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ENVIRONMENTAL

Environmental and Social Impact Assessment Report for the

Koidu Kimberlite Project

Koidu Holdings SA

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Project Title: ESIA Report for the Koidu Kimberlite Project

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Name	Responsibility	Signature	Date
Johan Hayes	Project Manager		29 April 2011
Danie Otto	Senior Review		Click here to enter a date.

EXECUTIVE SUMMARY

Introduction

Digby Wells Environmental (Digby Wells), in association with Cemmats Group Ltd (Cemmats), were appointed as independent consultants to assess the potential environmental and social impacts associated with the expansion of the existing Koidu Mine's capacity from 50 tonnes per hour (tph) to 180 tph.

The Koidu Kimberlite Project is located in the Kono District of Sierra Leone, approximately 360 km east of the capital Freetown, and is owned and operated by Koidu Holdings S.A ("Koidu Holdings" or "the Company"), a company wholly owned by BSG Diamonds Ltd, a subsidiary of BSG Resources Ltd. Koidu Holdings was originally formed in September 2003 as a joint venture company between the previous mineral rights owners Energem Resources Inc (formerly named DiamondWorks Ltd) and a subsidiary of BSG Resources, Magma Diamond Resources Ltd. From incorporation onwards, various changes in the shareholding structure of the Company took place, with BSG Diamonds progressively increasing its stake in Koidu Holdings to 100% by February 2007.

Development of the mine commenced in 2003, with the construction of a 50 tph dense media separation (DMS) plant and associated mining infrastructure required for bulk sampling and trial mining of No. 1 Pipe (K1) and No. 2 Pipe (K2).

Processing of the first kimberlitic material from K1 began in January 2004 and continued until mid-2004, when sampling switched to K2. This allowed for preparation of the planned vertical pit at K1, which required waste rock stripping and construction of the headgear, hoist and winder at the collar of the planned K1 vertical pit.

Between August 2005 and December 2007, the mine focussed on extracting ore from the K1 vertical pit and initiated a comprehensive exploration programme to locate and evaluate all kimberlite ore bodies on the property, develop an optimal life of mine (LoM) plan and compile a full bankable feasibility study. Evaluation of the kimberlite deposits was completed in mid-2010 and the feasibility study was completed towards the end of 2010.

Koidu Holdings was awarded an Environmental Impact Assessment Licence for the current 50 tph operation in September 2003. However, the proposed mine plan to increase the life of the operation, mine larger and deeper pits and to progress to underground mining methods requires updating of the EIA and identification of any new impacts on the social and physical environments within the lease area as well as beyond its boundaries.

The purpose of this report is to present the findings of the Environmental and Social Impact Assessment (ESIA) that has been undertaken for the Koidu Kimberlite Project, and to propose an Environmental Management Plan (EMP) to maximise the positive aspects of the project and to minimise or manage the negative impacts.

The mining lease area measures 4.9873 km^2 and is located adjacent to the town of Koidu. As no mining activities are to take place within the Extended Affected Area, no biophysical assessments were undertaken. Updated socio-economic baseline information was used in the assessment of the socio-economic impacts on the communities within this area.

Biophysical assessments for this ESIA included the area provisionally earmarked for resettlement due to the expansion of the Koidu Kimberlite Project. A detailed social assessment of this and other potential replacement land will be conducted during the development of the RAP.

Social issues due to resettlement are a very significant aspect of the proposed project. However, these aspects can only be scoped and assessed to a point in the ESIA phase. Some details need to be addressed in the consultative RAP process with full community participation.

Regulatory Requirements

Project funding will be sourced from financial institutions who are signatories to the Equator Principles (EPs) and, hence, the Koidu Kimberlite Project ESIA will aim to comply with the applicable International Finance Corporation (IFC) Performance Standards and the applicable General and Industry Specific Environment Health and Safety (EHS) Guidelines, in addition to the EPs.

The relevant IFC Performance Standards are:

- Performance Standard 1: Social and Environmental Assessment and Management System;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Pollution Prevention and Abatement;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management; and
- Performance Standard 8: Cultural Heritage.

The anticipated impacts on the existing biophysical and social environment, associated with the Koidu Kimberlite Project, led to the project categorised at a **Category A** project.

Project Description

The proposed project consists of the following main project components:

- Increase of the K1 and K2 open pit diameters and depths over the first four years of the mine plan, prior to switching to underground mining of the kimberlite pipes, dyke zones and blows. The associated increase in the blast radius around the open pits to 500 m will extend beyond the existing mining lease boundary into an area referred to as the new Extended Affected Area. No mining will take place within the Extended Affected Area, however, for safety reasons, resettlement of the households, community structures and businesses will be required;
- Increase the LoM by another 15 years;
- Construction of a security perimeter (in line with international best practice in the diamond mining industry and to ensure compliance with the Kimberley Process) around

the mining lease area, necessitating the diversion of the Koidu-Gandorhun Road around the southern boundary of the mining lease area;

- Management and storage of additional tailings, slimes and waste rock;
- Construction of a new plant, employee accommodation camp and other infrastructure;
- Diversion of the Koidu-Gondorhun road; and
- Resettlement of people currently residing within the extended 500 m blasting envelope (Extended Affected Area).

Project Benefits & Motivation

Despite the high quality of diamonds contained in the Koidu kimberlite pipes, dykes and blows, the small size of the two kimberlite pipes, which are the main source of production, is a major factor governing the options for the future mining operation. In addition, the relatively low grade of the larger of the two pipes (K2) and the lack of immediate access to ore from the richer pipe (K1) adds further complications. Various scenarios and options were considered in terms of the scale of the operation that could be supported by the diamond resources as currently understood, taking into account the limitations posed by the close proximity to the community, realistic mining rates and schedules and the economics related to each of these options.

With the reliance on the lower grade K2 pipe for the early part of the mine plan until access to K1 ore (either through significant waste stripping for continued open pit mining or decline development for an underground operation) and the lower revenue due to the lower grade and value per carat, maintaining the existing plant configuration and processing tonnages was shown to be uneconomic and that the mine would operate at a loss.

This scenario was found unattractive to all stakeholders, with the implication that the mine would close. Therefore, in order to get the economies of scale right and ensure the continued economic viability of the operation, an economic optimisation study was undertaken, in which the 180 tph processing capacity was identified as the best option.

Environmental Status

A number of specialist studies were undertaken in 2003 to understand the impacts associated with the development of the Koidu Mine. For the proposed expansion of the mine, a desktop review of the 2003 information was done and where possible, the 2003 baseline information was updated with recent studies to reflect current baseline conditions and to understand the additional impacts of the proposed expansion project.

Additional specialist studies were undertaken to update the baseline information and to quantify anticipated impacts on the environment associated with the Project. An extensive public consultation and disclosure process (PCDP) was conducted to involve relevant stakeholders in the ESIA process. The impact assessment did not indicate any fatal flaws that would hamper the commencement of the expansion of Koidu Kimberlite Project. A summary of the site specific environment is outlined below.

Climate

The regional climate is described as wet tropical monsoon, with a single wet season each year between mid-May and mid-November. The average rainfall is approximately 2 540 mm, with the wettest month usually in August and rivers attaining maximum discharge in mid-September. The dry season is between December and February. River discharge is at its lowest in March and April, and begins to increase gradually in May with the onset of the rains. Groundwater levels do not rise significantly until late July.

Normal temperature range is 20°C to 33°C, although it can drop as low as 10°C at night during the Harmattan season in January. Day temperatures average 31°C in the dry season and 28°C in the wet season.

Topography

The site is located at an elevation of approximately 390 mamsl, and is undulating with the significant natural topographical feature being Monkey Hill, which has a peak elevation of approximately 470 mamsl and is characterised by slopes which are steeper than that of the rest of the site. The topography of the site has been altered by historical and current mining activities (both formal and artisanal). Since the site is already topographically disturbed, the additional impacts associated with the Koidu Kimberlite Project are estimated to be of low significance.

Air Quality

In the quantification of fugitive dust emissions, use was made of emission factors which associate the quantity of a pollutant to the activity associated with the release of that pollutant. Use was made of the comprehensive set of emission factors and equations published by the US Environmental Protection Agency (US-EPA) in its AP-42 document Compilation of Air Pollution Emission Factors. The US-EPA AP-42 emission factors are of the most widely used in the field of air pollution. Particulate emissions and dust fallout from potential sources were calculated using a combination of emission limits, design specifications, mass balance calculations and emission factors. In characterising the dispersion potential of the site reference was made to hourly average meteorological data recorded at Koidu for the years 2009 and 2010.

The predicted air pollution concentrations and dust-fallout rates were compared to proposed international standards to facilitate compliance and impact assessments. These concentrations were summarised and form the basis of the compliance assessment and evaluation.

Predicted average daily dustfall levels as a result of operations at the proposed Koidu Kimberlite Project and the town of Koidu were predicted to result in lower levels than the international limits. Dustfall levels predicted at the proposed resettlement area were below the respective SANS Target and Residential Action levels of 300 and 600 ug/m²-day.

Noise

From the study it is expected that the noise levels generated by the proposed plant will not impact on the ambient noise levels in Koidu town due to the distance of the location of the proposed plant being too great. The open pit mining activities are expected to impact on the ambient noise levels at measured locations K5 and K6 during the night time w. These impacts are expected to be moderate and will cease once mining progresses underground.

It is expected that the blasting activities will also impact on certain locations in Koidu town during the operational phase. Blasting activities will only take place for a period of four years, after which open pit mining will cease. However, if the recommended mitigation measures are applied the significance of the impact can be reduced from Moderate to Minor.

Soils

Almost all the soils in the uplands and the swamps within the project lease area have been previously mined out by historical commercial and illicit artisanal mining pre-2003. This has resulted in the loss of topsoil. The operations conducted by Koidu Holdings have resulted in minimal topsoil loss but management has taken remedial actions to reverse the damage done by historical artisanal mining by stockpiling any topsoil found in the lease area for rehabilitation and creation of agricultural land. By continuing the soils management measures that Koidu Holdings conducts as part of its daily operations, the identified impacts of the proposed Koidu Kimberlite Project on the soils within the mining lease area are of low significance.

Geology

The Koidu kimberlite cluster comprises two main pipes and several small blows associated with four main sub-vertical to vertical kimberlite dyke zones that extend for approximately 5 km along strike. The dykes both pre-date and post-date the formation of the pipes that were emplaced into Archean granitoids of the Man craton approximately 146 million years ago. Significant quantities of high quality macro-diamonds have been recovered from the dykes, pipes and blows with grades ranging from 0.2 to 0.7 carats per tonne (cpt).

The main pipes, named K1 and K2 are smooth, steep sided pipes that are morphologically similar to those mined in the Kimberley area of South Africa. Surface expressions of the pipes are approximately 0.3 hectares (ha) for K1 and 0.5 ha for K2. The external morphology and infill present within the pipes is consistent with a diatreme setting and significant erosion of the pipes has occurred. The pipes are infilled by multiple phases of kimberlite characterised by contrasting textures due to different emplacement processes (highly explosive vs. intrusive). Texturally, the infill within the bodies is dominated by massive to locally bedded volcaniclastic kimberlite classified as tuffisitic kimberlite breccia (TKB).

Fauna and Flora

During field work 64 plant species were encountered, of these 22 species were of medicinal use or edible. One exotic species was encountered with five weed species found. The tree species *Albizia ferruginea*, recorded on site is currently vulnerable according to the IUCN.

Eight mammal species were encountered during the field work. This low number was expected with the close proximity of the site to Koidu Town, as the animal numbers are a function of the available habitat and the level of threats present, which were poor and severe respectively.

The avifauna component yielded 68 bird species during the field work. Bird habitat on the concession area included open areas, forests, ridges and wetlands. The species found were very well established communities. Common bulbuls, swallows, turacos and bee-eaters were found to dominate the ridge area. In the more forested sites, hornbills, woodpeckers and sunbirds were abundant. Open areas were dominated by doves and crows, and finally wetlands and rivers included birds dependant on these systems such as herons, kingfishers and ducks.

A total of three amphibian species and six reptile species were recorded during the survey.

Aquatic Environment

An integrated water resources assessment was conducted for the Koidu Kimberlite Project. This specialist study consisted of a separate assessment of the lotic systems (rivers and streams) and lentic systems (wetlands and dams). The aim of the study was to determine the current ecological state and functioning of the available surface water resources and to determine the severity of the proposed expansion associated with the Koidu Kimberlite Project on these resources, both with and without recommended mitigation measures.

Methodologies recognised both in South Africa as well as internationally were implemented for the two specialist components. Methodologies described by the River Health Programme of South Africa and the United States Environmental Protection Agency were considered for the assessment of the Meya River and associated streams. Additionally, methodologies recognised by the Department of Water Affairs of South Africa and the United States Army Corps of Engineers were considered for the assessment of the wetland areas.

The Koidu region has been mined both commercially as well as by artisanal miners in excess of 70 years. This has resulted in the water resources associated with the project area being severely modified. In addition to this, the local artisanal mining and agricultural activities continue to impact on these water resources. In addition to this, the bathing and ablutions by locals into the system have also impacted on the state of the system. The primary ecological service provided by the systems is cultivated foods for the local users, whereas services suitable for the enhancement of water quality and the maintenance of biodiversity have largely been lost.

The Koidu Kimberlite Project has not directly impacted on the integrity and functioning of the Meya River, but this system should continue to be monitored in order to determine temporal and spatial trends for the system. The Koidu Kimberlite Project will result in the loss wetlands due to the placement of the tailings and slimes dams in these areas. The severity of this impact is considered to be minor prior to mitigation, as well as minor post mitigation. This may be attributed to the poor current state of these systems.

In light of this development, it has been recommended that the wetland areas which will not be lost should be rehabilitated in order to provide a form of compensation for the lost areas and lost services. As a result of this, the conservation of biodiversity as well as the management of sustainable natural resources would be addressed as a requirement for the project. Additionally, monitoring of the wetland areas and Meya River should continue for the life of the project.

Surface Water

The project area lies within the Meya stream sub-catchment covering an area of about 188 km^2, which is a tributary of the Bafi River. Many of the streams which flow directly or indirectly into the Meya stream have their source at Monkey Hill and run through the project area. The regional drainage is from south to north.

The bulk of the water supply in the area comes from rivers, streams and swamps. The pH of the water in the major rivers in Sierra Leone ranges between 6.5 and 7 in the wet season and 6.2 and 6.5 in the dry season. The pH of water in the swamps ranges between 5.2 and 6.0. The pH for samples selected in the project area ranges between 6.4 and 7.6 with a mean value of 6.9.

The catchments are summarised as follows:

- Catchment A includes the catchment to the south of the mine area. The catchment is presently minimally impacted upon by mining and the river flows to the south. In the future expanded mine this catchment will include the tailings dump, plant, offices, change houses, clinic and workshops and will form the hub of the mining;
- Catchment B includes the existing K1 pit and the water drains to the North West of the mining area;
- Catchment C in an area to the north west of the site and the river from catchment B flows into catchment C;
- Catchment D is to the west of catchment A and presently is not impacted upon by the mine but is in a catchment that is a possible site for the tailings dump. The river in this catchment flows to the south of the mine;
- Catchment E includes the present day plant area and main dam and the water exits the site to the east; and
- Catchment F G, H and I and smaller catchments presently flowing into the K2 pit.

Water quality of the surface water at five locations within the mining lease area was measured. It was found that water quality exceeds the required standards for drinking water set by the World Health Organisation (WHO).

Groundwater

A conceptual hydrogeologic model of the Koidu mine area was developed based on the hydrologic data from previous investigations and the data that were collected at the site in 2009 including groundwater levels and hydraulic conductivities of the granite and leached granite, the depths and shapes of the kimberlite bodies provided by Koidu, and site-specific rainfall data collected over the past 5 years.

The groundwater inflows to the K1 and K2 pits will reach a maximum of about 1,400 and 1,200 m^3/day, respectively. The maximum groundwater inflows to the K1 and K2 underground mines will reach a maximum of about 2,250 and 2,400 m^3/day, respectively. Active dewatering utilising a ring of drainholes at the 150 mamsl level in the K2 underground will initially intercept about 1,200 m^3/day and reduce inflows to the K2 pit by about 600 m^3/day during early mining. More importantly, however, this active dewatering will also reduce pore pressures in the highwalls of the K2 pit, beneficial with respect to the relatively weak leached granite that will form part of the highwalls. Inflows to Dykes A and B East and Dyke B West are estimated to reach cumulative maximums of about 4,000 and 3,000 m^3/day, respectively. These relative larger inflows are primarily a factor of their lengths.

All of the above inflows are relatively small and should be easily manageable without major impacts on the planned mining. Sumps and pumping capacity will, of course, have to be designed for both pits to manage the direct precipitation and runoff, including that from high intensity rainfall events.

Analysis of potable water quality within the Koidu Holdings lease area indicated that the measurements of the parameters tested were all within the permissible limits recommended by the World Health Organisation (WHO). It also indicated that the water had high chemical bacteriological qualities and is good for human consumption.

Visual

The mine is not highly visible and there are numerous disturbances due to previous mining activities on and adjacent to the site. It can be seen by comparing the two viewshed models that the visibility of the mining activities within the local area will increase. The fact that the area surrounding Kono Town is already aesthetically disturbed together with the rehabilitation of vegetation within the mining lease area reduces the significance of this impact.

Archaeological and Cultural

The objective of the archaeological study was to use internationally recognised measures to identify, document and assess potential sites of archaeological and heritage significance in the project area in order to conserve, mitigate and manage heritage sites and artefacts according to the recommendations and criteria of the relevant heritage authorities and legislation.

Three sites were identified during the fieldwork, as indicated below:

- A possible residential settlement on a low hill to the south-west of Monkey Hill;
- A metalworking site on the southern slope of Monkey Hill; and
- A metalworking site and possible residential settlement on the crest and upper slopes of Monkey Hill.

In order to assess the significance of the identified sites, a literature review and additional research were undertaken. This determined that a) there are known archaeological sites in the project area, and b) these sites may be significant in terms of the archaeological history of the area, as well as providing an understanding of the expansion and influence of West African cultures southwards.

Currently, the significance of the three sites identified has been preliminarily rated. However, the significance of these sites will only be determined once dating and data collection, which is currently being done, have been finalised.

Socio-Economic Status

The resettlement of a significant number of households residing in the 2003 mining lease area required the development of a RAP for implementation prior to and during the exploitation of the deposits. A detailed RAP was developed in 2003, which was in line with the World Bank Standards at the time.

In support of the 2003 RAP, a household survey was undertaken with households located within the blasting envelope. When mining activities resumed in 2008, a second household survey of the lease area was undertaken to cover all households who were not included in the 2003 survey. At present, all the households within the 2010 confirmed mining lease area have been surveyed and they form part of the 2003 RAP as amended and agreed upon in August 2009.

A total of 144 houses have been constructed between 2004 and April 2011 and another 112 (use end May figures) households still need to be resettled. All replacement houses are provided with Ventilated Improved Pit latrines (VIPs) and shower facilities on the residential stand. Current community facilities in the resettlement village include community taps, a market and a recreational field.

The project site shows a mixture of commercial and residential plots and limited agriculture activities (vegetables) due to the dense settlement pattern. There are three settlements expected to be impacted by the proposed expansion, namely Saquee Town, Yormandu and New Sembehun. These settlements partially fall within the extended 500 m blasting envelope, and the affected households will therefore have to be resettled. A Resettlement Action Plan (RAP) is currently being developed for the Extended Affected Area. In addition to replacing all affected dwelling structures, community services and facilities affected in the Extended Affected Area will also be replaced.

<u>Main Biophysical Impacts Identified</u>

A summary of the impacts which have been regarded as high and medium high are summarised below. Biophysical impacts of medium-high significance are expected during construction and operation due to noise and impacts on the fauna within the lease area. After the appropriate mitigation measures are implemented, these impacts will however, be of medium significance. During decommissioning of the mine, natural habitat for fauna will be restored and will be of medium positive significance. Air quality impacts of medium significance may occur during the decommissioning of mining infrastructure however, after the recommended mitigation measures are implemented, the impacts will be of low significance. A detailed evaluation of all the anticipated biophysical impacts can be found in Appendix A.

Biophysical impacts rated as medium-high and high during construction

Activity, Phase and Impact			Impact before mitigation							Impact Rating (after mitigation)						
Impacted Environment	Activity	Summary of Impact	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)
Noise	Mining & Material dumping area preparation	Noise of machinery and vehicles may impact on noise receptors in the vicinity of the project	N	4	2	5	11	7	77	N	4	2	4	10	5	50
Fauna	Site clearance	Site clearance during the construction of mining infrastructure may negative impact on the existing fauna within the mining lease area	N	4	6	5	15	7	105	N	3	5	4	12	6	72
			N	3	6	4	13	6	78	N	2	3	4	9	5	45

Biophysical impacts rated as medium-high and high during operation

Activity, Phase and Impact			Impact before mitigation							Impact Rating (after mitigation)						
Impacted Environment	Activity	Summary of Impact	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)	Nature of Impact (positive /	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)
Noise	Open pit mining	Noise from blasting, vehicles and mining activities will impact on senstitive receptors in the area	N	4	3	5	12	7	84	N	4	3	4	11	5	55
	Underground mining		N	4	5	4	13	6	78	N	3	5	3	11	4	44

Biophysical impacts rated as medium-high and high during decommissioning

Activity, Phase and Impact			Impact before mitigation							Impact Rating (after mitigation)						
Impacted Environment	Activity	Summary of Impact	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)	Nature of Impact (positive /	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)
Fauna	Rehabilitation of void and mining areas	Rehabilitation of the final void and mining area may will lead to an increase in habitat for fauna species.	P	3	4	5	12	7	84	No mitigation for Positive						
Air Quality	Decommissioning of mining infrastructure	During decommissioning of mining infrastructure, air quality impacts (mainly dust) may negatively impact the adjacent environment	N	3	5	5	6	13	78	N	1	1	1	1	3	3

Heritage and Archaeology

The following impact assessment on archaeological and heritage resources was completed in compliance with the impact assessment criteria implemented for the environmental impact assessment report, as well as in accordance with significance ratings and archaeological impact assessment criteria established by the Association of Southern African Professional Archaeologists (ASAPA) and applicable international best practice guidelines.

All potential impacts will occur during the construction phase, thus, no additional impacts are expected during the operational and decommissioning phases.

Currently, the significance of the impacts on archaeological resources is rated as medium-high prior to mitigation. However, after mitigation impacts will be of medium and low importance. It has to be noted that Koidu Holdings is currently in the process of implementing the recommended mitigation measures. Once this process is complete, the significance of the sites found will be defined.

Impacts on archaeological resources during construction

Site, Phase and Impact			Recommended mitigation	Impact significance (pre-mitigation)	Impact significance (post-mitigation)
RES967/001	C	Tailings facility will impact on site	Archaeological mitigation of site that may include test excavation, mapping, surface sampling and materials analyses	117	33
RES967/002	C	Tailings facility will impact on site	Archaeological mitigation of site that may include test excavation, mapping, surface sampling and materials analyses	117	33
RES967/003	C	Expat camp and associated infrastructure	Archaeological mitigation of site that may include test excavation, mapping, surface sampling and materials analyses	117	33

Main socio-economic impacts assessed

Impacts have been assessed in terms of anticipated effects of the Project on the receiving socio-economic environment, on directly affected households and stakeholders at the local, district, national and international level (where applicable).

The overall project impacts will predominantly be of a cumulative nature. Consequently, the assessment of impacts resulting from the Project was carried out within this context, i.e. taking into account the combined impacts of the overall Koidu Kimberlite Project. The table below provides a summary of impacts assessed and significance status before and after mitigation.

Impact	Significance	
	Pre-Mitigation	Post Mitigation
Physical and economic resettlement	Major negative	Moderate positive
Increase in government revenue	Moderate positive	Moderate positive

Impact	Significance	
	Pre-Mitigation	Post Mitigation
Increased dependence of the national economy on mining	Minor negative	Minor negative
Procurement of local goods and services	Minor positive	Moderate positive
Impact on local government capacity for infrastructure and service delivery	Minor negative	Minor positive
Employment creation	Minor positive	Moderate positive
Community anger and resistance	Major negative	Minor negative
Access and mobility	Minor negative	Minor positive
Community well being	Moderate negative	Minor negative
Local economic development	Minor positive	Moderate positive

Environmental Management Plans

In order to achieve appropriate environmental management standards and ensure that the findings of the environmental studies are implemented through practical measures, and provided for in engineering designs of the facility, the recommendations from this ESIA have been used to compile an EMP.

The role of the EMP is to assist Koidu Holdings in reducing potential impacts and risks and achieving its environmental objectives as well as fulfilling its commitment to the environment. The EMP will be used to ensure compliance with environmental specifications, monitoring and management measures.

The EMP will need to be implemented from site preparation through to decommissioning and closure.

Project Timing and Implementation

The Koidu Kimberlite Project schedule commenced in the fourth quarter of 2010, with the ordering of the new plant and other long lead time items, such as earth moving equipment. Construction of the plant and infrastructure is planned for the second quarter of 2011, to ensure all civil engineering work is completed by the time the plant and equipment arrive on site. According to current planning the resettlement of houses in the Extended Affected Area will also commence in the second quarter of 2011.

The five year open pit mining phase of the operation will be followed by underground mining of both K1 and K2, as well as the dyke zones and blows, for the remainder of the life of the mine.

Closure and Financial Provision

Closure costs for the Koidu Mine, inclusive of the Koidu Kimberlite Project, have been calculated at approximately $ 13,917,964.65. The closure plan and costs will be revised regularly and as the mine plan changes. Closure costs were calculated based on the following objectives:

- To return the land, other than the open pits, to a land capability similar to that which existed prior to mining;
- To ensure pits are made safe by shaping the pit walls and constructing a berm wall around the relevant pits. Any available waste rock or tailings should be used to help fill the pits;
- To demolish all mine infrastructure which cannot be utilised by subsequent land users or any third party. Once demolition has occurred prompt topsoil application and re-vegetation should take place. Where buildings can be used by a third party, arrangements will need to be made to ensure their long term sustainable use;
- To clean up all spills on site;
- To ensure that all wetlands within the project site impacted on by the relevant mining activities are rehabilitated such that they restore and improve the health and functioning of the whole wetland system prior to the existence of mining;
- To annually assess the closure impacts thereby ensuring progressive and integrated closure throughout the life of the project;
- To leave a safe and stable environment for both humans and animals and make their condition sustainable;
- To maintain and monitor all disturbed and rehabilitated areas following re-vegetation;
- To involve all relevant stakeholders, authorities and communities in the mine closure process; and
- To allow for the mine to leave the surrounding community in a more economically sustainable manner than prior to mining.

Conclusion

The Koidu Kimberlite Project is being undertaken with due consideration of biophysical, social and economic factors, as well as the relevant legislative requirements. The economic benefits of such a development are numerous, however, as in any mining project of this nature there also negative impacts which will require planning, monitoring and mitigation during construction, operation, decommissioning and post-closure. While none of these negative impacts are considered to be fatal flaws, the resettlement of households and community structures in particular constitutes a major impact which will require an integrated resettlement and development approach.

The Koidu Mine is essentially the most advanced operating mine in the country of Sierra Leone which has a focussed, technically skilled and committed management team and which contributes to the national fiscus in a meaningful way. One of the unintended consequences of the successful implementation of the project will be the fact that the social environment will become disjointed as a result of the creation of a prosperous area in an economically challenged region historically scarred by unemployment, civil strife, conflict and massive environmental damage created during the civil war. Koidu Holdings cannot employ everybody or create individual benefits for the entire population of Sierra Leone, and the very success of the project and the local people it employs may attract negative interventions and pressures from persons and institutions with their own interest at heart.

National and regional leaders in the country, security services, as well as NGOs and the international community, must interact with management to protect the Project from unnecessary and unwanted negative interventions which may have as their sole purpose the creation of economic advantage for individuals to whom none is due or owing.

ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
%	Percentage
AMD	Acid Mine Drainage
BAP	Biodiversity Action Plan
Cm	Centimetre
cm^2	Centimetre Squared
CBO	Community Based Organisation
CBD	Convention on Biological Diversity
CCD	Convention to Combat Desertification
CDA	Community Development Agreements
CEC	Cation Exchange Capacity
CEPESL	Creating an Enabling Policy Environment in Sierra Leone
CITES	Convention for International Trade for Endangered Species
Cpt	Carats per tonne
dB	Decibel
DMS	Dense Media Separation
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EMP	Environmental Management Plan
EPs	Equator Principles
EPAA	Environmental Protection Agency Act
IDM	Illicit diamond miners
IFC	International Financial Corporation
kg	Kilogram
km	Kilometre
km^2	Kilometre squared
kV	Kilovolts
Le	Leones
LHD	Load haul dumpers
LoM	Life of Mine
M	Metre
m^2	Metre squared
m^3/hr	Cubic metre per hour

mg	Milligram
Mg/l	Milligram/litre
mg/m³	Milligrams per cubic metres
mm	Millimetre
MRCP	Mine Reclamation and Closure Plan
Mt	Million tonnes
NACSA	The National Commission for Social Action
NBSAP	National Biodiversity Strategy and Action Plan
NGOs	Non-Governmental Organisations
NOU	National Ozone Unit
NDMC	National Diamond Mining Company
OD	Operational Directive
ODS	Ozone Depleting Substances
POPs	Persistent Organic Pollutants
ppm	Parts per million
PCDP	Public Consultation and Disclosure Process
PS	Performance Standard
RAP	Resettlement Action Plan
SALWACO	Sierra Leone Water Company
SIA	Social Impact Assessment
SL	Sierra Leone
SLEPA	Sierra Leone Environmental Protection Act
SLST	Sierra Leone Selection Trust
T	Tonnes
TKB	Tuffisitic kimberlite breccia
Tph	Tonnes per hours
Tpm	Tonnes per month
TSF	Tailings Storage Facility
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
VRC	Village Resettlement Committee
WB	World Bank
WHO	World Health Organisation

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLANS

1. INTRODUCTION

Digby Wells Environmental (Digby Wells), in association with Cemmats Group Ltd (Cemmats), were appointed as independent consultants to assess the potential environmental and social impacts associated with the expansion of the existing mine's production plant from 50 tonnes per hour (tph) to180 tph, at the Koidu Kimberlite Project.

The Koidu Kimberlite Project is located in the Kono District of Sierra Leone, approximately 330 km east of the capital Freetown, and is owned and operated by Koidu Holdings S.A ("Koidu Holdings" or "the Company"), a company wholly owned by BSG Diamonds Ltd, a subsidiary of BSG Resources Ltd. Koidu Holdings was originally formed in September 2003 as a joint venture company between the previous mineral rights owners Energem Resources Inc (formerly named DiamondWorks Ltd) and a subsidiary of BSG Resources, Magma Diamond Resources Ltd. From incorporation onwards, various changes in the shareholding structure of the Company took place, with BSG Diamonds progressively increasing its stake in Koidu Holdings to 100% by February 2007.

Development of the mine commenced in 2003, with the construction of a 50 tph dense media separation (DMS) plant and associated mining infrastructure required for bulk sampling and trial mining of No. 1 Pipe (K1) and No. 2 Pipe (K2).

Processing of the first kimberlitic material from K1 began in January 2004 and continued until mid-2004, when sampling switched to K2. This allowed for preparation of the planned vertical pit at the K1, which required waste rock stripping and construction of the headgear, hoist and winder at the collar of the planned K1 vertical pit.

Between August 2005 and December 2007, the mine focussed on extracting ore from the K1 vertical pit and initiated a comprehensive exploration programme to locate and evaluate all kimberlite ore bodies on the property, develop an optimal life of mine (Lom) plan and compile a full bankable feasibility study. The exploration programme was completed in mid-2010 and the feasibility study completed by the fourth quarter of 2010.

Koidu Holdings was awarded an Environmental Impact Assessment (EIA) Licence for its current 50 tph operation in September 2003. However, the proposed mine plan to increase the life of the operation, mine larger and deeper pits and to progress to underground mining methods requires updating of the ESIA and identification of any new impacts on the social and physical environments within the lease area as well as beyond its boundaries.

The purpose of this report is to present the findings of the Environmental and Social Impact Assessment (ESIA) that has been undertaken for the Project, and to propose an Environmental Management Plan (EMP) to maximise the positive aspects of the project and to minimise or manage the negative implications.

As no mining activities are to take place within the Extended Affected Area, no biophysical assessments were undertaken within the Extended Affected Area. Updated socio-economic baseline information was used in the assessment of the social impacts on the affected communities within the Extended Affected Area.

People residing within the 500 m blasting envelope (Extended Affected Area) associated with the Koidu Kimberlite Project expansion will be resettled. For this purpose a Resettlement Action Plan (RAP) is currently being developed.

1.1. Terms of reference

In terms of Section 24 of the Environmental Protection Agency Act, 2008 (Act 11 of 2008), any person who wishes to undertake a project in the mining and extractive industries must apply to the Sierra Leone Environmental Protection Agency (SLEPA) for an Environmental Impact Assessment (EIA) licence.

The undertaking of an ESIA for the proposed expansion from 50 tph to 180 tph is also a requirement of the Mines and Minerals Act, 2009 (Act 12 of 2009), which states that when the holder of a mining licence proposes to make a change in its mining operations that would cause a need for a material change in the Environmental Management Programme (EMP). The mining licence holder must submit an updated EMP for approval by the Director of Mines.

This ESIA report has been compiled in fulfilment of the above legislative requirements and further aims to comply with the Equator Principles (EPs) for socially and environmentally responsible project finance and the International Finance Corporation (IFC) '*Environmental, Health and Safety Guidelines, 2007*'.

1.2. Background and context

The following section sets the scene for the ESIA report by providing a brief description of the history of Koidu Kimberlite Project, as well as an overview of the proposed expansion.

1.2.1. Company history

The rights to the Koidu Kimberlite Project were originally secured in 1995 by Branch Energy Limited ("Branch Energy"). Branch Energy had obtained a 25-year mining lease for the Koidu Kimberlite Project and initiated development of the property in November 1996.

The democratically elected government (which was elected in 1996) ratified and re-enacted the 1994 Mines and Minerals Decree under which the lease was issued. The Koidu mining lease was specifically ratified by an Act of Parliament in December 1996.

In 1996, a Canadian listed company called DiamondWorks, acquired Branch Energy and all its mineral rights. In May 1997, the project was at the plant commissioning stage when a *coup d'etat* took place in Sierra Leone. Branch Energy was forced to halt its activities and invoke *force majeure* and, over the ensuing 5 years of conflict, the company's assets at Koidu were completely destroyed and no further work could be undertaken on the exploration properties. DiamondWorks revisited the mineral holdings in Sierra Leone after the war in 2002, targeting the Koidu Kimberlite Project, and began construction and re-development of facilities damaged during the period of civil unrest.

In June 2002, DiamondWorks and Magma Diamond Resources Limited entered into a 50/50 joint venture agreement for the re-development of the Koidu Kimberlite Project. Magma was a wholly owned subsidiary of the privately owned BSG Resources Limited ("BSG Resources"). BSG Resources is the resources arm of the Beny Steinmetz Group ("BSG"), a private international investment group focusing on diamonds, natural resources, real estate, finance and asset management. BSG Resources has been involved in various major investments in the natural resources arena worldwide, including the Simandou Iron Ore Project in neighbouring Guinea.

The initial joint venture was replaced by a new joint venture agreement, entered into between *inter alia* DiamondWorks, Branch Energy and Magma during September. In terms of the New JV Agreement, Magma and Branch Energy each held a 50% equity stake in the newly formed JV Company, Koidu Holdings S.A and were obliged to fund the working capital and running cost requirements of the Company *pro rata* their shareholding in the Company.

Koidu Holdings S.A was incorporated in the British Virgin Islands and licensed to do business in Sierra Leone in terms of the Business Registration Act on 29 September 2003. A Certificate of Registration of Business and a Licence were issued to Koidu Holdings on 1 October 2003 in accordance with the Companies Act, Cap. 249 of the Laws of Sierra Leone 1960.

Magma and Branch Energy agreed to a dilution of Branch Energy's shareholding in Koidu Holdings, such that the shareholding would be in proportion to the contributions made by the Shareholders to the Company. Further, Magma and Branch Energy agreed to the assignment by Magma of a portion of its Shareholders' loan to its holding company BSG Resources, and the introduction of BSG Resources as a Shareholder in Koidu Holdings.

In terms of the Shareholders' Agreement, the new shareholding in Koidu Holdings became: 40% DiamondWorks, 35% Magma and 25% BSG Resources. In January 2004, BSG Resources assumed overall direction, supervision and management of Koidu Holdings.

In February 2007, BSG Resources acquired the shareholding of DiamondWorks (renamed Energem Resources Ltd) in Koidu Holdings S.A. and Magma's 25% holding was transferred to BSG Resources. Koidu Holdings is presently wholly owned by BSGR Diamonds, Ltd, which is wholly owned by BSG Resources (Figure 1-1).

In May 2008, the GoSL announced that it intended to review all industrial mining licences and agreements and, at Koidu Holdings' request, the review started with the mining lease for the Koidu Kimberlite Project.

Figure 1-1: Koidu Holdings SA company structure

1.2.2. Exploration & mining history

The property hosts two small diamondiferous kimberlite pipes and four diamondiferous kimberlite dyke zones, along which four small blows or enlargements have been discovered. Development of the mine commenced in 2003, with the construction of a 50 tph Dense Media Separation (DMS) plant and mining infrastructure required for bulk sampling and trial mining of K1 and K2. Processing of the first kimberlite from K1 began in January 2004 and continued until mid-2004, when sampling switched to K2 to allow for waste stripping and establishment of the headgear, hoist and winder and associated infrastructure required at the collar of the planned vertical pit at K1.

During the period August 2005 to December 2007, the mine focussed exclusively on extracting ore from the K1 vertical pit, and was successful in establishing the largest and deepest one of its kind in operation world-wide, while attempting to minimise the impact on the nearby Koidu community.

Given the limited lifespan of the vertical pit (maximum 80 m from collar), the Company embarked on an exploration core drilling programme to delineate sufficient resources for at least the remaining life of the mining lease period. From 2003 to 2008, four phases of core drilling were completed and once the magnitude of potentially mineable resources began to emerge, desktop studies considering the possible scenarios for the future expansion of the mining operation were undertaken.

The full extent of the diamond resources at Koidu was understood towards the end of 2008, at which time the Company entered the prefeasibility study stage, contracting industry leaders in resource estimation, geohydrology, mine design and various other disciplines required in order to ultimately bring the project to a bankable feasibility study level.

After significant additional bulk sampling exercises in 2009 and 2010, both from large scale surface excavations and large diameter drilling programmes on K2, Dyke Zones A and B, as well as the four blows intended to form part of the LoM plan, 4.175 million tonnes of indicated resources and 10.162 million tonnes of inferred resources were signed-off by independent competent persons, with an additional 3.707 million tonnes of kimberlite identified as geological potential requiring further drilling and sampling.

While the feasibility study was being concluded and following on after the completion of the bulk sampling programmes at K2, the first cut of the open pit mining schedule for K2 was initiated in order to fund the operation, with the intention of dovetailing with the final pit design determined in the feasibility study.

1.2.3. The Koidu Kimberlite Project

The feasibility study demonstrated that the optimal project plan for the expansion of operations at Koidu was technically and economically viable. The plan includes mining both kimberlite pipes by open pit methods, to a depth of approximately 310 m below surface for K1 (March 2011 to September 2016) and approximately 244 m below surface for K2 (from September 2010 to October 2015), at which time the transition to underground mining methods would be made. Taking into account the additional production that could be derived by mining the kimberlite dykes and blows from underground, an optimal plant size of 180 tph has been selected, mining at a rate of 100,000 tonnes of ore per month and 1.4 million tonnes of waste per month.

The implications of the dramatic increase in mining and processing capacity are that an entirely new plant and mining fleet with associated infrastructure will be required. The Project schedule commences in the fourth quarter of 2010, with the ordering of the new plant and other long lead time items, such as earth moving equipment. Construction of plant and infrastructure will commence during the second quarter of 2011, to ensure all civil engineering work is completed by the time the plant and equipment arrive on site.

The mine will continue producing with the existing 50 tonne per hour plant until the new plant is erected, commissioned and has ramped up to full production (end June 2012), after which the existing plant will be dismantled and relocated to the Tongo Diamond Field Project south of Koidu.

The five year open pit mining phase (to end 2015) of the operation will be followed by underground mining of both kimberlite pipes, as well as the dyke zones and blows, for the remainder of the life of the mine. Construction of the underground access will commence in early 2012 with first ore being extracted from the underground in 2016.

The Project is expected to increase the production from the two open pits from approximately 10,000 carats per month currently being achieved to an average of 45,000 carats per month from 2012 to 2015, tapering off as production from the underground comes on line and the operation is maintained at 100,000 tonnes processed per month.

The mine is currently in the process of constructing a security perimeter in the form of a wall around the mining lease area in order to fall into line with international best practice with regards to diamond mining operations as implemented in South Africa, Botswana, Namibia, Angola and Lesotho, as well as to ensure the compliance of the Project with the Kimberley Process, an objective which is both in the interest of the company as well as the government of Sierra Leone. The Koidu-Gandorhun Road which runs through the mining lease area will consequently have to be diverted around the southern boundary of the mining lease area. The additional distance is not excessive.

1.3. Project motivation

Despite the high quality of diamonds contained in the Koidu kimberlite pipes, dykes and blows, the small size of the two kimberlite pipes which are the main source of production, is a major factor governing the options for the future of the mining operation. In addition, the relatively low grade of the larger of the two pipes (K2) and the lack of immediate access to ore from the richer pipe (K1) added further complications. Various scenarios and options were considered in terms of the scale of the operation that could be supported by the diamond resources delineated, taking into account the limitations posed by close proximity to the community, realistic mining rates and schedules and the economics related to each of these.

With the reliance on the lower grade K2 pipe for the early part of the mine plan until access to K1 ore (either through significant waste stripping for continued open pit mining or decline development for an underground operation) and the lower revenue due to the lower grade and value per carat, maintaining the existing plant configuration and processing tonnages was shown to be uneconomic and that the mine would operate at a loss.

This scenario was found unattractive to all stakeholders, with the implication that the mine would close. Therefore, in order to get the economies of scale right and ensure the continued economic viability of the operation, an economic optimisation study was undertaken, in which the 180 tph processing capacity was identified the best option.

1.4. Objectives of the ESIA

The objectives of this ESIA report for the Koidu Kimberlite Project are to:

- Provide important background information to the project and its proposed expansion;
- Describe the project and its proposed expansion in terms of the project applicant, location, scale, timing, duration and sequence;
- Describe the need and desirability of the proposed expansion;
- Identify all legal and legislative requirements that should be fulfilled prior to the commencement of the proposed expansion;
- Consider and analyse all possible alternatives to the proposed expansion;
- Describe the current biophysical, cultural and social environment of the project area;
- Identify the potential environmental and social impacts associated with all of the phases of the proposed expansion and determine their significance;
- Describe cumulative impacts of the proposed expansion;
- Formulate a management plan for achieving the environmental and social objectives for the project and mitigate the identified impacts;
- Indicate the public consultation and disclosure (PCDP) process that was conducted in support of this ESIA; and
- Formulate a preliminary closure plan for the proposed expansion.

2. PROJECT DESCRIPTION

This chapter provides a detailed description of the Koidu Kimberlite Project in terms of the project applicant, location, scale, timing, duration and sequence.

2.1. Applicant details

The applicant details and contact information are summarised in Table 2-1. A brief history of the rights to the Koidu Kimberlite diamond mine was provided in Chapter 1.

Table 2-1: Project application details

Project title:	Expansion of the Koidu Kimberlite Project
Project applicant:	Koidu Holdings SA
Contact person:	Mr Dino Coutinho – Chief Operating Officer Mr Ibrahim Kamara – Chief Communications Officer
Postal address:	PO Box 72, Freetown, Sierra Leone
Telephone no:	+232 22 232257
Fax no:	+232 22 232390
E-mail address:	dcoutinho@koiduholdings.com ikamara@koiduholdings.com
Project location:	Koidu Town, Kono District, Sierra Leone

2.2. Project details and location

The Koidu Kimberlite Project is situated approximately 2 km south of the town of Koidu within the Tankoro Chiefdom of the Kono District in the Eastern Province of Sierra Leone (Plan 1).

2.2.1. Regional setting

The Kono District lies within the West African tropical rainforest belt of Sierra Leone. Diamond mining has been part of the history and heritage of the Kono District.

Koidu Town lies to the north of the Koidu Kimberlite Project. Koidu is currently the 4^{th} largest city in Sierra Leone and serves as the capital and economic centre of the Kono District. The town is ethnically and culturally diverse and its population includes a significant number of foreign diamond workers, both legal and illegal artisanal miners.

2.2.2. Local setting

The original mining lease area that was issued in 1995 measured approximately 4 km^2 (Plan 1: Regional setting

). As part of the mining lease area verification for the Mining Review Process, a delegation from the Ministry of Mineral Resources and Political Affairs visited the project site on 2 March 2010 and resurveyed all beacons. It was confirmed that the original coordinates did not correspond with the actual beacon positions and that those coordinates had been based on the wrong coordinate system.

A new set of coordinates was issued by the acting Director of the Geological Survey, Deputy Director of the Geological Survey, Government Mining Engineer for the Kono District and Mining Cadastre Officer of the Geological Survey. The coordinates were signed off by the Minister of Mineral Resources and incorporated into the new Mining Lease Agreement. The new mining lease area measures 4.9873 km^2 and the coordinates are provided in Table 2-2.

Table 2-2: Coordinates for the Koidu Kimberlite Mining Area

Point no.	X-coordinates	Y-coordinates	UTM Zone
1	282268	955286	29
2	282642	955042	29
3	282662	954725	29
4	283850	955350	29
5	284251	955540	29
6	284251	955165	29
7	284780	955440	29
8	284660	953210	29
9	284500	953200	29
10	282569	953198	29
11	282283	953340	29
12	282276	953701	29
13	281930	954195	29
14	281930	954195	29
15	282268	954363	29

2.2.3. Land tenure

The mining lease issued in 1995 was valid for a 25 year period. However, due to the civil war, *force majeure* was invoked in May 1997 and was lifted following the official declaration of the end of the war on 18 January 2002. The 1995 mining lease was transferred to Koidu Holdings, including all rights, privileges, duties, obligations, title and interest as from 1 October 2003.

In terms of the Mining Review Process initiated by GoSL in 2008, the mining lease held by Koidu Holdings was renegotiated and a new agreement entered into between the Republic of Sierra Leone and Koidu Holdings on 6 September 2010. The term of the mining lease was extended to 22 July 2030 and shall continue in force until the expiry, surrender or termination of the mining lease. The mining lease may be renewed for a further period of 15 years.

In addition to the mining lease, Koidu Holdings holds a surface lease over the land adjacent to the western boundary of the mining lease area which is used for the accommodation complex.

2.2.4. Nearby settlements

Within the surveyed project area there are five main settlements, namely New Sembehun, Saquee Town, Sokogbe, Swarray Town and Yormandu. These settlements fall within or border on the mining lease area. A sixth settlement, Manjamadu (which includes the existing resettlement site), is located along the eastern boundary of the mine. Other neighbouring settlements are Old Meama, Wordu and Kanya.

2.2.5. Accessibility

The primary means of access to the Koidu Kimberlite Project is by motor vehicle. The road linking Freetown and Koidu has been upgraded since 2007 and is currently in good condition for approximately 200 km from Freetown. The final 160 km between Makeni and Koidu is in very poor condition, but plans to upgrade this section have been approved for the next dry season. The aggregate to be used in the construction of this upgraded road will be sourced from the waste rock produced from the Koidu mining operation.

Roads inside the concession area are on average 9 m wide and cover approximately 15.5 km. Roads are constructed with waste rock and topped with compacted kimberlite tailings. Most of the roads in use are utilised by heavy mining and light vehicles and are maintained on an ongoing basis.

The regional airstrip is situated at Yengema airfield, which is situated approximately 15 km west of the mining license area and is accessed by the main road leading from Koidu town to Freetown. The runway is approximately 14 m wide and 800 m long with a tarmac surface. Maintenance on the runway and the surrounding areas is done by the local population and is funded by Koidu Holdings.

The helipad is situated west of the security camp and covers an area approximately 2 712 m^2. The helipad was constructed on a waste rock foundation and topped with kimberlite tailings. The surface is compacted to prevent excessive dust with the landing and take-off of helicopters. The helipad is marked and is equipped with a windsock.

2.2.6. Fuel storage and handling

The existing diesel storage area is situated between the workshop and logistical area and covers an area of approximately 256 m^2. Fuel is stored in two 40 500 L tanks and is distributed through a metered electric pump.

Fuel is obtained from the Total (SL) Ltd depot in Freetown and is transported to Koidu by Total fuel bowsers.

Fuel is delivered into the tank that is used for daily distribution. From there, fuel is pumped via a fuel polishing filtration system to the main storage tank.

Heavy machinery working in the different areas of the mining lease area are supplied fuel by a 10 000 L mobile fuel bowser which receives its fuel from the fuel station. In turn, the fuel bowser is equipped with a metered pump. A fuel consumption database is maintained by the logistics department and audited by the finance department.

2.2.7. Explosives storage

Liquid emulsion is stored at the main logistical store and is considered non-explosive until sensitised with sodium nitrate. The explosives magazine encompasses a fenced and gated area of approximately 7 178 m². The main magazine consists out of a number of roofed containers which are situated inside a 4 m high sand/laterite berm barrier with a concealed entrance.

Access to the magazine is strictly controlled and is only permitted in the presence of security personnel. All issues and consumption is logged by the security department and is verified against the registers Koidu Kimberlite Project by the key holder whom is a licensed blasting operator.

2.2.8. Reagent storage and handling

Hydrofluoric acid is currently not utilised or handled at the mine, although some remain in stock. The residue of the hydrofluoric acid that still remains on site is currently stored at the plant site in polyethylene containers. The storage area is located inside the final recovery security area inside a specially constructed container.

2.2.9. Existing infrastructure

The location of existing surface infrastructure is illustrated in Table 2-3 and includes the following:

- Workshops and workshop offices;
- Vehicle wash bays, parking and maintenance area;
- Process plant;
- Administration offices;
- Logistical stores;
- Resettlement offices and stores;
- Brick manufacturing plant;
- Clinic;
- Core shed;
- Employee accommodation camp and recreation area;
- Security camp;
- Fuel storage area;
- Reagents storage area; and
- Explosive magazine.

2.3. Project description and resource requirements

This section provides a description of the proposed project activities that will be undertaken as part of the Koidu Kimberlite Project. An estimation of the mining equipment, employment and capital required for the Project is also provided.

2.3.1. New infrastructure

The infrastructure to be constructed are listed and described in Table 2-3 and indicated on the proposed infrastructure layout plan (Plan 4).

2.3.2. Mine plan

The mine plan consists two distinct phases employing different mining methods, namely open pit and underground mining methods. The open pit operational phase will overlap with the construction of infrastructure for the underground mining phase in order to ensure a seamless transition from surface to underground production.

Open pit mining at K2 commenced in October 2008 with the removal of 1,150,000 tonnes of waste in preparation for the controlled extraction of a 5 m slice across the ore body as part of the bulk sampling programme. The waste development and bulk sampling formed part of an interim cut planned to generate funds and keep the mine in production during the feasibility study period and beyond. The interim pit was incorporated in the final pit design for K2 and the mining will continue uninterrupted.

Therefore, the No. 2 open pit will not go through another construction phase, but rather the current operational phase will be ramped up to meet the increased tonnages required to meet the new plant processing targets. Mining activities at K1 will get underway in March 2011 with substantial waste stripping required to cut back the vertical pit highwalls and gain access to ore beneath the vertical pit.

Koidu Holdings, in conjunction with SRK Consulting, have conducted open pit optimisation studies on the K1 and K2 ore bodies. The optimal pit shells were selected by considering the trade-off between the open pit and underground operations, serving as a guide for the final open pit designs. Due to the potential impact on the surrounding infrastructure and community, the decision was made to increase the safe blasting radius for the open pits from 250m to 500m.

The K1 open pit will include portions of Blow A and Blow B, as well as the two dyke zones (DZA and DZB) which bound the northern and southern extents of K1 and extend to the blows. These pit designs will take the development of the K1 pit down to 80 mamsl and K2 down to 140 mamsl. The open pit operations at K1 and K2 are scheduled to be completed by December 2015.

Current indications are that the development of the main underground access decline should commence in 2012, with production ramp-up from underground from 2015 onwards.

Table 2-3: Proposed infrastructure associated with the Koidu Kimberlite Project

Infrastructure	Area	Description
Main gate	816 m^2	• The main gate with a floor space of 840 m^2 will only allow access to mining employees by means of a pedestrian entrance; • Searching facilities will ensure property security; • A visitors counter will issue visitor permits; • A vehicle entrance will allow access to large vehicles; and • A security staff manning station with ablution facilities.
Clinic	607m^2	• Clinic with a floor space of 420 m^2 will be located at the main entrance; and • Clinic is to consist of 3 wards, an emergency treatment centre, an x-ray facility and dental facilities.
Mine mess	898 m^2	• Mine mess will provide employees with a meal prior to the commencement of their shift; and • Mess will consist of seating facilities for 200 people, an industrial kitchen and ablutions and washing facilities.
Change house	5 640 m^2	• Change house to accommodate 250 male and 80 female employees per shift; • Locker facilities for 1000 people, with 900 and 100 locker facilities for male and female employees, respectively; and • Laundry facility and change house (985 m^2).
SHE	534 m^2	• SHE Department with a floor space of 544 m^2 to be fitted with a 70 seating training room; and • PPE store with ablution facilities;
Mine stores	1 738 m^2	• Mine store with a floor space of 1738 m^2 to comprise of a sheeted secure building with industrial racking for items up to a weight of 200 kg; • Outside lay down area for heavier items; • Facilities for loading and off-loading trucks carrying containers up to 12 m; • Storage area for lubricants and FeSi; and • Ablutions facilities and dedicated office block.
Mine workshops	2397 m^2	• The workshop with a floor area of 2397 m^2 will consist of a machine shop section, 6 bays for heavy mining equipment, 4 bays for light duty vehicles and a separate building for tyre repairs and hydraulic pipe repairs; and • A wash bay for the cleaning of fleet.
Explosives store	905 m^2	• Explosive store will have earth walls around the perimeter and a Q-deck roof will be used; and • To be constructed to provide protection should an explosion occurs.

Infrastructure	Area	Description
		• Lightning protection will be provided
Incinerator house	80 m^2	• Incinerator house consisting of a brick building with a chimney through the roof will have a floor space of 80 m^2; and • General waste from the mine site will be incinerated.
Emulsion shed	1125 m^2	• Dedicated emulsion shed with an office block and plinths to support emulsion dispensing tanks.
Generator house	344 m^2	• Generator house with a floor space of 344 m^2 will allow for additional generators, as required.
Camp mess and kitchen	1371 m^2	• To be located at the foot of Monkey Hill; • Kitchen facility will cater for 120 seated people; • Ablution facilities, washing facilities and relaxation areas; and • Swimming pool and gym facilities.
Main camp	4315 m^2	• Accommodation for 84 personnel consisting of ablution facilities and single room bedding.
Security and fencing		• Central security control centre to supply 2 tier security monitoring; • Fencing of the entire concession area will be done consisting of a 3 m x 1 m gabion wall. The wall is to be electrified and have surveillance cameras installed; • The Koidu-Gandorhun Road which runs through the mining lease area will have to be diverted around the wall; • The store, workshops and buildings will be fenced off with standards perimeter fencing; and • The plant area will have double fencing around the perimeter.
Road and conveyor infrastructure	1 100 m	• Upgrade of approximately 5 km of road will take place of which 70% are existing roads; • Roads will typically be 12 m wide with drainage furrows on the side; • Surfacing of roads to be done with a mixture of aggregate and finer gravel material; • A mixed layer of 300 mm will be placed and compacted; • Conveyors of the modular gantry type will be restricted to the plant and tailings areas. Columns are to be supported on civil bases; and • Conveyor head pulleys will prevent spillage underneath the belts.
Power supply	-	• Power plant with an installed capacity of 9 MVA consisting of five prime mover low voltage generators; • Generator cooling will be forced ventilator radiator cooling; • Output voltage will be 400 V, stepped up to 11 kV; • Substation to be housed in a brick building with a steel sheeted roof; and

Infrastructure	Area	Description
		• Potential spillage of oil and lubricants will be bunded with a suitable drainage and pumping system.
Sewage treatment	-	• Three sewage collection networks to cater for accommodation units at Monkey Hill and plant area, respectively; • Each treatment plant will have adequate capacity to peak and average demands; • Treatment will take place via anaerobic and aerobic processes leading to minimum odour; • Clean treated water will be discharged to the environment through reed beds.
Waste disposal	-	• Waste will be stored at demarcated areas within the concession and collected on a fixed roster and transported to the incinerator; • Two incinerators will be installed; • One unit includes a mild steel chimney, oil burners and a control panel and is capable of burning 500 kg/hour of general waste with a plastic content of 5%; • One unit will be capable to dispose of 50 kg/hour waste with a plastic content of 15%; • Incinerators comprise features leading to smokeless operation and saving of valuable fuel.
Tailings	30 ha	• Tailings and grits will be stockpiled as a combined stream on one footprint; • A conveyor with spreader will be used to transport and deposit the material; • The tailings stockpile will have a maximum height of 50 m to elevation 420 mamsl. Total tonnes stored will be 11,317,500 tonnes; and • A total life of 14 years will be available
Slimes	37 ha	• The slimes facility will be a waste rock impoundment type facility with a maximum height of 20m to elevation 400 mamsl; • Life of the slimes dump facility is 14 years. • The waste rock containment wall will have a crest width of 10m and will be raised in 6m lifts. • A downstream method of wall development will be used. • Water from the slimes containment facility will be decanted via the penstock to a return water dam and then pumped to the plant via the return water line.
Road Diversion	±3 km	• Diversion of the Koidu-Gandorhun road to the southern border of the mining lease area. This diversion is required to ensure efficient access control to the Koidu Kimberlite mine.

2.3.3. *Open pit mining*

An open pit optimisation and practical design exercise was carried out on both K1 and K2 ore bodies. Both pipes will be mined by means of two interim cuts and concluded with a third and final cut. The final open pit at K1 will be 310 m deep and at K2 will be 240 m deep (Figure 2-1).

The open pit optimisation process was constrained by an underground operation resulting in the final pit depth of K1 being 80 m shallower than for a fully optimised open pit. This is due to the underground starting to contribute more than the open pit operation from a depth of about 310 m with the associated waste stripping ratio of +/- 17:1.

Open pit mining will be executed by Koidu Holdings with an owner operator approach. The final open pit plans are generally considered to be conservatively designed, with an aggressive execution schedule applied. Figure 2-1 illustrates the open pit high level schedule and results.

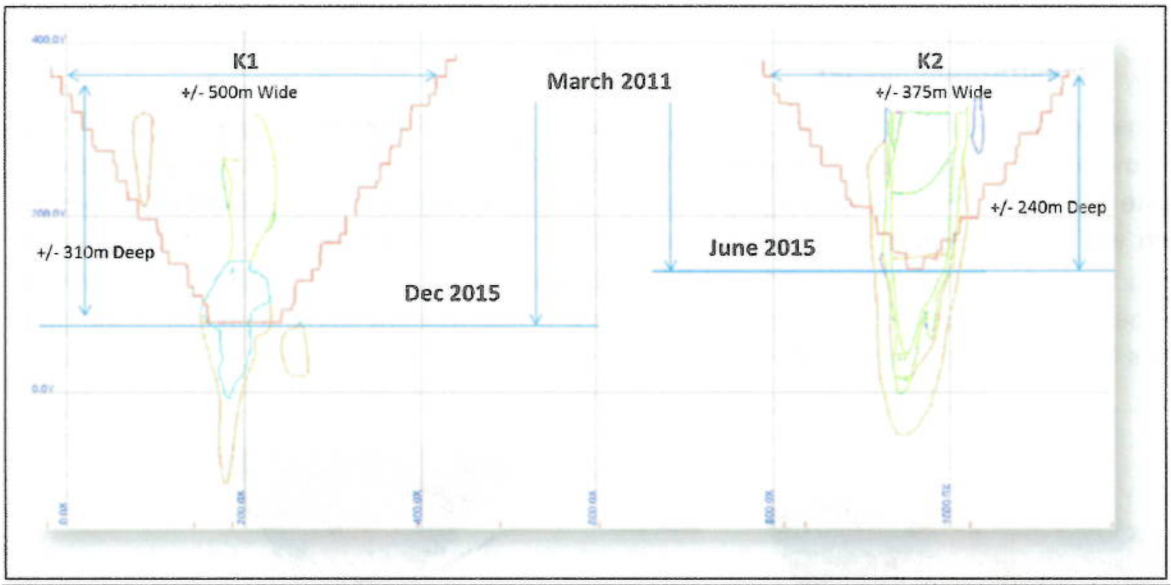


Figure 2-1: Open pit high level schedule and illustration

Table 2-4 summarises the open pit mining equipment fleet required.

Table 2-4: Open pit mining equipment

Open Pit Mining Equipment	2011	2012	Total Open Pit
Main Fleet			
Volvo – EC700B Excavators	5	1	6
Volvo – A40E ADT's	20	5	25
Volvo – L350F Wheel Loader	1	0	1
CAT – D9R Bull Dozer	2	0	2
Mercedes Benz – Water Bowzer (20kl)	2	0	2
Sandvik – DP1500 Drill Rigs	8	2	10
Support Fleet			

Mercedes Benz – Diesel Bowzer (8kl)	1	0	1
Mercedes Benz – Service Truck	1	0	1
Mercedes Benz – Charging Trucks	2	0	2
Flyght BIBO Pumps	2	0	2
LDV's	4	0	4
Volvo – SD160Dx Compactor	1	0	1
Slope Radar	0	1	1
Geomoss Survey Monitoring System	1	1	2

2.3.4. Underground mining

The main underground operation will be accessed through a single decline, protected by a "cut and covered" portal on surface (Figure 2-2). Dyke Zone B West will also be accessed through a decline developed from the existing open trench. Return air will be directed to return air passes which will also be equipped to serve as emergency outlets. Blast Hole Open Stoping is the mining method proposed for the K1 and K2 ore bodies, with no crown pillar left in-situ between the open pit and underground operations. Figure 2-2 illustrates the general lay-out of the open stopes beneath the K1 and K2 open pits.

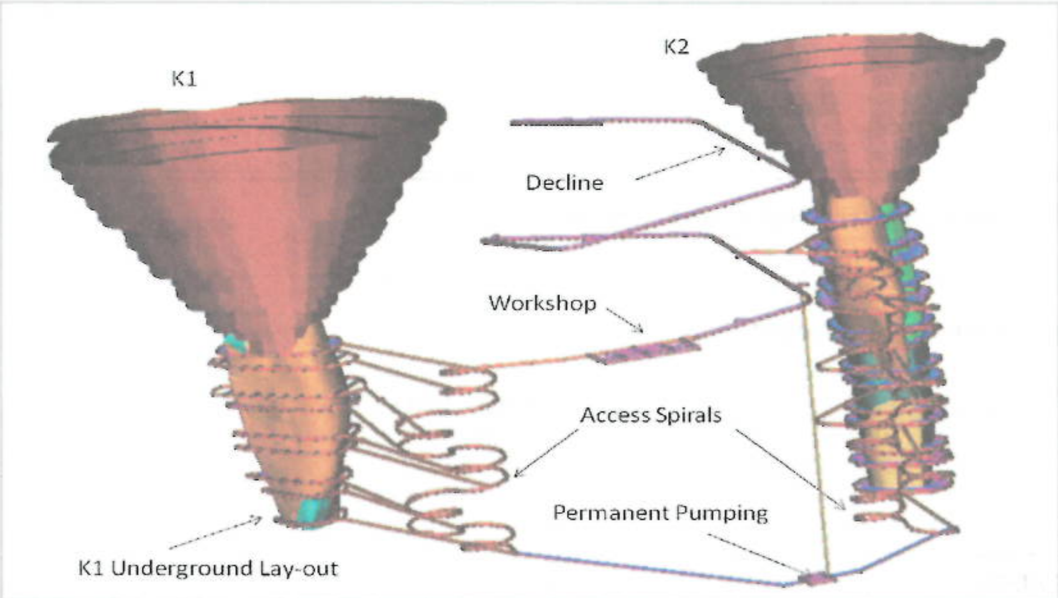


Figure 2-2: Decline layouts for K1 and K2 underground access

Mechanised Long Hole Stoping (non-entry) is the proposed mining method for the Dyke Zones, with a 30 m crown pillar left in-situ between surface and the first working levels of the dyke zones. The ore strike drives will be developed to the currently determined dyke limits, with production blasting then commencing targeting only the dyke zone portion between two consecutive drives (20 m vertically apart). The blasted material will be loaded by small load haul dumpers and dumped into a series of ore passes. These passes discharge on every fifth level, on which a haulage is also developed. The ore is then re-handled out of the passes into 20 tonne dump trucks and transported through a haulage, access spiral and decline ramp to the plant. Figure 2-3 illustrates the general lay-out of the mining infrastructure at a dyke zone mining operations. Figure 2-4 illustrates the high level underground development plan for the main ore bodies.

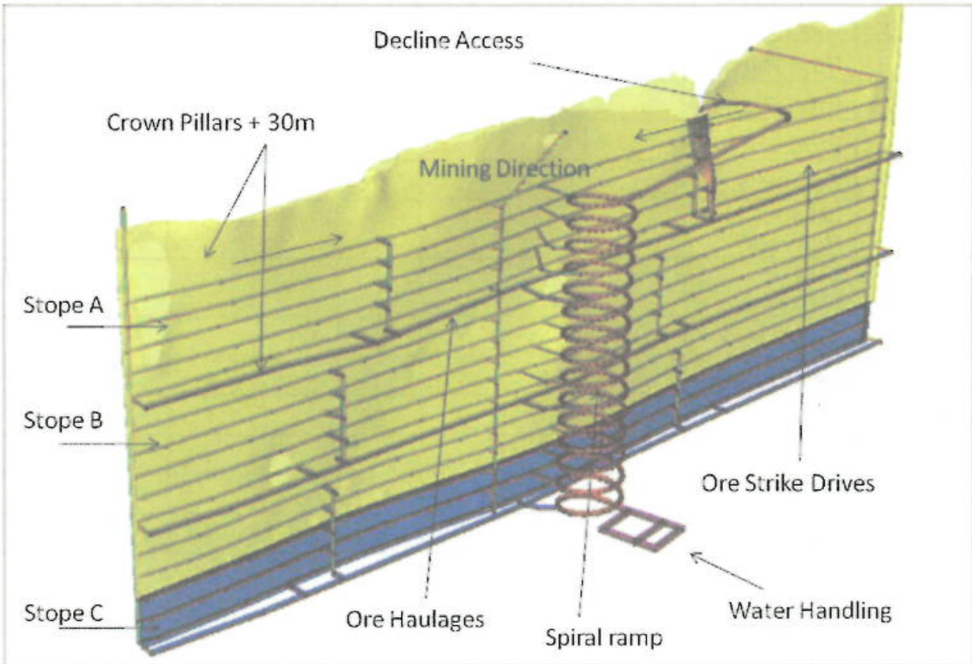


Figure 2-3: General layout of the mining infrastructure at a dyke zone mining operations.

Standard trackless diesel powered mobile equipment will be used in the underground operation. The fleet will consist of development rigs, long hole production drilling rigs, load haul dumpers, haul trucks and other utility type equipment. Table 2-5 summarises the underground mining equipment fleet purchase schedule.

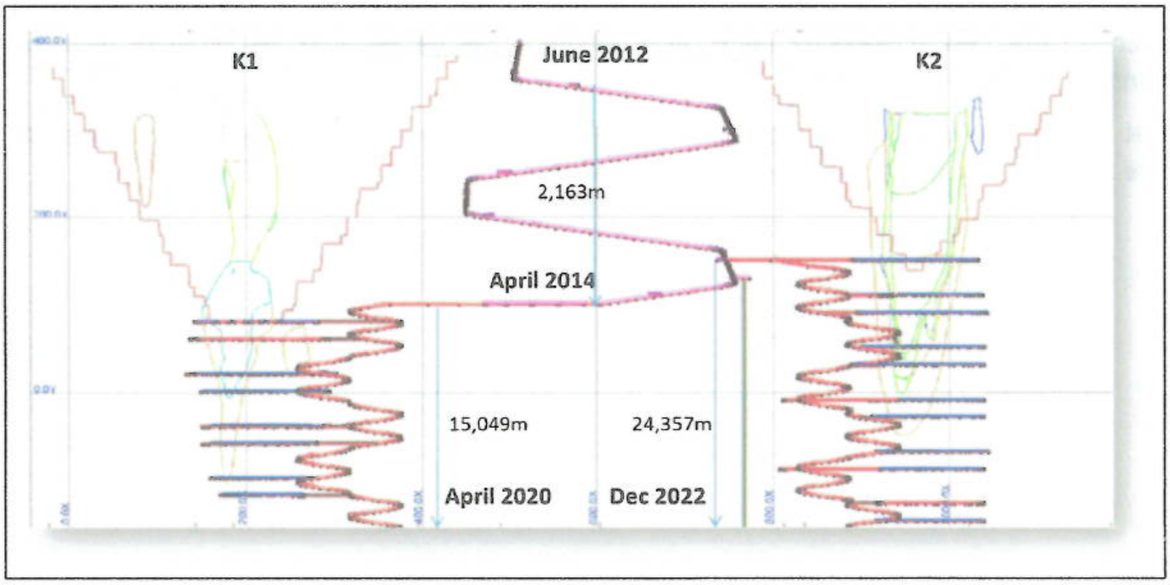


Figure 2-4: High level underground development plant for the main ore bodies.

Table 2-5: Underground mining equipment.

Underground Fleet Purchases	Description	2012	2013	2014	2015	2016	2017	2018	Total
Sandvik DD320 (2 X Boom)	Dev Rig	1		2					3
Sandvik DD210 (1 x Boom)	Dev Rig		1	1	1				3
Sandvik DL320-7 (89 mm)	Prod Rig				1	1			2
Sandvik DL210 (64 mm)	Prod Rig						1	1	2
Sandvik LH 307 (6.5T)	Prod LHD				2	2	2		6
Sandvik LH203 (3.5T)	Dev LHD	1	1	1	2		2		7
Sandvik LH301 + Hammer	LHD + Hammer				1				1
Sandvik LH203 + Hammer	LHD + Hammer						1		1
Sandvik 30SX (30 T)	Prod Truck				2	3			5
Sandvik TH320 (20t)	Dev Truck	2	1	1	1		1		6
Sandvik TH205L (Casette)	Utility	1		2	2		1		6
Sandvik TH205L (S/Lift)	Utility		1		3	2		1	7
Sandvik TH205L (Blast)	Blasting		1		2	2		1	6
Toyota Land Cruiser	Utility		1		3	1	2	1	8

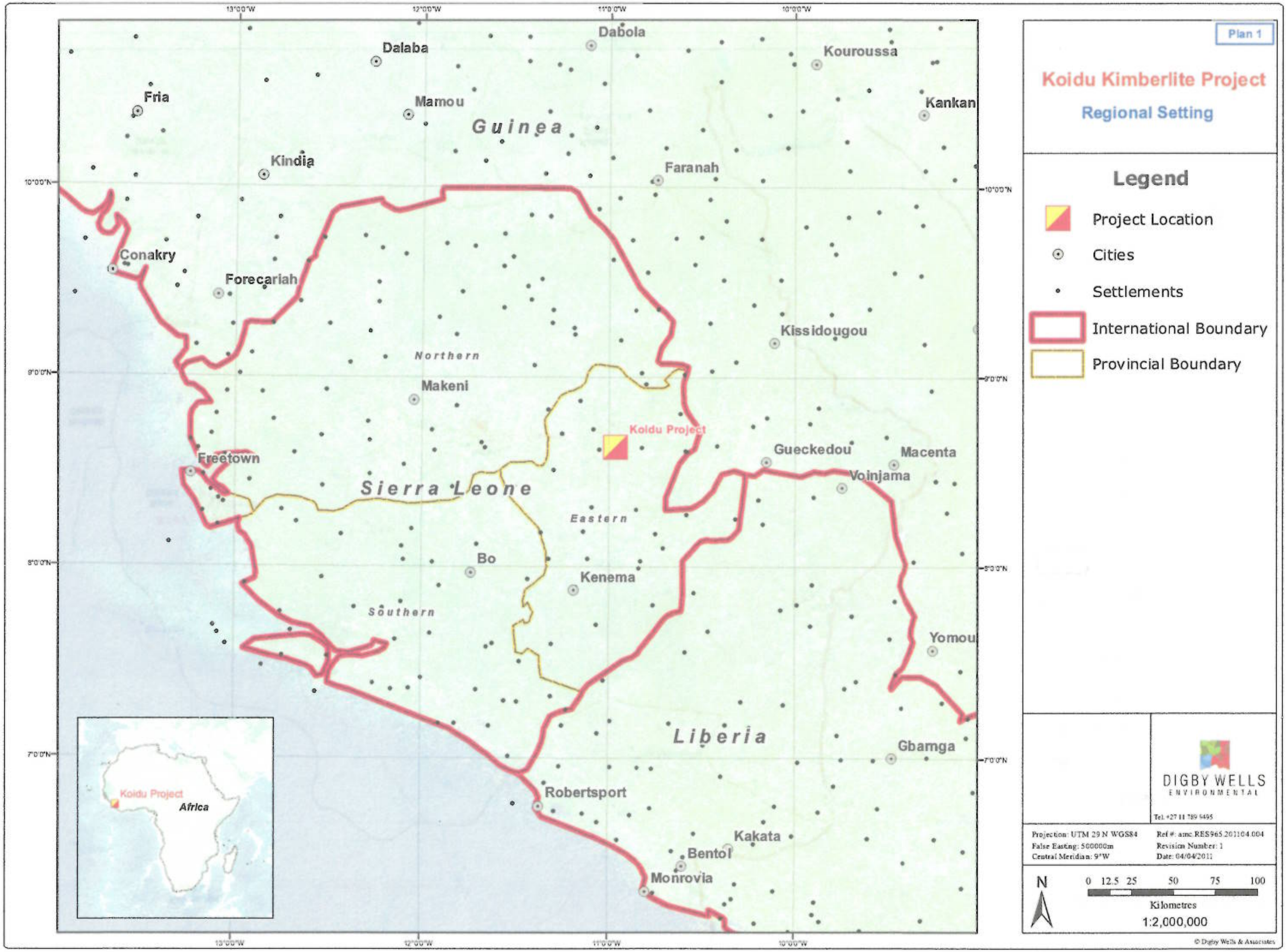
2.3.4.1 Waste rock management

All hard rock will be drilled by a fleet of hydraulic self-propelled drill rigs and then blasted using bulk emulsion explosives. The blasted material will be excavated by a fleet of excavators and hauled to surface by a fleet of articulated dump trucks. The waste material will be loaded and hauled to designated waste rock dumps in close proximity to the pits.

2.3.4.2 Ore handling

All the ore material will be loaded, hauled and tipped into the primary crusher at the processing plant. Excess ore production will be stockpiled for limited periods on designated stockpiles adjacent to the new processing plant, from where it will be fed into the process plant on demand.

A fleet of utility vehicles including dozers, graders and re-fuelling trucks will be deployed to ensure sufficient support to the main production fleet.



Plan 1
Koidu Kimberlite Project
Regional Setting
Legend
Project Location
Cities
Settlements
International Boundary
Provincial Boundary
Guinea
Sierra Leone
Liberia
Northern
Eastern
Southern
Koidu Project
Africa
Dabola
Dalaba
Kouroussa
Fria
Mamou
Kankan
Kindia
Faranah
Conakry
Forecariah
Kissidougou
Makeni
Freetown
Gueckedou
Macenta
Voinjama
Bo
Kenema
Yomou
Gbarnga
Robertsport
Kakata
Bentol
Monrovia
13°0'0"W
12°0'0"W
11°0'0"W
10°0'0"W
10°0'0"N
9°0'0"N
8°0'0"N
7°0'0"N
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Tel. +27 11 789 9495
Projection: UTM 29 N WGS84
False Easting: 500000m
Central Meridian: 9°W
Ref #: amc.RES965.201104.004
Revision Number: 1
Date: 04/04/2011
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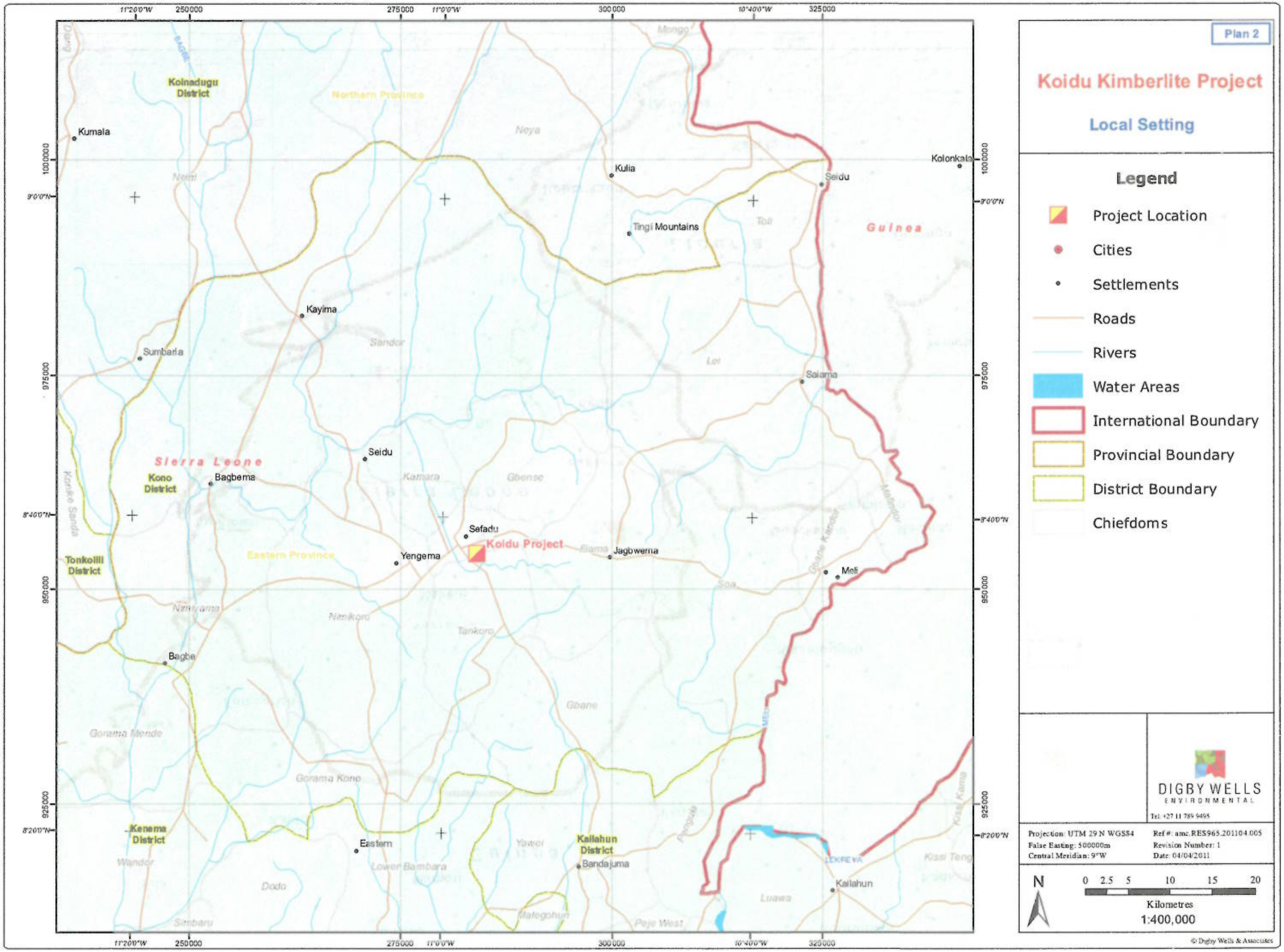
Plan 2
Koidu Kimberlite Project
Local Setting
Legend
Project Location
Cities
Settlements
Roads
Rivers
Water Areas
International Boundary
Provincial Boundary
District Boundary
Chiefdoms
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Projection: UTM 29 N WGS84
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Revision Number: 1
Date: 04/04/2011
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Kilometres
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Koidu Project
Guinea
Sierra Leone
Northern Province
Eastern Province
Koinadugu District
Kono District
Tonkolili District
Kenema District
Kailahun District
Kumala
Kulia
Kolonkala
Seidu
Tingi Mountains
Kayima
Sumbaria
Salama
Seidu
Bagbema
Sefadu
Yengema
Jagbwema
Meli
Bagbe
Eastern
Bandajuma
Kailahun
Neya
Sandor
Lei
Toli
Kamara
Gbense
Nimikoro
Tankoro
Gbane
Soa
Gorama Mende
Gorama Kono
Nimiyama
Yawei
Lower Bambara
Dodo
Wandor
Simbaru
Malegohun
Peje West
Luawa
Kissi Teng
Kissi Kama
Mafindor
Gbane Kandor
Penguia
Konike Sanda
Diang
Mongo
Nimi
Fiama
LEKREVA
MELI
BAGBE
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11°0'0"W
10°40'0"W
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950000
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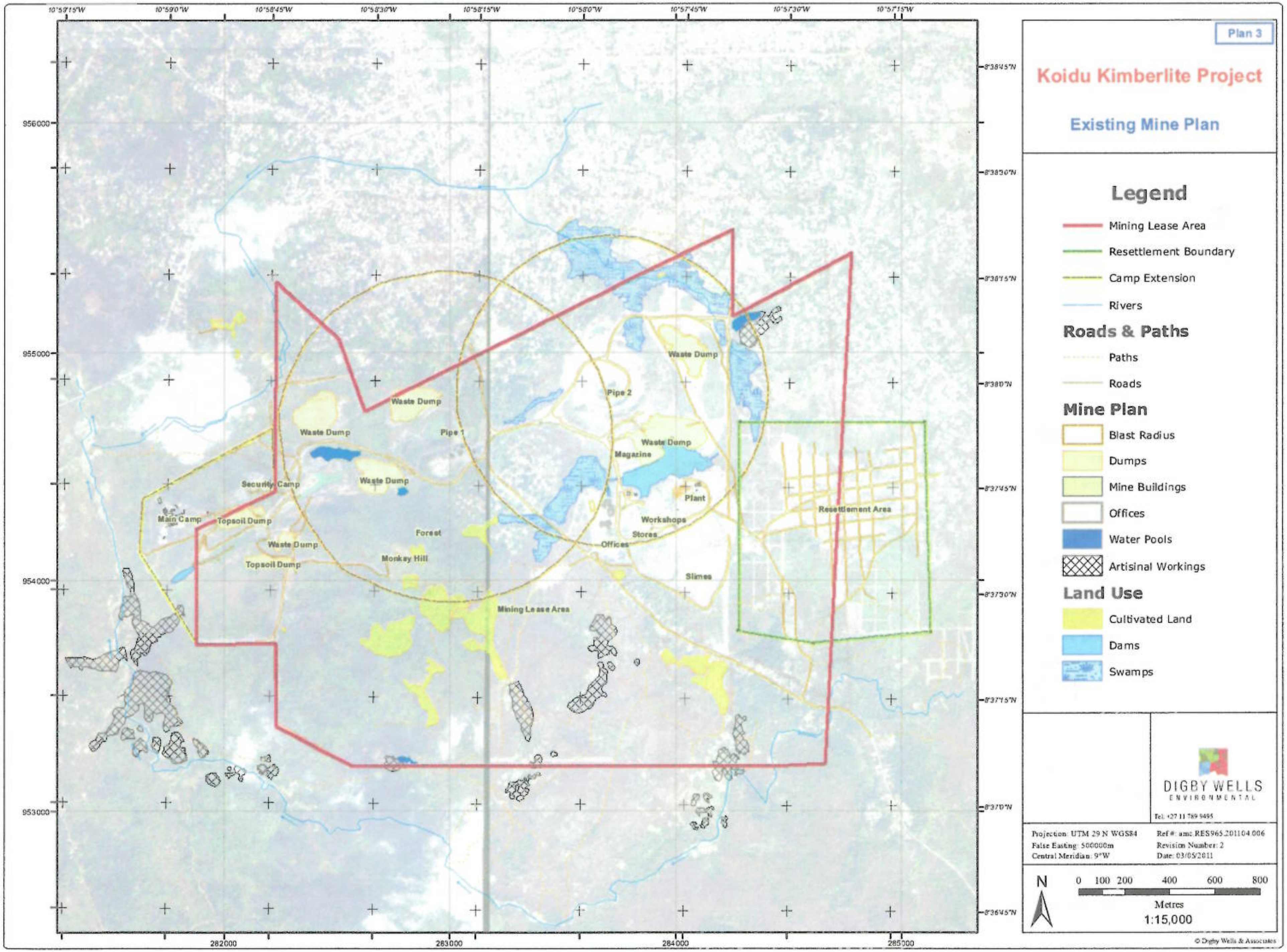

Plan 3
Koidu Kimberlite Project
Existing Mine Plan
Legend
Mining Lease Area
Resettlement Boundary
Camp Extension
Rivers
Roads & Paths
Paths
Roads
Mine Plan
Blast Radius
Dumps
Mine Buildings
Offices
Water Pools
Artisinal Workings
Land Use
Cultivated Land
Dams
Swamps
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Central Meridian: 9°W
Ref #: amc.RES965.201104.006
Revision Number: 2
Date: 03/05/2011
N
0 100 200 400 600 800
Metres
1:15,000
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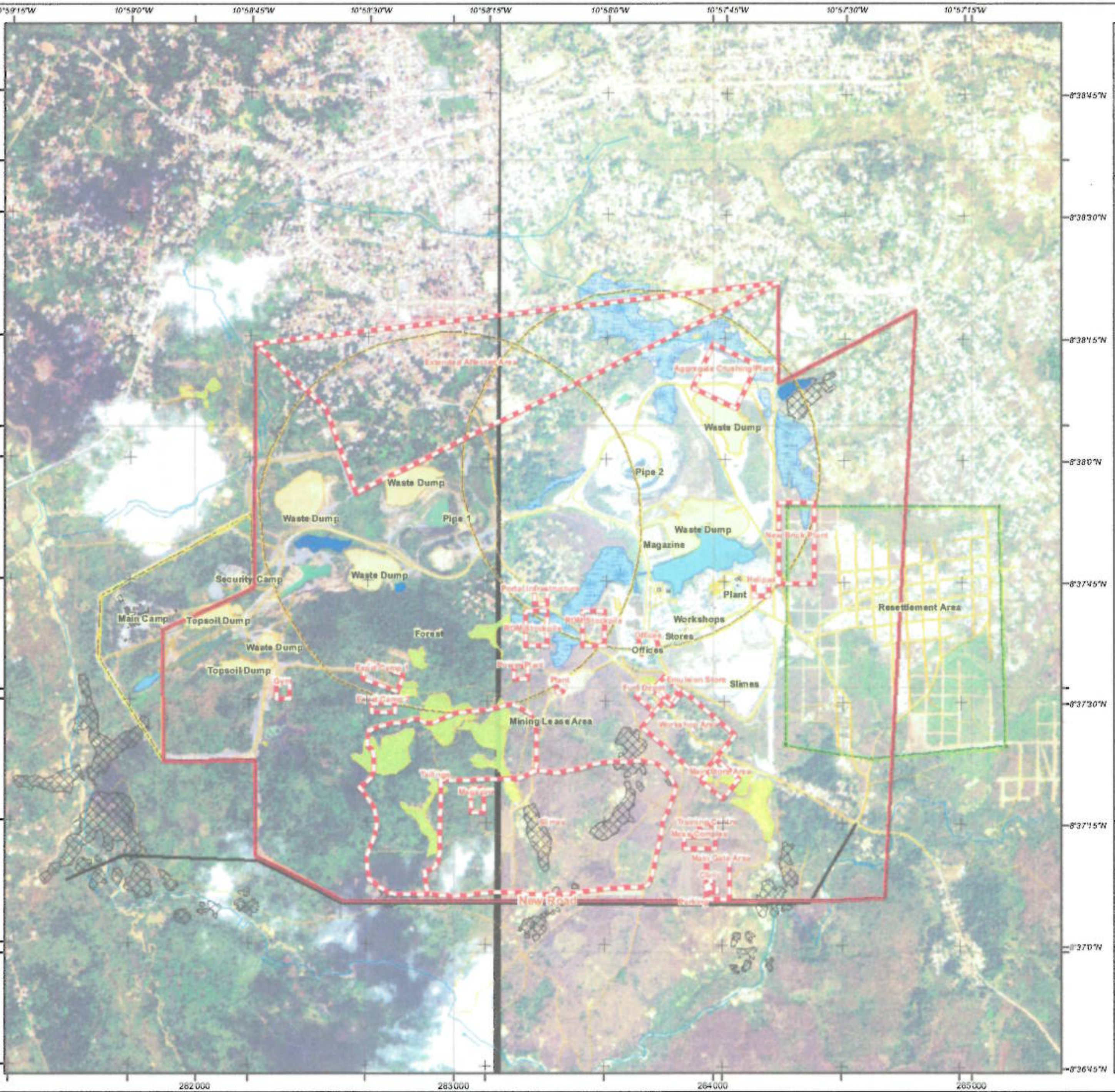
Waste Dump
Pipe 1
Pipe 2
Magazine
Plant
Workshops
Stores
Offices
Slimes
Security Camp
Main Camp
Topsoil Dump
Forest
Monkey Hill
Mining Lease Area
Resettlement Area
282000
283000
284000
285000
953000
954000
955000
956000



Plan 4

Koidu Kimberlite Project

Proposed Mine Plan

Legend

- New Road
- Paths
- Roads
- Proposed Additional Infrastructure
- Mining Lease Area
- Resettlement Boundary
- Camp Extension
- Rivers

Mine Plan

- Blast Radius
- Dumps
- Mine Buildings
- Offices
- Water Pools
- Artisinal Workings

Land Use

- Cultivated Land
- Dams
- Swamps

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Central Meridian: 9°W

Ref #: amc.RES965.201104.007
Revision Number: 3
Date: 03/05/2011

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2.3.5. *Waste management*

2.3.5.1 *Domestic waste*

No hazardous waste is generated during operations and all domestic waste that is generated will be collected and disposed of by use of the incinerators.

2.3.5.2 *Tailings and slimes management*

Once the diamonds have been recovered from the Kimberlite, there are two waste streams that come from the plant that need to be disposed. There is a -0.5 mm slimes portion and a -28+0.5 mm tailings portion.

The -0.5mm slimes is pumped into a slimes dump. This dump is an impoundment type dam that has walls constructed out of waste material from the pit. The tailings are disposed of via several deposition points into the tailings storage facility (TSF). The TSF is equipped with a penstock-this is used to recover water from the dam, and is equipped with trenches to catch any water that leaks out of the dam. All water recovered from the dam will be channelled into a return water dam. From the return water dam, the water will be pumped into the processing plant for re-use.

The tailings will be transported by a conveyor belt to the tailings deposition dump. A tripper and spreader arrangement will be used on the dump to deposit the tailings in a heap. The tailings will be deposited such that it is a maximum of 50 m from the ground level. Additional conveyor segments will be constructed to ensure that the deposition can take place.

2.3.6. *Storm water management*

Storm water will be pumped out from the open pits by means of electrical submersible pumps powered by diesel-driven generators. Adequate water storage and pumping capacity will be provided for the underground workings in order to ensure a safe underground working environment.

2.3.7. *Water supply to local community*

Several dewatering boreholes were drilled in 2007 around the perimeter of K1 and pumps were introduced into these boreholes in an effort to control water influx into the vertical pit. The discharge from these pumps was directed away from K1 into a drainage system that would carry the water into the stream flowing into the Meya River. The 7.5 kW pumps were approximately 90 m deep and had a water delivery capacity of 8 000 L per hour. The discharge of one of the pumps was located near to where the local community could benefit from the use of the water.

A borehole was drilled in 2008 in the planned resettlement area and is equipped with a diesel engine driven mono-pump installed to a depth of 73 m, with a water delivery capacity of 18 000 L per hour. A system of water tanks has now been erected at strategic points to supply water to the community in the area, water samples were taken from this water source, and was deemed fit for human consumption by the Sierra Leone Water Company (SALWACO).

Installation of a water reticulation system which will benefit the resettlement community is currently in progress. Four large water tanks, each with a capacity of 30 000 L, have been erected on at the highest point in the resettlement area, a water reticulation pipe system has been installed to provide every four houses with a water outlet point. The current delivery capacity is approximately 400 000 L per day.

2.4. Mineral processing

The following section details the mineral processing to be followed.

2.4.1. Ore receiving

The ore will be tipped into a receiving bin which is fitted with a 600 mm square aperture static grizzly. Any oversize material that has not passed through the 600 mm opening will be either broken using a static rockbreaker or hydraulically lifted and removed.

The material that passes through the 600 mm static grizzly will be drawn out of bin using an apron feeder and discharged onto a vibrating grizzly feeder. The vibrating grizzly feeder has a setting of around 120 mm and any material that does not pass through the opening is discharged into a primary jaw crusher. The jaw crusher has an open-side setting of around 90 mm and delivers a discharge product of around 150 mm.

Both the jaw crusher product and the vibrating grizzly undersize discharge onto the primary feed conveyor. The primary feed conveyor discharges into a 2.4 x 6.0 m roller supported scrubber. The scrubber has been included in the circuit to allow for flexibility in material processing, should the characteristics of the material from the pit change. Although the plant should be treating very competent Kimberlite, there is still the possibility that the plant will be fed with material that contains clay. The scrubber is able to process the material and remove the clay.

2.4.2. Primary sizing, secondary crushing and coarse DMS

The scrubber discharges onto the 1 830 mm x 3 600 mm primary sizing screen. The primary sizing screen is a double deck fitted with 28 and 1.2 mm panels. The >28 mm material is then feed to the secondary crushing section. The 1.2 to 28 mm fractions are classified as fines and the <1.2 mm as slimes.

The >28 mm material discharges onto the secondary screen feed conveyor. The secondary screen is a double deck 2 100 mm x 4 200 mm screen fitted with 55 mm and 28 mm panels. The >55 mm material is conveyed to the secondary crusher surge bin. This conveyor is fitted with a weightometer for accounting purposes. The material is drawn out of the surge bin with a 750 mm x 1 500 mm vibrating pan feeder into a Sandvik CH440EC secondary cone crusher. The cone crusher product is discharged onto a conveyor and is re-circulated back to the secondary screen.

The 28 to 55 mm fractions report to the 150 tph coarse DMS feed conveyor. This conveyor is fitted with a weightometer for accounting purposes. The coarse DMS has been designed with a large diameter 800 mm DMS cyclone to handle the bigger size fractions delivered to it.

Due to the fact that there is a good chance of a large diameter diamond being present in the feed, it is important that the possible recovery of this diamond is maximised before the material goes to secondary crushing.

The coarse DMS can handle a high tonnage throughput. The size fraction being fed into the coarse DMS has been set at around 55 mm. This allows utilisation of the DMS to its capacity and reduction of the DMS requirements downstream. The coarse DMS is fitted with a 2 440 mm x 4 270 mm floats screen. Once the material has passed through the DMS, the floats portion is conveyed to the secondary crusher.

The sinks from the coarse DMS is conveyed using a specialised and secure pipe conveyor to the final recovery building.

2.4.3. Fines Dense Media Separation (DMS) and re-crusher

The <28 mm material from the primary and secondary screens is conveyed to the fines 260 t DMS surge bins. The fines DMS surge bins discharge onto the DMS feed conveyors using two 750 mm x 1 500 mm variable speed vibrating pan feeders. The pan feeders are connected to a weightometer which regulates the feed to the DMS.

The fines DMS modules are configured as 130 tph DMS utilising two 510 cyclones each. The DMS has a double deck floats screen with an 8 mm aperture. The >8 mm material is conveyed to the re-crush 2 500 t stockpile. The re-crush stockpile conveyor is fitted with a weightometer for accounting purposes.

The re-crusher feed is drawn out from underneath the stockpile using two 750 mm x 1500 mm variable speed vibrating pan feeders and will discharge into the tertiary crusher feed conveyor. The conveyor will feed two Sandvik CH440F tertiary cone crushers. The cone crushers will be wet flushed (if required) to assist in the crushing process and will discharge directly onto the re-crusher sizing screen.

The re-crusher sizing screen is a 2 440 mm x 4 200 mm double deck screen fitted with an 8 and 1.2 mm aperture. The >8 mm material is transported back to the re-crusher stockpile. The <8 mm is conveyed back the fines DMS surge bin and the <1.2 mm material reports to the water recovery section.

The <8 mm material from the fines DMS is conveyed to a camel back movable stacker conveyor that will deposit the tailings onto the tailings dump. The sinks material from the fines DMS is jet pumped to the final recovery

2.4.4. Final recovery

The concentrate from the fines DMS jet pump is received into a concentrate holding bin. The concentrates are drawn out of the holding bin into the attrition scrubber. The 1 m x 3.5 m attrition scrubber has been designed for a 12 minute retention time to give adequate scrubbing. The material is then jet pumped up to the 1 220 mm x 2 440 mm primary de-watering screen. The primary de-watering screen is fitted with 1.2 mm^2 polyurethane panels and is inclined at 5° to facilitate maximum drainage.

The oversize from the de-watering screen discharges onto the 610 mm x 4 270 mm x-ray sizing screen. Here the material is sized into 16 to 28 mm; 8 to 16 mm; 4 to 8 mm; 2 to 4mm and 1.2 to 2 mm fractions. These fractions are stored in the 1 m^3 x-ray surge hoppers under the screen.

The undersize from the de-watering screens drains to a splitter box. The splitter box operates as a decanting device which allows for the separation of the fine material and water. The fines material separated in the splitter is diverted to the final tailings screen. The water from the splitter is then diverted back to the jet pump motive sump for re-use.

The 28 to 55 mm material is delivered to a 15 t surge bin from where it is drawn out and sorted through a single pass, wet x-ray sorter. All other size fractions are fed through double stage wet x-ray sorters.

The rejects from the x-ray sorters that are larger than 8 mm report to the recrush section for further crushing and diamond recovery. All -8mm rejects is stockpiled in the recovery yard on a tailings stockpile.

The concentrate from the ultrafine x-ray sorters is discharged into a tube feeder and the concentrate from the x-ray sorters treating the fines, middlings and coarse fractions is discharged into another tube feeder. Both tube feeders discharge into the concentrates bin ahead of the dryer.

All effluent from the other operations in the recovery plant, namely x-ray effluent and dewatering screen effluent, report to the final tailings pump. The final tailings pump delivers the effluent to the thickening section of the plant.

All concentrates are then fed through the Infrared dryer. This dryer is a rotary belt dryer utilising both low frequency infra-red drying and hot air blowers to dry the concentrate. Once dried, the concentrates are discharged onto the sort house gloveboxes.

All glove box pickings are sent from the glove boxes to the accounting glove box. Here the diamonds are weighed and sized. A drop safe is attached to the accounting glove box to facilitate direct deposit of packaged diamonds. All pickers' rejects are conveyed out of the sort house and onto the recovery tailings conveyor which will exit the side of the recovery building and discharge onto the recovery tailings stockpile conveyor.

2.4.5. Water recovery circuit and process water

All <1.2 mm material from the primary screen, secondary screen, re-crusher screen and both DMS plants will be pumped to a degrit plant. From the degrit plant, the slurry is separated into a +0.5 and a -0.5mm fraction via a cyclone. The +0.5mm fraction reports to the tailings conveyor for disposal while the -0.5mm fraction is sent to the thickener. The thickener is a high rate type thickener as currently used on the Koidu site.

The slimes being pumped to the thickener will receive flocculent addition from an automated flocculent make-up and dosing plant. Thickener underflow will be pumped to the slimes dam at a distance of 400 m using steel and high pressure high-density polyethylene (HDPE) piping. Clear water overflow from the thickener will be collected in process water dam situated next to the thickener. The process water dam will have the plant process water pump connected to it.

Make up water from the river water pump at a distance of 2 000 m will supply any short fall of water required due to the loss of water through slimes pumped to the slimes dump. Slimes dump return water will also be returned to the process water dam through a penstock ring and overflow dam with pumps which have been provided.

2.5. Employment opportunities

During the construction of the infrastructure and plant 200 local employment opportunities will be created. Post construction, in excess of 1000 employment opportunities (skilled, semi-skilled, unskilled) will be created. The total national staff complement at full operation is indicated in Table 2-6.

Table 2-6: Total national staff complement at full operation of the Project

Nationals	No of Staff
Strategic Management	1
Freetown Office	14
Mine Management	36
Mining Department	563
Metallurgy Department	167
Engineering Department	144
Support Functions	261
Security Department	2
Total	**1 188**

2.6. Project timing

The proposed expansion project schedule commences in October 2010 as indicated in Table 2-7, with the ordering of the new plant and other long lead time items, such as earth moving equipment. Construction of plant and infrastructure will commence in January 2011, to ensure all civil engineering work is completed by the time the plant and equipment arrive on site.

The mine will continue producing with the existing 50 tph plant until the new plant is erected, commissioned and has ramped up to full production, after which the existing plant will be dismantled and relocated to the Tongo Diamond Field Project south of Koidu.

The five year open pit mining phase of the operation will be followed by underground mining of kimberlite pipes, as well as the dyke zones and blows, for the remainder of the life of the mine. Construction of the underground access will commence with first ore being extracted from the underground in 2015.

Table 2-7: Proposed timing, duration and sequence of the project

Project implementation	Expected commencement date	Expected duration
Ordering of equipment	Quarter 4 of 2010	3 months
Construction of plant	Quarter 1 of 2011	12 months
Construction of underground access	Quarter 1 of 2012	24 months
UG Infrastructure Development	Quarter 4 of 2013	9 months

2.7. Project activities

The project activities have been categorised into three project phases, namely the construction, operational and decommissioning, closure and post-closure phases.

2.7.1. Construction phase

The following activities will be conducted during construction of the Koidu Kimberlite Project expansion:

2.7.1.1 Preparation for mining

During the project construction phase, the mining operations will be executing the open pit mining plans for both the K1 and K2 pits. Preparing for open pit mining will consist of the following activities:

- Procurement of new earth moving fleet;
- Recruitment and training of new employees to man the expanded fleet;
- Mining and material dumping area preparation; and
- Establishment of dewatering infrastructure.

2.7.1.2 Site clearance

This project is expanding a current brownfields operation and the site clearance for mining areas will consist only of dozing and levelling of areas that will fall within the mining push-back zone and the waste-dumps' expansion foot print. There are plans for the topsoil to be stockpiled separately for future use.

The construction areas will also be cleared and levelled by means of dozers and other earth moving equipment. Attempts will be made to preserve indigenous fauna as far as practically possible.

2.7.1.3 Sourcing of construction materials

Concrete and building aggregates will be sourced locally. Sand will be made available from existing borrow pits. Stone will be produced by crushing waste rock from the mining operation, thus alleviating the amount of unusable material being generated during mining.

Cement will be procured locally. Bricks will be manufactured locally with sand from the borrowing area. All other materials of construction will be sourced from South Africa and Europe and imported to site.

2.7.1.4 Disturbances to natural water courses

Wherever the installation of a new facility interferes with a natural water course, the course will be replaced and re-routed by a suitable furrow or canal or be linked to the drainage network and be joined up with the natural course downstream.

In the instance of a road crossing a natural water course, a practical and suitable culvert will be installed to allow normal continuation of the water. Silt traps will collect the majority of silt from the drainage networks before it deposits its water back into natural courses.

Velocity breakers by means of a sudden drop in canal floor depth and width will also be utilised to minimise the force with which the drainage network deposits water into the natural courses.

2.7.1.5 Construction of new infrastructure

The infrastructure to be constructed are listed and described in Table 2-3.

2.7.1.6 *Diversion of the Koidu-Gandorhun road*

Diversion of the Koidu-Gandorhun road to the southern border of the mining lease area is required to ensure efficient access control and security to the Koidu Kimberlite Mine. The total length of the road diversion route is approximately ± 3km.

2.7.1.7 *Resettlement*

Resettlement under the 2003 RAP is on-going. Households located between the 250 and 500 meter blasting envelope (the Extended Affected Area) will be resettled during the construction phase following the completion of the RAP for this area.

2.7.2. *Operational phase*

During the operational phase, the activities described below will take place. Mining and processing will be done according to existing practices as described in Section 2.4.

2.7.2.1 *Access to resource*

During the open pit operations, the resource will be accessed by means of a spiral ramp developed as part of the mining operations. This 20 m wide ramp will be developed at a gradient of 10% and the road surface compacted and graded to ensure a smooth and safe running surface for the mining trucks.

The underground resources will be accessed through an access decline tunnel. This 5 m x 5 m tunnel will be developed at a gradient of 14% and will be protected on surface by means of a portal. Once the decline tunnel reaches the ore horizon levels in the ore bodies, access to it changes to access spirals in close proximity to the ore bodies.

2.7.2.2 *Fuel and chemicals storage and use*

A dedicated cordoned off area for refuelling will be constructed. The area will consist of a 55 000 L tank into which diesel will be received. It will be transferred via a filtration plant into ten separate 55 000 L diesel storage tanks. It will then go via another filter plant prior to the diesel being dispensed for refuelling.

These storage tanks will be stationed within a bunded concrete area, which will be capable of containing 110% of diesel in the tanks, should some catastrophic failure cause a complete spill.

There will be three double fuelling stations, of which two will service big machinery and one bay will service light vehicles. The area will have a dedicated lab for quality control of the incoming and outgoing diesel. The area will also include an emergency fire suppression area.

Chemicals will be stored in demarcated areas, which will be controlled, in the main store facility. Should there be any requirements to treat a spill of any of these chemicals the store area will ensure that correct requirements are in place.

Emulsion for blasting (non explosive until pumped into the blast hole) will be manufactured on site and stored in dedicated silos at the emulsion manufacturing facility. Blasting Accessories which are considered high explosives, will be stored in dedicated explosives storage areas, with the area securely fenced-off and accessed controlled.

2.7.2.3 *Transport and roads*

All equipment, supplies and material will be transported in by truck or car via road. Access on site is by means of 12 m wide graded dirt roads. These roads are maintained periodically by the mine. New access roads will be established as per the general site lay-out plan.

Mine haul roads are constructed for the exclusive use of mining equipment. These haul roads link the pits to the waste rock dumps and/or the ore process plant. These roads are maintained by the mining department and dust allayed by means of periodical sprinkling with a water bowser.

2.7.2.4 Water requirements and supply

Process plant

The 180 tph processing plant will require a total of 610 m^3 water per hour. Of this requirement, 550 m^3/hr will be re-used from the return water from the thickening system that will be installed with the plant. The remaining make-up water will be pumped from the main storage dam that is situated approximately 1.5 km from the plant at the foot of Monkey Hill.

As the TSF is built up and brought into operation there will be a return water supply from the TSF which will then reduce the quantity of water required from the main dam. The total water requirements for the proposed expansion are summarised in Table 2-8.

Table 2-8: Total process water requirements for the project

Water use	Quantity
Plant process water	778 m^3/hr
Process water treated and re-circulated	700 m^3/hr
Process water required from water storage dam	78 m^3/hr

Potable water

Raw water will be pumped from a local borehole to a temporary storage tank of approximately 100 000 L capacity. Thereafter the water will go through a treatment plant into another 100 000L surge tank, prior to being pumped into a storage tank of approximately 250 000L which will be situated on Monkey Hill.

Surface water drainage

Rainfall will be collected via a gutter system and channelled to intermediate V-shaped drainage canals. As these join together and the volumes of water increase, these canals will be replaced by U-shaped canals, channelling water towards natural water courses.

Silt traps will be allocated to these waterways, whereby a method of slowing the water speed in certain areas will be used to settle fines and gravel out of the water. This material will be deposited in suitable areas that need to be backfilled.

Water storage

Water pumped from the main dam will be stored in the plant's 300 m^3 process water dam for use within the plant. The process water tank is of a galvanised sectional design and is erected on site during the construction phase. Treated water will be stored in 2 x 50 000 L closed reservoirs and a 10 000 L water tower.

Process water and treatment facility

The process water from the main treatment plant circulates at volumes of 778 m^3/hr. All process water used by the plant will be pumped to a high-rate thickening system. With the aid of flocculent addition, the solid particles will be settled out and pumped to the slimes dump. The clear water overflow from the thickener is transferred to the process water dam for re-use.

The slimes will be pumped to the slimes dump at a rate of 10 to 15 tph and will consist of -0.5 mm solids with an SG of 1.2 to 1.35. The slimes dump will be fitted with penstock rings to allow water return from the slimes dump. This return water will be channelled to a return water dam located next to the slimes dump from where it will be pumped back to the process water dam in the plant for re-use.

2.7.3. Decommissioning, closure and post-closure phases

The majority of the area disturbed during the operation of the mine will be restored to a land capability as close as possible to that practiced before operations commenced. For reasons of safety, and in order to protect certain rehabilitation works from damage, portions of the mine area may, however, be designated as areas not available for farming. Access to such areas by humans and/or livestock will be discouraged until such time as they are deemed safe and the rehabilitation has been stabilised. The protected areas will predominantly apply to the areas of ongoing rehabilitation during the LoM. After closure, flooding of open pits will occur. The pits can be used for water storage and fish farming.

In terms of closure cost assessment, it is assumed that all infrastructure will be removed and the area will be stabilised and revegetated. A framework closure plan forms part of the ESIA and a detailed closure plan will be developed closer to the time of closure.

3. REGULATORY AND ADMINISTRATIVE FRAMEWORK

The legislative and administrative framework in respect of environmental and social management of mining projects in Sierra Leone has changed significantly in the past few years. The following section presents a brief history of environmental and mining policy development in the country, with specific reference to the Koidu Kimberlite Project.

3.1. Policy development

A Core Minerals Policy (CMP) was developed in 2003, with the aim of providing an enabling and investor-friendly environment for the sustainable development of Sierra Leone's mineral resources. The objective of the policy was to facilitate foreign and domestic investment in the minerals sector, to provide economic benefits to the people, and to ensure protection of the environment.

In line with this policy, specific reforms have been undertaken by government through the World Bank and DFID in the areas of fiscal, legal and regulatory frameworks as well as institutional capacity strengthening through the formulation of a National Minerals Agency transformation plan leading to the enactment of a law to govern the administration of the institution. The CMP was updated in 2009, but has not yet been published.

The Creating an Enabling Policy Environment in Sierra Leone (CEPESL) Project was designed by USAID to support the Government of Sierra Leone in developing an enabling environment for improved natural resources management. The project team commenced in 2009 with information gathering and analysed information on the existing policy, legal, and regulatory frameworks for forestry, conservation, mining and agriculture and consulted extensively with stakeholders from the Government of Sierra Leone and civil society to identify priority reform needs. The Forestry, Mining and Agricultural sectors required law reform measures and the following policies and laws were identified as priority:

- Forestry Policy;
- Wildlife Policy;
- Artisanal Mining Policy;
- Forestry Act;
- Wildlife Act;
- Companies Act;
- Cooperatives Act; and
- Regulations relating to the Forestry, Mining and Agriculture sectors.

In January 2010, two draft policies were completed, namely the *Forestry Policy* and *Wildlife Conservation Policy*. The process of developing the first draft of the *Artisanal and Small-Scale Mining Policy* was also underway.

Once the draft policies are finalised CEPESL will immediately begin working with the Law Reform Commission to draft the associated laws and regulations.

3.2. Legislative reform

Of particular importance to the ESIA process, are the recently promulgated Environmental Protection Agency Act, 2008 (Act 11 of 2008) and the Mines and Minerals Act, 2009 (Act 12 of 2009). However, all relevant Acts and Regulations were considered in order to guide the environmental and social studies and to ensure the projects overall compliance with national legislative provisions. The following National Acts are therefore relevant to the Koidu Kimberlite Project:

- The Constitution of Sierra Leone (Act No. 6 of 1991
- Environmental Protection Agency Act, 2008 (Act 11 of 2008);
- Mines and Minerals Act, 2009 (Act 12 of 2009);
- Forestry Act, 1988; and
- Forestry Regulations, 1989.

3.2.1. The Constitution of Sierra Leone (Act No. 6 of 1991

Section 15 of the Constitution states that: "... every person in Sierra Leone is entitled to the fundamental human rights and freedoms of the individual." This includes protection from deprivation of property without compensation. Section 21(1) further stipulates that no property of any description shall be compulsorily taken possession of, and no interest in or right over property of any description shall be compulsorily acquired, except where land is required by the GoSL in the public interest.

3.2.2. The Environmental Protection Agency Act, 2008 (Act 11 of 2008)

The Environment Protection Agency Act, 2008 (Act 11 of 2008) was enacted to establish the Sierra Leone Environment Protection Agency (SLEPA) and to provide effective measures for the management and protection of the environment. The Act repeals the Environment Protection Act, 2000 (Act 2 of 2000).

In terms of Section 24 of the Act, any person who wishes to undertake any of the projects set out in the First Schedule of the Act must apply to SLEPA for an EIA licence. The projects or activities in the First Schedule of the Act that require an EIA licence include extractive industries, e.g. mining, quarrying, extraction of sand, gravel, salt, peat, oil and gas.

The application for an EIA Licence must be accompanied by a description of the proposed project to be undertaken. SLEPA must within 14 days of receiving an application decide whether an EIA is required for the project or not. Section 25(2) requires SLEPA to take the matters set out in the Second Schedule to the Act into consideration when deciding on whether an EIA is required in respect of the project. The factors for determining whether a project requires an environmental impact assessment includes the following:

- Environmental impact on the community;
- Location of the project;
- Whether the project transforms the locality;
- Whether the project has or is likely to have substantial impact on the ecosystem of the locality;

- Whether the project results in the diminution of the aesthetic, recreational, scientific, historical, cultural or other environmental quality of the locality;
- Whether the project will endanger any species of flora or fauna or the habitat of the flora or fauna;
- Scale of the project;
- Extent of the degradation of the quality of the environment
- Whether the project will result in an increase in demand for natural resources in the locality; and
- Cumulative impact of the project together with other activities or projects, on the environment.

The applicant will be advised in writing where a decision has been taken that an EIA is not necessary for the project. In instances where projects require an EIA Licence the applicant will be requested to prepare and submit an ESIA in respect of the proposed project. The content of the ESIA are included in the Third Schedule to the Act.

Section 27 of the Act provides that SLEPA must after receiving an ESIA, circulate it to professional bodies or associations, Government Ministries and NGOs for their comments. The ESIA must also be made available for public review and comments. Notice of the public review must be given in two consecutive issues of the Government Gazette and two issues in a newspaper. In respect of the newspaper publication an interval of at least seven days must be afforded between the first and second publications. Public comments on the ESIA must be submitted to SLEPA within 14 days of the last publication in the Gazette or newspaper. Failure to comply with the EPA Act of 2008 is a punishable offense.

3.2.3. The Mines and Minerals Act, 2009 (Act 12 of 2009)

The Mines and Minerals Act, 2009 (Act 12 of 2009) ushers in a new era of mineral development in Sierra Leone by consolidating and amending the previous minerals legislation and by introducing new improved provisions for exploration, mine development and marketing of minerals and mineral secondary processing for the benefit of the people of Sierra Leone. The Act intends to:

- Ensure that management of the mineral sector is transparent and accountable in accordance with international best practice;
- Promote improved employment practices in the mining sector;
- Improve the welfare of communities adversely affected by mining; and
- Introduce measures to reduce the harmful effects of mining activities on the environment and to provide for other related matters.

The Mines and Minerals Act, 2009 repealed the Mines and Minerals Act, 1994 as well as the Commission for the Management of Strategic Resources, National Reconstruction and Development Act, 1999.

Any mineral right or permit granted under prior laws or amendments will continue to be valid until it expires by the passage of time. The holder of a mineral right granted prior to the Mines and Minerals Act, 2009 may apply for a mineral right covering the area subject to its existing right on a priority basis.

In terms of the Act, a mineral right is defined... *"A right to explore for or to mine minerals by holding a valid reconnaissance licence, exploration licence, artisanal mining licence, small-scale mining licence, or large-scale mining licence, as the context requires*". The mineral rights holder is hereby defined as... *"The holder of a mineral right in whose name the mineral right is registered under this Act*".

3.2.3.1 Environmental Impact Assessment

Of particular importance to the Koidu Kimberlite Project are the provisions of the Act contained in Part XV which deals with the protection of the environment. Section 131(2) of the Act provides that all small-scale and large-scale mining licence holders to acquire an EIA Licence as prescribed under the Environmental Protection Act, 2000 (Act 2 of 2000). The Environmental Protection Act, 2000 has since been repealed by the Environment Protection Agency Act, 2008 (Act 11of 2008) and the EIA Licence must therefore be obtained in terms of the provisions of the new Act.

The holder of a mineral right is required to carry on its operations in a manner that is reasonably practicable in order to minimise, manage and mitigate any environmental impact including but not limited to pollution resulting from such operations and is subject to all laws of the Republic concerning the protection of the environment.

Section 133 provides that an EIA prepared by a small-scale or large-scale mining licence applicant shall be based on environmental baseline assessment work and shall contain the types of information and analysis reflecting international mining best practice which shall include:

- A detailed environmental baseline description, backed up with applicable measurements (air quality, water quality, etc.) to present the environment prior to any mining operations;
- A detailed description of the project including all phases of development, operations, reclamation and closure including but necessarily limited to:
- Detailed resource requirements and emissions;
- Identification of the likely major environmental and social impacts;
- Review of residual and immitigable environmental impacts;
- Broad and detailed objectives regarding each major environmental and social impact and means of achieving them;
- Predicted or expected effect of each environmental mitigation activity;
- Timetables and budgets for implementation;
- Projected budget and budget timetable to achieve environmental objectives;
- Identification of employee position responsible for implementation of environmental mitigation;
- Mitigation measures for each major negative social impact;
- The person or agency responsible for monitoring, the methodologies to be used for monitoring of potential negative impacts and the effectiveness of mitigation and the source of funding for monitoring; and
- An Environmental Management Plan (EMP).

The public consultation requirements are included in Section 133(2) of the Act and provide that an applicant or mining licence holder is required to consult with the public to introduce the project and to verify the possible impact of the project from the public and stakeholders perspective. Further details in respect of public consultation are not provided in the Act. However, the Act does make provision for public access to the contents of the EIA report and the EMP [Section 133(3)], as well as the annual EMP Reports [Section 134(4)] which should be made available for public review at the Mining Cadastre Office.

In instances where the holder of a mining licence proposes to make a change in its mining operations that would cause a need for a material change in the EMP, mining licence holder must submit an updated EMP for approval.

Section 134 of the Act requires a mining licence-holder to annually update the EMP Report and to submit the updated EMP Report to the Director in triplicate. The initial update must be submitted within a year after the first year in which commercial production first occurred. The updated EMP Report must be sufficiently detailed so that the Director can determine whether the EMP is succeeding. If the Director determines that the plan is not succeeding, the Minister may suspend the licence until such time as measures are taken to insure its success. The Director shall provide a copy of any annual EMP Report to SLEPA.

The Act also introduces the requirement to provide financial provision for the performance against any obligation originating from an EIA and EMP. The eligible forms of financial provision include surety bonds, trust funds, insurance policies, cash deposits or annuities.

A Section 137 directive may be issued to any mining company in order to comply with the condition of the mineral right for the protection of the environment. The Act provides that should a company not comply with the directive, the Minister may undertake the necessary steps or remedial measures as provided in the directive and recover the costs thereof from the mineral right holder. Where two or more persons constitute, or constituted, the holder of a mineral right, those persons are jointly and severally liable for the payment of any costs and expenses which may be recovered under this section from the person who is or was the last holder of the mineral right.

3.2.3.2 Compensation and resettlement

Section 38 of the Mines and Minerals Act introduces the rights to resettlement for parties directly affected by mining operations. The Minister shall ensure that all owners or lawful occupiers of land who prefer to be compensated by way of resettlement as a result of being displaced by a proposed mining operation are resettled on suitable alternate land. The resettlement process must have due regard to the economic well-being and social and cultural value of the affected parties so that their circumstances are similar to or improved when compared to their circumstances before resettlement. Resettlement must be carried out in accordance with the relevant planning laws.

The cost of resettlement shall be borne by the holder of the mineral right as agreed by the holder and the owner or lawful occupier of land or by separate agreement with the Minister. The mineral right holder shall on demand being made by the owner of any crops, trees, buildings or works damaged during the course of such operations, pay compensation for such damage. If the owner or lawful occupier of any land is dissatisfied with compensation offered, such compensation may be determined by the Minister on the advice of the Minerals Advisory Board.

3.2.3.3 Community development

A general duty is placed on holders of a mining licence to assist in the development of mining communities affected by its operations to promote sustainable development, enhance the general welfare and the quality of life of the inhabitants and must recognise and respect the rights, customs, traditions and religion of local communities. Besides this general duty, companies may be required to enter into formal Community Development Agreements (CDA). A CDA does not replace other obligations and/or agreements associated with resettlement, surface rents, or compensation.

The criteria used to establish whether a formal CDA is required depends on the mine's throughput and where the licence holder employs more than 100 employees or workers on a typical day. The CDA is intended to benefit the primary host community situated within 30 km of any boundary defining the mining licence area.

The holder of the mining licence is required in terms of Section 139(4) to expend in every year that the community development agreement is in force no less than one percent of one percent (0.1%) of the gross revenue amount earned by the mining operations in the previous year to implement the agreement.

The content of the CDA must be negotiated with the primary host community and must include the following:

- Details of the primary host community representative;
- Objectives of the CDA;
- Obligations of the licence holder, including:
  - Social and economic contributions that the project will make to the sustainability of the community;
  - Assistance in creating self-sustaining, income-generating activities, such as but not limited to, production of goods and services needed by the mine and the community; and
  - Consultation with the community in the development of mine closure measures that seek to prepare the community for the eventual closure of the mining operations.
- Obligations of the primary host community with regard to the licence-holder;
- The means by which the CDA will be reviewed by the licence-holder and primary host community every five calendar years,
- The consultative and monitoring frameworks and community participation in the planning, implementation, management and monitoring of activities carried out under the agreement; and
- A statement defining a dispute resolution process as prescribed by the Act.

The CDA entered into by a mining licence holder and the primary host community must be approved by the Minister who is authorised to return the CDA for further deliberation and negotiations. In instances were parties cannot come to an agreement the Minister is empowered to make the relevant determinations.

3.2.4. *Forestry Act, 1988*

The Forestry Act is mostly concerned with the management of classified forests which could be either national or community forests. The Chief Conservator of Forests is the responsible authority tasked with the management of the forest resources of the country. He is required to compile a national inventory of forest resources and a national forest management plan designed to obtain the "*...optimum combination of economic, social and environmental benefits*".

The Act is relevant to the Koidu Kimberlite Project in respect of Section 21 and 22 of the Act which makes provision for the Minister to declare protected areas for soil, water, flora or fauna conservation and protected trees anywhere in Sierra Leone. There are no protected areas within the mining lease area.

In a protected area no vegetation may be cut, burned, uprooted, damaged or destroyed without a written permission from the Chief Conservator. Protected trees may not be cut, burned, uprooted, damaged or destroyed without a licensed issued in terms of the Act. The removal, destruction or exploitation of forest, without legal permission, is considered a criminal offence.

Anyone that is permitted to fell timber has to pay a deforestation fee. However, if the Mine Company embarks on reforestation upon closure or mine decommissioning and satisfies the requirements of the Chief Conservator, then the fee previously paid for reforestation will be refunded.

3.2.5. *Forestry Regulations, 1989*

The application for a licence to fell or cut a protected tree is provided in Regulation 14 of the Forestry Regulations of 1989. A protected tree licence shall be in the form set out in the Ninth Schedule. A clearance licence to remove vegetation in a classified forest may be issued for mining purposes however the removal of vegetation will only be possible under the following conditions:

- Removal of vegetation, can be done for mining operations only within an area licensed for this purpose;
- The specified land area, shall be cleared within a stated time, but trees requested not to be felled, removed or damaged, are to be left standing;
- Trees to be felled shall be identified, except where total felling is authorised;
- A forest severance fee and a minor forest produce fee shall be paid in respect of all forest produce that is merchantable, which may be removed by clearance of vegetation;
- At the completion of mining, the area shall be replanted with approved crops or trees by the mining company, or provision made for this to be done by payment of the estimated reforestation cost; and
- Required method of cultivation and silviculture, specified by the Chief Conservator, must be employed.

This excludes land between the high and low water marks on both sides of the bank of any waterway, covering a distance of one hundred feet or sacred bushes protected by stipulated regulations.

3.3. International Conventions and Protocols

Sierra Leone has accepted its role within the international community by being a signatory party to numerous environment agreements, treaties and conventions. Table 3-1 below provides a list of the key environmental international conventions applicable to Sierra Leone.

Table 3-1: Key international conventions and protocols relevant to environmental management in Sierra Leone

Convention or protocol	Ratification date
The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	26/01/1995
The Convention on Biological Diversity (CBD)	1994
The United Nations Convention to Combat Desertification (CCD)	1997
The Convention on Wetlands of Importance as Waterfowl Habitat (Ramsar Convention)	13/04/2000
The Vienna Convention for the protection of the Ozone layer	2001
The Montreal Protocol on the Substances that deplete the Ozone layer	2001
The United Nations Framework Convention on Climate Change (UNFCCC)	1995
Kyoto Protocol to the Framework Convention on Climate Change	2006
The Convention Concerning the Protection of the World Cultural and Natural Heritage	7/01/2005
Stockholm Convention on Persistent Organic Pollutants	2003
Convention to Combat Desertification	1997

These International Conventions have particular relevance to Koidu Holdings, as the company must be aware of commitments made by the host country under the relevant conventions to ensure that mining activities, environmental emissions and resource use are not in conflict therewith.

3.3.1. Convention on Biological Diversity

The GoSL signed and ratified the Convention on Biological Diversity (CBD) in 1994 and 1996, respectively. By ratifying the convention the government pledged to support the basic objectives of the Convention namely:

- Conservation of biological diversity;
- The sustainable use and the equitable sharing of the benefits accruing from the use of genetic resources; and
- Develop a National Biodiversity Strategy and Action Plan (NBSAP) and to integrate the plan into the overall development plan of the country.

The overall goal and strategic objectives of the National Biodiversity Strategy and Action Plan is to seek conservation measures that provide the framework for the sustainable exploitation of the country's biodiversity for the benefit of present and future generations. Koidu Holdings should ensure that biodiversity management on the mining area takes place in accordance with the goals set by government for the conservation of biodiversity. Performance Standard 6 of the

IFC Performance Standards requires the compilation and implementation of a Biodiversity Action Plan.

3.3.2. United Nations Framework Convention on Climate Change (UNFCCC)

The objective of this Convention, as stated in Article 2, is "...to stabilise, in accordance with the relevant provisions of the Convention, concentrations of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner".

Sierra Leone ratified the UNFCCC in January 1994 and as part of the Convention Sierra Leone is required to record their emissions of greenhouse gases (GHG). To facilitate the government's responsibility under the Convention it is necessary for the Koidu Kimberlite Project to estimate and record the GHG emissions generated from the mining activities on the basis of the chemical composition or through direct measurements.

3.3.3. Montreal Protocol on Substances that Deplete the Ozone Layer

Sierra Leone is a party to both the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer. The country acceded to both multilateral agreements and its amendments in 2001. Sierra Leone has set up the mandatory structures for the implementation of the Protocol in the country, which includes the preparation of the Country Programme for the phase out of Ozone Depleting Substances (ODS) and setting up of the National Ozone Unit (NOU).

Enforcement of the ODS regulation is undertaken by the National Ozone Office. The ODS legislation is incorporated in the Environment Protection Agency Act, 2008. This legislation regulates the importation and use ODS and ODS dependent equipment in the country.

In terms of the Protocol Sierra Leone has implemented a Terminal Phase-out Management Plan (TPMP) which is aimed at a gradual but sustainable phase out of ODS in Sierra Leone. This objective is to implement chloro-flourocarbons (CFC) phase out and to sustain zero consumption of other ODSs controlled by the Montreal Protocol after 2010 except for hydro-chloro-flourocarbons (HCFCs).

It is therefore important that in all applications in which ODS could be utilised at the Koidu Kimberlite Project, such as refrigeration, air conditioners, degreasers, solvents and cleaning agents, aerosols spray cans, fumigants and fire extinguishers for example do not contain ODS which are covered by the Montreal Protocol. Suitable alternatives should be sourced and where these do exists a programme to phase out the ODSs should be implemented.

3.3.4. Stockholm Convention on Persistent Organic Pollutants

Sierra Leone acceded to the Stockholm Convention on Persistent Organic Pollutants (POPs) commonly known as the POPs Convention in 2003.

By acceding to the Convention, the GoSL has agreed to stop production and use of POPs. All intentionally produced POPs are mostly pesticides and not directly applicable to the Koidu Kimberlite Project. PCBs may however be available in transformer oils and it is recommended that any new transformers to be installed at the mine are PCB free.

The Stockholm Convention requires that equipment containing PCBs must be phased out by 2025. Any PCBs recovered in the interim from such equipment must be treated and eliminated by 2028. Current in situ equipment, such as transformers and capacitors, may remain in place and operational as long as all reasonable steps are taken to prevent leaks which may lead to soil and water contamination.

3.4. IFC Performance Standards

The Koidu ESIA will make reference to and aim to comply with the applicable IFC Performance Standards and the applicable General and Industry Specific Environmental Health and Safety (EHS) Guidelines.

The relevant IFC Performance Standards are:

- Performance Standard 1: Social and Environmental Assessment and Management System;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Pollution Prevention and Abatement;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage.

The latest versions of the *World Bank Group Environmental, Health and Safety Guidelines* (known as the EHS Guidelines) have been compiled by the IFC and are applicable from 30 April 2007. The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). According to IFC requirements, where Sierra Leone regulations differ from the levels and measures presented in the EHS Guidelines, the Koidu ESIA is required to apply, whichever is more stringent. The relevant Industry Sector Guideline relevant to Koidu is the Environmental Health and Safety Guidelines for Mining.

3.5. Equator Principles

The Equator Principles (EPs) will be adhered to during the Koidu Kimberlite Project and are as follows:

- Principle 1: Review and Categorisation - Projects are classified according to social and environmental impacts, in Category A (significant impacts), Category B (limited impacts) and Category C (minimal or no impacts);
- Principle 2: Social and Environmental Assessment - For Category A and B projects, sponsors complete an Environmental Assessment;
- Principle 3: Applicable Social and Environmental Standards;
- Principle 4: Action Plan and Management System;
- Principle 5: Consultation and Disclosure;

- Principle 6: Grievance Mechanism;
- Principle 7: Independent Review;
- Principle 8: Covenants;
- Principle 9: Independent Monitoring and Reporting; and
- Principle 10: Equator Principle Finance Institutes (EPFI) Reporting.

3.5.1. Project categorisation

As part of the review of a project's expected social and environmental impacts, EPFIs use a system of social and environmental categorisation, based on the IFC's environmental and social screening criteria, to reflect the magnitude of impacts understood as a result of assessment. These categories are:

- Category A – Projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented;
- Category B – Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and
- Category C – Projects with minimal or no social or environmental impacts.

The anticipated impacts on the existing biophysical and social environment, associated with the Koidu Kimberlite Project, led to the Project categorised at a **Category A** project. This categorisation is furthermore supported by:

- The anticipated impacts associated with open pit and underground mining; and
- Resettlement of people from within the 500 m blasting envelope..

3.5.2. Land acquisition and involuntary resettlement

Involuntary resettlement according to Performance Standard 5 refers to both physical displacement (relocation or loss of shelter) and to economic displacement as a result of project related land acquisition. Land acquisition includes both outright purchase of property and purchase of access rights, such as rights of way.

Resettlement is considered involuntary when affected individuals or communities do not have the right to refuse land acquisition that result in displacement. This occurs in the case of:

- Lawful expropriation or restrictions on land use based on eminent domain; and
- Negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail.

This Performance Standard applies to physical or economic displacement resulting from the following types of land transactions:

- Type I: Land rights for a private sector project acquired through expropriation or other compulsory procedures; and
- Type II: Land rights for a private sector project acquired through negotiated settlements with property owners or those with legal rights to land, including customary or traditional rights

recognised or recognised under the laws of the country, if expropriation or other compulsory process would have resulted upon the failure of negotiation.

In the case of Type I and Type II transactions that require physical displacement of people, the mine is required to develop a Resettlement Action Plan (RAP) or a resettlement framework.

3.5.3. Biodiversity management

In accordance with the requirements of Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management the ESIA process must include the assessment of the significance of the project impacts on all levels of biodiversity. The services of a qualified and experienced external expert must be obtained to assist in conducting an ecological assessment of the Koidu area of influence.

The assessment must take into account the differing values attached to biodiversity by local communities and other interested parties and will identify impacts on ecosystem services and must focus on major threats to biodiversity which include habitat destruction and invasive alien species.

Once it has been identified that the Koidu area of influence includes critical habitats or species or legally protected areas a Biodiversity Action Plan (BAP) will be required for the project area. The ecological assessment should culminate in the development of Management Plans relevant to the protection of fauna and flora, the management of alien invasive species and the introduction of indigenous species for rehabilitation and soil stabilisation purposes. Management plans should also consider the remedial measures required to deal with loss of biodiversity in the form of provisioning services and cultural services, such as the loss of grazing, use of firewood and building materials and the use of medicinal plants.

3.5.4. Closure Requirements

The EHS Guidelines for Mining includes particular requirements for closure and post-closure activities. Closure and post-closure activities should be considered as early in the planning and design stages as possible and a Mine Reclamation and Closure Plan (MRCP) must be prepared for the proposed mining operation. The MRCP should include the following key aspects:

- Drafted prior to the start of production;
- Clearly identify allocated and sustainable funding sources to implement the plan;
- Include both physical rehabilitation and socio-economic considerations;
- Be an integral part of the project life cycle;
- Designed that future public health and safety are not compromised;
- Designed that the after-use of the site is beneficial and sustainable to the affected communities in the long term and adverse socio-economic impacts are minimized and socioeconomic benefits are maximised;
- Should address beneficial future land use;
- Detailed consultation process which includes regulatory agencies, local communities, traditional land users, adjacent leaseholders, civil society and other impacted parties;
- Regularly updated and refined to reflect changes in mine development and operational planning, as well as the environmental and social conditions and circumstances;

- Records of the mine works should also be maintained as part of the post-closure plan;
- Include appropriate aftercare and continued monitoring of the site, pollutant emissions and related potential impacts;
- The duration of post closure monitoring should be defined on a risk basis, however, site conditions typically require a minimum period of five years after closure or longer;
- Include contingencies for temporary suspension of activities and permanent early closure.

Further objective in respect of financial feasibility and physical, chemical and ecological integrity are included in the Mining Guidelines.

4. PROJECT ALTERNATIVES

4.1. Mining method alternatives

The initial conceptual mining layout considered for the expansion of the Koidu Kimberlite Project envisaged immediately accessing the K1 kimberlite orebody from newly developed underground workings.

This conceptual layout was abandoned in favour of an open pit option as a consequence of the risk that the remnants of the K1 vertical pit would pose to an underground operation directly underneath the old vertical pit. Both safety and economic considerations thus made the underground option from the onset of the expansion less favourable, measured both in terms of Net Present Value (NPV) as well as the safety of workmen.

4.1.1. Block caving vs open stoping

Block caving versus open stoping was evaluated as a potential mining method for the underground operations in the main ore bodies. Open stoping was chosen as the preferred option due to the competent rock characteristics of the Koidu kimberlites, the hardness of which makes caving virtually impossible.

4.1.2. Dykes

Mechanised long holing was chosen over the labour intensive over-hand shrinkage method for the kimberlite dyke orebodies. This was mainly done due to better integration of the mechanised solution with the main production operations as well as the establishment of a safer work environment for the workers working in the dyke zones.

4.1.3. Underground access

During an earlier study, alternative underground access methods were also evaluated. A vertical shaft was compared to a declined tunnel access. The decline tunnel option was chosen as the preferred option based on the life of mine cost benefit, with the fairly shallow operating depth and high cost of electricity penalising the vertical shaft option. This trade-off will be re-evaluated in future should cheaper electricity become available in the form of hydro-power.

4.2. Beneficiation plant

4.2.1. Upgrade of the existing 50 tph Plant to 100 tph

It was envisaged that the existing plant could be upgraded from a 50 tph plant to a 100 tph. This would assist the mine in increasing the overall tonnage treatment capacity of the mine and would incur the least amount of capital expenditure from the mine.

In order to increase the throughput of the existing plant, it would be necessary to install a complete new ore receiving and primary crushing section. This would comprise a larger feed bin with a new rock breaker; the bin would also be large enough to accommodate direct tipping from the dump trucks.

A new vibrating grizzly feeder and primary jaw crusher would be installed capable of handling 800 mm lump sizes. The primary jaw crusher will discharge onto a new primary feed belt that will transfer the material to a new scrubber. The scrubber has a bell mouth discharge configuration that will expel directly onto a new double deck primary sizing screen.

The primary double deck screen is fitted with a 45 mm and 1.2 mm deck. The -120 +45 mm material from the screen will be transferred to a new secondary crusher installation capable of handling the tonnages; the secondary crusher product is conveyed back to the scrubber feed conveyor.

The -45 +1.2 mm material will be transferred via a new conveyor to a secondary sizing screen fitted with 8mm and 1.2mm poly decks. The -45 +8 mm product from the screen will be transferred onto a new conveyor feeding a new coarse DMS module capable of handling the -45 mm lump size.

The -8 +1.2 mm fraction from the secondary sizing screen will be conveyed to a new 40 t surge bin that has a double chute arrangement in order to allow the product to be fed to two 50tph fines DMS units, one new and the other utilising the existing 50 tph DMS.

The floats fraction from the coarse DMS unit will be screened on a double deck floats screen at 8 mm. The +8 mm fraction will be transferred to a new feed bin and tertiary crusher. The tertiary crusher will discharge onto a conveyor back to the secondary sizing screen and will be sized into the correct fraction to go through to the fines DMS units.

Product from the three DMS units will be jet-pumped to the final recovery; a completely new final recovery will be needed for this function. It will comprise a feed receiving screen which will divide the feed into four fractions. The fractions will be discharged into holding bins under the screen until they are required to be fed through the X-ray units.

Wet X-ray machines will be utilised in the recovery section; two new ones and two from the existing plant. The fractions will be fed through the X-ray units individually. Concentrate from the X-ray units will discharge onto a UVIR dryer prior to being discharged into the glove boxes in the final sorting area.

The tailings from the X-ray machines will be attrition scrubbed and pass over a grease table for audit of the X-ray tailings before being conveyed onto the recovery stockpile.

DMS floats from the two 50 tph DMS units will be conveyed to a floats stockpile.

The existing water recovery and thickening system will be used for this plant configuration, along with a de-grit section to assist the thickener in handling the increase in load through the plant.

Additional power generation and electrical requirements for the new equipment required for the upgrade will be needed.

To upgrade the existing plant to allow the feed rate to be increased to 100 tph entails major equipment changes and retrofitting of the existing plant, to such an extent that very little of the existing plant equipment can be used.

Due to the extent of the changes that need to be implemented into the existing plant to enable the plant to run efficiently at 100 tph, the cost of the changes required would be very close to the costs that would be incurred should a total green field's plant of the same size be built.

In conjunction with the capital outlay required, the current plant would have to be taken offline for the duration of the construction phase in order for the retrofitting to be successful. The duration of construction would be in the order of at least 4 months to effect the changes and upgrades required. This would mean that a total loss of production for this period would be incurred.

4.2.2. *New 100 tph Greenfields plant*

A detailed flow sheet was designed for a new 100 tph. This flow sheet is the same as that which was developed for the 180tph plant option, with the exception of the equipment sizing being related to a 100tph plant. The layout and concept of the plant and its philosophy remain the same for the two plants (see 180tph plant description).

An OPEX for the two relevant plants was drawn up as well as a detailed costing schedule for the two plants.

From the detailed OPEX and CAPEX for these two plants, it is noticeable that the CAPEX for the 100 tph plant is not significantly lower than that required for the 180 tph plant. This is mainly due to the fact that the two plants require very similar infrastructures and only certain elements of the 100tph plant are in fact smaller than the 180 tph plant.

The 100 tph plant still requires the 800 mm cyclone DMS for large diamond recovery and is not a factor of throughput but rather of lump size requirements. Thus the coarse DMS is common in both plants.

The recovery section for the 100tph plant has fewer X-ray machines, but the layout and building requirements required for each size plant is similar.

The primary crushing station for both plants is the same in order to cater for direct tipping of the dump trucks and for the lump size entering the jaw crusher.

The secondary and tertiary crusher requirements for the 100 tph plant are slightly smaller than the 180 tph plant.

In conclusion, the capital outlay for a new Greenfield's 100 tph plant is only marginally lower than that required for the 180 tph plant. In conjunction with this the cost per ton treated on the 100 tph plant is more, as the economies of scale come into play with the higher throughput of the 180 tph plant.

Therefore, the 180 tph treatment plant is the more economically viable of the two options with regards to a new Greenfield's plant.

4.3. No-mining alternative

The "no go" alternative entails the maintenance of the status quo. Without the expansion of the existing mining activities at the Koidu Kimberlite Project, the resource will not be exploited. As all the expansion facilities are to occur within Koidu Holdings' existing mining area, the proposed project area will remain fallow. The current land use potential and capability to uplift the local population would thus remain unchanged and the resource would remain unused. The regional economic benefits associated with the project would not occur and no employment will be created.

When considering the "no go" alternative, it must be noted that assessment of potential impacts of the proposed expansion project would be made against the status quo, thus allowing the "impact" of the "no go" alternative to be inferred. If the project were not to proceed, the foreign revenue, economic activity and available jobs would not be created. This would have a negative impact on the country as Sierra Leone has a paucity of revenue generating, profitable, operating mines and the Koidu Kimberlite project is a technically advanced, world class mining operation.

Koidu Holdings from 2003 to date has a record of delivery by management. As a direct consequence of the mining operations and interventions by Koidu Holdings management, the general environment has been vastly improved and much of the damage done during the time of the civil war reversed.

5. DESCRIPTION OF THE RECEIVING PHYSICAL ENVIRONMENT

5.1. Introduction

The Koidu Kimberlite Project is located on the southern outskirts of Koidu town and is unusual in that the town has expanded into the mining lease area unchecked since the initial demarcation of the larger mining lease area held by Sierra Leone Selection Trust (SLST) in 1934. The property has been subject to mining activities since the discovery of diamonds in the area and the scale and impact of the early workings and artisanal diggings was significant.

Much of the environmental degradation in the area is as a result of these early activities by SLST and National Diamond Mining Company (NDMC) and more recent illegal activities during the 1990's. It must be pointed out from the outset that since the initiation of the operations of Koidu Holdings in 2003, the general environment, environmental damage as a consequence of artisanal mining, infrastructure, housing and safety and health of the general population in Koidu town has been improved, largely as a result of initiatives by the operational management of the mining operation.

In previous years, the absence of a boundary wall or fence which is the norm at diamond mining and other operations worldwide, made controlling of artisanal mining activities extremely difficult during the period SLST and the NDMC held the rights to the property, and was one of the factors that contributed to the closure of their operations. In the current environment in 2010, the necessity for properly securing the mine property in line with security standards in South Africa, Botswana, Namibia, Lesotho and other diamond producing regions of the world has become a paramount consideration for both management and government, particularly when compliance with the Kimberley Process and the establishment of an auditable Chain of Custody for the diamond product is a stated objective of Koidu Holdings management and in line with government policy. Sierra Leone is a signatory to the Kimberley Process. The risk posed to the local population by machinery in the form of heavy earthmoving equipment and metallurgical plant can also be ameliorated by securing the lease area and restricting access to the site.

The problem of encroachment became more pronounced from the 1990s onwards, with a substantial influx of people into the concession area and Koidu town prior to the commencement of operations after the end of the war in 2002, mostly driven by an expectation of the work and financial benefits an operational mine could possibly bring. It was against this backdrop that Koidu Holdings undertook to develop the mine, with the understanding that the newly elected government would take the necessary steps to enable the mine to operate safely in order to promote economic growth in the area. Regrettably, this did not occur and the Company was forced to manage an increasingly difficult situation and, despite 24 hour guard patrols, illegal mining of the alluvial deposits has continued sporadically during Koidu Holdings' tenure, as can be seen by the pock marked features of some of the drainage systems to the south of Monkey Hill where the Company has not had a strong presence to date. With the limited access control achieved, the vegetation on and around Monkey Hill has begun to re-establish itself and the clean water sources created by the mine have attracted many different bird species into the area.

Approximately 0.36 km^2 of the mining lease area is occupied by Monkey Hill, which reaches a height of just over 470 mamsl, surrounded by gently undulating topography (between 365 m and 391 m amsl) where the kimberlites occur. Monkey Hill forms a watershed, with the northern tributaries draining into the Woyie River and those to the south joining up with the Meya River. Both of these rivers merge into the Moinde River which flows in a north westerly direction along the Meya-Moinde Fault. All of the water courses in the mining lease area were reported to contain alluvial diamonds (Hall, 1969) which are easily accessible to artisanal miners and on which all of the illicit mining in the country is focussed.

5.2. Climate

The climate in the region is described as wet tropical monsoon, with a single wet season each year between mid-May and mid-November. The average rainfall is approximately 2 540 mm, with the wettest month usually in August and rivers attaining maximum discharge in mid-September. The dry season is between December and February. River discharge is at its lowest in March and April, and begins to increase gradually in May with the onset of the rains. Groundwater levels do not rise significantly until late July.

Normal temperature range is 20°C to 33°C, although it can drop as low as 10°C at night during the Harmattan season in January. Day temperatures average 31°C in the dry season and 28°C in the wet season.

Although the heavy rainfall does impact on the operation, making working conditions difficult, to date it has not resulted in any significant production delays.

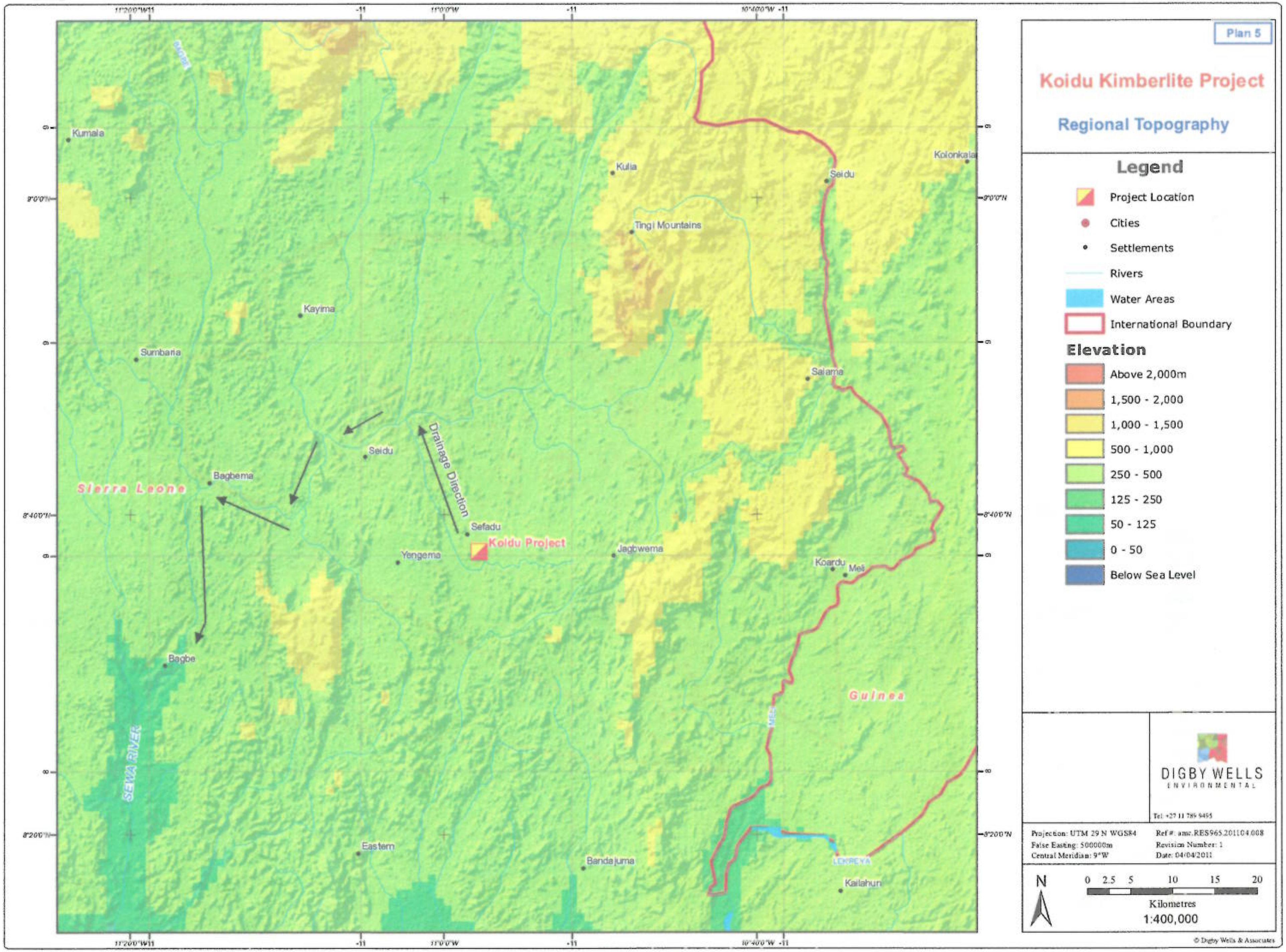
5.3. Topography

Regionally the Koidu site is located in the Tankoro Chiefdom within the Kono District of the Eastern Province of Sierra Leone. This area (Plan 5) is on a plateau which is typically higher in elevation in relation to the rest of the country. The Tingi Mountains, located approximately 40 km to the north of the site are one of the highpoints in the country at an elevation of 781 mamsl.

The stream directly south of the site drains in a westerly direction before turning north-west. Thereafter, the stream heads in a south-westerly to southerly direction and feeds into Sewa River which eventually terminates in the North Atlantic.

Locally, the site is located at an elevation of approximately 390 mamsl, with the significant natural topographical feature being Monkey Hill, which has a peak elevation of approximately 470 mamsl and is characterised by slopes which are steeper than that of the rest of the site (Plan 6). The topography of the site has been altered by historical and current mining activities focussed primarily on the alluvial deposits surrounding the town (both formal and artisanal). The waste rock and tailings facilities as a consequence of the mining of the K1 and K2 kimberlites have as a matter of course minimally altered the topography of the area, but this has since 2003 been properly planned and implemented by Koidu Holdings management.

Since the site is already topographically disturbed, the additional impacts associated with the project are estimated to be of low significance, as the waste rock and tailings deposition facilities have been properly planned by current management in order to minimize to impact on the topography of the area.


Plan 5
Koidu Kimberlite Project
Regional Topography
Legend
Project Location
Cities
Settlements
Rivers
Water Areas
International Boundary
Elevation
Above 2,000m
1,500 - 2,000
1,000 - 1,500
500 - 1,000
250 - 500
125 - 250
50 - 125
0 - 50
Below Sea Level
DIGBY WELLS
ENVIRONMENTAL
Tel: +27 11 789 9495
Projection: UTM 29 N WGS84
False Easting: 500000m
Central Meridian: 9°W
Ref #: amc.RES965.201104.008
Revision Number: 1
Date: 04/04/2011
N
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Kilometres
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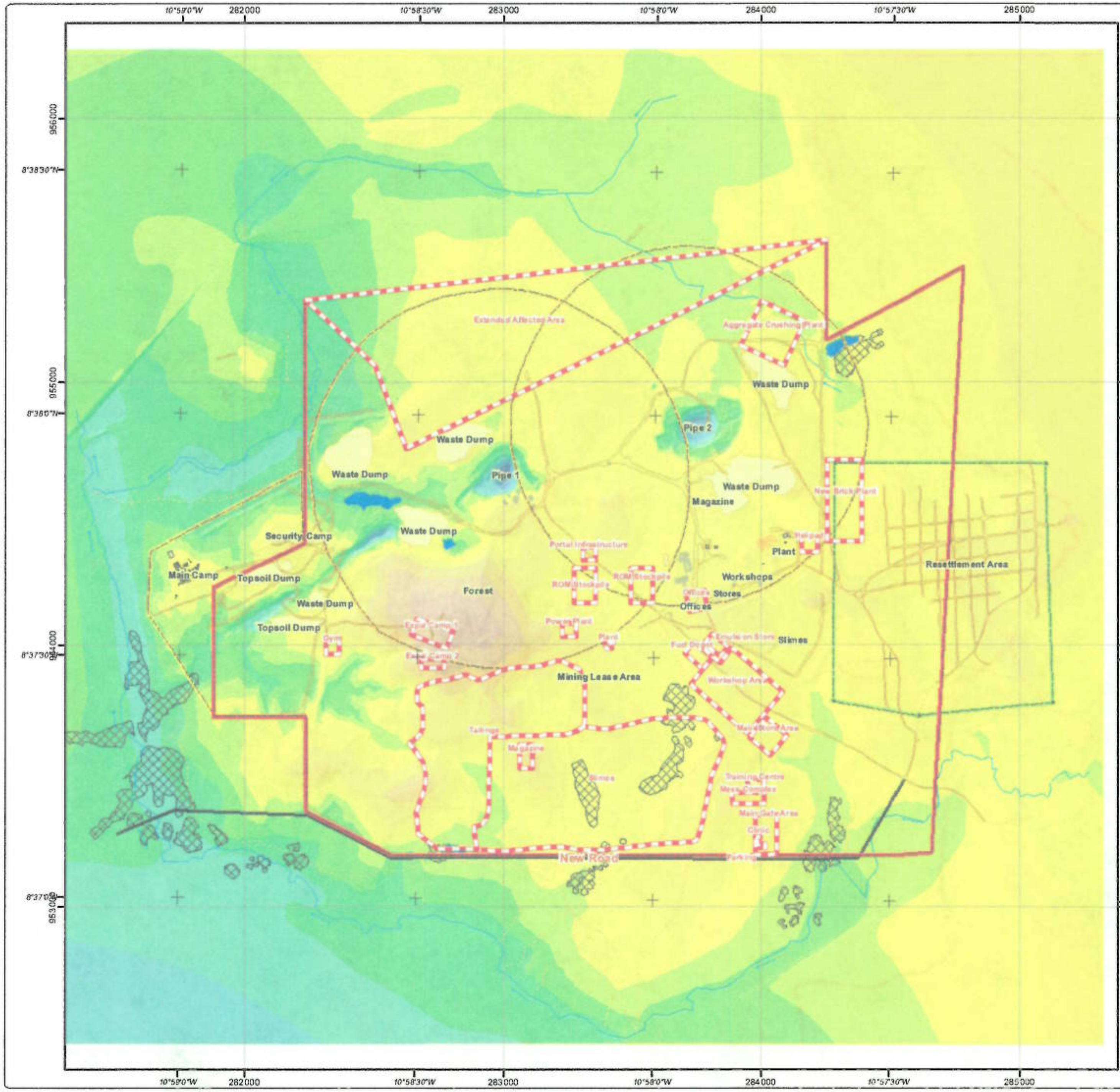
© Digby Wells & Associates
Kumala
Kulia
Seidu
Kolonkala
Tingi Mountains
Kayima
Sumbaria
Salama
Seidu
Drainage Direction
Bagbema
Sierra Leone
Sefadu
Koidu Project
Yengema
Jagbwema
Koardu
Meli
Bagbe
Guinea
SEWA RIVER
Eastern
Bandajuma
LEKREYA
Kailahun
11°20'0"W
11°0'0"W
10°40'0"W
9°0'0"N
8°40'0"N
8°20'0"N



Plan 6

Koidu Kimberlite Project

Local Topography

Legend

- Proposed Infrastructure
- Mining Lease Area
- Resettlement Boundary
- Camp Extension
- Rivers
- New Road
- Paths
- Roads

Mine Plan

- Blast Radius
- Dumps
- Mine Buildings
- Offices
- Water Pools
- Artisinal Workings

Elevation (m.a.m.s.l.)
445 - 475
421 - 444
403 - 420
392 - 402
385 - 391
380 - 384
374 - 379
367 - 373
362 - 366
355 - 361
339 - 354
307 - 338
267 - 306

DIGBY WELLS ENVIRONMENTAL

Tel: +27 11 789 9495

Projection: UTM 29 N WGS84
False Easting: 500000m
Central Meridian: 9°W

Ref #: amc.RES965.201104.009
Revision Number: 3
Date: 03/05/2011

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5.4. Air Quality

In characterising baseline air quality, reference is made to details concerning the study area, atmospheric dispersion potential and other potential sources of atmospheric emissions in the area. The consideration of the existing air quality is important so as to facilitate the assessment of the potential for cumulative air pollutant concentrations arising due to the proposed development.

5.4.1. Atmospheric Dispersion Potential

In the assessment of the potential for air quality impacts on the surrounding environment and human health, a good understanding of the regional climate and local air dispersion potential of a site is essential.

Meteorological characteristics of a site govern the dispersion, transformation and eventual removal of pollutants from the atmosphere (Pasquill and Smith, 1983; Godish, 1990). The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. Dispersion comprises vertical and horizontal components of motion. The vertical component is defined by the stability of the atmosphere and the depth of the surface mixing layer. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field.

The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction and the variability in wind direction, determine the general path pollutants will follow, and the extent of cross-wind spreading (Shaw and Munn, 1971; Pasquill and Smith, 1983; Oke, 1990).

Pollution concentration levels fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field. Spatial variations, and diurnal and seasonal changes, in the wind field and stability regime are functions of atmospheric processes operating at various temporal and spatial scales (Goldreich and Tyson, 1988). Atmospheric processes at macro- and meso-scales need therefore be taken into account in order to accurately parameterise the atmospheric dispersion potential of a particular area.

Parameters that need to be taken into account in the characterisation of meso-scale ventilation potentials include wind speed, wind direction, extent of atmospheric turbulence, ambient air temperature and mixing depth.

5.4.1.1 Local Wind Field

The analysis of hourly average meteorological data is necessary to facilitate a comprehensive understanding of the ventilation potential of the site, and to provide the input requirements for the dispersion simulations. A comprehensive data set for one year of detailed hourly average wind speed, wind direction and temperature data are needed for the dispersion simulations.

In characterising the dispersion potential of the proposed open cast pits, reference was made to hourly average meteorological data recorded at Koidu for the years 2009 and 2010 using the United States Environmental Protection Agency (US-EPA) approved AERMET meteorological model. The AERMET meteorological data was obtained from Lakes Environmental and comprised of surface hourly meteorological hourly average data in closer proximity to the proposed site. Upper air data used was also obtained from Lakes Environmental.

5.4.1.2 Surface Wind Field

The vertical dispersion of pollution is largely a function of the wind field. The wind speed determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness.

Wind roses comprise 16 spokes, which represent the directions from which winds blew during the period. The colours used in the wind roses below, reflect the different categories of wind speeds; the red area, for example, representing winds of 4 m/s to 5 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s are also indicted.

Period, day-time and night-time wind roses for Koidu are presented in Figure 5-1. The wind regime largely reflects the synoptic scale circulation. The flow field is dominated by south-westerly and westerly winds, with little or no flow from the north-easterly sectors. Thermo-topographical impacts on the flow regime give rise to distinct diurnal trends in the wind field. During the day-time, the predominant wind flow is from the southwest, with frequent winds also from the south and the southeast. Strong winds (> 5 m/s) occur from the westerly sector. During night-time the decrease in winds from the south-easterly sector are evident with the prevailing winds from the southwest. A decrease in the wind velocity is also apparent with wind mainly between 1m/s to 3m/s for most of the time. This is typical of night-time airflow when calm periods and low wind speeds are generally more prevalent.

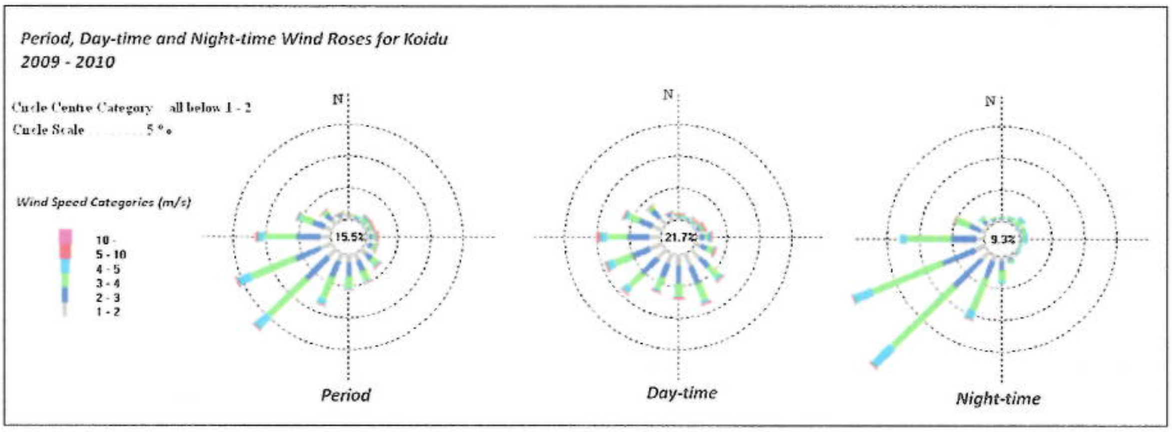


Figure 5-1: Period, day-time and night-time wind roses for Koidu (2009 – 2010)

Seasonal average wind roses reflect distinct shifts in the wind field between summer, autumn, winter and spring months. These are portrayed in Figure 5-2 overleaf. During the summer months the average wind direction is from the northeast, the southeast and southwest, with limited flow from the north. During autumn the north-easterly component decreases with increased airflow from the southwest. During winter the field shifts towards the west, with a distinct decrease in winds from the easterly sector. During spring time the wind field shifts again to reflect the prevailing wind directions as in autumn (i.e. southwest and west).

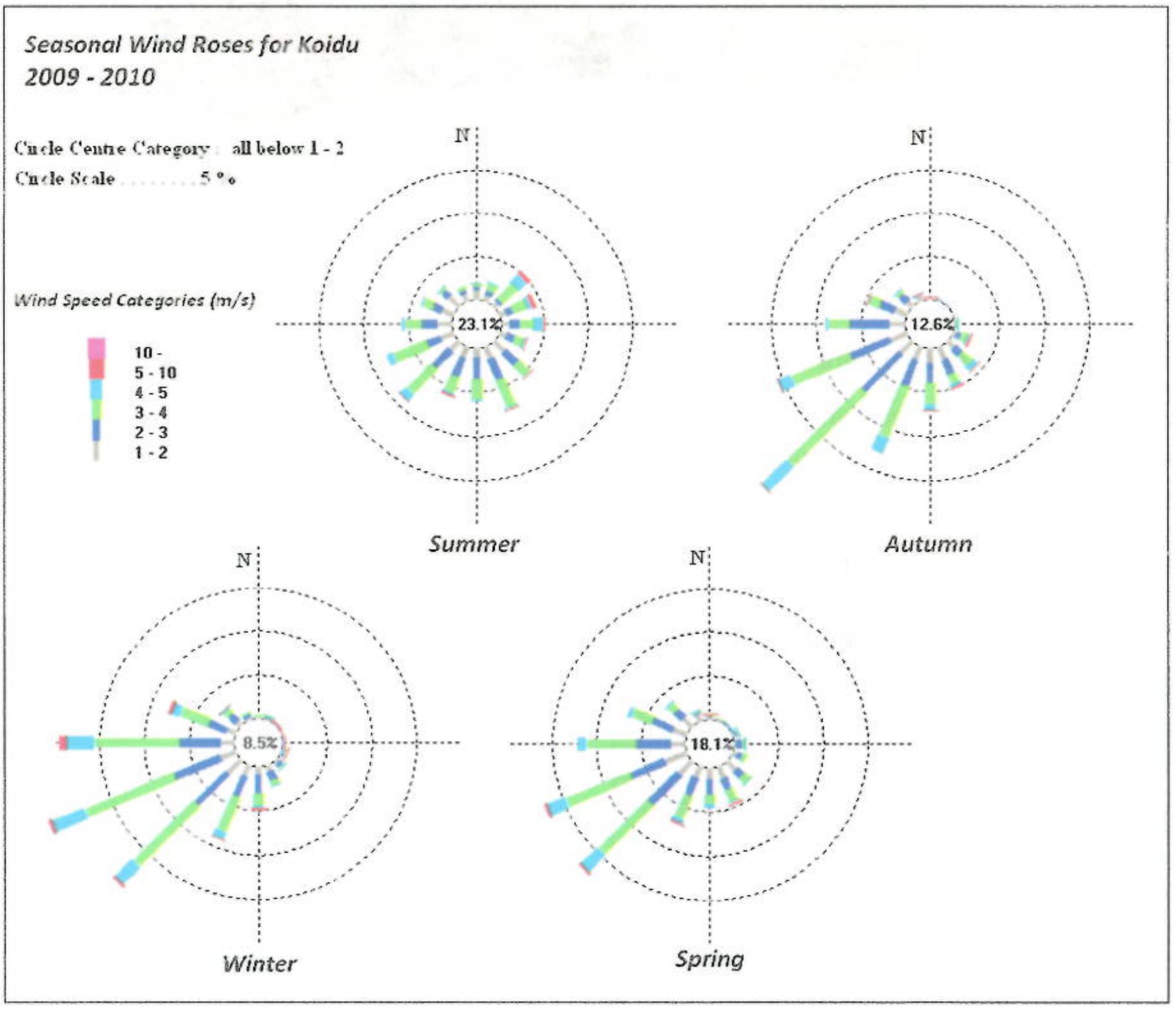


Figure 5-2: Seasonal average wind roses for Koidu (2009 – 2010)

5.4.1.3 Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers.

The seasonal and diurnal variations in temperatures recorded at Koidu are depicted in Figure 5-3. At Koidu the average daily maximum temperature is about 30.5 °C, the minimum temperature is 22.1°C and the average temperature of 25.9 °C.

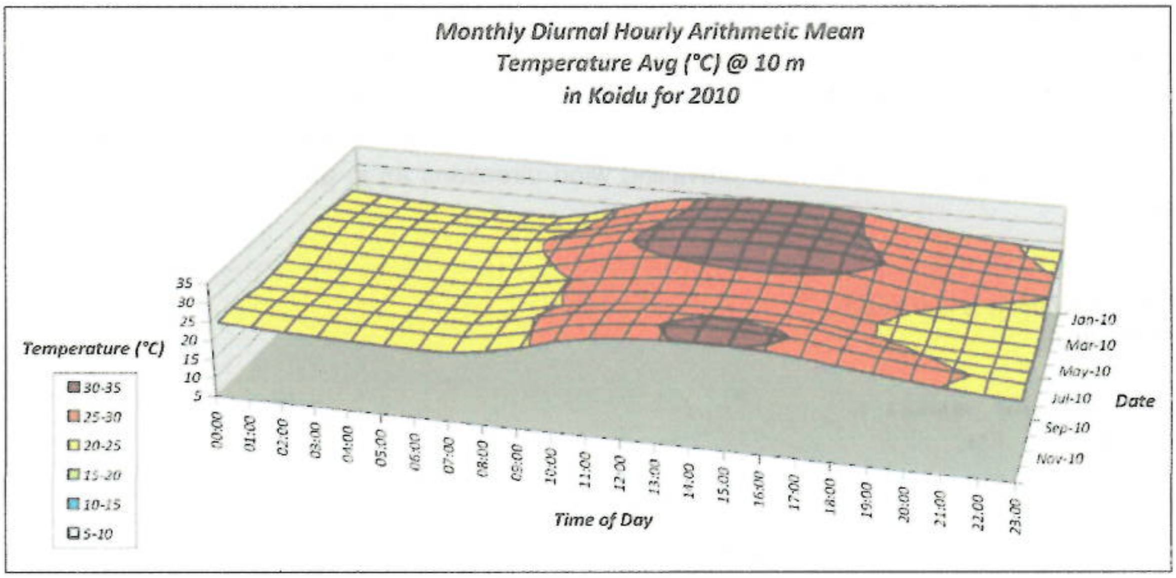


Figure 5-3: Diurnal temperature trends modelled at Koidu (2010)

The maximum, mean and minimum temperatures recorded at Koidu are given in Table 5-1. Annual maximum temperature of 32.5 °C was recorded during the month of May 2010 with minimum temperatures ranging from 21 °C to 24 °C in June.

Table 5-1: Minimum, maximum and mean temperatures (°C) recorded at Koidu (2010)

Month	Minimum	Maximum	Mean
January	21.1	31.2	25.9
February	22.2	31.1	26.4
March	23.4	31.7	26.9
April	24.0	32.5	27.7
May	23.4	32.5	27.6
June	22.4	31.0	26.4
July	21.3	28.9	24.7
August	21.3	28.3	24.3
September	21.2	28.5	24.3
October	21.7	29.9	25.4
November	21.9	30.6	25.8
December	21.2	30.1	25.3

5.4.1.4 Mixing Height and Atmospheric Stability

The vertical component of dispersion is a function of the extent of thermal turbulence and the depth of the surface mixing layer. Unfortunately, the mixing layer is not easily measured, and must therefore be estimated using prognostic models that derive the depth from some of the other parameters that are routinely measured, e.g. solar radiation and temperature. During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface and the extension of the *mixing layer* to the lowest elevated inversion. Radiative flux divergence during the night usually results in the establishment of ground based inversions and the erosion of the mixing layer. The mixing layer at the proposed site ranges in depth from ground level (i.e. only a stable or neutral layer exists) during night-times to the base of the lowest-level elevated inversion during unstable, day-time conditions.

Atmospheric stability is frequently categorised into one of six stability classes. These are briefly described in Table 5-2. For the model used here, atmospheric stability is described as a continuous variable in terms of the Monin-Obukhov length and the height of the mixing layer.

The atmospheric boundary layer is normally unstable during the day as a result of the turbulence due to the sun's heating effect on the earth's surface. The thickness of this mixing layer depends predominantly on the extent of solar radiation, growing gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. This situation is more pronounced during the winter months due to strong night-time inversions and a slower developing mixing layer. During the night a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

Table 5-2: Atmospheric Stability Classes

A	very unstable	calm wind, clear skies, hot daytime conditions
B	moderately unstable	clear skies, daytime conditions
C	unstable	moderate wind, slightly overcast daytime conditions
D	neutral	high winds or cloudy days and nights
E	stable	moderate wind, slightly overcast night-time conditions
F	very stable	low winds, clear skies, cold night-time conditions

For elevated releases, the highest ground level concentrations would occur during unstable, daytime conditions. The wind speed resulting in the highest ground level concentration depends on the plume buoyancy. If the plume is considerably buoyant (high dust velocity and temperature) together with a low wind, the plume will reach the ground relatively far down-wind. With stronger wind speeds, on the other hand, the plume may reach the ground closer, but due to the increased ventilation, it would be more diluted. A wind speed between these extremes would therefore be responsible for the highest ground level concentrations. The highest concentrations for low level releases would occur during weak wind speeds and stable (night-time) atmospheric conditions. Air pollution episodes frequently occur just prior to the passage of a frontal system that is characterised by calm winds and stable conditions.

5.4.2. Current Ambient Air Quality

The quantity of dust particles in the air was recorded within and around five settlements that will be affected directly or indirectly by the mining activities of the project. The measurements were recorded at different times and for different durations.

Readings were taken using a portable micro-dust aerosol monitoring system. This was done by carrying the equipment held above the head within and around the selected settlements. After recording the levels, the measurements were calculated, compiled and interpreted.

Table 5-3 below indicates the air quality monitoring results in terms of the dust particle quantity in the atmosphere at the different settlements. The maximum value ranges between 0.036 and 0.049 mg/m^3 while the average value ranges between 0.033 and 0.038 mg/m^3. These values are below the WHO air quality guidelines discussed in above.

Table 5-3: Air quality levels for settlements within and close to the Koidu mining lease area (ESIA Report, 2010)

Location	Date	Starting time	Duration	Average values (mg/m^3)	Maximum values (mg/m^3)
Yamandu	05/11/2008	03:48 PM	41 mins	0.038	0.041
New Sembehum	06/11/2008	10:49 AM	3 hrs, 40 mins	0.034	0.038
Sokogbe	07/11/2008	10:14 AM	1 hr, 40 mins	0.038	0.049
Swarray Town	07/11/2008	04:02 PM	1 hr, 2 mins	0.033	0.036
Saquee Town	09/11/2008	10:14 AM	3 hrs, 10 mins	0.034	0.039

The results indicate that the settlements had a good air quality with respect to particulates when the measurements were taken. Yamandu and Sokogbe have the highest average values with Sokogbe having the highest maximum value of dust particulate in the atmosphere. This is due to the fact that Yamandu settlement is one of the largest and populated with significant movement of people and vehicles while Sokogbe is along a very busy and dusty road. The lowest average and maximum values are recorded in Swarray Town because of its small size and lower population with very limited activities.

5.4.3. Identification of Sensitive Receptors

All the residential areas in the vicinity of the proposed development should be regarded as containing sensitive population from the point of view of health impact. These include the town of Koidu located north of the site as well as the proposed resettlement area which is located in the east of the mining lease area. Given the location of the site and the wind direction distribution, both the sensitive receptors will have a lower probability of being impacted.

5.5. Noise

The approach used in investigating noise impacts for this project is based on guidelines provided by the IFC EHS. According to the IFC EHS guidelines, noise impacts should not exceed the levels presented in Table 5-4 below, or result in a maximum increase in background levels of 3 dBA at the nearest receptor location off-site.

Table 5-4: Acceptable rating levels for noise in districts (IFC EHS, 2007)

Noise level guidelines	One Hour LAeq (dBA)	
Receptor	**Daytime 07:00-22:00**	**Night time 22:00-07:00**
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Baseline noise measurements were taken at seven locations in Koidu village to measure the general noise climate in the village. The noise measurement locations are presented in Table 5-5 and illustrated on Plan 7.

According to the IFC EHS: 2007 guidelines, 'daytime' is defined as anytime between 07:00 to 22:00 and 'night time' between 22:00 to 07:00. As a result of these guidelines, measurements were taken once during the daytime and once during night time at each location. Monitoring was taken at a measurement of 1.5 meters above ground level, and for a minimum period of one hour.

Table 5-5: Noise measurement locations

ID	Description of location	GPS coordinates
N1	Measurements were taken at a residential area off of Mining road in the village of Koakoyima	8°37'13.62"N; 10°59'12.06"W
N2	Measurements were taken at a residential area in Koidu Town, near the north western boundary of Koidu Mine	8°37'58.91"N; 10°58'56.55"W
N3	Measurements were taken at a residential area in Koidu Town, on the northern side of Koidu Mine	8°38'31.60"N; 10°58'31.06"W
N4	Measurements were taken in Gbessengumbu street, at Ansurul boys primary school, Koidu town	8°38'30.32"N; 10°57'59.63"W
N5	Measurements were taken in Bongalou village, Koidu town	8°38'0.55"N; 10°57'28.60"W
N6	Measurements were taken in the new resettlement area on the eastern side of Koidu Mine	8°37'31.67"N; 10°57'5.15"W
N7	Measurements were taken at a residential area 430 meters of the south eastern corner of Koidu Mine	8°37'1.52"N; 10°57'14.99"W

5.5.1. *Daytime noise baseline results*

The results from the daytime noise meter recordings for all the sampled locations as well as the rating limits according to the IFC guidelines are presented in Table 5-6. The results of the noise measurements taken of the ambient noise levels at relevant locations in Koidu Town, indicated that the baseline noise levels are below that of the IFC daytime guideline levels for residential districts, at N1, N2, N5 and N6.

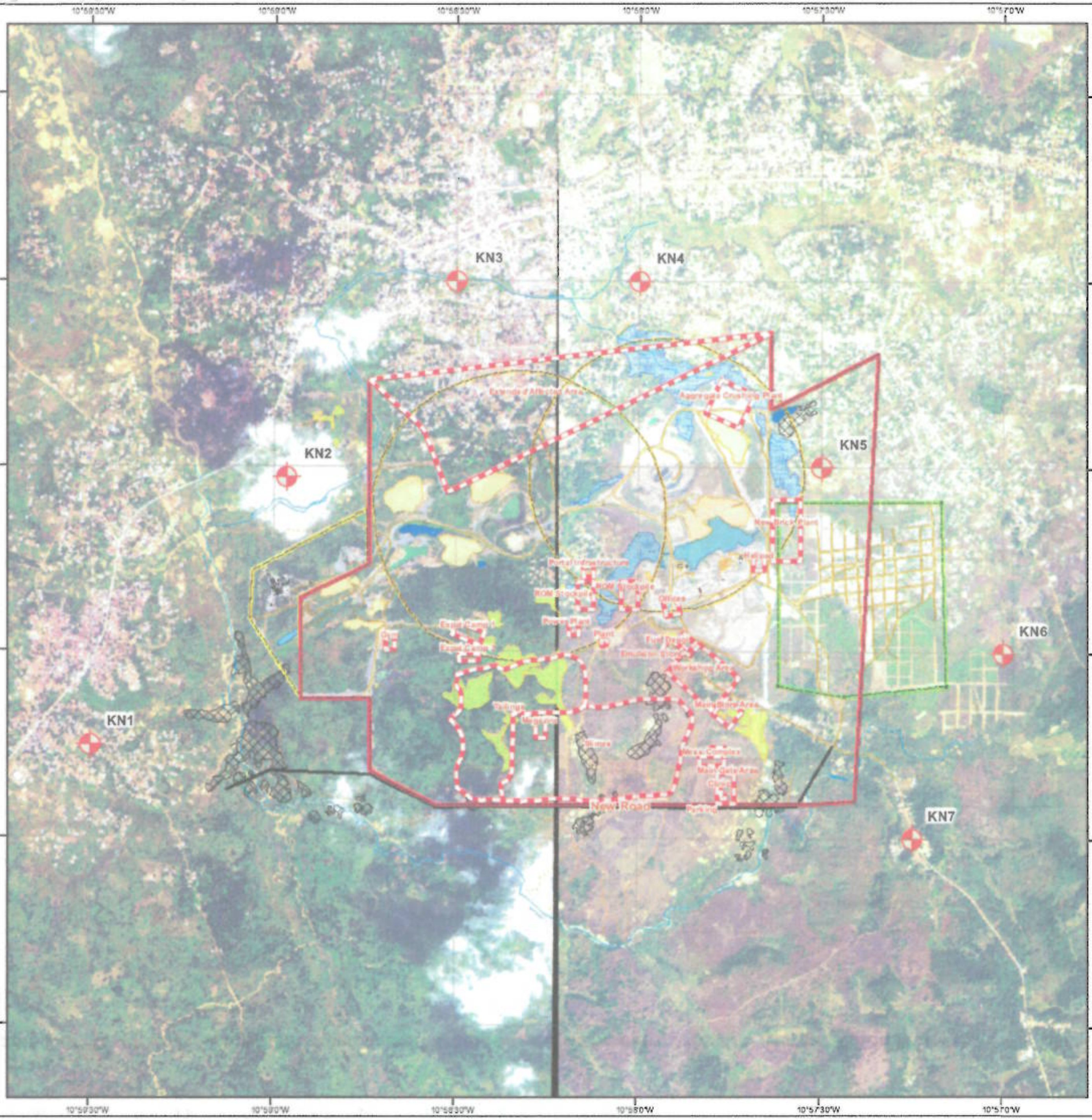
Baseline levels measured above the daytime guidelines at N3, N4 and N7. The ambient noise levels at KN3, KN4 and KN7 were impacted on by the noise produced by vehicular activity, mostly motorbikes as well as the social activities by the local people.

5.5.2. *Night time noise baseline results*

The results from the night time noise meter recordings for all the sampled locations as well as the rating limits according to the IFC guidelines are presented in Table 5-6.The results of the noise measurements taken of the ambient noise levels at relevant locations in Koidu Town, indicated that the baseline noise levels are mostly above the IFC night time guideline levels for residential districts, the levels were only below the guidelines at KN5 an KN6.

The baseline levels measured above the night time guidelines at N1, N2, N3, N4 and N7. The night time ambient noise levels at N1, N2, N3, N4 and N7 were mostly impacted on by the noise produced by *Gryllidae* (crickets) and frogs. Additional noise producing sources included community generators running throughout the night at KN3 as well as a cinema at KN4 near the Ansurul boys primary school which was screening local movies.

Noise that was audible during the baseline measurements and which was responsible for the day/night time measurements are summarised in Table 5-7.



Plan 7

Koidu Kimberlite Project

Noise Measurement Locations

Legend

- Noise Sampling Points
- Proposed Infrastructure
- Mining Lease Area
- New Road
- Paths
- Roads
- Rivers
- Resettlement Boundary
- Camp Extension

Mine Plan

- Blast Radius
- Dumps
- Mine Buildings
- Offices
- Water Pools
- Artisinal Workings

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Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 27°E

Ref #: amc.RES965.201104.012
Revision Number: 3
Date: 03/05/2011

N

0 250 500 1,000

Metres

1:20,000

Table 5-6: Results of the baseline noise measurements taken at receptors located around Koidu Mine

Sample ID	IFC rating limit			Measurement details		
	Type of district	Period	Acceptable rating level dBA	$L_{Areq,T}$ dBA	Maximum/Minimum dBA	Date/Time
N1	Residential	Daytime	50	39	53 / 32	03/02/2011; 09:00
		Night time	40	50	52 / 45	03/02/2011; 22:00
N2	Residential	Daytime	50	46	58 / 38	03/02/2011; 10:10
		Night time	40	54	56 / 50	03/02/2011; 23:10
N3	Residential	Daytime	50	51	69 / 41	03/02/2011; 11:20
		Night time	40	58	59 / 57	07/02/2011; 23:15
N4	Residential	Daytime	50	56	78 / 44	04/02/2011; 09:10
		Night time	40	56	75 / 48	04/02/2011; 22:00
N5	Residential	Daytime	50	44	56 / 38	04/02/2011; 10:15
		Night time	40	39	49 / 35	04/02/2011; 23:10
N6	Residential	Daytime	50	49	74 / 33	04/02/2011;11:30

Sample ID	IFC rating limit			Measurement details		
	Type of district	Period	Acceptable rating level dBA	$L_{Areq,T}$ dBA	Maximum/Minimum dBA	Date/Time
N7	Residential	Night time	40	35	48 / 32	04/02/2011; 22:00
		Daytime	50	55	81 / 35	07/02/2011; 11:05
		Night time	40	43	64 / 38	07/02/2011; 22:00
	Indicates $L_{Aeq,T}$ levels above either the daytime rating limit or the night time rating limit					

Note: $L_{Aeq,T}$ is the equivalent continuous A-weighted sound pressure level, in decibels, determined over a time period of not less than 30 minutes (the average noise level over the specified time period). The maximum/minimum is the highest/lowest reading during the specified time period over which the measurement was taken. 'A-weighted' is a standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.

Table 5-7: Summary of noise sources that were audible during the baseline measurements around the proposed site.

Noise source description				
ID	**Day**	**Duration**	**Night**	**Duration**
N1	Birdsong	Intermittent	Frogs	Continuous
	Villagers socializing	Continuous	*Gryllidae*	Continuous
N2	Birdsong	Intermittent	*Gryllidae*	Continuous
	Villagers socializing	Continuous	Frogs	Continuous
N3	Birdsong	Intermittent	*Gryllidae*	Continuous
	Villagers socializing	Continuous	Generators	Continuous
	Motorbikes	Intermittent	Frogs	Continuous
N4	Birdsong	Intermittent	*Gryllidae*	Continuous
	Villagers socializing	Continuous	Cinema	Continuous
	Motorbikes	Intermittent	Frogs	Continuous
N5	Birdsong	Intermittent	*Gryllidae*	Continuous
	Villagers socializing	Continuous		
	Motorbikes	Intermittent		
N6	Birdsong	Intermittent	*Gryllidae*	Continuous
	Villagers socializing	Continuous		
	Motorbikes	Intermittent		
N7	Villagers socializing	Continuous	*Gryllidae*	Continuous
	Motorbikes	Intermittent	Frogs	Continuous

5.6. Soils

Almost all the soils in the uplands and the swamps within the project lease area have been previously mined out by historical and illicit artisanal mining prior to initiation of operations in 2003. The mining operations conducted by Koidu Holdings in the K1 pit have had a minimal to negligible impact on the soils in the lease area, as the total area affected by ore extraction from the kimberlite pipe is less than 0.5 hectares.

The mainly illicit artisanal mining activities which have never been monitored or controlled have resulted in the previous loss of topsoil, a situation which the management of Koidu

Holdings is attempting to reverse in the areas under its direct influence and control. Koidu Holdings recovers and stockpiles the topsoil prevalent in the area on which operations are focussed, which topsoil is earmarked for rehabilitation and the re-establishment of land suitable for agriculture. The topsoil is recovered from its own operations as well as during the rehabilitation of areas damaged by historic artisanal operations.

By continuing the soils management measures as currently implemented by Koidu Holdings management, the identified impacts of the Koidu Kimberlite Project on the soils within the mining lease area are of low significance.

The general description of the soils in the Project area is indicated in Table 5-8.

Table 5-8: General description of the soils in the Koidu Kimberlite Project area

Soil map unit	Land form	Soils
A	Isolated hillcrests; short to medium length; almost flat with boulders and locally rocky.	Shallow soils to bedrock with pockets of deep soil over saprolite (> 100cm). Well drained, strongly acid
B	Isolated hill slope; short, straight; steep to moderately steep (15-30%), locally with boulders and rocks.	Deep, well drained. Sandy loam to coarse sandy clay loam over coarse sandy clay sub-soil
C	Dissected low uplands with interfluve crest, gentle slopes (1-2%)	Deep, well drained sandy clay to sandy clay loam over gravely sandy clay sub-soil
D	Irregular interfluve slopes; short to long undulating, very gentle-to-gentle slope (2-5%),	Deep, well drained gravely sandy clay loam over gravely sandy clay sub-soil
E	Inland valley swamps; level; 20-150 m wide; Locally channelled; previously mined out	Deep, very poorly drained silty clay loam to sandy clay loam over coarse sandy clay to clay sub soil
E1	Inland valley swamps nearly level; 20-150m wide; locally channelled; currently mined out	Deep to moderately deep, imperfectly to poorly drained, sandy clay loam to gravely sandy clay over coarse sandy clay.

Plan 8 contains the historic data as previously surveyed. Groups A and B represent isolated hill crests and isolated slopes. Soils are generally well-drained. Texture ranges between sandy loam and sandy clay loam overlying sandy clay to gravely coarse sandy clay sub soil. Colours range between dark brown to brownish yellow in the topsoil to dark red in the subsoil.

Groups C and D represent low uplands (interfluves crest) and interfluves side slopes. Soils are generally well drained and of similar textures than groups A and B. Colours vary from greyish brown to dark yellowish brown in the topsoil over brownish yellow to strong brown subsoil. Reddish yellow and yellowish red mottles in the subsoil due to weathering of ironstone gravels.

Group E represents soils of the inland valley swamps. These soils are extensively disturbed by historical illegal mining activities prior to 2002. The soils are of gravelly texture but poorly drained and as a result permanently waterlogged. The soil colours are greyish brown to yellowish brown topsoil over light olive brown to dark greenish grey sub soils.

5.7. Geology

The Koidu kimberlite cluster comprises two main pipes and several small blows associated with four main sub-vertical to vertical kimberlite dyke zones that extend for approximately 5 km along strike. The dykes both pre-date and post-date the formation of the pipes that were emplaced into Archean granitoids of the Man craton approximately 146 million years ago. Significant quantities of high quality macro-diamonds have been recovered from the dykes, pipes and blows with grades ranging from 0.2 to 0.7 carats per tonne (cpt).

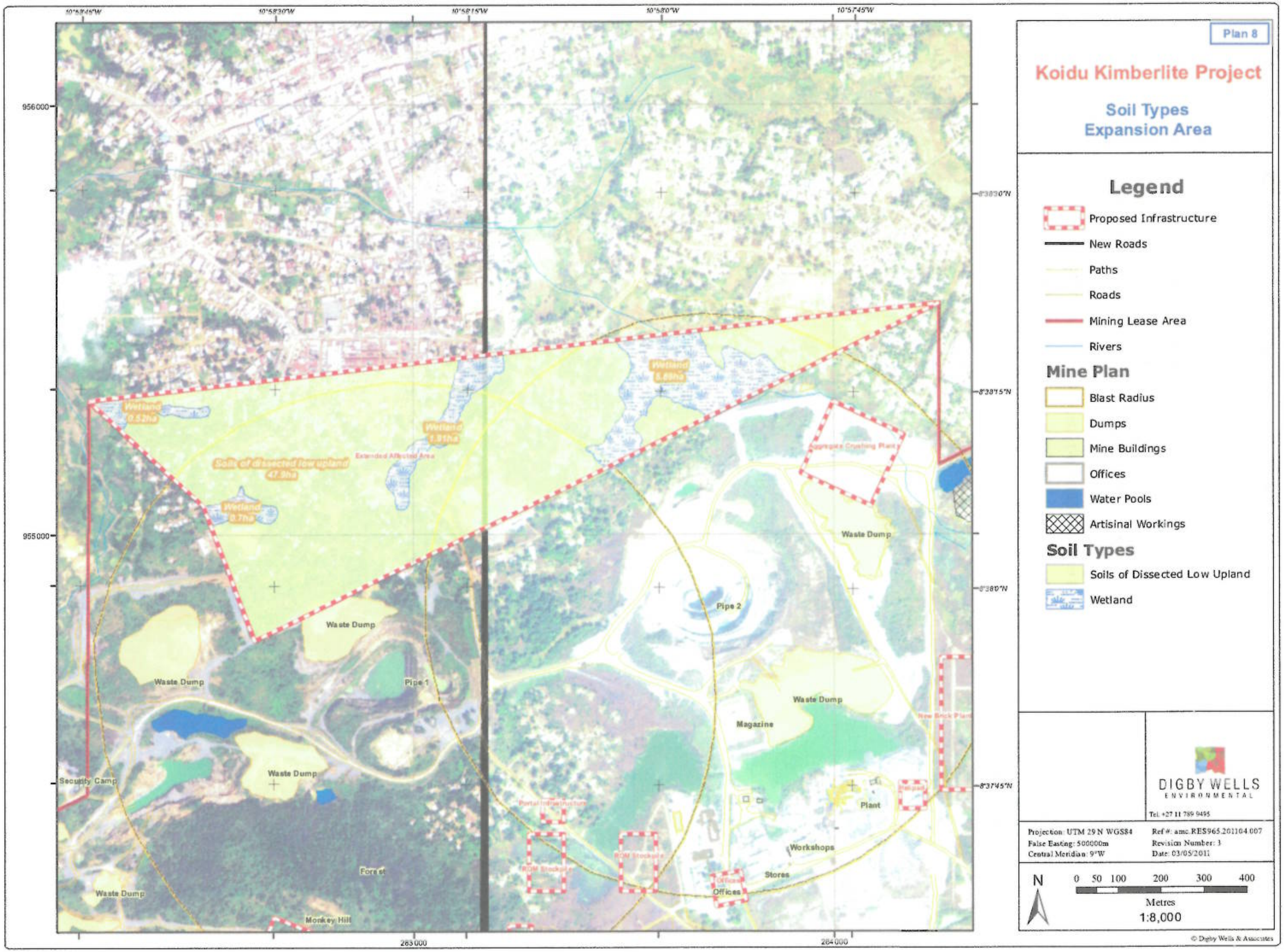
The main pipes, named K1 and K2 are smooth, steep sided pipes that are morphologically similar to those mined in the Kimberley area of South Africa (Class 1). Surface expressions of the pipes are approximately 0.3 ha for K1 and 0.5 ha for K2. The external morphology and infill present within the pipes is consistent with a diatreme setting and significant erosion of the pipes has occurred. The pipes are infilled by multiple phases of kimberlite characterised by contrasting textures due to different emplacement processes (highly explosive vs. intrusive). Texturally, the infill within the bodies is dominated by massive to locally bedded volcaniclastic kimberlite classified as tuffisitic kimberlite breccia (TKB).

Volcaniclastic rocks are typically associated with a high proportion (15 – 90%) of fresh granite xenoliths and variable proportions of olivine, mantle derived indicator minerals and mantle xenoliths. Coherent kimberlite is less common but volumetrically significant within the pipes and occurs as main pipe infill, as well as late stage dykes and rare sills. The different rock types or phases of kimberlite present within the pipes are characterised by different grades.

In addition to the well-formed pipes, there are a number of blows that represent poorly developed, small, volcanically immature pipes. These bodies are named Blow A, Blow B1, Blow B2 and Blow B3. These bodies are characterised by more complicated external pipe shapes compared to K1 and K2 and are dominantly infilled with coherent kimberlite, textural transitional kimberlite (characterised by both coherent and volcaniclastic features) and less common, well developed, massive volcaniclastic kimberlite classified as TKB.

The four main dyke zones, termed DZA, DZB, DZC and DZD, were emplaced along a southwest to northeast structural trend and are classified as Group 1, macrocrystic, phlogopite (± calcite and monticellite) hypabyssal kimberlites. Structurally, the dykes consist of irregular, braided and en-echelon arrays typically made up of multiple segments each ranging in thickness from a few centimetres to over 4 m. Simple single segment dykes are less common. In addition to variations in external morphology, the dykes display considerable internal variation in the size and proportion of olivine macrocrysts, the type and abundance of mantle derived indicator minerals, mantle xenoliths and diamond grade. The dykes in general are characterised low proportions (<5%) of country rock xenoliths.

Associated with the main pipes and blows and less commonly with the dykes are locally extensive zones of leached granite (SiO_2 removed) and marginal (or contact) breccias that contain typically low proportions (<10%) of kimberlite. The development of these zones is interpreted to both predate and postdate the formation of the pipes and have been incorporated into the geological models. Concentric 'onion-skin' shells of altered granite surrounding rounded granite cores are also observed, as well as joints filled with pulverised, angular shards of country rock around many of the dyke exposures and pipe walls. Although these zones will in most cases not be considered as ore, these zones will have an impact on the mine design.


Plan 8
Koidu Kimberlite Project
Soil Types
Expansion Area
Legend
Proposed Infrastructure
New Roads
Paths
Roads
Mining Lease Area
Rivers
Mine Plan
Blast Radius
Dumps
Mine Buildings
Offices
Water Pools
Artisinal Workings
Soil Types
Soils of Dissected Low Upland
Wetland
DIGBY WELLS
ENVIRONMENTAL
Tel: +27 11 789 9495
Projection: UTM 29 N WGS84
False Easting: 500000m
Central Meridian: 9°W
Ref #: amc.RES965.201104.007
Revision Number: 3
Date: 03/05/2011
N
0 50 100 200 300 400
Metres
1:8,000
© Digby Wells & Associates
Wetland 0.52ha
Wetland 1.91ha
Wetland 5.69ha
Wetland 0.7ha
Soils of dissected low upland 47.9ha
Extended Affected Area
Waste Dump
Pipe 1
Pipe 2
Security Camp
Forest
Monkey Hill
Magazine
Plant
Workshops
Stores
Offices
956000
955000
283000
284000

5.8. Ecology (Fauna and Flora)

To achieve the aim of the study the characterisation of the fauna and flora present on site and along the road diversion route at this time was set as one of the objectives. This objective was accomplished by following accepted methodologies used to quantify the presence of the following habitat components:

- Vegetation, according to Braun-Blanquet (1964);
- Mammals (Visual, trapping);
- Birds (Visual);
- Reptiles (Visual, trapping); and
- Amphibians (Visual, trapping, auditory).

The above mentioned five measurable habitat components were measured according to the methodologies set forth in fauna and flora report contained in Volume 3. The survey was undertaken to gain insight into the current state of the habitat present on the project area. Furthermore, the delineation of habitat units was accomplished by noting the effect that landscape features and anthropogenic activities have on fauna and flora assemblages.

5.8.1. Flora

5.8.1.1 Regional natural environment

As a transitional habitat between the rain forests of the Guinean-Congolian region and the dry savannas of Sudan, the Guinean Forest-Savanna Mosaic ecoregion is home to a wide range of species. This area is a convergence zone for savanna and forest species. The predominantly savanna habitat is checked with forest patches that run along the rivers and streams and occasionally adorn hilltops, mountains, and ridges. Wetland areas of this ecoregion host a diversity of waterfowl and wading birds. These varied habitats are home to Ghana Worm Lizards, Emerald Starlings, hunting spiders, Patas Monkeys, and many other species.

5.8.1.2 Local natural environment

The tropical rainforest cover of Sierra Leone is characterised by seven different vegetation types: moist rain forest, semi-deciduous, montane, mangrove, wooded grassland, farm bush, and swamp forests (Maley 1994). Farm bush arises from slash-and-burn agriculture and is becoming the dominant vegetation type in Sierra Leone.

The vegetative cover for Sierra Leone (NAPA, 2007) indicates that the savannah woodlands are limited to the northern parts of the country. The savannah woodlands and wooded grasslands are increasingly being subjected to frequent fires, both man-made and natural. Most of the moist and semi-deciduous forests are located within protected areas, often on mountaintops and slopes (USAID, 2007).

The current vegetation cover for the project area comprises a limited coverage of secondary forest, forest regrowth, grass cover on mined-out uplands and hydromorphic/aquatic vegetation in swamps (Inland Valley Swamps).

5.8.1.3 Habitat/Vegetation types

A total of six vegetation and/or habitat types were delineated for the project area and are presented in Table 5-9 as well as Plan 9. Wetland habitats were investigated during an aquatic assessment conducted as part of the Koidu Kimberlite Project Environmental and Social Impact Assessment (ESIA).

Table 5-9: Hectares of vegetation types

Name	Area in ha.	Percentage of total (%)
1. Secondary Forest	41.18	4.87
2. Wooded grassland	240.46	28.45
3. Villages/Local Housing	180.80	21.39
4. Degraded Areas	216.55	25.62
4.1. Agriculture	169.91	20.10
4. 2. Artisanal Mining	46.64	5.52
5. Mining Infrastructure	135.00	15.97
6. Aquatic Environments	Refer to Aquatic Study	

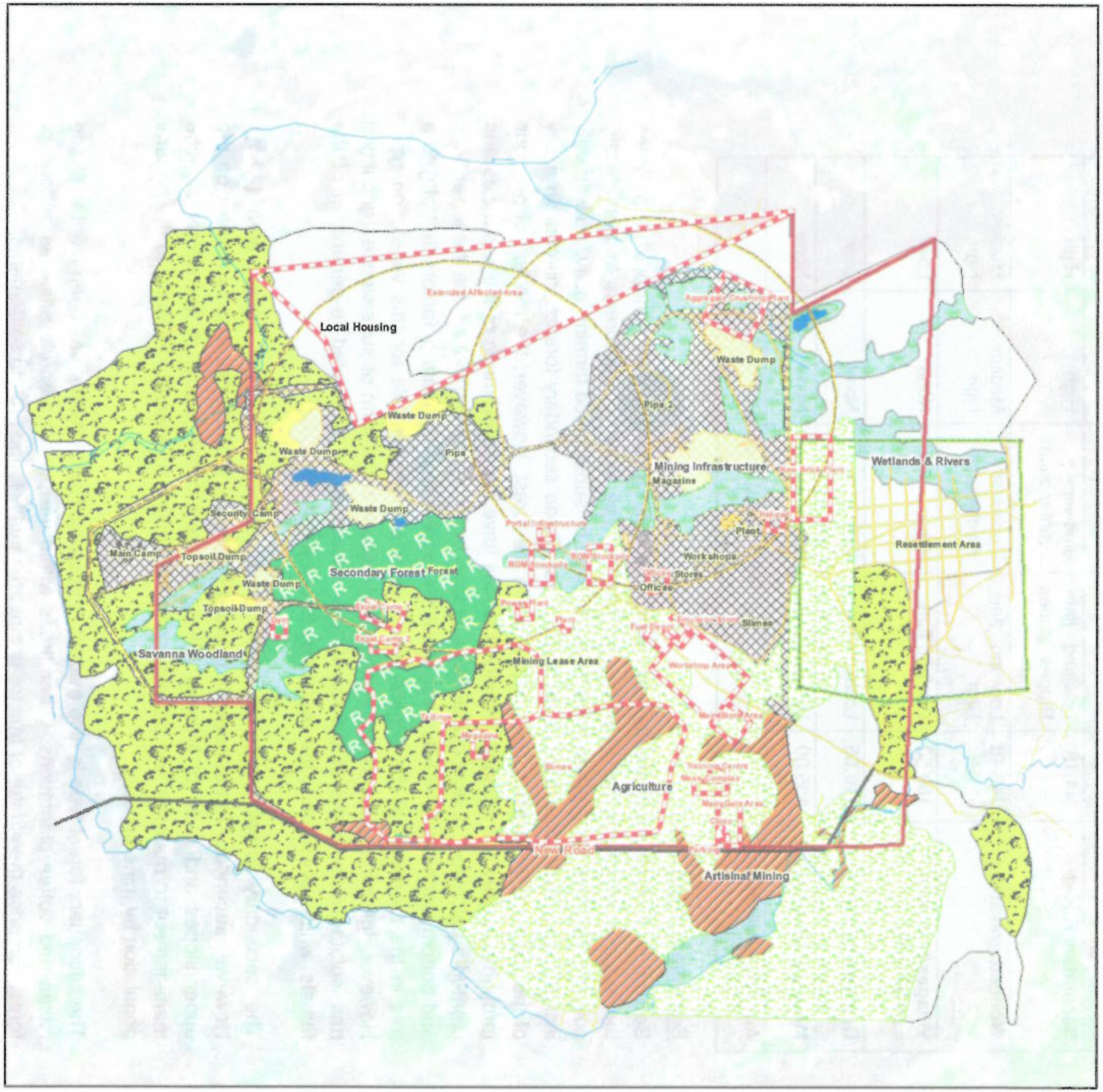
The degraded areas habitat type was sub-divided to illustrate the artisanal mining and agriculture subtypes. Topographic features were the primary consideration for the delineation of the various units. These features included the location of the habitat type in the landscape, influence of available soil type, influence of available moisture, gradient and aspect. The above mentioned factors have an effect on the habitat type in isolation and in conjunction with each other.

Secondly, anthropogenic activities were also considered to assist with the delineation of vegetative and/or habitat types. Owing to the settlement of rural communities within the area, plantations, previous and current artisanal mining and subsistence farming landscape features have formed in the area. As is the case with natural factors, anthropogenic factors could have an effect in isolation or in conjunction with other factors.

Plan 9

Koidu Kimberlite Project

Vegetation Types Identified



Legend

- Proposed Infrastructure
- Mining Lease Area
- New Road
- Paths
- Roads
- Rivers
- Resettlement Boundary
- Camp Extension

Mine Plan

- Blast Radius
- Dumps
- Mine Buildings
- Offices
- Water Pools

Vegetation Types

- 1 Secondary Forest
- 2 Wooded Grassland
- 3 Local Housing
- 4.1 Agriculture
- 4.2 Artisinal Mining
- 5 Wetlands & Rivers
- 6 Mining Infrastructure

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Projection: UTM 29 N WGS84
False Easting: 500000m
Central Meridian: 9°W

Ref #: amc.RES965.201104.013
Revision Number: 4
Date: 04/05/2011

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Metres
1:15,000

Below in Table 5-10 the habitat types identified during the survey are summarized into individual topographic setting, ecological functioning, ecological integrity and ecological sensitivity. . As can be seen, secondary forest and wetland cover the two smallest portions of the study area host the highest ecological integrity and therefore the highest ecological sensitivity.

Table 5-10: Description of habitat types

Vegetative Unit	Size (ha)	Topographic Setting	Ecological Functioning	Ecological Integrity	Ecological Sensitivity
Secondary forest	41.18	Lowland flats, Ridges, slopes	Biodiversity maintenance	High	High
Wooded grassland	240.46	Lowland flats, Hills	Biodiversity maintenance	Medium high	Medium high
Villages/Household compounds	180.80	Lowland flats	None	None	Low
Degraded Areas	216.55	Lowland flats	None	None	Low
Mining Infrastructure	135.00	Lowland flats	None	None	None
Aquatic Environment	Refer to Aquatic Study				

Secondary forest

Secondary forests are characterised by tall trees with a fairly closed canopy that provides the required shade for the underlying plantations. The extent of the forests that historically covered the lower lying areas have been reduced by subsistence farming activities with only isolated remnants occurring in sheltered areas. These secondary forests still contain many of the more hardy forest species found within the forest. However, the method of previous farming and previous artisanal mining practices have destroyed much of these species and created a patchwork of agricultural fields or farm bush and mining pits across the lower lying and bottom slope areas of hills throughout the project site. The natural factors that played a role in the formation of the original forest were also responsible for this vegetation type. However, the introduction of anthropogenic pressure in the form of subsistence agricultural has isolated many parts of the forest type, producing an attempted re-generation of the forests, which gives rise to the secondary forest vegetation

The secondary forest vegetation type is not common within the project area (4.8%). However, secondary forest cover is present within the project area and, is evident on the upper slopes and crest of Monkey Hill as a direct consequence of the efforts of mine management to maintain and protect it and the limited accessibility afforded to the general population by mine security.

The secondary forest type is also evident in Swarray Town where it has been used to shade cacao and coffee plantations. Other areas within the project area classified as secondary forest comprise the cluster of fruit trees that are usually found around settlements.

Wooded grasslands

The secondary forests and regenerating woodlands give way to expansive, wooded grasslands that characterize this ecoregion (Mayaux *et al.* 1999, Justice 1997) and covers 28.4% of the study area. Most of the tall grass savannas are fire-climax communities that generally grow on well-drained soils. Woody complexes regenerate on these grasslands when burning is halted and seed trees are available (White 1983). Savanna woodland (and shrubland) is more densely vegetated than *Acacia* savanna or wooded grassland, but not densely enough to form a closed canopy. The open canopy allows sunlight to reach the ground, allowing grass to grow and form a significant groundcover.

The wooded grassland areas are under constant threat from anthropogenic expansion in the form of two identified land uses. These are firstly agricultural, artisanal mining and plantation areas and secondly, human habitation, not necessarily in that order.

The natural factors responsible for the formation of this vegetation type has made it very attractive to humans in the sense that these areas are low lying, relatively flat, has medium clay content soil with good water holding capacity - this does not include the hill areas which also counts under this vegetation type. These flat areas are suitable for agricultural practices such as plantations and grazing areas. The hills in the study area is also partially covered with the wooded grassland vegetation type, however the gradient of these hills have made them un-attractive for farming and building. They do however suffer from the same uncontrolled burning regime as the lowland moist savannah.

Degraded, Agriculture and Artisanal Mining

The degraded areas encountered within the mine lease area consisted of areas where anthropogenic activities have impacted heavily on the natural occurring habitat types totalling 25.6%. The practice of artisanal mining and various stages of agricultural development were noted. The agricultural expansions consisted of uncontrolled burning that is used to clear vegetation and prepare areas for planting crops. These fires often spread further than the intended agricultural patch and therefore clear large areas not used for actual planting of crops.

The natural factors that was suitable for agricultural expansion, such as slope that is not to steep, or suitable but not excessive water accumulation, has resulted in the formation of this sub-habitat type. These areas are exclusively used for agricultural practices, with isolated huts being found. This land use has destroyed much if not all if the natural species in these areas. Agricultural and plantation areas were mostly encountered on the relatively flat lower lying areas, very similar to wooded grassland areas, except for more human disturbance.

As mentioned previously a correlation exists between habitat quality and animal species present. The habitat quality in these areas was highly modified which has resulted in the loss of ecosystem functioning and services offered to wild animals, such as shelter and food. Relying on this correlation, the species diversity within this vegetation type was not expected to be high.

Villages

Areas suitable for human habitation are reliant on natural features, these features are much the same as what is needed for agricultural activities, and they include relatively level surfaces, with minimal slope. The untransformed and natural vegetation type associated with these features are the wooded grassland and secondary forest habitat units, it therefore stands to reason that these two natural vegetation types made way for the areas of human habitation. This habitat type was identified as the most transformed of all six of the identified habitat types. Subsequently its ecosystem value in terms of services that are provided has been compromised and animal species that were reliant on these services are not expected to occur in these areas. This habitat type occurs predominantly to the north of the mine, with isolated areas occurring in the north east of the study area totalling 21.3%.

5.8.1.4 Conservation areas

Secondary forest

Isolated forest patches or secondary forest vegetation types were encountered where the natural factors made the area unsuitable for agriculture and housing. The secondary forest paths occur in areas similar to gallery forests, however as mentioned previously, these areas are isolated. The relationship between these vegetation types go further than this in that they share 42 % of the plant species encountered between them. Furthermore, the fact they share certain species, will mean that a number of principles that apply for one will apply for the other, such as gap formation. This vegetation type occupied 4.8 % of the total area of concern or 41.1 ha. Within this area, 59 % of the plant species encountered during the survey occurred here.

Once more, secondary forest occupies a relatively small area that harbours a large amount of plant species, indicating an important area for conservation. Tree species found in these areas included *Ficus elastica, Klainedoxa gabonensis, Mitragyna stipulosa*. With the shrub component consisting of *Bridelia ripicola* and *Sida acuta.*

Wooded Grassland

On flatter and drier areas that are higher lying, the wooded grassland vegetation type was encountered. Plant species encountered here were very often the re-growth of previous season burning practices mixed with oil palm trees, where only a small area was deliberately burnt but the fire spread to a larger part of the wooded grassland vegetation type.

Common grasses, many growing taller than two meters, include *Andropogon* spp., *Hyparrhenia* spp. and *Loudetia* spp. Fire-adapted woodland trees grow in varying densities, depending on fire frequency and current or previous land use.

Upper slopes and crests of many of the hills support wooded grasslands. The vegetation type includes trees and shrubs, such as *Albizia ferruginea*, *Acacia* sp. and *Erythrina abyssinica* with the undergrowth including species such as *Trema orientalis*, *Spathodea campanulata* and *Harungana madagascariensis*.

The herbaceous layer on drier ground is dominated by, *Thaumatococcus daniellii*, *Marantochloa congensis*, *Aframomum sanguineum*, *A. laurentii*, and *Costus lucanusianus*. Various grass species are also present. The herbaceous layer under woody vegetation is dominated by *Olyra latifolia*. Mainly due to unregulated and frequent fire occurrences only fire adapted plant species occur in these areas for more than one season.

Forest regrowth

Forest regrowth is considered to be the vegetation derived from the shifting cultivation pattern of farming common in Sierra Leone. It is generally found on both low and high uplands (hills of variable heights) throughout the country. Within the Koidu Kimberlite Project area, however, this vegetation type is mainly evident on the middle and lower slopes of Monkey Hill. This may be attributed to this area being about the only land area that presents cultivation viability following the shifting cultivation practice. Forest regrowth is scattered on these slopes and generally ranges from a mixture of low shrubs, grasses, herbs and crop remnants to thicket vegetation. Specific areas of forest regrowth are uncommon due to the previous intensive /extensive artisanal diamond mining which depleted the area of agriculturally viable lands, occurring over much larger areas.

The regrowth vegetation community with its undergrowth of shrubs, herbs and grasses such as the *Scleria barteri* (Sword Grass), is generally much more difficult to penetrate than the secondary forest. Tree species include *Musanga cecropioides* (Umbrella Leaf Tree), *Morinda geminata* (Brimstone), *Elaeis guineensis* (Oil Palm), *Terminalia ivorensis* (Ronko Tree) and *Ceiba pentandra* (Cotton Tree). Fruit trees such as *Arisophillea laurina* (Monkey Apple), *Dialum guineense* (Tamarind) and *Magnifera indica* (Mango) are also identified. The sensitive plant, *Mimosa pudica* is also evident in places helping to hinder penetration with its thorny creeping stem.

The various species comprising this vegetation type are not rated as threatened or endangered, because regrowth vegetation usually persists in areas where the forest was removed for the purpose of cultivation. Often such clearing does not involve much de-stumping and this makes it possible for the same species to regenerate when left to fallow.

Due to limited accessibility to the mining lease area, a positive impact on the vegetation cover and rehabilitation of previously disturbed areas is observed within the mining lease area.

5.8.1.5 *Medicinal species*

These plant species have properties that relieve or cure ailments and have been used by local people or foreigners alike. Various parts of a plant may contain the substance that possesses these properties, these include, roots, tubers, bark, stem, leaves, flowers or fruit. Plant species with medicinal properties are very often exploited which results in their populations and individuals being under threat and in need of conservation. The plant species identified during the field work yielded 20 medicinal species, 24 % of the total number of pants encountered. Of these medicinal species 50 % was exclusively found within the confines of the secondary forest, which, as discussed earlier only occupies 4.7 % of the total land area of the area of concern. This further emphasises the fact that forest habitat type is of importance and must be conserved.

5.8.1.6 *Alien invasive species*

Alien invasive plant species are non-specific in their habitat requirements, which is one of the characteristics that make them successful. A complete list of alien invasive species can be found in Table 5-14.

The secondary forest habitat type contained one alien invasive species *Chromolaena odorata*. According to the ISSG (Invasive species specialist group) database *Chromolaena odorata*, species that was encountered in this vegetation type is a fast-growing perennial shrub, native to South America and Central America. It has been introduced into the tropical regions of Asia, Africa and the Pacific, where it is an invasive weed. Also known as Siam weed, it forms dense stands that prevent the establishment of other plant species. It is an aggressive competitor and may have allelopathic effects. It is also a nuisance weed in agricultural land and commercial plantations. It ranks no. 23 on the worst invasive species in the world (ISSG.com).

Furthermore the secondary forest contained the alien invasive, *Bambusa vulgaris* which occurs spontaneously or naturalised mostly on river banks, road sides, wastelands and open ground; generally at low altitudes. In cultivation it thrives best under humid conditions up to 1000 m altitude, but tolerates unfavourable conditions as well. Plants may become completely defoliated during the dry season, the plants can survive low temperature (grows up to 1200 m altitude, survives -3 degrees C) and also tolerates a wide range of soil types (Ohrnberger 1999).

Bambusa vulgaris forms extensive monoculture stands where it occurs, excluding other plant species. *B. vulgaris* colonises along streams into forest (Blundell *et al.* 2003).

Bambusa vulgaris is used for construction of houses, huts, boats, fences, props and furniture; as raw material for paper pulp; shoots are rarely used as a vegetable or as livestock fodder (Ohrnberger 1999; Quatrocchi 2006).

The plantation habitat type contained three exotic plant species and one invasive plant species, with the exotic plants not necessarily being aggressive invaders. It was expected that this area contained high numbers of exotic or alien plants as this vegetation unit is actively stocked by any plant species that are edible by the local population, with no regards given to ecological status of these plants.

5.8.1.7 *Protected species*

Albizia (*Albizia ferruginea*) is considered to be of conservation significance and has to be protected and conserved. This tree was encountered in secondary forest only. It is listed as being Vulnerable by the IUCN (www.IUCN.org). It is described as a widespread and often common timber species, which has suffered heavy exploitation. The IUCN descriptive code for *Albizia ferruginea* is VU A1cd.

Protected plant species that could also occur in the mining concession is *Entandrophragma cylindricum* (VU A1cd), *Entandrophragma angolense* (VU A1cd), *Milicia excels* (Lower Risk/near threatened), *Terminalia superba*. None of the aforementioned species were identified within the vegetation types delineated.

5.8.2. Fauna

5.8.2.1 Mammals

Table 5-11 lists the mammals that were identified and found to occur within the project area:

Table 5-11: Mammals that occur on the project area.

Scientific name	Common name
Cephalopus rufilatus	Red flanked duiker
Cercopithecus sabaeus	Green monkey
Felis serval	Serval cat
Ichneumia albicauda	White tailed mongoose
Mus setulosus	Peter's mouse
Paraxerus poenis	Green squirrel
Sylvicapra grimmia	Bush duiker
Tragelaphus scriptus	Bushbuck

Of the mammals found on site, none have a Red Data status according to IUCN red species list and are not protected. However, it is recommended that the mammals that do occur on site be given protection.

The fact that no Red Data species occur on site can also be related to the high anthropogenic pressure present. Although forested areas occur on the concession area, it is freely accessed by the local community that utilise it for firewood and food, unsustainably. Further, the site has been severely impacted by previous and current illegal artisanal mining activities.

However, although these species are not listed, they play a very important role in the ecology of the site and without protection will become extinct within the area. Predatory animals such as Serval found on site play an important role in ecological systems. The Serval is not a commonly found species in Africa, but only a few countries protect it due to a lack in a protected species lists/legislation in some countries such as Sierra Leone. It has not been evaluated specific to Sierra Leone, so its status locally is unknown.

Due to the lack of background information, any of the species found can be keystone species that play vital part in the ecological system of the site and may need a protective status within the country. When consultation occurred with the local community, they indicated that they have not seen any predatory animals and that they are hard to find, indicating the necessity to conserve where possible specifically for the predatory Felidae and Canidae. Currently the probability that Red Data species might occur on site is seen as low, but with conservation efforts of forest and sensitive areas, habitat availability for Red Data species can increase to moderate to high probability.

5.8.2.2 Avifauna

The following birds were identified to occur on the project area as seen in Table 5-12.

Table 5-12: Avifauna that occurs on the project area

Scientific name	Common name
Actophilornis africanus	African jacana
Andropadus virens	Little greenbul
Apus affinis	Little swift
Ardea cinerea	Grey heron
Ardea goliath	Goliath heron
Batis senegalensis	Senegal batis
Bubo cinerascens	Greyish eagle owl
Bycanistes fistulator	Piping hornbill
Campephaga phoenicea	Red-shouldered cuckooshrike
Campethera maculosa	Little green woodpecker
Caprimulgus inornatus	Plain nightjar
Centropus senegalensis	Senegal coucal
Ceryle rudis	Pied kingfisher
Columba unicincta	Afep pigeon
Corvus albus	Pied crow
Crinifer piscator	Western grey plantain-eater
Cuculus solitarius	Red-chested cuckoo
Cynnyris cupreus	Copper sunbird
Cynnyris minullus	Tiny sunbird
Cypsiurus parvus	African palm swift
Dendrocygna viduata	White-faced duck
Dendropicos fuscescens	Cardinal woodpecker
Dyaphorophyia castanea	Chestnut wattle-eye
Egretta ardesiaca	Black heron
Egretta garzetta	Little egret
Egretta intermedia	Yellow-billed egret
Elminia longicauda	African blue flycatcher
Estrilda melpoda	Orange-cheeked waxbill
Gallinula chloropus	Common moorhen
Gymnobucco calvus	Naked-faced barbet
Gypohierax angolensis	Palmnut vulture
Halcyon leucocephala	Grey-headed kingfisher
Hirundo rustica	European swallow
Hirundo semirufa	Red-breasted swallow
Indicator minor	Lesser honeyguide
Ispidina picta	African pygmy-kingfisher

Lagonosticta rubricata	African firefinch
Lanius collaris	Common fiscal
Macrodipteryx longipennis	Standard-winged nightjar
Merops pusillus	Little bee-eater
Milvus aegyptius	Yellow-billed kite
Milvus migrans	Black kite
Muscicapa striata	Spotted flycatcher
Necrosyrtes monachus	Hooded vulture
Nettapus auritus	African pygmy goose
Numida meleagris	Helmeted guineafowl
Onychognathus hartlaubi	Chestnut-winged starling
Ploceus cucullatus	Village weaver
Podica senegalensis	African finfoot
Polyboroides typus	Gymnogene
Psalidoprocne nitens	Square-tailed saw-wing
Pteronetta hartlaubii	Hartlaub's duck
Pycnonotus barbatus	Common bulbul
Quelea erythrops	Red-headed quelea
Scopus umbretta	Hammerhead
Serinus canicapillus	West african seedeater
Serinus mozambicus	Yellow-fronted canary
Spermestes cucullata	Bronze mannikin
Streptopelia semitorquata	Red-eyed dove
Streptopelia senegalensis	Laughing dove
Tauraco persa	Guinea turaco
Tchagra minuta	Marsh tchagra
Tchagra senegalus	Black-crowned tchagra
Terpsiphone viridis	African paradise-flycatcher
Tockus erythrorhynchus	Northern red-billed hornbill
Tockus hartlaubi	Black dwarf hornbill
Treron calvus	African green pigeon
Turtur afer	Blue-spotted wood-dove

None of the birds found have a Red Data status or are protected within Sierra Leone, however this does not mean that the species do not need protection. The lack of protection is due to the lack of environmental studies and legislation. Sierra Leone does not have a protected species list indicating sensitive species and by the rate that the environment is being impacted, such an effort is urgent.

Bird habitat on the concession area included open areas, forests, ridges and wetlands. The species found were very well established communities. Common bulbuls, swallow, turacoes and bee-eaters were found to dominate the ridge area. In the more forested sites, hornbill, woodpeckers and sunbirds were abundant. Open areas were dominated by doves and crows, and finally wetlands and rivers included birds dependant on these systems such as herons, kingfishers and ducks. Vultures and kites were found feeding on kitchen waste around a dump site on the concession area. The current probability that Red data species might occur is seen as medium, but with the conservation of sensitive areas and limiting impacts and pollution, this could be increased to a high probability.

5.8.2.3 Herpetofauna

Snakes are commonly occurring and abundant in Sierra Leone. Although the site is impacted, it is suggested by Menzies (1966) that this will allow for the penetration of Savannah species into impacted forested areas, whereas forest snake species are becoming less common and only locally occurring. Reptile and amphibians found on site are presented in

Table 5-13. None of these species have a Red Data status. The frog species found was abundantly represented in all the aquatic habitats on site. Species were found by more than one ecological specialist during the field survey; also local people assisted in mentioning species they have seen. Due to the impacted nature of the site, the occurrence of Red Data Herpetofauna is seen as medium to low.

Table 5-13: Herpetofauna that occur on the project area.

Species Name	Common Name
Agama agama	Agama lizard
Arthroleptis sp.	Squeaker
Mehelya poensis	Forest file snake
Naja nigricollis	Spitting cobra
Natriciteres variegata	Forest marsh snake
Philothamnus heterodermus	Variable green snake

5.8.3. Conclusion

The summary of the habitat types and the fauna associated with the habitat types, as per the field work, is shown in

Table 5-14. The number equals the amount of individuals found during the field survey and the value is seen as ecological value linked to species richness.

Table 5-14: Summary of Fauna and Flora

Habitat Type	Flora	Mammals	Birds	Amphibians	Reptiles	Value
Secondary	39	5	43	-	2	High
Woodland	20	2	12	-	1	High
Wetlands	16	-	19	1	-	High
Degraded	16	2	4	-	-	Low
Village	12	-	3	-	-	Low

Mine	3	-	6	-	2	Low

From the results discussed above, it is evident that the area of concern is under anthropogenic pressure, most notably from the surrounding communities and to an extent the effects of previous and current mine workings. It is largely due to human actions that the degree and type of differentiation between vegetation types has taken place. The identification of these vegetation types were on the basis of presence, absence and assemblages of plant species and the effect of natural and human factors. The subsequent habitat types created smaller niches where animals were adapted to survive.

A major threat to natural habitat types, and subsequently wild animals, was informal subsistence agriculture practiced by locals, in these instances a piece of natural habitat is burnt to remove vegetation. Thereafter, the area is ploughed and planted. The effect of this action is far reaching, firstly the natural vegetation is removed which decreases the amount of available graze and browse, thereafter a fallow piece of land will provide good habitat for alien and invasive species to colonise. If an area is cleared and receives a large amount of rainfall before planting has commenced, the surface runoff will be much greater because of the reduced infiltration, this in turn will cause erosion and a loss of valuable topsoil. A second major threat is the practice of illegal artisanal mining within the boundaries of the mining concession. This not only destroys the vegetation present on the footprint but also the vegetation where the discarded soil is dumped. The frequency of these small pits and not their size is the major contributing factor in the destruction of the vegetation type.

The subsequent reduction in natural habitat has meant that adaptable animal species have remained in the area, with sensitive species having moved away to more suitable habitat. However, availability of habitat is not the only driving force in the emigration of animal species, frequent small scale hunting for bush meat has reduced the numbers of wild animals even further. The presence of many homemade snares found during the field work was evidence of this.

As mentioned previously the proliferation of informal subsistence farming and the accompanied slash and burn practice has created favourable conditions for alien and invasive plant species.

The size and condition of the habitat types identified in the area revealed an advancing degraded land which consists of agricultural/artisanal mining (216 ha) and village (180 ha) habitat types driven by human expansion. This expansion is as a result of the need for natural resources to support natural as well as anthropogenic activities in Koidu Town, resulting in a shrinking or declining secondary forest and wooded grassland type. Furthermore, monitoring how the interfacing ecosystems advance and retreat can offer insight into the nature and rate of environmental change over time, and into the causes of this change (Furley 1992). Such changes between domination by secondary forest or savanna woodland habitats are believed to have occurred many times over the past few million years (Kingdon 1989, Maley 1994). However, the introduction of the anthropogenic factor has changed the dynamics of the ecosystem to a large extent.

During the field survey no Red Data or protected fauna species were found. Not only is this due to the already impacted environment and the hunting pressures of the community, but also due to the fact that no locally protected species lists exist. This is due to the fact that there are no environmental studies defining species in Sierra Leone, no funding to conduct such needed studies and no legislation protecting current occurring species, apart from international legislation. Also, little is known on the ecological processes and any of the species that were found can be keystone species in the ecological functioning of the system. This study did confirm there is a continuing decline of species within the study area, specifically predatory species, and for this reason all species and its habitat need protection before they become locally extinct. At this point the concession area is providing a form of protection to fauna species. The Project will further promote the protection of fauna and flora by placing infrastructure in already disturbed or degraded areas.

In addition, a perimeter wall is currently being constructed for security purposes and to comply with Kimberley process requirements. Access control due to the wall will also aid in protecting fauna and flora from poaching, fires and logging.

A solid wall may result in ecological impacts by secluding the concession area from the outside environment, and may lead to:

- Seclusion of species from other species (system limitations);
- Seclusions of food resources from included species, such as predatory animals will have limited feeding options and will not be able to seek food outside of the concession area; and
- Limitation on mating/reproducing opportunities (genetic limitations).

This seclusion from the outside environment will need continual, human interference, accurate management and studies of the concession ecosystem. This is in line with Koidu Holdings' current rehabilitation and environmental management carried out in support of their intention to establish a nature conservation area within the concession.

5.9. Aquatic Environment

The water resources considered for this study included the associated wetland areas as well as the local rivers/streams. In order to assess the current status of these two systems, different methodologies were applied. Information pertaining to the different methodologies is contained in the Aquatic Specialist Report (Volume 3).

5.9.1. Water quality (in situ)

The overall *in situ* water quality of the Meya River was in an acceptable state, with no water quality parameters being considered a limiting factor for aquatic biota. The *in situ* water quality results for the system are presented in Table 5-15.

Table 5-15: The *in situ* water quality results for the Meya River

Parameter	Acceptable Range	Meya River
Temperature (°C)	5 - 30	21.6
pH	6.5 - 9.0	7.2
Dissolved Oxygen Saturation (%)	80 - 120	119.6
Dissolved Oxygen Concentration (mg/l)	> 5	10.11
Total dissolved solids (mg/l)	< 1000	25

Note: denotes water quality parameter measured to be within a desired range

According to the South African Water Quality Guidelines for Aquatic Ecosystems (DWAF, 1996), the temperature of water plays an important role for aquatic ecosystems by affecting rates of chemical reactions and, therefore, also the metabolic rates of organisms. The rate of development, reproductive periods and emergence time of organisms are all affected by temperature. The temperature of 21.6°C recorded for the survey was within the desired range.

According to DWAF (1996) both geology and the atmosphere has an influence on the pH of natural waters. Fresh water systems are mostly well buffered and more or less neutral, with a range from 6.5 to 8.5. Most species will tolerate and reproduce successfully within a pH range of 6.5 – 9.0 (DWAF, 1996) and as result, this is the adopted range for the study. As a result of the presence of bicarbonates of the alkali and alkaline earth metals most fresh water systems are slightly alkaline (Bath, 1989). A pH of 7.2 was recorded for the system which is close to natural but slightly alkaline. This value is within the required range described.

The target water quality range for an aquatic ecosystem is between 80 – 120% of DO saturation (DWAF, 1996). The minimum allowable values for sub-lethal and lethal DO saturation is greater than 60% and 40%, respectively. The *in situ* DO saturation for the Meya River was recorded as 119.6% and this is within the desired range.

According to Mason (1991), dissolved oxygen (DO) is possibly the most important measure of water quality, especially for aquatic life. Both the survival and functioning of aquatic biota is dependent on the maintenance of aquatic DO concentrations because it is required for the respirations of all aerobic organisms. Thus, it may be stated that DO concentrations provide a useful measure of ecosystem health (DWAF, 1996). The median guideline for DO for the protection of aquatic biota is >5.0 mg/l (Kempster *et al.*, 1980). The DO concentration recorded for the Meya River (10.11 mg/l) was double this minimum limit, indicating a suitable concentration of dissolved oxygen within the system for aquatic biota.

Macro-invertebrate fauna appear to be sensitive to salinity, with acute toxic effects likely to occur in most of the sensitive species at salinities in excess of 1000 mg/l. The TDS concentration for the Meya River (25.0 mg/l) was considerably below this level.

The overall *in situ* water quality of the Meya River adjacent to the mining area is in a good state, with none of the assessed water quality variables being a limiting factor for aquatic biota. This is important to note, considering the activities such as washing, bathing, ablutions and artisanal mining which are abundant. It appears that the current activities and mining operation are not having an impact on the *in situ* water quality of the Meya River.

5.9.2. Index of habitat integrity

The scores pertaining to the IHI assessment for the Meya River are presented in Table 5-16. This index assesses the severity of any damage inflicted to the instream and riparian habitats of the system caused from anthropogenic perturbations.

Table 5-16: The scores of the IHI assessment for the Meya River

Instream habitat integrity	Score	Riparian habitat integrity	Score
Water abstraction	0	Vegetation removal	15
Flow modification	18	Alien encroachment	12
Bed modification	23	Bank erosion	13
Channel modification	17	Channel modification	18
Water quality	3	Water abstraction	3
Inundation	8	Inundation	8
Exotic macrophytes	3	Flow modification	13
Exotic fauna	2	Water quality	18
Solid waste disposal	4		
Integrity score	**43**	**Integrity score**	**23**
Integrity class	**Largely modified**	**Integrity class**	**Seriously modified**

Note: No impact (0), Small impact (1-5), Moderate impact (6-10), Large impact (11-15), Serious impact (16-20), Critical impact (21-25)

The overall instream habitat has been "largely modified" and this may be largely attributed to the artisanal mining activities within the system. These artisanal mining activities have caused serious impacts to the system, modifying the flow and channel structure. Additionally, artisanal mining activities have also imposed a critical impact on the Meya River due to bed modification. Similarly, the riparian habitat has been "seriously modified" due to the artisanal mining activities. These activities have had a serious impact due to channel modification and altered water quality. Additional impacts which are considered to be large resulting from the artisanal mining activities are the removal of vegetation, alien vegetation encroachment due to the placement of fields in the riparian areas, bank erosion and modifications to flow. The findings of the habitat integrity assessment indicate that the current artisanal mining activities are having a considerable impact on the habitat integrity of the Meya River.

5.9.2.1 Habitat assessment for low gradient stream

The results of the habitat assessment for the Meya River as per the USEPA (2006) guidelines are presented in Table 5-17. Based on these findings, the quality of habitat suitable for aquatic biota was determined to be "moderate" for the system. None of the assessed habitat parameters were determined to be optimal for the system. Vegetative protection and epifaunal substrate were determined to be the most intact and important for the system. This component includes the relative quantity and variety of natural structures in the stream, such as cobble (riffles), large rocks, fallen trees, logs and branches, and undercut banks, available as refugia, feeding, or sites for spawning and nursery functions of aquatic macrofauna. It was evident from the study that the surrounding artisanal mining activities are impacting on the habitat integrity of the system with the majority of the habitat parameters determined to be suboptimal in state. These activities have resulted in excessive sedimentation of the system, resulting in the decrease in habitat quality and a loss in habitat diversity.

Table 5-17: The habitat parameter scores for the low gradient Meya River

Habitat Parameter	Score
Epifaunal substrate/Available cover	14
Pool substrate characterization	11
Pool variability	8
Sediment deposition	4
Channel flow status	6
Channel alteration	12
Channel sinuosity	11
Bank stability (L) & (R)	11
Vegetative protection (L) & (R)	15
Riparian vegetative zone width (L) & (R)	7
Total score	**99**
Habitat percentage (%)	**49.5**
Habitat description	**Moderate**

5.9.2.2 *Benthic macroinvertebrates*

In order to assess the macroinvertebrate community structure of the Meya River, a variety of biotopes are sampled. These biotopes consist of various water velocities and depths, as well as habitat structures. A total of 13 macroinvertebrate taxa were sampled during the survey and a total of 505 individuals were sampled from the Meya River. The abundances of the sampled macroinvertebrate taxa and the respective sensitivities are presented in Table 5-18.

Macroinvertebrates with different tolerances to poor water quality were sampled from the Meya River. Ten of the taxa sampled are considered to be highly tolerant (1-5) to poor water quality and three of the taxa are considered to be moderately tolerant (6-10) to poor water quality. No taxa which are sensitive to poor water quality were sampled during the survey.

The total number of families within the three insect orders Ephemeroptera (Mayflies), Plecoptera (Stoneflies), and Trichoptera (Caddis flies) identified for the project was three. This metric gives an indication of the variety of the more pollution sensitive orders. Thus, this provides a confirmation that very few taxa considered to be sensitive to poor water quality were sampled for the study.

Table 5-18: The abundances of the sampled macroinvertebrate taxa and associated sensitivities for the Meya River as well as the respective EPT scores

Family	Taxon	Sensitivity	Abundances
ANNELIDA	Hirudinea	3	11
CRUSTACEA	Potamonautidae	3	7
ODONATA	Coenagrionidae	4	13
	Gomphidae	6	9
	Libellulidae	4	23
HEMIPTERA	Gerridae	5	49
	Nepidae	3	5
TRICHOPTERA	Hydropsychidae 2spp	6	96
EPHEMEROPTERA	Leptophlebiidae	9	3
DIPTERA	Ceratopogonidae	5	6
	Chironomidae	2	228
	Simuliidae	5	47
GASTROPODA	Planorbidae	3	8
Number of individuals			505
Number of Taxa			13
Ephemeroptera, Plecoptera, Trichoptera (EPT)			3

5.9.3. *Invertebrate habitat assessment system*

The IHAS assesses the quality and availability of habitat suitable for macroinvertebrate communities. The results of the IHAS assessment for the Meya River are presented in Table 5-19. Based on these results, the quality and diversity of habitat for the system was determined to be in a moderately suitable state. This is an indication that a large variety of biotopes are absent from the system. Additionally, the quality and quantity of the available habitat types and flow scenarios may be limited. These impacts are largely attributed to the local water uses and in particular to the artisanal mining activities. The reach of the Meya River considered for the study was largely unimpacted on by artisanal mining and agricultural activities.

Table 5-19: The scores of the IHAS assessment for the Meya River

	Biotope	Meya River
IHAS	Stones in current	14
	Vegetation	8
	Other habitats	12
	Stream condition	22
	IHAS score percentage (%)	56
	Classification	**Moderate**

5.9.4. *Ichthyofauna assessment*

In this assessment 164 individual fish were collected representing 9 types or species (known and unknown) of fishes from five families. This included a single species from the Characidae family, five Cichlidaens, one Clariidae species, one Mastacembelidae species and a single Mochokidae species. The identified genus and species as well as the associated quantities sampled for each are presented in Table 5-20.

Table 5-20: The fish species sampled for the study area and associated quantities

Family	Genus	Species	Local name	Quantity
Characidae	*Brycinus*	*nurse**	Shiny fish	43
Cichlidae	*Hemichromis*	*faciatus*	Ngog	12
Cichlidae	*Oreochromis*	*niloticus*	Ngog	45
Cichlidae	*Pelmatochromis*	*buettikoferi**	Ngog	32
Cichlidae	*Sarotherodon*	Unknown	Ngog	17
Cichlidae	*Tilapia*	*louka* *	Ngog	12
Clariidae	*Clarias sp*	Unknown	Slippery fish	1
Mastacembelidae	*Mastacembelus*	*cryptacanthus**	Snake fish	1
Mochokidae	*Chrysichthys*	*nigrodigitatus**	Spiny fish	1
Total abundance				**164**

Note: (*) denotes relatively uncertainty to identify to species

In addition, the preferences or sensitivities for each of the sampled fish species to water quality, habitat and flow and combined or total sensitivities are presented in Table 5-21. A brief review of the families of fishes collected is provided as well as considerations of taxa sensitivities.

Table 5-21: Overview of the types and abundances of fishes collected in the study including preferences or sensitivities of types to water quality, habitat and flow and combined or total sensitivities with species scoring 100% considered to be extremely sensitive types (blue), 83% representing very sensitive types (turquoise), 67% representing sensitive types (green), 50% representing tolerant types (yellow), 33% representing very tolerant types (orange) and 0-17% extremely tolerant species (red).

Family	Genus	Species	Water quality	Habitat	Flow	Sensitivity
Characidae	*Brycinus*	*nurse**	Moderate	Moderate	Low	33%
Cichlidae	*Hemichromis*	*faciatus*	Low	Moderate	Low	17%
Cichlidae	*Oreochromis*	*niloticus*	Low	Low	Low	0%
Cichlidae	*Pelmatochromis*	*buettikoferi**	Low	Moderate	Low	17%
Cichlidae	*Sarotherodon*	Unknown	Low	Moderate	Low	17%
Cichlidae	*Tilapia*	*louka* *	Low	Moderate	Low	17%
Clariidae	*Clarias sp*	Unknown	Low	Low	Low	0%
Mastacembelidae	*Mastacembelus*	*cryptacanthus**	High	High	High	100%
Mochokidae	*Chrysichthys*	*nigrodigitatus**	Moderate	High	Moderate	67%

Note: (*) denotes relatively uncertainty to identify to species

5.9.4.1 Characids represented by the Brycinus nurse collected in the study

This is a large family of African and South American freshwater fishes (Skelton, 2001). The Characidae family is identified by having sharp teeth and a small adipose fin. According to Skelton (2001) there are 18 genera and over 100 species of African characins confined to tropical water. They are considered to be a shoaling species.

5.9.4.2 Cichlidae family or Cichlids of which four were collected in the study

Cichlids form a very large family of fishes found throughout Africa, in South and Central America, Madagascar, Arabia and India (Skelton, 2001). They are considered to be an important source of food throughout the region and are an attractive aquarium fish that is cultured and relocated to all regions of the world. There are over 800 known species of Cichlids in Africa specifically from the great lakes in Africa. In this survey four Cichlids species were obtained and photographs of the sampled species are presented in Error! Reference source not found..

5.9.4.3 Clariids represented by the one Sharptooth catfish collected in the study

Clariids are found in Africa and Asia and are very important as aquaculture and fisheries species and as a targeted angling species. They are very hardy or tolerant and can often outlast many other fish in desiccating environments. They have a distinct bony helmet-like head and an elongated body with long dorsal and anal fins (Skelton, 2001). In Africa 12 genera and 74 species are known. In this study, a single Sharptooth catfish (*Clarias sp*) was collected from the Meya River system. A photograph of the sampled *Clarias sp* is presented in Error! Reference source not found.. These fish are extremely tolerant and are able to take advantage of adverse environmental conditions.

5.9.4.4 Mastacembelidae or Spiny eels represented by one species in the study

This slender eel like fish has an unusual rostral appendage and a series of detached spines along the back in front of the soft dorsal fin (Skelton, 2001). They are found in various freshwater environments in tropical Africa and Asia with two genera and about 45 species found in Africa (Skelton, 2001). In this study one species of Spiny eel (*Mastacembelus cryptacanthus*) was collected from the Meya System (Error! Reference source not found.). These Spiny eels are known to be sensitive to modified water quality and have specialist habitat requirements. The occurrence of this fish suggests that habitat availability and diversity as well as water quality states are suitable in the Meya River to maintain an acceptable fish community.

It is important to note that *M. cryptacanthus* has not been recorded in this region of West Africa and the presence of this species is indicates this to be a considerable range extension (SAIAB, 2011) which should be further investigated.

Mochokideans are endemic to Africa where 10 genera and approximately 170 species have already been identified. Distinct features of this family include their complex mouths and tough spines in the dorsal and pectoral fins. They can be difficult to identify due to the wide variation in features like colour patterns, teeth and barbells (Skelton, 2001). These species are known to be habitat specialists and were collected within riffle, rapid areas of the sites considered. In this study, only *Chrysichthys nigrodigitatus* was sampled from the Meya River system.

5.9.4.5 Considerations of the sensitivities of fishes obtained in the study

In this study a simple scoring system was used to score the possible sensitivities or preferences of the fishes collected to impaired water quality states, modified habitats and flow regimes. Results in Table 5-5 show that the fishes collected in the study have been determined to have a wide range of sensitivities to water quality modifications with all of the Cichlidae species and the *Clarias sp* having a "low" preference or determined to be insensitive to water quality and only the *Mastacembulus sp* being allocated a "high" score, determined to be a sensitive species. The habitat assessment revealed that only *O. nilotcus* and *Clarias sp* were determined to have a "low" score for habitat, while the *Mastacembulus sp* and *C. nigrodigitatus* received "high" scores. Most of the Cichlidae species and *B. nurse* received "moderate" scores. *B. Nurse, Clarias sp* and all of the Cichlidae species received "low" scores for flow preference. *C. nigrodigitatus* received a "moderate" score and *Mastacembulus sp* received a "high" score. The "high" sensitivity scores recorded for the flow component are surprising when considering the extreme low flow conditions experienced during the survey. No clear relationships between sites and these ecosystem components (water quality, habitat and flow) were observed.

In consideration of overall sensitivities, findings in Figure 8-8 initially reveal the total dominance of tolerant to extremely tolerant species for the Meya River system. In spite of this, a "sensitive" species as well as an "Extremely Sensitive" species was also sampled from the system. The abundances of the two sensitive species was extremely low with only a single species of each being sampled which constituted less than 1% of the sample population. In spite of this, it is encouraging to note that species considered to be sensitive to various driving components are present within the system in spite of the impacts on the system.

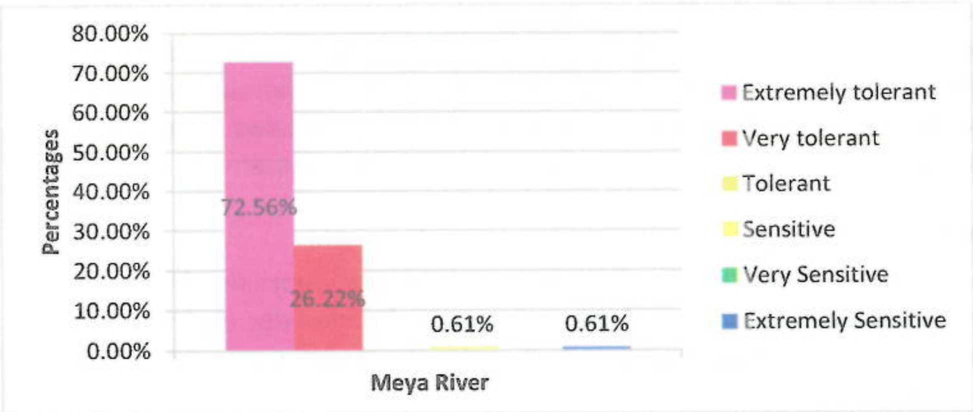


Figure 5-4: Percentage contribution of total sensitivities of fishes collected at each site

5.9.5. Conclusion

The water resources associated with the project area are in a largely impacted state when compared to natural reference conditions. This is in accordance with findings published by the US AID (US AID, 2007) stating that the water resources of Sierra Leone have been impacted on by rudimentary farming techniques and artisanal mining activities. The impacted water resources are largely representative of the adjacent and surrounding areas which have also been impacted on by local users.

The Koidu Kimberlite Mine has not impacted directly on the integrity of the Meya River with impacts most notably originating from the local water users and artisanal miners. In spite of this and in light of the proposed KKP expansion project, the Meya River should be considered for future monitoring objectives.

The wetlands associated with the project area have largely been formed due to mining activities and profiling in the area extending over a 70 year period. Thus the wetlands are not necessarily representative of historical natural reference conditions. In addition to this, the delineated wetland areas have been considerably impacted on by historic mining activities as well as by local artisanal mining operations. The placement of agricultural fields by locals within the wetlands has also impacted on the systems, but the severity is considered to be less severe than that of the artisanal mining operations.

The study component conclusions pertaining to each of the specialist study components are presented separately in the subsequent sections.

5.10. Wetland systems

5.10.1. Wetland delineation

The wetland area was delineated whereby features such as soil, vegetation, topography and hydrology were collectively considered (Plan 10). The extent of the artisanal mining and agricultural activities within the system is a concern.

5.10.2. Wetland unit characterisation

The wetland unit associated with the Koidu mining project area was initially identified at desktop level and then ground truthing was conducted to confirm these findings. The wetlands in the study area are linked to both perched groundwater and surface water. A single HGM type of natural wetland system occurs within the area assessed. The HGM unit identified for the project area is an unchanneled valley bottom wetland system.

5.10.3. Wetland unit setting

The identification of various wetland units is often characterised by the position of the units in the landscape and the general topography of the survey area. A schematic diagram of how the identified wetland unit for the project area is positioned in the landscape and the general topography of the study area is illustrated in Figure 5-5. A description based on the setting of the identified HGM unit in the landscape and the associated hydrologic components is presented in Table 5-22.

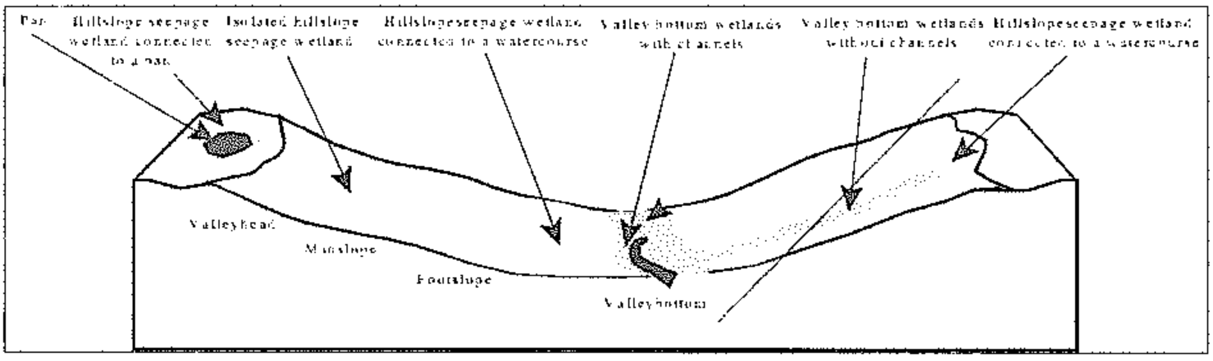


Figure 5-5: A schematic illustration of the HGM wetland types identified for the study area

Table 5-22:The definition of the different HGM wetland types occurring in the study area [based on the system first described by Brinson (1993) and modified by Marneweck and Batchelor (2002), and further developed by Kotze, Marneweck, Batchelor, Lindley and Collins (2004)]

	TOPOGRAPHIC SETTING	DESCRIPTION	
Valley bottom wetlands without channels	Occur in the shallow valleys that drain the slopes	Valley bottom areas without a stream channel. Are gently or steep sloped and characterized by the alluvial transport and deposition of material by water.	
	HYDROLOGIC COMPONENTS		
	Inputs	Throughputs	Outputs
	Receive water inputs from adjacent slopes via runoff and interflow. May also receive inputs from a channelled system. Interflow may be from adjacent slopes, adjacent hillslope seepage wetlands if these are present, or may occur longitudinally along the valley bottom.	Surface flow and interflow.	Variable but predominantly stream flow.

5.10.4. *Description of unchanneled valley bottom wetlands*

This type of wetland resembles a floodplain in its location and gentle gradient, with potentially high levels of sediment deposition (Kotze *et al.*, 2007). Extensive areas of these wetlands remain saturated as stream channel input is spread diffusely across the wetland even at low flows (Kotze *et al.*, 2007). These wetlands also tend to have a high organic content. Facultative wetland indicator plant species, comprising a mixture of grasses and sedges, are evident as longitudinal bands within a relatively narrow zone along the valley bottoms. Facultative wetland plant species usually grow in wetlands (67-99% of occurrences) but occasionally are found in non-wetland areas. Lateral seep zones form part of the adjacent hillslope seepage wetlands, this is a characteristic for all the valley bottom wetlands. The primary drivers for these systems, owing to the shallow gradients along the valley bottoms are diffuse horizontal surface flow and interflow. There is generally a clear distinction in the transition in the vegetation structure between the mixed grass-sedge meadow zones that characterise these wetlands to the more intermittently wet grassland habitats associated with the adjacent hillslope seepage wetlands (Kotze *et al.*, 2007).

5.10.5. *General wetland functional description*

Valley bottom wetlands without channels also offer a service in the enhancement to the quality of water. This is with respect to the removal of toxicants and nitrates. This removal is higher than in valley bottom wetlands with channels owing to the greater contact of the wetland with runoff waters, particularly if there is a significant groundwater contribution to the wetland (Kotze *et al.*, 2007). According to Cronk and Siobhan Fennessy (2001) and Keddy (2002) the phosphate retention levels may be lower because a certain amount of phosphate may be re-mobilized under prolonged anaerobic conditions. These wetlands provide an additional service in trapping and the retention in the wetland itself of sediment carried by runoff waters. Valley bottom wetlands without channels reduce the flooding potential as a result of diffuse flows over the surface of the wetland, thereby reducing the severity of floods downstream. This depositional environment is created by the surface roughness caused by the vegetation. The depositional environment is enhanced through the presence of dams. These wetlands provide valuable grazing ground during winter periods and early spring as a result of extended periods of wetness

5.10.6. *Ecological functional assessment*

The general features of the wetland unit were assessed in terms of functioning and the overall importance of the hydro-geomorphic unit was then determined at a landscape level. The level of functioning supplied by the hydro-geomorphic unit for various ecological services for the project area is presented in Table 5-23. The result from the "WET-EcoServices" tool for the respective wetland unit is presented below in

Figure 5-6.

Table 5-23: A listing and scoring of ecological services offered by the HGM unit identified for the project area

Ecological service	Valley bottom wetland without a channel Overall Score
Flood attenuation	1.3
Streamflow regulation	0.9
Sediment trapping	1.1
Phospahte trapping	1.2
Nitrate removal	1.1
Toxicant removal	1.0
Erosion control	0.8
Carbon storage	0.9
Maintenance of biodiversity	0.5
Water supply for human use	1.0
Natural resources	0.8
Cultivated foods	3.3
Cultural significance	1.0
Tourism and recreation	0.3
Education and research	0.1

Note: Moderately high importance (3 – 4)
Intermediate importance (2 – 3)
Moderately low importance (1 – 2)
Low (0 – 1)

The identified wetland unit provides a variety of ecological services of varying importance. The majority of the services provided were determined to be of low ecological importance. Some of the assessed services considered for water quality enhancement such as phosphate trapping and nitrate removal were determined to be of moderately low importance.

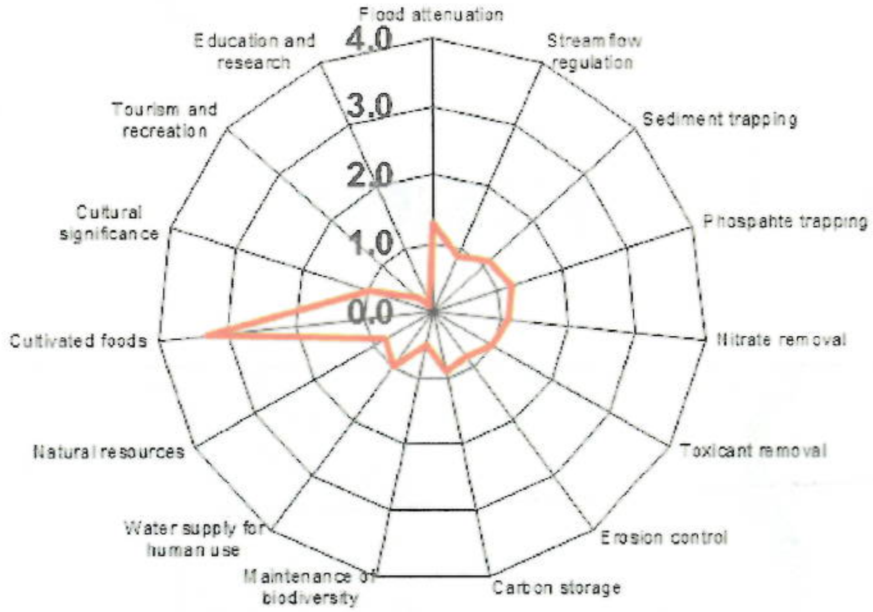


Figure 5-6: Radial plot of functions performed by the identified wetland unit

This is important to note due to the fact that unchanneled valley bottom wetlands contribute considerably to the improvement of water quality for such a system. The provision of "cultivated foods" by the system was determined to be of moderately high importance. This may be attributed to the dependence of local villages on these systems for their potatoes and rice plantations. It may be concluded that the placement of these plantations into the system has affected the ability of these systems to enhance water quality and this may provide an opportunity for the KKP to rehabilitate these areas in order to restore ecological functioning to the catchment.

5.10.7. Conclusion

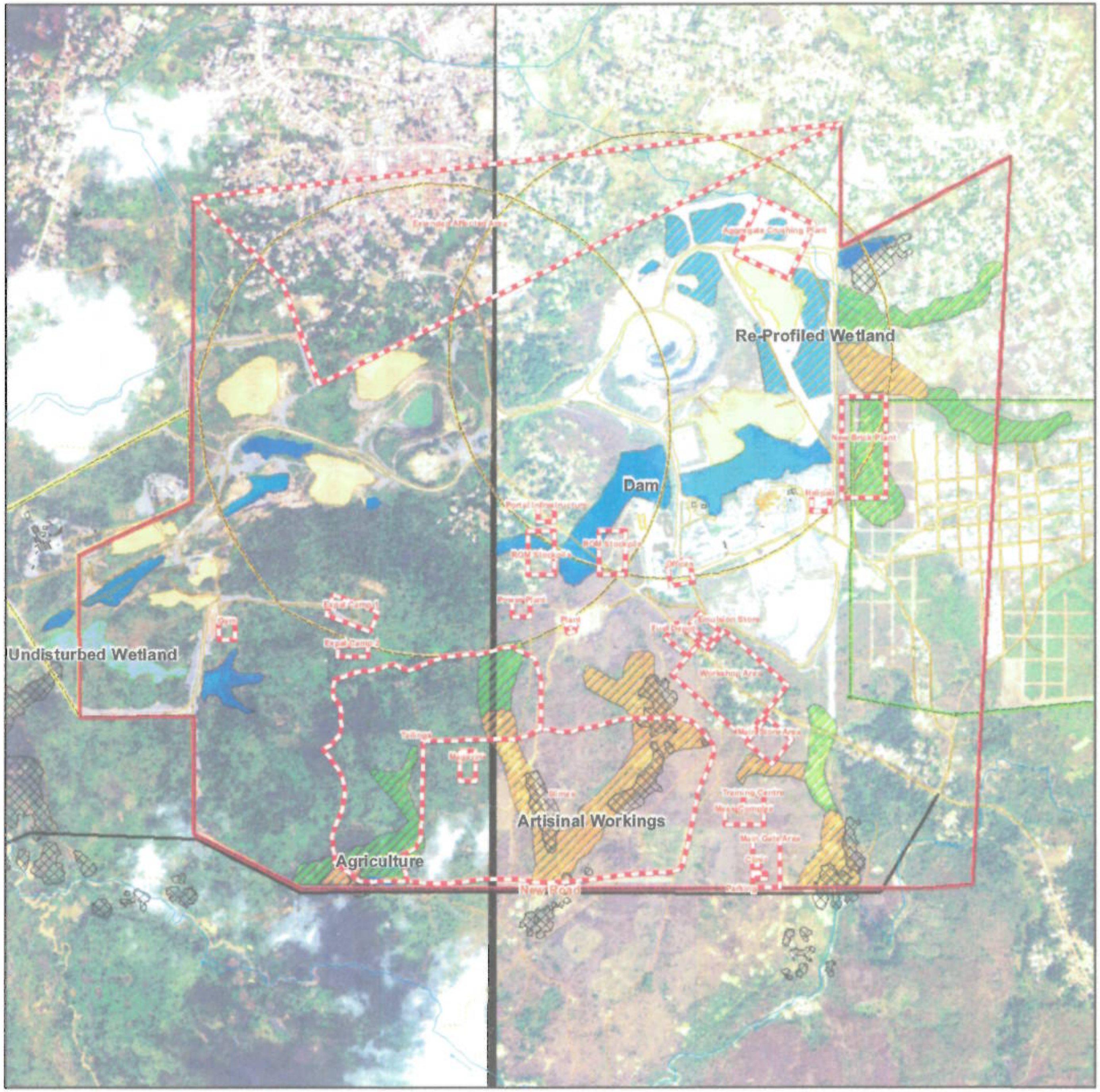
The wetland system assessed for the project area has largely been formed due to extended periods of commercial and artisanal mining as result of artisanal pit creation and profiling. In addition to this, the current land uses, namely artisanal mining and agricultural activities have impacted considerably on the functioning and integrity of this system. Thus important ecological services pertaining to the enhancement of water quality and the maintenance of biodiversity have been lost. The severity of the associated impacts is considered to be severe.

The prevention of agricultural and artisanal mining activities within the wetland systems within the Project area would provide an opportunity for these systems to potentially recover. Thus, long term objectives would need to be defined for these systems in order to ensure that none or limited future impacts are imposed onto these systems so as to assist the recovery of ecological integrity and functioning for the catchment. The Koidu Kimberlite Project would therefore be afforded the opportunity to contribute to the rehabilitation of these wetland areas.

Plan 10

Koidu Kimberlite Project

Wetland Types Identified



Legend

- Mining Lease Area
- Rivers
- Resettlement Boundary
- Camp Extension
- New Road
- Paths
- Roads

Mine Plan

- Blast Radius
- Dumps
- Mine Buildings
- Offices
- Water Pools
- Artisinal Workings

Wetlands

- Agriculture
- Artisinal Workings
- Dam
- Re-Profiled Wetland
- Undisturbed Wetland
- Water Areas

DIGBY WELLS ENVIRONMENTAL
Tel: +27 11 789 9495

Projection: UTM 29 N WGS84
False Easting: 500000m
Central Meridian: 9°W

Ref #: amc.RES965.201104.014
Revision Number: 4
Date: 04/05/2011

N

0 100 200 400 600
Metres
1:12,500

5.11. Surface Water

5.11.1. Rainfall

The Koidu area is extremely wet with about 2 600 mm of rain falling during the year. Approximately 2 400 mm falls within an eight month period from April to November with five of the months exceeding 300 mm. The rainfall measurements between 2005 and 2010 that were recorded at the project site are summarised Table 5-24.

Table 5-24 : Rainfall measurements at the Koidu Kimberlite Project, 2005 – 2010

Month	Rainfall (mm)						Monthly statistics			
	2005	2006	2007	2008	2009	2010	Mean	1 σ	CV	% of total
January	-	0	0	0	0	0	0	0	-	0%
February	-	0	9	105	95	20	46	50	109.4%	1.7%
March	-	68	0	126	124	97	83	52	62.7%	3.2%
April	93	159	113	229	80	178	152	58	38.1%	5.8%
May	178	218	147	145	158	315	197	30	15.4%	7.5%
June	153	309	246	219	333	402	302	73	24.1%	11.5%
July	153	481	430	361	500	150	384	142	36.9%	14.6%
August	150	402	571	590	550	321	528	86	16.2%	20.1%
September	290	36	629	402	363	-	465	244	52.6%	17.6%
October	325	482	327	307	416	-	383	81	21.2%	14.5%
November	229	72	85	59	156	-	93	43	46.6%	3.5%
December	7	0	0	3	2	-	2	2	237.7%	0%
Total	-	**2 655**	**2 556**	**2 545**	**2 776**	**1 161**	**2 632**	-	-	**100%**

The evapo-transpiration for the area is approximately 1 400 mm and therefore there is significantly more rainfall than there is runoff at the mine and spillages and discharges will occur (UNDP/FAO- TR5, 1980).

5.11.2. Rainfall statistical analysis

A statistical analysis was done on rainfall data for the last 4 years, as well as 1 day data, that were available for the Koidu site in Sierra Leone. The mean annual precipitation for the study areas was determined from the rainfall data as 2 600 mm for the catchments. The adopted 1 day rainfall depths of the respective areas for the various return periods are given in Table 5-25.

Table 5-25: Adopted design rainfall

Duration	Return Period Rainfall (mm)						
	1:2	1:5	1:10	1:20	1:50	1:100	1:200
1 day	122	155	181	209	251	288	330

5.11.3. Catchment description

As outlined in the 2003 EIA, the project area lies within the Meya stream sub-catchment covering an area of about 188 km^2, which is a tributary of the Bafi River. Many of the streams which flow directly or indirectly into the Meya stream have their source at Monkey Hill and run through the project area. The regional drainage is from south to north.

The bulk of the water supply in the area comes from rivers, streams and swamps. The pH of the water in the major rivers in Sierra Leone ranges between 6.5 and 7 in the wet season and 6.2 and 6.5 in the dry season. The pH of water in the swamps ranges between 5.2 and 6.0. The pH for samples selected in the project area ranges between 6.4 and 7.6 with a mean value of 6.9.

The mine area has been divided into nine areas and each of the areas is described in more detail below. Figure 5-7 indicates the catchment boundaries while Figure 5-8 indicates the proposed and existing layout of the mine. Included in the mitigation measures are initial thoughts on the clean and dirty water diversions that will be updated during the next few weeks as more information is made available.

The catchments are summarised as follows:

- Catchment A includes the catchment to the south of the mine area. The catchment is presently minimally impacted upon by mining and the river flows to the south. In the future expanded mine this catchment will include the tailings dump, plant, offices, change houses, clinic and workshops and will form the hub of the mining;
- Catchment B includes the existing K1 pit and the water drains to the North West of the mining area;
- Catchment C in an area to the north west of the site and the river from catchment B flows into catchment C;
- Catchment D is to the west of catchment A and presently is not impacted upon by the mine but is in a catchment that is a possible site for the tailings dump. The river in this catchment flows to the south of the mine;
- Catchment E includes the present day plant area and main dam and the water exits the site to the east; and
- Catchment F G, H and I and smaller catchments presently flowing into the K2 pit.

5.11.4. Catchment characteristics

A catchment area is defined as the total area drained by a river or stream, measured from the mouth of that particular water body. Assuming an evenly distributed rainfall event, a bigger catchment in area will collect, and based on its slope, feed its water body with more water than a small catchment. This is one, amongst others, of the catchment characteristics such as, slope, vegetation cover, soil type, hydraulic length, etc that affect the volume of water running in a river given the type and duration of rain falling. The catchment sizes, their hydraulic lengths, and average slopes (measured from 10-85% of hydraulic length) are given in Table 5-26 below. Refer to Figure 5-7 for the delineated catchment areas.

Table 5-26: Catchment characteristics

Catchment name	Incremental area (km^2)	Longest watercourse (m)	10:85 slope (m/m)	Tc (hrs)	C-Factor
A	0.395	925	0.0076	0.37	0.401
B	0.638	1120	0.0339	0.24	0.401
C	0.034	350	0.0486	0.08	0.396
D	0.230	916	0.0677	0.16	0.396
E	0.573	1288	0.0023	0.74	0.421
F	0.011	158	0.0823	0.04	0.365
G	0.022	243	0.0206	0.09	0.417
H	0.3	248	0.0323	0.08	0.395
I	0.675	1 704	0.0017	1.03	0.378

Please note:

- These catchment characteristics were determined using 1m contour detail and aerial photographs in GIS.
- 10-85 slopes denote the slope of the catchment from a point 10% from the end point and 85% of the distance to the furthest point.
- Time of concentration denotes the length of time it takes for a raindrop to travel from the furthest point of the catchment to the outlet point.
- The runoff factor was adopted to describe the runoff response of the specific catchment to the design rainfall.

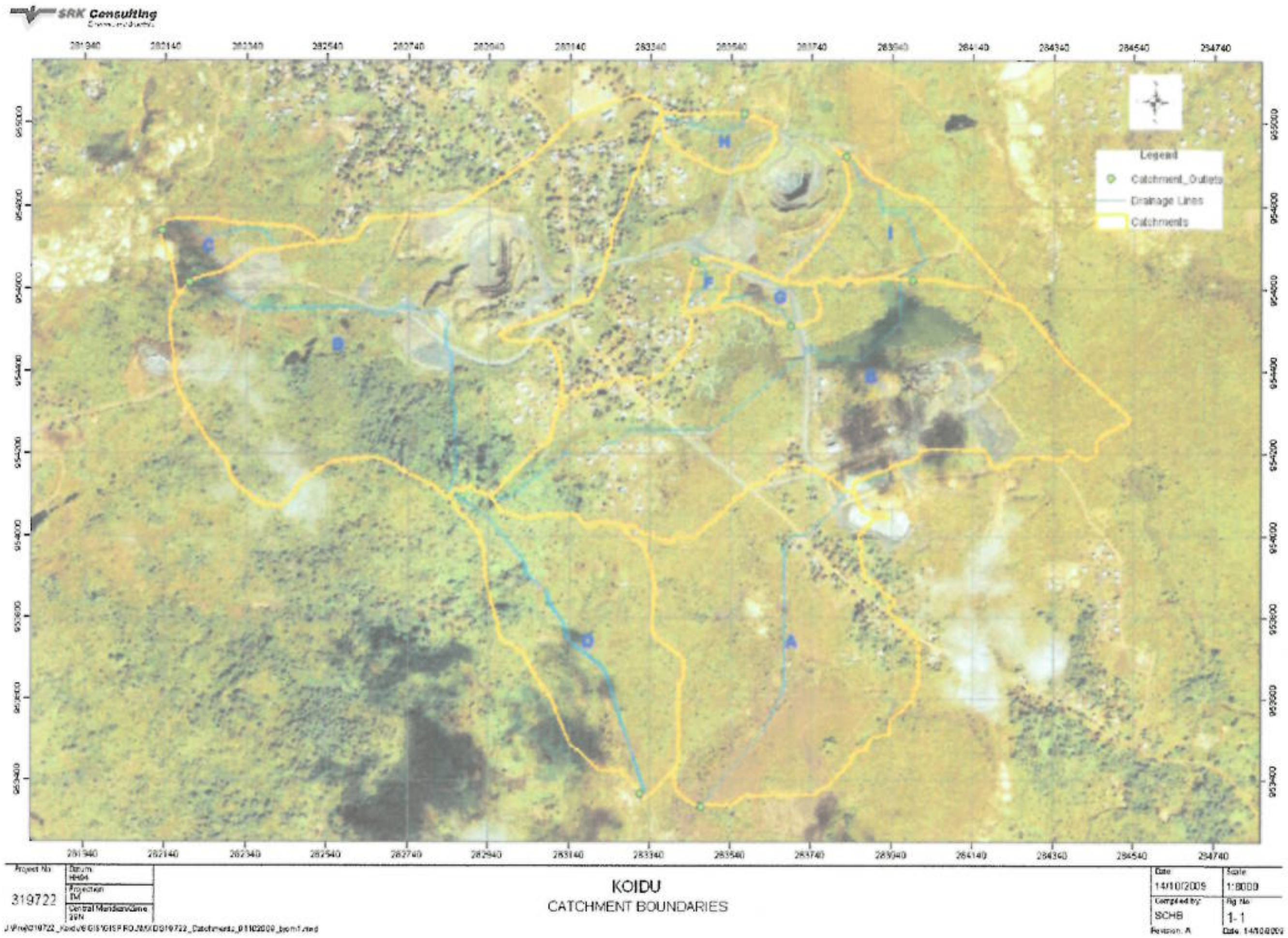


Figure 5-7: Catchment Boundaries for Water Course Outlets (SRK, 2009)

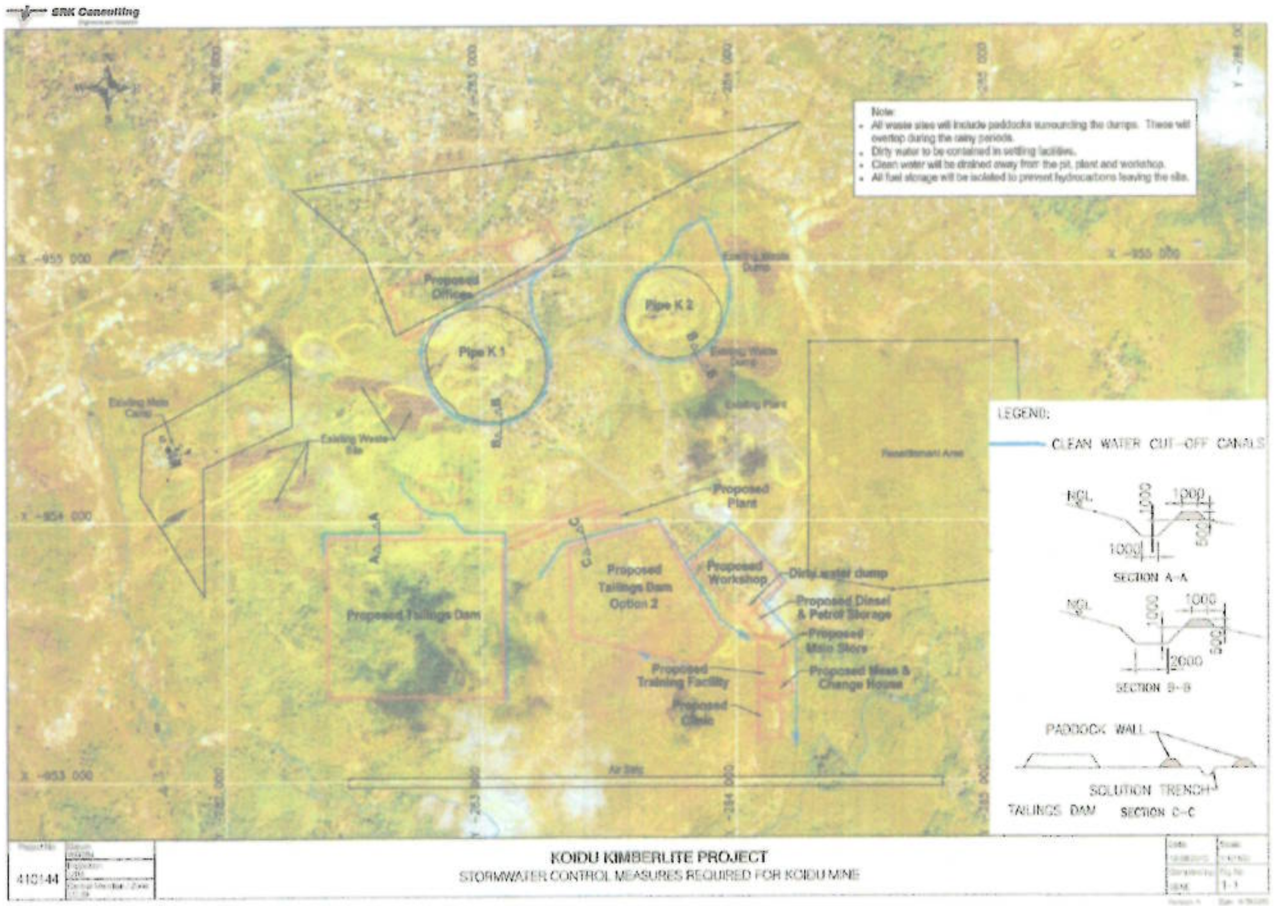


Figure 5-8 : Existing and proposed mine layout (SRK, 2010)

5.11.5. Flood hydrology

Flood hydrological methods used in this study include the Rational method and the SCS method. These models are suited for a catchment of these size ranges. The Universal Programs for Discharge software incorporates the Rational method and the VisualSCS software incorporates the SCS method. These programs were therefore used by SRK Consulting to model the flood peaks.

Table 5-27 below gives a summary of the 1:50 and 1:100 year flood peaks calculated using the methods described above.

Table 5-27: Summary of flood peaks

Catchment name	Area (km^2)	Return period years (m^3/s)						
		2	5	10	20	50	100	200
A	0.395	6.60	9.10	11.30	13.80	17.50	20.80	24.50
B	0.638	13.60	18.70	23.30	28.30	35.90	42.60	50.30
C	0.034	14.00	19.0	24.0	29.0	36.0	43.0	51.0
D	0.230	6.00	8.20	10.30	12.50	15.80	18.80	22.00
E	0.573	6.20	8.60	10.70	13.10	16.60	19.80	23.40
F	0.011	0.80	1.10	1.40	1.70	2.10	2.50	3.00
G	0.022	0.80	1.10	1.40	1.70	2.10	2.50	3.00
H	0.030	1.20	1.70	2.10	2.60	3.20	3.90	4.50
I	0.675	5.90	8.10	10.20	12.40	15.80	18.80	22.20

The adopted peak selected for all the catchments is based on the SCS T_C Method. This method produced the most conservative results and is a preferred method for catchments of these sizes.

5.11.6. Pit inflows

The runoff into the K1 pit has will be substantial during a storm event to about 38 000 m^3 for a 1:50 year storm (see Table 5-29 below). An in-pit sump will be required to cater for the 1:5 year, 1 hour storm rather than the 50 year event. This will mean that during larger storms water might be lying at the bottom of the pit for 8 to 10 days. Mining could continue on the higher benches but it will mean more water will seep into the underlying material.

5.11.7. Water quality

Surface and groundwater samples were at five locations within the Koidu mining lease area (Table 5-28). The hydrochemical analysis was undertaken by M&L Laboratories in Johannesburg and included major ions, pH, EC, TDS and an ICP scan for dissolved metals following filtering of the sample on site.

Table 5-28: Surface and groundwater monitoring points within the mining lease area

Sampling Point	Description	Co-ordinates
SW1	Near proposed new tailing dump	953299.227 283360.703 378.633
SW2	Discharge from dam below plant	954467.7 284120.21 382.549
SW3	Discharge from dam slurry dams	954553.43 284240.128 382.95
SW4	Stream down-gradient of pit	955141.481 283862.204 374.75
BH1	Borehole at main accommodation	954252.652 281810.302 386.821
BH2	Borehole at office complex	954221.822 283763.263 390.721
BH3	Borehole at resettlement	954597.873 284513.472 388.31
WBH2	Piezometer at K1 Pit	954563.462 282867.562 375.38
WBH5	Piezometer at K1 Pit	954748.97 283086.94 383.2

The following water quality results were obtained:

- Camp water supply (BH 1): The water quality is reflective of recent recharge with a calcium/bicarbonate signature, and no evidence of chemical contamination that might affect its use as drinking water (although it should always be disinfected for drinking). The water is moderately saline (as indicated by the Total Dissolved Solids – TDS) and moderately hard (as indicated by the calcium concentration). All constituents analyzed including dissolved metals and metalloids comply fully with the WHO Drinking Water Quality Guidelines (2008);
- BH 2, Near Plant: Low TDS and hardness, without indication of chemical contamination, and fully compliant with the WHO Guidelines (2008).
- BH3, Background groundwater quality: Water quality is reflective of recent recharge (calcium / bicarbonate signature), with moderately high TDS and acceptably low hardness, and fully compliant with WHO Guidelines (2008);
- SW 1, Background Surface Water Quality: Low TDS dominated by calcium and bicarbonate with other constituents at trace levels. The cation-anion imbalance at -8% is slightly high but explained by the trace levels of many of the cation and anions, analyzed at concentrations close to their analytical detection limits. Dissolved metals and metalloids are generally close to detection limits, apart from iron probably derived from suspended soil particles in a slightly acid water;
- SW 2 and SW 3, Water discharged from dam below the Plant (SW 2) and from slurry dumps (SW 3): These waters are essentially similar in composition with pH values slightly in the alkaline range and moderately high TDS values showing evidence of slightly elevated sulfate and nitrate values indicative of contact with mining wastes. The cation-anion imbalance for SW 2 is higher than desirable (orange shading) indicating minor under-recoveries of calcium and magnesium during analysis, although these are not considered significant. Despite these minor alterations to the

background water quality, these analyses remain fully compliant with the WHO Drinking Water Quality Guidelines (2008);

- SW 4, Surface water down-gradient of the Pit: Neutral water moderately low in TDS and hardness with no evidence of chemical contamination. Metals and metalloids remain in compliance with WHO Guidelines except for iron soluble iron and manganese which are widespread in these geological formations and probably leached from the suspended soil particles in the watercourse. At these levels the iron and manganese have nuisance value but no adverse health connotations. It is likely that the Fe and Mn in solution interfered slightly with the cation and anion analysis resulting in the rather high cation-anion imbalance, which is not considered significant; and
- WBH 5 and WBH 2, Piezometer holes adjacent to the Pit: This water complies with the WHO Guidelines except for elevated iron and manganese in WBH 5 and (of more concern) elevated dissolved lead at levels non-compliant with the WHO Guidelines (2008). The soluble lead indicates the presence of lead in the mineralogy around the Pit, and this should be noted in follow-up sampling of groundwater in the area.

Table 5-29 : Runoff into the K1 Pit

Return period	Runoff into K1 pit (24-hr storm)						
	2	**5**	**10**	**20**	**50**	**100**	**200**
Curve number	84.18	84.18	84.18	84.18	84.18	84.18	84.18
24 hour design rainfall (mm)	124.30	159.50	190.30	224.40	276.10	323.40	378.40
Runoff depth (mm)	85.41	118.24	147.56	180.41	230.73	277.11	331.29
Runoff from external catchment	7 119	9 856	12 299	15 037	19 231	23 097	27 614
Runoff from haulroads	6 038	8 359	10 431	12 754	16 311	19 589	23 420
Direct pit area volume	1 287	1 652	1 971	2 324	2 860	3 350	3 919
Total inflow into pit	**14 444**	**19 866**	**24 701**	**30 115**	**38 402**	**46 036**	**54 953**

Table 5-30 : Runoff into K2 Pit

Return period	Runoff into K2 pit (24-hr storm)						
	2	**5**	**10**	**20**	**50**	**100**	**200**
Curve number	84.18	84.18	84.18	84.18	84.18	84.18	84.18
24 hour design rainfall (mm)	124.30	159.50	190.30	224.40	276.10	323.40	378.40
Runoff depth (mm)	85.41	118.24	147.56	180.41	230.73	277.11	331.29
Runoff from external catchment	4 473	6 193	7 728	9 449	12 084	14 513	17 351
Runoff from haulroads	3 794	5 252	6 554	8 014	10 249	12 309	14 716
Direct pit area volume	809	1 038	1 238	1 460	1 797	2 105	2 463
Total inflow into pit	**9 076**	**12 483**	**15 521**	**18 923**	**24 130**	**28 926**	**34 529**

5.12. Groundwater

A hydrogeological investigation was conducted in 2009-2010 in the Koidu mine area to define the hydrogeological framework of the area, to predict the groundwater conditions that will most likely be encountered during proposed mining, and to predict the potential impacts of mining and dewatering on groundwater resources in the vicinity of the mine. The field investigation included hydraulic testing in three coreholes drilled in the granite country rock adjacent to the K1 and K2 pits and a 3-day pumping test of the leached granite adjacent to the K2 kimberlite. The primary analytic tool for making the predictions was a 3-dimensional groundwater flow model.

The geohydrology is divided into the two main aquifer types present in the area, the upper weathered aquifer and the underlying fractured aquifer. The weathered aquifer consists of in-situ weathered host rock as well as transported material. The underlying fractured aquifer can be subdivided into the various geological units from which they are derived.

5.12.1. Hydrogeological Framework

The K1 and K2 pits and their planned underground extensions are within slightly fractured to massive granites with a bulk hydraulic conductivity ranging from 3 x 10-3 to 2 x 10-2 m/day. Hydraulic testing conducted in 2009 (HCltasca, 2009) indicate that the near-surface sub-horizontal (exfoliation) joints and the NNW-SSE striking high angle joints observable in the ramp to Blow A do not extend to depth, and thus have no hydrologic significance with respect to future mining.

The only hydrogeologic unit of significance is the so-called leached granite that forms an altered 10- to 30-m wide rind with a hydraulic conductivity of about 6 x 10-1 m/day around the K2 kimberlite.

5.12.2. Dewatering

The peak amounts of inflow, the approximation duration of the inflows, and the total volumes of water to be managed for the 50- and 100-year rainfall events (using data provided by SRK) are summarised in the following table for various stages of the mine.

Recurrence frequency(yrs)		**50**			**100**		
Mine	**Depth Interval (mamsl)**	**Peak inflow (m^3/hr)**	**Approx Duration (hrs)**	**Total Volume (m^3)**	**Peak inflow (m^3/hr)**	**Approx duration (hrs)**	**Total Volume (m^3)**
K1	above 0	4,500 - 8,000	48	38,000	5,500 - 13,000	48	46,000
	-40 to -100	8,000-15,000	24		10,000-17,000	24	
	-120 to -160	12,000 - 16,000	12		17,000 - 12,000	12	
K2	above -30	1,800 4,500	72	24,000	4,500 – 9,000	48	42,000
	-70 to 130	2,000 -	48		3,000 –	48	29,000

Recurrence frequency(yrs)		50			100		
Mine	Depth interval (mamsl)	Peak inflow (m^3/hr)	Approx Duration (hrs)	Total Volume (m^3)	Peak Inflow (m^3/hr)	Approx duration (hrs)	Total Volume (m^3)
		5,000			6,500		
	below - 150	2,800 - 5,200	48		3,500 – 6,200	48	

These are quite large inflows and volumes of water. Koidu has designed pumping their pumping systems based on the information above.

As a result of the overall low hydraulic conductivity of the granite country rock, the predicted mine inflows will be managed passively (i.e., without any active dewatering) with two exceptions:

- The water contained in the near surface joints around the K1 kimberlite that was intercepted by wells installed by Aqua Earth in 2006 to help minimise inflow to the K1 vertical pit will be captured by a series of underground drainholes drilled from a dewatering ring at about the 250 mamsl level; and
- The leached granite will be pre-drained by a series of underground drainholes drilled into it from a dewatering ring around the K2 kimberlite at about the 150 mamsl level in order to depressurise the leached granite to improve slope stability in the pit, and to minimise inflow to the underground mine.

5.12.3. Depth of water table

It is expected that a difference in water table is present between the weathered and fractured aquifers. Eighteen water level measurements were taken in March 2003 and the level varied between 0.8 meter below ground level (mbgl) and 6.5 mbgl (Cemmats, 2003). All these measurements were taken in hand dug wells and are therefore believed to be indicative of the weathered aquifer water levels.

Within the No. 2 pipe the water levels is 296.7 mamsl according to the levels surveyed on site. This is expected to be an indication of the water levels within the kimberlite aquifer and the fractured granitic aquifer is expected to have a similar level.

5.12.4. Presence of boreholes, wells and springs and their estimated yields

Twenty two wells in the study area were investigated by Cemmats (2003), but this represents a sample of the wells and not the total number. The only indication of yield is the daily abstraction volume, which varies between 100 l/day and 2 500 l/d. These yields could also be a function of the number of people utilising the wells and test pumping is required to establish the yields.

The formations of springs are governed by the geology and are generally associated with a pinching out of the weathered aquifer by an impermeable layer, e.g. the underlying rock bed. No springs were recorded by Cemmats but surface water-groundwater interaction does occur in low-lying areas as is evident from the numerous low-lying areas that are marshland or are flooded. The weathered aquifer is expected to discharge in low lying areas, but this discharge may occur below the water level of the receiving body thereby not appear as a spring.

5.12.5. *Groundwater quality*

During a study conducted in 2009, the quality of potable water in the Koidu Holdings mining lease area was sampled and analysis. During this study the following parameters were measured:

- Physical parameters consisting of temperature, turbidity, conductivity and residual chlorine;
- Chemical parameters consisting of Iron, Manganese, Nitrogen, Sulphate, Copper, Aliminium, Magnesium, Ammonia, Bromine, Nitrate, Phosphate, Silicone, Sulphide and Clorine; and
- Bacterial parameters consisting of faecal coliforms.

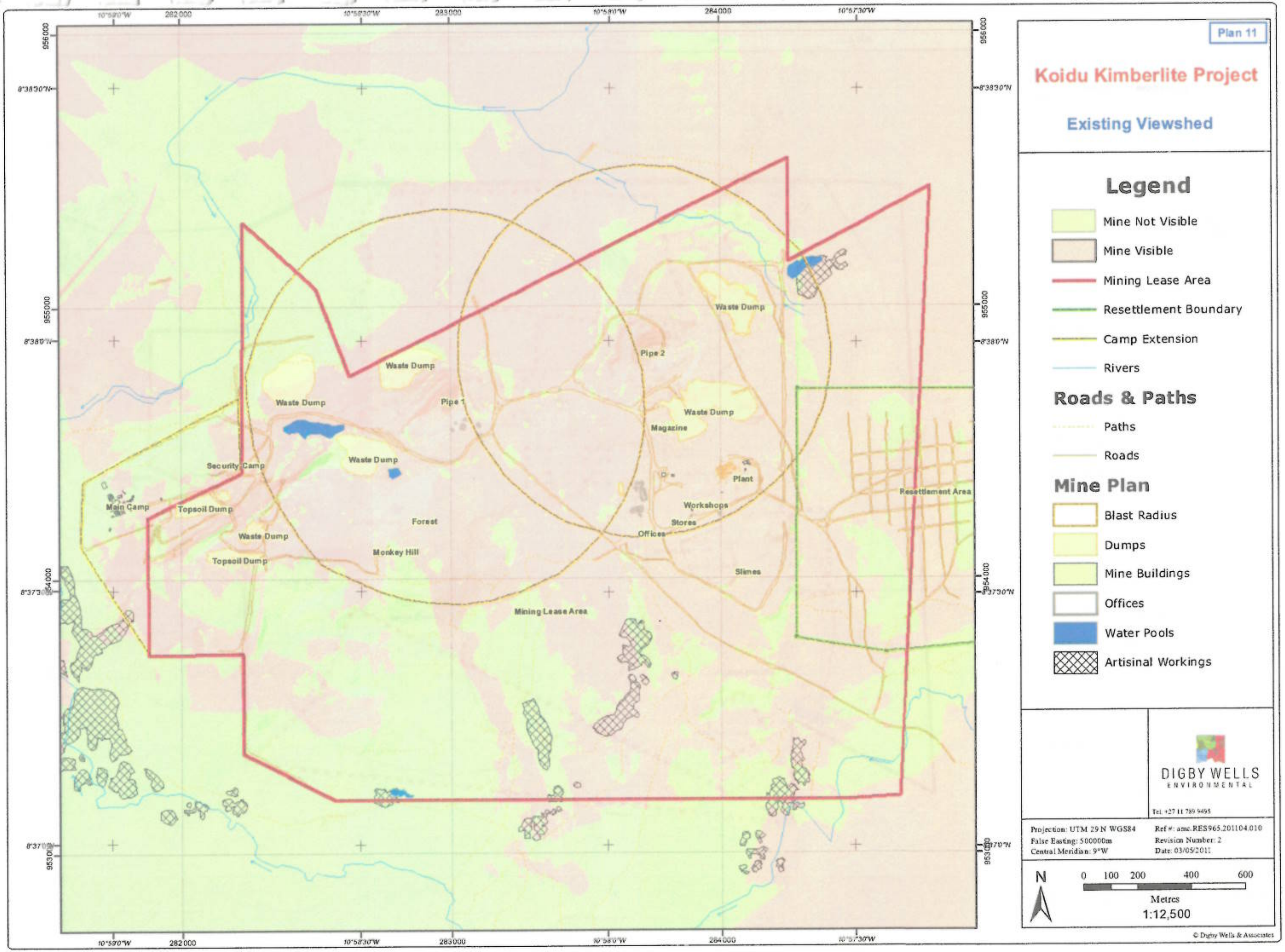
The analysis indicated that the measurements of the parameters tested were all within the permissible limits recommended by the World Health Organisation (WHO). It also indicated that the water had high chemical bacteriological qualities and is good for human consumption.

5.13. Visual

In order to assess the visual disturbance of the site, Viewshed modelling was employed. Within a Geographical Information System (GIS), a Digital Terrain Model (DTM) was created from contour information to digitally display the relief of the topography surrounding the proposed mine. This DTM was then used to create a theoretical viewshed model which is the total area that theoretically has a direct visual connection with the project based on topographical features. The theoretical viewshed model does not take into account aspects such as vegetation and atmospheric conditions such as haze or fog.

Plan 11 depicts the extent of the viewshed of the current mining activities, it is evident that the mine does have a high visibility within the local area already and that the area is already largely disturbed from an aesthetic point of view, largely as a result of mining activities conducted pre-2002.

Plan 12 depicts the viewshed model based on the proposed additional infrastructure in addition to the existing infrastructure The area surrounding Koidu Town is already historically aesthetically disturbed. This, together with the existing rehabilitation of vegetation within the mining lease area, reduces the potential visual impacts of the Koidu Kimberlite Project. The mine is also compatible with the area as there are mining operations all around and it is not near any historical or scenic site.



Plan 11
Koidu Kimberlite Project
Existing Viewshed
Legend
Mine Not Visible
Mine Visible
Mining Lease Area
Resettlement Boundary
Camp Extension
Rivers
Roads & Paths
Paths
Roads
Mine Plan
Blast Radius
Dumps
Mine Buildings
Offices
Water Pools
Artisinal Workings
DIGBY WELLS
ENVIRONMENTAL
Tel: +27 11 789 9495
Projection: UTM 29 N WGS84
False Easting: 500000m
Central Meridian: 9°W
Ref #: amc.RES965.201104.010
Revision Number: 2
Date: 03/05/2011
N
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Metres
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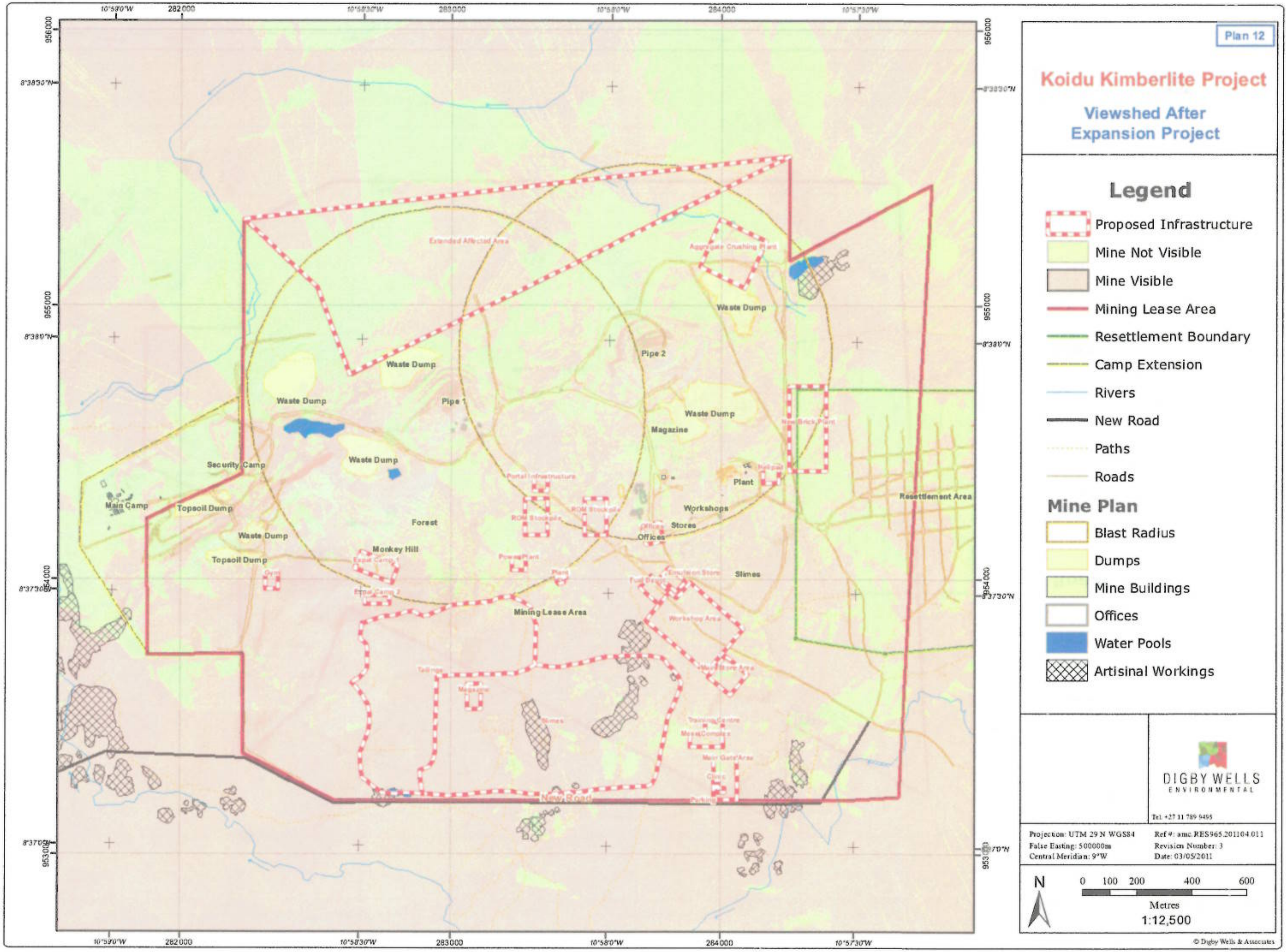
© Digby Wells & Associates
Waste Dump
Pipe 2
Pipe 1
Magazine
Plant
Workshops
Stores
Offices
Slimes
Resettlement Area
Security Camp
Main Camp
Topsoil Dump
Forest
Monkey Hill
Mining Lease Area
10°59'0"W
282000
10°58'30"W
283000
10°58'0"W
284000
10°57'30"W
956000
955000
954000
953000
8°38'30"N
8°38'0"N
8°37'30"N
8°37'0"N



Plan 12
Koidu Kimberlite Project
Viewshed After Expansion Project
Legend
Proposed Infrastructure
Mine Not Visible
Mine Visible
Mining Lease Area
Resettlement Boundary
Camp Extension
Rivers
New Road
Paths
Roads
Mine Plan
Blast Radius
Dumps
Mine Buildings
Offices
Water Pools
Artisinal Workings
Waste Dump
Pipe 2
Pipe 1
Magazine
Plant
Workshops
Stores
Offices
Slimes
Forest
Monkey Hill
Security Camp
Main Camp
Topsoil Dump
Mining Lease Area
Resettlement Area
New Road
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Tel: +27 11 789 9495
Projection: UTM 29 N WGS84
False Easting: 500000m
Central Meridian: 9°W
Ref #: amc.RES965.201104.011
Revision Number: 3
Date: 03/05/2011
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5.14. Archaeology

5.14.1. Archaeological resources at the Koidu Kimberlite Project

As part of the environmental and social investigations required for the Koidu Kimberlite Project (Koidu Project), an Archaeological Impact Assessment (AIA) was conducted. The overall objective of the archaeological study was to use internationally recognised measures to identify, document and assess potential sites of archaeological and heritage significance in the project area in order to conserve, mitigate and manage heritage sites and artefacts according to the recommendations and criteria of the relevant heritage authorities and legislation.

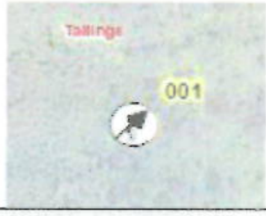
Three sites were identified during the fieldwork (Plan 13):

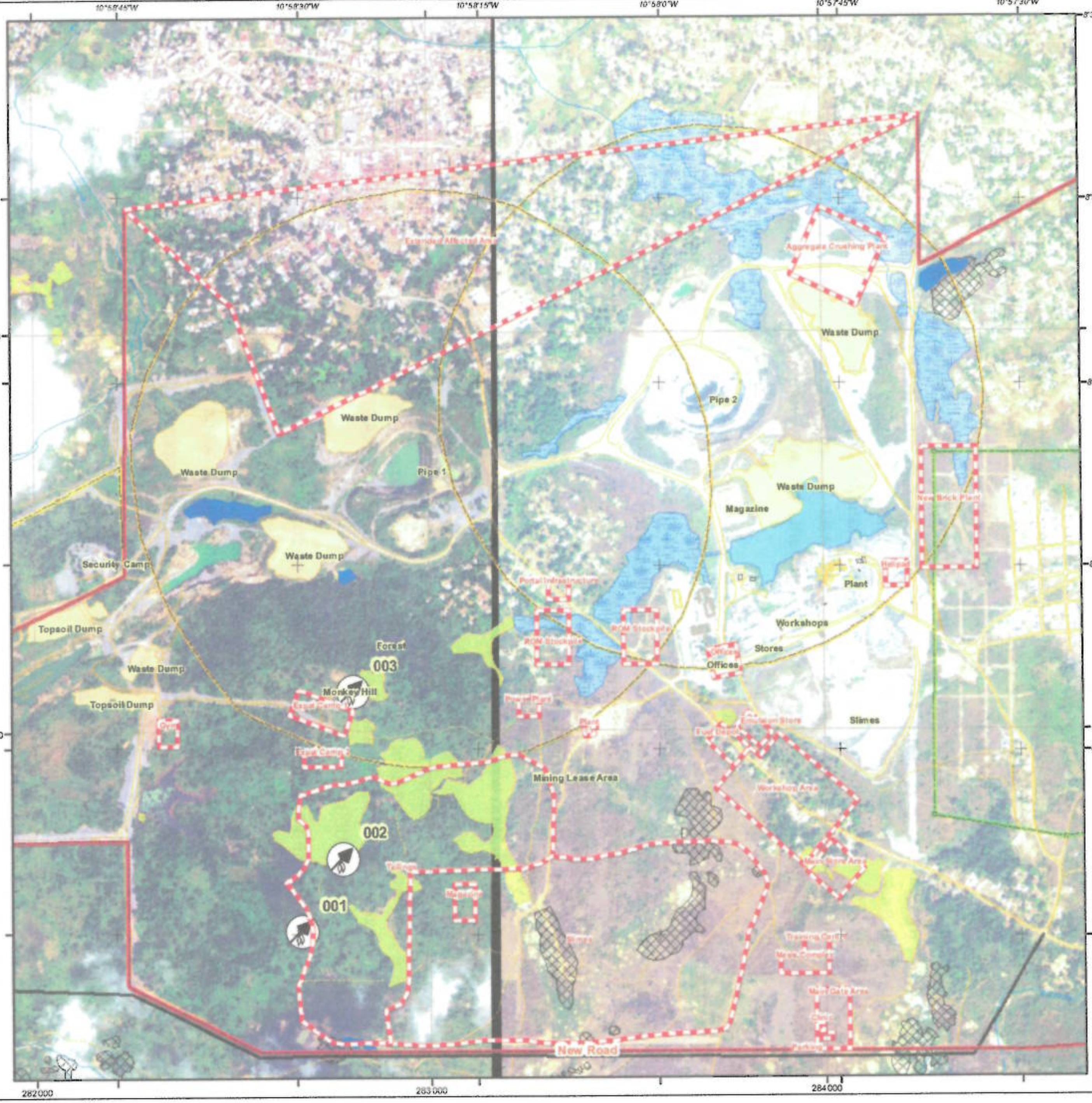
- A possible residential settlement on a low hill to the south-west of Monkey Hill. Potsherds found in close association with settlement deposit. There is evidence of potential vegetable gardens and house mounds that may be related to sites RES967/002 and 003.
- A metalworking site on the southern slope of Monkey Hill. Evidence of metalworking, especially iron reduction and smithing found. Artefacts include fragments of pottery vessels, tuyérè pipes (blow pipes), iron slag, bloom and ore. May be related to sites RES967/001 and 003. The site is at least 100 m^2 in extent. The site has been partly damaged and altered by agricultural activities, illegal woodcutting and other informal impacts by the local community.
- A metalworking site and possible residential settlement on the crest and upper slopes of Monkey Hill. Evidence of metalworking, especially iron and copper reduction found. Artefacts include fragments of pottery vessels, tuyérè pipes (blow pipes), iron slag, bloom and ore. May be related to sites RES967/001 and 002. The site seems to occupy the entire hilltop of Monkey Hill, and possibly also the upper 360° slopes of the hill. It may represent a type of fortified site as described by DeCorse (1981, 1983).

In order to assess the significance of the identified sites, a literature review and additional research were undertaken. This determined that a) there are known archaeological sites in the project area, and b) these sites may be significant in terms of the archaeological history of the area, as well as providing an understanding of the expansion and influence of West African cultures southwards. Currently, the significance of the sites identified has been preliminarily rated. Once dating and data capturing, which is currently being conducted, are complete, will the significance of these sites be defined. Table 5-31 outlines the three archaeological sites found within the Koidu Kimberlite lease area.

Currently, the significance and potential impacts were determined to be medium-high. However, the potential impacts can be mitigated in order to decrease the severity of these impacts. The recommended mitigation required is to excavate, sample, record, document and map the sites according to internationally accepted archaeological techniques and methods. Once this has been done, the appropriate significance rating can be assigned. As the sites have already been impacted on by local farming and artisanal mining activities, this recommended mitigation may be seen as a positive impact. Based on these results, it is recommended that archaeological mitigation should take place at all three sites. The environmental impacts will result in positive impacts if provision for the sampling, recording, documentation and analyses of the sites are made, as this information will contribute substantially to international research on West African archaeology and societies' histories.

Table 5-31: Archaeological sites found within the mining lease area

Site ID	GPS Location	Description	Illustration
RES967/001	*N8.62090 W10.97485*	A settlement - probably small homestead - on a low hill.	
RES967/002	*N8.62254 W10.97391*	Metalworking, notably iron, and possible settlement	
RES967/003	*N8.62631 W10.97370*	Metalworking, evidence of both iron and copper, and possible fortification.	



Plan 13

Koidu Kimberlite Project

Archaeological Sites

Legend

- Proposed Infrastructure
- Archaeological Sites
- New Road
- Paths
- Roads
- Mining Lease Area
- Resettlement Boundary
- Camp Extension
- Rivers

Mine Plan

- Blast Radius
- Dumps
- Mine Buildings
- Offices
- Water Pools
- Artisinal Workings

Land Use

- Cultivated Land
- Dams
- Swamps

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Projection: UTM 29 N WGS84
False Easting: 500000m
Central Meridian: 9°W

Ref #: amc.RES965.201104.007
Revision Number: 3
Date: 03/05/2011

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6. DESCRIPTION OF THE SOCIAL ENVIRONMENT

6.1. Background

At the time of the re-establishment of the Koidu Kimberlite Project in 2003, Sierra Leone was recovering from a particularly brutal civil war which had seen massive displacement and forced removal of the civilian population, particularly in the diamond rich Kono District. The war caused widespread destruction of infrastructure, dwelling structures and agricultural land. Kimberlite pipes near Koidu Town were left relatively untouched during this time, as the exploitation of these requires considerable capital resources and technical expertise. However, all mining equipment and infrastructure left on site at the beginning of the civil war were completely destroyed.

The resettlement of a significant number of households residing in the 2003 mining lease area required the development of a Resettlement Action Plan (RAP) for implementation prior to and during the exploitation of the deposits. A detailed RAP was developed in 2003, which was in line with the World Bank Standards at the time. In support of the RAP, a household and agriculture survey was undertaken with directly affected households and construction of replacement houses for affected households commenced in 2004.

From 2003 to 2007 the Koidu Kimberlite Project experienced various challenges in managing the impacts of the mine on surrounding communities. This was compounded by the need to maintain security, access control and a safe working environment in line with international norms for the diamond industry. In December 2007, mining operations were suspended for several months following civil unrest in the project area. The Sierra Leonean government subsequently reviewed the then mining lease agreement and after extensive consultation between stakeholders, a formal agreement between Koidu Holdings (KH) the Government of Sierra Leone, directly affected parties and the Tankoro Native Administration was signed in 2008.

When mining activities resumed in 2008, a second household survey of the lease area was undertaken to ensure that all households within the 250 meter blasting buffer zone were surveyed. At present, all the households within the 2010 confirmed mining lease area have been surveyed and they form part of the 2003 RAP as amended and agreed upon in August 2009.

A total of 144 replacement houses have been constructed between January 2004 and April 2011. Construction delays have plagued the resettlement process since 2004, with result that 112 households still have to be resettled. Koidu Holdings has now adopted stringent measures in order to finalise the resettlement process.

All replacement houses are provided with Ventilated Improved Pit latrines (VIPs) and shower facilities on the residential stand. All affected households have also been compensated for the loss economic trees. Community facilities in the resettlement village include community taps, a market and a recreational field.

6.2. Political Context

The Republic of Sierra Leone is situated in West Africa. It is bordered by Guinea to the north and east, Liberia to the south-east, and the Atlantic Ocean to the west and south-west. The country covers a total area of 71,740 km^2 and had an estimated population of 4.9 million in 2004 (Sierra Leone Population and Housing Census, 2004).

The British entered Sierra Leone in 1787 in search of natural resources and land for repatriated and shipwrecked slaves from Great Britain and the United States of America The country was established in 1792 and became a British colony in 1808. Under British colonial rule Sierra Leone became a major trading site, as well as a source of resources such as iron, palm kernel, diamonds, gold and chromites. Diamonds were unearthed in the Kono District of Sierra Leone since the 1930s.

During the mid 1950s, British rule gradually diminished as Great Britain handed over government responsibilities to the Sierra Leoneans. The country became independent in 1961.Over time, the government became increasingly centralised which resulted, amongst other factors, in the neglect of rural communities. Corruption, deprivation and the abuse of power have led to political instability and poor economic growth. This has led to the brutal and destructive civil war between 1991 and 2001. The war officially ended in 2002.

6.3. Project Location

The Koidu Kimberlite Project is located in the Kono District of Sierra Leone. The Kono District is located in the eastern part of Sierra Leone. The administrative capital is Koidu Town. The District is bordered by Kenema and Kailahun districts to the south, Tonkolili and Koinadugu districts to the east and Koinadugu District to the north respectively. It has a land size of about 5,641 km^2 and is densely populated.

The Koidu Kimberlite Project is located near Koidu Town in the Tankoro Chiefdom of the Kono District. The project area is surrounded by six settlements, namely, New Sembehun, Saquee Town, Sokogbe, Swarray Town, Yormandu and Manjamadu (the resettlement site). These settlements fall within or border on the existing mining lease area. Other neighbouring settlements are Old Meama, Wordu and Kanya.

The Extended Affected Area is approximately 58 ha and is situated at the southern limits of Koidu Town, to the north of the mining lease area (Figure 6-1) Three townships will be affected by the proposed expansion project (excluding potential host communities at resettlement sites). These townships are Saquee Town, Yormandu and New Sembehun. They partially fall within the extended 500 m blasting envelope, and the houses located within this area will have to be resettled. According to current planning all residential houses, businesses and public/community facilities affected in the Extended Affected

Area will be replaced. A comprehensive RAP is currently being developed for the Extended Affected Area.

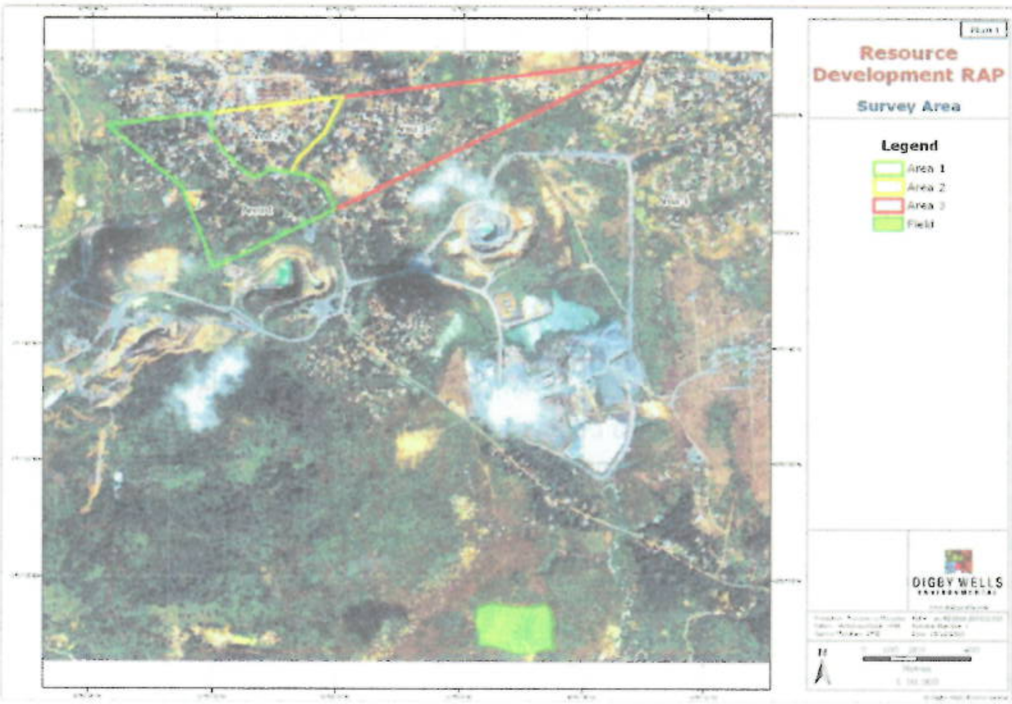

Figure 6-1: Extended Affected Area

6.4. Legislative Framework

The legislative framework relevant for this ESIA report is discussed in Section 3.

6.5. Administrative Framework

Administratively, Sierra Leone is divided into four distinct areas; the Northern Province with its headquarters in Makeni, the Southern Province with Bo as its headquarters, the Eastern Province with Kenema as its headquarters and the Western Area comprising the Freetown Peninsular with Freetown as its headquarters.

<u>Provincial government</u>

Provincial administration is governed by the Ministry of Local Government and Rural Development. The Minister is assisted by a Resident Minister in each of the provinces whose offices are in the respective provincial headquarter towns. The resident ministers are assisted by provincial secretaries. Provinces are divided into districts which are divided into chiefdoms headed by Paramount Chiefs.

District government

Following the enactment of the Local Government Act of 2004, decentralized governance was re-introduced in Sierra Leone in 2004. Local councils were established and a number of activities and functions of government ministries, departments and agencies (excluding the Sierra Leone Police and the Armed Forces), were devolved to district councils. The Ministry of Local Government and Rural Development coordinates district councils and oversees decentralization of local government reform. District administration is carried out by district councils.

The Kono District capital is Koidu Town (also referred to as Koidu-New Sembehun City in order to include more recent township additions). The District comprises 14 chiefdoms, 70 sections, eight parliamentarian constituencies and 29 wards and 36 townships. They are responsible for the overall management of the districts including the provision of critical social services to the population. Local administrators assist the councils.

Local Government

The Local Government Act of 2004 provides for Local and/or Town Councils, which are the highest political authority in the locality, with legislative and executive powers, and the responsibility for promoting the development and welfare of the people in the locality with the resources at its disposal.

The Local Council is responsible, among other things, for:

- Mobilising human and material resources necessary for the overall development and welfare of the people of the locality;
- Promoting and supporting productive activity and social development;
- Initiating and maintaining programmes for the development of basic infrastructure and provide works and services;
- Initiating, drawing up and executing development plans for the locality;
- Overseeing Chiefdom Councils in the performance of functions delegated to them by the local councils; and
- Determining the rates of local taxes, approving the annual budgets of Chiefdom Councils and overseeing the implementation of such budgets.

Local councils play an important role in the management of its development programmes and the collection of licenses and taxes within their localities. Generally, mining surface rent payments are made to local authorities as compensation. Cash compensation is also paid for housing and cultivation within the surface rent area, should relocation of these be necessary.

Koidu Town is administered by the Koidu-New Sembehun City Council. The Council is one of 15 councils in the Kono District constituted by the provision of the Local Government Act of 2004. Koidu-New Sembehun City Council lies within the confines of Koidu and New Sembehun, the administrative capitals of the Gbense and Tankoro chiefdoms respectively. The Council includes 15 councillors, seven of which are elected from the Tankoro Chiefdom and eight councillors from the Gbense Chiefdom. Representatives of the key line ministries serve on the Council's Technical Planning Committee.

Chiefdom

Districts are divided into chiefdoms. Each of the chiefdoms in Sierra Leone is headed by a Paramount Chief who is ultimately responsible for the administration, maintenance of law and order, and the development of his chiefdom. The Paramount Chief inherits custodian rights over the land within his chiefdom.

Chiefdoms are administered by chiefdom councils with the Paramount Chief as chairman. Paramount Chiefs are assisted by Chiefdom Speakers. Paramount Chiefs are elected for life-long terms by Chiefdom Councillors, who in turn are selected by the residents of their chiefdoms. The Paramount Chief is assisted by a Chiefdom Committee, Council of Elders and a Native Administration. The primary function of the chiefdom structure is the distribution of land, collection of land taxes and the settlement of disputes.

The Chiefdom is divided into sections comprising a number of villages. Tankoro Chiefdom comprises three sections. Each section is headed by a Section Chief and each town by a Town Chief. Sections are further divided into areas.

The Ministry of Local Government and Rural Development, in consultation with Paramount Chiefs, appoints local court chairmen in the 149 chiefdoms in the country. The local court houses are known as court barriers, of which there are 287 throughout the country.

6.6. Socio-Economic Baseline Conditions

6.6.1. National Context

6.6.1.1 Demographic aspects

Population

According to the results of the Sierra Leone Population and Housing Census (2004), the population of Sierra Leone was estimated at 4.9 million in 2004. Population growth rate for the period 1985 to 2004 was estimated at 1.8 percent. Approximately 64 percent of the population resided in rural areas.

Freetown, the capital of Sierra Leone, had a population density of 1,224 persons per km^2 whereas Koinadugu, the largest district in Sierra Leone, had a density of 21.4 persons per km^2.

Age and mortality rates

The country's population is young, with 41.8 percent being younger than 15 years (Figure 6-1). Life expectancy is low, estimated at an average of 40 years, and the infant mortality rate is amongst the highest in the world at 165/1000 live births (World Health Organisation, 2006).

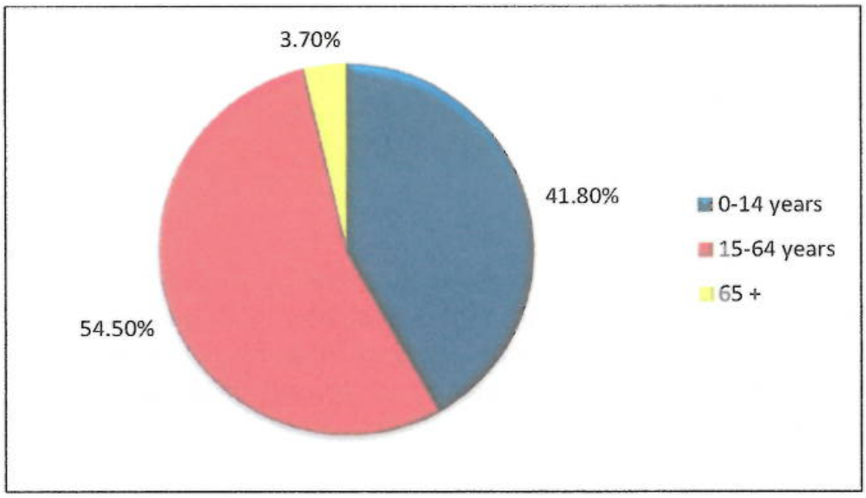

Figure 6-1: Age distribution of Sierra Leone (*Source: Central Intelligence Agency, World Fact Book (2011)*)

Ethnicity

According to the CIA World Factbook (2011) the two largest and most dominant ethnic groups in Sierra Leone are the Mende and Temne, each comprising 31 percent and 35 percent of the total population respectively. The Mende is predominantly found in the South-Eastern Province and the Temne in the Northern Province. The third and fourth largest ethnic groups are the Limba comprising eight percent and the Kono comprising 2 percent of the total population respectively (Figure 6-2). The Kono is primarily found in the Kono District in eastern Sierra Leone. Other ethnic groups in Sierra Leone include the Kriole[1], Mandingo, Loko, and migrants predominantly including people from Europe, Lebanon, Pakistan, and India.

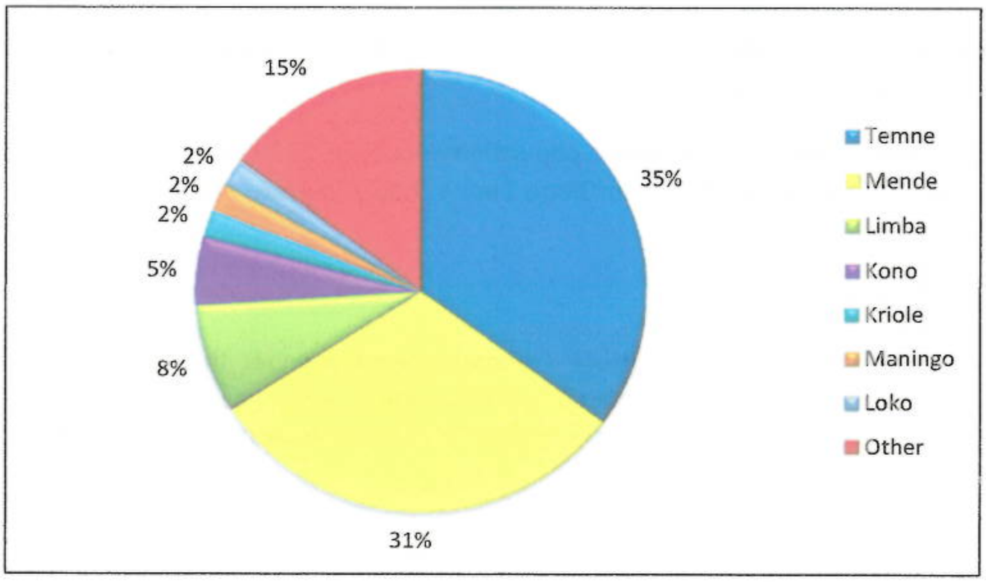

Figure 6-2: Ethnic groups of Sierra Leone

Source: Central Intelligence Agency, World Fact Book (2011)

Language and religion

According to the CIA World Factbook (2011), English is the official language of Sierra Leone, but Krio (language derived from English and several African languages and native to the Sierra Leone Krio people), is the most widely spoken language in nearly all parts of Sierra Leone. The Krio language is spoken by 97 percent of the country's population and unites the different ethnic groups.

According to the United Nations High Commissioner for Refugees (UNHCR) report on *International Religious Freedom in Sierra Leone, 2010,* followers of Islam are estimated to comprise 77 percent of Sierra Leone's population. According to the same report, 21 percent of the total population are followers of Christianity; and 2 percent of the population practice indigenous beliefs (Figure 6-3).

[1] Descendants of freed Jamaican slaves who were settled in the Freetown area in the late 18th century, also known as Krio.

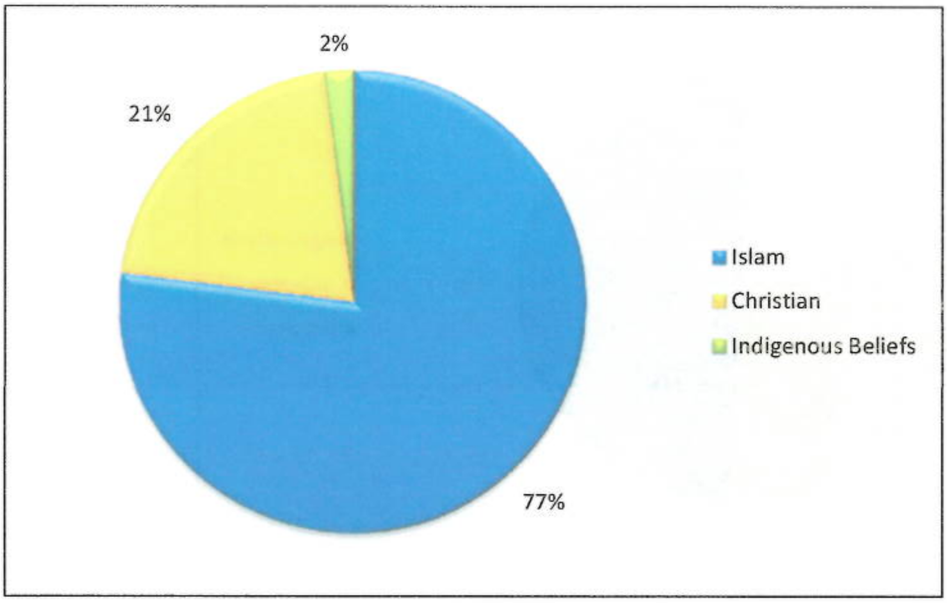

Figure 6-3: Religious groups in Sierra Leone

Source: Report on International Religious Freedom in Sierra Leone, 2010 (UNHCR)

6.6.1.2 Economic overview

Sierra Leone was ranked last among the 177 countries surveyed globally in the 2007/2008 United Nations Human Development Index, with a per capita GDP of about US$806. The United Nations Development Program (UNDP) 2007/2008 Human Development Report estimates that in 2005 about 52 percent of the population lived on less than US$1 a day (UNDP, 2007).

Despite all the natural resources, the country, like all developing countries, is still dependent on the developed world for the export of its primary products. The country is also highly dependent on donor support and foreign companies, especially for restructuring and poverty alleviation programmes, including expansion of the mining sector.

According to the Sierra Leone Demographic and Health Survey (2008), Sierra Leone's GDP grew by 6.4 percent in 2007. The economy has been unable to create jobs at a rate to match the rising labour force demand.

Figure 6-4 shows Sierra Leone's sector contribution to GDP for 2005. The largest contributor was the agriculture sector followed by industry. Agricultural products include rice, coffee, cocoa, palm kernels, palm oil, peanuts; poultry, cattle, sheep, pigs and fish. Agriculture is also a very important occupation for people living in rural areas mainly as a source of food. Industry consists largely of diamond mining, small-scale manufacturing, petroleum refining and small commercial ship repair (CIA, World Fact Book, 2010).

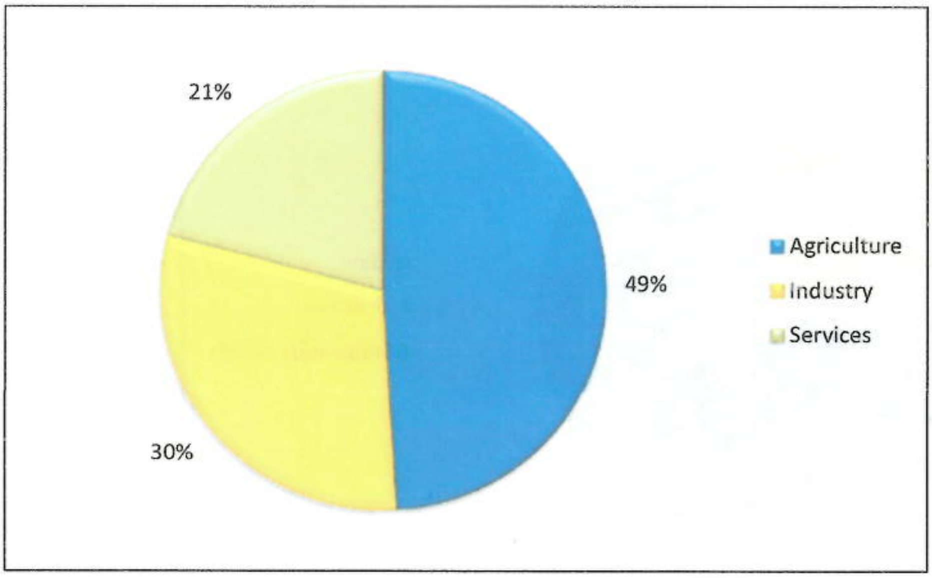

Figure 6-4: Sierra Leones contributors to its GDP, 2005

Source: Central Intelligence Agency, World Fact Book (2011)

6.6.1.3 Health

Health care provision in Sierra Leone is predominantly the responsibility of government. In April 2010, the government has instituted the Free Health Care Initiative which commits to free services for pregnant and lactating women, and children under the age of 5. This policy has been supported by increased aid from the United Kingdom and is recognised as an initiative that other African countries may follow. The maternal death rate is at 2,000 deaths per 100,000 live births (World Health Organisation, 2006). The country suffers from epidemic outbreaks of diseases including yellow fever, cholera, Lassa fever and meningitis. According to the Sierra Leone Demographic and Health Survey (2008), acquired immune deficiency syndrome(AIDS) awareness is relatively high among Sierra Leonean adults aged 15-49, with 69 percent of women and 83 percent of men saying that they have heard about AIDS.

The prevalence of HIV/AIDS in the population is 1.5 percent among adults aged 15 to 49. This is higher than the world average of 1 percent but lower than the average of 6.1 percent in Sub-Saharan Africa (Sierra Leone Demographic and Health Survey 2008).

6.6.1.4 Education

According to the Sierra Leone Demographic and Health Survey (2008), Sierra Leone's education system has been unstable for more than 10 years as a result of the civil war; however, restructuring of the infrastructure and educational programme is being undertaken by the government. The war resulted in the destruction of 1,270 schools, and in 2001 approximately 67 percent of all children were no longer attending school. The government of Sierra Leone has since adopted a policy of free primary education in all government schools for all children. In addition, the government is also undertaking renovation of infrastructure that was damaged during the war, and it is revising and expanding programmes in the educational system.

Despite the restructuring of the educational system, it is still faced with a shortage of schools and teachers. However, the situation has improved considerably since then with primary school enrolment doubling between 2001 and 2005 and the reconstruction of many schools since the end of the war. According to the UNESCO Institute for Statistics, Sierra Leone has a low level of literacy among adults with only 39.8 percent of adults being literate in 2008.

According to the Sierra Leone Demographic and Health Survey (2008) approximately 58 percent of women and 46 percent of men in Sierra Leone have no education. Only one in four women (25 percent) and 28 percent of men have some primary education. A low percentage of men and women (22 and 12 percent respectively) attended secondary school.

6.6.1.5 Poverty

For many years, Sierra Leone has been ranked at the bottom of the Human Development Index (HDI). The Sierra Leoneans HDI indicators, including illiteracy, primary school enrolments, life expectancy, maternal deaths, malnutrition, and child mortality rates, are about the worst in the world. The infant mortality rate (IMR) is about 165/1000, while life expectancy at birth is 40 and 37 years for females and males respectively (World Health Organisation, 2006) compared to 46 years in Sub-Saharan Africa (UNDP, 2004). The adult literacy rate is estimated at 30 percent, while approximately 57 percent of the population has access to safe drinking water (World Health Organisation, 2006). Approximately 70 percent of the population lives in absolute poverty, with expenditures below 1 US$ a day.

Approximately 26 percent of the population is too poor to buy food on a daily basis and rural villagers struggle to remain at subsistence levels [Poverty Reduction Strategy Paper, (PRSP) 2005]. Poor health indicators reflect the lack of access to basic services specifically health, sanitation and safe drinking water. Sanitary conditions are poor as sewage and refuse disposal systems do not exist or function effectively (PRSP, 2005).

The PRSP (2005) reported that poverty is highest in the rural sector with approximately 79 percent of those engaged in the subsistence agricultural sector being poor. Households headed by farmers have the highest rate of poverty estimated at 83 percent (PRSP, 2005).

Approximately 70 percent of the 4.9 million inhabitants of Sierra Leone are rural (PRSP, 2005). According to the Agriculture Sector Review Report, 2000, the major causes of poverty in the rural areas are lack of social services (such as health, education, safe drinking water and sanitation, lack of agricultural inputs, market access and low incomes from the sale of produce); weak infrastructure (e.g. bad road networks, lack of storage facilities); lack of economic and employment opportunities; devastation by the war; and social barriers (such as large family size within the rural communities).

The lack of sufficient food is concentrated mainly in rural areas. About 68 percent of the population cannot afford enough food to eat. It is reported that about three out of four people in rural areas outside Freetown do not attain the minimum daily calorie intake (2700 calories). A poor and undernourished population is more susceptible to various diseases. Rising maternal and child mortality rates, increasing illiteracy rates and rising unemployment levels characterize the living conditions in many parts of Sierra Leone (Poverty Reduction Strategy Paper, March 2005).

6.6.2. Regional context

The Kono District is located in the North Eastern part of Sierra Leone. It covers an area of approximately 5,641 km^2 and is densely populated. The District's capital is Koidu New Sembehun City. The Kono District borders with the Republic of Guinea to the east and Koinadugu, Tonkolili, Kenema and Kailahun Districts to the north, west, and south respectively. The district comprises 14 Chiefdoms, 70 Sections, eight Parliamentarian Constituencies, 29 Wards and 36 Townships (Digby Wells Focus Group Meeting with Township Chiefs, 16 April 2011).

6.6.2.1 Environment: Natural and mineral resources

The main natural resources of the district comprise arable land base clay and sand deposits. Sand and clay mining are carried out along streams sides and swamps, which have led to the degradation of soil fertility (Kono District Development Plan, 2010 – 2012).

A large part of the district population depend on natural resources from forests and rivers for the use of foodstuff, fuel (fuel wood and charcoal), construction materials, crafts, medicinal plants and recreational materials (raffia, ornaments). The wildlife population has, however, been significantly reduced during the civil war and through hunting practices. Although fishing is not predominantly undertaken in the district, it is undertaken at inland rivers in the country (Kono District Development Plan, 2010 – 2012).

According to the Kono District Development Plan (2010 – 2012), major threats to biodiversity and the environment include subsistence agriculture, livestock farming, forest exploitation, energy exploitation, mining, transportation, urbanization and waste disposal.

The main mineral resources found in the district are diamonds and gold. Mining activities have also contributed to the degradation of the environment, causing air and water pollution as well as food contamination.

6.6.2.2 *Demographic aspects*

Population

Kono has had one of the highest population displacements in the country as a result of the civil war. According to the Sierra Leone Population and Housing Census (2004), the population for the Kono District was 335, 401 in 2004. The census was however affected by a large number of immigrant miners from northern Sierra Leone moving out of the Kono District at the time when the census was undertaken in search of alternative resource deposits in the country (Kono District Development Plan, 2010 – 2012).

The district has a low population density of approximately 30 persons per km^2. The low population density in the district can be attributed to the decrease in the availability of mining resources and the damage to housing and community infrastructure as a result of the civil war. The 2004 population and household census show that the average household size for the district is 5.7. Family planning is not commonly practiced in the district (Kono District Development Plan, 2010 – 2012).

Ethnicity

Ethnic affiliation in the district is largely homogeneous with the Konos constituting 55% of the population. The other ethnic groups in the district are the Kissis, Kurankos, Mandigos and Temne.

6.6.2.3 *Health*

According to the Kono District Development Plan (2010 – 2012) the main illnesses and diseases affecting the residents in the district are: malaria, diarrhoea, skin diseases, hypertension, pneumonia, anaemia, intestinal worms, rheumatism, ear infection and onchocerciasis. The main causes of the above-mentioned diseases include the breeding of mosquitoes in stagnant pools of water, poor sanitation facilities, improper refuse disposal, the use of contaminated water, unhealthy dietary habits and the lack of personal hygiene.

The Kono District Development Plan (2010 – 2012) also reported that teenage pregnancy is a source of concern in the district. Most residents in the district showed some knowledge and understanding (awareness) of HIV/AIDS. Recent statistics for the levels of HIV/AIDS in the district is however difficult to be ascertained. This may be due to the fact that people are shy to speak about having HIV/AIDS. A Voluntary Confidential Counselling Team has been established at the district hospital for this purpose.

According to the Kono District Development Plan (2010 – 2012), the district's healthcare system has gone through three stages subsequent to the civil war:

- Stage 1 – a transitional period of emergency development during early 2004;
- Stage 2 – a period of health system reform with the decentralization of healthcare delivery to the District Councils and the formation of the district health board; and
- Stage 3 - the termination of the operation of some international health service organizations due to the lack of funding.

The district has also improved access to healthcare facilities. The district has 67 health facilities including one hospital that is now fully operational with three doctors and a total of 294 medical staff, including an anaesthetist, pharmacists and laboratory technicians. The hospital has two ambulances, eight motorbikes and two vans to transport patients to and from healthcare facilities.

In addition to the hospital, the district has 11 Community Health Centres, 25 Community Health Posts and 33 Maternal Health Posts.

The district has trained 500 Traditional Birth Attendants (TBAs) who have been provided with "child birth kits" from UNICEF. Two collaborative centers for TBA/Leprosy Management have been established at Jaiama Sewafe and the hospital. These centres mainly provide maternal health care services to the population. These facilities collectively provide healthcare services to approximately 60 percent of the district population.

Health care in the district has been focussed on reducing maternal and infant mortality and improving the general health status of the community. The healthcare system in the district and the management thereof is however compromised by a lack of resources, specifically personnel in the form of doctors and administrative staff.

Nutrition

The morbidity trends among children specifically are indicative of general poor and mal-nutrition in the community. A typical meal for the majority of the population in the district comprises mainly rice, cassava and/or potatoes. Protein and vitamin intake is low even though households in the district grow and produce citrus and vegetables. The prevalence of certain diseases further suggests that the majority of the population live on an unbalanced diet (Kono District Development Plan, 2010 – 2012 and Sierra Leone Demographic and Health Survey, 2008).

According to the Kono District Development Plan (2010 – 2012), the district Health Management Team is aiming to alleviate this problem by providing iodized salt supplements to the population and through nutrition surveillance programmes. These programmes aim to strengthen and reinforce the regular growth monitoring at maternal and child health clinics at the sub district level. The district also provides supplementary feeding programmes at Periphery Health Units (PHUs). Vitamin A supplements are also available to the population in all PHUs.

Immunisation

In addition to undertaking feeding programmes, the district Health Management Team has undertaken immunisation programmes among children in the Kono District. The programme aims to enhance resistance in children against the main life-threatening diseases in the district namely: measles, diphtheria, whooping cough and tetanus.

6.6.2.4 Education

The District Directorate of the Ministry of Education Science and Technology is responsible for managing and overseeing the education system in the district. This includes formal, non-formal, public and private schools.

The population density in the chiefdoms has been a major determinant in the placement of schools. The uneven distribution of schools and the low enrolment rates are major concerns for the development of education in the district. The other major concern is the number of children dropping out of schools at the primary level. The main reasons for this, according to the Kono District Development Plan (2010 – 2012), are poverty and accessibility to schools (travelling distances). Other factors contributing to poor education in the district are: inadequate and insufficient teaching and learning material for science and technology, ill-equipped laboratories, ill-equipped libraries, insufficient furniture and lack of decent accommodation facilities for teachers.

6.6.2.5 Economic overview

The main economic activities in the district comprise mining (diamond and gold), and agriculture (rice, oil palm and other crop plantations e.g. coffee and cocoa). Goods are traded with people moving through the district from neighbouring towns.

The district is predominately rural, with most of its residents engaged in crop and livestock agriculture. Most agricultural activities are undertaken at subsistence level and commercial agriculture is not evident. According to the Kono District Development Plan (2010 – 2012) the district has the potential to become an agricultural driven economy if the relevant resources and mechanisms are implemented.

Mining[2] is the other main economic activity undertaken by the people in the Kono District and approximately 50 to 55 percent of the total population of the district total population depends directly or indirectly on mining. Mining leases and surface rent paid to

[2] "Mining" in the district consists predominantly of artisanal alluvial mining.

government enables small scale mining undertakings by chiefdoms and the district at large (Kono District Development Plan, 2010 – 2012).

Other economic activities in the district include owning/running bars, as well as petty trading (selling of assorted items including cell phone products, clothing, food stuff) (Kono District Development Plan, 2010 – 2012).

Taxes

Community members are obliged to pay monthly taxes to the Kono District Council. According to the Kono District Development Plan (2010 – 2012), residents above the age of 18 have to pay a monthly fee of Le 5000. The taxes are divided between the District Council and Native Administration at 40 and 60 percent respectively.

The District Council utilises the money for various official expenditures including salaries for staff, payments to government (including the Ministry of Health and Sanitation, the Ministry of Agriculture and Food Security, Ministry of Social Welfare and the Ministry of Education) and community development projects.

6.6.2.6 Services and infrastructure

Roads and transport

The main form of transport in the Kono District is by land (road) and water (rivers and canoes). The population of Kono rarely owns private vehicles and they predominantly walk or rely on public transport (taxi vans and motorbikes) for transport (Kono District Development Plan, 2010 – 2012).

The roads in the Kono District are not tarred and during the raining season, heavy rains lead to soil erosion (*Photo 1*) resulting in poor and dangerous road conditions and damage to vehicles.

Photo 1: Motorbike taxi travelling on eroded gravel road

Source: flickr.com

Communication

The majority of the population of Kono communicate by using cell phones through the Zain and Sierratel cell phone services providers (Kono District Development Plan, 2010 – 2012). Communication by land-line telephones is limited. Koidu Town has a post office, which is not currently operational due to damage caused during the civil war.

Housing

The Kono District suffered 94% housing infrastructure loss as a result of the burning of houses (*Photo 2*) during the war. Despite the efforts made by NGOs, most community members still live in partially constructed/burnt houses with trampoline/plastic sheet covers used for walls and roofs (*Photo 3*). Some houses have been re-constructed with sandcrete and mud bricks (*Photo 4*) with corrugated iron roofs. The average number of persons per household in the district is five and the average number of rooms per house is two in the urban areas while the rural parts have houses that may have more than three rooms.

Photo 2: Burnt down house in the Kono District

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 3: Burnt house with partial room

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

<u>Water and sanitation</u>

People in the Kono District predominantly source water from wells (*Photo 5*), boreholes, ponds and rivers. Infrastructure for piped-borne water has been installed in only 5 of the 24 wards in the district.

Photo 4: House constructed with mud bricks

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

There are currently 397 standpipes in the district. According to the Kono District Development Plan (2010 – 2012), the current water supply is not adequate to serve the growing population. The majority of the rural communities does not have access to potable water, and therefore are compelled to use water from streams or rivers which are often contaminated.

Photo 5: Hand-dug well in the Kono District

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

People in the Kono District predominantly make use of pit latrines. Most households have access to a toilet on their property or a neighbour's facility. The toilets are generally constructed out of plastic/corrugated iron sheets with no roof (*Photo 6*) or a more permanent structure constructed with bricks and a corrugated iron roof (*Photo 7*). The condition of sanitation facilities is generally poor.

Photo 6: Pit latrine constructed with plastic sheets

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 7: Pit latrine constructed with bricks

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Energy

There is no regional electricity supply within the Kono District and the only form of electricity generation is by utilising generators (Kono District Development Plan, 2010 – 2012). The rural population mostly get their energy from shops or individuals selling wood and charcoal within the community. Other sources are filling stations (for kerosene) and generators generated electricity.

Refuse disposal

There is no formal waste disposal system or landfill site in the Kono District. Solid waste is mostly disposed of in the bush or at open public dumping sites or in the backyards of individual households (Kono District Development Plan 2010 – 2012).

6.6.3. Local context

The Expansion Project is located within Koidu Town which is the capital of the Kono District. Koidu Town is governed by the Koidu New Sembehun City Council with Koidu Town and New Sembehun Township forming the largest part of its geographical administrative area. These two towns are also the headquarters of the Gbense and Tankoro Chiefdoms respectively, covering approximately 80 percent of the total area of the two Chiefdoms. The Koidu New Sembehun City Council is divided into three electoral wards namely:

- Tankoro South – also known as Ward 62
- Tankoro North – also known as Ward 63
- Gbense – also known as Ward 64

The council borders Imikoro to the south-west and Kamara to the north-west and is characterised by extensive wetland and swamp areas used for subsistence agriculture in the rainy seasons. The area is also characterised by vast areas of "waste land" as a result of extensive artisanal mining activities (Koidu New Sembehun City Council Development Plan, 2011 – 2013).

6.6.3.1 Demographic aspects

Population

According to the Koidu New Sembehun City Council Development Plan (2001 – 2013), Koidu Town has an estimated population of 80,025 (Figure 6-5) and approximately 95 persons per km^2. The population is predominantly involved in trading, mining and subsistence farming as their main economic activities.

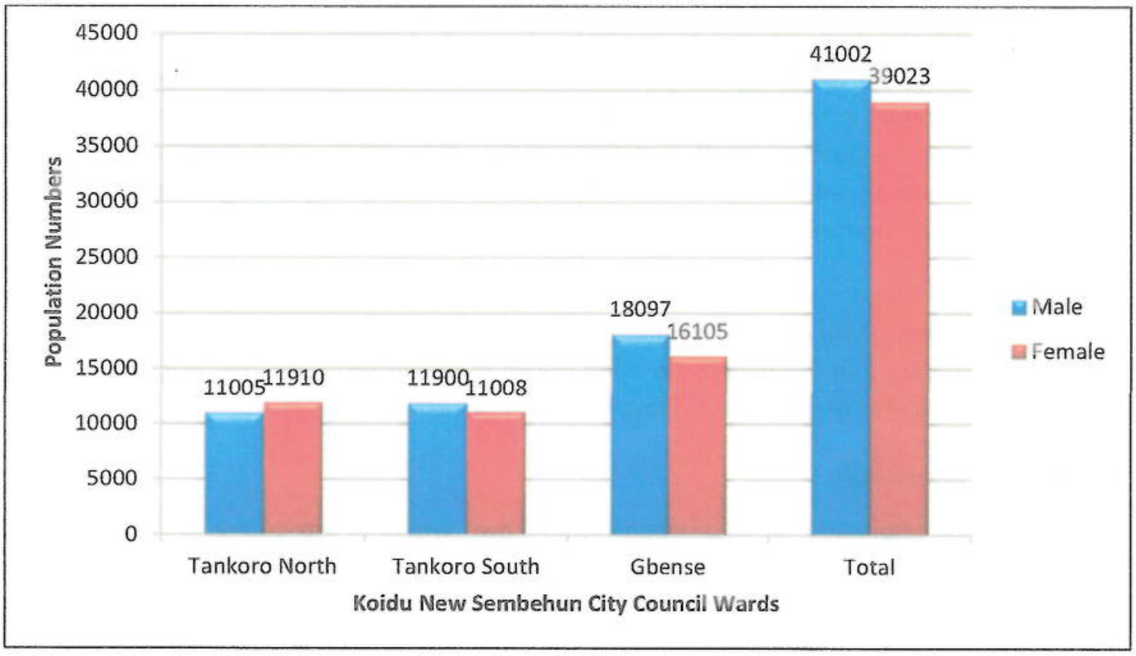

Figure 6-5: Population statistics for Koidu Town

Source: Koidu New Sembehun City Council Development Plan (2011 – 2012) taken from the Sierra Leone Population and Housing Census (2004)

During key informant interviews undertaken by Digby Wells (April 2011) with the Tankoro Youth Development Association, it was established that approximately 65 percent of the population in Koidu consists of youth between the ages 15 to 35 years. The population numbers in Tankoro has reportedly increased subsequent to the war, as children who were born and people who were living in refugee camps in Guinea have moved back into the area.

Household structure

Most households in the Tankoro Chiefdom are made up of extended family units spanning a few generations. Household sizes can range from four to thirty people in one household.

The main role of women is to take care of the household and to undertake agricultural and petty trading activities to earn an income. Men who are employed will bring money into the household whilst women mostly contribute to the maintenance of the household. The women from the Tankoro Women's Organisation expressed a desire to be treated equally to men when considered for formal employment. The main role of children, when not attending school, is to fetch water and wood and run general errands for the household (Digby Wells interviews, April 2011).

Ethnicity and religion

Similar to the ethnic composition of the Kono District, the dominant ethnic group in local area is the Kono. Other ethnic groups in the area include the Mende, Temne, Kissi and Limba. The ethnic groups generally live together in harmony (Digby Wells interviews, April 2011).

As in the larger Sierra Leone and the Kono District, the dominant religions within the Tankoro Chiefdom area are Muslim and Christianity. Traditional religion is still practiced by some community members in the area but is mostly conducted in a private manner.

6.6.3.2 *Education*

A survey undertaken by the Koidu New Sembehun City Council (2009/2010) has established the number of education facilities and resources in Koidu. These figures are presented in Table 6-1.

Table 6-1: Education facilities and enrolment for the Tankoro Chiefdom

Pre-Schools	
Number of Schools	**01**
Number of male pupils	04
Number of female pupils	07
Total Number of Pupils	**11**
Government Assisted and Community Primary Schools	
Number of Schools	**40**
Number of male Pupils	6 438
Number of female Pupils	7 845
Total Number of Pupils	**14 283**
Junior Secondary Schools	
Number of Schools	**10**
Number of male pupils	3 435
Number of female pupils	1 626
Total Number of Pupils	**5 061**

Senior Secondary Schools	
Number of Schools	03
Number of male pupils	977
Number of female pupils	298
Total Number of Pupils	1 275

In addition to the educational facilities listed above, Kono also has one Technical Training Institute which currently has an enrolment of 109 males and 269 females. The inspector of schools for the Kono District explained during an interview with Digby Wells (19 April 2011) that the education system in Koidu comprises the following:

The school year comprise of three terms: September to December; January to April; and May to July. The subjects that are presented for the respective levels of education are presented in Table 6-2.

Table 6-2: Subjects provided for different levels of education in Koidu

Level of Education	Length of level of Education	Subjects
Pre-primary (ages three – five)	Three years	Basic numeracy and literacy.
Primary (from age six) Class one to six	Six years	Maths, English, Social Studies, Integrated Science (Including Biology), Social Studies (Including History Civics, Geography) Physical Health Education, Some Schools Home Economics.
Junior Secondary School	Three years	Maths, English, Social Studies, Integrated Science (Including Biology), Social Studies (Including History, Geography) Physical Health Education, Some Schools Home Economics.
Senior Secondary School	Three years	Maths, English, Social Studies, Integrated Science (Including Biology), Social Studies (Including History Civics, Geography) Physical Health Education, Some Schools Home Economics.

Source: Digby Wells Key Informant Interview – 19 April 2011

The inspector explained that the Government approved teacher to pupil ratio is 1 to 40/45 students and in Koidu it currently stands at an average of 1 to 70-80 students. The education system is compromised by a lack of infrastructure, qualified teachers and teaching materials. High school drop-out levels as a result of teenage pregnancies is a major concern. Levels of education are low in Koidu and there is a need for education, specifically adult-based education.

All primary education in Koidu is provided at no cost to pupils. Payment is required for boys from the "Junior Secondary Level" but not for girls. This is to encourage girls to enrol for higher levels of education. The costs for the first three years for Junior Secondary School and Senior Secondary School is Le 20 000[3] and Le 75 000 per term respectively.

Tertiary education is generally provided by private intuitions and too expensive for general community members to afford. As a result, the approximate 50 percent of pupils who write the West African Senior School Examination at the end of Senior Secondary School do not proceed to get a tertiary education (Digby Wells Key Informant Interview, April 2011).

6.6.3.3 Health

During an interview with the Koidu Hospital on 18 April 2011, Digby Wells established that there are six healthcare facilities within the Tankoro Chiefdom. The facilities and associated resources are listed in Table 6-3.

Table 6-3: Health Care Facilities within Tankoro Chiefdom

Clinic	Number of Beds	Staff
Koaquine (CHC)[4]	8	1 Lab Assistant 1 Vaccinator 2 MCHA's 1 CHO
Baiana (MCHP)[5]	4	1 Vaccinator 1 MCHA
Woana (MCHP)		1 Vaccinator 1 MCHA
Swarray Town (MCHP)		1 Vaccinator 2 MCHA
Tongoro (MCHP)		1 Vaccinator 1 MCHA
Kainsai (MCHP)		1 Vaccinator 1 MCHA
Kamiya (currently being constructed)		
Koidu Government Hospital	130	2 Doctors 1 Matron 1 Secretary

[3] Sierra Leonean Leones - 1US$ = SLL 4,350 (28 April, 2011)

[4] Community Health Centre

[5] Maternal, Child and Health Posts

		1 Finance Officer 2 CHO's 5 Mid Wives 2 Staff Nurse 17 Sechn 5 MCH Aide 40 Nursing Aide 4 Lab Technicians 4 Lab Assistance 3 Pharmacy Technicians 5 Orthopaedic 3 Drivers 1 Clerk 1 Cook 3 Security 40 Volunteer Nursing Aide

Source: KHG – Digby Wells interview – 18 April 2011

Minor medical cases are admitted to community health centres, while serious and emergency medical cases are admitted to government hospital. The Community Health Centre (CHC) and Maternal and Child Health Posts (MCHPs) currently provide the following health care to the Tankoro population:

- Immunisation
- Family planning
- Antenatal care
- Baby deliveries
- Postnatal services
- Outreach programs

Health care services are provided for free to children under the age of five, pregnant and lactating women, while the rest of the community has a pay for health care and medication.

The Koidu Government Hospital (KGH) representative noted that the services offered at the medical facilities within Tankoro are often not adequate to provide comprehensive services to everyone in the rural areas. The KGH representative listed the following inadequacies in the health care facilities:

- Inadequate accommodation for medical staff (only two clinics has staff quarters);
- Lack of medical facilities and equipment;
- Transport constraints;
- Lack of medical supplies;
- Lack of water and electricity; and
- Poor access to information (e.g. internet)

The most common diseases in Tankoro, as obtained from the KGH medical records, are presented in Table 6-4.

Table 6-4: Common diseases cases recorded for Tankoro 2010/2011 (to date)

Disease	No. of Patients 2010	No. of Patients 2011 (year to date)
Diarrhoea	956	71
AFP	3	2
Measles	55	35
Yellow Fever	2	1

Source: KHG – Digby Wells interview – 18 April 2011

Other diseases/medical conditions prevalent in the community are malaria, malnutrition, respiratory diseases and bilharzia (KGH, April 2011).

The maternal death rates recorded for 2010 were 857/100,000 live births. The most common cause of death in Koidu is malaria (KGH, April 2011). The average life expectancy for people living in Koidu is 47 years.

The KGH noted that HIV and STD infection rates have stabilised in 2010 but that accurate statistics could not be provided as people do not generally disclose their HIV status. The KGH undertakes HIV/AIDS awareness campaigns in the community through the National AIDS Secretariat, Community Based Organisations (CBO's) and health management teams. The campaigns promote the use of condoms and encourage voluntary testing.

The KGH noted that there is high occurrence of teenage pregnancies in Koidu. This can be attributed to poverty, unemployment and peer pressure. The occurrence of mental and physical disabilities in Koidu is low, and the few cases that have been reported resulted from the rebel war (KHG, April 2011).

6.6.3.4 Employment and unemployment

There are high levels of unemployment in the Koidu with approximately 80 percent of the population being unemployed (Digby Wells Focus Group Meeting with Town Chief, 16 April 2011). Current staff strength on the Koidu Kimberlite Project is 648 permanent employees and 115 casual labourers.

Despite its high agricultural, commercial and mining potential in Koidu, approximately 98 percent of the population live on less than US$1 per day. The poverty level has forced many young girls into commercial sex. With the high level of unskilled youth members, unemployment is common. The frustration has also coerced some youth members to indulge in drug-abuse and addiction resulting in a high incidence of crime in Koidu Town (Koidu New Sembehun City Council Development Plan, 2011 – 2013).

6.6.3.5 Land use and ownership

The dominant land use in the Koidu area is agriculture. The community use extensive areas in Koidu for the planting of economic trees such as cocoa, coffee and oil palm. The main crops that are cultivated are rice, cassava and maize. The land is also used for keeping livestock such as sheep, goats and chickens. Cattle are not generally kept in urbanised areas. This is enforced through an informal law that was developed by the town chiefs (Digby Wells Focus Group Interview with Town Chiefs, 16 April 2011).

Officially, all land is owned by the Paramount Chief. Land within each settlement is allocated by the relevant Town Chief through the endorsement of the paramount Chief. New landowners pay for the land by giving a token to the Town Chief. The amount is paid once off and the value is determined by the Town Chief. Land ownership is also allocated through inheritance within families (Digby Wells Focus Group Interview with Town Chiefs, 16 April 2011).

6.6.3.6 Services and infrastructure

Similarly to the larger Kono District, Koidu Town has experienced severe damage to community infrastructure as a result of the rebel war. Between 2004 and 200, efforts were made, through the Sierra Leonean Government, to rehabilitate and restore some of the services and infrastructure but there is still a 55 percent backlog in terms of services provision. Some individual households have reconstructed their own houses. The Sierra Leone Road Agency (SLRA) also undertook basic road maintenance by reconstructing drainage systems and culverts on main roads.

As in the larger Kono District, there is no formal electricity supply in Koidu and community members use private generators for power generation. The Koidu New Sembehun Council is however committed to supplying electricity to the larger town provided that they have access to the relevant resources (Koidu New Sembehun City Council Development Plan, 2011 – 2013).

The Town Chiefs of Tankoro noted in an interview with Digby Wells on 16 April 2011 that the most critical community needs in terms of services provision within Koidu are:

- Roads (to improve access to markets in larger cities such as Freetown);
- Water supply;
- Electricity supply;
- Health Services;
- Meeting places; and
- Credit facilities.

6.6.4. Extended Affected Area (EAA)

This section contains information regarding the population that will be directly affected by the proposed Expansion Project. Digby Wells gathered socio-economic information in conjunction with a survey of all affected assets under the Expansion Project (Nov 2010 – Jan 2011) and key-informant interviews undertaken with stakeholders in the community (15 April 2011 to 22 April 2011).

The EAA is situated to the north of the existing mining lease area along the boundaries of the KP1, KP2 KP3 KP4 and KP5 beacons. The size of the area is approximately 50 ha. The townships of Saquee Town, New Sembehun and Yormandu are located within this area. There are approximately 1,290 structures located within the Extended Affected Area. This includes primary residential dwellings and outbuildings such as toilets, shops/stores, kitchens, animal pens and recreational facilities.

New Sembehun

New Sembehun is located on the north-western boundary of the concession area partly falls within the concession area, along the boundary of the KP1 to KP2 beacons. Three streets of New Sembehun run through the current Koidu concession area, namely Turay Street, Bayoh Lane and Bayoh Street. There are approximately 300 houses in New Sembehun within the Extended Affected Area that will have to be resettled under the Expansion Project...

Yormandu

The portion of the Yormandu Township lying within the concession area is bounded by beacons KP3/4C to KP4 and KP4 to KP4/B and also by a tributary of the Woyie River. It is located to the north of the concession area and falls within the the concession. The section of the township that falls within the Extended Affected Area has approximately 99 houses.

Saquee Town

Saquee Town lies on the outskirts of the mining lease area and within the concession area. In certain areas, it lies within the existing 250m blast zones of the K1 and K2 kimberlite pipes. There are 313 houses within Saquee Town that will need to be resettled.

Digby Wells has identified that approximately 4,000 people in Saquee Town will be affected by the Expansion Project.

6.6.4.1 Administrative framework in the EAA

The administrative structure in the broader project area is discussed in Section 6.1. The primary native administration heads for the three settlements affected by the Project are presented in Table 6-5.

Table 6-5: Native administration of project affected settlements

Name	Designation
Chief P. Saquee	Paramount Chief
Chief T. Gando	Town Chief for Saquee Town
Chief S. Ndomaina	Town Chief for New Sembehun
Chief S. Fillie	Town Chief for Yormandu

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

An important administrative structure in the project area is the Village Resettlement Committee (VRC). The VRC was established in 2009, following the signing of stakeholder agreements with regards to resettlement principles and standards. The VRC is chaired by the Paramount Chief and consists of representatives of the project affected area including:

- Affected Property Owners Association (APOA);
- Town chiefs of the affected settlements;
- National Government
- Cemmats Environmental Consultants;
- Koidu Holdings;
- Youth;
- Councilor(s);
- Koidu Deputy Mayor; and
- Department of Housing.

The VRC holds monthly meetings where issues pertaining to the current resettlement process are discussed. The VRC is also responsible for resolving grievances and disputes lodged by those affected by the resettlement[6], including those within the extended blasting buffer area. The VRC will be re-elected in 2011 to ensure full representation by households and groups affected by the Project.

6.6.4.2 Population

According to the survey conducted in 2008 by the Cemmats Group, the total population of the three project-affected settlements is estimated at 2,086 inhabitants (Table 6-6).

[6] This includes people still living within the concession area and people who have already been moved to the new resettlement host site.

Table 6-6: Population Estimates for Settlements within the larger Project Area

Settlement	Population
Sokogbe	1,842
Saquee Town	1,393
Swarray Town	415
New Sembehun	387
Yormandu	1,026
Manjamadu (Resettlement host site)	740

Source: Cemmats: 2008

The asset and socio-economic survey for the Expansion Project (November 2011 to January 2011) has estimated number of people living within the Extended Affected Area on 8,218 (Figure 6-6). This is a significant increase when compared to the total combined population of 2,806 in the three villages as recorded by Cemmats in 2008. This increase may partly be as a result of the influx of people to the area seeking employment opportunities associated with the Koidu Kimberlite Project. However, it is likely that respondents in the 2011 survey included all occupants/tenants in the survey questions on household size. This aspect will be investigated during the social studies for the Project RAP. The number of people recorded in 2011 living in a household range from 5 to 15 with an average of 6.9 people per household.

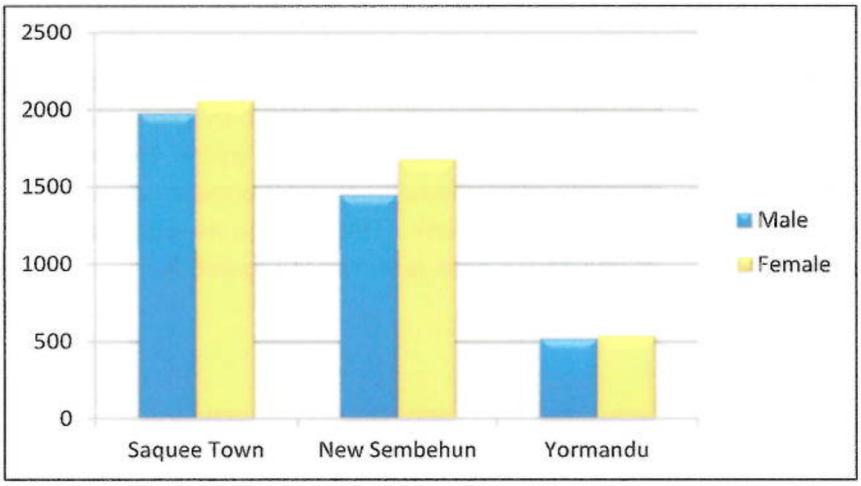

Figure 6-6: Number of people (male and female[7]) living within the Extended Affected Area

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

6.6.4.3 Economy

Digby Wells established during the asset survey (November 2010 – January 2011) that people living within the project-affected area mostly partake in a combination of activities to earn an income such as petty trading activities (Figure 6-7), including selling second-hand clothes, crops, fruit and other assorted items. Approximately 47 percent of the people living in the affected area make money by selling fruit and crops and 12 percent by selling their livestock such as goats, chickens and sheep. Although artisanal mining may be a source of income in the larger area, it is not the main sources of income in the Extended Affected Area.

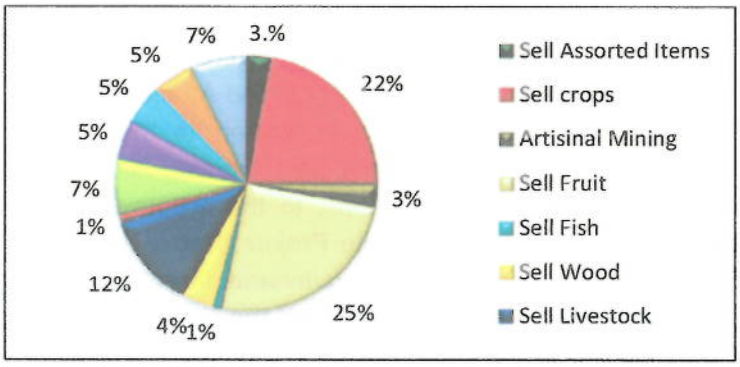

Figure 6-7: Main sources of income within the Extended Affected Area

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Although not all household heads were prepared to provide an indication of their income during interviews it was established during the asset survey undertaken by Digby Wells (November 2011-January 2011) that the majority of household heads in the Extended Affected Area earn between Le5000 to Le35 000 (Sierra Leonean Leones) per week which equates to approximately 1 USD to 8 USD per week. The average weekly income for household heads in the three project-affected villages is shown in Figure6-8.

[7] These figures include children

Figure 6-8: Average weekly income [Sierra Leonean Leones (SLL)] for household heads within Extended Affected Area

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Agricultural activities in the Extended Affected Area, includes vegetable farming and the planting of fruit trees. Vegetables are mostly cultivated for subsistence purposes whilst cacao and coffee and rice are grown for commercial purposes. The fruit from trees are both sold for an income and used for subsistence (Digby Wells, Nov 2010 – Jan 2011).

Valley swamps are used for the cultivation of rice, the staple food of Sierra Leone. The higher lands are used to cultivate crops such as cassava, beans, sweet potatoes, groundnut, ginger, cocoyam, and maize during the wet season. Vegetables such as pepper, egg plant, African spinach, onions, okra, tomatoes, sorrel, cucumber, cabbage and pumpkin are also cultivated on the higher lands. Maize, groundnut and cassava are cultivated in the dry season. Agricultural fields are prepared for planting in the wet season by burning down grass and plants that grew during the dry season. Cultivation is done using traditional tools such as hoes, shovels and cutlasses. Generally, fertilizers are not widely used as it is too expensive for most farmers, and as a result yields are generally low.

Photo 8: Rice Field in Saquee Town

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

A wide variety of fruit trees are planted by people within the Extended Affected Area. Fruit trees are mainly located within household compounds and include mango, avocado, banana, kolanut, coconut, cacao, coffee, guava and oil palm trees (Asset survey, November 2011 – January 2011). The most commonly planted trees within the Extended Affected Area are bananas as shown in Figure 6-9. Although not commonly planted, other trees such as Moringa, apple, plum and cottonwood trees were also recorded in the Extended Affected Area.

Fruit and crops grown by the people in the Extended Affected Area provide both food and income. The leaves of the cassava plant is finely chopped and then cooked with the oil from the oil palm whereafter meat and/or fish is added to the dish. The dish (*Photo 9*) is served with rice and Digby Wells noted that it is the most commonly consumed food in the Extended Affected Area.

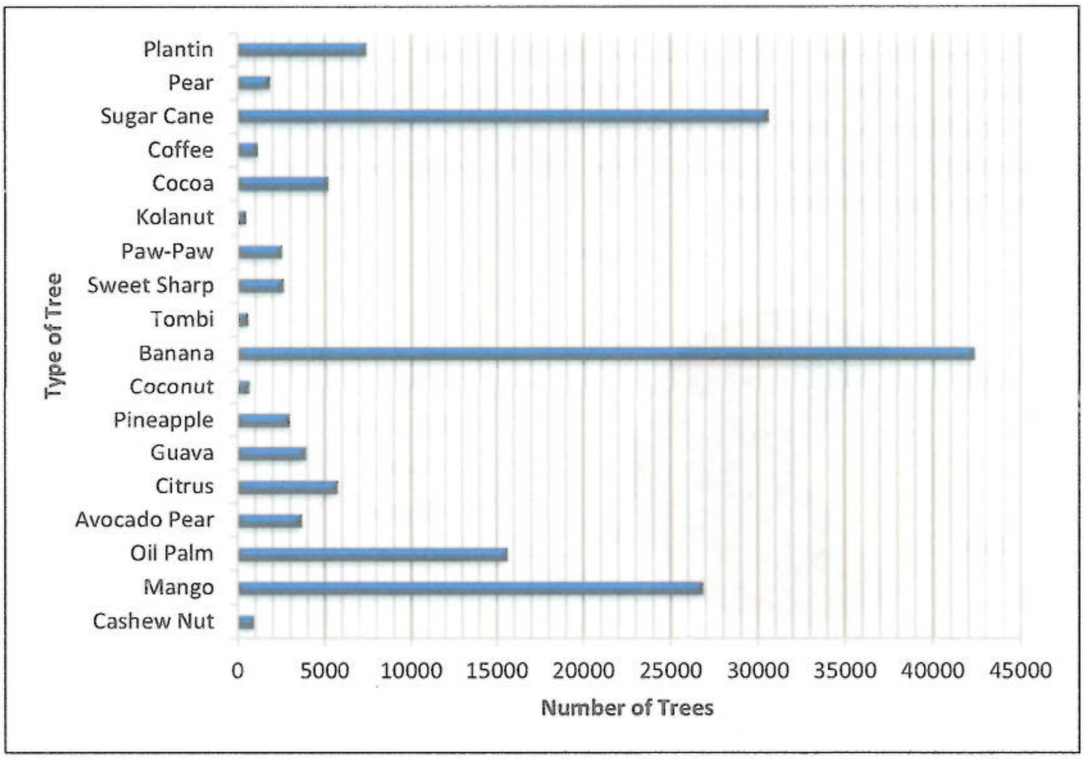

Figure 6-9: Economic trees recorded in the Extended Affected Area

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 9: Example of Cassava sauce served with rice

Source: flickr.com

Similar to crop farming, livestock production is an important part of the community's livelihoods. Goats, sheep and chickens are the most commonly kept livestock by households as shown in Figure 6-10 Cattle are mostly found in the rural areas of the Tankoro Chiefdom. No horses or donkeys were observed during the asset survey. The livestock mainly provides a source of food but the selling of livestock also provides a source of income to households.

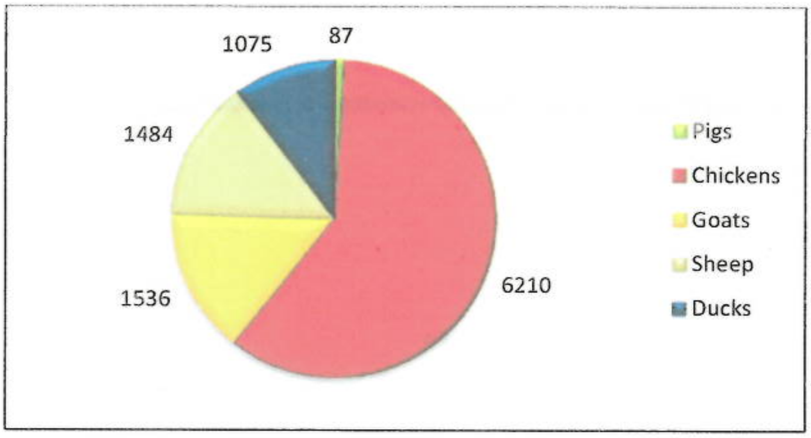

Figure 6-10: Approximate number of livestock recorded for households within the Extended Affected Area.

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Artisanal diamond mining on easily accessible alluvial terraces is prevalent in the project area and is mainly carried out by men (Key Informant Interviews, April 2011). This is principally a subsistence activity in which Kimberlite deposits are not included. Valley swamps and river terraces are mined by the use of shovels with which the soil is excavated and then washed in a shaker/sieve in a stream. When terraces are excavated, the soil is loaded into rice sacks and then carried to a stream, where it is washed to extract the diamonds (Cemmats, 2010). No artisanal mining is permitted within the Koidu mining lease area. Digby Wells established during key informant interviews (April 2011) that artisanal mining in the area has become challenging as most of the mining areas have been depleted.

6.6.4.4 Services and infrastructure

Approximately 88 percent of all households within the Extended Affected Area use firewood and charcoal as the main source of energy for cooking, as illustrated in Figure 6-11. There is no national electricity supply within the project area and the only form of electricity generation is generators. These are used by both private households and for commercial purposes. It was established during the asset survey that few households are equipped with electrical infrastructure. Petrol and kerosene are also available within the study area. Petrol is predominantly used as fuel for motorbikes whilst kerosene is used for generating light (kerosene lamps and lanterns) and for igniting firewood and charcoal.

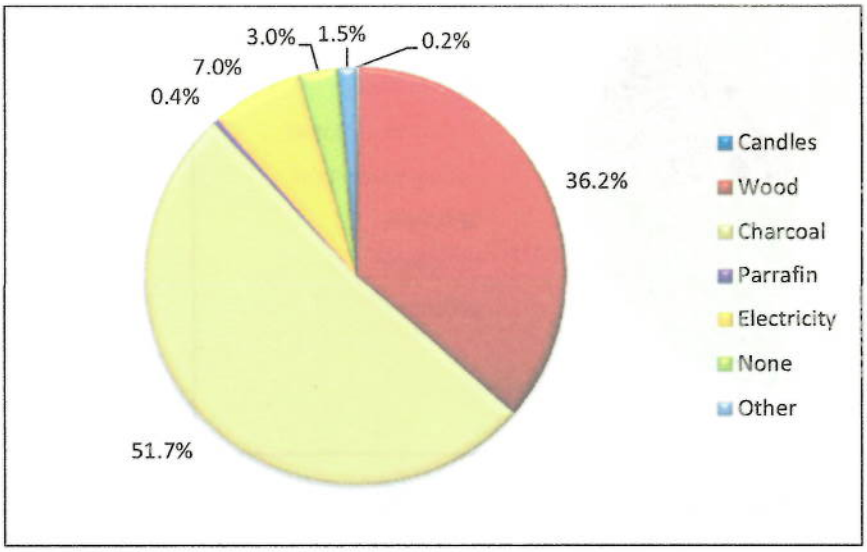

Figure 6-11: Main sources of energy within the Extended Affected Area

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Potable water and sanitation facilities within project-affected settlements were found to be poor. Approximately 82% of households within the Extended Affected Area predominantly obtain water for cooking and drinking from community, private or neighbour's wells (Figure 6-12). Wells are generally dug to a depth of 5 m, and are usually located within the household compound (*Photo 10*). Laundry is commonly washed in nearby streams or in plastic buckets at households. Koidu Holdings is presently supplying the resettlement village with running potable water and every fourth house has been fitted with a stand pipe.

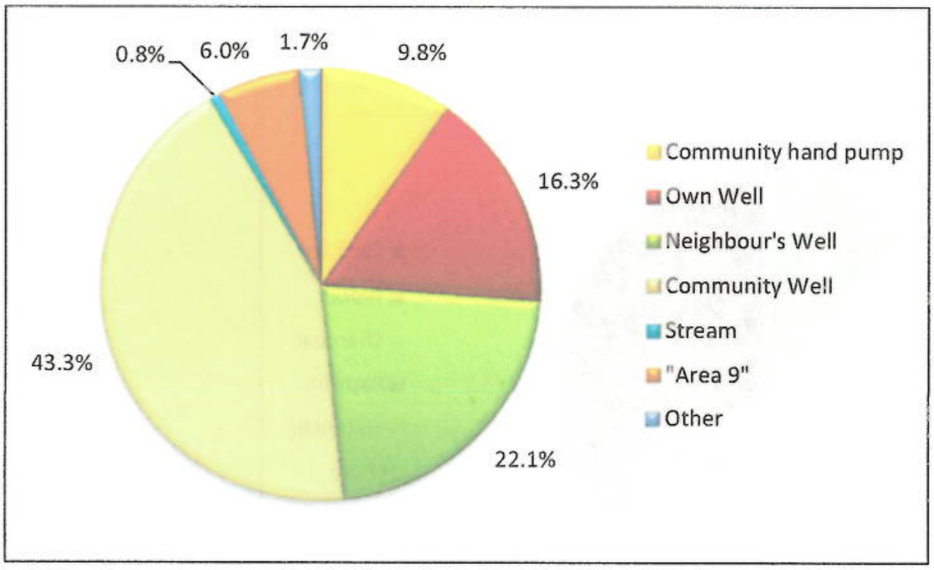

Figure 6-12: Main sources of water within the Extended Affected Area

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 10: Community members collecting water from well located within a household compound

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Sanitation facilities within the Extended Affected Area are of poor quality (*Photo 11*). Approximately 58 percent of the households in the project affected area have pit latrine facilities located within their household compound but some household use their neighbour's facility, which is generally also a pit latrine (Figure 6-13).

Photo 11: Typical pit latrine structure in villages

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

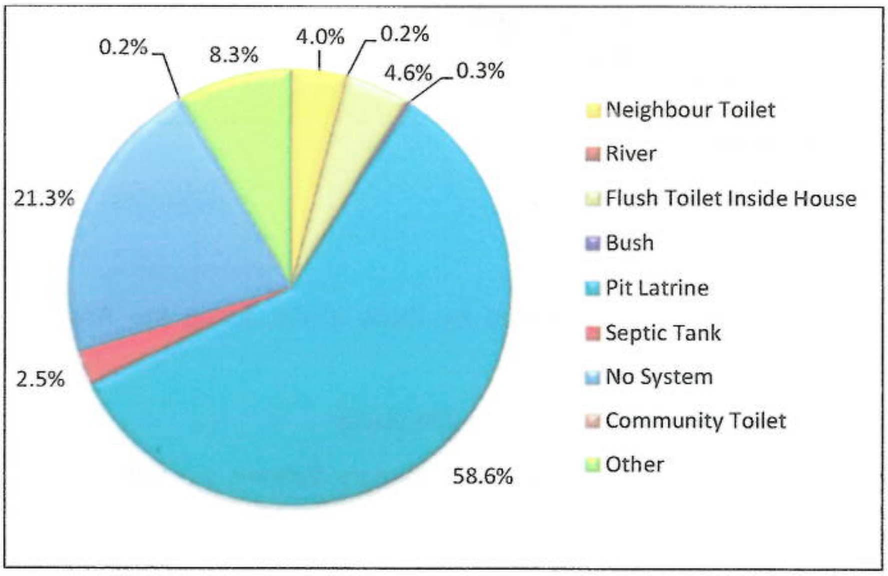

Figure 6-13: Sanitation facilities utilised by households within the Extended Affected Area

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

In some instances, pit latrines are located uphill from water wells, possibly causing bacteriological contamination. Koidu Holdings currently supply each residential unit within the resettlement village with its own pit latrine.

6.6.4.5 *Health facilities*

During the Digby Wells Asset Survey (Nov 2010 – Jan 2011) it was established that there is no government hospital within the Extended Affected Area, while the closest hospital is located in Koidu Town approximately 4.5 km away. The Dr. Korji Hospital (*Photo 12*), located on Turay Street in New Sembehun is no longer operating as a hospital. There are currently 20 families residing in the building. .

Photo 12: Former Dr. Korji Hospital

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

6.6.4.6 *Education*

The following educational facilities were recorded by Digby Wells during the Asset Survey (Nov 2010 – Jan 2011):

- God Is Our Light Primary School (*Photo 13*) – with 426 pupils
- UMC Primary (Photo 14) – with 486 pupils and Secondary Schools) – with 1150 pupils for girls which share the same compound;

Seven Day's Advantage (SDA) Primary (*Photo 16*) with 900 pupils and Secondary Schools (

- Photo 17Photo 17) with 118 pupils; and
- The Ansarul Islamic Boys School (Photo 18) with 2840 pupils.

Photo 13: God is our Light Primary School

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 14: UMC Primary School for Girls

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 15: UMC Secondary School for Girls

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 16: Seven Days Advantage Primary School

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 17: Seven Days Advantage Secondary School

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 18: Ansarul Islamic School for Boys

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Digby Wells established during the asset survey that the education levels of the head of households within the Extended Affected Area is low with most having some level of a secondary education or no education as shown in *Figure 6-14*. It was recorded that approximately 1,112 family members in the Extended Affected Area have completed secondary school. Approximately 51 percent of all head of households who were interviewed has not attended school.

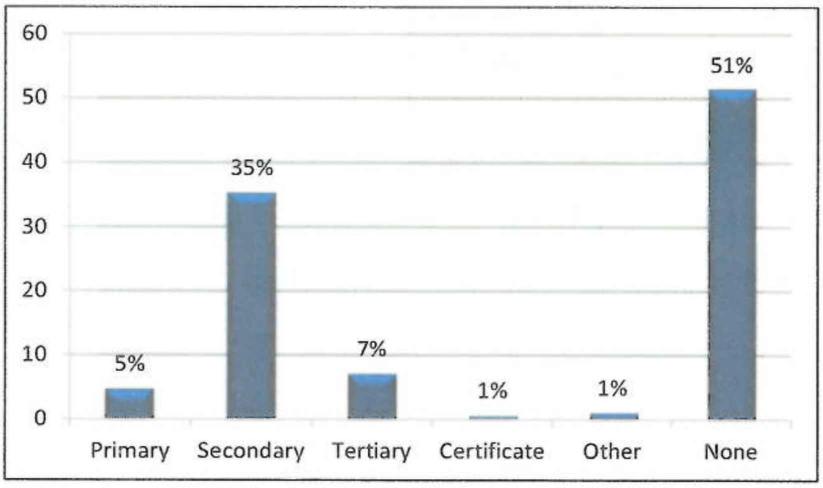

Figure 6-14: Level of education of heads of households within the Extended Affected Area

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

6.6.4.7 Court houses, markets and community centres

Within the Extended Affected Area, only New Sembehun has a local court house which was built by the Tankoro Native Administration.

New Sembehun also has a market place built by the city council, while a new market place is under construction in Yormandu. Often, goods are sold from homes, or in small stalls (*Photo 19*), at compounds or by people going from door to door. Koidu Holdings has constructed a new market for the inhabitants of the resettlement village.

Photo 19: Petty trader selling assorted items in New Sembehun Township

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

6.6.4.8 Transport

During the asset survey it was observed that taxi buses and motorcycles are the main source of transportation in the Extended Affected Area. The roads within the concession area are small, community feeder roads about four meters wide which were constructed for low traffic and with limited load-bearing capacity. Most of these roads have been reduced to vehicle tracks lacking drainages and adequate camber due to continuous erosion and lack of maintenance (Digby Wells Asset Survey, Nov 2010 – Jan 2011).

During an interview with the Motor Drivers and General Transport Workers Union by Digby Wells on 19 April 2011, it was established that there are three types of vehicle licences in Koidu:

- A: Light Vehicles;
- C: Vans; and
- D: Heavy Vehicles.

The poor road conditions in the area discourage people from buying and driving private cars, and therefore, the majority of the people make us of public transport. Members of the Kono Bike Riders Association indicated in an interview with Digby Wells on 18 April 2011 that most bike riders rent the bikes from its owners and that the profits made from transporting passengers are not enough to sustain them.

6.6.4.9 Communication

Communication mainly occurs through local radio stations, newspapers and television. General community issues are taken to the Town Chiefs or elders for resolution (Digby Wells Focus Group Interview with Town Chief, 16 April 2011).

The other form of communication in the Extended Affected Area is by cellular telephone. The most commonly used mobile-phone service providers are Africell and Zain (Digby Wells Asset Survey, Nov 2010 – Jan 2011).

6.6.4.10 Religious and other sacred places

Mosques and churches are common throughout the Extended Affected Area and can vary from formal structures to people who use their homes for worship and services.

The following religious institutions were recorded by Digby Wells during the asset survey (Nov 2010 – Jan 2011):

- United God is Our Light Church – New Sembehun (*Photo 20*)
- Mosque at Ansarul Islamic School for Boys (*Photo 21*)
- St Francis Catholic Church – New Sembehun (*Photo 22*)
- Free Gospel Church – Saquee Town (*Photo 23*)
- Mosque in Saquee Town (*Photo 24*)

Photo 20: United God is Our Light Church

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 21: Mosque at Ansarul Islamic School for Boys

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 22: St Francis Catholic Church

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 23: Free Gospel Church

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 24: Mosque in Saquee Town

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

A number of shrines were also identified within the Extended Affected Area. Shrines (Photo 25) can vary in form and range from piles of stones/artefacts to specific boulders or trees/bushes.

Photo 25: Shrine at household

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

In addition to these sites, it is a common practice for community members in the Extended Affected Area to use the bush for burial of the deceased. During the war, burials were done within the townships. Graves (*Photo 26*) are traditionally constructed within the household compound behind residential dwellings with the permission of the relevant town Chief (Digby Wells Asset Survey, Nov 2010 – Jan 2011).

Photo 26: Typical grave in the backyard of a household

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

6.6.4.11 Housing

Houses within the Extended Affected Area are predominantly constructed with mud blocks or sandcrete bricks. Most of the houses are suburb bungalows with walls of about 3 m high, with timber doors and windows (*Photo 27*).

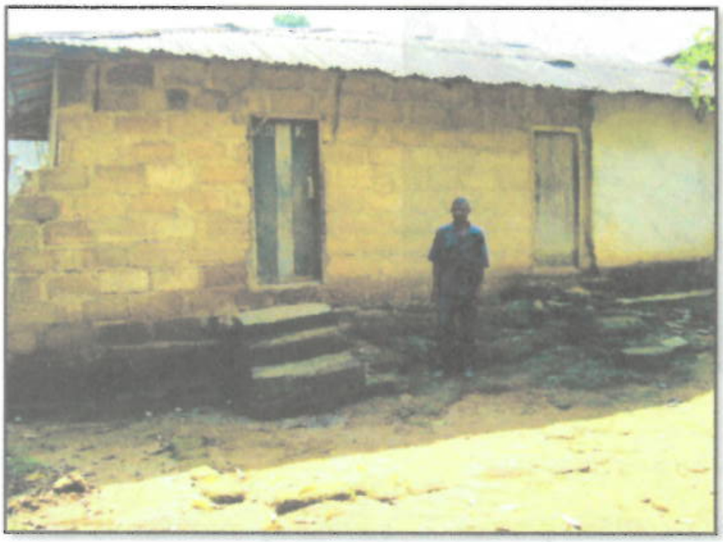

Photo 27: Typical house within the Extended Affected Area

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

The Chiefs have no formal building policy for the construction the structures built within the Extended Affected Area and many of the houses do not have documentation as required by government housing regulations. Permission to own or build a house within the Extended Affected Area is granted by the relevant Town Chiefs.

As stated before, Koidu Holdings is currently in the process to resettle all the households within its mining lease area to the new resettlement village where new houses are provided to those affected (*Photo 28*).

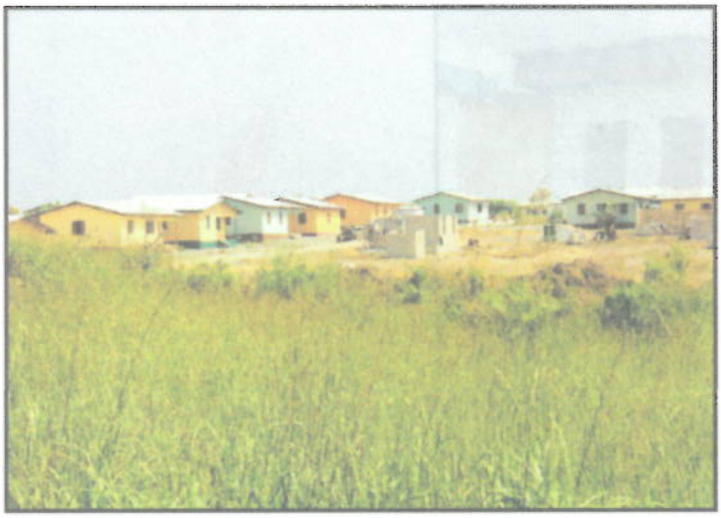

Photo 28: Koidu Resettlement Village

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

The replacement houses that are being constructed by Koidu Holdings (*Photo 29*) vary in size, the smallest being a two bedroom house with a living area, to the largest being a seven bedroom house with a living area. All the houses have a front and back door with verandas at each entrance. Each house has an outside kitchen and VIP toilet (*Photo 30*). The toilet structure includes a bathing room. All structures are made from concrete bricks and have corrugate iron roofs.

Photo 29: Example of a replacement house in the Koidu resettlement village

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

Photo 30: Example of newly constructed VIP toilet in resettlement village

Source: Digby Wells Asset Survey (Nov 2010/Jan 2011)

6.6.4.12 Refuse disposal

There are no formal refuse disposal system and sites within the Extended Affected Area. The bulk of the household refuse is disposed of behind dwellings, in the bush, in streams or swamps.

The Koidu New Sembehun City Council (KNSCC) is responsible for refuse removal in the Resettlement Village. Short term planning is geared toward establishing a waste bin system in the village. Koidu Holdings have agreed to transport a number of two cum bin (skips) from Freetown for placement in the resettlement village. Refuse will be deposited in the skips by residents and the truck will move through the village on a schedule with residents then responsible for transferring refuse from the skips to the truck. The refuse will be dumped at the KNSCC waste dump at Gboroma outside of Koidu Town. The KNSCC waste management system at Gboroma consists of burning the waste which is not recyclable.

Although town refuse removal will remain the responsibility of the City Council, Koidu Holdings has planned for the construction of an industrial incinerator within the mining lease area in 2011/12, to facilitate the disposal of waste generated by the operation. The resettlement village refuse disposal system will be further developed with a view to incorporating incineration of resettlement household refuse into the operational refuse disposal plan. It is envisaged that the KNSCC refuse truck will deposit refuse at the incinerator plant according to a refuse disposal schedule.

6.6.4.13 Recreation and leisure

Some recreational activities observed by Digby Wells during the asset survey, were soccer and board games. Other recreational activities are mainly school based, and organised as competitions between schools. These activities are generally held on school premises.

No formal recreational infrastructure was observed by Digby Wells (Nov 2010 – 2011). The only entertainment centres are local palm wine bars which are makeshift sheds built with natural materials such as bamboo or wood. Video and night clubs are only found in Koidu Town. Leisure activities comprise the drinking of alcoholic beverages and palm wine at home, and in make-shift bars (locally referred to as "Limba Corner"), watching satellite television and videos/DVDs, dancing, going to night clubs, listening to the radio, as well as traditional dancing.

6.7. Koidu Kimberlite Project's non-mining related activities

6.7.1. Introduction

Since its inception in 2003, the Koidu Kimberlite Project has contributed time and resources to the implementation of community development initiatives in both the Tankoro Chiefdom and the Koidu New Sembehun City. Developmental activities were carried out in line with internally developed annual community development action plans, with additional activities implemented on an ad hoc basis. In keeping with the provisions of the Mines and Minerals Act of 2009, the Project has recently initiated discussions with lead stakeholders for the development of a formal Community Development Agreement (CDA).

The following sections provide an overview of the Project's current and past contributions to local and community development and how this has contributed to the current socio-economic baseline conditions in the broader project area:

6.7.1.1 Road Refurbishment Programme

The Project has been directly involved in the improvement of roads and infrastructure in and around Koidu Town. It has graded laterite roads that become severely potholed during the rainy season, and has provided materials for road surfacing. In 2009, the Project has rehabilitated 15 of the town's major roads and cleared all the garbage sites across the town.

In 2007, the Project refurbished the abandoned Old Yengema Road following the collapse of the Koaquima Bridge. In 2006 it refurbished the road linking the Kono and Kenema districts (the Koidu-Tongo road), which has increased commercial activities between the two districts and their environs. Most recently, the Project has partnered with the Kono District Council to rehabilitate the Koidu-Gandorhun Road.

6.7.1.2 Infrastructure Programme

KH has contributed to various district infrastructure projects since 2003. These include

- The rehabilitation of both the Tankoro and Motema Police Stations
- Materials for work concluded at the RSLAF 9bn headquarters
- Backfill material to the new Koidu market location and earth moving machinery to conclude the earthworks
- Provision of aggregate tailings and mined granite to various local community projects.
- The development of a metal recycling project in 2010. According to current planning the proceeds will be contributed to the Tankoro Chiefdom Authority (TCA) for development programmes. The first proceeds (in excess of US$ 20,000) have been committed, in accordance with a proposal received from the TCA, to the refurbishment of the Tankoro Native Administration (TNA) building. Work on the refurbishment started in April 2011 and is currently in progress.
- The Project has provided earth moving machinery to conduct the bulk earth works for the New Koidu Power Station site and committed a total of 18,000 blocks from its brick factory to the building of infrastructure at the site.

6.7.1.3 Education

In the early stages of its operations, the Koidu Kimberlite Project has collaborated with the Diamond Dealers Association to award scholarships to deserving Junior Secondary (JSS) Students. The scholarships covered tuition fees and learning materials. Between 2004 and 2007, over 50 children have benefited from this initiative.

In March 2011, the Project has awarded scholarships to 25 university students. With effect from 2010, it will allocate USD $100,000 annually for skills training and scholarships to Kono indigenes. These funds will be managed by a Board of Trustees including formed by various stakeholders from Kono District and central government. The Board will be responsibility for establishing the criteria for eligibility and ensuring that the awarding of scholarships is conducted in a fair and transparent manner.

From 2004 until 2007, Koidu Holdings had provided regular support to the Kono Students' Union (KONSU) with facilitating holiday lessons for secondary school pupils and undertaking other academic related activities in Koidu Town. The Project has also assisted with the refurbishment of a number of learning institutions, such as the United Methodist Church Girls Secondary School and the Ansarul Islamic Boys Secondary School, both located in Koidu Town.

6.7.1.4 Feeding Scheme

Since 2003 the Project has supported polio victims through the Polio Victims Association in Koidu. It assists them with their daily meals. The Project is currently reviewing a request for an increase in their weekly subvention.

6.7.1.5 Clean Water Supply

The Project has developed the necessary infrastructure to provide pipe borne water to the resettlement site. The water, which is sourced from a borehole, was tested by the Sierra Leone Water Company (SALWACO) and meets WHO standards. The water is pumped from the borehole to a 120,000 litre reservoir facility and then further reticulated to standing tap point in the resettlement village. A total of thirty eight tap points are functional, providing running water to 152 resettled households. The reticulation programme is part the on-going resettlement process, with one tap point allocated for every four houses. Currently the resettlement village is the only settlement in Koidu with pipe borne water supply.

6.7.1.6 Health Care

Koidu Holdings has established a clinic, with a full-time medical doctor, an advanced life support (ALS) paramedic and three nurses in the project site area. The clinic has the capacity to accommodate 30- 40 patients per day and is equipped with an electrocardiogram machine, defibrillator, laboratory and a fully equipped ambulance.

In October 2010, the Project has provided fuel to the District Health Management Team, (Ministry of Health and Sanitation), in order to ensure the provision of free drugs and health care to peripheral District Health Centres throughout the 14 District Chiefdoms.

6.7.1.7 Agricultural Pilot Project

In 2007, the Project launched its Agricultural Development Pilot Project. The aim of this initiative is to assist resettled households to embark on small to medium scale agricultural activities. Prior to the suspension of its operations in 2007, the Project was ready to allocate 100 plots of 50 square meters each per household in the resettlement village for cultivation of high quality vegetables. According to current planning the pilot project will be re-launched in 2011 and will provide the initial capital outlay. Koidu Holdings will also provide the farmers with seeds, fertilizers and pesticides. Once production commences, the Company will help the farmers to market their produces.

To provide guidance to farmers, the Company has sent two of its employees, both of whom are Kono indigenes, to the University of Bloemfontein in South Africa for a week's training in vegetable cultivation and agricultural management. The Project has also set aside 0.1% of its annual export revenue for agricultural development in Tankoro Chiefdom.

6.7.1.8 Local Business Development

The Koidu Kimberlite Project has been constrained over the years by the unavailability of qualified service providers relative to its operations. It has endeavoured to enhance the growth of local businesses across the country by extending business opportunities to petty traders, small scale, medium and large scale enterprises in especially Koidu and Freetown. This work extends from Koidu, where the Project works with vegetable sellers, charcoal sellers, the local market women, timber sellers, local supermarkets and banks, to Freetown where it works with companies such as CEMMATS, Total, Monoprix Supermarket, Yazbeck Motors, etc.

The bulk of the resettlement project building materials are purchased in Sierra Leone, with a large portion of this material being sourced in Koidu Town from local suppliers.

6.7.1.9 Sport Development Programme

Since 2007, the Project has supported the Kono District football team, the Diamond Stars. This support started with a USD 10,000 annual sponsorship plus soccer kits, boots, and footballs commitment. The sponsorship programme experienced some difficulties, but the Project will increase its sponsorship in 2011 to USD 50,000 annually, in addition to the provision of kits, boots, footballs, etc. Currently Koidu Holdings is the official sponsor of the Diamond Stars Football Club. Support has also been extended to the Gem Stars Football Club of Tongo, bringing the Project's annual investment in the development of sport in the Eastern region to USD 100,000.

6.7.1.10 Employee Development Scheme

From 2004, KH has made employee development an integral part of its operations in Sierra Leone. The Company has committed to supporting its Sierra Leonean employees through training programmes and skills transfer. The Company has established an employee-training programme to provide hands-on training on safety precautions, mining practices, production management and data capturing. It has also enrolled staff in specialist training courses in Freetown and outside the country. Employees who qualified for training have been sent for drilling and blasting training in Ghana, health and safety and mining related training in South Africa, and computer training in Freetown. In February 2011, the Company has sent three of its operators (Sierra Leoneans) to Sweden for a two-week training programme at Volvo.

Koidu Holdings has recently hired the services of Prisma Mining Services, a South Africa based company, to carry out specialised in-house operator training for its employees and new recruits for a period of six months. The training modules are specifically tailored to meet the training needs of the employees.

6.7.1.11 Employee Welfare

Koidu Holdings provides its employees with one cooked meal per day and provides medical facilities to all its employees and two of their chosen dependants.

6.8. Development constraints and priorities

In its efforts to stimulate economic growth through wealth creation, the Sierra Leonean Government has published a Poverty Reduction Strategy Paper (SL- PRSP) in 2005. In terms of the PRSP, District Councils are required to draw up District Development Plans, including a Medium Term Expenditure Framework (MTEF), based on the PRSP thematic areas of good governance, peace and security, pro-poor sustainable growth, and human development. The relevant development plans are discussed in order to provide an overview of development constraints in the broader project area. This overview will assist KH in identifying where best to focus its development support.

6.8.1. Kono District Development Plan

The Local Government Act of 2004 makes it obligatory for all district councils to prepare a District Development Plan (DDP). The purpose of the 2010-2012 Kono District Development Plan is to enhance sustainable growth focusing on poverty alleviation and community development in the Kono District.

The development needs for services provision in the Kono District that have been identified in the Kono District Development Plan (2010 – 2012) is summarised in the following section.

6.8.1.1 Education

The provision of quality education to the population in the Kono District is hindered by the following constraints:

- High dropout rate of pupils;
- Overcrowding in schools: High teacher/pupil ratio;
- Lack of technical professional training institutions;
- Lack of trained and qualified teachers;
- Inadequate school structures, lack of maintenance of school buildings.
- Low community participation;
- Low morale of teachers;
- Lack of funds for sufficient salaries for teachers;
- Lack of teacher accommodation;
- Lack of resources, i.e furniture teaching and learning material;
- Inability of parents to pay school fees; and
- Influence of traditional beliefs.

The District goal for education development is to reduce the illiteracy rate through the provision of affordable education in both the formal and informal education sectors. The overall objectives for education in Kono are:

- To increase the efficiency of management and support to provide quality education;
- To ensure quality teaching and learning at the basic level;
- To introduce information communication and technology in schools;
- To encourage private sector involvement in the educational sector;
- To renovate 30 percent of all the primary schools in the District by the end of 2012 and provide the schools with conducive teaching materials;
- To improve the quality of text books;
- To improve the teacher/pupil ratio from 1:6 to 1:4 by 2012;

- To renovate 60 percent of the Junior Secondary Schools and construct additional classrooms by the end of 2012; and
- To reduce to drop out rate from 70 percent to 40 percent by the end of 2012.

The Kono District Council plans to achieve these objectives by:
- Allocating adequate resources to support the expansion of the education system;
- Provide training in other sectors like socio-economic and civil rights activities;
- Mobilising resource and funds to improve the standard and quality of science and technology education in Senior Secondary Schools; and
- Reinforcing supervision and monitoring of the district inspectorate of the Ministry of Education Science and Technology.

6.8.1.2 Health and nutrition

The Kono District Development Plan (2010 - 2012) noted that the services offered at the medical facilities within Kono are often not adequate to provide comprehensive services to everyone, particularly in rural areas. Inadequacies in the Health Care Facilities identified in the Kono district are as follows:

- Inadequate health centers;
- Lack of funds for sufficient salaries for personnel;
- Inadequate drugs in health facilities;
- Lack of adequate treatment equipment;
- Lack of knowledge about HIV/AIDS; and
- Lack of trained and qualified personnel.

The overall objective for the development of the health sector in Kono as defined by the Kono District Development Plan (2010-2012) is to provide affordable and appropriate health care delivery services to the population of the Kono District. More specifically, the objectives for improving the provision of health services are:
- To establish emergency response systems for epidemic outbreaks;
- To improve and extend reproductive health and family planning services;
- To improve and strengthen supervision, monitoring and coordination of health care;
- To improve sanitation and waste disposal services and facilities in the district;
- To provide trained supporting staff to doctors and nurses;
- To improve birth and death registration systems;
- To improve the general health of school going children;
- To ensure the effective distribution of medication;
- To increase the number of women and children (0– 59 months) sleeping under repellent-pregnated nets from 60 percent to 80 percent to prevent malaria;
- The reduce acute respiratory infection from 90 percent to 60 percent by the end of 2012; and
- To encourage more pregnant women to attend antenatal care.

The strategies to achieve these objectives are through:

- Strengthening and expanding healthcare facilities by employing adequately trained nurses;
- Establishing cost recovery schemes in the district to deal with the rising cost of health care;
- Giving priority to the improvement of preventive health care;
- Ensuring regular procurement and timely supply of essential and basic medication;
- The provision of sex education at all levels to reduce the spread of HIV/AIDS in the district;
- Streamlining maternal and child health care programmes and making the services available to all.

6.8.1.3 Water and sanitation

According to the Kono District Development Plan (2010 – 2012) the main challenges for the provision of water and sanitation services in the Kono District are:

- Insufficient drinking water;
- Limited access to safe drinking water, made difficult by uneven terrain;
- Poor maintenance of water collection points by the community;
- Water borne diseases especially in the dry season;
- Walking distances to water collection points;
- Inadequate family/community toilets;
- The use of the bush for defecation causing environmental and health hazards; and
- Inadequate hygiene awareness in the communities.

The overall objective for water and sanitation services provision in Kono is to improving water and sanitation in the district through proper garbage collection and disposal, additional installation of water collection points and the construction of additional and adequate VIP toilets. More specifically the Kono District would like to:

- Provide access to safe and adequate drinking water in the 24 wards by the end of 2012 by constructing water collection points in close proximity to the communities;
- Train 100 maintenance workers in the 24 wards by 2012;
- Provide / make use of alternative means to provide water e.g. gravity, boreholes by 2012;
- Provide individual family pit latrines to households in 12 of the 24 wards by 2012; and
- Organize hygiene workshops for ward committees by end of 2012;

The Kono District Council aims to achieve these objectives through:

- The construction of boreholes where feasible;
- Training maintenance personnel for the operation and maintenance of water and sanitation facilities;
- The construction dams for storage of water;
- The construction of gravity feeding water systems; and
- The construction of individual household pit latrines.

6.8.1.4 Roads and transport

Roads were identified as a priority issue in the Kono District Development Plan (2010 - 2012). This is mainly due to the poor state of both the primary roads and the internal circulation routes (especially in the rural areas) in Kono. The inadequate maintenance of these roads can mainly be attributed to a lack of funds, human resources, capacity and equipment and lack of appropriate road maintenance policies. The internal feeder roads often experience problems due to the type of road surface (such as gravel) and the resulting carrying capacity, coupled with the high volumes of traffic along these routes. The specific objectives of the Kono District Council for the improvement of transport and systems are:

- To promote access to adequate community infrastructural facilities;
- To promote access through developing formal road networks to economically viable chiefdoms to enhance cohesion; and
- To improve/ up-grade the existing feeder roads.

The Kono District Council proposed the following strategy to achieve these objectives:

- Improving the maintenance on existing roads including the construction of better drainage systems to prevent erosion during the rainy season;
- The construction of additional linkage roads to connect ward sections; and
- The employment of road maintenance crews for the maintenance of roads.

6.8.1.5 Agriculture

The following challenges are prevalent in the agricultural sector of the Kono District (Kono District Development Plan (2010 – 2012) :

- Crop and livestock pests and diseases;
- Farmers' inability to expand due to financial and other resource constraints;
- Lack of adequate faring equipment;
- Farmers limited access to technical advice;
- Persistent use of traditional system of crop and livestock production and
- Marketing of farm produce.

The main objective for advancing the agricultural sector in Kono is to increase and diversify food production. More specifically the objectives are:

- To increase productivity per hectare for crops by 50 percent by the end of the year 2012;
- To reduce harvest losses for crops production by 30 percent by the end of 2012;
- To provide modern equipment to 25 percent of the small-scale farmers who are currently using traditional farming methods; and
- To improve life stock farming in most wards of the district.

The Kono District Council intends to accomplish these objectives by:

- Identifying marketable crops and increasing their production;
- Expanding cash crop (Oil palm, Cocoa, Citrus and vegetables) farms;
- Focussing on inland valley swamp rice cultivation with new varieties of rice;
- Setting up small-scale local markets in villages;
- Designing functional, affordable and improved storage facilities based on traditional concepts for all types of perishable crops;
- Improving the road network for the transport of agricultural products;
- Establishing agricultural processing units with improved appropriate technology; and
- Embark on institution building for the strengthening of existing marketing association and the developments of marketing cooperatives.

6.8.1.6 Housing

The Kono District suffered severe housing infrastructural damage during the war. Although efforts have been made by NGOs like Adventist Development and Relief Agency (ADRA) to provide shelter to affected households, most community members still live in dilapidated houses and the provision of housing remain a significant problem for the Kono District Council (Kono District Development Plan, 2010 – 2012). The objectives for housing development in Kono are:

- The construction of modern housing estates through housing schemes;
- Allocation of loans to households for replacing tarpauline (plastic sheets) roofs with corrugated iron roofs;
- Encourage shared housing construction in some communities; and
- Construction of adequate drainage systems on and resurfacing of roads to prevent water damage to houses.

According to the Kono District Development Plan (2010 – 2012), the Kono District Council mostly relies on donor support in order to address the housing problems in Kono.

6.8.1.7 *Economy*

Economic growth and development is an important aspect to employment and an improvement in living standards. The economy and subsequent living standards of the Kono population is dependent on local trade and commerce activities. In order to develop the local economy in Kono, the Kono District Council identified the following priorities (Kono District Development Plan, 2010 – 2012):

- Rehabilitation of existing markets centres and structures for periodic markets;
- Expansion of existing marketing facilities;
- Scheduling of proper timetable for market operations; and
- Maintenance of trunk roads linking the district and the capital to reduce transport cost, which will eventually reduce prices of commodities.

The Kono District Council proposes to achieve this through:

- Improving productivity through improving trading and market infrastructure;
- Promoting the employment of youth;
- Establishing small-scale credit schemes in the community (to provide loans to potential entrepreneurs);
- Encouraging community involvement in development planning and implementation;
- Providing tools and equipment to artisan workers (e.g furniture, tailors etc).

6.8.2. Koidu-New Sembehun District Development Plan

The Local Government Act of 2004 makes it obligatory for all city councils to prepare a City Development Plan (CDP). The Koidu New Sembehun City Council Development Plan for 2011-2013 states that the goal of the Council shall be to create an enabling environment for effective and efficient resource mobilization, management, utilization and sustainable democratic community development within the micro and macro economic framework.

A brief overview of the most critical developmental opportunities, constraints and challenges in terms of services provision as identified in the Koidu Mew Sembehun City Council development Plan (2011 – 2013) is provided below.

6.8.2.1 *Roads and Transport*

The road network is one of the main development problems in Koidu. It is characterized by poor road conditions and inadequate feeder/connection roads between townships and larger towns. The lack of development/maintenance of the roads can be attributed to a lack of funds and resources. These constraints can be addressed through effective collaboration with the Sierra Leone Roads Agency (SLRA) and the National Commission for Social Action (NacSA). The challenges can be managed through intensive revenue mobilisation, creating linkages with relevant MDAs and donors, and developing relevant project proposals.

6.8.2.2 Agriculture

Low levels of agricultural productivity are a concern for the population of Koidu. The low levels of productivity can largely be attributed to a lack of resources and equipment and unavailability of arable land for farmers. The Koidu New Sembehun City Council is of the opinion that the problem can be alleviated through improving crop varieties and with the assistance from commercial banks and other financial institutions and NGOs. The challenges can be managed through capacity building and the provision of additional and improved market facilities.

6.8.2.3 Economy

Limited economic activities coupled with low levels of income are a critical development problem in Koidu. Institutions like "Osusu" and micro credit schemes, the high business potential of the Town, and assistance from "Finance Salone", could possibly assist with the development of the local economy.

6.8.2.4 Health and sanitation

Inadequate health and sanitation services delivery poses as one of the development problems in Koidu. The Koidu New Sembehun City Council Development Plan (2011 – 2013) noted that effective and integrated resource mobilization as well as proper co-ordination and collaboration between the Sierra Leonean Government, the World Bank, UNICEF and community health and sanitation projects can mitigate the constraints and challenges with regard to service delivery in this regard.

6.8.2.5 Education

As in the larger Kono District, the quality of education in Koidu has been identified as a constraint in the Koidu New Sembehun City Council Development Plan (2011 – 2013). The poor quality of education can be attributed to a lack of resources and infrastructure. The Koidu City Council proposes to address this problem by:

- Recruiting adequately trained and qualified teachers;
- Providing efficient teaching material to schools;
- Improving services provided to teachers; and
- Reducing school dropout rates.

This can be achieved with the assistance of local NGOs, the Sierra Leonean Government and the Local Council Education Committee.

7. ESIA LIMITATIONS

The following limitations of this ESIA have been identified:

7.1. Air Quality

The range of uncertainty of the model predictions could to be -50% to 200%. A model represents the most likely outcome of an ensemble of experimental results. The total uncertainty can be thought of as the sum of three components: the uncertainty due to errors in the model physics; the uncertainty due to data errors; and the uncertainty due to stochastic processes (turbulence) in the atmosphere.

7.2. Fauna and Flora

This assessment was based on information collected during a single site visit. The survey was conducted in February 2011 during the dry season. In order to obtain a comprehensive understanding of the dynamics of communities and the status of endemic, rare or threatened species in any area, faunal assessments should consider investigations at different time scales (across seasons/years) and through repetition.

Satellite images were supplied to assist in the identification of the more important features such as homogenous vegetation units, hills, wetlands and human settlements.

Lastly sampling and trapping efforts were limited to due to fact that the site was easily accessed by the public. Traps used during the survey such as pitfall trapping and Sherman traps although well hidden could be tracked by the locals and taken. Locals utilized the site for the poaching of animals, gathering of edible vegetation or that of cultural importance and the collection of firewood. For this reason trapping was limited to areas where the traps remained undiscovered instead of following a spatial distribution plan, covering different vegetation communities.

7.3. Aquatic environment

Information pertaining to water resources for Sierra Leone in general is limited, with little or no information available for the study area. In light of this, internationally recognised methods were considered for the study.

The study area has been mined in excess of 70 years (documented) and this has had a considerable impact on the wetlands for the area, due to these activities. This has resulted in the topography of the area being altered, profiling implemented and the integrity of the wetlands being considerably impacted upon. In light of this, selected wetland areas have been "formed" due to these mining activities and recommendations have taking this into consideration

7.4. Heritage and Archaeology

Although this report has been written as comprehensively and inclusive as possible, it should be noted that most archaeological sites are located below ground, or some areas may have been disturbed to such an extent that any potential *in situ* deposit was unnoticed. This report may therefore not give a full perspective of archaeological and heritage sites found in the project area and consequently chance find procedures must be implemented. This implies that an archaeologist or heritage specialist must immediately be contacted should any archaeological or heritage features be uncovered during the construction or operational phase. Chance find procedures may form part of the environmental monitoring programme. Such archaeological and heritage features and/or objects may not be disturbed or removed in any way until such time that the specialist has been able to do an assessment of the site (or object).

The significance of these sites is uncertain and has preliminarily been rated. It was recommended that archaeological mitigation should take place at all three sites. These studies are currently being undertaken, after which the significance will be determined.

7.5. Blasting Assessment

The possible need for a blasting assessment has been identified. However, a blasting assessment was not conducted as part of this ESIA, as blasting-related issues raised during the Public Consultation and Disclosure Process (PCDP) indicated that concerns stemmed from within the Extended Affected Area, and blasting is only to occur during the first four years prior to open pit mining ceasing. As people residing within the Extended Affected Area will be resettled, the immediate need for this study was not identified.

However, as a result of the blasting-related issues raised, a blasting monitoring plan is recommended and contained in the EMP. Grievances relating to blasting can be lodged using the grievance mechanism which is contained in Volume 2 of this ESIA.

7.6. Social Environment

Biophysical assessments for this ESIA included the area provisionally earmarked for resettlement due to the expansion of the Koidu Kimberlite Project. A detailed socio-economic assessment of this and other potential replacement land will be conducted during the development of the RAP.

8. ENVIRONMENTAL IMPACT ASSESSMENT

8.1. Impact assessment methodology for biophysical and heritage impacts

In order to clarify the purpose and limitations of the impact assessment methodology, it is necessary to address the issue of subjectivity in the assessment of the significance of environmental impacts. Even though Digby Wells, and the majority of environmental impact assessment practitioners, propose a numerical methodology for impact assessment, one has to accept that the process of environmental significance determination is inherently subjective. The weight assigned to the each factor of a potential impact, and also the design of the rating process itself, is based on the values and perception of risk of members of the assessment team, as well as that of the I&AP's and authorities who provide input into the process. Whereas the determination of the spatial scale and the duration of impacts are to some extent amenable to scientific enquiry, the severity value assigned to impacts is highly dependent on the perceptions and values of all involved.

It is for this reason that it is crucial that all ESIA's make reference to the environmental and socio-economic context of the proposed activity in order to reach an acceptable rating of the significance of impacts. Similarly, the perception of the probability of an impact occurring is dependent on perceptions, aversion to risk and availability of information.

It has to be stressed that the purpose of the ESIA process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context. The methodology employed for environmental impact assessment is divided into two distinct phases, namely, impact identification and impact assessment.

8.1.1. Impact identification

Impact identification is performed by use of an Input-Output model which serves to guide the assessor in assessing all the potential instances of ecological change, pollution and resource consumption that may be associated with the activities required during the construction, operational, closure and post-closure phases of the project. These activities were listed in Table 8-1.

Table 8-1: Activities identified during each different phase of the project

No	Activity
	Construction
1	Procurement of new earth moving fleet
2	Recruitment and training of employees
3	Mining and material dumping area preparation
4	Establishment of dewatering infrastructure
5	Site clearance
6	Sourcing of construction materials
7	Disturbances to natural water courses
8	Construction of new infrastructure and the diversion of the Koidu-Gandonhum road
9	Access to resource
	Operation
10	Open pit mining including blasting
11	Underground mining
12	Fuel and chemicals storage and use
13	Transport and roads
14	Domestic and hazardous waste handling
15	Management of waste rock, tailings and slimes
16	Water requirements and supply
	Decommissioning
17	Retrenchment
18	Removal of infrastructure
19	Rehabilitation of void by means of passive natural flooding
20	Spreading of topsoil and sub-soils (where possible)
21	Rehabilitation of areas disturbed by infrastructure
22	Profiling and contouring to assist in drainage lines
23	Environmental monitoring of decommissioning activities
24	Post-closure monitoring and rehabilitation.

Outputs may generally be described as any changes to the biophysical and socio-economic environments, both positive and negative in nature, and also include the product and waste produced by the activity. Negative impacts could include gases, effluents, dust, noise, vibration, other pollution and changes to the bio-physical environment such as damage to habitats or reduction in surface water quantity. Positive impacts may include the removal of invasive vegetation, construction of infrastructure, skills transfer or benefits to the socio-economic environment. During the determination of outputs, the effect of outputs on the various components of the environment (e.g. topography, water quality, etc.) is considered.

8.1.2. *Impact rating*

The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the Input-Output model. As discussed above, it has to be stressed that the purpose of the ESIA process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context. This gives the project proponent a greater understanding of the impacts of this project and the issues which need to be addressed by mitigation and also give the regulators information on which to base their decisions.

The equations and calculations were derived using Aucamp (2009).

The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability

Where *Consequence = Severity + Spatial Scale + Duration*

And *Probability = Likelihood of an impact occurring*

The matrix calculates the rating out of 147, whereby Severity, Spatial Scale, duration and probability are each rated out of seven as indicated in Table 8-2. The weight assigned to the various parameters for positive and negative impacts in the formula.

Table 8-2: Impact assessment parameter ratings

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	**Social, cultural and heritage**			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
6	Significant impact on highly valued species, habitat or ecosystem.	Irreparable damage to highly valued items of cultural significance or breakdown of social order.	National Will affect the entire country	Permanent: Mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate	Very serious widespread social impacts. Irreparable damage to highly valued items	Province/ Region Will affect the entire province or region	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year	On-going serious social issues. Significant damage to structures / items of cultural significance	Municipal Area Will affect the whole municipal area	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting ecosystem function. Rehabilitation requires intervention of external specialists and can be done in less than a month.	On-going social issues. Damage to items of cultural significance.	Local Local extending only as far as the development site area	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental	Minor medium-term social impacts on local population.	Limited Limited to the site and its	Short term Less than 1 year	Rare/ improbable Conceivable, but only in

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
	damage can be rehabilitated internally with/ without help of external consultants.	Mostly repairable. Cultural functions and processes not affected.	immediate surroundings		extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures
1	Limited damage to minimal area of low significance, (e.g. ad hoc spills within plant area). Will have no impact on the environment.	Low-level repairable damage to commonplace structures.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the EMP. The significance of an impact is then determined and categorised into one of four categories, as indicated in Table 8-3 which is extracted from Figure 8-1. This methodology is used to accommodate social and heritage impacts.

Table 8-3: Significance threshold limits

Significance		
High	108- 147	
Medium-High	73 - 107	
Medium-Low	36 - 72	
Low	0 - 35	

A neutral impact implies that it causes the area to return to a pre-project state. This is not regarded as positive, as there would be no need for this activity if the operation was not carried out.

Significance

	Consequence (severity + scale + duration)								
Probability / Likelihood	1	3	5	7	9	11	15	18	21
1	1	3	5	7	9	11	15	18	21
2	2	6	10	14	18	22	30	36	42
3	3	9	15	21	27	33	45	54	63
4	4	12	20	28	36	44	60	72	84
5	5	15	25	35	45	55	75	90	105
6	6	18	30	42	54	66	90	108	126
7	7	21	35	49	63	77	105	126	147

Figure 8-1: Probability Consequence Matrix

The full impact assessment matrix for the Koidu Kimberlite Project is in Appendix A. Following the establishment of the significance of each activity on each aspect, a weighting system is used to eliminate subjectivity. The weighting system is whereby all aspects impacted on by the project are weighed from one to seven, one being the least significant and seven the most significant. Surrounding land use, land capability, cumulative impacts and overall aspect significance to the area is taken into consideration.

9. POTENCIAL ENVIRONMENTAL IMPACTS

9.1. Significant impacts identified

A summary of the impacts which have been regarded as high and medium high are summarised in the table below. Table 9-1 and Table 9-2 indicate that medium-high impacts are expected during construction and operation due to noise and impacts on the fauna within the lease area. After the appropriate mitigation measures are implemented, these impacts will however, be of medium significance. The impact due to construction activities on the aquatic environment may be of high significance but after mitigation will be of medium significance. During decommissioning of the mine, natural habitat for fauna will be restored and will be of medium positive significance (Table 9-3). Air quality impacts of medium significance may occur during the decommissioning of mining infrastructure however, after the recommended mitigation measures are implemented, the impacts will be of low significance. A detailed evaluation of all the anticipated biophysical impacts can be found in Appendix A.

9.1.1. Significant biophysical impacts

9.1.1.1 Biophysical impacts during construction

Table 9-1: Biophysical impacts rated as medium-high and high during construction.

Activity, Phase and Impact			Impact before mitigation							Impact Rating (after mitigation)						
Impacted Environment	Activity	Summary of Impact	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)
Noise	Mining & Material dumping area preparation	Noise of machinery and vehicles may impact on noise receptors in the vicinity of the project	N	4	2	5	11	7	77	N	4	2	4	10	5	50
Fauna	Site clearance	Site clearance during the construction of mining infrastructure may negative impact on the existing fauna within the mining lease area	N	4	6	5	15	7	105	N	3	5	4	12	6	72
			N	3	6	4	13	6	78	N	2	3	4	9	5	45

9.1.1.2 Biophysical impacts during operation

Table 9-2: Biophysical impacts rated as medium-high and high during operation.

Activity, Phase and Impact			Impact before mitigation							Impact Rating (after mitigation)						
Impacted Environment	Activity	Summary of Impact	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)	Nature of Impact (positive /	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)
Noise	Open pit mining	Noise from blasting, vehicles and mining activities will impact on senstitive receptors in the area	N	4	3	5	12	7	84	N	4	3	4	11	5	55
	Underground mining		N	4	5	4	13	6	78	N	3	5	3	11	4	44

9.1.1.3 *Biophysical impacts during decommissioning*

Table 9-3: Biophysical impacts rated as medium-high and high during decommissioning

Activity, Phase and Impact			Impact before mitigation							Impact Rating (after mitigation)						
Impacted Environment	Activity	Summary of Impact	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)	Nature of Impact (positive /	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)
Fauna	Rehabilitation of void and mining areas	Rehabilitation of the final void and mining area may will lead to an increase in habitat for fauna species.	P	3	4	5	12	7	84	No mitigation for Positive						
Air Quality	Decommissioning of mining infrastructure	During decommissioning of mining infrastructure, air quality impacts (mainly dust) may negatively impact the adjacent environment	N	3	5	5	6	13	78	N	1	1	1	1	3	3

9.1.2. *Significant impacts on heritage and archaeology*

This section aims to assess the significance of the potential impacts (threats or sources of risk) on archaeological and heritage resources in the proposed project area. The following impact assessment was completed in compliance with the impact assessment criteria implemented for the environmental impact assessment report, as well as in accordance with significance ratings and archaeological impact assessment criteria established by the Association of Southern African Professional Archaeologists (ASAPA) and applicable international best practice guidelines.

All potential impacts will occur during the construction phase, thus, no additional impacts are expected during the operational and decommissioning phases.

9.1.2.1 *Archaeological impacts identified during construction*

As indicated in Table 9-4, the significance of the impacts on archaeological resources are rated as high prior to mitigation. However, after mitigation impacts will be of medium and low importance. It has to be noted that Koidu Holdings is currently in the process to conduct the mitigation measures recommended.

Table 9-4: Impacts on archaeological resources during construction

Sites identified	Phase	Impact	Nature (Positve or Negative)	Scale	Duration	Severity	Consequence	Probability	Significance	Nature (Positve or Negative)	Scale	Duration	Severity	Consequence	Probability	Significance
RES967/001	C	Tailings facility may impact on site	N	5	7	7	19	6	117	P	4	2	4	10	3	33
RES967/002	C	Tailings facility may impact on site	N	5	7	7	19	6	117	P	4	2	4	10	3	33
RES967/003	C	New camp site may impact on site	N	5	7	7	19	6	117	P	4	2	4	10	3	33

9.2. All impacts identified during construction

A detailed description of each impact environment relating to the project activities is described in the next section.

9.2.1. Topography

During construction there will be excavation for foundations of buildings and sites of infrastructure which will result in excess overburden and rock which will be stockpiled, creating new features on the landscape. Stripping of waste rock will lead to new rock stockpiles and the enlargement of some existing ones. Waste rock will be crushed and used for aggregate on the mine and in the local community. It is also proposed by mine management that the aggregate will be supplied to the national roads authority in order to maintain and repair road infrastructure throughout Sierra Leone.

In spite of the volume of material to be excavated, the overall impact on topography during construction is of low significance as the topography is already disturbed due to historical mining activities.

9.2.2. Air Quality

The project activities have been categorised into three project phases, namely the construction, operational and decommissioning phases. As the open cast operational phase has the highest potential to produce air quality impacts, this was used to produce a conservative estimate of impacts.

9.2.3. Noise

The following activities during the construction phase are identified as possible noise sources and may impact on the ambient noise level of the area:

- Site clearance; and
- Construction of new infrastructure.

The construction machinery will be a source of continuous noise throughout the construction phase. The noise levels of the construction machinery, according to the predicted noise levels, will measure above the IFC EHS guidelines for residential areas at the measured locations but only during the night time. The impact is expected to be insignificant at most of the locations because the predicted noise levels will be substantially lower than the existing ambient noise levels in the area during the day and night time. The noise level from the construction phase is expected to impact on location KN5 and KN6 during the night time.

9.2.4. Geology

During construction, the geology will be impacted on through mining activities. The impact to geology will be moderate, but will be of a permanent nature.

Due to the nature of the rocks being excavated, namely granites and kimberlites, no acid mine drainage (AMD) is expected.

9.2.5. Soils

9.2.5.1 Site Clearing

During the construction phase of the mining project, the work carried out will be mainly the setting up of mine infrastructure, haul roads, conveyors, fuel storage, buildings, and workshops. Heavy machinery will be used to clear vegetation and level out areas. This will result in the disturbance of the topsoil and ultimately soil loss during this operation. The topsoil recovered will be removed and stored in stockpiles for use later for rehabilitation.

9.2.5.2 Temporary Fuel Storage and Movement of Construction Vehicles

The contamination of the soil by fuel and oils due to general construction activities may take place during construction activities. This impact could take place in areas where refuelling and servicing take place, or during normal site activities. Once soil is contaminated, it has to be removed and treated or declared as waste.

9.2.6. Fauna

9.2.6.1 Site clearing

The existing vegetation within the proposed area of development will be impacted on as the existing vegetation will be removed to facilitate the construction of mining related infrastructure. Activities will include the complete removal of vegetation and soil as the exact footprints are developed. This activity is considered to be medium in duration as it will be required for the construction and operating phases of the mine. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be medium.

The partial degradation of natural vegetation and habitat for animal life has already taken place within the surrounding environment due to current land use practices which include artisanal mining and slash and burn farming practices. The destruction of the areas with remaining natural wooded grassland and secondary forest areas will result in the permanent reduction of natural habitat of reptiles, birds, frogs, insects and mammals present within the areas. The secondary forest, wooded grassland and surrounding vegetation offers habitat to certain birds, reptiles, frogs, insects and mammals that could be present. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be moderate.

9.2.6.2 Construction of new infrastructure

The construction of the additional infrastructure will increase open areas which is favourable habitat for alien invasive plant species to establish themselves. The area designated for surface infrastructure will no longer allow for seepage of surface water into underground aquifers due to the hardening of surfaces. The infiltration will increase the surface water run-off, which in turn will increase erosion that will lead to loss of topsoil, which is detrimental to plant species. This activity is considered to be short in duration as well as local in extent. The severity of the impact was determined to be moderate.

9.2.7. *Flora*

9.2.7.1 Site clearance

Although site clearance is limited to certain parts of the concession area, the whole of the ecological system will be impacted and changed. A reduction in the impact significance will be noticeable from where the clearance is implemented (high significance) to the area furthest from the clearance (low significance, only some change in the ecological system).

By clearing the site, all vegetation cover will be removed. Removal of all vegetation will eliminate existing fauna habitat, possible habitat and food resources. For this reason fauna species will be eliminated from the site, the biodiversity will be reduced and the total ecological system changed.

9.2.7.2 Construction of infrastructure

Construction will produce a higher level of human activity, more waste and more noise, that will result in the reduction of fauna activity and so negatively affecting ecological functioning.

9.2.8. *Aquatic Environment*

9.2.8.1 Tailings dump and slimes dam

The proposed placement of the tailings dump and slimes dam will result in the direct loss of wetland areas. The proposed placement area consists predominantly of wetlands already severely degraded by agriculture, historical commercial and artisanal mining activities, as well as current illegal artisanal mining. Thus the resulting loss of wetland functioning will be negligible owing to the poor and impacted state of the systems. The current services offered by the wetland system may not be of a high importance due to the imposed impacts, but the loss of these units would result in the increase of pressures on an already considerably impacted system. A long term concern would be the potential impacts caused by the tailings dump on the water quality of the catchment due to seepage. However, according to Ochieng *et al.* (2009) the long term environmental risks associated with acidity and leaching of heavy metals is insignificant.

9.2.9. *Hydrology*

9.2.9.1 Impact of pollution of water resources

The absence of clean water diversion structures within the proposed mining lease area will result in:

- Pits being flooded during storm events of a high magnitude;
- Erosion of the downstream rivers;
- The upstream clean water system not being separated from the dirty water system, resulting in downstream pollution of the stream running through the mine area; and
- Flooding of the plant area by the upstream cleanwater system.

9.2.10. Visual

Certain activities which are to take place during the construction phase will impact on the visual nature of the site. These activities include the removal of vegetation, construction of new infrastructure, construction of the security wall and the creation of waste rock dumps, tailings dump and slimes dam.

9.3. All impacts identified during operation

9.3.1. Topography

Stripping of waste rock will lead to new rock stockpiles and the enlargement of some existing ones. Waste rock will be crushed and used for aggregate on the mine and in the local community. It is also envisaged that aggregate be provided to the Sierra Leone roads authority to be used in the maintenance, repair and creation of road infrastructure.

In spite of the volume of material to be excavated, the overall impact on topography during construction is of low significance as the topography is already disturbed due to historical mining activities.

9.3.2. Air Quality

Dispersion modelling was undertaken to determine highest daily and annual average incremental ground level concentrations for each pollutant. These averaging periods were selected to facilitate the comparison of predicted pollutant concentrations with relevant air quality standards and dust-fall limits.

It should be noted that the ground level concentration isopleths depicted present interpolated values from the concentrations predicted by the model for each of the receptor grid points specified. Plots reflecting daily averaging periods contain only the 99^{th} percentile predicted ground level concentrations, for those averaging periods, over the entire period for which simulations were undertaken. It is therefore possible that even though a high daily average concentration is predicted to occur at certain locations, that this may only be true for one day of the year.

9.3.2.1 Predicted PM_{10} Concentrations

The predicted concentrations were compared to annual and daily World Health Organisation Air Quality PM10 guidelines of 20 µg/m³ and 50 µg/m³, respectively. Both daily and annual concentrations resulting from the mining operations were below the WHO guidelines during the current operations and proposed expansion conditions. Predicted ground level PM_{10} concentrations at selected sensitive receptors for both scenarios are presented in Table 9-5 below.

Table 9-5: Predicted PM_{10} concentrations

Receptor	Baseline		Expansion	
	Highest daily PM_{10} (µg/m³)	Annual average PM_{10} (µg/m³)	Highest daily PM_{10} (µg/m³)	Annual average PM_{10} (µg/m³)
Koidu Kimberlite parameter	7.97	1.17	27.7	1.59
Resettlement Area	18.9	1.88	7.69	0.93

9.3.2.2 Predicted Dust-fall Levels

Predicted average daily dustfall levels as a result of operations at the proposed Koidu Kimberlite Project and the town of Koidu are summarised in Table 9-6 below.

Accurate dust-fall predictions rely on accurate site specific particle size distributions. Particle size distributions used in calculations were based on analyses of general particle sizes for unpaved industrial roads. Furthermore a particle size distribution was selected from these that would result in the highest fallout rates and was assumed to represent the most conservative estimate.

Proposed open pit operations were predicted to result in lower levels than the international limits. Dustfall levels predicted at the proposed resettlement area were below the respective SANS Target and Residential Action levels of 300 and 600 mg/m²-day.

Table 9-6: Predicted dustfall levels

Receptor	Baseline		Expansion	
	Average Daily Dustfall (mg/m²-day)	Maximum Daily Dustfall (mg/m²-day)	Average Daily Dustfall (mg/m²-day)	Maximum Daily Dustfall (mg/m²-day)
Koidu Kimberlite Fenceline	2.08	3.55	3.21	1.55
Resettlement Area	4.06	7.86	3.07	0.82

9.3.3. Noise

The following activities during the operational phase are identified as possible noise sources and may impact on the ambient noise level of the area:

- Blasting for the first five years;
- Mining of kimberlite and
- Transport and roads.

The machinery in the mining of the kimberlite will be a source of continuous noise throughout the operational phase. The blasting will cause the highest sound power levels but the activity is intermittent of nature.

The noise levels of the mining machinery, according to the predicted noise levels, will measure above the IFC EHS guidelines for residential areas at all the measured locations but only during the night time. The impact is expected to be insignificant at most of the locations because the predicted noise levels will be substantially lower than the existing ambient noise levels in the area during the day and night time. The noise level from the operational phase is expected to impact on location N5 and N6 during the night time.

The blasting activities will impact on the ambient noise levels at N1, N2 and N5 during the daytime at the time of the blasts. The overall significance of the noise impact of the blasting activities will depend on the frequency of blasts.

9.3.4. Soils

9.3.4.1 Temporary Fuel Storage and Movement of Vehicles

The contamination of the soil by fuel and oils due to general operational activities may take place. This impact could take place in areas where refuelling and servicing take place, or during normal site activities. Once soil is contaminated, it has to be removed and treated or declared as waste.

9.3.5. Geology

During operation, the geology will be impacted on through mining activities. The impact to geology will be moderate, but will be of a permanent nature.

Due to the nature of the rocks being excavated, namely granites and kimberlites, no acid rock drainage (ARD) is expected.

9.3.6. Fauna

9.3.6.1 Fuel and chemicals storage and use

Spillages from fuel and chemical storage areas may pollute soil and water resources.

9.3.6.2 Transport and roads

Transport areas are should be limited to demarcated areas and existing speed limits should be adhered to prevent the generation of excess dust.

9.3.6.3 Management of waste rock, tailings and slimes

Management procedures should be strictly implemented, so that no waste or pollution spread from the demarcated areas into the surrounding environment, reducing the ecological integrity of the site.

9.3.7. Flora

9.3.7.1 Transport and roads

The vehicular activity will result in the creation of dust which will increase the deposits these materials on plant leaves. Natural dust will be created from use of the haul road. This dust will be created during transport by haul trucks. This will impact on the vegetation health and availability as food items as well as inhibit the ability of the plants units to provide ecological services. This activity is considered to be long term in duration as it will be required for the life of mine. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be moderate.

9.3.7.2 Management of waste rock, tailings and slimes

The removal of topsoil and overburden will result in stockpiling of the material which will increase the potential of the stockpiles becoming eroded as a result of high winds moving across the areas. As the vegetation present on the actual footprint is secondary forest and wooded grassland, the removal of these plants will negatively affect soil binding, and surface runoff. This activity is considered to be medium in duration as it will be required for the construction and operational phases. The impact will be site specific in extent with impacts likely to on site. The severity of the impact was determined to be low.

9.3.8. Aquatic Environment

9.3.8.1 Management of waste rock, tailings dump and slimes dam

The primary impact caused by these infrastructure units will be to the overall water quality of the catchment due to seepage. A return water dam will be constructed to trap and store dirty water which will then be treated prior to discharge. The slimes dam will be constructed from suitable material and lined with geo-fabric to minimise seepage.

9.3.9. Hydrology

9.3.9.1 Impact of pollution water resources due to upstream clean water mixing with dirty water

The impact of no cleanwater diversion structures within the proposed mine will result in:

- Pits being flooded during storm events of a high magnitude;
- Erosion of the downstream rivers;
- The upstream clean water system not being separated from the dirty water system, resulting in downstream pollution of the stream running through the mine area.
- Flooding of the plant area by the upstream cleanwater system
- Flooding of the plant from water backing up against the TSF.

9.3.9.2 Impact of excess water discharged to environment

The mine will have excess water that cannot be used in the process. This water together with surface water will be discharged to the environment if it cannot be used. The impact of excess dirty water being discharged into the environment is:

- Pollution of nearby surface water courses
- Dirty water percolating into the groundwater store and polluting the available groundwater.

9.3.9.3 Impact of scouring of water course

The upstream watercourse will be affected by erosion at the outlets of the clean water diversion catchments. Presently the wetland acts as a sponge and once the sponge is removed then higher peak discharge rates at the clean water diversion structures will result in scouring of the water course at the outlet points. This is primarily due to high velocities of surface water captured in the clean water diversion structures. The extensive scouring will result in higher sediment loads being transported and deposited downstream of the river.

9.3.10. Geohydrology

9.3.10.1 Mining and Pit Lake Infilling

Removal of groundwater from both passive inflow and active dewatering will lower groundwater levels in the granite. The maximum extent is defined by the 3-m isopleth, a value that takes into consideration reasonable uncertainty in spatial and seasonal variations in the water levels and the precision of numerical models. The possibility exists that water levels in boreholes may be impacted upon.

The groundwater flow model predicts that it will take about 30 years for each pit lake to fill to pre-mining water levels if the only contributing water is groundwater and direct precipitation the footprint of the pits. If runoff were allowed to enter the pits, the infilling would be much quicker. These pit lakes will be able to provide water supply, potential for fish farming depending on quality, and recreational possibilities.

9.3.10.2 Drawdown of Water Table

The 3-D model of the Koidu project area predicts that the 3- m drawdown isopleth will extend about 1.3 km to the west of the K1 pit, about 1.6 km to the east of the K2 pit, about 2 km to the south of both pits, and at least to the model boundary to the north. The latter includes an area where there are presumably many shallow hand dug or drilled boreholes. This potential impact, since predicted drawdown will exceed more than 10 m over much of this area, will need to be confirmed and addressed. The impacts on Koidu's water supply wells for the camp, office, and resettlement areas should also be evaluated.

9.3.11. Visual

Certain activities which are to take place during the operational phase will impact on the visual nature of the site. These activities include the creation and operation of waste rock dumps, tailings dump and slimes dam.

9.4. All impacts identified during decommissioning

9.4.1. Air Quality

The project activities have been categorised into three project phases, namely the construction, operational and decommissioning, closure and post-closure phases. As the open cast operational phase has the highest potential to produce air quality impacts, this was used to produce a conservative estimate of impacts.

9.4.2. Noise

The machinery in operation during the following activities throughout the decommissioning phase is identified as sources of noise:

- Removal of all infrastructure; and
- Spreading of sub-soils and topsoil.

The machinery responsible for the demolishing of infrastructure as well as rehabilitation activities will be the source of noise during the decommissioning phase.

The noise levels of the machinery, according to the predicted noise levels, will measure above the IFC EHS guidelines for residential areas at all the locations but only during the night time. The significance of the impact will be low because of the duration of the decommissioning phase.

9.4.3. *Flora*

9.4.3.1 *Removal of infrastructure*

The demolition and removal of infrastructure may result in impacts to vegetation, as large machinery is needed for removal of infrastructure. Of concern here is the destruction of vegetation, creation of favourable habitat for fast growing invasive plants and ground compaction. Also of concern are the possible spillages from infrastructure holding hazardous material. These spillages and leaks may be considered for infrastructure such as sewerage and waste facilities, toxicant, pollutant and fuel storage infrastructure and general vehicle use. In the event that this infrastructure is not demolished properly and with caution, resulting spillages and leaks would impact on vegetation and soil quality. The demolition of infrastructure may require vehicles making use of non-designated areas, special care must be taken not to destroy rehabilitated areas. This activity is considered to be short in duration as well as site specific in extent with impacts being on site. The severity of the impact was determined to be minor.

9.4.3.2 *Rehabilitation of areas disturbed by infrastructure*

This may be considered to be a positive impact if implemented properly. The replacement of overburden and topsoil throughout the life of mine as well as the final replacement during the decommissioning phase may result in the restoration of the natural vegetation. Control of invasive plant species will have be carried out in conjunction with rehabilitation.

This activity is considered to be medium in duration as it will be required for the decommissioning phase. The extent will be site specific with effects being on site. The severity of the impact was determined to be moderate.

9.4.4. *Geohydrology*

9.4.4.1 *Impact of mine closure on groundwater levels*

Aquifer groundwater levels will start to recover once mine dewatering stops. New groundwater equilibrium will be reached which will differ from pre-mining conditions due to the large differences between the rehabilitated mine and aquifer flow. Groundwater levels and flow gradients in and close to mine workings will remain slightly altered from pre-mining levels and gradient(s), however this residual impact will be site specific and will not impact on groundwater users. No decanting of collecting water to the surface will occur.

9.4.5. *Visual*

Removal of infrastructure, rehabilitation of haul roads and mine area will be the primary activities affecting the visual nature of the area during the Decommissioning and Closure

Phases. Post closure will involve maintaining the rehabilitation programme and restoring the visual environment. It is unlikely the visual environment will be returned to that which is was prior to mining, however with mitigation the visual impact can be improved to that which blends into the surrounding environment.

10. SOCIAL IMPACT ASSESSMENT

10.1. Methodology

The primary goals of this assessment are (a) to identify and assess the extent and significance of potential social impacts associated with the Koidu Kimberlite Project according to defined assessment criteria; and (b) to develop measures required to avoid, minimize, reduce or compensate for potential adverse effects. In this context, a positive social impact is defined as an improvement of the baseline conditions resulting in a positive change or effect. Conversely, a negative impact represents a deterioration of the baseline conditions resulting in undesirable change.

The methodology for the assessment and mitigation of social impacts as described in this section differs from that used for the physical environment. This was done in order to adequately address both positive and negative impacts associated with the Project. Furthermore, the criteria used for assessing environmental impacts do not always apply to social impacts. Due to the intrinsic nature of social processes, the application of numerical values is often inappropriate or unrealistic. The methodology adopted for this assessment is therefore informed by international best practice for the assessment of social impacts.

It is important to note that the current social assessment does not include a comprehensive assessment of anticipated health impacts. Health Impact Assessment is a highly specialised field which requires the implementation of control measures, analysis of the nutritional status of affected parties and laboratory testing, to mention only a few requirements. Similarly, the current assessment does not comprehensively address the Project's potential impact on the national economy. This would require a separate specialist study in order to do justice to the potential national, regional and local economic impacts.

10.1.1. Impact Assessment

Impacts are identified by considering the project activities or aspects that may influence daily social processes and/or may affect existing socio-economic baseline conditions. The types of impacts and the terminology used in this assessment are discussed in the table below:

Table 10-1: Types of impacts

Impact Type	Description
Routine/Planned Impact	Resulting from common or regular project activities
Non-routine/Unplanned Impact	Resulting from exceptional events/emergency conditions
Direct Impact	Resulting from direct interaction between a planned project activity and the receiving social environment
Indirect Impact	Resulting from indirect activities that are encouraged to happen as a consequence of the Project
Induced Impact	Third level impacts caused by a change in the Project environment (e.g. increased disposable income)

Cumulative Impact	Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect existing social processes and/or socio-economic conditions
Impact Magnitude	**Description**
Duration	**Temporary:** Short duration; intermittent or occasional **Short-term:** Impact is predicted to last only for the duration of the construction period. **Long-term:** Impact will continue for the life of the Project, but cease when the Project stops operating. **Permanent:** Impacts that occur during the development of the Project and cause a permanent change in the affected receptor or resource.
Scale	**On-site or Local:** Impacts that affect an area in a radius of 20 km around the project site. **Regional:** Impacts that affect regionally important productive resources or are experienced at a regional scale as determined by political-administrative borders. **National:** Impacts that affect nationally important productive resources or have macro-economic effects. **International/Trans-boundary:** Impacts that affect internationally important productive resources or international protocol.
Impact Likelihood	**Description**
Low	Impact does not usually occur
Medium	Impact occurs infrequently
High	Impact occurs frequently or regularly

The criteria for assessing the significance of impacts are as follows:

- The magnitude (scale and duration) of the change to the socio-economic environment (e.g. increase in employment opportunities). Magnitude also refers to the sensitivity of the household, community or wider societal groups in terms of adaptability to changes.

- The likelihood (probability) that the impact will occur. This estimate is largely based upon experience and/or evidence that such an outcome has previously occurred.

The definitions for impact significance are described in Table 10-2 below. Definitions refer to both positive and negative impacts.

Table 10-2: Definitions for impact significance

Negligible Impact	A negligible (or insignificant) impact is where people and/or their assets will not be directly affected (either positively or negatively) by a particular activity, or where the impact is indistinguishable from daily social processes.
Minor Impact	A minor impact is one where an effect will be experienced but the magnitude of the impact is sufficiently small (with and without mitigation) in order not to significantly affect socio-economic conditions either positively or negatively.
Moderate Impact	A moderate positive impact has the potential to provide affected parties with clearly distinguishable benefits. A moderate negative impact falls within internationally accepted limits and standards with regard to reasonable living conditions and basic human rights.
Major Impact	A major positive impact is where affected households and/or communities as a whole will experience significant benefits and improved socio-economic conditions as a direct or indirect result of project activities. A major negative impact is one where internationally accepted limits and standard are exceeded. For some aspects there may still be major negative residual impacts after all practicable mitigation options have been exhausted. It is then the function of regulators and stakeholders to carefully weigh such residual negative factors against the positive ones such as employment, in coming to a decision on the Project.

Impacts are rated prior to mitigation and again after consideration of the proposed mitigation measures. It should be noted that impact matrices act as a guide to the assessor and there may be situations and/or conditions where their rigid application is inappropriate and where stakeholder perceptions and actions play a significant role. The following impact matrix has been prepared to guide the assessment of project impacts:

Table 10-3: Overall significance criteria

Negative Social Impacts							
Socio-Economic Outcome	**Severity**				**Likelihood classification**		
	Magnitude			**Severity classification**	**Low**	**Medium**	**High**
	Duration	**Scale**	**Ability to Adapt**				
Inconvenience but with no long-term changes to livelihoods, resources, quality of life, standard of living, infrastructure and services	Short –term (< 1 year) Low frequency	Individual/ household level	Those affected will adapt easily to changes and maintain pre-impact living conditions	Low	Negligible	Minor	Minor

Negative Social Impacts							
Socio-Economic Outcome	Severity				Likelihood classification		
	Magnitude			Severity classification	Low	Medium	High
	Duration	Scale	Ability to Adapt				
Direct and indirect impacts on livelihoods, quality of life, standard of living, resources, infrastructure and services	Medium term (1 – 6 years) Medium or intermittent frequency	Small number of households	Those affected will only be able to adapt to changes in living conditions with some support	Medium	Minor	Moderate	Moderate
Widespread and diverse, direct and indirect impacts that will be difficult to reverse or compensate for.	Long-term (> 6 years) Irreversible Constant frequency	Large part or whole settlement/ community	Those affected will not be able to adapt without substantial support	High	Moderate	Major	Major

Positive Social Impacts							
Socio-Economic Outcome	Severity (Desirability)				Likelihood classification		
	Magnitude			Desirability classification	Low	Medium	High
	Duration	Scale	Ability to Adapt				
Temporary benefits to individuals or households	Short –term (< 1 year) Low frequency	Individual/ household level	Those affected will find it difficult to gain from benefits	Low	Negligible	Minor	Minor
Direct and indirect positive impacts on livelihoods, quality of life, standard of living, resources, infrastructure and services	Medium term (1 – 6 years) Medium or intermittent frequency	Small number of households or small social groups	Those affected will be able to gain from project benefits with some support	Medium	Minor	Moderate	Moderate

Positive Social Impacts							
Socio-Economic Outcome	Severity (Desirability)				Likelihood classification		
	Magnitude			Desirability classification	Low	Medium	High
	Duration	Scale	Ability to Adapt				
Widespread and diverse, direct and indirect positive impacts likely to provide benefits to nation and whole communities.	Long-term (> 6 years) Irreversible Constant frequency	Large part or whole settlement/ community	Those affected will gain from project benefits and create permanent beneficial changes	High	Moderate	Major	Major

10.1.2. *Mitigation*

Mitigation measures are developed to avoid, minimize, reduce, remedy or compensate for negative impacts identified, and to create and/or enhance socio-economic benefits. These measures are often established through legal or best practice standards such as those of the World Bank Group. Preferably, mitigation measures will prevent or minimize impacts through project design and management rather than through rehabilitation and compensation.

Major negative impacts are considered to be unacceptable and require mitigation. In some situations a major negative impact may be offset by a positive impact of similar magnitude. The relative importance of these particular impacts must then be considered in assessing their acceptability. For moderate negative impacts, the focus of specific mitigation measures is to reduce these impacts to as low as reasonably practicable. Minor impacts are generally controlled through the adoption of best practice management measures.

The mitigation of social impacts associated with the Project is aimed at meeting IFC Performance Standards and international industry guidelines. The hierarchy of mitigation measures for events and impacts is outlined below (avoidance of impact being the preferred option):

- Avoid/reduce at source;
- Abate on site;
- Abate at receptor/recipient;
- Repair/remedy; and
- Compensate in cash or kind.

10.1.3. *Residual impacts*

A residual impact is the impact that is predicted to remain after mitigation measures have been applied. In the case of the Project, mining activities are currently in progress directly adjacent to the Extended Affected Area. It is therefore not always possible to identify residual impacts that are directly attributable to the Project. Identifiable residual impacts that are expected to be of high significance/importance will be addressed in this SIA.

10.1.4. Uncertainties

Whilst this SIA reflects professional consideration of the potential impacts of the Project, uncertainties about the significance of some impacts still remain. This is primarily due to the fact that human responses to events and changes are not definite or predictable. Thus, uncertainties stemming from the ongoing development of the Koidu Kimberlite Project will be approached conservatively, following a precautionary approach.

10.2. Assessment of identified social impacts

10.2.1. Introduction

The assessment of the social impacts associated with the Project is discussed in this section. Impacts have been assessed in terms of anticipated effects of the Project on the receiving socio-economic environment, on the directly affected households and stakeholders at the local, district, national and international level (where applicable). The assessment is based on data collected during the socio-economic baseline studies carried out for the ESIA, environmental specialist studies, the results of the asset survey for the Project, and the findings of focus group interviews and community consultation meetings.

The Koidu Kimberlite Project has been in operation since 2003/2004. The Project has an important impact on the national and local economies, mainly through the payment of royalties, taxes and surface lease rent, local job creation, replacement and compensation of affected assets, local capacity building, as well as infrastructure and service provision at the resettlement site. Concurrently, it is likely that the Project has indirectly contributed towards population influx into the broader project area (in particular Koidu Town) and an associated increased pressure on local infrastructure and services.

The Project will involve the extension of, or increase in, activities in the existing mining and surface lease areas. Against this background, it is likely that the Project will increase the magnitude of impacts discussed above. However, it is anticipated that the Project will not result in any significant new or additional socio-economic impacts (with the exception of impacts associated with the fencing of the concession area). It is anticipated that the overall project impacts will predominantly be of a cumulative nature. Consequently, the assessment of impacts resulting from the Project is carried out within this context, i.e. taking into account the combined impacts of the overall Koidu Kimberlite Project.

10.2.2. Stakeholder issues and concerns

The social impact assessment has taken into account the overall issues and concerns raised by stakeholders during community consultation meetings and focus group interviews. The most common issues and concerns are listed in the PCDP report (Volume 2).

10.2.3. Physical and economic resettlement

10.2.3.1 Impact description

<u>Construction Phase</u>

International finance organisations generally recognise that involuntarily resettlement gives rise to severe socio-economic problems. These may include dismantled production systems, loss of productive assets and income sources, as well as weakened community structures, social networks and traditional authority structures. Involuntary resettlement may therefore cause long-term hardship, impoverishment, and social damage unless appropriate measures are carefully planned and implemented.

The potential significance of resettlement impacts is considered in terms of the vulnerability of many households in the Extended Affected Area. This vulnerability relates to marginal living conditions, insecure livelihood strategies, income instability, food insecurity and prevailing poverty. Many affected households are poor by international standards and resettlement mitigation measures must therefore be designed to include poverty-related issues.

The Extended Affected Area is approximately 50 ha in size. The project site shows a mixture of commercial and residential plots and limited agriculture activities (vegetables) due to the dense settlement pattern. As mentioned earlier, there are mainly three settlements expected to be impacted by the proposed expansion, namely Saquee Town, Yormandu and New Sembehun. Portions of these settlements fall within the extended 500 meter blasting envelope. According to current information, the Project will require the physical resettlement of 675 households (approximately 8,000 people), and 717 associated dwelling structures.

Six schools, three churches, two mosques, as well as a number of government buildings and community facilities will have to be replaced. Access to graves and community shrines in the project site area will also be lost. A large number of economic trees and vegetable gardens will have to be compensated. Provision has been made for replacement agricultural land, but no agricultural projects are currently being implemented. Economic resettlement is therefore likely to cause the disruption of the subsistence agricultural cycle for households who are dependent on this activity for food. This could impact negatively on household food security.

Construction of the security perimeter around the mining lease area will require the diversion of the Koidu-Gandorhun Road around the southern boundary of the mining lease area. This road diversion will potentially impact on a small number of houses, economic trees and artisanal mining sites along the route. However, it is expected that these impacts can be avoided by re-aligning the road accordingly. Economic trees lost will be compensated while affected artisanal miners will be allowed to continue activities until their mining licences expire.

Current resettlement actions for the Koidu Kimberlite Project (under the 2003 RAP) is being undertaken in line with stakeholder agreements initially developed in 2003 and amended in 2009. Stakeholder agreements currently in place are: Resettlement Action Plan; Agricultural Compensation Agreement; and Construction Agreement. A comprehensive and revised RAP is being developed for the implementation of the Project resettlement. In order to ensure consistency and fair compensation measures, the same resettlement principles and standards will be adopted for the resettlement of the households in the new extended affected area.

The Project will involve extending the blasting zone for both kimberlite pipes to 500m. No temporary relocation during blasting will therefore be necessary beyond this zone once relocation has taken place. It is expected that resettled households will not be directly exposed to safety hazards resulting from fly-rock, or structural damage to their houses as a result of blasting.

While not underestimating the severity of the resettlement impacts discussed above, this assessment takes into consideration the fact that the physical resettlement of households under the 2003/2009 RAP has been in progress for many years. The social studies undertaken for this ESIA have confirmed that residents of the Extended Affected Area are generally aware of the existing mitigation measures and what to expect in terms of replacement houses and compensation for economic trees.

The construction method and standards of replacement housing under the 2003 RAP are specified in the relevant stakeholder construction agreement of 2009. This agreement, which was concluded after extensive consultation with affected households and key stakeholders, will be adopted for the Project resettlement. Resettlement houses and outbuildings are of a high standard. Residents also have access to domestic water by means of community taps.

All community facilities affected by the Project will be moved to and/or replaced at the new resettlement site. Compensation for economic trees will be in accordance with the 2009 stakeholder agricultural agreement, while households will have access to agricultural land in support of the restoration of livelihoods.

Operation and decommissioning phases

According to current planning, physical and economic resettlement of households affected by the Project will be completed during the construction phase.

10.2.3.2 Mitigation measures

- Wherever possible, avoid physical and economic resettlement of households and assets.
- Determine in consultation with all affected parties the need for resettlement during the project planning and design stages.
- Where resettlement cannot be avoided undertake an appropriate resettlement study in order to meet KH policy, country-specific legislation and IFC Performance Standards
- Initiate a full resettlement and compensation process as per procedures and measures contained within the Project RAP and associated stakeholder agreements.
- Ensure consistent application of the compensation procedures and mechanisms as well as stakeholder agreements under the 2003/2009 RAP for the Koidu Kimberlite Project.
- Assist affected parties to acquire alternative agricultural land. Where possible, replace land lost with land of a similar or better quality

- Investigate the development of commercial agricultural programmes in consultation with affected user groups.

Full details of the resettlement management and mitigation measures will be addressed in the Resettlement Action Plan (RAP). In terms of the Project's direct impact on households and assets, the full implementation of the above mitigation measures could mitigate this impact to moderate positive over the life of the mine and beyond.

10.2.3.3 Impact significance

Nature, type and grouping:	The resettlement of affected households will be ***negative***, ***routine*** and ***direct***	The resettlement of affected households post mitigation will be ***positive***, ***routine***, ***direct*** and ***indirect***
Duration:	The resettlement of affected households and assets is planned to take place during the construction phase. The duration of this impact will therefore be ***short-term***	The implementation of resettlement mitigation measures will positively contribute towards rebuilding and improving living conditions for affected households over the **long-term**
Scale:	The impact would take place on a ***local*** scale on the project site	Replacement houses will be constructed **locally** at a resettlement village adjacent to the project site
Magnitude:	The magnitude rating is classified as ***medium*** given the fact that affected households generally know what to expect in terms of resettlement and compensation	The magnitude rating post mitigation will be **high** given that resettled households will experience improved standards of living and opportunities for livelihood restoration
Likelihood:	The likelihood of this impact occurring is ***high***	The likelihood of this impact occurring is ***high***
IMPACT SIGNIFICANCE (PRE-MITIGATION): MAJOR NEGATIVE		**IMPACT SIGNIFICANCE (POST MITIGATION): MODERATE POSITIVE**

10.2.4. Increased government revenue

10.2.4.1 Impact description

Construction phase

Koidu Holdings is currently paying royalties and taxes to the Sierra Leonean government in terms of the existing KPP. This is in addition to surface rent payments directly to the Tankoro Chiefdom. Increased government revenue in this context refers to the royalties and taxes that KH will pay once the Expansion Project is operational.

Operation phase

Against the background of total government expenditure in Sierra Leone, and in combination with current royalties and taxes paid by Koidu Holdings, the Project will make a significant added contribution towards government revenue. Since the newly agreed mining lease came into effect, Koidu Holdings pays a 6.5% royalty to the government. The increased revenue to

the government relates to higher revenues that will be generated from increased production (i.e. expansion project), with an anticipated revenue increase of a factor of 5.
However, a portion of this revenue is redistributed to districts according to their planned development needs. In addition, the Koidu Kimberlite Project (KKP) currently pays a surface lease rent directly to the Tankoro Chiefdom.
However, a portion of this revenue is redistributed to districts according to their planned development needs. In addition, the Koidu Kimberlite Project (KKP) currently pays a surface lease rent directly to the Tankoro Chiefdom.

In addition to the above contributions, the overall KKP is expected to contribute approximately US$8 million annually to the local economy in the form of community contributions, salaries, and profit share in the Project (National pay roll will be ±$3M per annum, anticipated profit share (10% of net to community) ±$4M/annum, local procurement and community development programmes ±$1M / annum).

Decommissioning phase

The decommissioning and closure of the KKP will end KH's payment of royalties and taxes to the government, and will therefore potentially decrease government expenditure. This will be a negative indirect impact, particularly if the government has come to rely on this revenue. In terms of the current situation, government dependency on this income is high, and this is likely to remain so in the long term.

There is little that the KKP can do to mitigate this impact. However, mine closure and decommissioning will be a planned activity and the government could develop plans to deal with the termination of project revenues. While KH is likely to have little impact on the decisions of the Sierra Leonean Government, the residual impact associated with increased government revenues will remain of positive significance.

10.2.4.2 Mitigation measures

- Koidu Holdings should make royalty and tax payments in a transparent, accurate and timely manner.
- Koidu Holdings should ensure that sound financial principles and processes are in place to achieve the above.
- Koidu Holdings should maintain regular communication with government regarding mine decommissioning and closure to ensure that suitable plans are in place to address short term shortfall in revenues.

10.2.4.3 Impact significance

Nature, type and grouping:	The payment of royalties and taxes will be ***positive***, ***routine, indirect*** and ***induced***	The payment of royalties and taxes will be ***positive***, ***routine, indirect*** and ***induced***
Duration:	The payment of royalties and taxes will have a ***long term*** impact on the national economy.	The payment of royalties and taxes will have a ***long term*** impact on the national economy.

Scale:	The impact would take place on a ***national*** scale through contributing to the national economy and macro-economic processes.	The impact would take place on a ***national*** scale through contributing to the national economy and macro-economic processes
Magnitude:	As a result, the magnitude rating is classified as ***high***.	As a result, the magnitude rating is classified as ***high***.
Likelihood:	The likelihood of this impact occurring is ***high*** given that the payment of royalties and taxes is a legal requirement	The likelihood of this impact occurring is ***high*** given that the payment of royalties and taxes is a legal requirement
IMPACT SIGNIFICANCE (PRE-MITIGATION): MODERATE POSITIVE		**IMPACT SIGNIFICANCE (POST-MITIGATION):MODERATE POSITIVE**

10.2.5. Increased dependence of the national economy on mining

10.2.5.1 Impact description

Construction, operation and decommissioning phases

The Project (in combination with the overall KKP) is expected to indirectly increase Sierra Leone's dependence on revenues from the mining sector. This may inhibit diversification of the national economy away from mining (in particular diamond mining). This impact may therefore potentially be regarded as an induced negative impact associated with the Project, particularly when considered within the national economy's overall dependence on the mining sector.

10.2.5.2 Mitigation measures

The KKP should strive to ensure that sustainable economic development in the broader project area takes place. There is little else that the Project can do to minimise this impact.

10.2.5.3 Impact significance

Nature, type and grouping:	Increased dependence on mining will be ***negative***, ***unplanned, indirect*** and ***induced***	Increased dependence on mining post mitigation will remain ***negative***, ***unplanned, indirect*** and ***induced***
Duration:	Increased dependence on mining could have a ***long term*** impact depending on government interventions to promote economic diversification	Increased dependence on mining could have a ***long term*** impact depending on government interventions to promote economic diversification
Scale:	The impact would largely take place on a ***national*** scale and potentially on a ***regional*** scale if interventions aimed at the diversification of the economy are insufficient	The impact would largely take place on a ***national*** scale and potentially on a ***regional*** scale if interventions aimed at the diversification of the economy are insufficient
Magnitude:	The magnitude rating is classified as ***medium***	The magnitude rating remains ***medium*** as possible contributions by KH towards economic diversification is likely take

		place at local level
Likelihood:	The likelihood of this impact occurring is ***medium***	The likelihood of this impact occurring is ***medium***
IMPACT SIGNIFICANCE (PRE-MITIGATION): MINOR NEGATIVE		**IMPACT SIGNIFICANCE (POST MITIGATION): MINOR NEGATIVE**

10.2.6. Procurement of local goods and services

10.2.6.1 Impact description

Construction and operation phases

The construction and operation of the Project will require the purchase of sophisticated equipment and will generate large contracts for specialised technical work. These will be provided by specialist providers of goods and services. Since the KKP has been in operation for approximately seven years, it is expected that the Project will largely make use of established and trusted suppliers and service providers.

There may be opportunities for local businesses to become part of the existing supply chain. Services that could possibly be provided include catering services, food supply, building materials, maintenance of non-technical aspects and facilities maintenance, general vehicle maintenance, laundry and employee transport. However, locally owned businesses in the broader project area are relatively unsophisticated and the procurement opportunities that can be taken up by companies in the broader project area will be limited.

At a district and national level, opportunities may be less limited, and may be developed over time. For those national companies that do get the opportunity to be part of the supply chain, there will be lasting benefits through increased experience, capacity and training. The KKP is currently contracting with both national and local suppliers to supply some of the above services. It is anticipated that this will continue under the Project.

Decommissioning phase

It is likely that most contracts between the KKP and Sierra Leone based suppliers will be terminated during the decommissioning phase. However, those contractors will have gained considerable experience in procurement and supply chain management with large national and international companies, in particular mining companies.

10.2.6.2 Mitigation measures

The KKP should strive to optimise local procurement opportunities to ensure that Sierra Leonean companies who meet the Project requirements will have realistic opportunities to secure business with the Project. In doing so, the Project should:

- Develop a management structure to be accountable for the dissemination of information to potential bidders regarding procurement opportunities at the local and national level.
- Set and disseminate appropriate quality standards for provision of goods and services.

- Where applicable, unbundle contracts to allow smaller companies/businesses to provide goods and services.
- Invest in training and economic development to promote opportunities for companies to enter into the supply chain.
- Support existing agencies and organisations responsible for business development in the country.

10.2.6.3 Impact significance

Nature, type and grouping:	Opportunities for participating in the project supply chain will be ***positive***, ***routine, direct, indirect*** and ***induced***	Opportunities for participating in the project supply chain post mitigation will be ***positive***, ***routine, direct, indirect*** and ***induced***
Duration:	During operation, the impact will have ***medium*** to ***long term*** benefits for successful suppliers and service providers	During operation, the impact will have ***medium*** to ***long term*** benefits for successful suppliers and service providers
Scale:	The impact will take place on a ***national*** and possibly ***regional*** scale Opportunities at the local scale will be extremely limited	The impact will take place on a ***national*** and possibly ***regional*** scale. The implementation of mitigation measures may increase opportunities at the ***local*** level
Magnitude:	The magnitude rating is classified as ***low***.	The magnitude rating post mitigation is classified as ***medium low***
Likelihood:	The likelihood of this impact occurring is ***low*** considering that the expansion project will mainly use existing suppliers and/or service providers	The likelihood of this impact occurring is ***medium low*** as the implementation of mitigation measures could lead to an increase in procurement opportunities on a wide scale
IMPACT SIGNIFICANCE (PRE-MITIGATION): MINOR POSITIVE		**IMPACT SIGNIFICANCE (POST-MITIGATION): MODERATE POSITIVE**

10.2.7. Impact on local government capacity for infrastructure and service delivery

10.2.7.1 Impact description

Construction, operation and decommissioning phases

In Sierra Leone, district and local authorities are mainly responsible for the delivery of basic municipal services and facilities, with financial support from national government. Further administrative decentralisation is facilitated through the Paramount Chief, chiefdom councils and associated native administrations.

District and local government capacity for infrastructure and service delivery is very limited and will remain so in the medium and possibly long term. It is likely that the development of the Project will result in increased pressure on already limited resources, service delivery and local government capacity. This will be mainly due to population influx (people seeking to benefit from the Project) and settlement in the broader project area, as well as local government's added responsibility with regard to service delivery in the resettlement villages.

While the Project will provide basic infrastructure (for example roads and domestic water supply) to the new resettlement village, local government (the Koidu New Sembehun City Council) will be responsible for delivery and maintenance of basic infrastructure and services to these villages. As a result, lack of local government capacity and resources may impact negatively on the sustainability of the resettlement villages.

Koidu Holding's on-going support to local government with regard to maintenance and development of public infrastructure may partly off-set the above negative impact.

10.2.7.2 Mitigation measures

The KKP should strive to ensure that government's ability to deliver on providing services and utilities is not detrimentally affected as a result of the Project. It is emphasised, however, that the Project will not take on government's responsibility as service provider to resettlement villages.

The Project could potentially contribute considerably to infrastructure and service delivery in the broader project area. The following measures will facilitate this process:

- Investigate the establishment of capacity building and institutional strengthening programme for both local and district government.
- Investigate, in collaboration with government departments, feasible options for public-private partnerships in order to plan for anticipated increased demand (Section 6.8).
- Explore opportunities for collaboration with local police with regards safety and security issues relating to mining activities in general and contractor movement in particular.
- Explore opportunities for collaboration with national organisations involved in capacity building, training and the provision of specialised health and educational services.
- Form partnerships with organised business to address the provision of bulk services and infrastructure.

10.2.7.3 Impact significance

Nature, type and grouping:	Impact on local government capacity will be ***negative***, ***unplanned, indirect*** and ***induced***	Impact on local government capacity post mitigation will be ***positive***, ***planned, indirect*** and ***induced***
Duration:	During operation, increased pressure on local government capacity will be ***medium*** to ***long term*** as local government will have difficulty to adapt	During operation, contributions by KH towards infrastructure delivery and capacity building of local government will result in ***medium*** to ***long term*** benefits for local government and surrounding communities
Scale:	The impact will primarily take place on a ***local*** scale (Koidu Town and resettlement sites)	The impact will primarily take place on a ***local*** scale (Koidu Town and resettlement sites)
Magnitude:	The magnitude rating is classified as ***medium*** given the potential long-term	The magnitude rating is classified as ***medium*** given the potential long-term

	affect on local government	positive impact on local government and communities
Likelihood:	The likelihood of this impact occurring is ***medium*** to ***high*** considering that local government will be responsible for servicing and maintaining resettlement sites	The likelihood of KH providing support to local government regarding infrastructure improvement is ***high***
IMPACT SIGNIFICANCE (PRE-MITIGATION): MINOR NEGATIVE		**IMPACT SIGNIFICANCE (POST MITIGATION): MINOR POSITIVE**

10.2.8. Employment creation

10.2.8.1 Impact description

Construction and operation phases

At peak production Koidu Holdings will employ (directly) 1,118 nationals and 136 expatriates. During construction / development these numbers would double.This excludes off-site jobs in the supply chain (indirect employment); and jobs created in the country as a whole as result of employee spending (induced employment). It also does not include foreign jobs created in the supply chain or jobs created in other countries as a result of employee spending.

The majority of local employment opportunities during this project phase will involve short-term unskilled labour and casual labour. Income earned from these positions will contribute towards the quality of life of beneficiaries, but may also lead to dependence on this income. Overall, employment on the Project could result in a more steady flow of income to those employed. This impact will also be felt to a certain extent by those employed indirectly in the project supply chain. Direct and indirect employment will also result in the enhancement and upgrade of skills and experience.

Due to the highly technical nature of the Project, the level of skills required is very high, while the economic baseline assessment shows that the levels of education, skills and experience in the broader project area are very low. In the country as a whole it is anticipated that only a limited number of nationals have the experience and high levels of skills required by the KKP. It is therefore expected that only a limited number of Sierra Leoneans and an extremely limited number of people from the broader project area would qualify for skilled and semi-skilled positions during the operation of the Project. This is exacerbated by the fact that project contractors are likely to bring in their own workers who have specific experience in their commissioned tasks.

While perhaps limited in scope, employment positions filled by Sierra Leoneans will provide valuable opportunities for skills development and training. The Project will provide on-the-job, as well as formal training opportunities for employees. This could mean greater opportunities for employment beyond the life of the mine, which would create the potential for increased income stability on a more sustainable basis.

It is expected that contract workers will be housed on site, where the majority of their daily necessities in terms of food, health, hygiene and recreation will be provided. Therefore, the demand for goods and services in the broader project area by construction workers is likely to be limited.

Decommissioning phase

The Project will provide permanent benefits for those employed by the Project in terms of skills development and experience. The decommissioning and closure of the Project will terminate permanent and casual employment on the Project, but will create opportunities for unskilled and semi-skilled positions for the implementation mine closure plan measures.

10.2.8.2 Mitigation measures

- The Project should encourage and invest in alternative livelihoods development so that at decommissioning and closure phases, the local area is not reliant exclusively on the Project for employment and economic opportunities.
- The Project should attempt to optimise recruitment of people from affected communities, surrounding settlements and nationally, through its existing employment policy/strategy. This should be done at the initial recruitment stage (prior to construction and operation), as well as throughout construction and operation.
- The Project Human Resource office should develop/refine a project specific protocol for the fair treatment and employment of Sierra Leonean citizens.
- Where possible, maximise labour intensive methods to increase local employment opportunities.
- Carry out a skills audit in surrounding villages and maintain a detailed register for use by the Project and its contractors.
- Liaise with national and local labour offices for continually updated lists of applicable available skills.
- Create and maintain a register of casual employees from the surrounding villages for use when casual labour is required by project contractors.
- Ensure that employment opportunities and skills requirements are advertised locally and that recruitment centres (labour desks) are easily accessible to the local population.

10.2.8.3 Impact significance

Nature, type and grouping:	Employment creation by the project will be ***positive, routine, direct, indirect*** and ***induced***	Employment creation by the project will be ***positive, routine, direct, indirect*** and ***induced***
Duration:	During construction, the impact will have ***short term*** benefits for unskilled workers at the local level. For those who are able to secure permanent employment on the project, the impact will be ***long-term*** (for the duration of the project)	Implementation of mitigation measures will result in the project having ***short*** to ***medium term*** benefits for semi-skilled and skilled workers at the local level. For those who have secured permanent employment on the project, the impact will be ***long-term***
Scale:	The impact will mainly take place at the ***local*** level, in addition to limited	Implementation of mitigation measures may increase benefits on a ***local,***

	opportunities at the ***national*** level	***regional*** and ***national*** scale. However this increase is likely to be limited,
Magnitude:	Employment opportunities for skilled and semi-skilled positions will be limited. The magnitude rating is therefore classified as ***low***.	Employment opportunities for skilled and semi-skilled positions will remain limited but mitigation measures will contribute towards skills development and the development of alternative livelihood strategies. The magnitude rating is therefore classified as ***medium***.
Likelihood:	The likelihood of this impact occurring is ***low*** considering that the expansion project will mainly use existing suppliers and/or service providers	The likelihood of this impact occurring is ***medium low*** considering that the expansion project will mainly use existing suppliers and/or service providers
IMPACT SIGNIFICANCE (PRE-MITIGATION): MINOR POSITIVE		**IMPACT SIGNIFICANCE (POST-MITIGATION): MODERATE POSITIVE**

10.2.9. Community anger and resistance

10.2.9.1 Impact description

Construction, operation and decommissioning phases

The KKP has experienced incidents of community resistance and anger in the past. Incidents primarily related to dissatisfaction amongst members of the Affected Property Owners Association (APOWA), with regard to the design and construction material used for resettlement houses built between 2004 and 2007. This issue was resolved with the implementation of the 2009 Stakeholder Agreements, which included an undertaking of KH to refurbish all replacement houses built prior 2008 in line with the revised standards agreed upon in 2009. However, a number of organisations (mainly students) attempted to exploit the situation and demanded, amongst other, direct participation in project benefits.

The establishment of the VRC in 2008 significantly contributed towards improving relations between the KKP and affected households. Nonetheless, at the time of writing this report a group of students was involved in activities aimed at discrediting the KKP. The management of KH was accused of not contributing to the development of the affected communities and not honouring their commitments in terms of financial support to students. Respondents also referred to KH's alleged low level physical presence and visibility in the communities which lead to mistrust and the spreading of rumours.

The actions of the abovementioned groups appear to be partly as a result of misinformation and unrealistic expectations, although it is likely that there are other motives involved. The above impact is therefore likely to be on-going, but at least for the duration of negotiations around resettlement, compensation and community development projects. There is potential for this impact to be felt at the national level, should interested and affected parties gain the support of international NGOs to assist them in discrediting the Project and resisting project activities.

Many households in the broader project area will not be able to access the opportunities and benefits made available as a result of the Project. Additionally, there will be expectations around improved standards of living and economic development for affected communities and if these are not met, there may be community resentment and unhappiness associated with the KKP in general and the Project in particular.

While it is known that the Sierra Leonean government fully supports the KKP, this impact remains highly significant in that strained relationships between KH and local communities could impact negatively on KH's social licence to operate in the broader project area and, in fact, in Sierra Leone as a whole.

10.2.9.2 Mitigation measures

- Develop a proactive Stakeholder Engagement Programme that is founded on openness, mutual trust and inclusiveness in terms of project activities. This will empower both affected and surrounding communities to identify and address issues of concern to them and will facilitate solutions to the management of these concerns and possible claims against the Project.
- Ensure that all affected villages receive equal access to opportunities in terms of local recruitment, training, business development, procurement and community development programmes.
- Appoint a Community Relations Manager at the project site to develop community relations built on mutual trust, and to address grievances at a management level.
- Establish a local information office and appoint a permanent community liaison officer in the resettlement village (this is in place but requires additional resources and support from Management).
- Establish a site-based grievance office and associated procedure for addressing social, environmental, technical and operational issues (this is in place but requires additional resources and support from Management).
- Establish/develop on-going partnerships with relevant local organisations (e.g. NGOs) to facilitate and manage community expectations.
- Promote inter-village sport and recreational competitions to foster a sense of community within villages and healthy competition between villages.

10.2.9.3 Impact significance

Nature, type and grouping:	The impact of community anger and resistance will be ***negative***, ***unplanned, indirect*** and ***induced***	The impact of community anger and resistance post mitigation will remain ***negative, unplanned, indirect*** and ***induced***
Duration:	Incidents of community anger and resistance are anticipated to occur from time to time and may escalate during	Incidents of community anger and resistance are anticipated to occur from time to time during the life of the mine,

	the life of the mine. The duration of this impact will therefore be ***long-term***	notwithstanding efforts by KH to mitigate this impact. The duration of this impact will thus remain ***long-term.***
Scale:	The impact would take place on a ***local*** and potentially ***regional*** and ***national*** scale	Successful implementation of mitigation measures will contribute towards a better understanding of the project at all levels, but negative responses towards the project at the ***local*** level is likely to occur sporadically.
Magnitude:	The magnitude rating is classified as ***high*** given that this impact will put the project at risk	Successful implementation of mitigation measures will result in improved community relations, which is likely to reduce the frequency and impact of negative community responses to ***medium low***
Likelihood:	The likelihood of this impact occurring is ***high***	The likelihood of this impact occurring is ***high***
IMPACT SIGNIFICANCE (PRE-MITIGATION): MAJOR NEGATIVE		**IMPACT SIGNIFICANCE (POST-MITIGATION): MINOR NEGATIVE**

10.2.10. Access and mobility

10.2.10.1 Impact description

Construction phase

The construction and operation of the Project will impact on people's mobility and access to community facilities such as local markets, schools and churches. Access to graves and community shrines will also be lost due to the periphery wall. Moreover, the wall will cut through sections of Saquee Town and New Sembehun which will lead to the physical (and possibly social) fragmentation of these settlements.

Under the current resettlement process affected households are not resettled along township borders or in line with the respective town chief's area of jurisdiction. Resettlement under the Project should attempt to honour these relationships and areas of jurisdiction.

Affected households may potentially have to travel longer distances to community facilities (mainly schools). According to current planning, these facilities will be replaced with similar facilities in the new resettlement village. This may lead to residents living outside the wall but using facilities that will be moved, having to travel longer distances to the new facilities. This aspect was repeatedly raised at community consultation meetings.

Construction of the Project is likely to lead to the short-term obstruction of existing access routes, including the diversion of the Koidu-Gandorhun road which cuts across the project site. However, this impact will only be temporary, while the Koidu-Gandorhun road diversion will improve access between the resettlement village and Koidu Town.

Operation and decommissioning phases:

The broader project area will benefit from improved transport routes on condition that these roads are maintained by local government.

10.2.10.2 Mitigation measures

- Carefully plan and design the location of replacement land in order to minimise changes to movement patterns and its related disruption of social networks.
- Upgrade main routes used by project vehicles in the project area.
- Implement an education and awareness programme for health and safety (that includes a focus on traffic) in villages along transport routes.
- Ensure appropriate signage is placed around the project area such that local people can easily understand and respond to changed traffic conditions

10.2.10.3 Impact significance

Nature, type and grouping:	Impact regarding access and mobility will be ***negative, direct*** and ***indirect***	Impact regarding access and mobility post mitigation will be ***positive, direct*** and ***indirect***
Duration:	The impact will be ***short-*** to ***medium term***	Improved access will be ***medium*** to ***long-term*** for the duration of the project with the understanding that local government will fulfil its responsibilities with regards road maintenance
Scale:	The impact will primarily take place on a ***local*** scale (Koidu Town and resettlement sites)	The impact will primarily take place on a ***local*** scale (Koidu Town and resettlement sites)
Magnitude:	The magnitude rating is classified as ***medium***	The magnitude rating for improved access is classified as ***medium low***
Likelihood:	The likelihood of this impact occurring is ***high***	The likelihood of this impact occurring is ***medium high***
IMPACT SIGNIFICANCE (PRE-MITIGATION): MINOR NEGATIVE		**IMPACT SIGNIFICANCE (POST-MITIGATION): MINOR POSITIVE**

10.2.11. Community well being

10.2.11.1 Impact description

Construction phase

Project impacts regarding community wellbeing are discussed under the following headings: social support systems, social pathologies and health and safety.

Social support systems

Resettlement will negatively affect people's well-being as they struggle to establish a new sense of place amidst social change. Social relations are important in that they provide a sense of identity and belonging. Stakeholders that are likely to be most vulnerable include the elderly, traditional leaders, and the unskilled. Stability for traditional authority structures may be threatened as people are resettled without due concern for the areas of jurisdiction of township chiefs.

The physical resettlement of affected households may result in households losing access to existing social networks and support systems, and the material and emotional support that they provide. In impoverished communities where income sources are limited, these social support networks can be critical to survival. Physical resettlement could also result in the dislocation from family, tribal and religious affiliations.

The ability to adapt to this social disruption would vary across those affected. Larger households might be able to adapt more quickly to the change if resettlement happens as a family group. However, individuals who are largely dependent on others for emotional and material support may find adapting to the loss of social networks more difficult. It is however expected that after the construction phase, social networks and support strategies will be re-established and people will adapt to the changing situation.

The Project could contribute to the restoration of social networks and support systems by taking into consideration existing areas of jurisdiction for the different town chiefs.

Social pathologies

The presence of a large foreign workforce, combined with population influx of work seekers (and often their families) may increase affected communities' vulnerability and susceptibility to social pathologies, including drug and alcohol abuse, and increased incidence of sex workers, teenage pregnancies, crime and domestic violence. Those most vulnerable to drug and alcohol abuse would include the youth and unemployed, as well as the contract workers who are isolated from family and familiar support structures, coupled with limited recreational and social opportunities.

Aside from formal sex workers who could be drawn to the project area, it is single women and female teenagers, who would be most vulnerable to the risks of commercial and casual sex as they are less likely to be financially secure and generally more likely to succumb to peer pressure and sexual experimentation respectively.

Abuse of alcohol and drugs often correlates with an increase in levels of criminal behaviour and violence. Such behaviour will increase the number of people vulnerable to abuse. This may contribute to destabilising local households and has the potential to result in domestic violence, substance abuse and/or infidelity, further fuelling household tension and conflict.

It is emphasised that the above impacts are not new but will attribute cumulatively to current conditions.

Health and safety

The influx of contractors into the study area may increase the incidence of communicable diseases, HIV/AIDS and sexually transmitted diseases (STDs). Communicable diseases can also expose locals to previously unknown diseases (e.g. avian flu and yellow fever). Again, the above impact is not new but will attribute cumulatively to current conditions.

The KKP has established a clinic in the project site area with a full-time medical doctor, an advanced life support paramedic and three nurses. The clinic can accommodate 30 to 40 patients per day and is equipped with an electrocardiogram machine, defibrillator, and laboratory. The company has also provided a fully equipped ambulance to service the clinic.

Operation and decommissioning phases

The above impacts will remain prevalent for the duration of the Project, and possibly beyond but the implementation of the mitigation measures below, will reduce the negative impact on community well being

10.2.11.2 Mitigation measures

- The resettlement of people should be done with sensitivity to the re-establishment of social networks that have provided material and social security in the community. This will support people's ability to cope with project induced changes and will foster goodwill towards the Project.
- The development of the Project RAP should take into account measures to mitigate the loss of social networks. Vulnerable groups should be identified during the resettlement process and measures should be identified to ensure the restoration of livelihoods, with consideration for additional compensation measures that may be required.
- Provide access to appropriate information for the affected community well in advance of project impacts occurring to limit levels of uncertainty that may add to insecurity and vulnerability.
- Develop and implement induction programmes for new contract workers to increase sensitivity to local norms and customs.
- Work closely with local health services in monitoring and addressing changes in levels of community health and wellbeing.
- Implement a HIV/AIDS awareness programme addressing factual health issues as well as behaviour change. This should be implemented amongst contractors, employees and local villagers.
- Support inter-village recreational competitions to foster increased healthy lifestyles around sport and recreation.

10.2.11.3 Impact significance

Nature, type and grouping:	Impacts on community wellbeing will be ***negative, unplanned, indirect*** and ***induced***	Impacts on community wellbeing post mitigation will remain ***negative, unplanned, indirect*** and ***induced***

Duration:	The majority of impacts on community well being will be ***long term*** and may even be **permanent** as it will affect the fabric of social life	Impacts on community wellbeing is likely to remain ***long term*** post mitigation
Scale:	These impact will primarily take place on a ***local*** scale	These impact will primarily take place on a ***local*** scale
Magnitude:	The magnitude rating is classified as ***high*** given the potential long-term effect on the host communities. It is however important to keep in mind that many of the impacts described under community well being is not new to the project area	The magnitude rating is classified as ***medium*** as conditions may stabilise during operation, following health awareness and community outreach programmes
Likelihood:	The likelihood of this impact occurring is ***medium*** considering experience with similar projects in Africa	
IMPACT SIGNIFICANCE (PRE-MITIGATION): MODERATE NEGATIVE		**IMPACT SIGNIFICANCE (POST-MITIGATION): MINOR NEGATIVE**

10.2.12. Local economic development

10.2.12.1 Impact description

Increased activity and population movement associated with the construction and operation of the Project is likely to result in increased demand for goods and services in the area. This is also likely to result in a flow of goods and service providers, both formal and informal, to the broader project area, thus contributing to local economic development. On the other hand, while construction activities may provide opportunities for economic and business development other constraints such as access to finance; limited infrastructure and skills, and limited private sector in the broader project area will constrain local economic development.

Section 6 of this report provides an overview of socio-economic baseline conditions and development needs at district and local levels. The overview shows very low levels of living standards and quality of live in the broader project area. It is in this context where the Project can make a significant contribution through the provision of infrastructure and services and socio-economic investment at the district and local level.

Since 2004, the KKP has contributed to local and national development and it is anticipated that the continued operations will support local economic development for a relatively long period. Koidu Holdings has committed to providing continued assistance to district infrastructure projects and to broadening its support for community development initiatives in Tankoro Chiefdom and Koidu Town. Current initiatives include (also refer to Section 6.7):

- Road refurbishing programme
- Infrastructure programme
- Education

- Water supply
- Health care
- Agriculture programme
- Local business development
- Sports development
- Capacity building
- Employee welfare, and
- Employee career development

10.2.12.2 Mitigation

Koidu Holdings should consider the following measures in order to promote socio-economic development for affected communities and the broader project area,

- Investment and promotion of sustainable projects, training and education to help communities to develop alternative livelihoods and attempt to minimise economic dependence on the mine.
- Developing a Social Development Plan that will focus on the development of alternative economic opportunities locally. These programmes should be identified and developed in a participatory manner to increase their sustainability independently of the Project.
- Partner with government and relevant NGOs to support sustainable livelihood practices.
- Support and/or develop information and awareness programmes related to economic entrepreneurialism and small business development. Work in partnership with existing government and related organisations already well established to address these issues.

The above measures should be addressed through the development and implementation of Social and Community Development Plans.

<u>Decommissioning phase</u>

Koidu Holding's commitment to socio-economic development could have positive impacts far beyond the life of the mine. The company should therefore facilitate and promote sustainable development initiatives

10.2.12.3 Impact significance

Nature, type and grouping:	Company investment in socio-economic development will be ***positive***, **planned**, ***indirect*** and ***induced***	Company investment in socio-economic development will be ***positive***, **planned**, ***indirect*** and ***induced***
Duration:	During operation development projects will gain momentum over the ***medium*** to ***long term***	During operation development projects will gain momentum over the ***medium*** to ***long term*** and in some instances may have a ***permanent*** positive impact on local economic development
Scale:	The impact will primarily take place on a ***local*** scale when considering existing KPP activities with regards local economic development.	The impact will take place on a ***local*** scale but could extend to the ***regional*** level post mitigation, following the expansion of economic relationships

		between communities
Magnitude:	The magnitude rating is classified as ***medium*** given the potential long-term effect on local economic development	The magnitude rating is classified as ***medium*** given the potential long-term effect on local government
Likelihood:	The likelihood of this impact occurring is ***medium low***	The likelihood of this impact occurring is ***medium high***
IMPACT SIGNIFICANCE (PRE-MITIGATION): MINOR POSITIVE		**IMPACT SIGNIFICANCE (POST-MITIGATION): MODERATE POSITIVE**

Table 10-4 provides a summary of impacts assessed and significance status before and after mitigation.

Table 10-4: Summary of impacts significance

Impact	Significance	
	Pre-Mitigation	**Post Mitigation**
Physical and economic resettlement	Major negative	Moderate positive
Increase in government revenue	Moderate positive	Moderate positive
Increased dependence of the national economy on mining	Minor negative	Minor negative
Procurement of local goods and services	Minor positive	Moderate positive
Impact on local government capacity for infrastructure and service delivery	Minor negative	Minor positive
Employment creation	Minor positive	Moderate positive
Community anger and resistance	Major negative	Minor negative
Access and mobility	Minor negative	Minor positive
Community well being	Moderate negative	Minor negative
Local economic development	Minor positive	Moderate positive

11. CUMULATIVE IMPACTS

The following cumulative impacts have been identified:

11.1. Noise

Cumulative impacts should be considered for the overall improvement of ambient noise levels. The proposed Koidu Kimberlite Project is considered a relevant source of noise pollution that will contribute to the increase of the ambient noise levels in the area.

The existing noise sources at Koidu Mine are limited to haul trucks travelling between the pipes and the existing processing plant, the operation of the processing plant as well as light duty mining vehicles driving between the mining offices. The significance of the impacts of the existing noise sources on the relevant receptors is of a low significance. The low significance is due to the distance currently between the town of Koidu and the existing mining activities. If the proposed activities of the Koidu Kimberlite Project commences, the cumulative impact will be more severe on the existing ambient noise levels. The significance will increase to a moderate significance. Noise levels from the Koidu Project must therefore be monitored to determine potential sources of noise, increases and decreases in noise levels, and determine level of mitigation required.

Once open pit mining ceases (within 4 years) a significant reduction of noise will take place as no surface blasting will occur.

When the kimberlite from the proposed project area has been mined, processed and decommissioned, overall ambient levels will decrease to the pre-mining baseline and the cumulative impacts in the area could improve.

11.2. Fauna and Flora

The socio-economic climate within the country of Sierra Leone has been very unstable in the past few decades and this previous instability in the country has brought about a situation where people have to provide for themselves through agriculture or mining of diamonds to survive.

Through these circumstances the protection of the natural environment has not been of high priority and systematic degradation with no re-generation has been taking place for a long time. The local people have been burning the vegetation to create clearings for crop production for many generations (slash and burn), long before Koidu mine was operational.

The mining boundary of Koidu does however enclose natural areas of conservation potential, as recognised by Koidu Holdings. Currently the concession area is not enclosed with limited access control whereby local people are able to practice illegal artisanal mining, felling of the trees for fuel wood and building material and setting of traps. The natural environment within the mine boundary is thus partially protected

With the construction of the new perimeter wall access control will be rigid, providing protection to all natural resources within the concession.

11.3. Aquatic Ecosystems

The natural resources of Sierra Leone in general are under threat due to the relevant land and resource users (US AID, 2007) and the KKP is no exception. By the end of 2012 there will be no further demands on these resources by the local users owing to the resettlement initiative to move people from the project area and to prevent further access. The water resources associated with the study area have been impacted on due to historical commercial and artisanal mining operations as well as the current agricultural and artisanal mining activities. These activities are characteristic of the Koidu region and evident both within as well as beyond the project area.

The proposed expansion project will result in the loss of wetland areas already severely impacted on by the current artisanal mining activities. The wetland areas considered for this study were predominantly formed by commercial and artisanal mining activities spanning a 70 year mining period.

Thus, considering the history of mining in the region as well as the impact of the artisanal mining and agricultural activities on these wetland systems, the severity of the expansion project on the water resource is considered to be low. As a result of this, a rehabilitation strategy has been proposed to compensate for the expected loss of additional wetland areas due to the expansion project. This in turn will help to restore ecological functioning and integrity to the immediate catchment area. Thus, the proposed expansion may afford the KKP an opportunity to improve on the overall status of the water resource for the area should the recommended rehabilitation strategy be implemented.

11.4. Social environment

Cumulative impacts are defined as impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect normal social processes and/or socio-economic conditions.

Mining activities are currently in progress directly adjacent to the Extended Affected Area. It is therefore not always possible to clearly define cumulative impacts that are directly attributable to the Project. However, it is anticipated that the Project will not result in any significant new or additional socio-economic impacts and it is likely that the overall project impacts will predominantly be of a cumulative nature.

12. CLOSURE AND FINANCIAL PROVISION

12.1. Mine Closure

Mine closure is an on-going programme designed to restore the physical, chemical and biological quality or potential of air, land and water regimes disturbed by mining to a state acceptable to the regulators and to post mining land users. The activities associated with mine closure are designed to prevent or minimise adverse long term environmental and social impacts, and to create a self-sustaining natural ecosystem or alternate land use based on an agreed set of objectives. The objective of mine closure is to obtain legal (government) and community agreement that the condition of the closed operation meets the requirements of those entities, whereupon the company's legal liability is terminated.

Closure should be modified and adapted as the mining project continues and more knowledge is generated about the mine environment and the impacts of the Project. Adequate provision must also be made to mitigate the loss of employment opportunities as a result of mine closure and to promote the sustainability of socio-economic development programmes initiated by the Project. Consequently a detailed closure plan should be developed as more information is available.

Irrespective of the rehabilitation outcome, the environmental authority must ensure that the rehabilitation will endure expected climatic variations and that the land will be sustained for a land use consistent with the surrounding area.

12.2. Objectives for Mine Closure

The overall objectives for the project are:

- To return the land, other than the open pits, to a land capability similar to that which existed prior to mining;
- Flooding of pits to serve as water sources;
- To demolish all mine infrastructure, which cannot be utilised by subsequent land users or any third party. Once demolition has occurred prompt topsoil application and re-vegetation should take place. Where buildings can be used by a third party, arrangements will need to be made to ensure their long term sustainable use;
- To clean up all spills on site;
- To ensure that all wetlands within the project site impacted on by the various activities are rehabilitated;
- To annually assess the closure impacts thereby ensuring progressive and integrated closure throughout the life of the project;
- To leave a safe and stable environment for both humans and animals and make their condition sustainable;
- To maintain and monitor all rehabilitated areas following re-vegetation;
- To involve all relevant stakeholders, authorities and communities in the mine closure process; and
- To allow for the mine to leave the surrounding community in a more economically sustainable manner than prior to mining.

12.3. Activities for Mine Closure

12.3.1. Processing plant

All infrastructure associated with the plant needs to be stripped and broken down to natural ground level. Inert building material should be placed into the pits, be buried next to the plant or be disposed of at a registered waste facility. This includes any conveyors, foundations and any concrete between buildings. Any building material with the potential to pollute the environment must either be treated or disposed of at a registered waste facility. Areas disturbed by surface infrastructure and demolition activities need to be top-soiled (500 – 1000 mm of top-soil) and re-vegetated with indigenous species.

12.3.2. Steel and reinforced concrete structures and housing, facilities and services

All steel, brick and concrete structures not to be kept for community services need to be demolished to 1 m below ground level. remaining inert rubble may be buried adjacent to the building sites, may be placed into the pits or be disposed of at a registered waste facility. Any building material with the potential to pollute the environment must either be treated or disposed of at a registered waste facility. Areas disturbed by surface infrastructure and demolition activities need to be top-soiled (300mm of top-soil) and re-vegetated with indigenous species.

12.3.3. Openpit rehabilitation

The purpose of open pit rehabilitation is to ensure the site becomes safe for humans and animals. The upper pit slopes should be shaped to a gradient of 1:3 so that the risk of humans and animals is minimised. In addition to stabilising the pit walls, all remaining waste rock, overburden and / or non-hazardous waste must be placed into the final void. The pits will then be allowed to fill with water to create artificial dams.

Berm walls will be constructed around the pit to limit access to the pits. These berm walls must be constructed such that they create a 10 metre buffer from the pit edge and they must allow surface water from precipitation to drain into the pits, thereby, filling the final void with water and minimising risk to both humans and animals. Signage will be placed around the pits, warning the public of the danger posed by them.

12.3.4. Other components

Overburden and spoils

Any remaining overburden and spoils with a low pollution potential, need to be shaped and replaced with 500 – 1000 mm of soil and vegetated. All remaining waste rock must be shaped to a 1:3 slope to ensure long-term sustainability and stability of the slopes.

12.4. General rehabilitation

General surface rehabilitation must involve the shaping of the surface topography to match the surrounding landscape and 500 – 1000 mm of topsoil, where available, need to be added to the site. During the process of shaping the landscape drainage lines must be properly reinstated into the topography. Any heaps of excess material also need to be removed.

12.5. Maintenance and aftercare

Maintenance and aftercare must be planned for three years after the mining production has ceased. Maintenance will specifically focus on vegetation, on rehabilitated areas and on the tailings and slimes facilities , as well as any alien vegetation that needs to be controlled. Furthermore, monitoring will have to take place for both surface and groundwater at the slimes dam and at mining production areas. It has been recommended that slimes facilities are monitored for five years after closure or until such time as a long-term acceptable trend can be determined.

12.6. Financial Provision

The closure cost assessment involves the quantification of mining and infrastructure components and applying rates to rehabilitate each component. The environmental liability is described in monetary terms in order for a financial provision to be set aside in a dedicated fund for closure and rehabilitation purposes. The costing must be reviewed on an annual basis for the duration of the project, to ensure that the financial provision is sufficient for effective rehabilitation of the site.

The approach followed during these calculations was to assume a "snapshot in time" approach, i.e. costs have been calculated assuming that the mine would have to close immediately. The closure cost for the current mine infrastructure, in accordance with the above-mentioned activities proposed for closure, is $ 13,917,964.00 and is summarised in Table 12-1 **below.** Table 12-2 summarises the Life of Mine closure costs, which is $ 15, 278, 388.00, as planned at the end of its current mine plan. Both costings seek to realise effective rehabilitation or remediation of relevant impacts on the environment and the surrounding community. Savings are possible by the application of a number of different methods of reducing environmental liability during operations or after closure.

Table 12-1: Summary of rehabilitation for Current Infrastructure

Koidu Diamond Mine	
Summary of Current Infrastructure	
Area 1: Mine Infrastructure	
Demolition	$ 746,164.45
Rehabilitation	$ 321,877.93
Total	**$ 1,068,042.39**
Area 2: Pits	
Earthworks	$ 9,185.99
Rehabilitation	$ 3,207.81
Total	**$ 12,393.80**
Area 3: Waste Rock Dumps & Topsoil	
Earthworks	$10,630,587.90

Rehabilitation	$ 283,097.45
Total	**$10,913,685.35**
Area 4: Tailings	
Earthworks	$ 16,775.26
Monitoring	$[8]
Total	**$ 120,875.26**
Total	**$12,010,896.80**
Monitoring Costs	**$ 104,100.00**
Signage	**$ 1,333.33**
Project Management	**$ 600,544.84**
Contingency	**$ 1,201,089.68**
Grand Total	**$13,917,964.65**

Table 12-2: Summary of rehabilitation for Life of Mine

Koidu Diamond Mine	
Summary of Life of Mine Infrastructure	
Area 1: Mine Infrastructure	
Demolition	$ 746,164.45
Rehabilitation	$ 321,877.93
Total	**$ 1,068,042.39**
Area 2: Proposed Infrastructure	
Demolition	$ 646,825.77
Rehabilitation	$ 71,400.52
Total	**$ 718,226.29**
Area 3: Pits	
Earthworks	$ 9,185.99
Rehabilitation	$ 3,207.81
Total	**$ 12,393.80**
Area 4: Waste Rock Dumps & Topsoil	
Earthworks	$10,630,587.90
Rehabilitation	$ 283,097.45
Total	**$10,913,685.35**
Area 5: Tailings	
Earthworks	$ 300,482.46

[8] The monitoring costs of the tailings have been included under the heading of 'Monitoring Costs'

Monitoring	$[9]
Total	$ 612,782.46
Total	$13,012,830.29
Monitoring Costs	$ 312,300.00
Signage	$ 1,333.33
Project Management	$ 650,641.51
Contingency	$ 1,301,283.03
Grand Total	$15,278,388.16

[9] The monitoring costs of the tailings have been included under the heading of 'Monitoring Costs'

13. ENVIRONMENTAL MANAGEMENT PLAN

The role of the Environmental Management Plan (EMP) is to assist the organisation in achieving their environmental objectives and fulfilling their commitment to the environment (Environmental Protection Agency, 1995). The EMP describes methods and plans used to reduce environmental impacts, as well as identify indicators to assess the progress of the EMP.

The EMP will be implemented from site preparation through to decommissioning and closure. Furthermore, there is a commitment to continuous and progressive rehabilitation as the project advances. In this regard, it is anticipated that monitoring and assessment of the ongoing rehabilitation will occur on a regular basis (variable depending on aspects to be monitored).

The EMP serves as a framework for implementing the mitigation measures during each phase of the project.

13.1. EMP framework

The EMP is a framework comprising a number of plans designed to ensure the implementation of mitigation measures reduce the negative impacts and enhance the positive impacts on the social, economic and physical environment. The following table includes additional mitigation measures that will form part of the EMP for the Project.

13.2. Summary EMP for the Koidu Kimberlite Project

The following tables summarise the management and monitoring for the identified impacts per project phase. Where Key Performance Indicators (KPI) exist, they have been included in the table. Guidelines provided by the World Bank Group have been used (indicated as "WB"). In some cases a variety of KPI's exist depending on the source, receptor, timing and environment.

The overall accountability for the implementation of this plan lies with Koidu Holdings. Various parties will remain responsible for certain activities, however Koidu Holdings will remain accountable for ensuring the mitigation measures, monitoring and corrective action contained in the EMP are implemented. For this reason the table below does not include a column indicating who is accountable but rather who is responsible for a particular aspect.

Table 13-1: EMP for the Koidu Kimberlite Project

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
	NOISE MANAGEMENT		
Minimize noise impact	• The blasting operations are generally intermittent and should be limited to daylight hours when ambient noise levels are highest; • Reduction of the powder factor, that is, use of less explosive per cubic yard of overburden; • Maintaining good public relations with the surrounding communities i.e warning the villagers in advance before blasts;	For every blast (open pit)	Environmental Manager

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
	• Vehicles to be switched off when not in use; • Regular maintenance on mining vehicles to ensure silencing equipment is still effective i.e. exhaust mufflers; and • Fixed noise producing sources such as generators, pump stations and crushers to be to be either housed in enclosures or barriers put up around the noise source. The barriers should be installed between the noise source and sensitive noise receptor, as close to the noise source as possible. A basic rule of thumb for barrier height is: Any noise barrier should be at least as tall as the line-of-sight between the noise source and the receiver, plus 30%. So if the line-of-sight is 10m high, then the barrier should be at least 13m tall for best performance (Sound Fighter Systems, 2007).	Vehicles to be serviced according to vehicle services handbook;	Environmental Manager
	• Noise monitoring programme	Programme to be followed according to section 10 in the environmental noise impact assessment report	Environmental Manager
FAUNA & FLORA			
To minimize clearance, loss and disturbance to the natural environment, in particular plants	• Sensitive areas need to be avoided were possible (Monkey Hill and surrounding wetland and forest). • Avoid access in areas not earmarked for construction and/or operation. • Rehabilitation can include the establishment of habitat through vegetation growth.	Restriction or limitation of development in sensitive areas.	Environmental Manager / appointed consultant
Avoid sensitive areas such as water courses, if not, disturbance should be minimized	• Where possible disturbance to watercourses should be avoided. • The aquatic systems that remain need to be protected to ensure habitat and resources (vegetation) availability for fauna throughout the lifetime of the project.	Rehabilitation of areas were possible through maintenance of vegetation/habitat	Environmental Manager

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
To minimize disturbance to the natural environment and to maintain sensitive areas and other habitat possibilities	• Avoid areas not earmarked for construction and operation. • Removal should only occur in demarcated areas and where possible the natural environment should be rehabilitated to ensure ecological functioning. • Rehabilitation can include the establishment of habitat through vegetation growth.	Ecological monitoring	Environmental Manager
To prevent leakages and accumulation of pollutants in the environment	• Storage facilities should be monitored, to ensure that no dangerous chemicals or pollutants escape into the surrounding environment. • Hydrocarbon spill kits to be kept near storage areas and used on spills (e.g. Supazorb or Eretech1) • Direct and indirect affects will be to plants and animals	No spills unaddressed	Environmental Manager
To prevent loss of fauna and flora	• Vehicles need to remain within demarcated areas. • Roads need to be efficiently planned as to minimise disturbance to the natural environment. • Speed limits need to be applied and adhered to.	Speed Reduction Vehicle restrictions in place	Environmental Manager
To properly dispose of waste. To avoid the establishment of alien invasive plant species.	• Waste management is crucial and waste should be properly disposed according to the type of waste. • Pollution of the surrounding environment should be prevented by constant monitoring. • Re-vegetation of these areas must be completed to minimise dust and establishment of alien invasive plants.	Successful risk management through monthly inspection of waste rock, tailings and slimes	Environmental Manager
To minimize disturbance to fauna and flora properly dispose of waste	• Removal of infrastructure will accumulate a lot of building rubble that should be disposed of correctly. • To prevent pollution and the loss of ecological integrity. • Vehicles involved must be restricted to demarcated areas.	Correct disposal methods of waste in place. Limited disturbances in demarcated areas	Environmental Manager
TOPOGRAPHY			

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
To maintain the integrity of the landscape and to minimise disturbance to the natural topography	• All construction activities should be restricted to defined work areas and draw up a post-mining topography plan during construction so that the end goals are established upfront; • Be able to capture erosion from stockpiled materials; • Place waste rock in a location where it will not disturb drainage lines & where appropriate volume can be stored	No excessive erosion and drainage lines avoided	Environmental Manager
VISUAL			
To reduce the impact of the proposed activities on the aesthetic integrity of the area.	• Retain as much existing vegetation to reduce the visual impact of permanent structures, colours for roofing, walls, etc. should be of a matt finish to reduce reflection. • To reduce the visual impact of permanent structures, colours for roofing, walls, etc. should be of a matt finish to reduce reflection.	Construction activities not impacting on the visual nature of the site	Environmental Manager
AIR QUALITY			
To reduce the negative impacts of dust emitted from material transport and crushing.	• Introduce road spaying program based on rainfall, evaporation rate, and traffic frequency to reduce dust being emitted from road transport • Conduct dust analysis once the new plant is commissioned to determine the appropriate mitigation measures, if required. • Initiate dust fallout monitoring program to monitor efficiency of dust management measures	Reduce emissions from unpaved roads	Environmental Manager
SOIL			

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
To minimise the loss of topsoil	• Planning of clearing activities to minimize areas stripped (bush clearing); • Clearing activities to be carried out in dry conditions, in order to maintain soil structure; and stripping all available soil materials and stockpiling appropriately.	Only clearing essential areas and maintaining soil structure and fertility for use in rehabilitation and finally mine closure.	Environmental Manager
To minimise the risk for spillage of fuel and oil on site.	• Limit the movement of vehicles on site as much as is practical;	Less spills	Mine Safety officer, & Site Manager
AQUATIC ENVIRONMENT			
To minimise the loss of wetland areas and subsequent loss of ecological services.	• The footprint size of the tailings and slimes facilities should be kept to a minimum. A return water dam should be implemented to trap dirty water. This water could then be re-used for the operation or released back into the system should it be of a suitable quality. • The quality of water in the return water dam should be monitored. Dirty water could be re-used for the operation, or alternatively it should be treated to comply with international drinking water standards and may be released back into the system.	Once for the construction of the impermeable base Weekly for the monitoring of the water quality in the return water dam	Engineer and Environmental Manager
HERITAGE AND ARCHAEOLOGY			
To retrieve as much viable archaeological information from site before further damage and/or destruction occurs.	• Archaeological mitigation of site that include test excavation, mapping, surface sampling and materials analyses	Once-off.	Archaeologist
GEOHYDROLOGY			
Mining and Pit Lake Infilling	• Monitoring borehole levels	Prevent impact on water levels of boreholes	Environmental Manager

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
Drawdown of Water Table	• Monitoring of borehole levels • The impacts on Koidu's water supply wells for the camp, office, and resettlement areas should also be evaluated.	Prevent the drawdown of underground water levels Must do this!	Environmental Manager
	SOCIAL ENVIRONMENT		
To optimise medium and long-term benefits resulting from physical and economic resettlement	• Wherever possible, avoid physical and economic resettlement of households and assets. • Determine in consultation with all affected parties the need for resettlement during the project planning and design stages. • Where resettlement cannot be avoided undertake an appropriate resettlement study in order to meet KH policy, country-specific legislation and IFC Performance Standards • Initiate a full resettlement and compensation process as per procedures and measures contained within the Expansion Project RAP and associated stakeholder agreements. • Ensure consistent application of the compensation procedures and mechanisms as well as stakeholder agreements under the 2003/2009 RAP for the Koidu Kimberlite Project. • Assist affected parties to acquire alternative agricultural land. Where possible, replace land lost with land of a similar or better quality • Investigate the development of commercial agricultural programmes in consultation with affected groups and surrounding villages.	Develop and implement a Resettlement Action Plan in accordance with IFC requirements.	Project Manager Resettlement Manager
To promote feasible district and local socio-economic development based on increased government revenue	• Ensure that payment of royalties and taxes takes place in a transparent, accurate and timely manner. • Ensure that sound financial principles and processes are in place to achieve the above. • Maintain regular communication with government regarding mine decommissioning and closure to ensure that suitable plans are in place to address short term shortfall in revenues.	As per mitigation measures	Project Manager
To decrease dependence of national economy on mining	• Strive to ensure that sustainable economic development in the broader project area takes place with a focus on diversifying the local economy.	Have sustainable non-mining in place before mine closure	Project Management

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
To optimise the procurement of goods and services by the project	• Develop a management structure to be accountable for the dissemination of information to potential bidders regarding procurement opportunities at the local and national level. • Set and disseminate appropriate quality standards for provision of goods and services. • Where applicable, unbundle contracts to allow smaller companies/businesses to provide goods and services. • Invest in training and economic development to promote opportunities for local companies to enter into the supply chain. • Support existing agencies and organisations responsible for business development in the country.	As per mitigation measures	HR Manager Public Relations Manager
To enhance local government capacity for infrastructure and service delivery	• Investigate the establishment of capacity building and institutional strengthening programme for both local and district government. • Investigate, in collaboration with government departments, feasible options for public-private partnerships in order to plan for anticipated increased demand. • Explore opportunities for collaboration with local police with regard to safety and security issues relating to mining activities in general and contractor movement in particular. • Explore opportunities for collaboration with national organisations involved in capacity building, training and the provision of specialised health and educational services. • Form partnerships with organised business to address the provision of bulk services and infrastructure.	As per mitigation measures	Project Manager
To optimise employment creation by the project	• Optimise recruitment of people from affected communities, the surrounding settlements and nationally. • Develop a project specific protocol for the fair treatment and employment of citizens. • Optimise labour intensive methods to increase local employment opportunities. • Carry out a skills audit in surrounding villages and maintain a detailed register for use by the Project and its contractors. • Liaise with national and local labour offices for continually updated	Review procurement policy	HR Manager Community Relations Manager

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
	lists of applicable available skills. • Create and maintain a register of casual employees from the surrounding villages for use when casual labour is required by project contractors. • Ensure that employment opportunities and skills requirements are advertised locally and that recruitment centres (labour desks) are easily accessible to the local population. Retain current local employees as far as possible.		
To build relationships of openness, mutual trust and inclusiveness with affected households and host communities	• Implement a proactive Stakeholder Engagement Programme • Ensure that affected villages receive equal access to opportunities in terms of local recruitment, training, business development, procurement and community development programmes. • Appoint a Community Relations Manager at the project (in-field) to develop sound community relations and grievance redress at management level. • Establish a local information office and appoint a permanent community liaison officer in the resettlement village. (This is in place but require additional resources and management support.) • Establish a site-based grievance office and associated procedure for addressing social, environmental, technical and operational issues. (This is in place but require additional resources and management support.) • Establish on-going partnerships with relevant local organisations (e.g. NGOs) to facilitate and manage community expectations. Clearly differentiate between the roles and responsibilities of partners, specifically those of KH versus government • Communicate KH's 'achievements' as far as community development is concerned to local, regional and national stakeholders.	As per mitigation measures	Project Manager Public Relations manager Community Relations Manager Community Liaison Officer(s)

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
	• Support inter-village sport and recreational competitions		
Improve road networks in the broader project area	• Carefully plan and design the location of replacement land to minimise changes to movement patterns • Upgrade main routes used by project vehicles in the broader project area. • Implement education and awareness programme for health and safety (with a focus on traffic) in villages along transport routes. • Ensure appropriate placement of signage around the project area • Construct the road diversion before (or as soon as possible) closing the existing road.	As per mitigation measures	Appropriate infrastructure development departments Community Relations Manage
Promote community well being	• Ensure that resettlement is undertaken with sensitivity to the re-establishment of social networks that have provided material and social security in the community, Take into account measures to mitigate the loss of social networks and promote the restoration of livelihoods. • Provide access to appropriate information for the affected community well in advance of project impacts occurring. • Develop and implement induction programmes for new contract workers to increase sensitivity to local norms and customs. • Work closely with local health services in monitoring and addressing changes in levels of community health and well being. • Implement a HIV/AIDS awareness programme on health issues and behavioural change amongst contractors, employees and villagers. • Support inter-village recreational competitions to foster increased healthy lifestyles around sport and recreation. • Partner with local education NGO's in the area and provide assistance in developing education within the project area. • Identify suitable local scholars and students and provide them with bursary and internship opportunities. • Partner with local schools and assist with education enhancement and	As per mitigation measures and management plans, in particular the RAP	Project Manager Resettlement Manager Community Relations Manager

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
	the provision of supplies and services wherever possible.		
Socio-economic development	• Invest in and promote sustainable projects, training and education to assist communities in developing alternative livelihoods and to minimise economic dependence on the project. • Develop a Social Development Plan that will focus on the development of alternative economic opportunities locally. • Develop a Community Development Plan that will focus on livelihood restoration and agricultural development projects • Partner with government and relevant NGOs to support sustainable livelihood practices. • Support and/or develop information and awareness programmes related to economic entrepreneurialism and small business development. • Work in partnership with existing government and related organisations already well-established to promote local economic development (refer to Section 6.8)	Management measures will be addressed through the development and implementation of Social and Community Plans	Project Manager
SURFACE WATER			
Impact of pollution of water resources due to upstream clean water mixing with dirty water	• A cleanwater diversion structure upstream of the plant, tailings dump, open pits and waste rock dumps will be constructed. • A detailed Plant Stormwater Management Plan is provided. This plan details the construction of stormwater canals within the plant area, and bunding around the Hydrocarbon storage facility.	The separation of clean and dirty water	Environmental Manager
Impact of excess water discharged to environment	• Identify what water will be available on the mine; • Understand the impacts of discharge from the various areas; • Identify what water can be used in what process • Develop a water management plan to identify what waters can be discharged from the mine, what waters will need to be cleaned and what waters can be used in the process;	Prevent excess water discharged to impact on the environment	Environmental Manager

Objectives	Mitigation/Management measure	Performance Target	Responsible Person
Impact of scouring of water course	• Energy dissipaters at canal outlet points • Grassed water ways and earth channels as recommended clean water diversion structures	Prevent scouring of the water source	Environmental Manager

13.3. Monitoring Plans

The following monitoring plans are proposed:

13.3.1. Climate

Climate monitoring should be carried out on site in order to detect changes in weather patterns throughout the operation.

13.3.1.1 Methodology

The weather meter on site is to be read and maintained. The variables which should be recorded are:

- Rainfall;
- Minimum and maximum temperatures; and
- Wind direction and velocity.

13.3.1.2 Monitoring locations

The monitoring station should be positioned on site preferably upwind of Monkey Hill (dominant wind direction).

13.3.1.3 Frequency of monitoring

Data should be down loaded monthly or bi-monthly (depending on the device). The meter should monitor at all times.

13.3.1.4 Monitoring data

Data from the meter should be downloaded and recorded on an excel spread sheet. These values can then be compared between months and eventually between years of the operation.

13.3.2. Fauna and flora monitoring plan

The monitoring of the flora environment is conducted by investigating the constituent components specifically the herb, grass shrub and tree layers. A monitoring program needs to evaluate the management actions of each of these components. The method of monitoring is the Braun Blanquet method, which is a specialised method designed specifically for vegetation survey/monitoring purposes.

- Monitoring must take place annually;
- Monitoring must be completed by qualified specialists;
- Adaptive management must applied;
- Monitoring during the wet season is essential; and
- Findings must be compared to previous years.

Following construction, assessments should be conducted annually determining the level of rehabilitation achieved and the current ecological state. Before the decommissioning phase a final survey should be conducted to determine how the environment can be improved based on the monitoring done over the life of the mine and facilitate in the final closing procedures, rehabilitation and management.

13.3.3. Wetland rehabilitation strategy

The wetland areas within the Project boundary are in a significantly modified state, largely due to historical commercial and artisanal mining activities. In addition to this, the current agricultural and illegal artisanal mining activities continue to degrade these systems, resulting in the limited ability of the systems to provide important ecological services. In light of the IFC performance standard (Performance Standard no. 6) which considers "Biodiversity Conservation and Sustainable Natural Resource Management", a wetland rehabilitation strategy is proposed for the Project. The proposed expansion project will result in the placement of infrastructure, most notably the tailings dump and slimes dam on wetland created by artisanal mining and previous mining activities from the 1960s. In light of this, an offset rehabilitation strategy is proposed for the project, the following recommendations have been provided:

- Mine plan – The placement of the tailings dump and slimes dam will be situated on the wetland areas considered to be the most degraded for the project area, most notably as a result of artisanal mining activities. The proposed design ensures that the smallest possible footprint area is achieved and that only the most degraded areas will be lost.
- Offset area – Wetland areas which have not been impacted on by artisanal mining activities and agricultural practices should be considered for the offset strategy. This is due to the severity of impacts imposed by the artisanal operations on the integrity and functioning of these systems. The proposed offset areas are situated on the lower slopes of Monkey Hill and could be incorporated into a conservation initiative for the project.

The rehabilitation of the proposed wetland offset areas associated with Monkey Hill would serve as some form of compensation for the expected loss of already degraded wetland areas due to the placement of the tailings dump and slimes dam. This strategy would require that wetland areas impacted on by agricultural activities be rehabilitated to represent the reference or close to natural conditions for the catchment area in order to restore ecological functioning and integrity to the catchment. This would be in alignment with the aim of the NBSAP which is to seek conservation measures that provide the solid framework for the sustainable exploitation of Sierra Leone's biodiversity for the benefit of present and future generations. The proposed phases for the rehabilitation strategy are as follows:

Phase 1: Planning

Phase 2: Submission of Draft Rehabilitation Report

Phase 3: Development of Final Rehabilitation Plan

Phase 4: Implementation of Wetland Rehabilitation Plan

13.3.4. Aquatic biomonitoring

Aquatic biomonitoring should be continued on the Meya River system adjacent to the mining activities. Additional monitoring sites should be selected on the Woyie and Congo rivers which should then be incorporated into the programme. The recommended monitoring sites are presented in Figure 13-1. Reference and monitoring sites should be selected for all three systems where possible. This will then allow for a comparative assessment of the monitoring (downstream) sites with the natural or close to natural reference (upstream) conditions.

Methodologies developed for the Rapid Bioassessment Protocols for use in Streams and Wadeable Rivers (USEPA, 2006) should be considered for the biomonitoring programme. In addition to this, toxicant screening should also be implemented and where toxicants are identified definitive analysis carried out. The frequency for such a monitoring programme should be implemented annually in the wet season for the life of the Project.

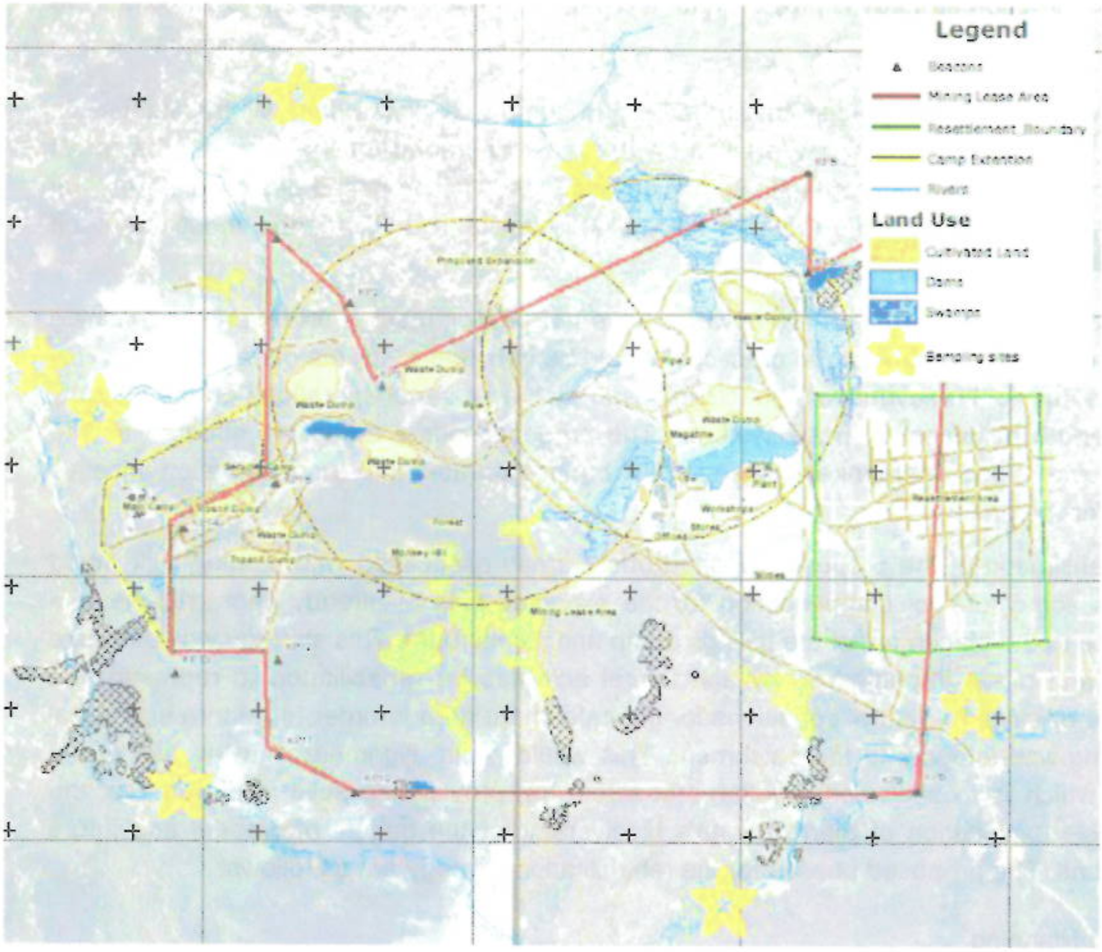

Figure 13-1: The recommended sampling sites for the project area

13.3.5. Wetland monitoring

Wetland areas which will not be impacted on by the proposed expansion should be monitored during the proposed rehabilitation and establishment (post-rehabilitation) of these systems. The monitoring of these areas will aim to assess the ability of the systems to provide important ecological services, as well as describe the ecological state of these areas. The integrity of the systems will be largely determined by assessing the systems importance to the maintenance of ecological diversity and functioning on a local scale as well as to the system's ability to resist disturbance and its capability to recover from disturbance once they have occurred. The frequency of the proposed monitoring component is as follows:

- Rehabilitation phase – the systems should be monitored on a monthly basis during this phase of the programme. This will aim to ensure that rehabilitation is being effectively and properly implemented.
- Post-rehabilitation phase – the systems should be monitored on a bi-annual basis for the first two years post rehabilitation. Thereafter the systems should continue to be monitored on an annual basis during the life of the operation.

13.3.6. Noise monitoring plan

Noise monitoring should be undertaken by a person or organisation possessing both the qualifications and the experience appropriate to perform the required measurements and reporting.

The noise from the open pit mining activities are predicted to impact in the area of N5 and N6, therefore it is recommend that a monitoring plan be implemented to determine the increases and decreases in noise levels, and determine level of mitigation required. Components to be included in the proposed monitoring plan are discussed below.

Baseline noise monitoring is to be conducted on a bi-annual basis to determine the impact of the noise levels on the ambient noise levels at the above mentioned locations as well as determine the level of mitigation. The noise measurements should be taken at location N5 and N6. A report must be compiled bi-annually, or depending on the intervals of the monitoring programme then submitted to management to ascertain compliance with the required standards. Mine management should be advised of any significant increase in the ambient sound level as operations continue. The ambient noise level will be sampled in terms of the following parameters:

- The A-weighted equivalent sound pressure level (LAeq) for duration not less than 30 minutes per monitoring point; and
- Measurements to be taken during both daytime (06:00 to 22:00) and the night time (22:00 to 06:00).

13.3.7. Blasting

For the purposes of checking compliance with the airblast overpressure conditions and ground vibration conditions and to ensure no structural damage is likely to occur, monitoring must be undertaken. As a minimum the following descriptors, characteristics and conditions should be determined:

- Maximum instantaneous charge (MIC) in kg;

- Location of the blast within the mine (including which bench level);
- Airblast overpressure level, dB (linear) peak;
- Peak particle velocity (mm/s);
- Location, date and time of recording;
- Meteorological conditions (including temperature, relative humidity, temperature gradient, cloud cover, wind speed and direction); and
- Distance/s from the blast site to noise-affected building/s, structure/s or the boundary of any noise-sensitive place.

Where access to a noise-affected property for monitoring purposes is not feasible, the measurement may be undertaken at the appropriate property boundary and the results extrapolated to reflect the impact at the receptor premises.

Noise from blasting shall be measured using noise measurement equipment with a lower limiting frequency of 2Hz (- 3dB response point of the measurement system) and a detector onset time of not greater than 100 microseconds.

13.3.7.1 Quality assurance – airblast overpressure and ground vibration

The measurement and reporting of airblast overpressure and ground vibration levels should be undertaken by a person or organisation possessing both the qualifications and the experience appropriate to perform the required measurements and reporting.

13.3.7.2 Recording

Details of the measurement instrumentation, measurement procedure, location, date and time of recording and conditions prevailing during measurements should be recorded for each assessment.

Records should be kept of the results of all airblast overpressure and ground vibration levels and other information required to be recorded in conjunction with such monitoring for the lifespan of the mine.

13.3.8. Vibration

In conjunction with the monitoring of blasting events, ground vibration measurements should be undertaken. The vibration instrumentation must be capable of measurement over the range 0.1 mms^{-1} to 300 mms^{-1} with accuracy within 5 % and have a frequency response flat to within 5 % over the frequency range of 4.5Hz to 250Hz.

Records should be kept of the results of all vibration levels and other information required to be recorded in conjunction with such monitoring for the lifespan of the mine.

13.3.9. Groundwater Monitoring Plan

Based on the results of predictive impact assessment, a groundwater monitoring plan is proposed throughout the operation and closure phases of the project.

The objectives of the monitoring programme include:

- To obtain water levels and samples from the sites identified for routine monitoring;
- To submit the samples for comprehensive analysis of the physical parameters, anions and cations and heavy metals concentrations, and to compare these in an annual report against the baseline qualities established during the pre-mining studies in 2003;
- To submit samples for biological and bacteriological analysis to understand the baseline conditions and the impacts of the project;
- To report on the compliance of the analytical results against standards and guidelines in order to identify problem areas and make recommendations for remedial actions;
- To identify areas and sources of pollution;
- To determine the extent of dewatering and impact on private groundwater users; and
- To determine the dynamics of groundwater contaminant plume movement.

The aims of the monitoring is to assess whether any changes are occurring to the ambient (baseline) water quality of local surface water and aquifers, either as a result of mining operations, or as a result of any contamination by the surrounding activities, and to then make recommendations for mitigation or remediation of any significant sources of contamination, if identified.

13.3.10. Heritage and Archaeology Monitoring Plan

Ideally, site monitoring should be conducted by an experienced and qualified archaeologist or heritage specialist. However, due to a number of constraints, this may not always be a viable option and as a minimum, the following measures should be followed to ensure adequate site monitoring is achieved by Environmental Offices and/or relevant employees.

- Induction training: Responsible staff identified by Koidu Holdings should attend a short course on heritage management and identification of heritage resources. It is assumed that this person/s will be the Environmental Officer/s (EO); and
- Site monitoring and/or watching brief: as most heritage resources occur subsurface, all earth moving activities must be monitored to record any resources accidentally exposed. The largest environmental impact on heritage resources is the initial soil stripping or earthworks associated during construction. The EO should monitor all such activities on a daily basis. In the event that any heritage resources are found, all work should be immediately suspended in that area. The EO must contact relevant authorities, archaeologist/ heritage specialist and where possible, the local or national museum. In the event of human remains being exposed, local police department must be informed.

13.4. Air Quality

Based on the predicted impacts on the surrounding environment it is recommended that ambient PM_{10} monitoring be done and a dust fallout monitoring network established on a continuous basis. A dust fallout and PM_{10} monitoring network can serve to meet various objectives, such as:

- Compliance monitoring;
- Validate dispersion model results;
- Use as input for health risk assessment;
- Assist in source apportionment;
- Temporal trend analysis;
- Spatial trend analysis;
- Source quantification; and
- Tracking progress made by control measures.

13.4.1. Dust fallout monitoring network

It is imperative that the dust fallout monitoring network be established before the start of expanded activities in view of the uncertainty regarding predicted dust-fall impacts. This will aid in the management of potential impacts as well as inform the relocation schedule planned for the village units within the concession area.

It is recommended that a dust fallout network comprising of at least 4 single dust fallout buckets be established. The proposed locations of the dust buckets are indicated in Figure 13-2 below.

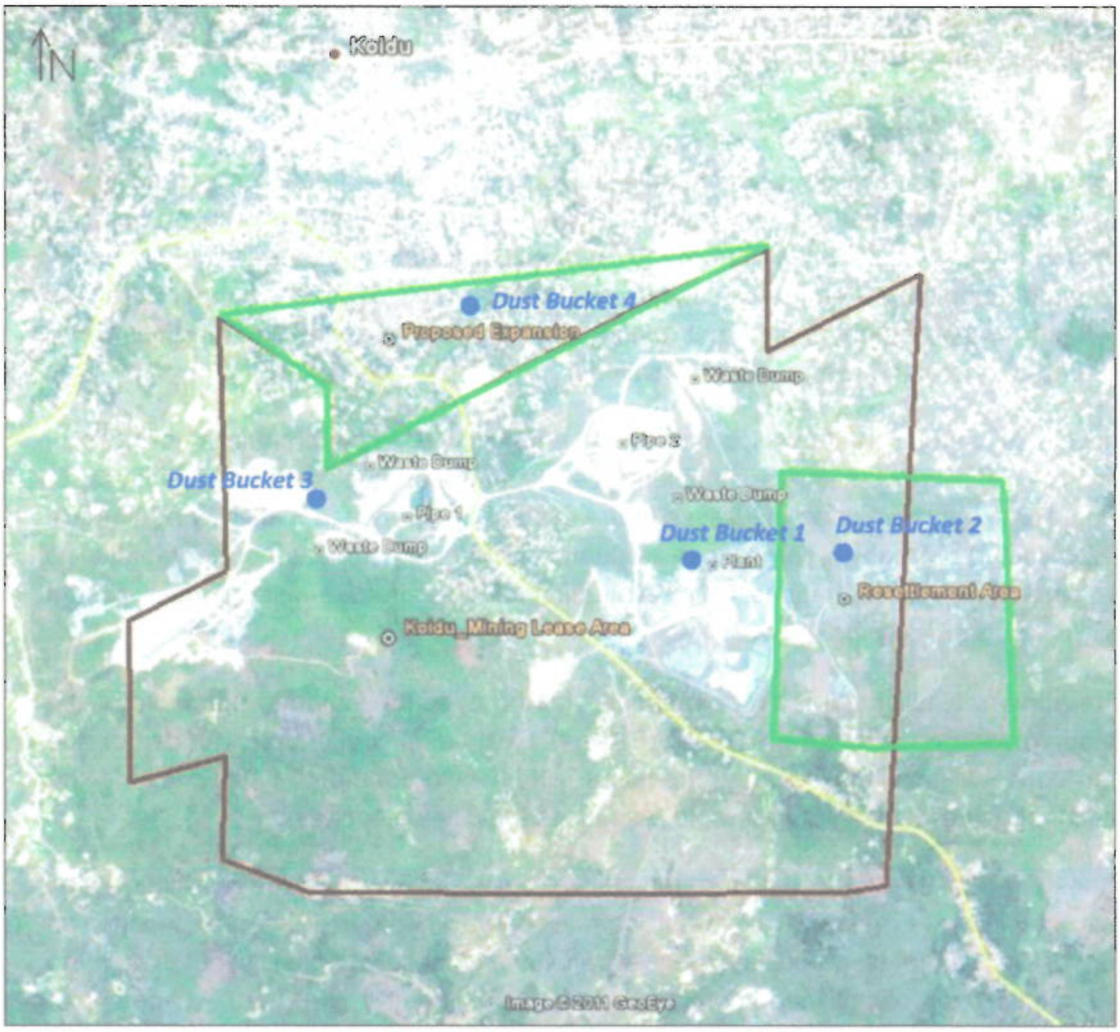

Figure 13-2: Proposed locations of the dust buckets

Dust deposition measurement should be carried out by method ASTM 1739- 98. This involves exposure of a standard bucket for a month, with weighing (and chemical analysis, if necessary) of the dust collected. The changing of the bucket can be done by on-site personnel while the weighing can be carried out at a suitable off-site or on-site laboratory.

The single bucket dust monitors are deployed following the American Society for Testing and Materials standard method for collection and analysis of dust-fall (ASTM D1739). The bucket stand comprises a ring that is raised above the rim of the bucket to prevent contamination from perching birds. The bucket holder is connected to a 2.1 m galvanized steel pole, which is either directly attached to a fence post or can be attached to a galvanized steel base plate, which is buried to a depth of 500 mm. This allows for a variety of placement options for the fallout samplers. The bucket contains about 500 ml of deionised water with copper sulphate as algaecide. Analysis of the contents of the bucket involves rinsing with deionised water to remove residue from the sides of the bucket, and the bucket contents filtered through a coarse (>1 mm) filter to remove insects and other course organic detritus. The sample is then filtered through a pre-weighed paper filter to remove the insoluble fraction, or dust fallout. This residue and filter are dried, and gravimetrically analysed to determine the insoluble fraction (dust fallout).

13.4.1.1 PM_{10} monitoring

Based on predicted impacts and considering the prevalent wind direction recorded in the area it is recommended that the PM_{10} ambient monitoring be done at five locations around the proposed mine. It is essential that the PM_{10} monitoring station also record basic hourly average meteorological parameters namely wind speed, wind direction, temperature and rainfall. It is however recommended that relative humidity, pressure and solar radiation also be measured at one of the two proposed locations.

A discussion of various methods for measuring ambient PM_{10} concentrations is given in Appendix A. The most suitable sampler type depends on the specific objectives of monitoring. Pertinent monitoring objectives in the case of the proposed mining operation are expected to include: on-going compliance evaluation, on-going estimation of contribution to airborne particulate concentrations, and evaluation of the effectiveness of dust control measures implemented at the mine.

Given the above objectives, it is recommended that the mine invest in the purchase of the filter-based, on-line monitor (e.g. TEOM, BAM). Real-time, continuous transfer of the measured concentrations (via telemetry, satellite, etc.) would contribute significantly to the use of such measurements to trigger rapid responses to pollution episodes.

Should the TEOM or BAM be considered too costly, investment in one of the non-filter based automatic monitors (e.g. DustTrak, DustScan, Topas). These instruments provide an indication of the range of particulate concentrations and despite possibly not being the preferred method for compliance monitoring, would provide the mine with a means of tracking progress made through emission reduction measure implementation.

13.5. Surface water

The surface water management plan including monitoring should be implemented to prevent (and through mitigation reduce) negative impacts on the surface water resources. The plan should be reviewed regularly as the operation progresses in order to address any deviations arising from the project description.

The objectives of the surface water monitoring programme are to monitor the surface water related impacts of the operations through the continuous analyses of water quality and quantity (where possible).

13.5.1. Methodology

13.5.1.1 Microbiological water samples

The following measures must be followed:

- Only sterilised sample bottles must be used;

- The sterilised sample bottle must remain closed and in a clean condition up to the point where it has to be filled with the water to be sampled;
- The sampling bottle must not be rinsed with any water prior to sampling;
- The sampler should wear gloves or wash his/her hands thoroughly before taking each sample. Hand contact with the neck of the bottle must be avoided;
- Once samples have been collected they must be placed in a cool place with a temperature of 5°C or less, the sample however must not freeze;
- Samples must be submitted to the lab within 24 hours.

13.5.1.2 Chemical water samples.

The following measures must be followed:

- The sample bottle must be kept closed and in a clean condition up to the point where it has to be filled with water to be analysed.
- The sample bottles (empty or filled with the water sample) must never be left unprotected in the sun.
- The bottle should be rinsed with the water to be sampled before filling.
- As little air as possible should be included in the bottle with the sample. This is achieved by making the sample bottle as full as possible.
- After the sample has been collected the sample bottle should be placed directly in a cool container.

Samples should be filtered in the field using a membrane filter system fitted with 0.45µm filters to remove all suspended materials. Water samples are to be kept cool before they are transferred to the laboratory. These samples should be preserved with nitric acid (HNO_3) for transport to an accredited laboratory. Unfiltered samples should also be taken and sent to the laboratory.

13.5.2. Frequency of monitoring

Sampling should be carried out monthly.

13.5.3. Monitoring data

Samples will be submitted to a reputable laboratory for water quality analysis. Water quality analyses should include the parameters listed in Table 13-2.

Table 13-2: Chemical constituents to be analysed

Chemical Constituent	
Iron as Fe	Mercury as Hg
Manganese as Mn	Molybdenum as Mo
Aluminum as Al	Suspended Solids
Cadmium as Cd	Chlorides as Cl
Total Chromium as Cr	Total Alkalinity as $CaCO_3$

Chemical Constituent	
Hexavalent Chromium as Cr^{6+}	Fluoride as F
Copper as Cu	Sulphate as SO_4
Nickel as Ni	Calcium as Ca
Lead as Pb	Magnesium as Mg
Selenium as Se	Sodium as Na
Boron as B	Potassium as K
Zinc as Zn	Conductivity in mS/m
Cobalt as Co	pH-Value at 25 ° C
Arsenic as As	Conductivity

The following field measurements should also be taken for the following constituents, simultaneously with the above sampling:

- pH
- Dissolved Oxygen;
- Turbidity;
- Total Dissolved Salts; and
- Conductivity.

Results must be captured in an excel spread sheet (or similar database) as they become available. Surface water quality trends for each monitoring point can then be maintained and assessed regularly. A full analysis report on the quality of the water will be compiled and filed on an annual basis.

13.6. Social monitoring and evaluation

Social monitoring will take place through the pre-construction, construction and operation phases of the Project. A detailed monitoring programme should be included in the Stakeholder Engagement Plan and Social Development Plan. Mechanisms for internal and external monitoring should be included in the RAP for the Project.

14. CONCLUSION

The Koidu Kimberlite Project is being undertaken with due consideration of biophysical, social and economic factors, as well as the relevant legislative requirements. The economic benefits of such a development are numerous, however, as in any mining project of this nature there also negative impacts which will require planning, monitoring and mitigation during construction, operation, decommissioning and post-closure. While none of these negative impacts are considered to be fatal flaws, the resettlement of households and community structures in particular constitutes a major impact which will require an integrated resettlement and development approach.

The Koidu Mine is essentially the most advanced operating mine in the country of Sierra Leone which has a focussed, technically skilled and committed management team and which contributes to the national fiscus in a meaningful way. One of the unintended consequences of the successful implementation of the project will be the fact that the social environment will become disjointed as a result of the creation of a prosperous area in an economically challenged region historically scarred by unemployment, civil strife, conflict and massive environmental damage created during the civil war. Koidu Holdings cannot employ everybody or create individual benefits for the entire population of Sierra Leone, and the very success of the project and the local people it employs may attract negative interventions and pressures from persons and institutions with own interest at heart.

National and regional leaders in the country, security services, as well as NGOs and the international community, must interact with management to protect the Project from unnecessary and unwanted negative interventions which may have as their sole purpose the creation of economic advantage for individuals to whom none is due or owing.

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APPENDIX A: IMPACT MATRIX

CONSTRUCTION PHASE

Activity, Phase and Impact			Impact before mitigation							Impact Rating (after mitigation)						
Impacted Environment	Activity	Summary of Impact	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)
Topography	Mining & Material dumping area	Excavating, stockpiling and construction activities will impact on the existing topography of the area	N	2	4	3	9	5	45	N	2	4	2	8	5	40
	Site Clearance		N	2	4	3	9	5	45	N	2	4	2	8	5	40
	Constuction of new infrastructure		N	2	4	3	9	5	45	N	2	4	2	8	5	40
Visual	Mining & Material dumping area preparation	Stockpiling, removal of vegetation and construction of infrastructure will impact on visual receptors	N	3	6	2	11	6	66	N	2	6	2	10	6	60
	Site Clearance		N	3	6	2	11	6	66	N	2	6	2	10	6	60
	Constuction of new infrastructure		N	3	6	2	11	6	66	N	2	6	2	10	6	60
Noise	Mining & Material dumping area preparation	Noise of machinery and vehicles may impact on noise receptors in the vicinity of the project	N	4	2	5	11	7	77	N	4	2	4	10	5	50
	Site clearance		N	3	2	2	7	4	28	N	3	2	2	7	3	21
	Construction of new infrastructure		N	2	2	2	6	4	24	N	1	2	2	5	3	15
Geology	Mining & Material dumping area preparation	Mining activities will impact on the geology	N	1	7	2	10	6	60	No mitigation						

Soils	Mining & Material dumping area preparation	Excavating, stockpiling and construction activities will impact on the soils of the project area	N	3	2	3	8	4	32	N	2	2	3	7	4	28
	Site clearance		N	3	6	2	11	6	66	N	3	6	2	11	4	44
	Construction of new infrastructure		N	3	2	3	8	4	32	N	2	2	3	7	4	28
Fauna	Site clearance	Site clearance during the construction of mining infrastructure may negative impact on the existing fauna within the mining lease area	N	4	6	5	15	7	105	N	3	5	4	12	6	72
			N	3	6	4	13	6	78	N	2	3	4	9	5	45
Flora	Constuction of new infrastructure	Site clearance and the disturbance of water courses during the construction of mining infrastructure may negative impact on the existing flora within the mining lease area	N	2	2	4	8	5	40	N	2	2	3	7	4	28
	Site clearance		N	2	5	3	10	7	70	N	2	5	2	9	6	54
	Constuction of new infrastructure		N	2	5	3	10	7	70	N	2	5	2	9	6	54
Aquatics	Construction of tailings and slimes dams	The construction of tailings and slimes dams may impact negatively on the aquatic environments in the vicinity of where these infrastructure are to be placed	N	3	5	2	10	7	70	N	3	5	2	10	4	40
Air Quality	Impact on air quality (dust) in adjacent residential areas	Construction activities may create dust, impacting on adjacent area	N	1	4	2	2	9	18	N	1	4	2	2	3	6

OPERATIONAL PHASE

Activity, Phase and Impact			Impact before mitigation							Impact Rating (after mitigation)						
Impacted Environment	Activity	Summary of Impact	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)	Nature of Impact (positive /	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)
Topography	Open pit mining	Excavating, stripping of rock and stockpiling will impact on the topography during operation	N	2	4	3	9	5	45	N	2	4	2	8	5	40
	Underground mining		N	2	4	3	9	5	45	N	2	4	2	8	5	40
	Management of waste rock, tailings and slimes		N	2	4	3	9	5	45	N	2	4	2	8	5	40
Visual	Management of waste rock, tailings and slimes	Creation, operation of waste rock dumps, tailings and slimes dams will have visual impacts on receptors in the area	N	3	6	2	11	6	66	N	2	6	2	10	6	60
Noise	Open pit mining	Noise from blasting, vehicles and mining activities will impact on senstitive receptors in the area	N	4	3	5	12	7	84	N	4	3	4	11	5	55
	Underground mining		N	4	5	4	13	6	78	N	3	5	3	11	4	44
	Transport and roads		N	3	3	3	9	4	36	N	3	5	3	11	4	44
Geology	Open pit mining	Mining activities will impact on the geology	N	1	7	2	10	6	60	No mitigation measures						
	Underground mining		N	1	7	2	10	6	60							
Soils	Fuel and chemicals storage and use	Materials handling, transport and the use and storage of chemicals may lead to soil pollution	N	3	2	3	8	4	32	N	2	2	3	7	4	28
	Transport and roads		N	3	2	3	8	4	32	N	2	2	3	7	4	28
	Domestic and hazardous waste handling		N	3	2	3	8	4	32	N	2	2	3	7	4	28
	Mining activities and water management	Mixing of clean and dirty water may lead to erosion and pollution of downstream water sources, flooding of the plant, tailings facility and pits	N	3	5	4	12	3	36	N	2	5	2	9	2	18

Hydrology	Discharge of excess water into the environment	Discharge of excess water may cause pollution of nearby water sources	N	2	5	3	10	3	30	N	2	5	2	9	2	18
	Scouring of the water course	Removal of wetlands may lead to souring of the water course at outlet points and downstream sedimentation	N	3	6	3	12	4	48	N	2	5	2	9	4	36
Geohydrology	Mining activities	Mining activities may lead to drawdown of the water table	N	3	5	3	11	4	44	No mitigation						
	Mining activities	Once open pit mining ceases, water levels will recover and lead to the formation of pit	P	1	5	3	9	4	36							
Fauna	Fuel and chemicals storage and use	Materials handling, transport and the use of tailings and slimes facilities may impact on fauna within the mining lease area	N	3	4	4	11	5	55	N	1	2	3	6	3	18
	Transport and roads		N	3	5	2	10	5	50	N	1	3	1	5	3	15
	Management of waste rock, tailings and slimes		N	3	4	5	12	5	60	N	2	3	3	8	3	24
Flora	Transport and roads	Materials handling, transport and the use of tailings and slimes facilities may impact on fauna within the mining lease area	N	3	5	2	10	5	50	N	2	3	1	6	4	24
	Management of waste rock, tailings and slimes		N	2	6	1	9	7	63	N	2	6	1	9	3	27
Aquatics	Management of waste rock, tailings and slimes	Management and operation of waste rock dumps, tailings and slimes facilities may negatively impact on the aquatic	N	3	5	2	10	7	70	N	3	5	2	10	3	30
Air Quality	Impact on air quality (dust) in adjacent residential areas	Blasting, materials handling and mining activities will increase dust levels	N	2	4	2	3	11	33	N	2	4	1	3	3	9

DECOMMISSIONING PHASE

Activity, Phase and Impact			Impact before mitigation							Impact Rating (after mitigation)						
Impacted Environment	Activity	Summary of Impact	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)	Nature of Impact (positive /	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)
Visual	Removal of all infrastructure	Removal of mining infrastructure and topsoil rehabilitation will have a posivtive impact on the visual environment	P	2	2	3	7	4	28	No mitigation for Positive						
	Spreading of sub-soils and topsoil		P	2	2	3	7	4	28							
Noise	Removal of all infrastructure	Removal of mining infrastructure and vehicular movement during the	N	2	2	3	7	4	28	N	2	2	3	7	4	28
Fauna	Removal of all infrastructure	Removal of mining infrastructure may have a negative impact on the fauna in the project area	N	2	5	2	9	4	36	N	1	1	1	3	2	6
	Rehabilitation of void and mining areas	Rehabilitation of the final void and mining area may will lead to an increase in habitat for fauna species.	P	3	4	5	12	7	84	No mitigation for Positive						
Flora	Removal of all infrastructure	Removal of mining infrastructure may have a negative impact on the flora in the project area	P	1	2	1	4	7	28	No mitigation for Positive						
	Rehabilitation of void	Rehabilitation of the final void and mining area may will lead to an increase in habitat for flora species.	P	2	1	5	8	7	56							
Air Quality	Decommissioning of mining infrastructure	During decommissioning of mining infrastructure, air quality impacts (mainly dust) may negatively impact the adjacent environment	N	3	5	5	6	13	78	N	1	1	1	1	3	3

APPENDIX B:CLOSURE COSTING SHEET

							Links		
	Koidu Holdings S.A.	Company			Date.	2011/04/02			
		Trust Fund			Assignment.	Closure Cost Assessment			
		Business Unit				Detailed Breakdown			
	Koidu	Mine							

Class	Item	Cls Std.	Quantity	Unit	Rate	Comment	Source	Plan No.	Dem. Cost
	Mine Infrastructure								
101	Single story brick building	DME 2.2	1481.90	m²	$ 21.51	Rate includes removal of foundation and transport of 2km			$ 31 881.60
102	Double storey brick building	DME 2.2		m²	$ 34.01	Rate includes removal of foundation and transport of 2km			
103	Triple Story Brick Building	DME 2.2		m²	$ 45.11	Rate includes removal of foundation and transport of 2km			
104	Buildings With Large Foundations			m²	$ 34.98				
105	Car Port			m²	$ 18.04	Demolish			
106	Coal Bay			m²	$ 11.51				
107	Un -Reinforced Concrete	DME 2.2	28.47	m³	$ 64.54	Rate includes removal and transport 2km - assumed thickness of 0.2 m			$ 1 837.79
108	Reinforced Concrete (low level)	DME 2.2		m³	$ 80.50	Rate includes removal and transport 2km - assumed thickness of 0.5 m			
109	Reinforced Concrete (high level)	DME 2.2		m³	$ 161.01	Rate includes removal and transport 2km - assumed thickness of 0.2 m			
110	Large bases	DME 2.2		m³	$ 176.28	Rate includes removal and transport 2km			
111	Dam			m³	$ 1.88	Water dams - Flatten the earth walls			
112	Hostel Rooms			m²	$ 28.32	Demolish			
113	Dam			m²	$ 0.28	Remove Plastic Liner.			
114	Dam			m³	$ 3.60	Remove Sludge - monitor			
115	Dams - Earth			m³	$ 1.07	Rate includes flattening and spreading earth			
116	Manhole			item	$ 75.92	1m Deep			
117	Manhole			item	$ 111.04	2m Deep			
118	Paved Areas	DME 2.2	297.00	m²	$ 0.69	Rate includes removal and transport 2km			$ 206.12
119	Pipelines			Km	$ 1 389.00				
120	Plug Shaft			m²	$ 902.20	Plug the shaft. Assume the shaft backfilled with rubble			
121	Plug Shaft			m²	$ 4 164.00	Plug the shaft. Assume the shaft not backfilled with rubble			
122	Prefab Building	DME 2.2	3692.51	m²	$ 8.33	Rate includes removal of foundation and transport of 2km			$ 30 751.21
123	Rails 36 Kg			Km	$ 18 044.00	36 Kg rails (Per single rail)			
124	Rails 22kg			Km	$ 18 044.00	22 Kg rails (Per single rail)			
125	Rehabilitation			m²	$ 8.33	Pick up Spilt Stone			
126	Rehabilitation			ha	$ 277.60	Grade an Area			
127	Rehabilitation			m²	$	General Clean Up			

					0.87				
128	Rehabilitation			m³	$ 4.72	Rubble - Load and Cart Away - 1km			
129	Rehabilitation			m²	$ 0.69	Replace Soil and Spread 150mm Thick			
130	Rehabilitation		190032.40	m²	$ 1.39	Replace soil and spread 300 mm thick			$ 263 834.37
131	Rehabilitation		19 01	ha	$ 3 053.60	Revegetate area and place topsoil where necessary			$ 58 043 56
132	Rehabilitation			m³	$ 0.97	Bulldoze Material - 50m			
133	Tarred Road		142552.00	m²	$ 1.74				$ 248 317.03
134	Gravel Road		11200 00	m²	$ 1.43				$ 16 011.97
135	Shaft Headgear - Steel	DME 2.2		t	$ 156.29	Dismantle steel and transport 2km			
136	Shaft Headgear - Concrete	DME 2.2		m³	$ 191.54	Rate includes removal and transport 2km			
137	Single Storey Steel Building	DME 2.2	16376.93	m²	$ 23.32	Rate includes removal of foundation and transport of 2km			$ 381 883 79
138	Double Storey Steel Building	DME 2.2	710.00	m²	$ 36.37	Rate includes removal of foundation and transport of 2km			$ 25 819.58
139	Triple Storey Steel Buildings	DME 2.2		m²	$ 49.27	Rate includes removal of foundation and transport of 2km			
140	Conveyor Steelwork (below 20m)	DME 2.2		t	$ 187.62	Dismantle steel and transport 2km			
141	Conveyor Steelwork (above 20m)	DME 2.2		t	$ 190.57	Dismantle steel and transport 2km			
142	Substation	DME 2.2		m²	$ 30.53	Rate includes removal of foundation and transport of 2km			
143	Tank (steel)	DME 2.2	538.00	m³	$ 7.55	Rate includes removal and transport 2km			$ 4 062.29
144	Tank (concrete)	DME 2.2		m³	$ 7.65	Rate includes removal and transport 2km			
145	Tailings dumps			ha	$ 1 405.27	Tops - Construct and vegetate contour walls - leach for 18 months (labour only no water costs included)			
146	Tailings dumps			ha	$ 2 218.02	Tops - Vegetate area between contour walls -dryland			
147	Tailings dumps			ha	$ 12 909.40	Sides - vegetate and leach for 18 months (labour only no water costs included)			
148	Tailings dumps			ha	$ 832.60	Sides vegetation maintenance/annum for 3 years			
149	Vent Shaft (short drift)	DME 2.5		Sum	$ 25 379.26	Fill with rubble and cover with topsoil			
150	Vent Shaft (long drift)	DME 2.5		Sum	$ 58 298.00	Fill with rubble and cover with topsoil			
151	Precast - 2m High Wall			m	$ 6.94				
152	Brick - 1m High - 1 Brick Thick Wall			m	$ 5.55				
153	Fencing		1089.60	m	$ 1.04				$ 1 134.48
154	Vertical Shaft Opening	DME 2.5		0	$ 55 520.00	Fill with rubble and cover with topsoil			
155	Inclined Shaft Opening	DME 2.5		0	$ 66 056.00	Fill with rubble and cover with topsoil			
156	Compact Collar Shaft Opening	DME 2.5		0	$ -				
157	Non-compact Collar Opening	DME 2.5		0	$ -				
158	Silos	DME 2.2		0	$ -				
159	Rehabilitation			m³	$ 22.90	Remove by hand - Cart 2km			

160	Conveyor		273.94	m²	$ 15.55				$ 4 258.61
161	Explosive Bay			m²	$ 11.80				
	Shallow Aquifer Impact								
	Radiation								
	Total - Mine Infrastructure								$ 1 068 042.39
	Proposed Infrastructure								
101	Single story brick building	DME 2.2	22155.00	m²	$ 21.51	Rate includes removal of foundation and transport of 2km			$ 476 642.67
102	Double storey brick building	DME 2.2		m²	$ 34.01	Rate includes removal of foundation and transport of 2km			
103	Triple Story Brick Building	DME 2.2		m²	$ 45.11	Rate includes removal of foundation and transport of 2km			
104	Buildings With Large Foundations			m²	$ 34.98				
105	Car Port			m²	$ 18.04	Demolish			
106	Coal Bay			m²	$ 11.51				
107	Un -Reinforced Concrete	DME 2.2		m³	$ 64.54	Rate includes removal and transport 2km - assumed thickness of 0.2 m			
108	Reinforced Concrete (low level)	DME 2.2		m³	$ 80.50	Rate includes removal and transport 2km - assumed thickness of 0.5 m			
109	Reinforced Concrete (high level)	DME 2.2		m³	$ 161.01	Rate includes removal and transport 2km - assumed thickness of 0.2 m			
110	Large bases	DME 2.2		m³	$ 176.28	Rate includes removal and transport 2km			
111	Dam			m³	$ 1.88	Water dams - Flatten the earth walls			
112	Hostel Rooms			m²	$ 28.32	Demolish			
113	Dam			m²	$ 0.28	Remove Plastic Liner.			
114	Dam			m³	$ 3.60	Remove Sludge - monitor			
115	Dams - Earth			m³	$ 1.07	Rate includes flattening and spreading earth			
116	Manhole			item	$ 75.92	1m Deep			
117	Manhole			item	$ 111.04	2m Deep			
118	Paved Areas	DME 2.2		m²	$ 0.69	Rate includes removal and transport 2km			
119	Pipelines			Km	$ 1 388.00				
120	Plug Shaft			m²	$ 902.20	Plug the shaft. Assume the shaft backfilled with rubble			
121	Plug Shaft			m²	$ 4 164.00	Plug the shaft. Assume the shaft not backfilled with rubble			
122	Prefab Building	DME 2.2		m²	$ 8.33	Rate includes removal of foundation and transport of 2km			
123	Rails 36 Kg			Km	$ 18 044.00	36 Kg rails (Per single rail)			
124	Rails 22kg			Km	$ 18 044.00	22 Kg rails (Per single rail)			
125	Rehabilitation			m³	$ 8.33	Pick up Spilt Slime			
126	Rehabilitation			ha	$ 277.60	Grade an Area			

127	Rehabilitation			m^2	$ 0.87	General Clean Up			
128	Rehabilitation		30000.00	m^3	$ 4.72	Rubble - Load and Cart Away - 1km			$ 141 576.00
129	Rehabilitation			m^3	$ 0.69	Replace Soil and Spread 150mm Thick			
130	Rehabilitation		42165.00	m^2	$ 1.39	Replace soil and spread 300 mm thick			$ 58 525.02
131	Rehabilitation		4.22	ha	$ 3 053.60	Revegetate area and place topsoil where necessary			$ 12 875.50
132	Rehabilitation			m^3	$ 0.97	Bulldoze Material - 50m			
133	Tarred Road			m^2	$ 1.74				
134	Gravel Road		20010.00	m^2	$ 1.43				$ 28 607.10
135	Shaft Headgear - Steel	DME 2.2		t	$ 156.29	Dismantle steel and transport 2km			
136	Shaft Headgear - Concrete	DME 2.2		m^3	$ 191.54	Rate includes removal and transport 2km			
137	Single Storey Steel Building	DME 2.2		m^2	$ 23.32	Rate includes removal of foundation and transport of 2km			
138	Double Storey Steel Building	DME 2.2		m^2	$ 36.37	Rate includes removal of foundation and transport of 2km			
139	Triple Storey Steel Buildings	DME 2.2		m^2	$ 49.27	Rate includes removal of foundation and transport of 2km			
140	Conveyor Steelwork (below 20m)	DME 2.2		t	$ 187.52	Dismantle steel and transport 2km			
141	Conveyor Steelwork (above 20m)	DME 2.2		t	$ 190.57	Dismantle steel and transport 2km			
142	Substation	DME 2.2		m^2	$ 36.53	Rate includes removal of foundation and transport of 2km			
143	Tank (steel)	DME 2.2		m^3	$ 7.55	Rate includes removal and transport 2km			
144	Tank (concrete)	DME 2.2		m^3	$ 7.55	Rate includes removal and transport 2km			
145	Tailings dams			ha	$ 1 403.27	Tops - Construct and vegetate contour walls - leach for 18 months (labour only no water costs included)			
146	Tailings dams			ha	$ 2 218.62	Tops - Vegetate area between contour walls -dryland			
147	Tailings dams			ha	$ 12 908.40	Sides - vegetate and leach for 18 months (labour only no water costs included)			
148	Tailings dams			ha	$ 832.60	Sides vegetation maintenance/annum for 3 years			
149	Vent Shaft (short drift)	DME 2.5		Sum	$ 25 379.26	Fill with rubble and cover with topsoil			
150	Vent Shaft (long drift)	DME 2.5		Sum	$ 58 296.00	Fill with rubble and cover with topsoil			
151	Precast - 2m High Wall			m	$ 6.94				
152	Brick - 1m High - 1 Brick Thick Wall			m	$ 5.55				
153	Fencing			m	$ 1.04				
154	Vertical Shaft Opening	DME 2.5		0	$ 55 520.00	Fill with rubble and cover with topsoil			
155	Inclined Shaft Opening	DME 2.5		0	$ 86 056.00	Fill with rubble and cover with topsoil			
156	Compact Collar Shaft Opening	DME 2.5		0	$ -				
157	Non-compact Collar Opening	DME 2.5		0	$ -				
158	Silos	DME 2.2		0	$ -				
159	Rehabilitation			m^2	$	Remove by hand - Cart 2km			

					22.90				
160	Conveyor			m²	$ 15.55				
161	Explosive Bay			m²	$ 11.80				
	Shallow Aquifer Impact								
	Radiation								
	Total - Proposed Infrastructure								$ 718 226.29
	Pits								
101	Single story brick building	DME 2.2		m²	$ 21.51	Rate includes removal of foundation and transport of 2km			
102	Double storey brick building	DME 2.2		m²	$ 34.01	Rate includes removal of foundation and transport of 2km			
103	Triple Story Brick Building	DME 2.2		m²	$ 45.11	Rate includes removal of foundation and transport of 2km			
104	Buildings With Large Foundations			m²	$ 34.98				
105	Car Port			m²	$ 18.04	Demolish			
106	Coal Bay			m²	$ 11.51				
107	Un -Reinforced Concrete	DME 2.2		m³	$ 64.54	Rate includes removal and transport 2km - assumed thickness of 0.2 m			
108	Reinforced Concrete (low level)	DME 2.2		m³	$ 80.50	Rate includes removal and transport 2km - assumed thickness of 0.5 m			
109	Reinforced Concrete (high level)	DME 2.2		m³	$ 161.01	Rate includes removal and transport 2km - assumed thickness of 0.2 m			
110	Large bases	DME 2.2		m³	$ 176.28	Rate includes removal and transport 2km			
111	Dam			m³	$ 1.88	Water dams - Flatten the earth walls			
112	Hostel Rooms			m²	$ 28.32	Demolish			
113	Dam			m²	$ 0.28	Remove Plastic Liner.			
114	Dam			m³	$ 3.60	Remove Sludge - monitor			
115	Dams - Earth			m³	$ 1.07	Rate includes flattening and spreading earth			
116	Manhole			item	$ 75.92	1m Deep			
117	Manhole			item	$ 111.04	2m Deep			
118	Paved Areas	DME 2.2		m²	$ 0.69	Rate includes removal and transport 2km			
119	Pipelines			Km	$ 1 388.00				
120	Plug Shaft			m²	$ 902.20	Plug the shaft. Assume the shaft backfilled with rubble			
121	Plug Shaft			m²	$ 4 164.00	Plug the shaft. Assume the shaft not backfilled with rubble			
122	Prefab Building	DME 2.2		m²	$ 8.33	Rate includes removal of foundation and transport of 2km			
123	Rails 36 Kg			Km	$ 18 044.00	36 Kg rails (Per single rail)			
124	Rails 22kg			Km	$ 18 044.00	22 Kg rails (Per single rail)			
125	Rehabilitation			m³	$ 8.33	Pick up Spilt Slime			
126	Rehabilitation			ha	$	Grade an Area			

					277.60				
127	Rehabilitation			m²	$ 0.87	General Clean Up			
128	Rehabilitation			m³	$ 4.72	Rubble - Load and Cart Away - 1km			
129	Rehabilitation			m²	$ 0.69	Replace Soil and Spread 150mm Thick			
130	Rehabilitation			m²	$ 1.39	Replace soil and spread 300 mm thick			
131	Rehabilitation		1.05	ha	$ 3 053.60	Revegetate area and place topsoil where necessary			$ 3 207.81
132	Rehabilitation		9454.50	m²	$ 0.97	Bulldoze Material - 50m			$ 9 185.99
133	Tarred Road			m²	$ 1.74				
134	Gravel Road			m²	$ 1.43				
135	Shaft Headgear - Steel	DME 2.2		t	$ 156.29	Dismantle steel and transport 2km			
136	Shaft Headgear - Concrete	DME 2.2		m³	$ 191.54	Rate includes removal and transport 2km			
137	Single Storey Steel Building	DME 2.2		m²	$ 23.32	Rate includes removal of foundation and transport of 2km			
138	Double Storey Steel Building	DME 2.2		m²	$ 36.37	Rate includes removal of foundation and transport of 2km			
139	Triple Storey Steel Buildings	DME 2.2		m²	$ 49.27	Rate includes removal of foundation and transport of 2km			
140	Conveyor Steelwork (below 20m)	DME 2.2		t	$ 187.52	Dismantle steel and transport 2km			
141	Conveyor Steelwork (above 20m)	DME 2.2		t	$ 190.57	Dismantle steel and transport 2km			
142	Substation	DME 2.2		m²	$ 36.53	Rate includes removal of foundation and transport of 2km			
143	Tank (steel)	DME 2.2		m³	$ 7.55	Rate includes removal and transport 2km			
144	Tank (concrete)	DME 2.2		m³	$ 7.55	Rate includes removal and transport 2km			
145	Tailings dams			ha	$ 1 403.27	Tops - Construct and vegetate contour walls - leach for 18 months (labour only no water costs included)			
146	Tailings dams			ha	$ 2 218.02	Tops - Vegetate area between contour walls -dryland			
147	Tailings dams			ha	$ 12 908.40	Sides - vegetate for 18 months (labour only no water costs included)			
148	Tailings dams			ha	$ 832.80	Sides vegetation maintenance/annum for 3 years			
149	Vent Shaft (short drift)	DME 2.5		Sum	$ 25 379.26	Fill with rubble and cover with topsoil			
150	Vent Shaft (long drift)	DME 2.5		Sum	$ 58 296.00	Fill with rubble and cover with topsoil			
151	Precast - 2m High Wall			m	$ 6.94				
152	Brick - 1m High - 1 Brick Thick Wall			m	$ 5.55				
153	Fencing			m	$ 1.04				
154	Vertical Shaft Opening	DME 2.5		0	$ 55 520.00	Fill with rubble and cover with topsoil			
155	Inclined Shaft Opening	DME 2.5		0	$ 66 056.00	Fill with rubble and cover with topsoil			
156	Compact Collar Shaft Opening	DME 2.5		0	$ -				
157	Non-compact Collar Opening	DME 2.5		0	$ -				
158	Silos	DME 2.2		0	$ -				

159	Rehabilitation			m^3	$ 22.90	Remove by hand - Cart 2km			
160	Conveyor			m^2	$ 15.55				
161	Explosive Bay			m^2	$ 11.80				
	Shallow Aquifer Impact								
	Radiation								
	Total - Pits								$ 12 393.80
	Waste Rock Dump & Topsoil								
101	Single story brick building	DME 2.2		m^2	$ 21.51	Rate includes removal of foundation and transport of 2km			
102	Double storey brick building	DME 2.2		m^2	$ 34.01	Rate includes removal of foundation and transport of 2km			
103	Triple Story Brick Building	DME 2.2		m^2	$ 45.11	Rate includes removal of foundation and transport of 2km			
104	Buildings With Large Foundations			m^2	$ 34.98				
105	Car Port			m^2	$ 18.04	Demolish			
106	Coal Bay			m^2	$ 11.51				
107	Un -Reinforced Concrete	DME 2.2		m^3	$ 64.54	Rate includes removal and transport 2km - assumed thickness of 0.2 m			
108	Reinforced Concrete (low level)	DME 2.2		m^3	$ 80.50	Rate includes removal and transport 2km - assumed thickness of 0.5 m			
109	Reinforced Concrete (high level)	DME 2.2		m^3	$ 161.01	Rate includes removal and transport 2km - assumed thickness of 0.2 m			
110	Large bases	DME 2.2		m^3	$ 176.28	Rate includes removal and transport 2km			
111	Dam			m^3	$ 1.88	Water dams - Flatten the earth walls			
112	Hostel Rooms			m^2	$ 28.32	Demolish			
113	Dam			m^2	$ 0.28	Remove Plastic Liner.			
114	Dam			m^3	$ 3.60	Remove Sludge - monitor			
115	Dams - Earth			m^3	$ 1.07	Rate includes flattening and spreading earth			
116	Manhole			item	$ 75.92	1m Deep			
117	Manhole			item	$ 111.04	2m Deep			
118	Paved Areas	DME 2.2		m^2	$ 0.69	Rate includes removal and transport 2km			
119	Pipelines			Km	$ 1 388.00				
120	Plug Shaft			m^2	$ 902.20	Plug the shaft. Assume the shaft backfilled with rubble			
121	Plug Shaft			m^2	$ 4 164.00	Plug the shaft. Assume the shaft not backfilled with rubble			
122	Prefab Building	DME 2.2		m^2	$ 8.33	Rate includes removal of foundation and transport of 2km			
123	Rails 36 Kg			Km	$ 18 044.00	36 Kg rails (Per single rail)			
124	Rails 22kg			Km	$ 18 044.00	22 Kg rails (Per single rail)			
125	Rehabilitation			m^3	$ 8.33	Pick up Spilt Slime			

126	Rehabilitation			ha	$ 277.60	Grade an Area			
127	Rehabilitation			m²	$ 0.87	General Clean Up			
128	Rehabilitation		2252625.00	m³	$ 4.72	Rubble - Load and Cart Away - 1km			$ 10 630 587.90
129	Rehabilitation			m²	$ 0.69	Replace Soil and Spread 150mm Thick			
130	Rehabilitation		163891.00	m²	$ 1.39	Replace soil and spread 300 mm thick			$ 227 480 71
131	Rehabilitation		18.21	ha	$ 3 053.60	Revegetate area and place topsoil where necessary			$ 55 616.74
132	Rehabilitation			m³	$ 0.97	Bulldoze Material - 50m			
133	Tarred Road			m²	$ 1.74				
134	Gravel Road			m²	$ 1.43				
135	Shaft Headgear - Steel	DME 2.2		t	$ 156.29	Dismantle steel and transport 2km			
136	Shaft Headgear - Concrete	DME 2.2		m³	$ 191.54	Rate includes removal and transport 2km			
137	Single Storey Steel Building	DME 2.2		m²	$ 23.32	Rate includes removal of foundation and transport of 2km			
138	Double Storey Steel Building	DME 2.2		m²	$ 38.37	Rate includes removal of foundation and transport of 2km			
139	Triple Storey Steel Buildings	DME 2.2		m²	$ 49.27	Rate includes removal of foundation and transport of 2km			
140	Conveyor Steelwork (below 20m)	DME 2.2		t	$ 187 52	Dismantle steel and transport 2km			
141	Conveyor Steelwork (above 20m)	DME 2.2		t	$ 190.57	Dismantle steel and transport 2km			
142	Substation	DME 2.2		m²	$ 36.53	Rate includes removal of foundation and transport of 2km			
143	Tank (steel)	DME 2.2		m³	$ 7.55	Rate includes removal and transport 2km			
144	Tank (concrete)	DME 2.2		m³	$ 7.55	Rate includes removal and transport 2km			
145	Tailings dams			ha	$ 1 403.27	Tops - Construct and vegetate contour walls - leach for 18 months (labour only no water costs included)			
146	Tailings dams			ha	$ 2 218.02	Tops - Vegetate area between contour walls -dryland			
147	Tailings dams			ha	$ 12 908.40	Sides - vegetate and leach for 18 months (labour only no water costs included)			
148	Tailings dams			ha	$ 832.60	Sides vegetation maintenance/annum for 3 years			
149	Vent Shaft (short drift)	DME 2.5		Sum	$ 25 379.26	Fill with rubble and cover with topsoil			
150	Vent Shaft (long drift)	DME 2.5		Sum	$ 58 296.00	Fill with rubble and cover with topsoil			
151	Precast - 2m High Wall			m	$ 6.94				
152	Brick - 1m High - 1 Brick Thick Wall			m	$ 5.55				
153	Fencing			m	$ 1 04				
154	Vertical Shaft Opening	DME 2.5		0	$ 55 520 00	Fill with rubble and cover with topsoil			
155	Inclined Shaft Opening	DME 2.5		0	$ 66 056.00	Fill with rubble and cover with topsoil			
156	Compact Collar Shaft Opening	DME 2.5		0	$ -				
157	Non-compact Collar Opening	DME 2.5		0	$ -				
158	Silos	DME 2.2		0	$				

					-				
159	Rehabilitation			m³	$ 22.90	Remove by hand - Cart 2km			
160	Conveyor			m²	$ 15.55				
161	Explosive Bay			m²	$ 11.80				
	Shallow Aquifer Impact								
	Radiation								
	Total - Waste Rock Dump & Topsoil								$ 10 913 685.35
	Tailings								
101	Single story brick building	DME 2.2		m²	$ 21.51	Rate includes removal of foundation and transport of 2km			
102	Double storey brick building	DME 2.2		m²	$ 34.01	Rate includes removal of foundation and transport of 2km			
103	Triple Story Brick Building	DME 2.2		m²	$ 45.11	Rate includes removal of foundation and transport of 2km			
104	Buildings With Large Foundations			m²	$ 34.98				
105	Car Port			m²	$ 18.04	Demolish			
106	Coal Bay			m²	$ 11.51				
107	Un -Reinforced Concrete	DME 2.2		m³	$ 64.54	Rate includes removal and transport 2km - assumed thickness of 0.2 m			
108	Reinforced Concrete (low level)	DME 2.2		m³	$ 80.50	Rate includes removal and transport 2km - assumed thickness of 0.5 m			
109	Reinforced Concrete (high level)	DME 2.2		m³	$ 161.01	Rate includes removal and transport 2km - assumed thickness of 0.2 m			
110	Large bases	DME 2.2		m³	$ 176.28	Rate includes removal and transport 2km			
111	Dam			m³	$ 1.88	Water dams - Flatten the earth walls			
112	Hostel Rooms			m²	$ 28.32	Demolish			
113	Dam			m²	$ 0.28	Remove Plastic Liner.			
114	Dam			m³	$ 3.60	Remove Sludge - monitor			
115	Dams - Earth			m³	$ 1.07	Rate includes flattening and spreading earth			
116	Manhole			item	$ 75.92	1m Deep			
117	Manhole			item	$ 111.04	2m Deep			
118	Paved Areas	DME 2.2		m²	$ 0.69	Rate includes removal and transport 2km			
119	Pipelines			Km	$ 1 388.00				
120	Plug Shaft			m²	$ 902.20	Plug the shaft. Assume the shaft backfilled with rubble			
121	Plug Shaft			m²	$ 4 164.00	Plug the shaft. Assume the shaft not backfilled with rubble			
122	Prefab Building	DME 2.2		m²	$ 8.33	Rate includes removal of foundation and transport of 2km			
123	Rails 36 Kg			Km	$ 18 044.00	36 Kg rails (Per single rail)			
124	Rails 22kg			Km	$ 18 044.00	22 Kg rails (Per single rail)			
125	Rehabilitation			m³	$	Pick up Spilt Slime			

					8.33				
126	Rehabilitation			ha	$ 277.60	Grade an Area			
127	Rehabilitation			m²	$ 0.87	General Clean Up			
128	Rehabilitation			m³	$ 4.72	Rubble - Load and Cart Away - 1km			
129	Rehabilitation			m²	$ 0.69	Replace Soil and Spread 150mm Thick			
130	Rehabilitation			m²	$ 1.39	Replace soil and spread 300 mm thick			
131	Rehabilitation		77.32	ha	$ 3 053.60	Revegetate area and place topsoil where necessary			$ 236 093.36
132	Rehabilitation			m³	$ 0.97	Bulldoze Material - 50m			
133	Tarred Road			m²	$ 1.74				
134	Gravel Road			m²	$ 1.43				
135	Shaft Headgear - Steel	DME 2.2		t	$ 166.29	Dismantle steel and transport 2km			
136	Shaft Headgear - Concrete	DME 2.2		m³	$ 191.54	Rate includes removal and transport 2km			
137	Single Storey Steel Building	DME 2.2		m²	$ 23.32	Rate includes removal of foundation and transport of 2km			
138	Double Storey Steel Building	DME 2.2		m²	$ 36.37	Rate includes removal of foundation and transport of 2km			
139	Triple Storey Steel Buildings	DME 2.2		m²	$ 49.27	Rate includes removal of foundation and transport of 2km			
140	Conveyor Steelwork (below 20m)	DME 2.2		t	$ 187.52	Dismantle steel and transport 2km			
141	Conveyor Steelwork (above 20m)	DME 2.2		t	$ 190.57	Dismantle steel and transport 2km			
142	Substation	DME 2.2		m³	$ 36.53	Rate includes removal of foundation and transport of 2km			
143	Tank (steel)	DME 2.2		m³	$ 7.55	Rate includes removal and transport 2km			
144	Tank (concrete)	DME 2.2		m³	$ 7.55	Rate includes removal and transport 2km			
145	Tailings dams			ha	$ 1 403.27	Tops - Construct and vegetate contour walls - leach for 18 months (labour only no water costs included)			
146	Tailings dams			ha	$ 2 218.02	Tops - Vegetate area between contour walls -dryland			
147	Tailings dams			ha	$ 12 908.40	Sides - vegetate and leach for 18 months (labour only no water costs included)			
148	Tailings dams		77.32	ha	$ 832.80	Sides vegetation maintenance/annum for 3 years			$ 64 389.10
149	Vent Shaft (short drift)	DME 2.5		Sum	$ 25 379.26	Fill with rubble and cover with topsoil			
150	Vent Shaft (long drift)	DME 2.5		Sum	$ 58 296.00	Fill with rubble and cover with topsoil			
151	Precast - 2m High Wall			m	$ 6.94				
152	Brick - 1m High - 1 Brick Thick Wall			m	$ 5.55				
153	Fencing			m	$ 1.04				
154	Vertical Shaft Opening	DME 2.5		0	$ 55 520.00	Fill with rubble and cover with topsoil			
155	Inclined Shaft Opening	DME 2.5		0	$ 66 056.00	Fill with rubble and cover with topsoil			
156	Compact Collar Shaft Opening	DME 2.5		0	$ -				
157	Non-compact Collar Opening	DME 2.5		0	$ -				

158	Silos	DME 2.2		0	$ -				
159	Rehabilitation			m³	$ 22.90	Remove by hand - Cart 2km			
160	Conveyor			m²	$ 15.55				
161	Explosive Bay			m²	$ 11.80				
	Shallow Aquifer Impact								
	Radiation								
	Total - Tailings								$ 300 482.46
	Total								**$ 13 012 830.29**
	Monitoring Costs*					***Monitoring based on 5 boreholes including the cost to sink boreholes**			**$ 312 300.00**
						***Monitoring on a quarterly basis over a five year period**			
	Signage**					****Costs of signage placed around pits**			**$ 1 333.33**
	Project Management (5%)								**$ 650 641.51**
	Contingency (10%)								**$ 1 301 283.03**
	GRAND TOTAL								**$ 15 278 388.16**