocoyam. The impact will be experienced prior to construction, when land is cleared to make way for construction along the RoW. Impact significance of economic displacement with the application of embedded and additional mitigation is predicted to be **Moderate** while the impacts associated with the loss of crops directly is considered to be **Minor**. This impact is also explored in more detail in the Resettlement Action Plan (RAP) for the Project.

Fuelwood

Chapter 14 on Socio-Economic Impacts and the Social Technical Annex explores the loss of access to important ecosystem services, including fuelwood. Following the application of embedded and additional mitigation, the impact to fuelwood and similar resources is considered to be **Negligible**.

Sand, natural gravel and ballast

Chapter 11 on Soils and Geology and the Soils and Geology Technical Annex assess the impacts to soils. Impacts to soils and geology associated with construction and operation are predicted to be either **Minor** or **Negligible**. The Project's reliance on sand, gravel and ballast is described in the Project Description, indicating that ballast will be sourced from waste material and therefore the Project will not impact on the availability of this important resource.

Sacred Sites

Chapter 16 on Cultural Heritage and the Cultural Heritage Technical Annex describe impacts to intangible cultural heritage, including sacred sites, streams and forest. Chapter 14 on Water also identifies a sacred stream. Sacred sites and rivers / streams near the RoW include the Huni, Diatuo, Twena, Baasin and Atta rivers in Huni Valley, the Huni, Esukokoo and Esuoben Bansa in Amoanda, and a sacred river in Bonaswire. Impacts may be direct during construction or indirect through disturbance by construction workers. Impacts are predicted to be **Moderate** with only the application of embedded measures, however the application of additional measures will reduce significance to **Negligible**.

14. SOCIO-ECONOMICS IMPACT ASSESSMENT

14.1 Introduction

The following socio-economic impacts have been identified in relation to the construction phase and are assessed in section 14.2, with the assessment summarised in Table 14-1:

- Physical and economic displacement (SE1);
- Impacts to priority ecosystem services (SE2);
- Direct and indirect local employment opportunities (SE3);
- Loss of employment (direct and indirect) at the conclusion of the construction phase (SE4);
- Community grievance over unmet expectations (SE5); and
- Influx and change to demographics (SE6).

The following impacts have been identified in relation to the operation phase and are assessed in section 14.3, with the assessment summarised in Table 14-2:

- Long term employment and economic benefits during operation (SE7).

Subject to its scope and activities, the closure and decommissioning phase is anticipated to create similar impacts and require similar mitigation measures to the construction phase. These impacts and mitigation measures are not repeated for closure and decommissioning; instead it is recommended that prior to closure a decommissioning plan is developed in line with the prevailing applicable standards and that this decommissioning plan include consideration of all those GIIP and mitigation measures that are outlined in this ESIA for the construction phase.

Socio-economic impacts are also controlled through the measures outlined in the following sections of the ESIA, and these are not repeated in this section: Chapter 8 Air Quality, Chapter 10 Noise and Vibration, Chapter 12 Water, Chapter 18 Transport, and Chapter 19 Waste. Safety risks to local communities from accidents are addressed through Chapter 20 Major Hazards. However, a community health screening is presented in Section **Error! Reference source not found.** summarising impacts identified across all impact sections.

Table 14-1: Socio-Economic Construction Impact Summary

Impact #	**SE1**	**SE2**	**SE3**	**SE4**	**SE5**	**SE6**
Receptor importance/ vulnerability	High	High	High	Medium	Medium	Medium
Frequency	Single Event	Single Event	Ongoing	Single Event	Low	Low
Likelihood	Certain	Certain	Certain	Certain	Low	Low
Extent	Local	Local	Local	Local	Local	Local
Duration	Permanent	Permanent	Construction	Permanent	Occasional	Limited
Magnitude	Large	Small to Very Small	Beneficial	Medium	Small	Very Small
Effect	Adverse	Adverse	Positive	Adverse	Adverse	Adverse

Impact #	SE1	SE2	SE3	SE4	SE5	SE6
Direct/ indirect	Direct	Direct	Direct and indirect	Direct and indirect	Direct	Direct and indirect
Significance	Major	Moderate to Minor	Positive	Moderate	Minor	Negligible
Additional mitigation or enhancement? (Y/N)	Yes	Yes	Yes	Yes	Yes	Yes
Residual Significance	Moderate	Minor to Negligible	Positive	Minor	Negligible	Negligible

Table 14-2: Socio-Economic Operation Impact Summary

Impact #	SE7
Receptor importance/ sensitivity	Medium
Frequency	Ongoing
Likelihood	High
Extent	Regional
Duration	Ongoing
Magnitude	Beneficial
Effect	Positive
Direct/ indirect	Direct and indirect
Significance	Positive
Additional mitigation? (Y/N)	Yes
Residual Significance	Positive

14.2 Construction Impacts

The Project will require land acquisition between Manso and Huni Valley through Sections 3 – 5 as defined in the Project Description in Chapter 3. These sections cover the route from chainage section 32.6 to 85.8. The section running through Nsuta to north of Tarkwa includes the most significant route alignment as well as the construction of the Nsuta and Tarkwa stations and the bypass to the east of Tarkwa. The land acquisition required for the Project will result in both physical and economic displacement for people residing, working and farming along the proposed new RoW. This will also impact how local communities access natural resources that provide important services and products for both household consumption and economic gain.

Construction will also bring new opportunities in the form of jobs and business. New people may migrate to the region to benefit from these opportunities, while also potentially changing the local demography.

14.2.1 Physical and Economic Displacement (SE1)

Impact Description

The permanent RoW for the standard gauge rail will generally be 30m either side from the centre of the track. Therefore, land acquisition will result in a width of approximately 60m along the route, that will intersect farmland and businesses along the route. As identified in the census and socio-economic survey of affected people, 1,253 Project Affected People (PAPs) will be affected by either physical and / or economic displacement resulting in the displacement of 1,612 assets. This will impact on the following livelihoods:

- Agricultural based livelihoods;
- Small, fixed businesses; and
- Informal street and market vendors.

This will result in a loss of livelihoods for those losing access to their land or business. The extent of impact will depend on the proportion of livelihoods affected by the land acquisition and the ability of PAPs to obtain access to replacement land or a new location to set up their businesses.

Additionally, it will result in the loss of permanent residences and ancillary buildings such as toilets, bathrooms, outdoor kitchens, animal enclosures, etc.

In summary the following assets and activities will be impacted by the Project:

- 560 properties including land, structures and structural improvements;
- 721 farms;
- 10 permanent street vendors;
- 93 temporary business structures;
- 61 ancillary residential structures including sanitary blocks, kitchens, sheds and storage;
- 53 business premises; and
- 114 tenants renting in affected accommodation.

Several categories of PAPs were identified as being highly vulnerable to physical and economic displacement including:

- Female headed households;
- Households headed by someone who is 65 years or older;
- PAPs with household size of 8 or more;
- Households who self-assessed as either being destitute, not having enough to eat in last 12 months or never having enough to get by.

Esuaso and Benso are the most impacted communities in terms of number of PAPs with 83 and 66 PAPs respectively impacted by land acquisition.

The Project may also result in severance impacts, where community members are cut off from their lands, which are divided by the protective fence along the RoW.

Impact Assessment

The GIIP measures that are referenced in the box below are detailed in Chapter 22, and in summary include:

– A Resettlement Action Plan (RAP) that will be developed to guide the resettlement process, including identification of PAPs, consideration of baseline conditions, eligibility requirements, entitlements, vulnerability, grievance mechanism and consultation / disclosure activities. The RAP outlines measures for compensation and livelihood restoration for all displaced PAPs, however vulnerable PAPs (as identified in Section **Error! Reference source not found.**) will be entitled to additional livelihood restoration measures and support.

Relevant ESIA GIIP: GPM45

The **frequency** of this impact will be **Permanent** prior to Project construction as the land must be made available to the Project ahead of construction commencing. The **likelihood** of the impact is **Certain**. The **extent** of the impact would be to individuals located within the RoW and so is classed as **Local**. The **duration** of the impact is **permanent** event prior to the commencement of construction. Based on these assessments and embedded mitigation, the **magnitude** is assessed as **Medium** with the application of a RAP developed to IFC Performance Standard 5 outlining the provision of adequate compensation, replacement housing options and livelihood restoration. Combined with the receptor vulnerability of High for identified vulnerable groups, the pre-mitigation significance is **Major** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

Additional mitigation recommended to lower PAP vulnerability and impact significance are outlined in Table 14-3.

Table 14-3 Impact SE1 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM69	A Stakeholder Engagement Plan shall be developed which articulates the stakeholder engagement programme. This Plan shall: • manage expectations through all engagement interactions, providing honest information on the availability of jobs, their duration and where local workers will be recruited from to ensure that local communities understand what is feasible in terms of job opportunities. • ensure transparency to prevent conflict over jobs both within and between communities. • clearly explain the RAP process, entitlements and livelihood restoration measures. • include measures for local employment and procurement of goods and services including making use of information channels accessible to communities such as posters and community announcements to provide adequate information on opportunities.
ADM25	A Community Grievance Mechanism (CGM) must be developed to provide a process for receiving grievances from communities, individuals, NGOs, and local government and managing them in an efficient and transparent manner. As part of this plan a Community Grievance Register will be used to record and track the completion of community grievances. This will be implemented throughout engagement on the RAP and entitlements. Communities will be made aware of the mechanism for registering

Mitigation ID	Mitigation Measure
	complaints and feedback relating to land acquisition, entitlements and any other Project impacts.
ADM70	Specific land acquisition engagement shall be conducted with PAPs during household sign-off on compensation measures. This shall include discussion of entitlements and livelihood restoration measures. The RAP implementation team will confirm vulnerability levels and support the PAP in choosing the most suitable livelihood restoration options for their individual circumstance.
ADM73	During detailed design, prior to construction, engagement with local communities will be undertaken on rail crossings points to identify the most suitable locations to enable communities to access their land on the other side of the RoW, taking into consideration technical and financial feasibility.

Residual Impact

With the application of engagement and a thorough household sign-off process, vulnerability of PAPs will be lowered, reducing impact significance to **Moderate**.

14.2.2 Access to Ecosystem Services (SE2)

Impact Description

Land acquisition will affect access to important ecosystem services including crops, forest and wooded areas that provide medicinal plants, fuelwood and non-timber forest products such as fruits, craft materials, thatch and other materials used to make household utensils and items. Farming is considered a priority ecosystem service (with 47.8% of households indicating that farming was either their primary or secondary source of income and supporting the livelihoods of 52% of affected households to some extent) but other services identified as important for PAPs in the Project area include gold, edible roots and fruits, firewood, sand, medicinal plants and edible insects. 134 households affected by land acquisition also rely on natural resource gathering to support their livelihood.

The fenced RoW will also potentially sever access to ecosystem services.

Impact Assessment

The GIIP measures that are referenced in the box below are detailed in Chapter 22, and in summary include:

- A Resettlement Action Plan (RAP) that will be developed to guide the resettlement process, including identification of PAPs, consideration of baseline conditions, eligibility requirements, entitlements, grievance mechanism and consultation / disclosure activities. The RAP outlines measures for compensation and livelihood restoration for all displaced PAPs, however vulnerable PAPs (as identified in Section **Error! Reference source not found.**) will be entitled to additional livelihood restoration measures and support.

Relevant ESIA GIIP: GPM45

The **frequency** of this impact will be **Permanent** prior to Project construction as the land must be made available to the Project ahead of construction commencing. The **likelihood** of the impact is **Certain**. The **extent** of the impact would be to individuals located within the RoW and so is classed as **Local**. The **duration** of the impact is **permanent** event prior to the commencement of construction. Based on these assessments and embedded mitigation, the **magnitude** is assessed as **Small** to **Very Small** with the application of a RAP developed to IFC Performance Standard 5 outlining the provision of adequate compensation for lost crops. Other services will be available outside of the RoW on community land. Combined with the receptor vulnerability of High for identified vulnerable groups, the pre-mitigation significance is **Moderate** for crops and **Minor** for other natural resources and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

Additional mitigation measures recommended to lower vulnerability of PAPs to loss of ecosystem services are outlined in Table 14-5.

Table 14-4 Impact SE2 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM69	A Stakeholder Engagement Plan shall be developed which articulates the stakeholder engagement programme. This Plan shall: • manage expectations through all engagement interactions, providing honest information on the availability of jobs, their duration and where local workers will be recruited from to ensure that local communities understand what is feasible in terms of job opportunities. • ensure transparency to prevent conflict over jobs both within and between communities. • clearly explain the RAP process, entitlements and livelihood restoration measures. include measures for local employment and procurement of goods and services including making use of information channels accessible to communities such as posters and community announcements to provide adequate information on opportunities.
ADM25	A Community Grievance Mechanism (CGM) must be developed to provide a process for receiving grievances from communities, individuals, NGOs, and local government and managing them in an efficient and transparent manner. As part of this plan a Community Grievance Register will be used to record and track the completion of community grievances. This will be implemented throughout engagement on the RAP and entitlements. Communities will be made aware of the mechanism for registering complaints and feedback relating to land acquisition, entitlements and any other Project impacts.
ADM73	During detailed design, prior to construction, engagement with local communities will be undertaken on rail crossings points to identify the most suitable locations to enable communities to access their land on the other side of the RoW, taking into consideration technical and financial feasibility.

Residual Impact

With the application of engagement and a thorough engagement process, vulnerability of PAPs will be lowered, reducing impact significance to **Minor** for crops and **Negligible** for other resources.

14.2.3 Direct and indirect local employment opportunities (SE3)

Impact Description

Unemployment levels are currently high in the Project area. The census survey conducted in August / September 2020 identified that out of the total affected population, there were 3,191 adults and youth available to work, however of this number, 720 (23%) were not in work. Education attainment and limited opportunities are key barriers to obtaining employment. Literacy levels for women average 69.4% in Western region and 81.8% for men. Average literacy levels for PAPs was 68.8%. The data also show that 8% of PAPs have never gone to school, while a further 12.6% have not progressed further than partially completing senior secondary school.

The Project will generate up to 200 construction jobs at the start of construction, rising to 800 at its peak along all work-fronts. Construction will last for approximately three years. An additional 60 contract staff will be required during the construction phase. The construction workforce is predicted to be 97% locally recruited with only 25 expatriates expected to make up the construction workforce.

This will provide much needed jobs in the Project area, which is a high priority for local stakeholders, youth and community leaders, as highlighted in the outcomes of stakeholder engagement in Chapter 6. Indirect benefits include the provision of goods and services opportunities for local contractors and service providers to support construction activities. This may include materials but also local shops, restaurants, bars, and other services that will benefit from the Project construction period.

Impact Assessment

The GIIP measures that are referenced in the box below are detailed in Chapter 22, and in summary include:

- Amandi HRM Policies, Procedures and Rules document with provisions for supporting local content; and
- Influx Population Surge Policy Implementation Plan to address influx and promote the recruitment of local labour.

Relevant ESIA GIIP: GPM31, GPM32

The **frequency** of this impact will be **Short Term** during the three-year construction period. The **likelihood** of the impact is **Certain** due to the certainty of labour requirements. The **extent** of the impact would be to individuals located within the RoW and so is classed as **Local**. The **duration** of the impact is **short term** for construction only. Based on these assessments and embedded mitigation, the **magnitude** is assessed as **Beneficial.** Impact significance is therefore assessed as **Positive**.

Additional Mitigation and Enhancement Measures

Additional enhancement measures recommended to enhance the benefit of job creation during construction are outlined in Table 14-5.

Table 14-5 Impact SE3 Enhancement Measures

Mitigation ID	Mitigation Measure
ADM71	A Local Content Policy and Plan shall be developed to supplement the Influx Management Plan, setting specific targets for local procurement and SME support within affected communities along the RoW. In the event that goods and services cannot be provided locally or within the affected MMDA (Mpohor, Tarkwa-Nsuam and Prestea Huni Valley), then preference will be given to companies in Wassa East and Takoradi-Secondi MMDA.
ADM36	The Project HR Plan shall be made available to all Project Workers as part of their induction and in accessible locations, e.g. at site office, on a noticeboard in rest areas etc. The Project HR Plan will include: • the key commitments that are made in relation to labour management for the Project. • all applicable measures outlined in the ESMP, ESIA and other Project Documentation (e.g. legal requirements). • measures to maximise access to employment for women by offering on the job training and skills enhancement schemes where relevant. • measures to ensure contract workers and labourers understand the details of their contract period so that they can prepare appropriately for termination of their employment. Existing HRM Policies and Procedures shall be expanded to specify clear contracting procedures and workers rights in accordance with Ghana Law and IFC PS2 and will be equally applied to Amandi and contract staff, with expectations on recruitment and adherence to national and IFC PS2 requirements made clear at the contractor bidding stage and integrated into contractor contracts.
ADM72	A fair and transparent recruitment process will be outlined as part of the Recruitment Management Plan for all openings including working with MMDAs and local authorities to advertise openings as early as possible to allow for potential candidates to apply and prepare their skillsets for local opportunities
ADM69	A Stakeholder Engagement Plan shall be developed which articulates the stakeholder engagement programme. This Plan shall: • manage expectations through all engagement interactions, providing honest information on the availability of jobs, their duration and where local workers will be recruited from to ensure that local communities understand what is feasible in terms of job opportunities. • ensure transparency to prevent conflict over jobs both within and between communities. • clearly explain the RAP process, entitlements and livelihood restoration measures. • include measures for local employment and procurement of goods and services including making use of information channels accessible to communities such as posters and community announcements to provide adequate information on opportunities.

Residual Impact

With the application of enhancement measures, the impact will remain **Positive**.

14.2.4 Loss of employment at the conclusion of the construction phase (SE4)

Impact Description

At the end of construction, contracts with workers will terminate. Construction contracts are relatively short term in nature and the employment period for individual workers may not all extend throughout the construction period of three years. On completion of the construction works, workers will need to find alternative employment. This will be a challenge for those remaining in the Project area, where employment opportunities are limited. For experienced contract workers, this will be standard practice and as such, they will have a lower vulnerability to the change than inexperienced labourers, whose households will have a high vulnerability. For these workers, who may be working for the first time, the situation may be more difficult. They will have become accustomed to receiving a regular and steady income and the loss of this may increase the vulnerability of their households if alternative income streams are not found. The multiplier effect associated with the indirect employment opportunities generated will also end. Receptors in general are considered to have medium vulnerability to this impact.

Impact Assessment

The GIIP measures that are referenced in the box below are detailed in Chapter 22, and in summary include:

- Amandi HRM Policies, Procedures and Rules document with provisions for supporting local content.

Relevant ESIA GIIP: GPM31

The **frequency** of this impact will be **One-off** event at the end of the construction period. The **likelihood** of the impact is **Certain** due to completion of the construction phase. The **extent** of the impact would be to workers and local service providers and so is classed as **Local**. The **duration** of the impact is **Permanent** since the phase will have ended. Based on these assessments and embedded mitigation, the **magnitude** is assessed as **Medium.** Impact significance is therefore assessed as **Moderate**.

Additional Mitigation and Enhancement Measures

Additional mitigation measures recommended to address the impacts associated with job losses are outlined in Table 14-6.

Table 14-6 Impact SE4 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM36	The Project HR Plan shall be made available to all Project Workers as part of their induction and in accessible locations, e.g. at site office, on a noticeboard in rest areas etc. The Project HR Plan will include: • the key commitments that are made in relation to labour management for the Project.

Mitigation ID	Mitigation Measure
	• all applicable measures outlined in the ESMP, ESIA and other Project Documentation (e.g. legal requirements). • measures to maximise access to employment for women by offering on the job training and skills enhancement schemes where relevant. • measures to ensure contract workers and labourers understand the details of their contract period so that they can prepare appropriately for termination of their employment. Existing HRM Policies and Procedures shall be expanded to specify clear contracting procedures and workers rights in accordance with Ghana Law and IFC PS2 and will be equally applied to Amandi and contract staff, with expectations on recruitment and adherence to national and IFC PS2 requirements made clear at the contractor bidding stage and integrated into contractor contracts.
ADM37	All Project Workers shall be provided with a clear contract of employment prior to starting their work on the Project and updated whenever there are changes to their employment terms and conditions. Contracts will clearly detail workers' rights, including at the time of retrenchment. As well as providing written contracts, the contract of employment must be explained verbally to Project Workers, particularly for those who are illiterate. A written record of the worker contract must be kept at the time of hire of each contracted Project Worker. The contract of employment will include: • the name of the company is working for; • the worker's job title; • the date employment began; • where the employment is not permanent, the anticipated duration of the contract; • the place of work or the main location; • the hours of work including any specific shift work requirements; • leave entitlements; • rules relating to overtime and overtime compensation; • the calculation of salary, wages and other benefits, including any rules related to deductions; • the pension and other social security arrangements applicable to the worker; • the length of notice which the worker can expect to give and receive on termination of employment; • reference to the Project's Worker Grievance Mechanism and the person to whom grievances should be addressed; • the requirement to comply with the Worker Code of Conduct; • the disciplinary procedures which are applicable to the worker, including details of representation available to the worker and any appeals mechanism; • any collective bargaining arrangements which apply to the Project Worker.
ADM43	A Project Worker Grievance Mechanism shall be developed, implemented and made available to all Project Workers. Project Workers will not be prevented from raising grievances, and any worker that raises a grievance will be treated fairly without retribution. Workers shall be allowed to raise grievances anonymously if they do not wish to be identified. Project Workers will be allowed to raise grievances in writing or verbally. A Worker Grievance Register must be used to record and track the completion of worker grievances.

Mitigation ID	Mitigation Measure
ADM42	A Project Worker Grievance Mechanism shall be developed, implemented and made available to all Project Workers. Project Workers will not be prevented from raising grievances, and any worker that raises a grievance will be treated fairly without retribution. Workers shall be allowed to raise grievances anonymously if they do not wish to be identified. Project Workers will be allowed to raise grievances in writing or verbally. A Worker Grievance Register must be used to record and track the completion of worker grievances.

Residual Impact

With the application of mitigation measures, the impact will be **Minor**.

14.2.5 Community grievance over unmet expectations (SE5)

Impact Description

Stakeholder engagement indicates that there is strong support for the Project as detailed in Chapter 6. Expectations include greater opportunities for jobs during construction and other income generation opportunities. Benefits are also expected during operation through the potential for increasing trade and reducing the cost of food and other goods. In general, there is high expectation over the economic benefits associated with the project during construction and operation. However, the expectation for jobs particularly amongst the youth is greater during construction. The Government of Ghana will also expect that the Project provides jobs for local unskilled workers. Vulnerability of youth and local labourers is considered to be medium.

Impact Assessment

There are currently no embedded ESIA GIIP associated with this impact.

Relevant ESIA GIIP: there are no specific embedded measures for this impact

The **frequency** of this impact will be **low** but could occur any time until the end of the construction period and into operation. The **likelihood** of the impact is **Low** as the level of expectation will vary amongst the various stakeholders. The **extent** of the impact would be classed as **Local**. The **duration** of the impact is expected to be **occasional** since the phase will have ended. Based on these assessments, the **magnitude** is assessed as **Small.** Impact significance is therefore assessed as **Minor**.

Additional Mitigation and Enhancement Measures

Additional mitigation measures recommended to address potential grievance are outlined in Table 14-7.

Table 14-7 Impact SE5 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM69	A Stakeholder Engagement Plan shall be developed which articulates the stakeholder engagement programme. This Plan shall: • manage expectations through all engagement interactions, providing honest information on the availability of jobs, their duration and where local workers will be recruited from to ensure that local communities understand what is feasible in terms of job opportunities. • ensure transparency to prevent conflict over jobs both within and between communities. • clearly explain the RAP process, entitlements and livelihood restoration measures. • include measures for local employment and procurement of goods and services including making use of information channels accessible to communities such as posters and community announcements to provide adequate information on opportunities.
ADM25	A Community Grievance Mechanism (CGM) must be developed to provide a process for receiving grievances from communities, individuals, NGOs, and local government and managing them in an efficient and transparent manner. As part of this plan a Community Grievance Register will be used to record and track the completion of community grievances. This will be implemented throughout engagement on the RAP and entitlements. Communities will be made aware of the mechanism for registering complaints and feedback relating to land acquisition, entitlements and any other Project impacts.

Residual Impact

With the application of mitigation measures, the impact will be **Negligible**.

14.2.6 Influx and changes to demographics (SE6)

Impact Description

Due to the high availability of local labour and the limited number of expatriates being recruited to the Project during construction, the Project area is not expected to experience any influx. Workers will be recruited locally, as much as possible from within the affected villages. The Project is not expected to operate any worker camps, therefore avoiding the concentration of workers in any one location. All 800 construction workers (during the peak construction period) will be spread along sections of the route. The presence of workers on this Project will not result in a change to the local demography. Receptor sensitivity to influx, if it occurred is considered to be medium.

Impact Assessment

The GIIP measures that are referenced in the box below are detailed in Chapter 22, and in summary include:

- Amandi HRM Policies, Procedures and Rules document with provisions for supporting local content; and
- Influx Population Surge Policy Implementation Plan to address influx and promote the recruitment of local labour.

Relevant ESIA GIIP: GPM31, GPM32

The **frequency** of this impact will be **low**. The **likelihood** of the impact is **Low** as the level of expectation will vary amongst the various stakeholders. The **extent** of the impact would be classed as **Local**. The **duration** of the impact is expected to be **limited**. Based on these assessments, the **magnitude** is assessed as **Very Small.** Impact significance is therefore assessed as **Negligible.**

Additional Mitigation and Enhancement Measures

Additional mitigation measures recommended to address influx are outlined in Table 14-8.

Table 14-8 Impact SE6 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM71	A Local Content Policy and Plan shall be developed to supplement the Influx Management Plan, setting specific targets for local procurement and SME support within affected communities along the RoW. In the event that goods and services cannot be provided locally or within the affected MMDA (Mpohor, Tarkwa-Nsuam and Prestea Huni Valley), then preference will be given to companies in Wassa East and Takoradi-Secondi MMDA.
ADM72	A fair and transparent recruitment process will be outlined as part of the Recruitment Management Plan for all openings including working with MMDAs and local authorities to advertise openings as early as possible to allow for potential candidates to apply and prepare their skillsets for local opportunities
ADM69	A Stakeholder Engagement Plan shall be developed which articulates the stakeholder engagement programme. This Plan shall: • manage expectations through all engagement interactions, providing honest information on the availability of jobs, their duration and where local workers will be recruited from to ensure that local communities understand what is feasible in terms of job opportunities. • ensure transparency to prevent conflict over jobs both within and between communities. • clearly explain the RAP process, entitlements and livelihood restoration measures. include measures for local employment and procurement of goods and services including making use of information channels accessible to communities such as posters and community announcements to provide adequate information on opportunities.
ADM25	A Community Grievance Mechanism (CGM) must be developed to provide a process for receiving grievances from communities, individuals, NGOs, and local government and managing them in an efficient and transparent manner. As part of this plan a Community Grievance Register will be used to record and track the completion of community grievances. This will be implemented throughout engagement on the RAP and entitlements. Communities will be made aware of the mechanism for registering complaints and feedback relating to land acquisition, entitlements and any other Project impacts.

Residual Impact

With the application of mitigation measures, the impact will remain **Negligible**.

14.3 Direct Operational Impacts

14.3.1 Long term employment and economic benefits during operation (SE7)

Impact Description

Operations will bring in several economic benefits including jobs associated with operating trains and stations as well as maintenance. Stations will become a hub of economic activity, providing opportunities for vendors and traders. The operation of the passenger trains will also enable people to become more mobile, making it more cost effective to reach the regional capital of Takoradi-Sekondi.

Stakeholder engagement highlights the support for the Project amongst communities due to the benefits it will create to travel within the region and trade or purchase cheaper foods in larger towns. Travel for employment in other towns along the route will become more feasible, increasing job opportunities indirectly for PAPs along the Project route. This is expected to have a positive knock-on effect for the wider local economy through the ease of movement of people, food items and traded goods.

Impact Assessment

There are currently no embedded ESIA GIIP associated with this impact.

Relevant ESIA GIIP: there are no specific embedded measures for this impact

The **frequency** of this impact will be **ongoing**. The **likelihood** of the impact is **High** given the opportunities created by the operation of the railway. The **extent** of the impact would be classed as **Regional**, affecting not only the local area but also the region as people, goods and services move more freely between Takoradi-Sekondi and Huni Valley. The **duration** of the impact is expected to be **ongoing**. Based on these assessments, the **magnitude** is assessed as **Beneficial.** Impact significance is therefore assessed as **Positive.**

Additional Mitigation and Enhancement Measures

Additional enhancement measures recommended to enhance the economic benefit of the Project are outlined in Table 14-9.

Table 14-9 Impact SE7 Enhancement Measures

Mitigation ID	Mitigation Measure
ADM72	A fair and transparent recruitment process will be outlined as part of the Recruitment Management Plan for all openings including working with MMDAs and local authorities to advertise openings as early as possible to allow for potential candidates to apply and prepare their skillsets for local opportunities

<table>
<tr><th>Mitigation ID</th><th>Mitigation Measure</th></tr>
<tr><td>ADM69</td><td>A Stakeholder Engagement Plan shall be developed which articulates the stakeholder engagement programme. This Plan shall:

manage expectations through all engagement interactions, providing honest information on the availability of jobs, their duration and where local workers will be recruited from to ensure that local communities understand what is feasible in terms of job opportunities.
ensure transparency to prevent conflict over jobs both within and between communities.
clearly explain the RAP process, entitlements and livelihood restoration measures.

include measures for local employment and procurement of goods and services including making use of information channels accessible to communities such as posters and community announcements to provide adequate information on opportunities.</td></tr>
</table>

Residual Impact

The residual impact will remain **Positive**.

15. COMMUNITY HEALTH, SAFETY AND SECURITY IMPACT ASSESSMENT

15.1 **Introduction**

The following community health, safety and security impacts have been identified in relation to the construction phase and are assessed in section 15.2, with the assessment summarised in Table 15-1:

- Injury to community members from site trespass or interaction with construction activity (CS1)
- Transmission of communicable diseases and STDs from Project workers to local communities (CS2)
- Increased transmission of malaria (CS3)
- Increased use of local health care services (CS4)
- Increased levels of violence in local communities (CS5)

The following impacts have been identified in relation to the operation phase and are assessed in section 15.3, , with the assessment summarised in Table 15-2:

- Increased levels of violence in local communities (CS6)

As the Project includes train stations that will operate as buildings open to the public, there would be an operation phase impact on disabled people if they were not designed with due consideration to the needs of disabled people, both in terms of emergency evacuation and provisions of universal access. The Project is managing this impact through station design that shall be inclusive and designed for physical and sensory disabilities (see Chapter 3).

Subject to its scope and activities, the closure and decommissioning phase is anticipated to create similar impacts and require similar mitigation measures to the construction phase. These impacts and mitigation measures are not repeated for closure and decommissioning; instead it is recommended that prior to closure a decommissioning plan is developed in line with the prevailing applicable standards and that this decommissioning plan include consideration of all those GIIP and mitigation measures that are outlined in this ESIA for the construction phase.

Impacts to community health and safety are also controlled through the measures outlined in the following sections of the ESIA, and these are not repeated in this section: Chapter 8 Air Quality, Chapter 10 Noise and Vibration, Chapter 12 Water, Chapter 18 Transport, and Chapter 19 Waste. Safety risks to local communities from accidents are addressed through Chapter 20 Major Hazards.

Table 15-1: Community Health, Safety and Security Construction Impact Summary

Impact #	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**
Receptor importance/ sensitivity	Medium to High	Medium	Medium to High	Medium to High	Medium to High
Frequency	Constant	Constant	Constant	Constant	Constant
Likelihood	Possible	Possible	Possible	Unlikely	Possible
Extent	Local	Local	Local	Local	Local
Duration	Medium-term	Medium-term	Medium-term	Medium-term	Medium-term

Impact #	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**
Magnitude	Medium	Medium	Medium	Small	Small
Effect	Adverse	Adverse	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct	Direct	Direct
Significance	Moderate to Major	Moderate	Moderate to Major	Minor to Moderate	Minor to Moderate
Additional mitigation? (Y/N)	YES	YES	YES	YES	YES
Residual Significance	Minor	Minor	Minor to Moderate	Negligible to Minor	Negligible to Minor

Table 15-2: Community Health, Safety and Security Operation Impact Summary

Impact #	**CS6**
Receptor importance/ sensitivity	Medium to High
Frequency	Constant
Likelihood	Unlikely
Extent	Local
Duration	Medium-term
Magnitude	Very Small
Effect	Adverse
Direct/ indirect	Direct
Significance	Negligible to Minor
Additional mitigation? (Y/N)	NO
Residual Significance	Negligible to Minor

15.2 Construction Impacts

15.2.1 Injury to community members from site trespass or interaction with construction activity (CS1)

Impact Description

The railway will be developed in areas that are located directly adjacent to residences, cultivated land and areas that are used frequently by pedestrians. This is particularly the case in the urban area of Takoradi-Sekondi as well as the parts of the route that are located in or adjacent to the built-up areas of communities including: Manso, Amantin, Benso, Esuaso, Bonsawire, Tarkwa, Abooso, Bompieso, and Huni Valley. Construction activity will therefore take place in areas in which community members will be close by, including those working and walking from place to place. This creates the risk of injury to community members as a result of:

– Construction equipment injuring community members while they are in operation or materials falling on / striking community members.

– Community members entering construction areas without permission and falling into any excavated areas, falling off scaffold or other equipment, or injuring themselves on equipment or materials.

The risk for this Project is heightened due to the proximity of people to active construction, and particularly with respect to:

– There being a high proportion of children living in Project AoI communities, with children potentially being tempted to play in construction areas and on equipment.
– There being a relatively high proportion of people who are in poverty, and the related risk of access to the construction sites for theft of valuable equipment or materials.

The receptor of this impact will be children resident in communities located within the Project AoI (with a High vulnerability) and men and women resident in communities located within the Project AoI (with a Medium vulnerability) (section **Error! Reference source not found.**).

Impact Assessment

The GIIP measures that are referenced in the box below are detailed in Chapter 3, and in summary include:

– Risk assessments of Project facilities shall be undertaken to determine appropriate safety zones which shall be demarcated and enforced.
– A Hazardous Materials Management Plan (HMMP) shall be developed and implemented which includes measures related to the production, handling, storage, and use of hazardous materials.

Relevant ESIA GIIP: GPM6, GPM23

The **frequency** of this impact would be **Constant** during the Project construction as the potential risk would be present continuously during construction. The **likelihood** of the impact is **Possible** rather than certain, as the GIIP measures will reduce the ability of employers from exploiting their workers, but does not guarantee that such impacts would not occur. The **extent** of the impact would be to individuals located close to the Project and so is classed as **Local**. The **duration** of the impact is **medium-term** as it would last for the duration of construction. Based on these assessments, the **magnitude** is assessed as **Medium**. Combined with the receptor vulnerability of High for children and Medium for adults, the pre-mitigation significance is **Moderate to Major** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in Table 15-3.

Table 15-3: Impact CS1 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM18	Prior to all activities, the Project shall assess the risks of the works to local people, including people walking by, people using nearby roads, residents of the houses close

Mitigation ID	Mitigation Measure
	to the activity, and any young or vulnerable people that may be present in schools or medical facilities close to the project site.
ADM19	Construction Method Statements (and relevant method statements for Maintenance and Operations) shall incorporate appropriate controls for the protection of Community HSS. Key community safety measures will include (but are not limited to): • All hazardous materials and equipment must be contained and access to them by local people must be prevented. • Access to scaffold and other structures should be prevented through physical controls. • Barriers and warning signs must be placed around open excavations to prevent people falling into them • Barriers and appropriate signage must be placed to prevent access to other hazardous areas, including areas in which equipment and vehicles are operating. • Where appropriate, flag persons shall be used to minimise risk to community members in areas of activity and where vehicles enter / exit the Project site, particularly in high risk areas such as near to schools or areas where children may be present. • Prior to commencing each activity, visual inspections must be conducted to confirm that nobody has entered the site and is in a hazardous location, e.g. people sleeping under equipment. • Project materials and equipment shall be stored securely stored to reduce the risk of theft or use as play areas for children. • Community awareness campaigns on the risks of accessing all Project sites through meetings and other formats shall be undertaken.
ADM27	As part of the stakeholder engagement programme prior to and during construction, community liaison officers will conduct meetings in local communities to provide sensitisation about the construction activity and the importance of not entering construction areas and obeying signs and direction from Project representatives. Engagement will include meetings targeted at any schools that are located in proximity to the construction sites.
ADM17	Where physical and administrative controls (barriers, fences, warning signs) cannot restrict access to hazardous areas where there is a material risk to community members, then Amandi will allocate security personnel to monitor sites and prevent access.
ADM25	A Community Grievance Mechanism (CGM) must be developed to provide a process for receiving grievances from communities, individuals, NGOs, and local government and managing them in an efficient and transparent manner. As part of this plan a Community Grievance Register will be used to record and track the completion of community grievances. This will be implemented throughout engagement on the RAP and entitlements. Communities will be made aware of the mechanism for registering complaints and feedback relating to land acquisition, entitlements and any other Project impacts.

Residual Impact

The mitigation measures will supplement the GIIP measures and reduce the likelihood that community members access hazardous areas of the construction activity. These mitigation measures will help to bring the impact down to a **Low** magnitude and likelihood of occurrence, resulting in a Residual Significance of **Minor**.

15.2.2 Transmission of communicable diseases and STDs from Project workers to local communities (CS2)

Impact Description

The Project will employ a large number of people from the Project AoI and the broader region, as well as some skilled and specialist labour from elsewhere in Ghana and overseas. With a relatively small level of non-local labour required there is a limited risk of introduction of communicable diseases, though presently Covid-19 is of international concern and could be spread through international travel to the Project AoI. The Project is not planned to operate new worker accommodation camps, thereby avoiding the risk of spread of disease amongst workers in such camps. However, workers that rent existing accommodation in local communities (i.e. hotel, rental housing) could contribute to the spread of communicable diseases that are already present in the region if the accommodation is not suitable (over-occupied, cramped, poor sanitation and ventilation). For workers that continue to live in their home community there is not expected to be an additional material risk as they will continue to interact with their household and communities.

HIV/AIDS and STDs are of concern due to their prevalence in the Project AoI and generally across Ghana (section **Error! Reference source not found.Error! Reference source not found.**). The Project could contribute to the spread of these diseases through interaction between Project workers and community members, including the use of sex workers by Project workers. The employment of local labourers and tradespeople will increase their disposable income and may lead to increased use of sex workers (which is known to be relatively common in the Western region as noted in section **Error! Reference source not found.Error! Reference source not found.**) and therefore risk of transmission of HIV/AIDs and STDs.

The receptor of this impact will be the men and women resident in communities located within the Project AoI, who have a Medium vulnerability (section **Error! Reference source not found.**). In this context, vulnerability relates to the limitations in the medical care that is readily available for the treatment of such diseases.

Impact Assessment

The GIIP measures that are referenced in the box below are detailed in Chapter 3, and in summary include:

- All work sites will have access to sanitary facilities for use by Project workers and open urination and defecation will be prohibited. Project workers will be provided with hand washing facilities and with sensitization on the importance of hand washing.
- Project workers must be informed of the nearest medical facilities during induction and must be able to access medical facilities when suffering from illness.

Relevant ESIA GIIP: GPM7, GPM8

The **frequency** of this impact would be **Constant** during the Project construction as the potential risk of disease transmission would be present continuously during construction. The **likelihood** of the impact is **Possible** rather than certain, as the GIIP measures will reduce the risk of disease transmission, but does not guarantee that such impacts would not occur. The **extent** of the impact would be to individuals located close to the Project and so is classed as **Local**. The **duration** of the impact is **medium-term** as it would last for the duration of construction. Based on these assessments, the **magnitude** is assessed as **Medium**. Combined with the receptor vulnerability of Medium for adults, the pre-mitigation significance is **Moderate** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in **Error! Reference source not found.**.

Table 15-4: Impact CS2 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM23	The Project shall develop a Covid-19 and Communicable Disease Management Plan. The plan shall: • Identify Programs for medical screening and medical surveillance of workers will be developed to help ensure that employees are fit for duty and any injuries or illnesses are identified in a timely manner. • Employ a qualified health professional to lead on the management of Covid-19 and communicable disease risk during construction, including on advising on the required controls related to social distancing, self-isolation and testing, and communications to Project workers and local communities about the measures that the Project is taking to control Covid-19 and other communicable diseases •Undertake Screening programmes for communicable diseases such as TB based on the prevailing risk profile. Screening will include provision of advice on required vaccinations and precautions for malaria and other diseases, particularly for non-local Project Workers. • Ensure Management measures are determined based on the prevailing conditions and government restrictions at the time of construction • Define the medical facilities that will be used to treat any suspected cases of disease, with facilities identified based on the criteria of having adequate capability and capacity to treat Project workers without impacting service provision to the local community. • Ensure adequate PPE is provided to staff to prevent prevent transmission of Covid-19 in accordance with the Conditions of the Environmental Permit • Undertake a practice test of the shift system to ensure adequate space for social distancing in line with the president directive on Covid-19 at the construction site in accordance with the Conditions of the Environmental Permit • Testing (as appropriate) of all staff hired or employed by the Project for Covid-19. This shall include the use of thermometer guns to check the temperature of all staff and visitors to Project sites in accordance with the Conditions of the Environmental Permit. • Recording and reporting of all communicable diseases that are experienced by Project Workers to the local and national health authorities and any restrictions or controls imposed by those authorities must be respected.
ADM24	Worker induction and Project training and awareness campaigns must include Sexually Transmitted Disease and HIV/AIDS. Condoms must be made available to Project workers. The use of sex workers will be prohibited and stated in the Project Worker Code of Conduct.

Residual Impact

The mitigation measure will supplement the GIIP measures and reduce the likelihood that the Project contributes to the transmission of Covid-19 and other communicable diseases. This mitigation measure will help to bring the impact down to a **Low** magnitude and likelihood of occurrence, resulting in a Residual Significance of **Minor**.

15.2.3 Increased transmission of malaria (CS3)

Impact Description

Malaria is prevalent in the Project AoI (section **Error! Reference source not found.**) and the Project could exacerbate this further if it created breeding habitat for the mosquito vector that transmits malaria. Such habitat can be created in many parts of the construction site where rainwater can collect, including in small indentations created during earthworks as well as in any drums or equipment that collects water.

The receptor of this impact will be the children, men and women resident in communities located within the Project AoI, who have a Medium to High vulnerability (section **Error! Reference source not found.**). In this context, vulnerability relates to the already high prevalence of malaria, the limited use of nets and other control measures (section **Error! Reference source not found.**) and the limitations in the medical care that is readily available for the treatment of malaria.

Impact Assessment

The Project will apply the GIIP measures that relate to general control of communicable diseases, as outlined above for impact CS2.

The **frequency** of this impact would be **Constant** during the Project construction as the potential risk of malaria transmission would be present continuously during construction. The **likelihood** that the Project will contribute to an increase in malaria transmission cannot be quantified, but in the absence of mitigation it is Possible to be at a noticeable level. The **extent** of the impact would be to individuals located close to the Project and so is classed as **Local**. The **duration** of the impact is **medium-term** as it would last for the duration of construction. Based on these assessments, the **magnitude** is assessed as **Medium**. Combined with the receptor vulnerability of High for children and Medium for adults, the pre-mitigation significance is **Moderate to Major** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in Table 15-5.

Table 15-5: Impact CS3 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM21	The Project shall apply good practice measures to minimise the creation of any area of standing water (e.g. empty drums or temporary excavated ground that fill with water) that provide habitat for mosquitos.
ADM22	The Project will provide all contracted Project workers with mosquito nets on a free of charge basis for their use in their accommodation.

Residual Impact

The mitigation measure will supplement the GIIP measures given in relation to impact CS2 and reduce the likelihood that the Project contributes to the transmission of malaria. This mitigation measure will help to bring the impact down to a **Small** magnitude and likelihood of occurrence, resulting in a Residual Significance of **Minor** to **Moderate**.

15.2.4 Increased use of local health care services (CS4)

Impact Description

The Project AoI has limited access to medical care, with existing health facilities known to have challenges related to the number of staff and the availability of drugs (section **Error! Reference source not found.**). The Project could impact the availability of local health care services for local people, if Project workers used these services at an excessive level for the treatment of their injuries and illnesses. The Project is not expected to create an influx of labour (due to its high use of local labour and limited requirements for non-local specialists), and because of the linear nature of the Project the demand for medical services will not be concentrated in a single area. However, even a small increase in demand for local care services from Project workers could noticeably impact availability for local people due to the existing limited capacity of the system.

The receptor of this impact will be the children, men and women resident in communities located within the Project AoI, who have a Medium to High vulnerability (section **Error! Reference source not found.**). In this context, vulnerability relates to the limited availability of medical facilities for the treatment of local people in the case of disease or injury.

Impact Assessment

The Project will apply the following GIIP measure as referenced in the box below and detailed in Chapter 3:

- Trained first aiders will be available to respond to injuries, with the number of first aiders per site to be established within the OHS Plan, based on the risk profile of the activities undertaken at each site.

Relevant ESIA GIIP: GPM42

The **frequency** of this impact would be **Constant** during the Project construction as the potential use of medical facilities could occur continuously during construction. The **likelihood** that the Project will contribute to an increase in medical facility use cannot be quantified, but as many of the workers will be local and GIIP measures will be in place to minimise any additional demand for services, it is considered that the overall impact is unlikely to be adverse at a noticeable level. The **extent** of the impact would be to medical facilities located close to the Project and so is classed as **Local**. The **duration** of the impact is **medium-term** as it would last for the duration of construction. Based on these assessments, the **magnitude** is assessed as **Small**. Combined with the receptor vulnerability of High for children and Medium for adults, the pre-mitigation significance is **Minor to Moderate** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in Table 15-6.

Table 15-6: Impact CS4 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM23	The Project shall develop a Covid-19 and Communicable Disease Management Plan. The plan shall: • Identify Programs for medical screening and medical surveillance of workers will be developed to help ensure that employees are fit for duty and any injuries or illnesses are identified in a timely manner. • Employ a qualified health professional to lead on the management of Covid-19 and communicable disease risk during construction, including on advising on the required controls related to social distancing, self-isolation and testing, and communications to Project workers and local communities about the measures that the Project is taking to control Covid-19 and other communicable diseases •Undertake Screening programmes for communicable diseases such as TB based on the prevailing risk profile. Screening will include provision of advice on required vaccinations and precautions for malaria and other diseases, particularly for non-local Project Workers. • Ensure Management measures are determined based on the prevailing conditions and government restrictions at the time of construction • Define the medical facilities that will be used to treat any suspected cases of disease, with facilities identified based on the criteria of having adequate capability and capacity to treat Project workers without impacting service provision to the local community. • Ensure adequate PPE is provided to staff to prevent prevent transmission of Covid-19 in accordance with the Conditions of the Environmental Permit • Undertake a practice test of the shift system to ensure adequate space for social distancing in line with the president directive on Covid-19 at the construction site in accordance with the Conditions of the Environmental Permit • Testing (as appropriate) of all staff hired or employed by the Project for Covid-19. This shall include the use of thermometer guns to check the temperature of all staff and visitors to Project sites in accordance with the Conditions of the Environmental Permit. • Recording and reporting of all communicable diseases that are experienced by Project Workers to the local and national health authorities and any restrictions or controls imposed by those authorities must be respected.
ADM25	A Community Grievance Mechanism (CGM) must be developed to provide a process for receiving grievances from communities, individuals, NGOs, and local government and managing them in an efficient and transparent manner. As part of this plan a Community Grievance Register will be used to record and track the completion of community grievances. This will be implemented throughout engagement on the RAP and entitlements. Communities will be made aware of the mechanism for registering complaints and feedback relating to land acquisition, entitlements and any other Project impacts.

Residual Impact

The mitigation measure will supplement the GIIP measure and reduce the likelihood that the Project contributes to an adverse increase in the use of local medical facilities. This mitigation measure will help to bring the impact down to a **Very Small** magnitude and likelihood of occurrence, resulting in a Residual Significance of **Negligible** to **Minor**.

15.2.5 Increased levels of violence in local communities (CS5)

Impact Description

National surveys have found that the Western region has relatively high levels of physical, sexual, economic and social violence (Chapter 7: Baseline). The Project could contribute to this prevalence of domestic and non-domestic violence in three principal ways:

- Security personnel hired by the Project could act violently when interacting with local community members, including physical and sexual violence as well as coercion and threats.
- Project workers could exert domestic economic abuse over their family members, and particularly female spouses, because of the wages that they will earn during their Project employment.
- Domestic economic abuse associated with resettlement compensation, particularly withholding of financial payments from spouses.

The receptor of this impact will be the children, men and women resident in communities located within the Project AoI, who have a Medium to High vulnerability (section **Error! Reference source not found.**). In this context, vulnerability relates to the risk that they could be subject to physical, sexual, economic or social violence.

Impact Assessment

The GIIP measures that will be applied by the Project are widely used in international projects to help reduce the risks associated with violence. The measures that are referenced below are detailed in Chapter 3, and in summary include:

- A Security Management Plan will be developed to align with the Voluntary Principles on Security and Human Rights and include an assessment of security risks and determination of proportional security arrangements.
- When employing any security personnel or engaging a security contractor, the Project will make reasonable inquiries to investigate the employment and criminal record, of individuals or firms.
- Amandi will not employ or use any individuals or companies that are known to have abused or violated human rights in the past.
- Amandi will verify that security personnel have been adequately trained for their role.
- Amandi will provide direction to security providers on the appropriate use of force and conduct towards Project workers and local communities.
- All security incidents reported to Amandi will be investigated. Investigations must include reporting to the police when there is evidence of a criminal act.

Relevant ESIA GIIP: GPM9

The **frequency** of this impact would be **Constant** during the Project construction as the potential for violence could occur continuously during construction. The **likelihood** that the Project will contribute to a noticeable increase in violence cannot be quantified, but given the existing prevalence and the existence of impact pathways that could contribute to violence, it is considered that the likelihood is **Possible**. The **extent** of the impact would be to Project workers and to community members in locations close to the Project and so is classed as **Local**. The **duration** of the impact is **medium-term** as it would last for the duration of construction. Based on these assessments, the **magnitude** is assessed as **Small**. Combined with the receptor vulnerability of High for children and Medium for adults, the pre-mitigation significance is **Minor** to **Moderate** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in Table 15-7.

Table 15-7: Impact CS5 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM26	As part of the HR Management Plan a Worker Code of Conduct shall be developed. The Code of Conduct shall: • Direct Project Workers on appropriate behaviours to help avoid negative interactions with local communities and promote a positive working environment. • Prohibit physical violence, discrimination, harassment, bullying, violence, and promote equal opportunity; • Require all project staff to adhere to safety measures; • Prohibit working under the influence of alcohol and prohibited drugs; • Prohibit intimidation, offensive language and behaviour, prostitution, or sexual harassment when on Project sites or in local communities. • Detail a mechanism for safe reporting of violations of these prohibitions and ensure investigation of any reported incidents. • Ensure, if proven, serious actions are taken up to and including dismissal of the worker and referral of cases to the police when there is evidence of criminal acts. The Worker Code of Conduct will be provided to all Project Workers before they sign their contract of employment, and the contract of employment must state that the Project Worker agrees to abide by the Worker Code of Conduct. In cases of low literacy, Project Workers must also be provided with a verbal explanation of the Worker Code of Conduct.
ADM27	Project training and awareness shall include a programme for Project workers to emphasise the prohibition on violence between Project workers, as well as provide education about how their behaviours could contribute to different types of domestic violence, including economic and social violence. This programme will be designed to be culturally appropriate for the audience, and will be delivered initially through the induction programme as well as through toolbox talk topics, work place posters and presentations.
ADM68	The Resettlement Action Plan will include measures to help prevent compensation payments being unfairly withheld from spouses and other eligible family members
ADM25	A Community Grievance Mechanism (CGM) must be developed to provide a process for receiving grievances from communities, individuals, NGOs, and local government and

Mitigation ID	Mitigation Measure
	managing them in an efficient and transparent manner. As part of this plan a Community Grievance Register will be used to record and track the completion of community grievances. This will be implemented throughout engagement on the RAP and entitlements. Communities will be made aware of the mechanism for registering complaints and feedback relating to land acquisition, entitlements and any other Project impacts.

Residual Impact

The mitigation measures will supplement the GIIP measures and reduce the likelihood that the Project creates or contributes to violence amongst Project workers and community members. These mitigation measures will help to bring the impact down to a **Very Small** magnitude, resulting in a Residual Significance of **Negligible** to **Minor**.

15.3 Operational Impacts

15.3.1 Increased levels of violence in local communities (CS6)

Impact Description

National surveys have found that the Western region has relatively high levels of physical, sexual, economic and social violence (Chapter 7: Baseline). The Project could contribute to this prevalence of domestic and non-domestic violence in two principal ways:

- Any security personnel hired by the Project for protecting stations or other Project facilities could act violently when interacting with local community members, including physical and sexual violence as well as coercion and threats.
- Project workers could exert domestic economic abuse over their family members, and particularly female spouses, because of the wages that they will earn during their Project employment. This is anticipated to be less of a risk during operations compared to construction due to the lower numbers of workers and the long-term, stable nature of the income earnt during operations.

The receptor of this impact will be the children, men and women resident in communities located within the Project AoI, who have a Medium to High vulnerability (section **Error! Reference source not found.**). In this context, vulnerability relates to the risk that they could be subject to physical, sexual, economic or social violence.

Impact Assessment

The GIIP measures that will be applied by the Project are widely used in international projects to help reduce the risks associated with violence. The measures that are referenced in the box below are detailed in Chapter 3, and are the same as those summarised above in section 15.2.5 for the construction phase.

Relevant ESIA GIIP: GPM9

The Community Grievance Mechanism and Worker Code of Conduct that are established during construction as outlined above in section 15.2.5 will continue during operations and help further reduce this impact.

The **frequency** of this impact would be **Constant** during the Project construction as the potential for violence could occur continuously during construction. The **likelihood** that the Project will contribute to a noticeable increase in violence cannot be quantified, but given the comprehensive GIIP measures to address what is anticipated to be a lower risk for operation than construction, it is considered that the likelihood is **Unlikely**. The **extent** of the impact would be to Project workers and to community members in locations close to the Project and so is classed as **Local**. The **duration** of the impact is **medium-term** as the GIIP measures would help to identify any violence-related impacts and allow the Project to put in place adaptive management, rather than allow them to continue long-term. Based on these assessments, the **magnitude** is assessed as **Very Small**. Combined with the receptor vulnerability of High for children and Medium for adults, the pre-mitigation significance is **Negligible to Minor** and so no additional mitigation is required.

Note that for this impact, no additional mitigation is required and therefore Residual Impact will remain the same as the impact assessment described.

16. CULTURAL HERITAGE IMPACT ASSESSMENT

16.1 Introduction

Table 16.1: Cultural Heritage Construction Impact Summary

Impact #	**CH1**	**CH2**	**CH3**
Receptor importance/ sensitivity	High	High	High
Frequency	Single event	Single event	Single event
Likelihood	High	Moderate	Low
Extent	Local to the receptor	Local to the receptor	Local to the receptor
Duration	Permanent	Permanent	Permanent
Magnitude	Large	Small	Small
Effect	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct
Significance	Major	Moderate	Moderate
Additional mitigation? (Y/N)	Yes	Yes	Yes
Residual Significance	Moderate	Negligible	Moderate

16.2 Construction Impacts

16.2.1 CH1: Loss and / or Disturbance of Tangible Cultural Heritage

Impact Description

Earthworks, site preparation and clearing associated with construction will encroach on existing cemeteries and require the relocation of graves. Receptors include Cemeteries in Esuaso, Manso, Benso and Angu Township, which are considered to be highly sensitive. RAP asset surveys in August 2020 confirm that part of Esuaso cemetery falls within the RoW and will be directly impacted although the number of graves affected have not been verified. During the RAP asset surveys, the surveyors were not permitted into the cemetery and so the extent of impact is not known, and a follow up survey will be required to determine the number of impacted graves. It is understood that the graves in the cemetery can be avoided through a small alignment adjustment, however this will result in the physical displacement of approximately four structures.

Impact Assessment

Due to the importance of cemeteries and buried remains, they are considered to be highly sensitive receptors and an underlying cause of community grievance if the impact is not managed effectively. While the extent is very localised, this will be a permanent impact and therefore the magnitude is considered to be large. Impact significance is predicted to be Major.

Embedded Mitigations considered in impact assessment:

Relevant Embedded Design Controls: N/A

Relevant ESIA GIIP: GPM41: A Resettlement Action Plan (RAP) will be developed to guide the resettlement process, including identification of Project Affected Peoples, consideration of baseline conditions, eligibility requirements, entitlements, grievance mechanism and consultation / disclosure activities.

Additional Mitigation and Enhancement Measures

Additional mitigation recommended for the loss of graves and disturbance to Esuaso cemetery and other tangible cultural heritage is outlined in Table 16.2.

Table 16.2: Impact CH1 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM28	A Cultural Heritage Management Plan shall be developed which outlines the Projects approach to management of cultural and archaeological heritage in accordance with IFC PS8 and Ghanaian requirements. Damage to and destruction of cultural heritage including cultural, sacred and archaeological sites shall be avoided as far as possible. In accordance with conditions identified in the Environmental Permit, where cultural heritage properties (e.g. cemeteries) are affected by Project construction performance of pacification rites shall be undertaken under an agreement with the local communities.
ADM29	The Cultural Heritage Management Plan shall define the process for the relocation of graves if required. The approach to moving graves and the new location shall be agreed with the affected community and individuals. All works must completed prior to any site activities.
ADM30	The Cultural Heritage management Plan shall ensure compensation for accidental damage, disturbance to or loss of a heritage asset is paid to the community (village chiefs and family heads). Items required for necessary rituals may include the presentation of animals (cow, goat or sheep) and / or specific drinks in addition to cash compensation.
ADM31	The Stakeholder Engagement Plan (SEP) shall ensure a robust process is in place to manage grievance associated with impacted graves and cemeteries and other tangible cultural heritage including through the use of the Grievance Mechanism.
ADM32	The Land Disturbance Process shall ensure engagement with community leaders and family heads is undertaken in advance of any works to proactively identify / locate sacred sites and deities that may not be directly impacted but which may be located near construction areas and accidentally trespassed. Workers will be instructed to stay away from these areas to avoid causing offence to communities and to avoid breaking any taboos.

Residual Impact

Following the application of additional mitigation, residual impact is predicted to be Moderate.

16.2.2 CH2: Loss and / or Disturbance of Intangible Cultural Heritage

Impact Description

Intangible cultural heritage includes deities and sacred sites, which form an important part of the local cultural fabric. Rivers in the Project area are closely associated with rituals, sacred sites and taboos and several sites are located near the proposed rail route in Huni Valley and Amoanda. There is also a shrine near the rail route in Amoanda. If impacted, deities and sacred sites would need to be relocated, requiring specific rituals lead by village chiefs and family heads.

Sacred sites may also be interfered with during construction activities, even if not damaged or removed. This may be caused by workers accidentally walking in or over sacred sites and deity locations, which may cause offence and grievance and interfere with local taboos.

Impact Assessment

The RAP asset survey in August 2020 did not identify any sacred site that would be directly impacted by the Project. However further engagement is required to understand how best to avoid sites close to the rail route during construction. Due to the sensitivity around sacred sites, sensitivity is considered to be high, however the impact magnitude is predicted to be small. Therefore, impact significance is predicted to be Moderate.

Embedded Mitigations considered in impact assessment:

Relevant Embedded Design Controls: N/A

Relevant ESIA GIIP: GPM41: A Resettlement Action Plan (RAP) will be developed to guide the resettlement process, including identification of Project Affected Peoples, consideration of baseline conditions, eligibility requirements, entitlements, grievance mechanism and consultation / disclosure activities.

GPM18: Cultural Heritage training shall be provided to construction workers prior to commencement of earthworks to increase awareness and educate on how to identify artefacts and the importance of protecting Ghanaian cultural heritage, including existing cultural monuments and archaeological sites and chance finds.

Additional Mitigation and Enhancement Measures

Additional mitigation recommended for the loss and / or disturbance to sacred sites and deities are outlined in Table 4.3.

Table 16.3 Impact CH2 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM28	A Cultural Heritage Management Plan shall be developed which outlines the Projects approach to management of cultural and archaeological heritage in accordance with IFC PS8 and Ghanaian requirements. Damage to and destruction of cultural heritage including cultural, sacred and archaeological sites shall be avoided as far as possible. In accordance with conditions identified in the Environmental Permit, where cultural heritage properties (e.g. cemeteries) are affected by Project construction performance

Mitigation ID	Mitigation Measure
	of pacification rites shall be undertaken under an agreement with the local communities.
ADM30	The Cultural Heritage management Plan shall ensure compensation for accidental damage, disturbance to or loss of a heritage asset is paid to the community (village chiefs and family heads). Items required for necessary rituals may include the presentation of animals (cow, goat or sheep) and / or specific drinks in addition to cash compensation.
ADM31	The Stakeholder Engagement Plan (SEP) shall ensure a robust process is in place to manage grievance associated with impacted graves and cemeteries and other tangible cultural heritage including through the use of the Grievance Mechanism.
ADM32	The Land Disturbance Process shall ensure engagement with community leaders and family heads is undertaken in advance of any works to proactively identify / locate sacred sites and deities that may not be directly impacted but which may be located near construction areas and accidentally trespassed. Workers will be instructed to stay away from these areas to avoid causing offence to communities and to avoid breaking any taboos.

Residual Impact

Following the application of additional mitigation, residual impact is predicted to be Negligible.

16.2.3 Disturbance to Archaeological or other Historic Sites

Impact Description

Archaeological and other historic sites have not been identified along the route, however this does not mean that they do not exist. Earthworks associated with Project construction may uncover important archaeological and / or other historic finds, given the rich cultural history of the area.

Impact Assessment

With the implementation of embedded mitigation (including a Chance Finds Procedure), the magnitude of impact is expected to be small. However, receptor sensitivity is still considered high due to the sensitivity of archaeological remains and its importance to Ghanaian national culture. Impact significance is therefore predicted to be Moderate.

Embedded Mitigations considered in impact assessment:

Relevant Embedded Design Controls: N/A

Relevant ESIA GIIP: GPM16: Construction works shall commence only once all relevant permits have been received from the responsible institution, the Administration for protection of the cultural heritage of the Ministry of Tourism, Culture and Creative Arts.

GPM17: A Chance Finds Procedure shall be developed which sets out the approach to be taken should any physical cultural resources be discovered (e.g. archaeological sites, historical sites, human remains, cemeteries, graves or other objects) in accordance with Ghanaian Law on Protection of Cultural Heritage and IFC PS 8 requirements.

GP18: Cultural Heritage training shall be provided to construction workers prior to commencement of earthworks to increase awareness and educate on how to identify artefacts and the importance of protecting Ghanaian cultural heritage, including existing cultural monuments and archaeological sites and chance finds.

Additional Mitigation and Enhancement Measures

Additional mitigation recommended for the loss and / or disturbance to sacred sites and deities are outlined in Table 16.4.

Table 16.4: Impact CH3 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM31	The Stakeholder Engagement Plan (SEP) shall ensure a robust process is in place to manage grievance associated with impacted graves and cemeteries and other tangible cultural heritage including through the use of the Grievance Mechanism.

Residual Impact

Following the application of additional mitigation, residual impact is still predicted to be Moderate due to the national importance of archaeological finds.

16.3 Direct Operational Impacts

Once the Project is operational, there will not be any direct impacts associated with the Project to cultural heritage.

17. LABOUR AND WORKING CONDITIONS IMPACT ASSESSMENT

17.1 Introduction

The following labour and working condition impacts have been identified in relation to the construction phase and are assessed in section 17.2:

- Workers exposed to poor and unfair working practices during construction (LW1);
- Workers exposed to unsafe or unhealthy working conditions during construction (LW2); and
- Use of forced or child labour during construction (LW3).

The following impacts have been identified in relation to the operation phase and are assessed in section 17.3:

- Workers exposed to poor and unfair working practices during operation (LW4);
- Workers exposed to unsafe or unhealthy working conditions during operation (LW5); and
- Use of forced or child labour during operation (LW6).

Subject to its scope and activities, the closure and decommissioning phase is anticipated to create similar impacts and require similar mitigation measures to the construction phase. These impacts and mitigation measures are not repeated for closure and decommissioning; instead it is recommended that prior to closure a decommissioning plan is developed in line with the prevailing applicable standards and that this decommissioning plan include consideration of all those GIIP and mitigation measures that are outlined in this ESIA for the construction phase.

A summary of the impacts described in sections 17.2 and 17.3 are provided in Table 17-1 and Table 17-2.

Table 17-1: Labour and Working Conditions Construction Impact Summary

Impact #	LW1	LW2	LW3
Receptor importance/ sensitivity	Medium	Medium	High
Frequency	Constant	Constant	Constant
Likelihood	Likely	Possible	Unlikely
Extent	Local	Local	Local
Duration	Medium-term	Medium-term	Medium-term
Magnitude	Medium	Medium	Low
Effect	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct
Significance	Moderate	Moderate	Moderate
Additional mitigation? (Y/N)	YES	YES	YES
Residual Significance	Minor	Minor	Minor

Table 17-2: Labour and Working Conditions Operation Impact Summary

Impact #	LW4	LW5	LW6
Receptor importance/ sensitivity	Low to Medium	Low to Medium	High
Frequency	Constant	Constant	Constant
Likelihood	Likely	Possible	Unlikely
Extent	Local	Local	Local
Duration	Long-term	Long-term	Long-term
Magnitude	Medium	Medium	Low
Effect	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct
Significance	Moderate	Minor to Moderate	Moderate
Additional mitigation? (Y/N)	YES	YES	YES
Residual Significance	Minor	Minor	Minor

17.2 Construction Impacts

17.2.1 Workers exposed to poor and unfair working practices during construction (LW1)

Impact Description

The Project will employ a large number of labourers and skilled tradespeople from communities within the Project AoI as well as elsewhere in Ghana, and a much smaller number of foreigners to fill specialised skilled roles. Project workers will be employed directly by Amandi as well as through contractors and subcontractors. For all workers on any project there is a theoretical risk that the recruitment and employment practices that are applied by their employer are unfair or do not otherwise address the applicable standards for the Project. This risk is elevated for those workers that:

- Are poor and have limited employment opportunities;
- Have no or limited experience of comparable work or formal employment; or
- Have low levels of education and literacy.

Such groups may be more susceptible to exploitation as they have limited alternatives for employment or limited ability to identify and challenge such exploitation. Exploitation could occur through the provision of poor wages, late or partial payments of wages, excessive hours, or non-adherence to promised benefits. These groups are also susceptible to exposure to unsafe working conditions and the potential for child labour in the supply chain of contractors and sub-contractors. The effect of this exploitation would be diminished wellbeing of workers individually, and a lost opportunity for the Project to help raise working conditions for workers and the economic situation of their households and broader communities.

The Project AoI has high levels of youth unemployment (section **Error! Reference source not found.**) and a notable proportion of the population living in poverty (section **Error! Reference source not found.**) and being illiterate (section **Error! Reference source not found.**). This risk of labour exploitation is therefore an applicable risk that requires management by the Project.

The receptor of this impact will be the local labourers and tradespeople who are seeking employment opportunities. This receptor has a Medium vulnerability (section **Error! Reference source not found.**).

Impact Assessment

The impact assessment is based on the assumption of no international standards being applied with respect to working practices. The **frequency** of this impact would be **Constant** during the Project construction as it would be experienced continuously by Project workers. The **likelihood** of the impact is **likely** as the relative poverty of workers create conditions in which they could be exploited. The **extent** of the impact would be to individuals employed by the Project and so is classed as **Local**. The **duration** of the impact is **medium-term** as it would last for the duration of construction. Based on these assessments, the **magnitude** is assessed as **Medium**. Combined with the receptor vulnerability of Medium, the pre-mitigation significance is **Moderate** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in Table 17-3.

Table 17-3: Impact LW1 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM35	The Contractor Management Process shall ensure that management measures related to labour and working conditions that are stated in this ESIA are applied to any contractors and sub-contractors working on the Project. Contracts with contractors must reference these measures as binding requirements, and these requirements must flow down to subcontractors.
ADM36	The Project HR Plan shall be made available to all Project Workers as part of their induction and in accessible locations, e.g. at site office, on a noticeboard in rest areas etc. The Project HR Plan will include: • the key commitments that are made in relation to labour management for the Project. • all applicable measures outlined in the ESMP, ESIA and other Project Documentation (e.g. legal requirements). • measures to maximise access to employment for women by offering on the job training and skills enhancement schemes where relevant. • measures to ensure contract workers and labourers understand the details of their contract period so that they can prepare appropriately for termination of their employment. Existing HRM Policies and Procedures shall be expanded to specify clear contracting procedures and workers rights in accordance with Ghana Law and IFC PS2 and will be equally applied to Amandi and contract staff, with expectations on recruitment and adherence to national and IFC PS2 requirements made clear at the contractor bidding stage and integrated into contractor contracts.
ADM37	All Project Workers shall be provided with a clear contract of employment prior to starting their work on the Project and updated whenever there are changes to their employment terms and conditions. Contracts will clearly detail workers' rights, including at the time of retrenchment. As well as providing written contracts, the contract of employment must be explained verbally to Project Workers, particularly for

Mitigation ID	Mitigation Measure
	those who are illiterate. A written record of the worker contract must be kept at the time of hire of each contracted Project Worker. The contract of employment will include: • the name of the company is working for; • the worker's job title; • the date employment began; • where the employment is not permanent, the anticipated duration of the contract; • the place of work or the main location; • the hours of work including any specific shift work requirements; • leave entitlements; • rules relating to overtime and overtime compensation; • the calculation of salary, wages and other benefits, including any rules related to deductions; • the pension and other social security arrangements applicable to the worker; • the length of notice which the worker can expect to give and receive on termination of employment; • reference to the Project's Worker Grievance Mechanism and the person to whom grievances should be addressed; • the requirement to comply with the Worker Code of Conduct; • the disciplinary procedures which are applicable to the worker, including details of representation available to the worker and any appeals mechanism; • any collective bargaining arrangements which apply to the Project Worker.
ADM38	Working terms and conditions of employment shall address national legal requirements as a minimum and be comparable to or better than the terms and conditions experienced by workers in similar construction projects in Ghana. Project workers will be provided with adequate holiday and parental leave, to address leave provisions given by national legislation as a minimum. Migrant workers (including foreign workers and workers from other regions of the country) will be given working conditions and terms of employment that are the same or substantially equivalent to those of non-migrant workers performing the same type of work.
ADM39	Project Workers shall be provided with an induction at the start of their employment on the Project, and include the following: • An introduction to the Worker Code of Conduct and HR Policy, including the importance of the policies on non-discrimination and harassment; • A description of the rights of the worker, including freedom of movement, access to personal belongings and documents (if they are held by their employer), and notice periods if they wish to end their employment; and • An introduction to the Worker Grievance Mechanism.
ADM40	Project Workers must not be discouraged from electing worker representatives, forming or joining workers' organizations of their choosing, or from bargaining collectively. There must be no discrimination or retaliation against Project Workers who participate, or seek to participate, in such organizations and collective bargaining. Management must not seek to influence or control any workers' organisations or alternative mechanisms used by Project Workers to express their grievances and protect their rights regarding working conditions and terms of employment. Management must

Mitigation ID	Mitigation Measure
	engage with any workers’ representatives and workers’ organizations that represent their Project Workers.
ADM41	There shall be no discrimination during any aspect of employment, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, and disciplinary practices. This means that there should be no distinction, exclusion or preference made on the basis of things that do not relate to the ability to do the job, including race or ethnic origin, colour, gender, sexual orientation, age, religion, nationality, family and socioeconomic status, marital status, membership or non-membership of a trade union and union activity, HIV or AIDS status, education, disability, and political ideology.
ADM42	All dismissals shall be carried out in accordance with the law and contracted terms. Notice periods, final payments and benefits must be provided in full and in a timely manner. If collective dismissals of Project workers are required due to economic, technical, organisational or other reasons that are not related to performance or other personal reasons, then an analysis of alternatives to dismissals must be conducted. If there are no viable alternatives, then a Retrenchment Plan must be developed and implemented to address the requirements of IFC PS2 and reduce adverse impacts to Project Workers and will outline the support to be offered upon termination. Where Contractors are required to make collective dismissals the principles of non-discrimination when making dismissals and giving workers access to the grievance mechanism must be applied. This may include provision of certification and references, which will assist in future job prospects.
ADM43	A Project Worker Grievance Mechanism shall be developed, implemented and made available to all Project Workers. Project Workers will not be prevented from raising grievances, and any worker that raises a grievance will be treated fairly without retribution. Workers shall be allowed to raise grievances anonymously if they do not wish to be identified. Project Workers will be allowed to raise grievances in writing or verbally. A Worker Grievance Register must be used to record and track the completion of worker grievances.
ADM29	Information that is recorded about Project Workers shall be kept to a minimum, have a clear and valid purpose, and be stored and managed in a confidential manner.
ADM26	As part of the HR Management Plan a Worker Code of Conduct shall be developed. The Code of Conduct shall: • Direct Project Workers on appropriate behaviours to help avoid negative interactions with local communities and promote a positive working environment. • Prohibit physical violence, discrimination, harassment, bullying, violence, and promote equal opportunity; • Require all project staff to adhere to safety measures; • Prohibit working under the influence of alcohol and prohibited drugs; • Prohibit intimidation, offensive language and behaviour, prostitution, or sexual harassment when on Project sites or in local communities. • Detail a mechanism for safe reporting of violations of these prohibitions and ensure investigation of any reported incidents. • Ensure, if proven, serious actions are taken up to and including dismissal of the worker and referral of cases to the police when there is evidence of criminal acts.

Mitigation ID	Mitigation Measure
	The Worker Code of Conduct will be provided to all Project Workers before they sign their contract of employment, and the contract of employment must state that the Project Worker agrees to abide by the Worker Code of Conduct. In cases of low literacy, Project Workers must also be provided with a verbal explanation of the Worker Code of Conduct.
MON05	Amandi will undertake 20 worker interviews per quarter during construction to help verify that measures related to labour and working conditions, including child and forced labour, are being implemented. The findings of the interviews will be used to identify corrective actions that must be applied by Amandi, contractor or sub-contractors to bring labour management into compliance with the measures outlined in this ESIA and the HR Policy and related management plans.
MON06	Amandi will undertake quarterly reviews of a sample of worker records to verify that the documentation that is retained for each worker shows compliance with the measures outlined in this ESIA and the HR Policy and related management plans. This review will include payment records, working time records, employment contracts, and induction and training records. The findings of the interviews will be used to identify corrective actions that must be applied by Amandi, contractor or sub-contractors to bring labour management into compliance with the measures outlined in this ESIA and the HR Policy and related management plans.

Residual Impact

These mitigation measures will help to bring the impact down to a **Small** magnitude and likelihood of occurrence, resulting in a Residual Significance of **Minor**.

17.2.2 Workers exposed to unsafe or unhealthy working conditions during construction (LW2)

Workers on all construction projects are susceptible to unsafe or unhealthy working conditions that can lead to injury and illness, ranging from minor ailments to fatalities. The Project will involve construction activity that is hazardous by its nature, including use of heavy equipment, loading and unloading of materials, use of vehicles, earthworks, and use of hazardous materials such as fuels, oils and chemicals. The construction hazards outlined above are fairly typical of large construction projects, and the GIIP measures summarised below are well understood and commonly applied to help manage such hazards.

It was noted in the baseline (section **Error! Reference source not found.**) that there are challenges in OHS management in Ghana, including the absence of a comprehensive national OHS policy, weak OHS infrastructures and poor funding, untrained and insufficient number of OHS professionals, lack of proper monitoring and surveillances for OHS diseases and injuries, and the general lack of adequate information about OHS. Many labourers and tradespeople in the Project AoI will lack experience in robust safety practices, with some having experience limited to illegal mining, which typically has poor practices.

The receptor of this impact will be the local labourers and tradespeople who will be employed on the Project. This receptor has a Medium vulnerability (section **Error! Reference source not found.**). OHS hazards for expatriate Project workers filling specialist and senior roles are also relevant for OHS management, but such workers are considered to be less vulnerable to this impact; as such, the impact assessment is based on the more vulnerable local worker but the measures outlined below will also be applicable to expatriate workers.

Impact Assessment

There are a range of GIIP measures that will be applied by the Project and are widely used in international projects to manage OHS. These measures will be applied at all work sites and for all Project workers, by Amandi, contractors and sub-contractors. Amandi will require (as contractual conditions) that contractors and subcontractors apply these measures. The measures that are referenced in the box below are detailed in Chapter 3, and in summary include:

- GPM37: Amandi will prepare a Project OHS Plan that defines the role and responsibilities for OHS management and references the procedures and other documents (including OHS risk assessment, job/task risk assessments, permit to work system).
- GPM38: Amandi will develop an overall OHS risk assessment for the Project. The overall OHS risk assessment will be supplemented with more detailed job / task risk assessments to be developed by Amandi and contractors.
- GPM39: A Permit to Work system will be implemented for high risk tasks that require these controls (to be identified as part of the OHS risk assessment).
- GPM44: In order to minimize potentially serious accidents caused by equipment malfunction or premature failure the Project will implement regular maintenance of vehicles/machines, use manufacturer approved parts, and ensure that the manufacturer recommended maintenance programs are implemented.
- GPM41: Amandi will develop and implement programs for medical screening and medical surveillance during the Project to help ensure that employees are fit for duty and any injuries or illnesses are identified in a timely manner.
- GPM40: An OHS reporting system must be developed and implemented to enable workers to report immediately to their supervisor any situation they believe presents a risk of injury or hazard to life or health.
- GPM42: First aid equipment and supplies will be kept at all active Project sites to help support first response to any injuries. Trained first aiders will be available, with the number of first aiders per site to be established within the OHS Plan, based on the risk profile of the activities undertaken at each site.

Relevant ESIA GIIP: GPM37, GPM38, GPM39, GPM40, GPM41, GPM42, GPM44

The **frequency** of this impact would be **Constant** during the Project construction as OHS hazards have the potential to exist at any time and at all work sites. The **likelihood** of the impact cannot be quantified with certainty, but with the GIIP measures put in place the risk of significant incidents occurring is expected to be limited but remains as Possible. The **extent** of the impact would be to individuals employed by the Project and so is classed as **Local**. The **duration** of the impact is **medium-term** as it would last for the duration of construction. Based on these assessments, the **magnitude** is assessed as **Medium**. Combined with the receptor vulnerability of Medium, the pre-mitigation significance is **Moderate** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in Table 17-4.

Table 17-4: Impact LW2 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM63	The Project will put in place a sufficient and competent organisation to effectively implement meet the Project OHS requirements. The Project will appoint, as a minimum, and document in an Organisation Chart: •A Senior Management Representative (S&E Supervisor), who shall be accountable for compliance with the Project OHS Requirements. •A Project-level OHS Manager/Advisor (Safety Manager), who will lead on compliance with the Project OHS Requirements across all worksites; •An OHS Representative (S&E Advisor) who will be responsible for ensuring that the requirements are implemented, and compliance is regularly monitored; •External medical service provider to provide worker health checks, medical surveillance and emergency assistance as needed; •Emergency Response mechanism (may be defined within the EPRP). Personnel assigned to the above-mentioned roles shall be assessed as competent for the role based on a combination of experience, qualifications and training, and in line with national standards and Good International Industry Practice (GIIP). Records of this competency assessment shall be maintained.
ADM64	The OHS Management Plan shall identify adequate training and awareness for all employees. Training will be provided for each individual, prior to the commencement of any activity, through a combination of induction, toolbox talks or specific job training. Training will be appropriate to the job role and responsibilities.
ADM65	During construction, a site walkover shall be conducted at the beginning of each day to ensure the site is safe for the commencement of work. Daily meetings with the construction staff shall be held to raise OHS awareness and provide an opportunity for staff to highlight any safety concerns associated with the tasks that are scheduled by the team during the work shift.
ADM62	Independent OHS specialists with experience in OHS management at the required International Standards shall be employed. These specialists shall review the OHS Plan prior to construction and monitor implementation of the OHS Plan during construction. The OHS specialists will be separate to the Project's OHS management personnel and will take an independent advisory role with the objective to help ensure compliance of the Project to the OHS requirements of the Applicable Standards.

Residual Impact

This mitigation measure will help to supplement the GIIP measures reduce OHS risks. The mitigation measures do not mean that OHS incidents will not occur, but will help to bring the impact down to a Low magnitude and likelihood of occurrence resulting in a Residual Significance of Minor.

17.2.3 Use of forced or child labour during construction (LW3)

As noted in the baseline section, a significant minority of children undertake work, sometimes in hazardous environments and there are known to be incidents of forced labour in Ghana (section **Error! Reference source not found.**). In the absence of any measures to prevent child or forced labour there is the risk that the Project could employ such labour, either directly and knowingly, or through contractors employing such labour for the Project. Child and forced labour is also a risk in relation to the third parties that operate the existing quarry operations from where the Project will source aggregate, and so the risks related to child and forced labour in this component of the supply chain is included within the scope of this impact[1]. As noted in section **Error! Reference source not found.** of the baseline, although the authorities in Ghana are taking steps to manage child and child labour there are areas for improvement compared to other international standards, and so there is a need for the Project to address this risk.

The principal receptor of this impact will be the children resident in communities located within the Project AoI. This receptor has a High vulnerability (section **Error! Reference source not found.**). Child and forced labour also creates a risk to adults in the Project AoI as well as others elsewhere in Ghana but such people are considered to be less vulnerable to this impact; as such, the impact assessment is based on the more vulnerable children from the Project AoI, but the measures outlined below will also be applicable to managing risk to all other children and adults.

Impact Assessment

There are a range of GIIP measures that will be applied by the Project and are widely used in international projects to manage child and forced labour risks. These measures will be applied at by Amandi, contractors and sub-contractors. Amandi will require (as contractual conditions) that contractors, subcontractors and key suppliers for which there is a child or forced labour risk (including quarries) apply these measures. The measures that are referenced in the box below are detailed in Chapter 3, and in summary include:

- GPM33: Restrictions on underage workers include:
  - No person under the age of 16 shall be employed on the Project.
  - No person under the age of 18 will be employed as a Project Worker if their work is potentially hazardous, including all construction activity that:
    - Is underground, under water, at dangerous heights or in confined spaces; involves dangerous machinery, equipment and tools;
    - Involves the manual handling or transport of heavy loads;
    - Is in an unhealthy environment which may, for example, expose children to hazardous substances, agents or processes, or to temperatures, noise levels, or vibrations damaging to their health;
    - Requires working for long hours or during the night.
- The age of all Project Workers must be verified and recorded through a check of worker documentation. Working hours for all employees under the age of 18 must be risk assessed for worker fatigue and hours adjusted accordingly. GPM34: The Project must not use any forced labour, which is any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty. The Project must not employ people who have been trafficked, which means transported to the area against their will. Project Workers must not be employed based on any of the following practices that may be classed as forced labour: 'bonded' labour where the worker is forced to work in order to pay off a debt that is so large that it is impossible or very difficult to ever pay off; the provision of excessive monetary deposits by the worker; excessive limitations on the freedom of movement of the worker; excessive notice periods such that they cannot leave employment when they wish; substantial or inappropriate fines; loss or delay of wages that prevent workers from voluntarily ending employment within their legal rights; retention of worker's identity documents, such as passports, or personal belongings so that the worker cannot access them in a timely manner;

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[1] It is noted that although the Guidance Notes for Performance Standard 2 state that the "supply chain requirements of Performance Standard 2 do not apply to material or components used in the construction phase of the project", the risk of child and forced labour in the supply of aggregate is a potentially important risk that needs to be assessed and managed in line with the requirements of Performance Standard 1.

charging recruitment fees to the worker or excessive amounts for travel, housing and meals that create unpayable debt obligations.

Relevant ESIA GIIP: GPM33, GPM34

The **frequency** of this impact would be **Constant** during the Project construction as child and forced labour risks exist throughout the period in which labour is recruited and employed. The **likelihood** of the impact cannot be quantified with certainty, but with the GIIP measures put in place the risk of employing child or forced labour is expected to be limited and reduced to Unlikely. The **extent** of the impact would be to individuals employed by the Project (even if there originate from elsewhere) and so is classed as **Local**. The **duration** of the impact is **medium-term** as it would last for the duration of construction, though impacts to the wellbeing of individuals could extend beyond the period of employment. Based on these assessments and particularly the low likelihood of occurrence with these measures in place, the **magnitude** is assessed as **Low**. Combined with the receptor vulnerability of High, the pre-mitigation significance is **Moderate** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in Table 17-5.

Table 17-5: Impact LW3 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM345	As part of the Recruitment plan, brief interviews with a sample of workers upon hire will be undertaken to verify that there is no indication that they are involuntarily providing their labour or have been trafficked to be employed on the Project. These interviews will include questions about any recruitment fees that they have made, any wages that are withheld, any restrictions imposed on their ability to leave the job, any retention of worker's identity documents or personal belongings, or the charging of excessive amounts for travel, housing and meals that create unpayable debt obligations. The sample will cover all contractors used on the Project. If the interviews identify risks of child or forced labour then investigations will be undertaken and additional measures will be defined to address the findings of those investigations.
ADM46	The Contractor Management Process shall set out the process for manging child or forced labour risks in the Supply chain. The Process shall: • Identify key potential risk areas in the supply chain for child and forced labour (e.g. aggregate supplies or other materials and waste). • Set out the requirements for audit of the primary supply chain and process for spot check visits. • Define the observations required to assess the risk including using visual observations of worker age, verification of documentation to prove ages, and discussions with workers and managers of the supplier. • Define the process for identifying and implementing corrective actions depending on the seriousness of the evidence found and the suppliers willingness to adopt corrective actions. Where appropriate alternate suppliers may be used.

Residual Impact

These mitigation measures will help to ensure that the GIIP measures applied in relation to this impact are being applied successfully and will provide a mechanism for identifying and addressing non-compliances. The mitigation measure does not mean that there will be zero risk of child or forced labour being used for the Project, but will help to bring the likelihood and scale of any occurrence down to a very small magnitude with a resulting in a Residual Significance of Minor.

17.3 Operational Impacts

17.3.1 Workers exposed to poor and unfair working practices during operation (LW4)

Impact Description

Compared to the construction phase, the operation phase will principally involve Project workers who are employed on a longer-term basis, with will likely mean a lower risk of the operator imposing poor and unfair working practices on their long-term employees. During routine and unplanned maintenance activities there will likely be a requirement for short-term workers, including those employed by contractors rather than the rail operator directly and those who may be more vulnerable to being exploited.

The receptor of this impact will principally be the skilled and semi-skilled workers employed in long-term roles during the operation phase (with a Low vulnerability), but also the local labourers and tradespeople who are seeking employment opportunities as part of short-term or contracted maintenance works (with a Medium vulnerability) (section **Error! Reference source not found.**).

Impact Assessment

The impact assessment is based on the assumption of no international standards being applied with respect to working practices. The **frequency** of this impact would be **Constant** during the Project construction as it would be experienced continuously by Project workers. The **likelihood** of the impact is **likely** as the relative poverty of workers create conditions in which they could be exploited. The **extent** of the impact would be to individuals employed by the Project and so is classed as **Local**. The **duration** of the impact is **long-term** as it would last for the duration of the operation phase. Based on these assessments, the **magnitude** is assessed as **Medium**. Combined with the receptor vulnerability of Medium, the pre-mitigation significance is **Moderate** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in Table 17-6.

Table 17-6: Impact LW4 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM53	The Contractor Management Process shall ensure that management measures related to labour and working conditions that are stated in this ESIA are applied to any contractors and sub-contractors working on the Project. Contracts with contractors must reference these measures as binding requirements, and these requirements must flow down to subcontractors.
ADM36	The Project HR Plan shall be made available to all Project Workers as part of their induction and in accessible locations, e.g. at site office, on a noticeboard in rest areas etc. The Project HR Plan will include:

Mitigation ID	Mitigation Measure
	• the key commitments that are made in relation to labour management for the Project. • all applicable measures outlined in the ESMP, ESIA and other Project Documentation (e.g. legal requirements). • measures to maximise access to employment for women by offering on the job training and skills enhancement schemes where relevant. • measures to ensure contract workers and labourers understand the details of their contract period so that they can prepare appropriately for termination of their employment. Existing HRM Policies and Procedures shall be expanded to specify clear contracting procedures and workers rights in accordance with Ghana Law and IFC PS2 and will be equally applied to Amandi and contract staff, with expectations on recruitment and adherence to national and IFC PS2 requirements made clear at the contractor bidding stage and integrated into contractor contracts.
ADM37	All Project Workers shall be provided with a clear contract of employment prior to starting their work on the Project and updated whenever there are changes to their employment terms and conditions. Contracts will clearly detail workers' rights, including at the time of retrenchment. As well as providing written contracts, the contract of employment must be explained verbally to Project Workers, particularly for those who are illiterate. A written record of the worker contract must be kept at the time of hire of each contracted Project Worker. The contract of employment will include: • the name of the company is working for; • the worker's job title; • the date employment began; • where the employment is not permanent, the anticipated duration of the contract; • the place of work or the main location; • the hours of work including any specific shift work requirements; • leave entitlements; • rules relating to overtime and overtime compensation; • the calculation of salary, wages and other benefits, including any rules related to deductions; • the pension and other social security arrangements applicable to the worker; • the length of notice which the worker can expect to give and receive on termination of employment; • reference to the Project's Worker Grievance Mechanism and the person to whom grievances should be addressed; • the requirement to comply with the Worker Code of Conduct; • the disciplinary procedures which are applicable to the worker, including details of representation available to the worker and any appeals mechanism; • any collective bargaining arrangements which apply to the Project Worker.
ADM38	Working terms and conditions of employment shall address national legal requirements as a minimum and be comparable to or better than the terms and conditions experienced by workers in similar construction projects in Ghana. Project workers will be provided with adequate holiday and parental leave, to address leave provisions given by national legislation as a minimum.

Mitigation ID	Mitigation Measure
	Migrant workers (including foreign workers and workers from other regions of the country) will be given working conditions and terms of employment that are the same or substantially equivalent to those of non-migrant workers performing the same type of work.
ADM24	Project Workers shall be provided with an induction at the start of their employment on the Project, and include the following: • An introduction to the Worker Code of Conduct and HR Policy, including the importance of the policies on non-discrimination and harassment; • A description of the rights of the worker, including freedom of movement, access to personal belongings and documents (if they are held by their employer), and notice periods if they wish to end their employment; and • An introduction to the Worker Grievance Mechanism.
ADM40	Project Workers must not be discouraged from electing worker representatives, forming or joining workers' organizations of their choosing, or from bargaining collectively. There must be no discrimination or retaliation against Project Workers who participate, or seek to participate, in such organizations and collective bargaining. Management must not seek to influence or control any workers' organisations or alternative mechanisms used by Project Workers to express their grievances and protect their rights regarding working conditions and terms of employment. Management must engage with any workers' representatives and workers' organizations that represent their Project Workers.
ADM41	There shall be no discrimination during any aspect of employment, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, and disciplinary practices. This means that there should be no distinction, exclusion or preference made on the basis of things that do not relate to the ability to do the job, including race or ethnic origin, colour, gender, sexual orientation, age, religion, nationality, family and socioeconomic status, marital status, membership or non-membership of a trade union and union activity, HIV or AIDS status, education, disability, and political ideology.
ADM42	All dismissals shall be carried out in accordance with the law and contracted terms. Notice periods, final payments and benefits must be provided in full and in a timely manner. If collective dismissals of Project workers are required due to economic, technical, organisational or other reasons that are not related to performance or other personal reasons, then an analysis of alternatives to dismissals must be conducted. If there are no viable alternatives, then a Retrenchment Plan must be developed and implemented to address the requirements of IFC PS2 and reduce adverse impacts to Project Workers and will outline the support to be offered upon termination. Where Contractors are required to make collective dismissals the principles of non-discrimination when making dismissals and giving workers access to the grievance mechanism must be applied. This may include provision of certification and references, which will assist in future job prospects.
ADM43	A Project Worker Grievance Mechanism shall be developed, implemented and made available to all Project Workers. Project Workers will not be prevented from raising grievances, and any worker that raises a grievance will be treated fairly without retribution. Workers shall be allowed to raise grievances anonymously if they do not wish to be identified. Project Workers will be allowed to raise grievances in writing or verbally. A Worker Grievance Register must be used to record and track the completion of worker grievances.

Mitigation ID	Mitigation Measure
ADM26	As part of the HR Management Plan a Worker Code of Conduct shall be developed. The Code of Conduct shall: • Direct Project Workers on appropriate behaviours to help avoid negative interactions with local communities and promote a positive working environment. • Prohibit physical violence, discrimination, harassment, bullying, violence, and promote equal opportunity; • Require all project staff to adhere to safety measures; • Prohibit working under the influence of alcohol and prohibited drugs; • Prohibit intimidation, offensive language and behaviour, prostitution, or sexual harassment when on Project sites or in local communities. • Detail a mechanism for safe reporting of violations of these prohibitions and ensure investigation of any reported incidents. • Ensure, if proven, serious actions are taken up to and including dismissal of the worker and referral of cases to the police when there is evidence of criminal acts. The Worker Code of Conduct will be provided to all Project Workers before they sign their contract of employment, and the contract of employment must state that the Project Worker agrees to abide by the Worker Code of Conduct. In cases of low literacy, Project Workers must also be provided with a verbal explanation of the Worker Code of Conduct.
MON05	Amandi will undertake 20 worker interviews per quarter during construction to help verify that measures related to labour and working conditions, including child and forced labour, are being implemented. The findings of the interviews will be used to identify corrective actions that must be applied by Amandi, contractor or sub-contractors to bring labour management into compliance with the measures outlined in this ESIA and the HR Policy and related management plans.
MON06	Amandi will undertake quarterly reviews of a sample of worker records to verify that the documentation that is retained for each worker shows compliance with the measures outlined in this ESIA and the HR Policy and related management plans. This review will include payment records, working time records, employment contracts, and induction and training records. The findings of the interviews will be used to identify corrective actions that must be applied by Amandi, contractor or sub-contractors to bring labour management into compliance with the measures outlined in this ESIA and the HR Policy and related management plans.

Residual Impact

These mitigation measures will help to bring the impact down to a Small magnitude and likelihood of occurrence, resulting in a Residual Significance of Minor.

17.3.2 Workers exposed to unsafe or unhealthy working conditions during operation (LW5)

During operations workers could be exposed to a range of hazardous activities and work environments that could affect human health. Hazards include those associated with the movement of rolling stock, the running and maintenance of the rail engines, and the loading and unloading of materials form the trains. Workers may also be exposed to fumes and chemicals involved in the running of the trains or in maintenance and cleaning. Workers involved in rail maintenance activities may also be exposed to hazards and human health risks comparable to those involved in construction, as well as the risk of being struck by trains when conducting maintenance activities on or near to the rail line.

As noted in the assessment for LW2, there are challenges in OHS management in Ghana and these also raise risks for the operations phase, though this is at least in part mitigated by the fact that there are existing rail operations and so there is experience in the country of managing OHS risks for rail operations. .

The receptor of this impact will principally be the skilled and semi-skilled workers employed in long-term roles during the operation phase (with a Low vulnerability), but also the local labourers and tradespeople who are seeking employment opportunities as part of short-term or contracted maintenance works (with a Medium vulnerability) (section **Error! Reference source not found.**).

Impact Assessment

There are a range of GIIP measures that will be applied by the Project and are widely used in international projects to manage OHS. These measures will be applied by the rail operator as well as any contractors and subcontractor, with binding requirements applied to them through contracts issued by the rail operator. The measures that are referenced in the box below are detailed in Chapter 3, and in summary include:

- GPM37: Rail operator will prepare a Project OHS Plan that defines the role and responsibilities for OHS management and references the procedures and other documents (including OHS risk assessment, job/task risk assessments, permit to work system).
- GPM38: Rail operator will develop an overall OHS risk assessment for operation. The overall OHS risk assessment will be supplemented with more detailed job / task risk assessments to be developed by the rail operator (and contractors when required).
- GPM39: A Permit to Work system will be implemented for high risk tasks that require these controls (to be identified as part of the OHS risk assessment).
- GPM44: In order to minimize potentially serious accidents caused by equipment malfunction or premature failure the Project will implement regular maintenance of vehicles/machines, use manufacturer approved parts, and ensure that the manufacturer recommended maintenance programs are implemented.
- GPM41: Rail operator will develop and implement programs for medical screening and medical surveillance to help ensure that employees are fit for duty, and particularly for those in safety critical roles.
- GPM40: An OHS reporting system must be developed and implemented to enable workers to report immediately to their supervisor any situation they believe presents a risk of injury or hazard to life or health.
- GPM42: First aid equipment and supplies will be kept at all active Project sites to help support first response to any injuries. Trained first aiders will be available, with the number of first aiders per site to be established within the OHS Plan, based on the risk profile of the activities undertaken at each site.

Relevant ESIA GIIP: GPM37, GPM38, GPM39, GPM40, GPM42, GPM44

The **frequency** of this impact would be **Constant** during the Project operation as OHS hazards have the potential to exist at any time. The **likelihood** of the impact cannot be quantified with certainty, but with the GIIP measures put in place the risk of significant incidents occurring is expected to be limited but remains as Possible. The **extent** of the impact would be to individuals employed by the Project and so is classed as **Local**. The **duration** of the impact is **long-term** as it would last for the duration of operation. Based on these assessments, the **magnitude** is assessed as **Medium**. Combined with the receptor vulnerability of Low (for operator employees) to Medium (for maintenance contractor employees), the pre-mitigation significance is **Minor to Moderate** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in Table 17-7.

Table 17-7: Impact LW5 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM63	The Project will put in place a sufficient and competent organisation to effectively implement meet the Project OHS requirements. The Project will appoint, as a minimum, and document in an Organisation Chart: •A Senior Management Representative (S&E Supervisor), who shall be accountable for compliance with the Project OHS Requirements. •A Project-level OHS Manager/Advisor (Safety Manager), who will lead on compliance with the Project OHS Requirements across all worksites; •An OHS Representative (S&E Advisor) who will be responsible for ensuring that the requirements are implemented, and compliance is regularly monitored; •External medical service provider to provide worker health checks, medical surveillance and emergency assistance as needed; •Emergency Response mechanism (may be defined within the EPRP). Personnel assigned to the above-mentioned roles shall be assessed as competent for the role based on a combination of experience, qualifications and training, and in line with national standards and Good International Industry Practice (GIIP). Records of this competency assessment shall be maintained.
ADM64	The OHS Management Plan shall identify adequate training and awareness for all employees. Training will be provided for each individual, prior to the commencement of any activity, through a combination of induction, toolbox talks or specific job training. Training will be appropriate to the job role and responsibilities.
ADM62	Independent OHS specialists with experience in OHS management at the required International Standards shall be employed. These specialists shall review the OHS Plan prior to construction and monitor implementation of the OHS Plan during construction. The OHS specialists will be separate to the Project's OHS management personnel and will take an independent advisory role with the objective to help ensure compliance of the Project to the OHS requirements of the Applicable Standards.

Residual Impact

These mitigation measures will enhance and help to ensure that the GIIP measures applied in relation to this impact will be applied successfully through a robust operation phase OHS Plan. The mitigation measures do not mean that OHS incidents will not occur, but will help to bring the impact down to a Low magnitude and likelihood of occurrence, resulting in a Residual Significance of Minor.

17.3.3 Use of forced or child labour during construction (LW6)

The risk of forced or child labour being employed during operations is comparable to that outlined for LW3, though may be lower due to the longer-term, more stable nature of operations. Additionally, the risks related to third party suppliers are lower as there is limited requirement for local aggregate or other supplies that could involve forced or child labour.

The principal receptor of this impact will be the children resident in communities located within the Project AoI. This receptor has a High vulnerability (section **Error! Reference source not found.**). Child and forced labour also creates a risk to adults in the Project AoI as well as others elsewhere in Ghana but such people are considered to be less vulnerable to this impact; as such, the impact assessment is based on the more vulnerable children from the Project AoI, but the measures outlined below will also be applicable to managing risk to all other children and adults.

Impact Assessment

The same GIIP measures that are outlined for impact LW3 will be applied by the rail operator during the operation phase, and will be embedded in the HR Policy and associated management plans and procedures. They will also be applied as contractual conditions to contractors, including those involved in maintenance. Implementation of these measures will substantially reduce child and forced labour risk, with the remaining risk principally related to any requirement to use quarries or other material suppliers for maintenance activities.

Relevant ESIA GIIP: GPM33, GPM34

The **frequency** of this impact would be **Constant** during the Project operation as child and forced labour risks exist throughout the period in which labour is recruited and employed. The **likelihood** of the impact cannot be quantified with certainty, but with the GIIP measures put in place the risk of employing child or forced labour is expected to be limited and reduced to **Unlikely**. The **extent** of the impact would be to individuals employed by the Project (even if there originate from elsewhere) and so is classed as **Local**. The **duration** of the impact is **long-term** as it would last for the duration of operation and any impacts to the wellbeing of individuals could extend beyond the period of employment. Based on these assessments and particularly the low likelihood of occurrence with these measures in place, the **magnitude** is assessed as **Low**. Combined with the receptor vulnerability of High, the pre-mitigation significance is **Moderate** and so additional mitigation is required.

Additional Mitigation and Enhancement Measures

The Project will apply the mitigation measures outlined in Table 17-8.

Table 17-8: Impact LW6 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM46	The Contractor Management Process shall set out the process for manging child or forced labour risks in the Supply chain. The Process shall: • Identify key potential risk areas in the supply chain for child and forced labour (e.g. aggregate supplies or other materials and waste).

Mitigation ID	Mitigation Measure
	• Set out the requirements for audit of the primary supply chain and process for spot check visits. • Define the observations required to assess the risk including using visual observations of worker age, verification of documentation to prove ages, and discussions with workers and managers of the supplier. • Define the process for identifying and implementing corrective actions depending on the seriousness of the evidence found and the suppliers willingness to adopt corrective actions. Where appropriate alternate suppliers may be used.

Residual Impact

This mitigation measure will help to address the risk related to suppliers that is not fully addressed by the GIIP measures. The mitigation measure does not mean that there will be zero risk of child or forced labour being used for the Project, but will help to bring the likelihood and scale of any occurrence down to a very small magnitude with a resulting in a Residual Significance of Minor.

18. TRAFFIC AND TRANSPORT IMPACT ASSESSMENT

18.1 Introduction

During construction deliveries of goods and services, worker transport, and waste removal vehicles will result in an increase in transport movements associated with the Project. During operations, the improved and upgraded rail network will be able to offer increased passenger services and to transport higher volumes of freight as necessary. This increase in rail usage would have a corresponding decrease in road use in the area. The increased use of the transport network during construction and improvements to the rail network during operations have the potential to impact upon the transport infrastructure and existing transport users. A summary of the potential impacts identified is provided in Table 18.1.

Table 18.1: Transport Impact Summary

Impact #	**TT1**	**TT2**
Phase	**Construction**	**Operation**
Receptor importance/ sensitivity	Medium	Medium
Frequency	Periodic	Periodic
Likelihood	Certain	Certain
Extent	Local	Certain
Duration	Short term	Long term
Magnitude	Small	Beneficial
Effect	Adverse	Beneficial
Direct/ indirect	Direct	Direct
Significance	Minor	Positive
Additional mitigation? (Y/N)	N	N
Residual Significance	Minor	Positive

18.2 Direct Construction Impacts

18.2.1 TT1: Increase Pressure on Existing Transport Network due to Construction Traffic

Impact Description

During construction materials will be transported within Ghana to the construction sites as far as is practical by rail, however some materials will need to be transported by road. The construction workforce will also be transported by road using two buses. This will result in a slight increase in the number of vehicles on the roads which has the potential to impact upon the road network and other road users.

Impact Assessment

Many of the materials required for construction of the railway will be delivered by sea via Takoradi Port. Given the poor state of some of the roads in the area, the Project intends to transport as much of the construction material as possible using the existing rail network. Road transport will be required to transport construction materials to sections of the rail which have fallen into disrepair and are not currently operational. A Traffic Management Plan (TMP) will be developed considering deliveries of goods and services, worker transport, and waste removal vehicles. The TMP will include management measures to control traffic safety at the construction sites and along routes used by the project, including prioritisation of routes that, where possible, avoid sensitive areas included but not limited to schools and residential areas, or other mitigation measures such as considering timing of vehicle movements and speed restrictions where this is not possible. The TMP will also detail who will be responsible for implementing these controls. The implementation of these measures shall be verified on an on-going basis.

Given the low utilisation of the existing rail network, the increase in train movements to transport materials and equipment required for construction is not anticipated to affect other users. The increase in rail movements will be infrequent and periodic across the construction period. Impacts as a result of increased rail movements are anticipated to be of Very Small magnitude.

Within Ghana, most transport movements are undertaken by vehicles on the road network. The number of vehicle movements associated with the project during construction will be limited. However, the roads in Ghana can be of poor quality and experience congestion, particularly in urban areas including in and around Takoradi Port. The increase in vehicle movements due to the Project during the short term construction period is unlikely to result in a deterioration of the existing transport conditions, but may increase the congestion experienced in settlements which cannot be access via the rail network. Temporary closure of road and pedestrian routes may also be required at road crossings during the construction or upgrade of the road crossings (e.g. for bridge construction or level crossing installation). These will be temporary in nature. As a result, the Project is expected to result in in Small magnitude impacts on the road network and other road users.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: Relevant Embedded Design Controls: PDM4, PDM6, PDM13, PDM14
Relevant ESIA GIIP: GPM46 (Traffic Management Plan)

Taking into consideration the receptor sensitivity (Medium) and impact magnitude (Small), the effect is considered to be of ***Minor*** significance.

Additional Mitigation and Enhancement Measures

As the effect is considered to be of Minor significance, no additional mitigation measures have been identified.

Residual Impact

No additional mitigation measures have been identified, therefore the effect remains of ***Minor*** significance.

18.3 Direct Operational Impacts

18.3.1 TT2: Increased Rail Capacity

Impact Description

Increased rail capacity for both freight and passenger movements, resulting in decreased pressure on the road network.

Impact Assessment

During operations, it is anticipated that up to 6 passenger trains per day will operate along the route, increasing the capacity of the rail network for commuters. Freight movements will continue to operate along the route, with the potential for an increase in freight movements should the demand arise. This would enable transfer of freight movements from road to rail. The increase in the trail network capacity will reduce dependence on the road network, and may help to reduce road congestion, or prevent an increase in congestion by enabling movement of both passengers and freight by rail.

The impact magnitude is considered to be Beneficial.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: Relevant Embedded Design Controls: PDM4, PDM6, PDM13, PDM14
Relevant ESIA GIIP: GPM46 (Traffic Management Plan)

Taking into consideration the receptor sensitivity and impact magnitude, the effect is considered to be of Positive significance.

Additional Mitigation and Enhancement Measures

The Project has been developed in line with the larger Railways Master Plan for Ghana in order to improve rail transport in the region. Enhancement of the positive effect may result from implementation the full Master Plan by Ghana Railways Development Authority, including completing upgrades as part of Phase 2 and implementing Phases 3-5. As the rail network improves across Ghana, the increase in network connections will increase the potential for both freight and passenger transport by rail. Following implementation of the remainder if the Master Plan, freight and passenger transport would be possible across Ghana, not just between Takoradi Port and Huni Valley.

Residual Impact

The Project will have a positive effect on transport in the AoI.

18.4 Indirect Impacts

No in combination impacts identified.

19. IMPACT ASSESSMENT

19.1 Introduction

Waste generation during all phases of the project has the potential to result in impacts to waste management receptors. Potential impacts may arise if hazardous waste is not properly stored onsite prior to collection, during transport (if not properly contained), and at the ultimate disposal sites if these are not designed and operated to adequate standards. Inert wastes have the potential to cause local nuisance due to dust and litter from the handling of the materials themselves.

Table 19.1: Waste Impact Summary

Impact #	WA1	WA2	WA3
Phase	**Construction waste generation**	**Operation waste generation**	**Decommissioning waste generation**
Receptor importance/ sensitivity	Low - Medium	Low	Low
Frequency	Periodic	Periodic	Periodic
Likelihood	Certain	Certain	Certain
Extent	Local	Local	Local
Duration	Medium term	Long term	Medium term
Magnitude	Small-Very Small	Small-Very Small	Small-Very Small
Effect	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct
Significance	Minor-Negligible	Negligible	Negligible
Additional mitigation? (Y/N)	N	N	N
Residual Significance	Minor-Negligible	Negligible	Negligible

19.2 Direct Construction Impacts

19.2.1 Construction Waste Generation WA#1

Impact Description

Although largely inert, construction wastes have the potential to cause local nuisance due to dust and litter from the handling of the materials themselves. This will occur during loading and unloading of the waste onto trucks for its transport, during transport (if not properly contained), and during offloading at the place of deposition.

Hazardous waste streams during construction may include waste oils, chemicals, electronic wastes and contaminated materials from spills. Potential impacts may arise if hazardous waste is not properly stored onsite prior to collection, during transport (if not properly contained), and at the ultimate disposal sites if these are not designed and operated to adequate standards. Potential impacts from improper treatment, storage and disposal of hazardous wastes may include contamination of soil or groundwater, and impacts to human health.

Refuse and Other Non-Hazardous Solid Wastes

Handling or disposal of general construction waste and refuse can give rise to a number of potential impacts including:

- lighter fractions such as paper being blown by the wind potentially causing a litter nuisance over a wide area;
- food waste attracting vermin and other disease carriers, or fauna, which can affect predator-prey relationships or cause other changes to ecosystems;
- food waste creating nuisance due to odour as it degrades (rots);
- gaseous emissions, either direct or from burning of combustible items, can be potentially toxic and/or create nuisance due to odours; and
- pollution of water courses/drinking water supplies – either direct from waste materials or from degradation products.

Hazardous Wastes

Hazardous wastes present a range of potential environmental impacts which are often specific to the type of waste. The consequences are typically more serious, immediate and/or difficult to remedy than the impacts caused by non-hazardous wastes. Many hazardous wastes are potentially toxic to humans and animals and have the potential for causing serious pollution of land and water if not properly managed.

Some of the specific issues associated with the more common types of hazardous waste are as follows:

- Oily waste (lubricating, and hydraulic oils, oil-contaminated rags and PPE and oil/water mixtures), solvent wastes (including paints), other organic wastes and wastes containing heavy metals (e.g. fluorescent tubes, batteries), if not properly contained, can potentially cause pollution of groundwater and surface water courses potentially resulting in death of wildlife and rendering the water unsuitable for human consumption.
- Acids (e.g. from vehicle batteries) and alkalis (from some cleaning products and process chemicals) are highly corrosive in concentrated form and can potentially affect the pH of the receiving waters impacting biological processes potentially causing death of fish and plants.
- Chemicals such as herbicides can be toxic or have the potential for longer term impacts (carcinogenic or mutagenic) and can potentially impact flora and fauna beyond the target species contaminate surface water and groundwater water resources.
- Medical waste, from first aid facilities facilities/clinics provided for the workforce, can contain a variety of potentially hazardous materials including syringes, soiled bandages (from treatment of minor injuries etc.) and possibly expired drugs. These wastes must be carefully managed to avoid transmission of infectious diseases, physical injury and release of potentially toxic substances.
- Existing stations and structures have the potential to contain Asbestos Containing Materials (ACMs) which can be harmful to health, with the potential to cause cancers and other diseases, including mesothelioma and asbestosis when in a friable condition. These wastes must be carefully managed and disposed of safely.

Sewage

Domestic sewage contains a variety of pathogens as well as having a high loading of organic pollutants, nutrients (nitrogen and phosphorous) and suspended solids. Discharge of untreated sewage can have a potential impact on receiving water bodies and the local environment – potentially causing serious health impacts to the local population and contamination of water supplies.

These potential impacts include:

- depletion of dissolved oxygen due to degradation of organic matter and/or suspended solids;

- aesthetic problems due to it unsightly appearance as well as odour;
- turbidity as a result of presence of suspended solids;
- eutrophication, an increase in nutrients which results in the proliferation of one species at the expense of the other species, thereby causing an imbalance in the ecosystem. Algal blooms are typical examples of such impacts; and
- public health impacts – such as:
  - faecal contamination of drinking water supply (groundwater or surface water); and
  - disease transmission by insects, rodents or other possible disease carriers that may come into contact with food or drinking water.

Impact Assessment

Estimated quantities of construction wastes are provided in Section 3.7.5 of Chapter 3: Project Description. The Project is committed to managing and disposing of wastes in accordance with good international practice and Ghana EPA, District/Municipal Assemblies requirements, including following the internationally recognised waste management hierarchy (Figure 19.1).

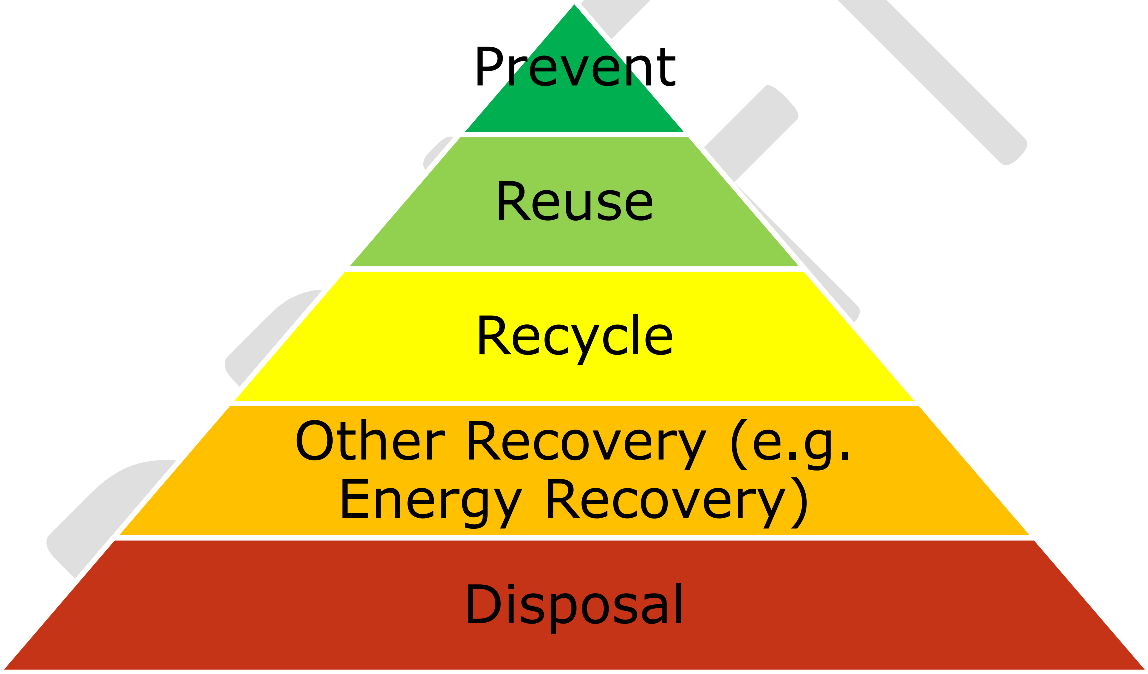

Figure 19.1: Waste Hierarchy

Waste generation will be reduced where possible, for example by limiting vegetation clearance in the Permanent RoW and restricting excavations to only areas required. Materials will be reused or recycled where possible. Where excavated material is deemed suitable for reuse, it will be stored in designated areas segregated from topsoil stockpiles and used for backfilling and ground restoration. Where possible existing infrastructure will be reused and recycled for the replacement rail and facilities if they are in an acceptable condition. Waste recycling is limited by the recycling facilities, but will include recycling of plastics, metal, paper and electronic wastes.

Waste streams will be separated and segregated at the source and collected in specific types of waste containers or skips at designated locations at worksites. The contractor will be responsible for providing a sufficient number of the different types of waste containers at each construction site. Waste will be collected by licenced waste management companies on a regular basis and transported to licenced facilities for recycling or disposal as appropriate.

Waste will be disposed of at only approved / licenced disposals including municipal landfill sites. These may include the Sofokrom engineered landfill site and Zoomlion recycling facilities.

Hazardous wastes will be stored in closed containers located away from the elements (direct sunlight, wind and rain) and shall not be stored onsite for more than 180 days. Temporary hazardous waste storage areas will be identified during construction with access restricted to trained personnel only. A Waste Management Plan will be developed which will provide the basis for all the waste management arrangements and act as a central point of reference for how wastes will be managed by the Project.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: PDM31 (Ballast material will be sourced from the waste fraction from the existing mines in the area, reducing the requirement for new materials to be sourced.)
Relevant ESIA GIIP: GPM47 (Waste Management Plan)**, GPM48** (Where possible existing

The Waste Management Plan will be developed and implemented in line with good international practice and national requirements. Waste volumes generated during construction requiring disposal at municipal waste management facilities are not anticipated to impact on treatment or disposal of other waste arisings at the municipal facilities. Recycling capacity within Ghana is currently limited, however work to increase the capacity is ongoing including a new waste recycling facility in Takoradi which is due for completion during the Project construction period.

An accredited company with expertise in asbestos analysis and management will be engaged to determine whether the buildings slated for demolition contain asbestos. If asbestos containing materials (ACM) are identified, an Asbestos Management Plan will be developed which identifies the location and condition of and the ACM present (e.g. whether it is in friable form with the potential to release fibres). For structures remaining in place procedures for monitoring ACM condition will be developed. The removal of ACMs should be undertaken only by specially trained personnel following Ghana Standards requirements. Following removal, ACMs shall be stored at the hazardous waste storage area prior to disposal at an approved hazardous waste landfill in accordance with the Schedule to the Environmental Permit for the Western Railway Line Infrastructure Project.

Wastewater during construction will be collected in septic tanks and collected for off-site disposal at registered facilities.

The magnitude of impacts on waste management facilities is therefore anticipated to be Small to Very Small. Taking into consideration the Low to Medium receptor sensitivity, the Project is expected to result in ***Minor to Negligible*** significance adverse effects on waste management.

Additional Mitigation and Enhancement Measures

Potential effects on waste management infrastructure are predicted to be of Minor to Negligible significance therefore no additional mitigation measures have been identified beyond the embedded mitigation measures.

Residual Impact

No additional mitigation measures have been identified therefore the residual significance remains ***Minor to Negligible***.

19.3 Direct Operational Impacts

19.3.1 Operational Waste Generation WA#2

Impact Description

Hazardous waste streams during operation will include wastes generated by maintenance activities at the light and heavy maintenance facilities and refuelling activities. These waste streams will include waste oils, chemicals, electronic wastes and contaminated materials from spills. Right of Way maintenance may involve the use of herbicides, which may generate hazardous wastes associated with waste containers or spills. Stations and maintenance activities may also generate electronic wastes. Potential impacts from improper treatment, storage and disposal of hazardous wastes may include contamination of soil or groundwater and impacts to human health.

Operational activities will also generate a range of inert wastes, with the potential to cause local nuisance due to dust and litter from the handling of the materials themselves. Wastewater during operation will be collected in septic tanks and collected for off-site disposal at registered facilities.

Impact Assessment

Estimates of operational waste volumes generated are provided in Section 3.7.5 of the Chapter 3: Project Description. In line with the construction phase, a Waste Management Plan shall be developed in line with IFC EHS Guidelines, international best practice and national legislation. Wastes will be managed, transported and disposed in accordance with IFC EHS Guidelines and Ghanaian requirements using only licenced facilities. The Waste Management Plan will include measures on waste segregation and storage, including requirements for safe storage of hazardous wastes at a hazardous waste storage location where access is restricted and wastes are stored in sealed containers, protected from the elements.

Embedded Mitigations considered in impact assessment

Relevant Embedded Design Controls: N/A
Relevant ESIA GIIP: GPM47 (Waste Management Plan), **GPM50** (discharge standards)

Annual waste volumes generated during operation which require disposal at municipal waste management facilities are not anticipated to impact on treatment or disposal of other waste arisings at the municipal facilities.

Taking into consideration the embedded mitigation measures, the magnitude of impacts on waste management facilities are anticipated to be Very Small. When combined with the Low receptor sensitivity, the Project is expected to result in effects of ***Negligible*** significance on waste management.

Additional Mitigation and Enhancement Measures

Potential effects on waste management infrastructure are predicted to be of Negligible significance therefore no additional mitigation measures have been identified beyond the embedded mitigation measures.

In the event that septic tanks are not used for the disposal of sewage from stations, the potential for impacts exists. Additional mitigation measures have been identified in relation to discharges to surface waters:

Table 5-2: Impact CS1 Mitigation Measures

Mitigation ID	Mitigation Measure
ADM85	No discharges to water bodies identified as Critical Habitats or as having potential to support Critical habitat features shall be allowed.
ADM86	The Wastewater Management Plan shall include pre-discharge review to identify the assimilative capacity of the receiving waterbody.
ADM92	Where drainage cut off drains discharge into local watercourses, discharge points must be microsited in the field to avoid further erosion and fitted with in-line silt traps to minimise sediment run-off at the discharge point.

Residual Impact

No additional mitigation measures have been identified therefore the residual significance remains ***Negligible***.

19.4 Direct Decommissioning Impacts

19.4.1 Decommissioning Waste Generation WA#3

Impact Description

Similar to construction, decommissioning wastes are largely inert, which have the potential to cause local nuisance due to dust and litter from the handling of the materials themselves during loading and unloading of the waste onto trucks for its transport, during transport, and during offloading at the place of deposition.

Existing buildings requiring decommissioning may contain Asbestos Containing Materials (ACMs). ACMs or other dangerous materials may be present in the ballast which has been used as subgrade for the existing railway. Lead-based paints may be present on structural steel components. Historically wooden railway sleepers may have been treated with creosote, a carcinogen, and may therefore require disposal as a hazardous waste.

Hazardous waste streams during decommissioning may also include waste oils, chemicals, electronic wastes and contaminated materials from spills. Potential impacts may arise if hazardous waste is not properly stored prior to collection, during transport (if not properly contained), and at the ultimate disposal sites if these are not designed and operated to adequate standards. Potential impacts from improper treatment, storage and disposal of hazardous wastes may include contamination of soil or groundwater and impacts to human health.

Impact Assessment

The Project is committed to managing and disposing of wastes in accordance with good international practice and Ghana EPA, District/Municipal Assemblies requirements, including following the internationally recognised waste management hierarchy (Figure 19.1).

Materials will be reused or recycled where possible. Where excavated material is deemed suitable for reuse, it will be stored in designated areas segregated from topsoil stockpiles and used for backfilling and ground restoration. Where possible existing infrastructure will be reused and recycled for the replacement rail and facilities if they are in an acceptable condition. Given the investment in waste recycling facilities, although capacity is currently limited bit is improving and recycling of a range of materials including plastics, metal, paper and electronic wastes is anticipated.

A Waste Management Plan (WMP) will developed prior to decommissioning of any facilities (GPM#43). The WMP will include measures related to segregation of waste streams, waste storage requirements and collection and disposal in line with national requirements and international good practice. Waste will be collected by licenced waste management companies on a regular basis and transported to licenced facilities for recycling or disposal as appropriate.

The Waste Management Plan will be developed and implemented in line with good international practice and national requirements. Waste volumes generated during decommissioning requiring disposal at municipal waste management facilities are not anticipated to impact on treatment or disposal of other waste arisings at the municipal facilities, however this will need to be determined prior to disposal.

Embedded Mitigations considered in impact assessment
Relevant Embedded Design Controls: N/A
Relevant ESIA GIIP: GPM47 (Waste Management Plan)**, GPM48** (Where possible existing infrastructure will be reused and recycled for the replacement rail and facilities if they are in an acceptable condition)

The magnitude of impacts on waste management facilities is therefore anticipated to be Small to Very Small. Taking into consideration the Low receptor sensitivity, the Project is expected to result in ***Minor to Negligible*** significance adverse effects on waste management.

Additional Mitigation and Enhancement Measures

Potential effects on waste management infrastructure are predicted to be of Minor to Negligible significance therefore no additional mitigation measures have been identified beyond the embedded mitigation measures.

Residual Impact

No additional mitigation measures have been identified therefore the residual significance remains ***Minor to Negligible***.

19.5 Indirect Impacts

No indirect or in combination impacts are anticipated.

20. MAJOR ACCIDENTS

20.1 Introduction

This chapters provides a qualitative assessment of potential risks and effects arising from the vulnerability of the Project to major accidents occurring due to unplanned events.

Unplanned events are episodes that are not planned to occur during the project's normal construction and operational phase activities, such as accidents, but which may conceivably occur, even with low probability. They can occur as a result of abnormal operating conditions, wear and tear, human error, equipment failure and other possible causes.

The scope and methodology of this assessment is centred on the understanding that the Project will be designed, built and operated in line with international best practice. As such, major accidents resulting from the proposed development will be highly unlikely but potentially possible scenarios, and whilst they are not expected to occur the impact of such occurrences needs to be considered. A risk analysis-based methodology that covers the identification, likelihood and consequence of unplanned events has been used for this assessment and is presented in Chapter 05: Methodology.

This chapter seeks to determine:

- The relevant major accidents and unplanned events, that the project could be vulnerable to;
- The potential for these major accidents to result in likely significant adverse environmental and social effects; and
- The measures that are in place, or need to be in place, to prevent or mitigate the likely significant adverse effect of such events.

20.2 Likely Significant Effects

It should be noted that at this stage of the Project, a full detailed assessment of major accidents has not been undertaken as information in relation to detailed construction practices for example, has yet to be developed. However, a Hazard and Operability Analysis (HAZOP) or other risk assessment process shall be followed to identify and assess Project risks during the different Project phases and used to inform the development of an Emergency Preparedness and Response Plan (EPRP). Such assessment will include specific consideration of risks to construction workers in the vicinity of active/existing rail operation where relevant.

To undertake the assessment at this stage, a preliminary set of typical key likely hazards posed on comparable rail schemes. Appropriate mitigation measures have also been outlined where necessary.

20.2.1 Effects During Construction

The main risks identified during the construction phase of the project include:

- Accidental spills of fuel and/or chemicals;
- Construction of the Eshiem bypass close to a fuel storage site;
- Worker safety where construction activities are undertaken on or in the vicinity of active/existing railways; and
- Pedestrian accidents associated with additional construction vehicles on the roads.

Accidental spills of fuel and/or chemicals

During construction fuel (diesel and fuel oil) will be stored in above ground storage tanks at the central construction camp. In addition, chemicals, such as herbicides for Rights of Way (RoW) clearance will also be stored at the central construction camp.

In the event of an accidental spill of fuel or chemicals from storage tanks located at the central construction camp, or fuel from construction vehicles, the impact would be directly associated with the duration and volume of the release of pollutants. Minor spills of fuel or chemicals are **possible** during the construction phase. The following embedded mitigation measures have been identified which will help to reduce the potential consequence of any spills:

- **GPM23:** A Hazardous Materials Management Plan (HMMP) shall be developed and implemented which includes measures related to the production, handling, storage, and use of hazardous materials.
- **GPM24:** A Spill Response Plan will be developed and implemented. The Plan will address potential oil, chemical and fuel spills from the facilities, transport vehicles, loading and unloading operations.

The consequence is considered **low** as any slight changes in groundwater or soil conditions will probably be reversible and limited to the construction site.

Therefore, the risk of the impact of accidental spills on groundwater and soil conditions is considered to be of minor significance. Larger accidental spillages of fuel or chemicals could result in a medium consequence on groundwater quality and a bigger extension of soil affected, though such an event is considered unlikely, and therefore the risk would be of **Minor** significance.

Construction of the Eshiem bypass close to a fuel storage site

As outlined in Chapter 3: Project Description the track at Eshiem will be realigned to provide a safe curvature. This will mean the line will move away from the settlement of Eshiem but closer to an existing fuel storage area. The exact details of the realignment are not yet known, but prior to construction, as part of detailed design, safe distances will be determined between the proposed route alignment and fuel tanks or storage areas to reduce the risk of explosion and fire hazard. It is thought that the likelihood of an explosion or fire at the fuel storage area in Eshiem is **unlikely.**

The following embedded mitigations have been identified which will help to reduce the potential consequence of major accidents associated with the construction of the Eshiem bypass:

- **GPM6:** Safe distances to sensitive receptors and communities shall be clearly demarcated. The Construction Method Statement shall define the purpose for the safe distance area, Where safe distances cannot be free from all activity, the Method Statement shall clearly define the activities that are and are not allowed within the zone.
- **GPM22:** A HAZOP or other risk assessment process shall be followed to identify and assess Project risks during the different Project phases and used to inform the development of an Emergency Preparedness and Response Plan (EPRP).

The consequences of the risk would be **high** with the potential for loss of life and damage to habitats. The overall risk to the project being located in close proximity to the fuel storage are at Eshiem is therefore considered of **Major** significance.

The alignment of the Eshiem Bypass has yet to undergo detailed design. In order to reduce the potential impacts from construction of the Eshiem Bypass the following additional mitigation measures have been identified:

- **ADM48–** The Land Disturbance Process shall include an assessment of safe distances from any existing industrial facilities. Where necessary, the railway alignment and construction activities shall be sited to avoid the existing industrial facilities and leave a safe distance.
- **ADM49-** At the Eshiem Bypass, construction activities must be sited away from the fuel storage area at the existing industrial facility.

- **ADM50-** A project access route must be established to the construction site which is not shared with the existing industrial facility near Eshiem.

By siting the route to avoid the existing facilities and micrositing of construction activities away from the fuel tanks at the existing facilities the potential consequence of explosion and fire hazard should be reduced to **improbable** and the resultant significance reduced to **Moderate**.

Worker safety where construction activities are undertaken on or in the vicinity of active/existing railways

In some areas (for instance in Section 1 where rails are to be installed on existing dual gauge sleepers), there is the potential for construction activities on or in the vicinity of active rail/train operations. Risks will be controlled through standard practices identified in the following embedded mitigations:

- **GPM11:** Construction method statements will be developed.
- **GPM36:** An Occupational Health and Safety (OHS) Management Plan for construction will be developed. Specific measures may include but are not limited to:
  - installation of barriers, warning tape/ net, signage, watchman, and proper lighting;
  - use of appropriate PPE by site personnel at all times during construction activities;
  - provision of adequate cool drinking water for construction workforce;
  - provision of back-up alarms, lights, and all other applicable safety devices for plant and equipment;
  - workforce induction on the project site safety requirements prior to commencement of activities covering activity safety issues and general safety requirements.
- **GPM38:** An overall OHS risk assessment will be developed for each phase of the Project as part of the OHS Plan. This assessment must follow an appropriate risk assessment methodology and result in the identification of hazards, risks and appropriate means of control, applying the hierarchy of controls . The overall OHS risk assessment will be supplemented with more detailed job / task risk assessments. These assessments must be updated each time a job or task changes, or when an accident, incident or near miss has occurred

This will be developed through the health and safety management system for the construction project. The adoption of these standard controls will mean that the likelihood of such an incident is **Unlikely**, but the consequence of one occurring could be high (due to potential for fatalities) and therefore the risk is considered as being of **Major** significance.

The following additional mitigations have been identified in order to reduce the resultant effect:

- **ADM51:** The Construction Method Statement for live rail working should identify standard practices including tag out tag in, communications protocols, careful work planning, adoption of working procedures, including a permit to work system, toolbox talks and appropriate PPE (including hi-Vis vests, etc).

Following implementation of the additional mitigation, the likelihood of fatalities due to working in the vicinity of live rails would be reduced. The residual effect is considered to be **Moderate**.

Pedestrian accidents associated with additional construction vehicles on the roads

Construction of the Project is expected to cause an increase in the numbers of HGVs on the local road network which in turn increases the risk of road accidents which might result in injuries and loss of life. During construction it is **unlikely** that there would be a road traffic accident.

The following embedded mitigations have been identified which would help to reduce the likelihood and consequence of traffic accidents:

- **PDM4:** Safety fencing will be installed at the stations, crossings and Heavy Rail Maintenance Facility to prevent pedestrian access to the rail.
- **GPM46:** A Traffic Management Plan (TMP) shall be developed and implemented that evaluates potential routes for the main Project related vehicle movements, such as deliveries of goods and services, worker transport, and waste removal vehicles. The TMP should prioritise routes that, where possible, avoid sensitive areas included but not limited to schools and residential areas. If avoidance is not possible, the TMP will consider alternative minimisation measures such as timing of vehicle movements, speed restrictions, staff training etc. The TMP should include management measures to control traffic safety at the construction sites and along routes used by the project. It will also detail who will be responsible for implementing these controls.

Taking into consideration the embedded mitigation, the consequence of a traffic accident occurring could be **high** therefore the risk is considered as being of **Major** significance.

- **ADM52:** Specific measures included within the Traffic Management Plan will include:
  - Reduced speed limits where selected vehicle routes pass schools and other sensitive receptors. Project speed limits of 20MPH shall be enforced in such areas.
  - Sites will be designed to include segregated pedestrian - vehicle access. Where complete segregation is not possible, pedestrian and vehicle traffic routes should be clearly marked.
  - Vehicle entrances to the site will be clearly marked and located where there is good visibility (i.e. not close to sharp bends). Where this is not possible, mirrors shall be installed. There should be separate entrances and exits for vehicles and pedestrians.
  - Consider use of convoys wherever possible
  - Alcohol/drug testing of drivers shall be undertaken.

A reduction in speed and ensure segregated access routes will reduce the residual effect to **Moderate**.

20.2.2 Effects During Operation

The main risks identified during operation of the project include:

- Bridge collapse;
- Accidental spills during refuelling;
- Fuel storage at heavy rail maintenance facility;
- Level crossing accidents and safety; and
- Train collision and train derailment.

Bridge collapse

The project will require 12 bridges which will generally be grade separated with the rail constructed over the top and perpendicular to the road or, as a minimum, at 45 degrees to allow safe transit for vehicles passing underneath. There is a risk of new and existing bridges collapsing however this is **improbable** given the design of bridges and also the development of maintenance and inspection regimes during the operation phase. The following embedded design mitigation measures have been identified which will help to reduce the potential consequence of any spills:

- **PDM5:** All Project facilities and main components shall comply with the relevant Project design standards as set out in the Chapter 2: Legislation and Standards, Section 2.8: Project

Design Standards including S EN 1993-2: Eurocode 3 - Design of steel structures – Steel bridges.

If a bridge did collapse whilst something was travelling under it the consequence could be would be **high** with the potential for loss of life. The overall risk of bridge collapse is therefore considered to be of **Moderate** significance.

Given the improbable likelihood of a bridge collapse additional mitigation measures are not required.

Accidental spills during refuelling

During operation the main heavy rail maintenance facility will be located adjacent to the Tarkwa Station and will undertake all maintenance on locomotives and wagons, including refuelling. In addition, a light maintenance facility near to Takoradi Port is already operational as part of the early phases of the upgrade work for the western rail. This rail facility will handle general maintenance, including refuelling.

The following embedded mitigation measures will help to reduce the likelihood and consequence of spills occurring during refuelling:

- **GPM11:** Construction method statements will be developed.
- **GPM23:** A Hazardous Materials Management Plan (HMMP) shall be developed and implemented which includes measures related to the production, handling, storage, and use of hazardous materials.
- **GPM24:** A Spill Response Plan will be developed and implemented as part of the EPRP, specifically to address, minimise and control potential for oil, chemical and fuel spills from the facilities, transport vehicles, loading and unloading operations.
- **GPM37:** The OHS Plan shall be updated for each phase of the Project. The plan shall define:
  - the role and responsibilities for OHS management
  - set out and define the requirements for associated procedures including the OHS risk assessment, job/task risk assessments, and permit to work system.
  - Set out the training and awareness requirements
  - Define the audit and inspection requirements to ensure implementation and compliance with the Plan.

In the event of an accidental spill of fuel at either the heavy rail maintenance facility or the light maintenance facility, the impact would be directly associated with the duration and volume of the release of pollutants. Minor spills of fuel are possible during refuelling, but the consequence is considered low as any slight changes in groundwater or soil conditions will probably be reversible and limited to the construction site. Therefore, the risk of the impact of accidental spills on groundwater and soil conditions is considered to be of **Minor** significance.

Fuel storage at heavy rail maintenance facility

The heavy rail maintenance facility adjacent to Tarkwa Station will house a fuel storage area which will comprise two storage tanks, located either above or below ground, each containing 50,000 litres of fuel. The design of any underground storage area will be in line with *European Standard EN 122855 – 1 ed 2 Workshop fabricated steel tanks - Part 1* or equivalent on the underground storage of flammable and non-flammable water polluting liquids. However, like with any fuel storage area, there is always the risk of explosion and fire hazard. The likelihood of an explosion or fire at the fuel storage area is **improbable** due to storage being in line with European Standards, however the consequences of the risk would be **high** with the potential for loss of life and damage to habitats. Other relevant embedded mitigation measures include:

- **PDM24:** Permanent UST fuel storage tanks shall, as a minimum:
  - Be located away from areas with potential for vehicle collisions and damage;
  - Include installation of a secondary containment systems to prevent the uncontrolled release of fuel (e.g. double wall construction);
  - Include installation of impermeable liners or structures under and around tanks (e.g. concrete vaults);
  - Include a leak detection systems to detect the presence of liquid or petroleum vapor within the interstitial space;
  - Use corrosion protection in steel tanks and piping (e.g. dielectric coating or cathodic protection);
  - Include automatic shut-off devices and catch basins around fill pipes;
  - Use unjointed polyethylene piping and continuous, flexible composite piping rather than metal pipes; and
  - Include provision of secondary containment for any pressurised piping system.
- **PDM25:** Where fuel storage is located in ASTs, these shall be designed to incorporate secondary containment measures including (but not limited to):
  - Installation of berms/or walls to contain 110% of the largest tank or 25% of the combined tank volume whichever is larger;
  - Impervious, chemically resistant hardstanding in the containment area;
  - Dedicated runoff/drainage area not connected to a municipal facility to allow storage and transfer to a special hazardous waste facility as required, and incorporation of shutoff valves with oil separators where segregation is not possible; and
  - Installation of leak detection equipment for the tanks.
- **GPM37:** The OHS Plan shall be updated for each phase of the Project. The plan shall define:
  - the role and responsibilities for OHS management
  - set out and define the requirements for associated procedures including the OHS risk assessment, job/task risk assessments, and permit to work system.
  - Set out the training and awareness requirements
  - Define the audit and inspection requirements to ensure implementation and compliance with the Plan.
- **GPM 23:** A Hazardous Materials Management Plan (HMMP) shall be developed and implemented which includes measures related to the production, handling, storage, and use of hazardous materials.
- **GPM24:** A Spill Response Plan will be developed and implemented as part of the EPRP, specifically to address, minimise and control potential for oil, chemical and fuel spills from the facilities, transport vehicles, loading and unloading operations.

The overall risk of the fuel storage area at the heavy rail maintenance facility is therefore consider of **Moderate** significance. Given the improbable likelihood, no additional mitigation measures have been identified.

Level crossing accidents and safety

Three fully automated level crossings will be provided as part of the project (see Chapter 03: Project Description for more details), with barriers that are the full width across the road to ensure vehicles and pedestrians are prevented from crossing. Security fencing will also be installed to prevent pedestrians trespassing onto the railway line. The crossings will be perpendicular to the rail (or as close as possible to this) to ensure safety, however there is still the risk of an accident associated with pedestrians and livestock crossing the track. The risk is **unlikely** to occur during the lifetime of the project.

The following embedded mitigation measures of relevance have been identified:

- **PDM4:** Safety fencing will be installed at the stations, crossings and Heavy Rail Maintenance Facility to prevent pedestrian access to the rail.
- **PDM13:** Pedestrian access will be provided as underpasses adjacent to the road crossing to ensure vehicles and pedestrians are segregated.
- **PDM14:** All at grade crossings will be designed to be fully automated and linked to the Central Control Facility.
- **PDM21:** The rail, stations and other infrastructure will be designed to allow for sustainable drainage of the track. Run off from the track will be managed through a series of channels and collected for discharge. Drainage under the track to allow for free flow movement of rainfall will be provided through a series of land drains and culverts sized according to the water conveyance requirements. Drainage will be installed parallel to the rail to ensure flooding from surface waters is controlled at level crossings.

Taking into consideration the embedded mitigation measures which would reduce the consequence of and impact to pedestrians or livestock involved in any accident to medium, the risk is considered to be of **Moderate** significance.

The following additional mitigation measures have been identified, several of which fall under the responsibility of GRDA:

- **ADM53:** As part of the Operational Phase Transport Management Plan for operation, GRDA shall implement a community education programme around railway traffic safety.

Train collision and train derailment

Train collision with other trains or with road vehicles as well as train derailment (e.g. due to collisions, rail buckling, embankment collapse, objects on the rails etc.) pose some of the greatest risks to both crew and passengers with the threat of serious injury and potentially multiple fatalities. Relevant embedded mitigation measures include:

- **PDM5:** All Project facilities and main components shall comply with the relevant Project design standards as set out in the Chapter 2: Legislation and Standards., Section 2.8: Project Design Standards.
- **GPM4:** An Integrated Vegetation Management Plan (IVMP) shall be developed which outlines measures for the regular maintenance of the RoW to control vegetation
- **GPM22:** A HAZOP or other risk assessment process shall be followed to identify and assess Project risks during the different Project phases and used to inform the development of an Emergency Preparedness and Response Plan (EPRP).
- **GPM44:** The Project will implement regular maintenance of vehicles/machines, use manufacturer approved parts, and ensure that the manufacturer recommended maintenance programs are implemented.

Such operational risks will be managed through a detailed safety assessment processes as part of the design (including infrastructure, safety control systems, signalling etc.), development of operational procedures, and maintenance. With these standard safety measures in place the likelihood of train derailment or collision is estimated to be **Unlikely**

The consequence of the impact could be high for those involved, therefore the risk is considered to be of **Major** significance. These risks will be assessed in more detail (including for example HAZOP studies, quantitative risk assessments etc.) as part of the detailed design.

The following additional mitigation measures have been identified, several of which fall under the responsibility of GRDA:

- **ADM54:** Following HAZOP or other appropriate risk assessments, it is recommended an Emergency Preparedness and Response Plan (EPRP) be developed, implemented and disclosed to local communities. The EPRP should focus on site impacts and response actions, communities and community actions. The EPRP shall include measures to update local authorities and communities if there are changes in the EPRP. Training of workforce on the EPRP shall be undertaken, with regular emergency drills/exercises to be undertaken at a frequency to be determined in the EPRP.
- **ADM55:** Operational procedures shall address the potential causes of train collisions and derailments identified within the HAZOP or other appropriate risk assessment.
- **ADM61:** The operational maintenance and inspection regime shall detail the minimum frequency of maintenance checks and inspections including track inspections and locomotive maintenance to reduce the roughness of running surfaces and inspections of fencing to identify unauthorised crossings.

Although these mitigation measures will help to reduce the likelihood of a train collision or derailment it is not possible to reduce the likelihood of an occurrence below unlikely, therefore the residual significance remains **Major**.

20.3 Residual Significance

Table 20-1 identifies the potential risk and residual effects arising from the vulnerability of the project to major accidents occurring due to unplanned events during construction and Table 20-2 for operation. Additional mitigation measures have been identified for evens of Moderate and Major significance, except where the likelihood of such event has already been reduced to improbable.

Table 20-1 Major Accidents Construction Effect Summary

Potential Risks	Likelihood	Consequence	Significance	Additional Mitigation?	Residual Significance
Accidental spills of fuel and/or chemicals	Unlikely	Low	Minor	N	Minor
Construction of the Eshiem bypass close to a fuel storage site	Unlikely	High	Major	Y	Moderate
Construction workers on / in vicinity of live rail operations (risk of injury/fatality)	Unlikely	High	Major	Y	Moderate
Pedestrian accidents associated with additional construction vehicles on the roads	Unlikely	High	Major	Y	Moderate

Table 20-2 Major Accidents Operation Effect Summary

Potential Risks	Likelihood	Consequence	Residual Effect	Additional Mitigation?	Residual Significance
Bridge Collapse	Improbable	High	Moderate	N	Moderate

Accidental spills during refuelling	Possible	Low	Minor	N	Minor
Fuel storage at heavy rail maintenance facility	Improbable	High	Moderate	N	Moderate
Level crossing accidents and safety	Unlikely	Medium	Moderate	Y	Minor
Train collision and train derailment	Unlikely	High	Major	Y	Major

21. CUMULATIVE IMPACTS

21.1 Introduction

The assessment of cumulative impacts is an integral part of the ESIA process to ensure that multiple effects on people, heritage and environmental receptors arising from the Project combined with impacts from other projects/activities have been identified and addressed. Environmental and social impacts arising from existing, planned and foreseeable future developments within the Project Area of Influence (AoI) might individually be insignificant, but when combined, could amount to a significant cumulative impact. Direct and indirect effects of the Project have been defined in the relevant impact assessment Chapters (*Chapters 8 – 19*).

In accordance with IFC Performance Standard 1, the cumulative impact assessment considers the potential impacts from the proposed Project in conjunction with other existing, planned or reasonably defined developments.

21.2 Approach

A six step Rapid Cumulative Impact Assessment (RCIA) methodology has been followed, as described in Figure 5.5 in Chapter 5 (Methodology) and summarised in Figure 21.1, aligned to the IFC (2013) *The Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets Handbook*.

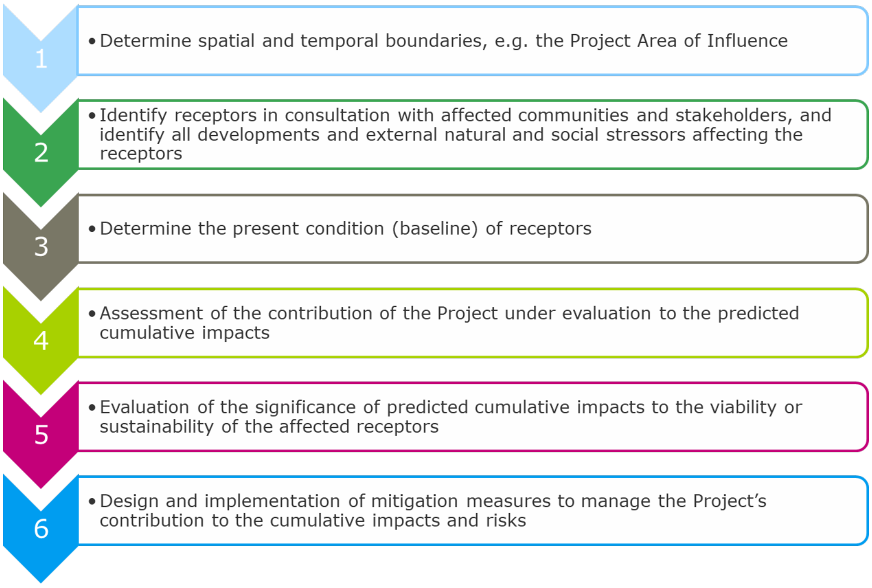

Figure 21.1: RCIA Stages

The focus of the cumulative impact assessment is limited to proposed developments and activities that have the potential to have a significant impact on sensitive human, heritage and environmental values and/or raise concerns from Affected Communities.

21.3 Stage 1: Spatial and Temporal Boundaries

21.3.1 Spatial Boundaries

The spatial boundaries of the RCIA have been defined by reference to the Project characteristics (see *Chapter 3: Project Description*). The AoI for each topic area are presented in the relevant topic annexes (*Annexes A-J*) and correspond to the assessment area for the defined Valued Environmental and Social Components (VECs).

While this scope has been used to identify potential interactions with any VECs present, it does not necessarily equate to the extent of the VECs being affected. A flexible approach has been maintained, with the geographical boundaries of the RCIA varying depending on the characteristics of the potentially impacted VEC. In some cases (e.g. mobile fauna), an interaction may occur in one area, but cumulative impacts may occur across the extent of the VEC. In these cases, the cumulative assessment has evaluated any impacts across the extent of the VEC.

21.3.2 Temporal Boundaries

The cumulative impact assessment temporal boundary covers the construction, operation and decommissioning phases of the Project. It should be noted that the further into the future the assessment looks, the greater the level of uncertainty around other potential developments.

21.4 Stage 2: Identify Receptors and Other Developments

21.4.1 Valued Environmental and Social Components

VECs are those prevailing environmental and social attributes within areas that are potentially impacted by the Project (during the construction and operation phases). VECs have been identified through the ESIA process, including through relevant stakeholder engagement (as detailed *in Chapter 6: Stakeholder Engagement*) and through reviews and assessments undertaken by relevant specialists as part of the ESIA process.

The VECs for which the Project itself is assessed to have a significant (Moderate or Major) adverse or positive effects will be considered as part of this RCIA. A summary of the VEC residual effects defined for the Takoradi to Huni Valley Railway Project are presented in Table 21.1, and only includes in-scope VECs that may be cumulatively impacted by the Project.

Table 21.1: Summary of Takoradi to Huni Valley Railway Project Major, Moderate or Positive Residual Effects

Aspect/ ESIA Chapter	VEC(s)	Impact	Phase [a]			Residual Significance
			C	O	D	
Noise and Vibration	Residents in close proximity to Project route	Noise Impacts from construction works	✓	-	-	Moderate Adverse
		Vibration impacts from construction works	✓	-	-	Moderate Adverse
Water Resources	Groundwater aquifers	Borrow pit excavation and dewatering	✓	-	-	Minor to Moderate Adverse
Biodiversity and Ecosystem Services	Sekondi Waterworks Forest Reserve	Direct Habitat Loss Impacts	✓	-	-	Moderate Adverse
	Flora	Operational habitat degradation	-	✓	-	Moderate Adverse
Socio-Economics	Residents of buildings that are located within or adjacent to the Project footprint	Physical and Economic Displacement	✓	-	-	Moderate Adverse
	Individuals located within or adjacent to the Project footprint	Access to ecosystem services	✓	-	-	Negligible to Minor Adverse

Aspect/ ESIA Chapter	VEC(s)	Impact	Phase (a)			Residual Significance
			C	O	D	
	Individuals located within or adjacent to the Project footprint	Direct and indirect local employment opportunities	✓	-	-	Positive
	Individuals located within the region	Long term employment and economic benefits during operation	-	✓	-	Positive
Community, Health, Safety and Security	Residents of buildings that are located within or adjacent to the Project footprint.	Increased transmission of malaria	✓	-	-	Minor to Moderate Adverse
Cultural Heritage	Cemeteries	Loss and/or disturbance of tangible cultural heritage	✓	-	-	Moderate Adverse
	Historic or archaeological finds	Disturbance to archaeological and/or other historic sites	✓	-	-	Moderate Adverse
Note: (a) Phase: C= Construction O= Operation D= Decommissioning						

21.4.2 Other Projects and Developments

A summary of the third-party developments identified as part of the RCIA are provided in Table 21.2. Figure 21.2 shows where the developments intersect with the Project AoI. These third-party developments have been screened to identify those with the potential to result in cumulative impacts when the spatial and temporal scope of the Project is considered.

Where existing operational developments have been captured as part of the baseline for the Project these have been screened out of the cumulative impact assessment as impacts have been captured as part of the topic assessments. Planned developments have been assessed subject to the availability of relevant ESIA reports and other readily available information. Where information is incomplete or unknown, these developments are deemed as having 'Deficient Data' and have been assigned as such in Table 21.3.

Table 21.2: Other Projects

Project Name	Status (planned/ constructed/ operational)	Description	Screened In / Screened Out
Railway			

Project Name	Status (planned/ constructed/ operational)	Description	Screened In / Screened Out
Ghana Railways Masterplan (GRM)	-	The masterplan consists of 6 phases for the rehabilitation and expansion of rail lines nation-wide. Construction works commenced in 2015 and are anticipated to be completed by 2047. As discussed in Chapter 3: Project Description, the Project comprises a 102 km section of rail line within Phases 1 and 2 (Western Line) of the masterplan. Accordingly, the works proposed within Phases 1 and 2 that form part of the Project have not been considered within the cumulative assessment.	-
GRM Phase 1: Western Line 0-10.2 km	Operational	<u>Phase 1: Rehabilitation of Existing Western Line 0–10 km</u> Upgrade to the track in 2017 between Takoradi and Kojokrom to facilitate the upgrade to standard gauge.	Screened out – considered in baseline
GRM Phase 1: Western Line 10.2-32.6 km	Under construction (40-50 % complete)	<u>Phase 1: Rehabilitation of Existing Western Line 10-32 km</u> Track upgrades have been funded via the government and are currently under construction with the majority of the earthworks completed. This excludes the offline section around Eshiem which is being realigned as part of the Project.	Screened out – no temporal overlap
GRM Phase 1: Western Line 85.8 km - end	Planned	<u>Phase 1: Rehabilitation of Existing Western Line 85.8 km to end</u> Track upgrades for remainder of Phase 1: Western Line from 85.8 km (Huni Valley) to Kumasi, including the branch to Awaso.	Screened In
Phase 1: Eastern Line	Planned	<u>Phase 1: Rehabilitation of Existing Eastern Line</u> The existing line from Accra and Tema to Kumasi will remain narrow gauge but will be modernised to new technical standards enabling a subsequent upgrade to standard gauge (Phase 2).	Screened out- no geographica l overlap
GRM Phase 2: Western Line	Planned	<u>Phase 2: Extension of Central Corridor</u> (Western Line) includes the doubling of the track of the Western Line rehabilitated in Phase 1 and the conversion to standard gauge. The section of the line included in the cumulative assessment starts at the end of the Project in Huni Valley and runs north.	Screened in
GRM Phase 2: Eastern Line	Planned	<u>Phase 2: Extension of Central Corridor</u> (Eastern Line) includes the doubling of the track of the Eastern Line rehabilitated in Phase 1 and the conversion to standard gauge.	Screened out – no geographica l overlap
GRM Phase 2: Central Spine	Planned	<u>Phase 2: Extension of Central Corridor (Central Spine) includes the</u> construction of the new	Screened out – no

Project Name	Status (planned/ constructed/ operational)	Description	Screened In / Screened Out
		standard gauge single track line that runs from Kumasi to Tamale and Paga in the North.	geographical overlap
GRM Phase 3	Planned	Phase 3: Extension of the Transversal Links comprises the construction of transversal links with standard gauge single tracks for the stretches Tamale-Yendi, Fufulsu-Sawla, Techiman-Kwadwokurom and Nyinahin-Kumasi for a total of approximately 484 km.	Screened out – no geographical overlap
GRM Phase 4	Planned	Phase 4: Extension of the Trans-ECOWAS Line comprises largely a coastal line with standard gauge single track, that runs from Aflao (near the border with Togo) westwards to Tema-Accra-Cape Coast-Takoradi-Tarkwa and Omanpe for a total of approximately 498 km. The alternative route option would be for the central portion of the line to run from Kotoku-Achiasi-Huni Valley.	Screened In
GRM Phase 5	Planned	Phase 5: Western Expansion comprises the construction of a single, standard gauge line that extends the existing Western Line northwards to reach and connect future mines. The expansion would run from Dunkwa-Awaso-Hamile for a total of approximately 729 km.	Screened out – no geographical overlap
GRM Phase 6	Planned	Phase 6: Eastern Expansion comprises the construction of a single, standard gauge line that runs along the east of Ghana from Yendi to the coast at Tema and potentially Keta, for a total of approximately 468 km.	Screened out – no geographical overlap
Port of Takoradi Expansion	Construction in progress – anticipated to be completed by Q3 2021	The project is for the expansion of the Takoradi Port, comprising construction of a dedicated on-dock container and multipurpose terminal inside the existing port to handle containers and containerized cargo and other multi-cargo commodities and related terminal services. The main project components include: dredging works for basins; land reclamation works; construction of buildings; and construction of new quay walls, terminal yard and utilities (including sewage water network and electrical network).	Screened out – construction works have been captured within the baseline data for this Project
New Takoradi/Princess Town Airport	Planned	Ghana Airports Company Limited is intending to construct a new international civilian airport for Takoradi, Western Region to receive larger planes (than the existing Takoradi Airport) to support the oil and gas community following the grant of more licences for off-shore oil exploration activities in the Western Region. The project is currently at the feasibility stage. A report by the Aviation Minister in 2019 indicated construction would commence in 2020.	Screened out – no geographical overlap
ECOWAS Coastal Highway –	Planned	ECOWAS and the AfDB are funding the 6-lane Abidjan-Lago Corridor Development Project, which is approximately 1,080 km long, connecting	Screened out – no

Project Name	Status (planned/ constructed/ operational)	Description	Screened In / Screened Out
Abidjan-Lagos		Abidjan, Accra, Cotonou, Lome and Lagos. The Tema-Aflao road project, which forms part of the highway, is anticipated to be constructed between 2020 and 2024.	geographical overlap
Takoradi PTC interchange	Construction in progress, anticipated to be completed in 2023	Construction works begun in September 2020 on the 3-tier interchange project at the PTC Interchange (the intersection of five roads: Agona-Nkwanta, Sekondi Bypass, Cape Coast, Liberation, and Axim roads) in Takoradi, which is being funded by SinoHydro and expected to be completed in 30 months.	Screened In
Paa Grand Interchange, Takoradi	Planned	The Cabinet has approved the Loan and Commercial Agreement for the construction the Paa Grant Interchange Phase 1, comprising the road expansion from Paa Grant Roundabout to Sekondi. Phase 2 (Paa Grant Interchange) is anticipated to commence once the Takoradi PTC Interchange is completed. The project is intended to improve traffic flow in Sekondi-Takoradi, with construction of Phase 1 anticipated to commence in Q4 2020.	Screened In
Dualisation of Takoradi-Tarkwa Roads	Planned	Parliament has approved credit facility for the dualization of the Takoradi-Tarkwa road, procurement processes underway.	Screened In
Dualisation of Takoradi-Sekondi Roads	Planned	Parliament has approved credit facility for the dualization of the Sekondi-Tarkwa road, with procurement processes underway.	Screened Out – no temporal overlap
Takoradi Market Circle	Construction in progress, anticipated to be completed in Q2 2023	The construction of the Project will comprise the redevelopment of the existing market to deliver over 2,000 stores, 33 restaurants and food courts, bulk breaking areas, visitor sparking, union offices, police station, fire station, clinic, and waste separation dock. The project is located within 1 km of Section 1 of the proposed Project railway.	Screened Out – no geographical overlap
Reconstruction of 2.4 km Road in Tarkwa-Nsuaem	Operational	Gold Fields Ghana has reconstructed the 2.4 kilometre Angu-University of Mines and Technology (UMaT) road in the Tarkwa-Nsuaem municipality of the Western Region	Screened out – considered in baseline

It is noted that the GRM Phase 1 (Western Line 10.2-32.6 km) has be screened out from the assessment on the basis that the construction works are anticipated to be completed prior to the construction of the Eshiem bypass. It has also been screened out in respect of operation on the basis that it has been considered to form part of the Project.

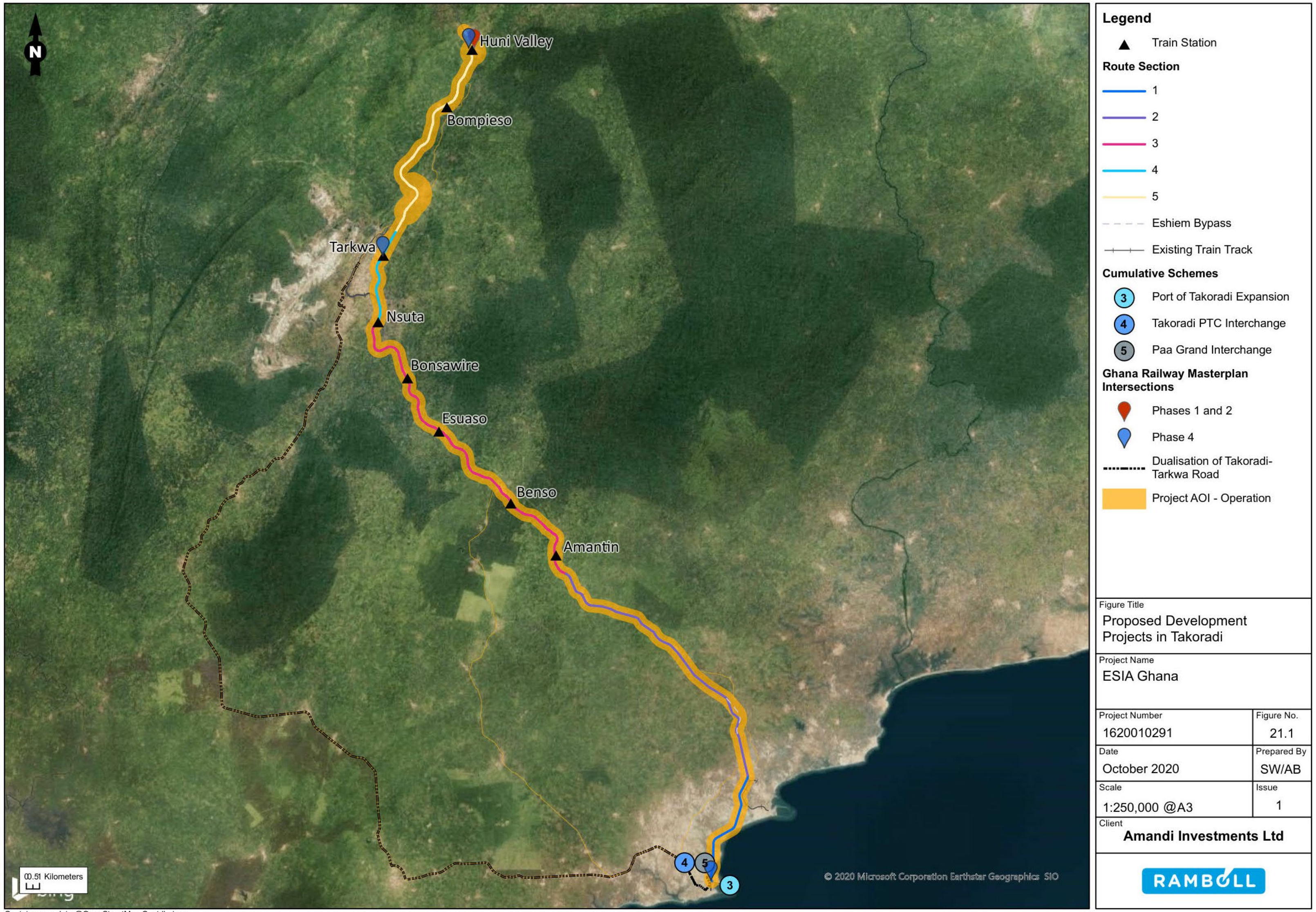

Figure 21.2: Proposed Development Projects in Takoradi

Table 21.3: Scoping of Other Projects for Consideration in Cumulative Impact Assessment

Project Aspect	VEC(s)	Potential Cumulative Impact	Project Phase			Developments (Existing/ Planned/ Reasonably Defined)					Scoped In/ Scoped Out
			Construction	**Operation**	**Decommissioning**	GRM Phases 1 & 2 Western Line	GRM Phase 4 Extension of Trans-ECOWAS Line	Dualisation of Takoradi-Tarkwa Roads	Tacoradi PTC Interchange	Paa Grand Interchange	
Noise and Vibration	Residential receptors in close proximity to Project route	Noise impacts from construction works	✓	X	X	✓	X	X	X	✓	Scoped In
		Vibration impacts from construction works	✓	X	X	✓	X	X	X	X	Scoped In
Water Resources	Groundwater aquifers	Borrow pit excavation and dewatering	✓	X	X	✓	X	X	X	X	Scoped In
Biodiversity and Ecosystem Services	Sekondi Waterworks Forest Reserve	Direct habitat loss impacts	✓	X	X	X	X	X	X	X	Scoped Out
	Flora	Operational habitat degradation	X	✓	X	✓	✓	X	X	X	Scoped In
Socio-Economics	Residents of buildings that are located within or adjacent to the Project footprint	Physical and economic displacement	✓	X	X	✓	✓	X	X	X	Scoped In

Project Aspect	**VEC(s)**	**Potential Cumulative Impact**	**Project Phase**			**Developments (Existing/ Planned/ Reasonably Defined)**					**Scoped In/ Scoped Out**
			Construction	**Operation**	**Decommissioning**	GRM Phases 1 & 2 Western Line	GRM Phase 4 Extension of Trans-ECOWAS Line	Dualisation of Takoradi-Tarkwa Roads	Tacoradi PTC Interchange	Paa Grand Interchange	
	Individuals located within or adjacent to the Project footprint	Access to ecosystem services	✓	X	X	✓	X	X	X	X	Scoped In
	Individuals located within or adjacent to the Project footprint	Direct and indirect local employment opportunities	✓	X	X	✓	X	✓	✓	✓	Scoped In
	Individuals located within the region	Long term employment and economic benefits during operation	X	✓	X	✓	✓	X	X	X	Scoped In
Community, Health, Safety and Security	Residents of buildings that are located within or adjacent to the Project footprint.	Increased transmission of malaria	✓	X	X	✓	X	X	X	X	Scoped In

Project Aspect	VEC(s)	Potential Cumulative Impact	Project Phase			Developments (Existing/ Planned/ Reasonably Defined)					Scoped In/ Scoped Out
			Construction	**Operation**	**Decommissioning**	GRM Phases 1 & 2 Western Line	GRM Phase 4 Extension of Trans-ECOWAS Line	Dualisation of Takoradi-Tarkwa Roads	Tacoradi PTC Interchange	Paa Grand Interchange	
Cultural Heritage	Cemeteries	Loss and/or disturbance of tangible cultural heritage	✓	X	X	X	X	X	X	X	Scoped out – no geographical overlap
	Historic or archaeological finds	Disturbance to archaeological and/or other historic sites	✓	X	X	✓	✓	X	X	X	Scoped In

DD = Deficient Data

X = No overlap in spatial/temporal scope, no potential for cumulative impacts

✓ = Potential for cumulative impacts

21.5 Stage 3: Receptor Baseline

For the VECs that have been screened into the cumulative impact assessment, the baseline conditions are summarised in Table 21-4. For all VECs more detailed information on baseline conditions is provided *Chapter 7: Baseline* and in the various topic area annexes (Annexes A-J).

Table 21.44 VEC Baseline CoTnditions

Aspect/ ESIA Chapter	VEC(s)	Baseline Conditions
Noise and Vibration	Residential receptors in close proximity to Project route	The noise baseline monitoring results at all residential receptor locations exceed both the IFC guidance levels and Ghanaian standards for day-time and night-time. Areas considered rural, suburban or urban located away from main roads or industry have a lower tolerance.
Water Resources	Groundwater Aquifers	Whilst groundwater resource potential in the basin is high, and has a relatively high recharge rate, the resource is under pressure, acting as an important source of water in the area for industrial and domestic use. Furthermore, there are many unregistered boreholes and hand-dug wells. Groundwater quality is generally found to be high across the region, although some areas are understood to have high metal concentrations and faecal coliforms.
Biodiversity and Ecosystem Services	Flora	A total of 176 Species in 60 Families and 157 Genera were encountered along the permanent RoW, comprising species which are either of Least Concern or Not Evaluated by IUCN. There are a number of internationally recognised areas within 5 km of the proposed RoW, including the Sekondi Waterworks Forest Reserve located adjacent to Section 2 of the proposed RoW, which comprises an undegraded, mature secondary forest with closed canopy, thin undergrowth and some emergent trees up to 40 m tall.
Socio-Economics, Employment & Livelihoods	Residents of buildings that are located within or adjacent to the Project footprint Individuals located within the region	Nearly a quarter of the population in Ghana were classed as being in poverty in 2016/17. There is a large regional variation in the incidence in poverty across Ghana, with 2.5 % classed as being in extreme poverty in the Western region, compared to the nation average of 8.2 %. Unemployment levels are currently high in the Project area of the total affected population available to work (3,191 adults and youth), 720 (23 %) were not in work. The dominant land use type within the railway corridor is subsistence agriculture, as most people have taken advantage of the period of rail dormancy to cultivate small-sized farms. In the context of the wider Western region, other land uses are associated within mining, timber processing and industry.
CHSS	Residents of buildings that are located within or adjacent to the Project footprint.	Malaria is prevalent in the Project AoI. Residents that live adjacent to the rail line are likely to include more vulnerable groups, such as squatters with limited access to resources to buy, build or rent alternative accommodation. Within these groups, vulnerability to malaria will be heightened for children under 5 and pregnant woman. The use of mosquito nets when sleeping, one measure to reduce exposure to malaria, is used for less than half adults and children under five.
	Cemeteries	Site reconnaissance visits undertaken as part of the National ESIA for the railway in July 2020 identified several cemeteries in Angu

Aspect/ ESIA Chapter	VEC(s)	Baseline Conditions
Cultural Heritage		Township, Manso, Esuaso and Benso located within 100 – 500 m from the RoW of the rail route. During these studies, community leaders in Esuaso were particularly concerned about the impact of the Project on their cemetery.
	Historic or archaeological finds	No significant archaeological fieldwork is known to have been carried out along the route; however, the region is understood to contain the remains of historic settlements which are significant for Ghanaian culture and history and cannot be replaced if disturbed or damaged.

21.6 Stage 4 &5: Assess Cumulative Impacts and Determine Effect Significance

This section discusses how in scope cumulative schemes may interact with the Project and may result in cumulative impacts.

21.6.1 Noise and Vibration

Noise Impacts from Construction Works

The construction works required for the Project and Phases 1 and 2 (Western Line) of the wider GRM Project, as well as the Paa Grand Interchange in Takoradi may result in cumulative noise impacts on sensitive receptors in the vicinity, including residential receptors as well as non-residential receptors such as hospitals and schools.

Given the duration of the works for the construction of the station at Huni Valley is anticipated to be approximately 12 months, it is possible that these works will coincide with the construction works for Phases 1 and 2 (Western Line) of the wider GRM Project. As the point of interface of the cumulative schemes would be in an urbanised area, there would be a large number of sensitive receptors that could be impacted by cumulative construction noise emissions. Whilst no information is available at his stage on the construction works for GRM Phases 1 and 2 (Western Line), the nature of the works would be similar as to those for the construction of this Project (up to Moderate Adverse). However, given the works for GRM Phases 1 and 2 (Western Line) would be limited to the construction of rail lines (and not a station), construction activities are expected to last for a period of one to three weeks, before the workfront moves northwards along the proposed rail route. Accordingly, the cumulative impact from construction works in Huni Valley, should the construction timeframe overlap, is considered to be **Minor Adverse** and not significant.

In respect of the cumulative construction noise impact in Takoradi, it is also possible the construction of the Paa Grand Interchange could occur at the same time as works for Section 1 of this Project. However, should the works overlap, this would likely be for a maximum period of one to three weeks before the Project workfront moves along the proposed route. Furthermore, the baseline noise conditions in Takoradi (69 dB $L_{Aeq,T}$ daytime and 64 $L_{Aeq,T}$ nightime) meets the IFC Noise Level Guidelines limits for industrial and commercial locations (70 dBA daytime/nightime), thereby reflecting the industrial nature of Takoradi and low sensitivity of the area. Accordingly, the cumulative impact from construction works in Takoradi, should the construction timeframe overlap, is considered to be **Negligible** and not significant.

Overall, the cumulative noise impacts are considered to be short-term and range between **Negligible** and **Minor Adverse**.

Vibration Impacts from Construction Works

The construction works required for the Project and Phases 1 and 2 (Western Line) of the wider GRM Project may result in cumulative vibration impacts on sensitive receptors where construction works for the cumulative schemes could intersect in Huni Valley. The main source of vibration is anticipated to result from compaction, primarily associated with the construction of stations. Given a station at Huni Valley is being constructed as part of this project, it is not expected that Phases 1 and 2 (Western Line) of the GRM Project would comprise the construction of a station or rail maintenance facility in the same locality. As such, vibration from plant associated with the construction of the rail line for Phases 1 and 2 (Western Line) is anticipated to be minimal and furthermore would likely only coincide with the Project for a maximum period of one to three weeks before the workfront moves. Accordingly, the cumulative vibration impact from construction works in Huni Valley is considered to be short-term **Negligible** and not significant.

21.6.2 Water Resources

The excavation works associated with borrow pits required for the Project and Phases 1 and 2 (Western Line) of the wider GRM Project may result in cumulative impacts on the quantity and quality of groundwater aquifers. Whilst the exact location of borrow pits along the ROW for the Project is unknown, it is possible that the borrow pits, and the 500 m AoI around the borrow pits, could be positioned where the Project ROW intersects with GRM Phases 1 and 2 (Western Line) in Huni Valley (see Figure 21.2). No information is available at this stage on the construction works for GRM Phases 1 and 2 (Western Line); however, given the nature of the works would be similar to this Project, the borrow pits would likely be located in close proximity to the proposed railway routes and could be located close to the Project in Huni Valley. Furthermore, the magnitude of impact from the excavation of borrow pits is also anticipated to be the same (Minor to Moderate Adverse). Piped supplies for Huni Valley are from groundwater sources and it is acknowledged there are multiple unregistered boreholes in the area; however, as aquifer recharge is relatively high in the basin, cumulative impacts on groundwater aquifers would only be expected to arise at a local scale should the borrow pits be located within 1 km of one another within Huni Valley and their AoI's overlap.

Accordingly, cumulative impacts on water resources is considered to be **Minor to Moderate Adverse** at a local scale and significant.

21.6.3 Biodiversity

Rail traffic and maintenance clearance during the operation of the Project and Phases 1 and 2 (Western Line) and Phase 4 (Expansion of Trans-ECOWAS Line) of the wider GRM Project may result in cumulative impacts to flora. Given the nature of the wider GRM Project is similar to that of the Project, the sustained habitat degradation and disturbance of fauna is anticipated at a local scale as a result of continued air quality degradation and noise and visual disturbance. Accordingly, the cumulative impacts are likely to be confined to be within 200 m of where the Project RoW intersects with these cumulative schemes at the proposed stations in Takoradi, Tarkwa and Huni Valley. Given these schemes would intersect within urbanised areas where existing habitat disturbance is prevalent, air quality is poor and the proportion of habitat affected would be low, the scale of impacts to fauna within these areas is anticipated to be low. Accordingly, cumulative impacts on fauna is considered to be **Negligible Adverse** and not significant.

21.6.4 Socio-Economics

Physical and Economic Displacement

Physical displacement related to land acquisition within the Project RoW will affect 417 households and 131 businesses who currently reside within the Project RoW, including 3 housholds and 2 businesses in Huni Valley and 116 households and 16 businesses across Tarkwa, as well as agricultural land. Cumulative impacts with Phases 1 and 2 (Western Line) and Phase 4 (Expansion of Trans-ECOWAS Line) may arise where these cumulative schemes intercept with the Project AoI in the Huni Valley and Tarkwa settlements, resulting in further economic and physical displacement. As land acquisition for the Project would be between Manso and Huni Valley, physical displacement would not occur in Takoradi where the Project intercepts with Phase 4 (Expansion of the Trans-ECOWAS Line).

Given the nature of the wider GRM Project is similar to that of this Project, the likely physical and economic displacement impacts are anticipated to be of a similar extent in Huni Valley. Accordingly, cumulative impacts on physical and economic displacement in Huni Valley is considered to be **Minor Adverse**.

Given displacement from the Project in Tarkwa is anticipated to be much larger, as a result of the construction of a bypass route and station, the in-combination magnitude of effect associated with the construction of Phase 4 (Expansion of the Trans-ECOWAS Line) would be high. Furthermore, potential severance impacts associated with the construction of the bypass route could be heightened through the construction of the cumulative scheme. Accordingly, cumulative impacts on physical and economic displacement in Tarkwa is considered to be **Moderate Adverse**.

Access to Ecosystem Services

Cumulative impacts on access to ecosystem services associated with Phases 1 and 2 (Western Line) and Phase 4 (Expansion of Trans-ECOWAS Line) may arise where these cumulative schemes intercept with the Project AoI in the Huni Valley, Tarkwa and Takoradi settlements.

Land acquisition will affect access to important ecosystem services including crops, forest and wooded areas. Whilst land acquisition for the Project and Phase 4 of the GRM Project may take place over different time periods, cumulative impacts may still arise due to the likely recovery period which follows. Given that the cumulative developments would intersect in urban areas where the importance and prevalence of ecosystem services is less, and considering the embedded mitigation and compensation measures, as well as the additional mitigation measures (ADM94, ADM11 and SEM4) in place for the Project, the in-combination effect on ecosystem services is considered to be **Negligible Adverse**.

Direct and Indirect Local Employment Opportunities

The construction phase of the project together with Phases 1 and 2 (Western Line) of the wider GRM Project, the dualization of the Takoradi-Tarkwa Road, the Takoradi PTC Interchange and the Paa Grand Interchange may result in cumulative impacts on direct and indirect local employment opportunities. Given the nature of the wider GRM Project, the level of employment generated during the construction phase is anticipated to be similar, with a construction workforce between 200 and 800 over a course of approximately 3 years. Whilst, the road projects would be much smaller in scale they would also contribute to the generation of much needed jobs in and around Takoradi. Furthermore, given the construction phase for the Project may only partially overlap with the other phases of the GRM Project, the construction workforce employed would be well equipped/trained to find further employment on the wider GRM Project once their contract on this Project is complete. Accordingly, the in-combination effect of direct and indirect employment opportunities is considered to be **Positive**.

Long Term Employment and Economic Benefits During Operation

The completed development phase of the Project together with Phases 1 and 2 (Western line) and Phase 4 (Expansion of the Trans-ECOWAS Line) of the wider GRM Project (once complete) would result in cumulative impacts on long-term employment and economic benefits. As the GRM Project is built out and become operational nation-wide, cumulative impacts will arise directly and indirectly as a result of connecting people with cities (such as the regional capital of Takoradi-Sekondi), such as creating increased employment opportunities through people being able to travel for employment. On a more local scale, economic benefits would be seen at and around the Project stations. The stations would become a hub of economic activity and increased passengers resulting from the operation of the nation-wide GRM Project would result in increased spend in these areas.

Accordingly, the in-combination effect of long-term employment and economic benefits during operation is considered to be **Positive**.

21.6.5 Community, Health, Safety and Security

The construction phase of the Project, together with Phases 1 and 2 (Western Line) of the wider GRM Project may result in cumulative impacts on the prevalence of malaria in the Project AoI. As stated previously, the construction works for the wider GRM Project are anticipated to have similar impacts to those identified in this ESIA. As such, the construction sites which intersect the Project AoI are likely to exacerbate the prevalence of malaria further through the creation of suitable breeding habitats for the mosquito vector that transmits malaria. However, where Phases 1 and 2 (Western Line) intersect with the construction works in Huni Valley, the works associated with the cumulative scheme are anticipated to be limited to the laying of tracks, therefore minimal earthworks are anticipated, presenting limited opportunity for the creation of suitable mosquito habitats. Furthermore, it is acknowledged that malaria prevalence in Ghana is already high, in part due to the tropical climate, with rainfall during the wet season creating stagnant surface water habitats suitable for mosquitos.

Accordingly, cumulative impacts on malaria transmission within the Project AoI is considered to be **Negligible Adverse** and not significant.

21.6.6 Cultural Heritage

The construction phase of the Project, together with Phases 1 and 2 (Western Line) and Phase 4 (Expansion of the Trans-ECOWAS Line) of the wider GRM Project may result of cumulative impacts to cultural heritage in respect of disturbance to archaeological or other historic sites. Whilst archaeological and other historic sites have not been identified along the route, this does not mean they do not exist. Earthworks associated with the construction of the Project and cumulative schemes may uncover large areas of important archaeological and historic finds where the projects intersect. Given the cumulative impacts would be limited to three points along the Project route (Takoradi, Tarkwa and Huni Valley), and considering the implementation of embedded mitigation (including a Change Finds Procedure) and additional mitigation (ADM17, referenced in Annex H), the cumulative impact is considered to be **Minor Adverse**.

21.7 Stage 6: Mitigation Measures

The purpose of the cumulative impact assessment is to identify and mitigate the Project's contributions to any potential significant cumulative impacts on VECs. Because potential cumulative impacts are often the result of different projects and different operators, mitigation measures for cumulative impacts need to be realistic, practical and focus primarily where the developer has full or partial control to successfully implement mitigation measures. For this reason, additional mitigation to manage cumulative impacts will focus on reducing the contributions to cumulative impacts from the Project. Additional mitigation measures are set out in Table 21.5, together with the cumulative residual impact.

Table 21.5: Mitigation Measures and Residual Impact

Cumulative Impact	Mitigation ID	Mitigation Measure	Residual Impact
Borrow pit excavation and dewatering in Huni Valley	ADM-CU1	Liaison with other developers to avoid any multiple impacts from abstractions, dewatering, construction activities	Minor Adverse (not significant)
	ADM59	Borrow Pit Management Plan should include in site definition the assessment of aquifer depth and conceptual groundwater model to ensure extraction activities maintain the required buffer above the aquifer.	
	ADM69	Cut-off drains shall be installed parallel to construction lines to control run-off from adjacent areas.	
	ADM61	An assessment of the potential for AMD or ARD be made during site definition depending on the likely design and location of the borrow Pit. Where this is identified, management of the potential effects from AMD/ARD shall be in line with the IFC EHS Guidelines for Mining	
Physical and economic displacement in Tarkwa	ADM-CU2	The RAP implementation team will consider displacement from wider Ghana Railway Masterplan when conducting specific land acquisition engagement with PAPs	Minor Adverse (not significant)
	ADM94	Stakeholder Engagement: A robust stakeholder engagement programme articulated through a Stakeholder Engagement Plan, to clearly explain the RAP process, entitlements and livelihood restoration measures.	
	ADM11	Grievance Mechanism: this will be implemented throughout engagement on the RAP and entitlements. Communities will be made aware of the mechanism for registering complaints and feedback relating to land acquisition, entitlements and any other Project impacts.	

Cumulative Impact	Mitigation ID	Mitigation Measure	Residual Impact
	AD95	Household Sign-off on Entitlements: Conduct specific land acquisition engagement with PAPs during household sign-off on compensation measures. This process is used to discuss entitlements and livelihood restoration measures. The RAP implementation team will be required to confirm vulnerability levels and support the PAP in choosing the most suitable livelihood restoration options for their individual circumstance.	

22. ENVIRONMENTAL AND SOCIAL MANAGEMENT

22.1 Introduction

This chapter covers the Project Environmental and Social Management System (ESMS) and describes how the various environmental and social (E&S) management activities to be undertaken by Amandi and Ghana Railways Development Authority (GRDA). A standalone Environmental and Social Management Plan (ESMP) has been developed based on the ESIA. It focuses on E&S management actions for the construction phase and high-level requirements for the operational phase.

22.2 Environmental and Social Management System

An Environmental and Social Management System (ESMS) will be developed to manage E&S risks during the construction phase of the Project, with an outline of measures which need to be carried forward into operations and implemented by the GRDA.

The ESMS shall incorporate the nine core elements of ESMSs, as required by IFC Performance Standards and described in the IFC ESMS Implementation Handbook [1], which include the following:

1. Policy;
2. Identification of Risks and Impacts;
3. Management Programs;
4. Organisational capacity and competency;
5. Emergency Preparedness and Response;
6. Stakeholder Engagement; and
7. Monitoring and Review.

The objectives of an ESMS are:

- To ensure all activities and persons responsible anticipate and take action to avoid as far as possible adverse impacts or risks to communities and the environment;
- To help ensure that Amandi and GRDA's activities comply with the relevant laws and regulations of the Government of Ghana and Lenders' requirements (referred to collectively as the "Project Standards");
- To identify and assess social and environmental impacts, both adverse and beneficial;
- To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, affected communities, and the environment;
- To ensure that affected communities and stakeholders are engaged on issues that could potentially affect them;
- To promote and provide means for adequate engagement with affected communities throughout the Project life-cycle on issues that could potentially affect them, and to ensure that relevant environmental and social information is disclosed and disseminated;
- To promote improved social and environmental performance through the effective use of management systems; and

[1] IFC (2015) Environmental and Social Management System Implementation Handbook, https://www.ifc.org/wps/wcm/connect/4c41260d-1ba8-4d10-a77d-f762d60a1380/ESMS+Handbook+General+v2.1.pdf?MOD=AJPERES&CVID=lIlFYII

- To ensure all activities and persons responsible consciously foster positive environmental and social impacts and benefits through proactive planning and Project design.

The ESMS will draw on the elements of the established business management process, outlined in IFC PS 1, forming the Plan-Do-Check-Act (PDCA) cycle (Figure 22-1), which provides a methodological approach to managing environmental and social risks and impacts in a structured way on an ongoing basis.

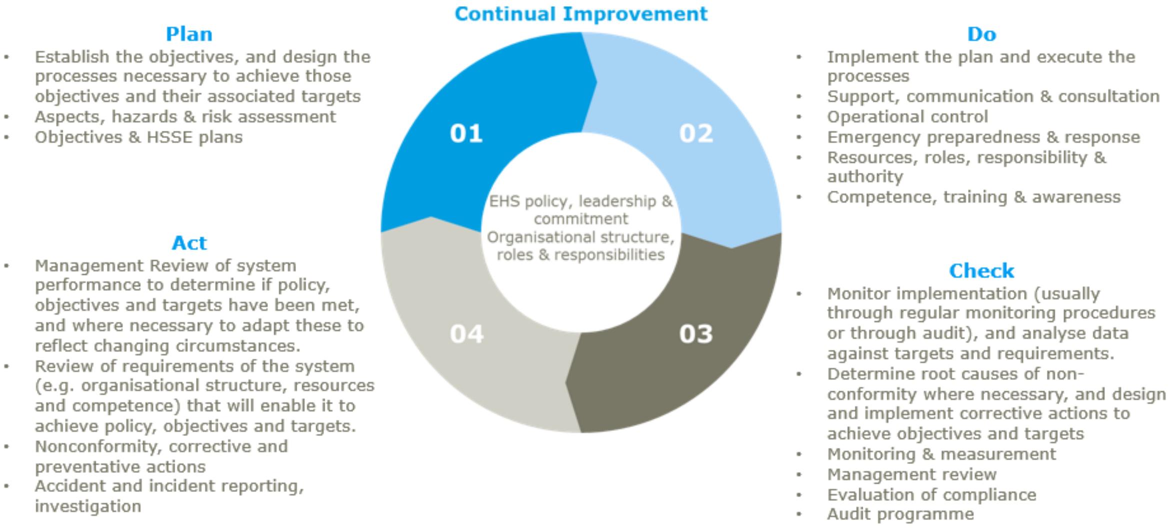

Figure 22-1 Plan, Do, Check, Act Cycle of Continuous Improvement

Key elements of an ESMS and how these align with the PDCA cycle for the construction phase of the Project are provided in Table 22-1. GRDA will need to implement corresponding policies and procedures to management E&S performance during operation.

Table 22-1 ESMS Elements and Alignment With the PDCA Cycle

Stage	Element	Objective/Function
Plan	Policy	The Amandi Environmental and Social Policy (see Section 22.2.1) will form part of the ESMS. The Policy should reflect leadership and accountability of Amandi in the commitment to sustainable development for the Project. The policies stipulate the environmental and social objectives and principles that guide Amandi to achieve sound environmental and social performance through establishment, documentation, implementation and continuous improvement of the Project ESMS.
	Project Standards, Legal Compliance & other requirements	The Amandi commits to comply with the IFC Environmental and Social Safeguard Policy and Performance Standards, as well as relevant Ghanaian environmental, occupational health and safety, labour and other and social law and regulations. A Legal Register identifying all applicable standards, legal requirements and requirements in relation to health, safety, communities and environment has been developed. A system of procedures will be established and communicated to all management and staff to ensure the project compliance.
	Identification of Risks & Impacts	Amandi will identify and set up a procedure to identify and assess associated risks and impacts throughout the Project life. This ESIA also addresses this element of the ESMS.
	Management programme	Amandi will define the objective, targets, criteria, standards, and actions for the management of identified potential risks and impacts. The Environmental and Social Management Plan (ESMP) and supporting

Stage	**Element**	**Objective/Function**
		plans fall under this element of ESMS. The ESMPs are a key component of the ESMS.
	Emergency Preparedness & Response Plan	Amandi will develop an Emergency Preparedness and Response Plan for the construction phase and allocate appropriate response and recovery resources.
Do	Management programme	Amandi will implement of all the mitigation, management and monitoring measures defined in the ESMPs through its contractual arrangements and audits/inspections.
	Organizational structure, role, & responsibility	Amandi will ensure sufficient management sponsorship of human and financial resources, establish roles and responsibilities for personnel to implement the Project ESMS and ESMPs within it. The organisational structure of the Project is presented in Section 22.3.1.
	Competence, training & awareness	Amandi will ensure personnel are aware of their role and responsibilities by appointing competent people and enable them to meet the requirements of their role. Amandi will also implement a training programme.
	Communication	Amani will establish and maintain effective communications, including internal communications between Amandi and GRDA as the party responsible for operation of the railway, and between management and the workforce as well as external communications with stakeholders and affected communities. The Stakeholder Engagement Plan (SEP) falls under this element of the ESMS. The SEP (including the Community Grievance Mechanism) is a key component of the ESMS.
	Operational controls & maintenance	Amandi will implement operational controls, procedures, and tools to manage impacts and risks, uphold environmental performance and project compliance. These will be further described in the supporting ESMPs to be developed.
	Documentation & record keeping	Amandi will systematically control and maintain documents and records associated with E&S management.
Check	Monitoring, evaluation, correcting & improving performance	Amandi will establish and implement procedures to monitor and evaluate E&S management and performance and take measures to continually improve performance. Processes such as inspection, audit and physical E&S monitoring will be implemented. Details of mentoring will be identified in the supporting ESMPs or corresponding monitoring plans where applicable.
	Monitoring, evaluation, correcting & improving performance	Amandi will prepare a Corrective Actions Register or other system to record non-conformances, promptly report and take corrective and preventive actions to reduce the likelihood of recurrence.
	Reporting	Amandi will ensure that responsible personnel report the compliance status of the Project ESMS and ESMP performance to Lenders, senior management, regulatory authorities and affected communities
Act	Management Review	Amandi will assign a responsible person to review the suitability, adequacy and effectiveness of the ESMS and identify improvement actions to facilitate continuous improvement policies, management plans and management system. This will need to be actioned through the remaining phases of the project.

Stage	Element	Objective/Function
	Management of change	Future development, construction, expansions or changes to this scope will require the applicability of the Project ESMS to be reviewed in accordance with a Management of Change Process as part of the ESMS. The MOC Process should define responsibility for updating the ESMS in response to changes in the Project (including expansion, additional sub project/sub activity, third parties, and associated facilities) and to changes in the organisation, personnel, operations and processes.
	Implementing improved policies, management plan & system	Amandi management will ensure that all Project personnel are aware, capable and competent in implementing the improved policies, management plans and system.

Audit Reporting and Corrective Actions

The aim of the ESMS, ESMP and supporting E&S management plans is for them to be live tools to allow E&S performance to be managed and monitored. Continual improvement of the ESMS, ESMP and supporting E&S management plans will be achieved by the continual evaluation of E&S management performance against relevant policies, objectives and targets to identify opportunities for improvement.

GRDA and Amandi HSE management teams will be responsible for analysing the monitoring data to assess compliance. Where non-conformance is detected:

- The results will be analysed by the relevant HSE management team in more detail, to determine possible causes for the non-conformance;
- A site inspection will be undertaken by the relevant HSE management team or nominee;
- Relevant personnel will be contacted and advised of the problem;
- An agreed action will be identified;
- Action will be implemented to rectify the problem; and
- A non-conformance report will be issued by the relevant HSE management team or nominee.

The outcomes of any (internal or external) audit undertaken will be documented and reported in an Audit Report. Any corrective actions and/or observations will be addressed through the same mechanisms as non-conformances detailed above. Resolutions of corrective actions and/or observations will be documented and filed with the Audit Report.

Effectiveness and proper implementation will be reviewed approximately annually or as required by the management team. The review will comprise:

- Reviewing the results of audits;
- Evaluating the system, including which improvements and corrective actions will be sought; and
- Evaluating the operation of the ESMP and supporting plans.

22.2.1 Amandi Environmental and Social Policy

Amandi has developed an environmental and social policy framework that supports for measures and interventions to be undertaken to safeguard the Project environment. Specifically, a Policy Statement on the Environment, Policy Objective on Environment, Occupational Health and Safety Policy and Field Operation Policy Guidelines have been developed.

The Company's Policy Statement seeks to:

- Develop an awareness and sensitivity on environmental and social issues among workers, management staff and project community residents.
- Promote a healthy total environment through positive actionable activities in the acquisition of basic understanding of the total environment, its associated problems and role of humanity.
- Develop strong feeling of concern for the environment through attitudes and habits adjustment.
- Institute and implement environmental and social problems solving skills acquisition in dealing with environmental and social challenges.
- Develop a sense of responsibility in solving environmental and social problems through direct participation.

22.3 Roles and Responsibilities

22.3.1 Construction Phase Organisation Structure

The organisational structure of Amandi is shown in Figure 22-2. The organisational structure of Amandi is shown in Figure 5-1. This structure has been identified based on the E&S management requirements identified through the ESIA process. Employees are assigned specific duties and responsibilities to ensure effective management of the Project's environmental, social and reputational performance. Selected sub-contractor(s) will have additional responsibilities and will be assigned appropriate E&S responsibilities as part of the ESMP.

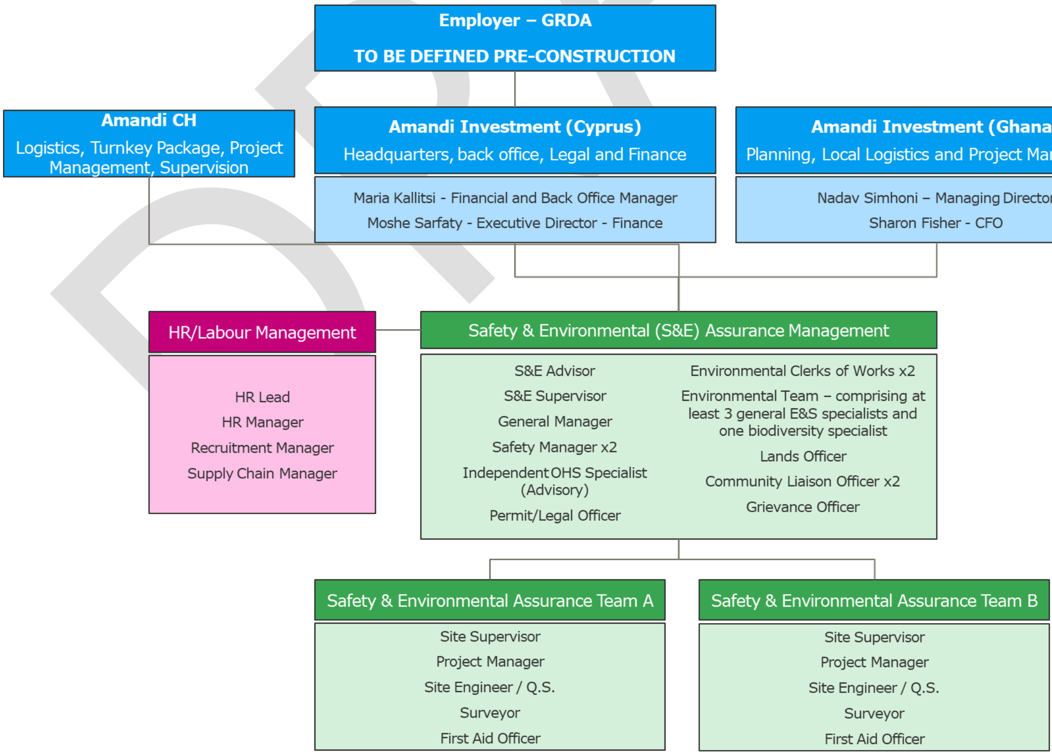

Figure 22-2: Amandi Organisational Structure and Staffing

22.3.2 Roles and Responsibilities

Table 22-2 outlines the key roles and responsibilities of employees in relation to E&S performance.

Table 22-2: Key Roles and Responsibilities

Role	Responsibilities
Safety & Environmental Supervisor	• To provide visible top management involvement in implementing Project safety; • To communicate the Environmental and Social Policy and E&S Management Plans to on-the-ground managers and define objectives to meet that goal as part of Amandi management's commitment to a safe and healthy workplace; • To commit the necessary personnel with managing authority and resources to ensure trade person's safety and health; • To assign Company plans responsibilities to trade persons at all levels; • To ensure the responsibilities are understood and that essential tasks are performed; • To verify that guidelines and procedures are in place to protect the trade persons and others associated with a project; • To encourage subcontractor management involvement in the review and update of the Subcontractor Safety programme to ensure their commitment and support for an Injury Free workplace; • To recognise team members for good Safety practices and discipline those disregarding Company procedures; • To drive the Incident Investigation Process; • To lead monthly Safety & Environmental Project meetings with management, where available. • Participation in resettlement committees
S&E Advisor	• Day-to-day environmental and social management responsibility across all project sites(s); • Create awareness and educate staff on environmental and social issues through training programmes and review meetings; • Motivate and maintain the interest of project staff in environmental and social issues through organisation of activities; • Conduct investigations into all types of incidents; • Conduct environmental audit in accordance with Project monitoring guidelines; • Develop work plan for ESMP implementation; • Produce environmental and social reports covering the Project.
General Manager	• Day-to-day responsibility across all Project sites(s); • Liaison with the client on Project implementation challenges and timeliness of project execution; • Develop construction methods and standardise materials usage under the contract; • Supervise project implementation work programme, contract specifications and attainment of conditionalities.
Safety Manager	• Day-to-day safety management responsibility of project sites(s); • Create awareness and educate staff on safety issues through training programmes and review meetings;

Role	Responsibilities
	• Motivate and maintain the interest of project staff in safety issues through organisation of activities; • Conduct investigations into safety types of incidents; • Conduct safety audits in accordance with Project monitoring guidelines; • Develop work plan for safety measures as part of ESMP implementation; • Input into environmental and social reports covering the Project
Independent OHS Specialist (Advisory)	• Responsible for reviewing the OHS Plan prior to construction • Monitoring implementation of the OHS Plan during construction. • The OHS specialists will be separate to the Project's OHS management personnel and will take an independent advisory role with the objective to help ensure compliance of the Project to the OHS requirements of the Applicable Standards.
Environmental Clerk of Works	• Reviewing environmental performance at the worksites and station construction sites • Work with Environmental Team in implementing the Land Disturbance process • Responsible for sign off on method statements developed • Undertake inspections and audit to ensure correct application of measures such as stockpile management, species translocation and replanting of species as part of • Sign off on reinstatement activities
Environmental Team	• Advise and support staff consistently with the requirements of the Project ESMS and ESMP. • Ensure the ESMS is operating and that the system is continuously improving. • Undertaking preconstruction surveys and implementation of the Land Disturbance Process across all construction locations (track and stations) • Undertaking environmental monitoring activities
Permit/Legal Officer	• Responsible for reviewing and updating the Project Legal Register • Tracking the status of and compliance with permit requirements • Reporting on compliance with permits
Lands Officer	• Responsible for ensuring compliance with the Lands Act and other associated legislation identified within the Legal Register.
Community Liaison Officer (CLO)	• Direct interaction with communities in order to manage and maintain positive relationships. • Ensure the effectiveness in implementation of the grievance mechanism.
Grievance Officer	• Tracking and investigation of community grievances received. • Ensure the effectiveness in implementation of the grievance mechanism.
Site Supervisor	• Directly responsible for ensuring compliance with method statements • Undertake site walkovers • Responsible for delivering training and awareness, implementing awareness campaigns

Role	Responsibilities
	• Supervising of works
Project Manager	• Responsible for directing and supporting delivery of the project onsite • Reporting to Amandi investment team liaising with government with respect to the worksites
Site Engineer	• Developing site specific method statements • Implementing method statements • Checking /auditing adequacy of construction prior to leaving the site
Surveyor	• Ensure levels are correct, laid out correctly, flagged correctly according to the method statements • Sign off upon reaching various levels during construction (e.g. ballast depth)
First Aid	• Incidents onsite • Ensuring correct PPE usage • Presence and appropriateness of first aid equipment • Liaising with safety people
HR Lead	• Sign off of HR policies and plans • Communicating with employer and GRDA • Investigation of any grievances
HR Manager	• Writing HR plans, policies and associated plans • Implementation of HR plans. Policies and associated plans • Working with HR Lead on grievance investigations
Recruitment Manager	• Responsible for Recruitment Plan and Influx Management Plan • Ensuring recruitment and retrenchment are undertaken to the required standards
Supply Chain Manager	• Contractor /subcon process, audit is being devolved
All personnel/workers	• All personnel/workers employed for the Project are responsible for carrying out their roles in accordance with the ESMS and ESMPs.

22.3.3 Operational Phase

The Project will be owned, maintained and operated by GRDA. The organisational structure that will be employed by GRDA during the operational phase has not yet been confirmed. This will be developed prior to the commencement of operations.

22.4 Training, Competency and Awareness

Amandi (for construction) and GRDA (for operation) shall ensure that all Project personnel are competent to fulfil their roles effectively based on a combination of experience, qualifications and training.

Key technical E&S personnel (specialists and officers) within Amandi and GRDA responsible for implementing the ESMS will, as a minimum, hold a nationally or internationally recognised HSE professional qualification (or equivalent).

Amandi will identify the knowledge and skills necessary for implementation of the ESMS and ESMP during construction and identify competency criteria and training needs for its personnel. Training may take the form of formal training sessions or may be delivered as part of regular ‘toolbox talks’ undertaken prior commencement of daily construction activities. All persons responsible for undertaking work during the life of the Project will be suitably competent to perform their duties and trained on the content of the Project ESMS.

Induction training will be provided to all workers. Project specific induction training shall include, but will not limited to:

- Definition of the environment;
- Need for environmental protection and management;
- Impact of construction activities on the environment;
- Adequate mitigation measures against such impact;
- Emergency Preparedness and Response Plan;
- Code of Conduct and social responsibility during construction, such as being considerate to local communities, community health, with a focus on the prevention of sexually transmitted infections;
- Project ESMS policy and objectives;
- The Project ESMP;
- Health and safety plans and procedures;
- Key occupational health and safety (OHS) hazards and controls on site;
- Current applicable regulation; and
- Grievance mechanisms.

Additional specialist training shall be provided as necessary in line with Ghanaian regulatory requirements, and to ensure understanding and effective implementation of the Project environmental and social requirements.

Amandi will develop a HSE Training Plan that will include:

- Induction (identifying different types that may be required);
- Training needs identification;
- Training schedule;
- Assessment of competency;
- Recognition of prior learning;
- Evaluation of training; and
- Register for maintaining records.

All training information, records and certificates will be properly documented by Amandi.

22.5 Supplier/Contractor Management

A *Contractor Management Process* will be developed and implemented to ensure that the procurement of equipment, materials and services, including labour (contractors and sub-contractors), satisfy the Project standards for E&S performance. The key stages of the *Contractor Management Process* are listed below:

- Defining the work scope;
- Supplier/contractor capability assessment and selection;
- Assigning Amandi management responsibility / leadership;
- Mobilisation and engagement; and
- Post service E&S performance review.

The specific management plans/programmes, or relevant parts thereof, will be issued to sub-contractors who will be required to demonstrate how they will comply with the. Compliance will be assured through a range of means, including audits and inspections.

The procedures to be implemented for the operations phase will need to be established in good time ahead of commencement of operations by GRDA.

22.6 Environmental and Social Management Plan

The ESMP provides a framework to enable the effective implementation of the E&S management measures developed through the ESIA. This ESMP has been developed as part of the initial ESIA undertaken in October 2020. It identifies and provides guidance for the development of the full suite of E&S management plans that will be prepared in due course, focussing on E&S management actions required for the construction phase and broader requirements for the operational phase. Decommissioning of the new rail track and infrastructure will be subject to a full decommissioning plan in line with national requirements and international best practice in place at the appropriate time. Consequently, E&S actions associated with the decommissioning phase of the Project are not included in this ESMP.

The purpose of the ESMP is to guide the implementation of mitigation measures and monitoring requirements identified through the ESIA process to reduce adverse environmental and social effects to acceptable levels and enhance positive effects. Broadly, the objectives of the ESMP are to:

- Ensure compliance with Project standards including the Ghanaian national legislative requirements and guidelines and International Good Practise through the IFC Performance standards and EHS guidelines;
- Support the development of detailed management plans for the Project and enable appropriate resources and responsibilities to be allocated;
- Demonstrate to stakeholders such as lenders and local communities how the commitments and mitigation measures identified through the ESIA process will be planned, implemented and monitored/checked.

The ESMP incorporates all mitigation measures identified within this ESIA, which are divided into the following categories (Table 22-3).

Table 22-3 ESIA Mitigation and Monitoring Measure Classification

Mitigation / monitoring	Description	Location in ESIA
Embedded Design Controls	Those mitigations that are inherent to the Project design and require only a one-time verification, for example using diesel generators that meet specific manufacturer emission standards). These measures are considered to be in place when determining the significance of an effect	Chapter 3 (Project Description)
ESIA Good International Industry Practice (GIIP)	Good practice mitigation measures that are identified in the project description and considered alongside embedded design controls to be in place when identifying the effect significance	
Additional Mitigation Measures	Project specific mitigation measures required above and beyond the embedded design controls and ESIA GIIP in order to reduce the significance of an effect to an acceptable residual level	Topic impact assessment Chapters 8-21

Mitigation / monitoring	Description	Location in ESIA
Enhancement Measures	Measures designed to enhance and increase the positive benefits generated by the Project	
Monitoring Measures	Monitoring is not a mitigation category, rather it may be required to confirm that the measures used to mitigate adverse impacts are working properly and that the impact is not worse than predicted. Monitoring should be clearly defined with a purpose and should be time bound and should consider feedback loops as part of the PDCA cycle of continuous management improvement.	

22.6.1 Supporting Environmental and Social Management Plans

Amandi will develop a detailed *Construction Environmental and Social Management Plan* (CESMP) and associated documents – topic specific plans, procedures and processes – to support delivery of the commitments made in this ESMP, as outlined in Table 22-4.

Table 22-4: Supporting E&S Management Documents

Documents	Categories			
	Design / Engineering	**Environment**	**Communities**	**Health & Safety**
Design Change Control Process	X			
Management of Change Process	X	X	X	X
Buildings and Structures Demolition Plan	X			X
Emergency Preparedness and Response Plan (EPRP)	X	X	X	X
Incident Investigation Process		X	X	X
Contractor Management Process		X	X	X
Standard Operating Procedure		X	X	X
Environmental and Social Operating Procedure		X	X	
Training Plan		X	X	X
Land Disturbance Process		X	X	
Borrow Pit Management Plan	X	X		
Hazardous Materials Management Plan		X		X
Spill Response Plan		X		X
Water Management Plan		X		
Construction Water Consumption Plan (CWCP)		X		
Wastewater Management Plan		X		
Waste Management Plan		X		
Construction and Demolition Waste Management Plan (CDWMP)		X		
Stockpile Management Plan		X		

Documents	Categories			
	Design/ Engineering	**Environment**	**Communities**	**Health & Safety**
Integrated Vegetation Management Plan (IVMP)		X		X
Invasive Species Management Plan		X		
Vegetation Clearance Procedure		X		
Stakeholder Engagement Plan			X	
Community Grievance Mechanism			X	
Resettlement Action Plan			X	
Chance Finds Procedure			X	
Security Management Plan			X	
Traffic Management Plan			X	X
Life and Fire Safety Plan			X	X
Occupational Health & Safety Management Plan				X
Covid-19 and Communicable Disease Management Plan				X
Asbestos Management Plan				X
Project HR Policy				X
Closure and Rehabilitation Plans	X	X	X	X

Decommissioning

Decommissioning activities will be covered by specific management plans to be developed during the operation phase, if necessary.

23. CONCLUSIONS

23.1 Introduction

This chapter presents the remaining significant residual effects identified through the ESIA process following application of additional mitigation measures.

In line with the methodology set out in Chapter 5: Methodology, when adverse impacts have been identified as part of the ESIA process (the effects of which cannot be managed via design controls/incorporated mitigation), additional mitigation measures have been developed following the mitigation hierarchy. Impacts were reassessed following the identification of mitigation measures to determine the magnitude and significance of any residual impacts. Any remaining significant residual effects (of Moderate or Major significance) are summarised in the tables below.

23.2 Significant Residual Effects from Planned Activities

Table 23.1 provides a summary of the significant construction residual effects (Major and Moderate adverse effects) and positive residual effects. Table 23-2 summarises the significant adverse and positive residual effects for operations.

All other impacts identified during the ESIA process as part of the topic specific assessments are considered to be of Minor or Negligible significance. Details of these impacts can be found in Chapters 8-19. Further supporting information can be found in the corresponding technical annex (Annexes A-J) where applicable.

Table 23.1: Significant Residual Effects during Construction

Impact #	**NV1**	**WQ1**	**SE1**	**SE3**	**CS3**	**CH1**	**CH3**
Impact description summary	Noise Impacts from Construction Works	Borrow Pit Excavation	Physical and economic displacement	Direct and indirect local employment opportunities	Increased transmission of malaria	Loss and / or disturbance of tangible cultural heritage	Disturbance to archaeological or other historic sites
Receptor sensitivity	High	High	High	High	Medium to High	High	High
Frequency	Periodic	Constant	Single Event	Ongoing	Constant	Single event	Single event
Likelihood	Certain	Likely	Certain	Certain	Possible	High	Low
Extent	Local	Local	Local	Local	Local	Local to the receptor	Local to the receptor
Duration	Short to Medium term (at stations)	Short-Medium term	Permanent	Construction	Medium-term	Permanent	Permanent
Magnitude	Medium – Large	Small - Medium	Large	Beneficial	Medium	Large	Small
Effect	Adverse	Adverse	Adverse	Positive	Adverse	Adverse	Adverse
Direct/ indirect	Direct	Direct	Direct	Direct and indirect	Direct	Direct	Direct
Significance	Moderate – Major	Moderate - Major	Major	Positive	Moderate to Major	Major	Moderate
Additional mitigation	ADM56, ADM57, ADM58, ADM59, MON07	ADM81, ADM83, ADM91	ADM69, ADM25, ADM70, AD73	ADM71, ADM36	ADM21, ADM22	ADM15, ADM16, ADM17	Yes
Residual Significance	Minor - Moderate	Minor - Moderate	Moderate	Positive	Minor to Moderate	Moderate	Moderate

Table 23-2: Significant Residual Effects during Operation

Impact #	**NV3**	**SE7**	**TT2**
Impact description summary	Noise Impacts from Operational Activities	Long term employment and economic benefits	Increased rail capacity
Receptor importance/ sensitivity	High	Medium	Medium
Frequency	Periodic- up to 22 trains per 24 hrs	Ongoing	Periodic
Likelihood	Certain	High	Certain
Extent	Local	Regional	Certain
Duration	Permanent	Ongoing	Long term
Magnitude	Medium-Small	Beneficial	Beneficial
Effect	Adverse	Positive	Beneficial
Direct/ indirect	Direct	Direct and indirect	Direct
Significance	Moderate - Major	Positive	Positive
Additional mitigation? (Y/N)	ADM57, MON07	ADM72, ADM69	N
Residual Significance	Minor - Moderate	Positive	Positive

23.3 Significant Residual Effects from Unplanned Activities

Table 23-3 summarises the residual significance of the construction major accidents (unplanned events) whilst Table 23-4 summarises the significant residual effects during operation.

Additional mitigation measures have been identified to reduce the significance of effects identified as being of Major or Moderate significance, except those where the likelihood is already considered to be improbable and further measures are not possible.

Table 23-3 Major Accidents Construction Effect Summary

Potential Risks	Likelihood	Consequence	Significance	Additional Mitigation?	Residual Significance
Construction of the Eshiem bypass close to a fuel storage site	Unlikely	High	Major	ADM48, 49 & 50	Moderate
Construction workers on / in vicinity of live rail operations (risk of injury/fatality)	Unlikely	High	Major	ADM51	Moderate
Pedestrian accidents associated with additional construction vehicles on the roads	Unlikely	High	Major	ADM52	Moderate

Table 23-4 Major Accidents Operation Effect Summary

Potential Risks	Likelihood	Consequence	Residual Effect	Additional Mitigation?	Residual Significance
Bridge Collapse	Improbable	High	Moderate	N	Moderate
Fuel storage at heavy rail maintenance facility	Improbable	High	Moderate	N	Moderate
Train collision and train derailment	Unlikely	High	Major	ADM54, 55 & 61	Major

23.4 Environmental and Social Management

As describe in Chapter 22: Environmental and Social Management, a separate Environmental and Social Management Plan (ESMP) has been developed which captures all embedded (embedded design and ESIA GIIP measures), additional mitigation measures, enhancement measures and monitoring measures identified as part of the ESIA.