

**Santa Fe  
Inc.**

**Integrated  
Farm  
Project**

**Rupununi Savannahs**

**Region 9**

**GUYANA**

**ENVIRONMENTAL & SOCIAL MANAGEMENT  
PLAN**

Prepared by:



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## ACRONYMS

CARICOM	Caribbean Community
CSME	Caribbean Single Market and Economy
EIA	Environmental Impact Assessment
EMBRAPA	Brazilian Agricultural Research and Development Institute
EMC	Environmental Management Consultants
ESMP	Environmental and Social Management Plan
EPA	Environmental Protection Agency
ERP	Emergency Response Plan
GDP	Gross Domestic Product
<b>GEOCOM</b>	Guyana Elections Commission
GLSC	Guyana Lands and Surveys Commission
GNBS	Guyana National Bureau of Standards
GoG	Government of Guyana
GPF	Guyana Police Force
GUYSUCO	Guyana Sugar Corporation
ITC	Interamericana Trading Corporation
LCDS	Low Carbon Development Strategy
MoU	Memorandum of Understanding
MSDS	Material Safety and Data Sheet
NARI	National Agriculture Research Institute
NEAP	National Environmental Action Plan
OH&S	Occupational Health and Safety
PPE	Personal Protective Equipment
RDC	Regional Democratic Council
SFI	Santa Fe Inc.

## 1.0 INTRODUCTION

### 1.1 Overview

Guyana is traditionally an agricultural based economy and the sector is a vital contributor to the nation's economy. Agriculture continues to grow and contributes between 30%-35% of the total Gross Domestic Product (GDP) of the country annually. The sugar and rice industries are at the forefront of agricultural activity in Guyana but "other crops", livestock and fisheries have continued to hold their own and in total, account for 10% of overall GDP and 32% of agricultural GDP<sup>1</sup>. Agriculture also provides employment and contributes significantly to income, especially in the rural areas. Commercial crop farming has been limited to the coastal area, but within recent years there is a push to expand to other areas, especially the intermediate savannahs.

Given the country's endowment of extensive and rich agricultural lands and its agricultural background, Guyana has always been touted as the food basket of the Caribbean. Currently, CARICOM countries import the majority of their food from outside of the region. Ensuring food security for the CARICOM region is certainly one of the main challenges faced by the Region, considering the fact that the region's food import bill is approximately US\$4 billion annually<sup>2</sup>. Guyana can capitalize on this market and earn significant foreign exchange. There are opportunities for further growth of the sector in areas not utilised for commercial agriculture but which have potential for agriculture development.

The GoG has recognized this opportunity and is moving towards expanding the sector. Guyana has always placed great emphasis on its agriculture sector and, more particularly, on ensuring that the country is food secure. This emphasis has been expanded within the past decade to cope with the ever-increasing threat of global warming and changing weather patterns. Given that approximately 70% of Guyana's residents live in rural households, and are primarily dependant on income generated from agricultural related activities, the GoG is placing significant emphasis on developing the agricultural sector in order to improve the standard of living and quality of life, while exploiting Guyana's agricultural potential. A wide range of activities are underway based on the expressed needs of producers for better infrastructure, improvements in the administration of land, an effective and responsive system for information exchange, training, fiscal measures to enhance competitiveness and guidance in market development. Agricultural diversification continues to be one of the principal pillars with specific emphasis on the implementation of the strategic plans for three cluster groups, namely fruits and vegetables, livestock and aquaculture. The country has seen an increase in recent years of non-traditional crops to overseas markets. However, the agricultural sector remains vulnerable to climate change and fluctuating markets demand and prices. Nevertheless, the GoG is moving ahead in expanding the sector and providing the necessary mechanism to cushion or prevent the effects of externals and climatic changes. In this regard, and in addition to the measures previously mentioned, the GoG has included 1.5 billion dollars in the 2011 annual budget to further develop the sector.

To contribute to the expansion of the sector, His Excellency, President Bharrat Jagdeo hosted a Regional Agricultural Investment Conference in June 2008. The conference was aimed at attracting investment in the sector and potential investors from the Wider Caribbean Region and further afield was invited to participate. Participants were exposed to the various opportunities which exist within the country for agriculture development. It this initiative which led to the conceptualisation of this Integrated Farm Project

### 1.2 Background to the Environmental and Social Management Plan

In response to the invitation by Guyana's Head of State to consider investing in a large scale, commercial agricultural project in Guyana, the developer, Sir Kyffin Simpson, responded by pursuing the drafting and signing of a Memorandum of Understanding (MoU) as the first step in the process of setting up the

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<sup>1</sup> Source: Ministry of Agriculture

<sup>2</sup> Source: Guyana Times March 04, 2011 edition

project. The development of this project has also been guided by the drive at the level of CARICOM to have meaningful intra regional investment flows in the context of the CARICOM Single Market and Economy (CSME).

On February 17, 2010, Interamericana Trading Corporation (ITC) signed an MoU with the GoG. The MoU was in support of the cooperation between the GoG and ITC to implement a 300,000 acre integrated farm project in the Rupununi Savannahs in Region 9, Guyana. In accordance with the MOU, Santa Fe Inc. (SFI) was incorporated as the local subsidiary of ITC which would implement the project.

Santa Fe Inc. has indicated it's willingness to undertake an agricultural project in the North Rupununi and applied to the Guyana Lands and Surveys Commission (GLSC) for an area. A lease of 4047 hectares (10,000 acres) was granted to the Company for agricultural purposes. As a condition of the lease the Company is required to obtain an Environmental Authorisation from the Environmental Protection Agency (EPA). The Company applied to the EPA for an Environmental Authorisation in November 2010 for an Integrated Farm Project at Santa Fe, North Rupununi. The application was processed by the EPA and the necessary screening conducted. The Agency determined that an Environmental Permit is required before the Project can be implemented. This decision by the EPA was communicated via letter dated December 03, 2010. A copy is attached as Appendix A. The Agency also determined that an Environmental Impact Assessment (EIA) is not required for the Project but the Company must prepare an Environmental and Social Management Plan (ESMP) and submit to the EPA for approval prior to the issuance of the Permit. This ESMP has been prepared to meet this requirement.

### **1.3 Approach and Methodology**

#### **1.3.1 Purpose and Objectives of the Environmental and Social Management Plan**

This ESMP has been prepared in accordance to the EPA Guidelines for the preparation of EMPs and was guided by the letter from the EPA to SFI dated December 03, 2010. The ESMP outlines measures to address all the potential impacts of the project on the physical, biological and socio-economic environment. The Plan concentrates on the environmental and social components of the Project. However, many of the activities also involve elements of occupational health and safety and quality management which are integrated, as far as is necessary, with environmental management. As such, these areas were also addressed where relevant.

The ESMP is supported by other documentation designed to achieve appropriate standards and consistency in the Company's environmental performance. By necessity, the ESMP is a dynamic document as it is a management tool that needs to reflect the changes in technology, legislation, industry best practices, the economic climate and the status of onsite activities.

This ESMP is prepared for the project as is currently conceptualized. Any major changes will be communicated to the EPA. This ESMP may also be updated from time to time based on any changes relating to the project that have occurred or any evaluation done on the effectiveness of the mitigation measures.

Environmental Management Consultants (EMC) was contracted by SFI to assist with the preparation of the ESMP. EMC commissioned a multidisciplinary team to prepare the ESMP. The composition of the Team is attached as Appendix B. The ESMP was prepared during the period of January to June 2011. The following tasks were performed by the Team in the preparation of the ESMP:

- Conducted a site visit to a large commercial rice cultivation and farm in Normady, Brazil, arranged by Santa Fe Inc. This provided an opportunity for a first hand visit to a similar activity across the border and allow for a better understanding of the activities and issues involved in such an operation.

- Compiled a description of the project environment and the relevant baseline information on the project area including its geology, soils, hydrology, water quality, climate and terrestrial and aquatic flora and fauna and socio-economic conditions.
- Identified and assessed the relevant legislation and institutions regarding the project.
- Conducted a floral and faunal assessment of the area.
- Identified potential impacts on the biological, physical and socio-economic environments.
- Prepared an ESMP which recommends measures to address those adverse impacts that can be avoided, or reduced to acceptable levels.
- Prepared an Emergency Response Plan (ERP) for the operations.
- Prepared an Environmental Monitoring Plan for the operations.

### 1.3.2 Methodology

A number of approaches were applied during the preparation of the ESMP to collect information. These include the use of existing information, interviews with key resource persons, interviews with communities, and on site field assessments. These approaches are further described below:

1. **Review of Existing Literature** – Some amount of existing data and literature are available on the Project and specific to the project site. These documents include the Santa Fe Business and the Technical Report by CAMPO. Other existing data, especially relating to the baseline information of the project environment such as biodiversity and weather conditions were reviewed.
2. **Interviews with Key Personnel/Stakeholders** – Interviews were conducted with key resource persons and stakeholders associated with the project to gather specific information necessary for the preparation of the ESMP and concerns that should be addressed by the ESMP. Stakeholders consulted included institutions, individuals from the project area and company personnel. Appendix C lists the stakeholders interviewed and contacted during this period.
3. **Site Visits** – Site visits were conducted to the project area to gather data on the project environment and to conduct the biological and social assessments. These visits also allowed for an understanding of the extent and current status of development, meeting with key stakeholders, determining the characteristics of the project environment and determining the possible potential impacts of the project. A visit was also conducted to Normandy in Brazil to observe a similar operation and to gain an understanding of the proposed project.
4. **Surface Water Testing** – Surface water testing was conducted to determine the quality of water within the project environment.

### 1.4 Company Background and Profile

Santa Fe Inc is a Guyanese corporation, incorporated under the laws of Guyana for the purpose of developing and implementing an Integrated Farm Project in the North Rupununi. The Company was incorporated on March 31, 2010. SFI is a wholly owned subsidiary of ITC, which is the parent company of Simpson Motors of Barbados and the SOL (Simpson Oil Ltd.) Group of Companies. SFI is managed by a Board of Directors comprising Mr. Ronald Harford, Chairman; Sir Kyffin Simpson, the Project Sponsor; Mr. Robert Kirby, Director; Dr. Lelde Schmitz, Director and Mr. Richard Vasconcellos, Director. Mr. William Hinds is currently serving as the Secretary and Project Director. Santa Fe Inc. local address is outlined below:

Lot BB Rome  
Agricola  
Greater Georgetown  
**GUYANA**

### **1.5 Company Policy**

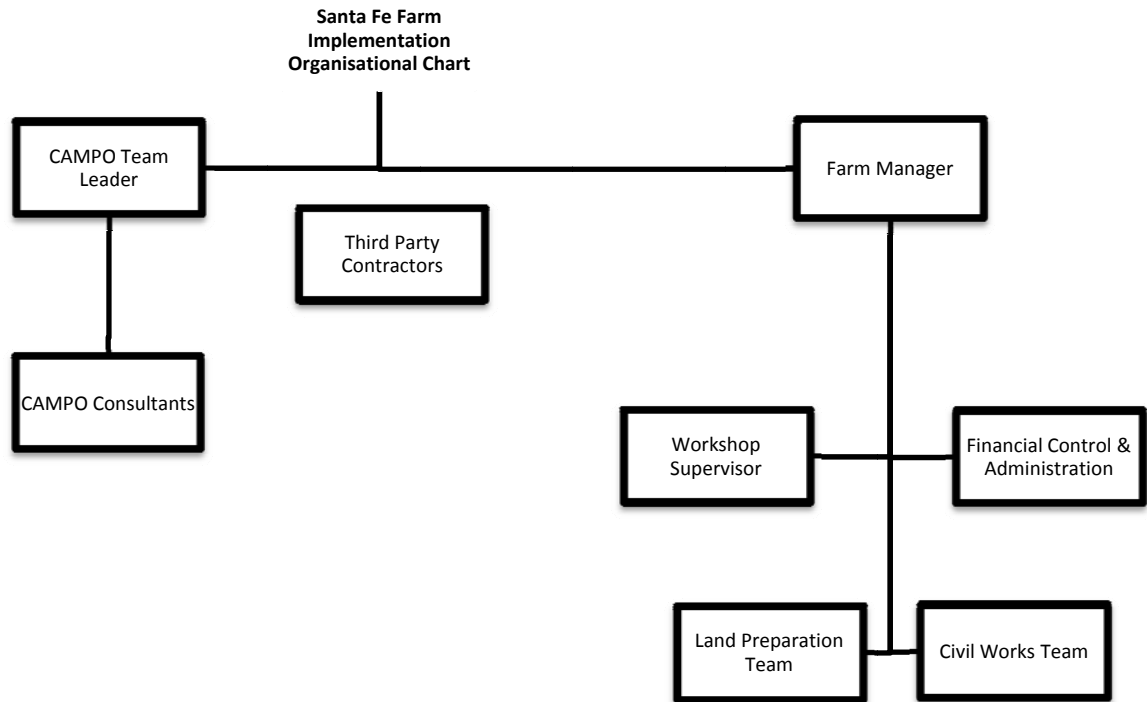
Santa Fe Inc. is committed to establishing an integrated and sustainable agricultural project which can serve as a model for Guyana and the rest of the Caribbean. In ensuring a sustainable project the Company intends to integrate three main goals: - environmental protection and health, economic profitability, and social and economic equity. Through the practice of sustainable agriculture Santa Fe Inc. intends to address many environmental and social concerns and incorporate innovative and economically viable practices taking into account topography, soil characteristics, climate, pests, availability of inputs and the social environment. In addition to the site specific conditions the Company intends to:

- Select species and varieties that are well suited to the site and to conditions on the farm;
- Diversify crops and integrate livestock to enhance the biological and economic stability of the farm;
- Manage the soil to enhance and protect soil quality; and
- Ensure efficient and humane use of inputs.

Santa Fe Inc. is committed to environmental preservation by identifying and maintaining areas of ecological importance within its property and environmental protection by conducting its operations in a safe and environmentally friendly manner.

### **1.6 Environmental Responsibilities and Implementation of the ESMP**

A Farm Manager will head the onsite operation. This individual will have the responsibility for the operational aspect of the project, including implementation of the ESMP and ensuring the conditions of the Environmental Permit are complied with. The Farm **Manger** would also oversee occupational health and safety. Initially, technical assistance will be provided by CAMPO, a Brazilian consultancy firm contracted by Santa Fe Inc to provide technical expertise and assistance in establishing and implementing the project. The proposed organizational structure for the operations aspect of the project is outlined below:



**Figure 1: SFI Organisational Structure**

### 1.7 Current Status of the Project

SFI conducted a preliminary reconnaissance of the 4047 hectares (10,000 acres) of land offered by the GoG and having found the site suitable for further technical study, SFI sought, and was granted permission from the GLSC to access the area in order to conduct soil, topographic, hydrological and other surveys and assessments to confirm its suitability to support a technically and economically viable integrated farm.

The proposed farm site, named Santa Fe, was first occupied by SFI personnel since May, 2010. A well was dug followed by the construction of three temporary, tarpaulin roofed, camp site buildings along with latrines, a generator house, a trestle and overhead water tanks. This temporary camp site was developed to house SFI personnel and equipment which would support the activities of the technical teams that would conduct the soil, topographic and other surveys and assessments on the site. SFI purchased three (3) extra cab pickup trucks and two ATV's to provide transportation for its personnel and the technical teams within the site and back and forth to and from Lethem. The Santa Fe site was also outfitted with a VHF radio system, a diesel powered generator, a gasoline powered water pump and other facilities to make it livable for the SFI personnel and the visiting technical teams who would reside there for extensive periods of time.

The main technical surveys consisted of a soil survey and a topographic survey. The results of the soil survey have confirmed that the soils at the Santa Fe site can be considered "typical savannah soils" in the context of what obtains across the border in the savannahs of Roraima state in Brazil. The results of the topographic survey have similarly confirmed "typical savannah land contours".

In addition to the camp site at Santa Fe, SFI established an office/residential presence in Lethem and an office in Georgetown, to provide administrative, logistical and management support to the field exercises. The figures below show the current camp facility.



**Figures 2 and 3: Current Camp Facilities**

## **2.0 PROJECT DESCRIPTION**

### **2.1 Project Location**

The proposed project area consists of approximately 4047 hectares (10,000 acres) which is located in the North Rupununi Savannahs in Region 9. The area is in close proximity to Meritzero and is bordered by the Ireng River to the west. The Georgetown – Lethem Road and the Karasabai Road passes through the property. The Ground Star Resources/Canacol Joint Venture Exploration activities are located just adjacent to the property on the east, with exploratory drilling currently being conducted. The Joint Venture has housing and other auxiliary facilities established. Also in close proximity is the Meritzero airstrip which is in good condition and is currently used by Santa Fe Inc. as well as the Joint Venture. The Meritzero Ranch, which is an outstation of the Pirara Ranch, is also located close by to the project area. On the Brazilian side of the border is the community of Normandy which is currently engaged in framing activities similar to the activities proposed by Santa Fe Inc. The figure below shows the general location of the project area.

## Map of Guyana Showing Location of Santa Fe

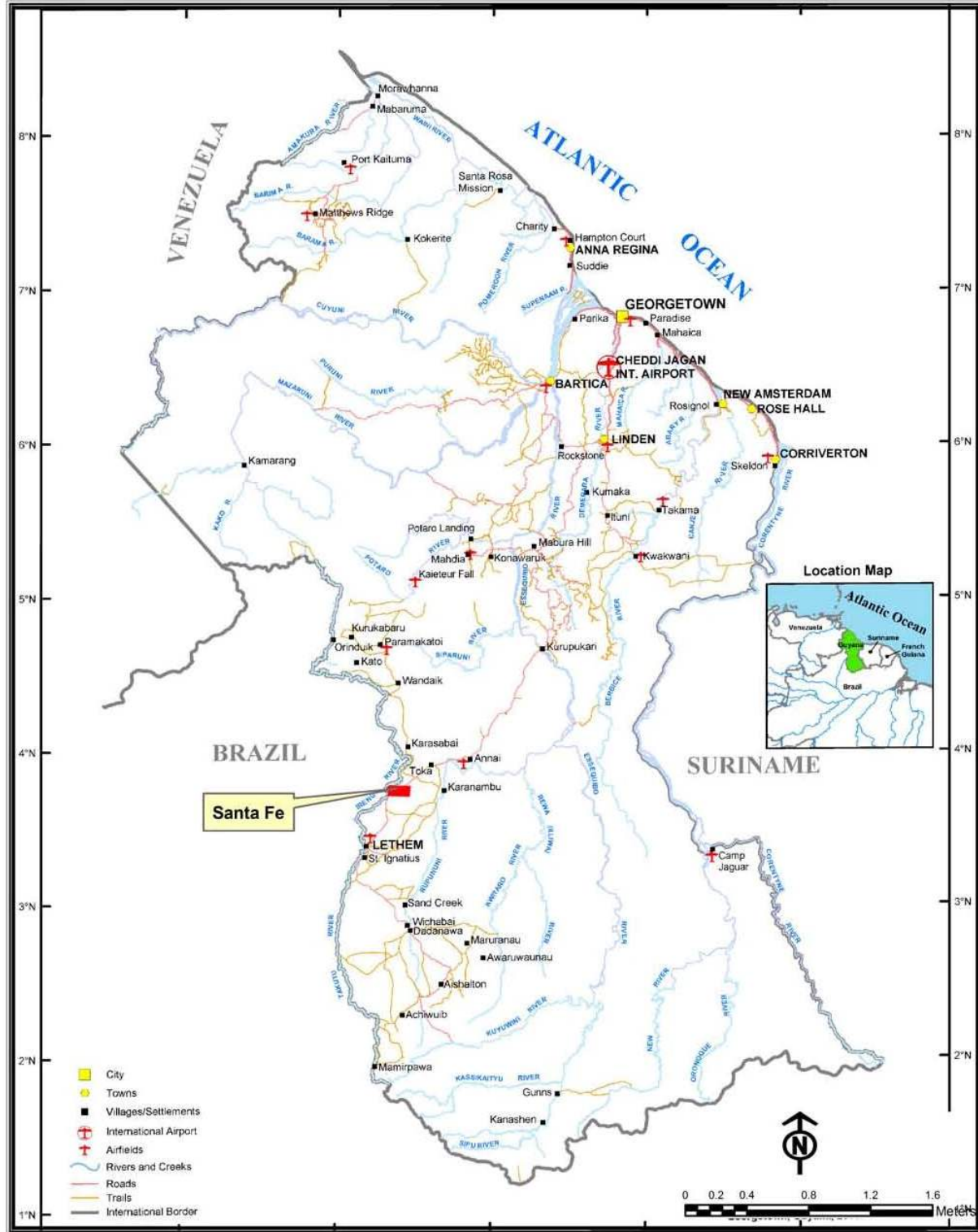


Figure 4: Location of Santa Fe

## 2.2 Project Synopsis

This project entails the establishment of a commercially viable, large scale integrated farm at the Santa Fe site. The project will be implemented in phases and will rely heavily on the technology successfully developed and implemented in Brazil. The main repository of this technology is EMBRAPA, the Brazilian Agricultural Research and Development Institute<sup>3</sup>, which is an agency of the Federal Government of Brazil. In addition, the National Agricultural Research Institute (NARI), an agency on the Ministry of Agriculture of Guyana, will play an integral role in the technical development of the project. The Campo Group<sup>4</sup> of Brazil has been contracted by Santa Fe Inc. to provide technical expertise. This group is currently working on developing the Farm Plan and will oversee the implementation of the Project.

SFI will implement the project in three distinct phases over a five (5) year period. Each phase will have strict technical and economic/financial benchmarks which, if met, will lead to the implementation of the next phase. The Santa Fe Integrated Farm will cultivate three principal crops in Phase 1. Rice, soya beans and cow peas (black eyed peas, red peas and others). Cattle and small ruminants (sheep and goats) will also be reared in Phase 1. Phase 2 and 3, will see the introduction of large scale aquaculture, the cultivation of permanent fruit crops, along with grains like corn, maize and sorghum.

The timing of the project coincides with the reality of a 60% reduction in the acreage of land under cultivation in neighboring Roraima State in Brazil. In the context of the long established Partial Scope Agreement between the Governments of Guyana and Brazil, SFI has the potential to sell all of its rice produced in Phase 1 into the Brazilian market.

The project will continue to maximize the use of local technical and non-technical skills wherever possible. Linkages will be established with the Guyana Sugar Corporation (GUYSUCO), the only other large scale farming enterprise in Guyana, to pursue joint skills development and management training wherever possible.

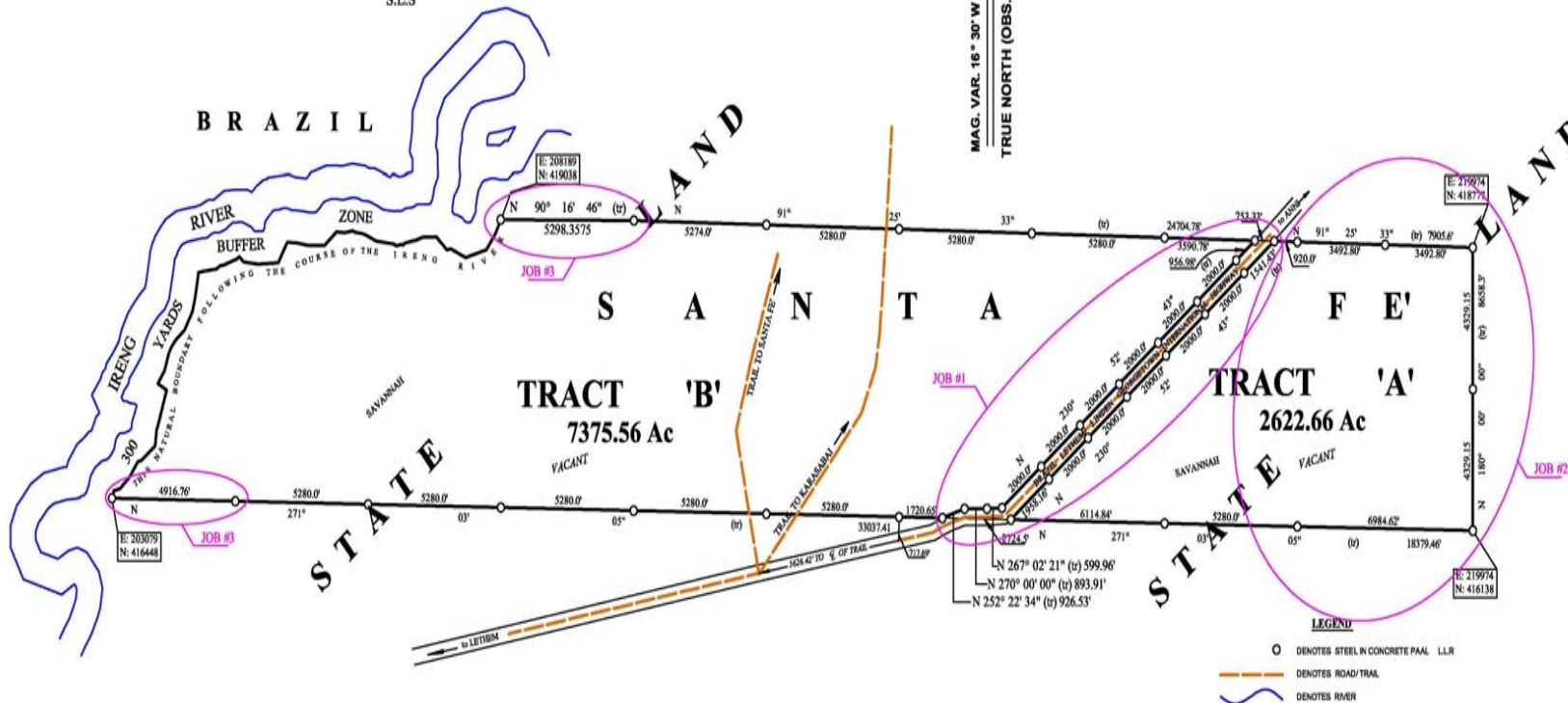
In addition to the significant positive impact that this project will have on Lethem and its environs, SFI will ensure that there is real technology transfer to the farming communities in the Rupununi. This should lead to the development of satellite farming enterprises in the latter phases of the project, which would benefit from SFI's agro-processing facilities.

The figure below shows the project area and the property boundary.

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<sup>3</sup> With 400 years of agricultural research in the savannah areas of Northern Brazil, EMBRAPA will participate in the project development through monthly visits by technical experts in agriculture and livestock to support technology transfer and validation during the period of 12 months.

<sup>4</sup> This Group has been participating in the agricultural development of Brazil since 1979 through different programs and has jointly executed with the public and private sector numerous projects in the Brazilian savannahs. The Group has converted large tracts of land that were considered to be without any agricultural value to integrated agricultural projects.



A detailed map of Guyana, a country in South America. The map shows its borders with Venezuela to the north, Suriname to the east, and Brazil to the south. Key cities and towns are marked, including Georgetown (the capital), Lethem, Santa Rosa, and various smaller settlements like Mabaruma, Baramba, and Essequibo. The map also shows the Atlantic Ocean to the north and the Guianas region. A small inset map shows the location of Guyana within South America.

1. NOTICE OF INTENDED SURVEY WAS SERVED ON THE MR. JOHNSON, THE COMMISSIONER OF GUYANA LANDS AND SURVEYS COMMISSION, THE REG CHAIRMAN OF REGION NO. 9.
2. THE SURVEY COMMENCED ON 09-07-2010 AND WAS COMPLETED ON 20-10-2010.
3. NO ONE ATTENDED THE SURVEY. THERE WAS NO OBJECTION.
4. REFERENCE WAS MADE TO THE FOLLOWING PLAN/ MAP ON RECORD AT THE GUYANA LANDS AND SURVEYS COMMISSION  
(a) PLAN # 59NC, 1/50,000 SCALE TOPOGRAPHIC MAP SHEET PREPARED UNDER THE INSTRUCTIONS OF THE COMMISSIONER OF GUYANA LANDS AND SURVEYS COMMISSION ON WHICH THE SURVEY IS BASED.
5. TRACT 'A' AND TRACT 'B' ARE PORTIONS OF STATE LAND.
6. THE SURVEY WAS EXECUTED IN KEEPING WITH THE STATE LANDS ACT AND REGULATIONS.
7. A LETTER WAS RECEIVED FROM THE COMMISSIONER OF GUYANA LANDS AND SURVEYS COMMISSION GIVING PERMISSION TO SURVEY THE SAID TRACT 'A' AND TRACT 'B'.
8. ALL ARRANGEMENT FOR THE PAYMENT OF INSPECTION FEES WAS MADE.
9. THE PURPOSE OF THE SURVEY WAS TO DEFINE TRACT 'A' AND TRACT 'B' FOR THE PURPOSE OF ISSUING A STATE LANDS LEASE.
10. THE 300 YARDS BUFFER ZONE IS IN KEEPING WITH THE RULES AND REGULATIONS FOR THE GUIDANCE OF SURVEYORS IN THE DEPARTMENT OF LANDS AND SURVEYS SUB SECTION 36 OF THE REGULATIONS UNDER THE SUBJECT RESERVATIONS PROCLAMATIONS BY THE GOVERNOR IN THE OFFICIAL GAZETTE DATED 24TH SEPTEMBER 1904, WHICH STATES THAT THERE SHALL BE RESERVED ON THE LAND FRONTIER OF THIS (COLONY) COUNTRY A BELT OF 300 YARDS WIDTH WHICH SHALL BE RETAINED FOR PUBLIC PURPOSES AND SHALL BE GRANTED TO NO ONE.
11. U.T.M COORDINATES WERE OBTAINED BY THE USE OF A GARMIN 12XL G.P.S.

### Figure 5: Project Area

### 2.3 The Integrated Farm

The Integrated Farm model will see the utilization of the land at Santa Fe based on suitability for the cultivation of specific crops or for animal rearing. Land suitability is determined by a number of factors including, topography, access to irrigation, soil fertility and drainage characteristics.

The results of the soil survey conducted by NARI indicates that the location is suitable for the cultivation of a range of crop types, inclusive of pasture development, once the appropriate tillage and crop management techniques are used. NARI also indicated that the soil at the Santa Fe site will have to be treated with inputs of limestone, fertilizers and micronutrients in order to successfully support the planned cultivation of crops and grasses. NARI recommended that the low grade phosphate currently being used by GUYSUCO should be used at the site. The farm land will be divided into distinct subdivisions for specific crop types, with intercropping and rotation of use taking place in the latter phases of the farm development.

In Phase 1, the proposed land use entails 1000 hectares (2,471 acres) of rice cultivation; 250 hectares (618 acres) of soya bean cultivation; 250 hectares (618 acres) of cow peas cultivation, and 500 hectares (1,237 acres) of pasture land for cattle and small ruminants. This initial 2000 hectares (4,942 acres) of land will be brought into use within 18 months of the commencement of initial land preparation activities.

The additional 2047 hectares (5,058 acres) will be brought into full use within 4 years from initial land preparation, during phases 2 and 3. These phases will entail the development of additional pasture land, rice cultivation, permanent fruit crops and large scale aquaculture. The table below shows the planned land development/utilization by years.

**Table 1: Proposed Land Development by Years**

	Year 1	Year 2	Year 3	Year 4	Year 5
Crops (acres)	2000	3000	5000	6000	6000
Pastures (acres)	3000	4000	4000	4000	4000
Total (acres)	5000	7000	9000	10000	10000

The farming model to be implemented is currently being practiced successfully in Normandy and several other areas in Brazil, similar to the environment which exists at Santa Fe. Similar species of crops and livestock will be cultivated and reared by farm. Rice will be grown in the lowland areas, closer to the Ireng River. An irrigation and drainage system will be implemented to facilitate the rice cultivation. Soya and cow peas will be grown on the higher areas. Livestock will also be reared in this area. Grass will be cultivated to provide food for the livestock. Some permanent fruit crops will be planted on the high patches located throughout the property. Aquaculture may be done in the wetland areas.

In addition to the drainage and irrigation system, some other preparatory works will have to be done. Shrubs, consisting mainly of wild cashew and sand paper trees will be cleared. These will be individually removed so as not to damage the topsoil. Forest islands will remain. Roads will be constructed to access the various sections of the farm. There are quite a few existing burrow pits which will provide material (laterite) for road construction, including a pit located next to the temporary campsite. The soil within the area is highly acidic and lime will have to be added to facilitate the growing of crops. A permanent facility to serve as housing, workshop, storage areas, etc. will also be constructed. It is planned that this facility will be constructed at the high area referred to as Santa Fe.

## 2.4 Project Components

### 2.4.1 Irrigated Rice

The total area currently under consideration for rice cultivation eventually is approximately 2041 hectares (5044 acres). During the first phase 1000 hectares (2471 acres) will be cultivated. The physical features of the Santa Fe area demonstrate a natural aptitude for irrigated rice production. To ensure the best use of the land flood irrigation is recommended utilising technology being used by EMBRAPA. The cultivation of rice by submergence of the soil needs about 2000 litres (2m<sup>3</sup>) of water to produce 1 kg off grain shell, and is among the crops which are most demanding in terms of water resources. Maintaining a cover of water over the soil surface has a number of benefits to the rice plants. The variety of rice to be cultivated is the Roraima variety which was developed by EMBRAPA and is currently being cultivated in Brazil.

Water management in irrigated rice comprises a set of procedures, all considered important, whether from an economic standpoint, or growth and development of plants. The uptake and distribution, the need for irrigation, the soil submersion period, the height of the water depth and soil drainage are important aspects that will have to be considered. The pictures below show rice cultivation in Normandy, Brazil. This environment is similar to the environment at Santa Fe.



**Figures 6 and 7: Rice cultivation at Normandy, Brazil**

### 2.4.2 Integrated Crop-Livestock: Soybean and Cow peas with Beef Cattle

The cultivation of soya bean and cow peas are intended to be cultures of soil improvement for later implantation of pasture for rearing of livestock. Both crops have the ability after harvest to increase soil fertility, by increasing organic matter and incorporation of bacteria which increase the nitrogen content of the soil. The improved fertility leads to better soil conditions and allows for successful development of pastures.

The crop-livestock integration system consists of different production systems of grains, fiber, wood, meat, milk, etc., in the same area, through rotation or succession, involving the planting of grain, pastures or tree crops. The system enables the recovery of degraded areas through intensification of land use, leveraging the complementary or synergistic effects between the different plant species and livestock, thus providing a sustainable higher production per area. The system also optimizes the use of soil; grain yields in pasture land, and improves the productivity of pastures due to its renewal by the utilization of residual fertilizer from the crop, facilitating greater nutrient cycling and increasing soil organic matter. The planting of crops to reduce the costs of recovery of degraded pastures is not new. The novelty is that this can be done with the adoption of combined techniques which generate high yields. One such technique involves minimal or zero tillage which minimizes the impacts of agriculture on the environment in the deployment of production systems. The benefit of this system includes:

- Utilization of the residue from crop fertilization;
- Production of better quality forage;
- Recovery of pasture productivity;
- Lower cost in developing new pastures;
- Increased productivity of meat;
- Weight gain of animals, even in the dry season.

At Santa Fe the crop-livestock integration system will consist of planting 250 hectares (617 acres) soya bean and 250 hectares (617 acres) of cow peas, and after the cycle of crops, utilising the total area for cattle. The variety of soya bean to be cultivated is the BRS Tracajá, which has a crop life of 108 days. The BRS Mazagão, with a crop life of 65 days, will be the variety of cow peas to be cultivated. These varieties are well established in Brazil.

The amount of cattle at the start will be 100 females of 250 – 300kg and 5 breeding bulls. The total area designated to be used for this exercise is 500 hectares (1236 acres). The pasture will be developed in a crop-livestock system through crop rotation in which grazing takes the residue of fertilizers of the last cultivation crop and recover the productivity. The pasture grass *Brachiaria*, which is grown in Brazil, will be used. The picture below shows livestock rearing adjacent to the rice growing area in Normandy, Brazil.



**Figure 8: Livestock Rearing at Normandy, Brazil**

The zoning of the project area for the various crops to be cultivated is currently being done through detailed land evaluation. The characteristics of the areas, including soil type, is being determined and analysed and compared with the requirements for each crop type. This is allowing for the various areas to be utilized by the most suitable crops, and will contribute to a sustainable and efficient agricultural system. Detailed soil surveys were conducted by NARI and the data is being utilized by CAMPO to zone the area. Based on the work conducted thus far the preliminary layout below has been developed of the initial targeted areas. This layout also includes areas for preservation.

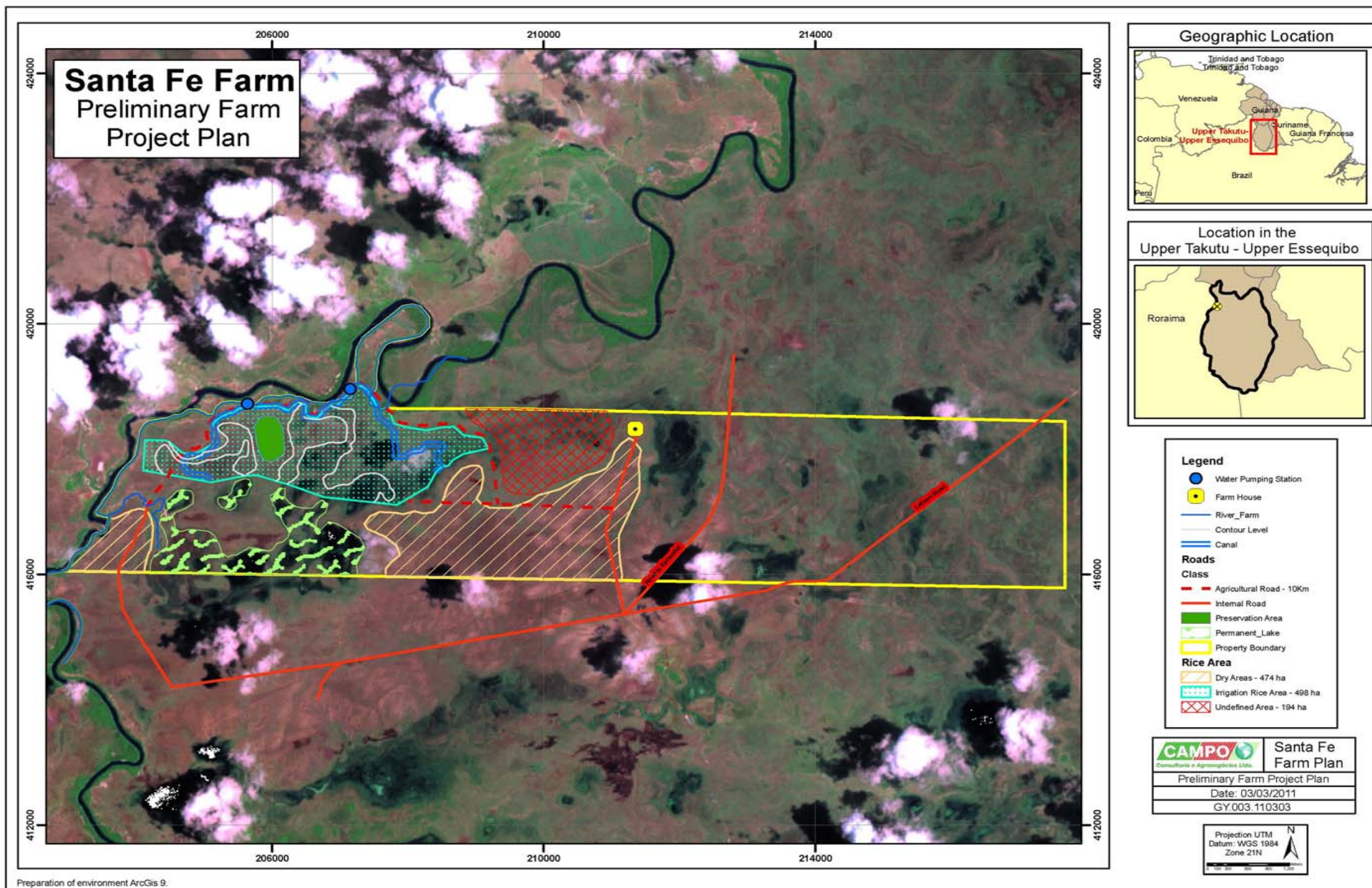


Figure 9: Preliminary Layout of the Site

### 2.4.3 Land Preparation

The farm development will commence with clearing of the natural shrubs which currently grow on the targeted cultivation areas. These shrubs commonly referred to as “wild cashew” and “sand paper” shrubs, are not present on all sections of the land, and in the areas where they are present they exist in varying degrees of density. Shrub clearing is a delicate exercise and due care will be taken during this process to minimize the disturbance of the top soils. This shrub clearing process has been developed to a highly scientific level by Brazilian farmers who clear these shrubs with minimal top soil disturbance. The pictures below show shrubs removed from the soil to facilitate rice cultivation in Normandy, Brazil. Note the minimal disturbance to the other vegetation and topsoil.



**Figures 10 and 11: Shrubs Removal at Normandy, Brazil**

The Santa Fe farm will also employ minimal and no till soil preparation techniques in keeping with the technical advice offered by EMBRAPA and NARI. Given the low fertility nature of the soils every effort will be made to retain their natural, positive characteristics while reducing the need for artificial enhancements. It is established that varying levels of limestone must be applied to all cultivation areas in order to bring the soil pH to the desired levels for cultivation of the various crops and grasses. The tillage technique to be used is a part of a Brazilian soil conservation system which involves the planting of crops where soil movement is limited only to the crop row, without preparing the soil and is based on the addition of residues (coverage) and the adoption of a crop rotation system. The picture below shows an area of land prepared for rice cultivation at Normandy, Brazil.



**Figure 12: Land Prepared for Rice Cultivation at Normandy**

Testing by NARI of the soil on the property to date has indicated a pH range from 3.7 to 6.5 with an average in the region of pH 4.5. The acidity level of the soil will not support commercial crop production without intervention. The consultants have concluded that lime and other nutrients need to be added to the soil to allow crop production. For cowpeas, soya and grass it is estimated that one (1) ton of lime will be added per hectare. For rice, it is estimated that 2.5 tons will be added per hectare. NARI has indicated that for liming to be effective it must be applied at least six months prior to cultivation. Since Guyana has no natural source of lime this product will have to be imported from countries such as Venezuela.

#### **2.4.4 Farm Infrastructure**

The Santa Fe Farm land model will require the use of water from the Ireng River to irrigate large sections of the farm land, especially the area under rice cultivation, during the prolonged dry season. The land will be irrigated by using large pumps to move water from the Ireng River to various sections of the land via canals. A network of canals will be constructed to facilitate the irrigation and drainage of the land. The canals will be small ditches dug into the land, as seen in the pictures below. The same system is currently being utilized across the border in Brazil. The pictures below show the current practices in Normandy, Brazil.



**Figures 13 and 14: Pumping Water from the Ireng River to Irrigate Rice**



**Figure 15: Irrigation Channel along Rice Field**

**Figure 16: Irrigation Channel under Construction at Normandy**

A network of access roads will be constructed on the farm to facilitate the movement of machinery, equipment, inputs and personnel to the various sections of land under cultivation and

the pasture. The road will be a basic savannah road, 4 meters – 5 meters wide, covered with between 15cm to 25cm of compacted laterite. Figure 17 below shows a road within the rice growing area in Normandy, Brazil. In addition, several kilometers of fence, as appropriate, will be installed to ensure the safe and secure pasturing of the farm's cattle and small ruminants. A typical fence used in Normandy, Brazil, is shown in Figure 18 below.



**Figure 17: Roads within Rice Cultivation Areas**



**Figure 18: Fence currently being used at Normandy for Livestock Areas**

The old Santa Fe Ranch compound, located in the north central section of the farm site will be developed to house the farm's residential and recreational facilities. Modern, well equipped housing accommodation will be provided for all management and support staff. Potable water, electricity, plumbing and on site "medics" service will be accessible to all farm personnel. A machinery and equipment storage shed and a fully equipped workshop will be developed on site. All farm machinery and spares will be housed in this compound, ensuring timely repairs and maintenance. The farm infrastructure are central to the strategic operation of the property, supporting administration functions, surveying and data collection, machinery maintenance, raw materials and production. Below is a description of the main facilities.

- **Administrative Office:** This consists of the administrative and financial unit of the farm. The office will have meeting rooms, human resources, financial, managerial and auxiliary staff in order to keep the management of the farm organized and efficient.
- **Ancillary Professional Accommodation:** This unit will operate as a building to house support staff who are experienced in operational, technical and administrative aspects of the farm and are there to train local professionals and workers who are to remain full time in the venture.
- **Drying and Storage Facility for rice, cow peas and soya beans:** Since almost all of these produce will have to be dried and stored for a period of time facilities will have to be provided to allow for this. Facilities will include administrative areas, pre-classification, operating rooms and control scales, machines, dryers and storage silo. Related equipment shall consist of vertical conveyors, horizontal belt conveyors, cleaning machines, dryers and storage silos. Three silos of 45,000, 20,000 and 10,000 bag capacity for drying and storage of rice, soya beans and cow peas respectively.
- **Storage of Fertilizers:** Would be designed to store fertilizer in a manner that guarantees the good quality and cater for the quantity demanded during the agricultural cycle planned for each year.
- **Warehouse of Agrochemicals:** Would be designed to store in conditions stipulated for

storage to ensure safety and avoid accidents at work and cater for the quantity of products demanded during the agricultural cycle planned for each year.

- **Mechanization Center:** The mechanization services unit is considered the main support of the production of rice, soya beans, cow peas, beans and pasture. This facility will be responsible for the maintenance and parking of machinery, agricultural implements and all related equipment.
- **Fuel Storage:** Fuel will be sourced from Georgetown, Brazil or Venezuela and transported to the site by fuel tankers. The fuel will be stored in above ground storage tanks with the necessary secondary containment.
- **Power Supply:** A 500 kVa generator will be used to supply the farm with power.

The location of the internal roads, irrigation channels and farm compound can be seen in Figure 9.

## 2.5 Markets

The reality of the existing infrastructure links between the Rupununi and the Guyana coast limits Santa Fe's initial potential markets to Brazil and Venezuela. Therefore, the Phase 1 investment thrust is based on the prospects that exist in these markets.

In Roraima State in Brazil, there exists the capacity to absorb all of SFI's unprocessed rice (paddy) production. The rice mills in Roraima State currently have 60% excess installed capacity when measured against the land currently under cultivation in the State. Recent successful initiatives spearheaded by the Government of Guyana have resulted in the access to the Venezuelan market for Guyana's processed and unprocessed rice (paddy). SFI expects that this access will continue and in fact expand to accommodate sales of SFI's rice production.

Unprocessed soya bean and cow peas production in Phase 1 will be sold to the established markets in Brazil and Venezuela. In Brazil, soya beans are processed and the oil is exported to markets throughout the world. As an export commodity, soya bean prices tend to be erratic at times, due to circumstances totally unrelated to the producer's home country (in this case Guyana) or the processors domestic market (in this case Venezuela or Brazil). Notwithstanding the obvious price risk involved in soya bean cultivation, SFI will prudently pursue its cultivation in Phase 1, as a part of the Integrated Farm model being implemented.

Cow peas have large "culture influenced" markets in both Brazil and Venezuela. All varieties of cow peas should find established packaging and distribution networks in both countries. While prices for cow peas fluctuate from time to time, they are generally stable given the domestic nature of the markets.

In Phase 1, cattle and small ruminants will have to be sold live into the Brazilian and Venezuelan markets. Since there is an absence of an acceptable abattoir facility in the Rupununi this is the only viable option available at this time. The abattoir in Boa Vista will provide the slaughtering facility for the company's cattle and small ruminant production. Prices for these products are considered stable given that they are sold exclusively into the Brazilian and Venezuelan domestic markets.

## 2.6 Management and Staffing

The Santa Fe Inc. farm development will require a management complement of three (3) persons, consisting of a Farm Manager, an Accountant and a Maintenance and Facilities Manager. In phase 1, it is anticipated that a total of thirty (30) staff will be employed in the farm's

operations. During the land preparation, construction and farm start up phases this number will be closer to fifty (50) persons employed.

Due to the pioneering nature of this integrated farm project, it is expected that many key management and staff positions will have to be filled initially by personnel not currently residing in Region 9. SFI is committed to upgrading the skills of locally hired personnel in the shortest possible time to ensure that they will have equal access to key positions within the company.

Efforts will be made to establish a formal apprenticeship and training program for qualified Region 9 residents employed by SFI. This initiative will be pursued in conjunction with the Guyana School of Agriculture, NARI and the Linden and Georgetown Technical Institute.

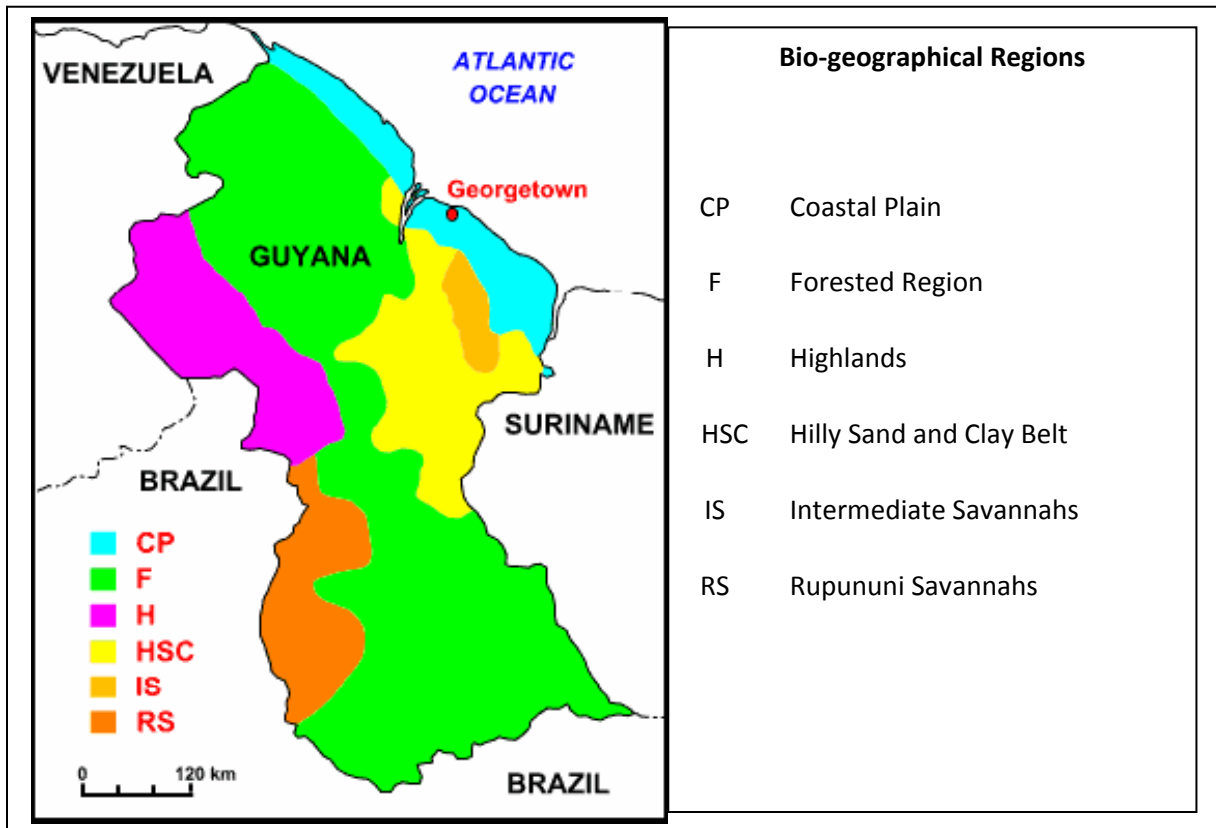
### 3.0 PROJECT ENVIRONMENT

#### 3.1 Physical Environment

##### 3.1.1 General Geography

Guyana is located in the north eastern corner of South America between 1° 10' and 8° 33' north latitude 56° 20' and 61° 22' west longitude. It is bordered on the north by the Atlantic Ocean, on the east by Suriname, west and north-west by Venezuela and south and south-west by Brazil. The country is one of the eight countries that shares the vast Amazon River Basin and is the westernmost of the three countries that is part of the northeastern shoulder of South America along the Atlantic coast commonly known as the "Guianas". The Guianas constitute only a part of a phytogeographic or natural area called the Guiana Shield (GAHEF, 1992).

The country is divided into ten (10) administrative and five (5) main bio-physical regions. The bio-geographical regions are the Coastal Plain, the Savannahs, the Pre-Cambrian Lowland Region, the Southern Upland Region and the Pakaraima Highlands (Daniel, 1990). These biophysical divisions are more familiarly referred to as the coastal plain, the highland region, the forested region, the hilly sand and clay belt, the Rupununi savannahs and the intermediate savannahs and are shown in the figure below.



**Figure 19: Bio-geographical Regions of Guyana**

The Project area is located within the North Rupununi savannahs. The interior savannahs account for almost 11% of the country's total area and are vegetated mostly by grasses, scrub and low trees. The savannahs extend in the west from the southern part of the sandy rolling plains to the Rio Branco savannahs of Brazil. The main grasslands are known as the Rupununi savannahs and the area is characterised by intense dry periods. Two (2) different savannah

types may be distinguished within the Rupununi region: the north savannah, associated with a deep rift valley; and the south savannah, associated with the Pre-Cambrian plain, and interspersed with rock formations up to 900m. The forested highlands make up approximately 64% of Guyana's landmass. There are four major mountain ranges in this region; Kanuku, Pakaraima, Imataka and Acarai. The interior is very sparsely populated, principally by native Amerindian communities.

### 3.1.2 The Savannah Environment

The Rupununi Savannahs, named after the Rupununi River, is among the largest untouched ranges of savannah lands in the world. This region is located in the south-western part of Guyana between the Rupununi River and the Brazilian border. The area is marked by flat grasslands and mountainous terrain.

The Rupununi savannah covers approximately 13,000km<sup>2</sup> and is divided into a northern and a southern part by the Kanuku Mountains. The Rupununi Savannah is in fact an extension of the larger Rio Branco Savannahs of Brazil. In terms of phytogeography the area belongs to the Amazon region. The drainage system of the Rupununi Savannah is usually unable to carry a high volume of surface runoff. As a result most rivers flood in the wet season. In a few places ground water drainage is impeded by clay and ponds and lakes persist for several months, thus giving rise to permanent and seasonal lakes<sup>5</sup>.



**Figures 20 - 23: The Savannah Environment on the Property**

<sup>5</sup> This description in the second paragraph is based on Jansen-Jacobs and ter Steege (2000).

### 3.1.3 Geomorphology and Soils

The geology of the North Rupununi region is complex due to its age. Early plutonic and volcanic rock formation, regional metamorphism, rifting, uplifting, and oscillating periods of sedimentary deposition and erosion have shaped the area into a patchwork landscape of varying geological characteristics. These processes have fundamentally influenced topography, soils, water flow, as well as the potential for commercial activities such as mining, agriculture and timber production. The North Savannahs is a product of block fault line that bisects the Guiana Shield. Continual throw down, subsidence and uplifting combined with oscillating changes in sea level created a series of sedimentary deposits that consolidated into a lacustrine and/or shallow marine environment. These sediments rest atop the Apoteri volcanics and consist of recent silts, clays, loams and sands with some localized conglomerates (perhaps brought from the Roraima formation). In a 2,600km<sup>2</sup> north-central portion of this rift valley (e.g. near Karanambo Ranch) standing water formed a thick duricrust of laterite almost 35 million years ago (the Nappi laterite formation) that remains a formative feature of the area. The soils of the Savannahs differ from that of the rainforest region because of their low mineral nutrients retention and storage resulting in soils of low fertility. As a result, the flora observed in the North Rupununi is specifically adapted for the existing environment.<sup>6</sup>

NARI conducted a soil survey across the entire property to determine the soil type. Four (4) main groups of soils present within the property were identified from the survey. Generally, the area consists of pockets of sandy clay, clay and sandy clay loam. The soil types identified from the survey are:

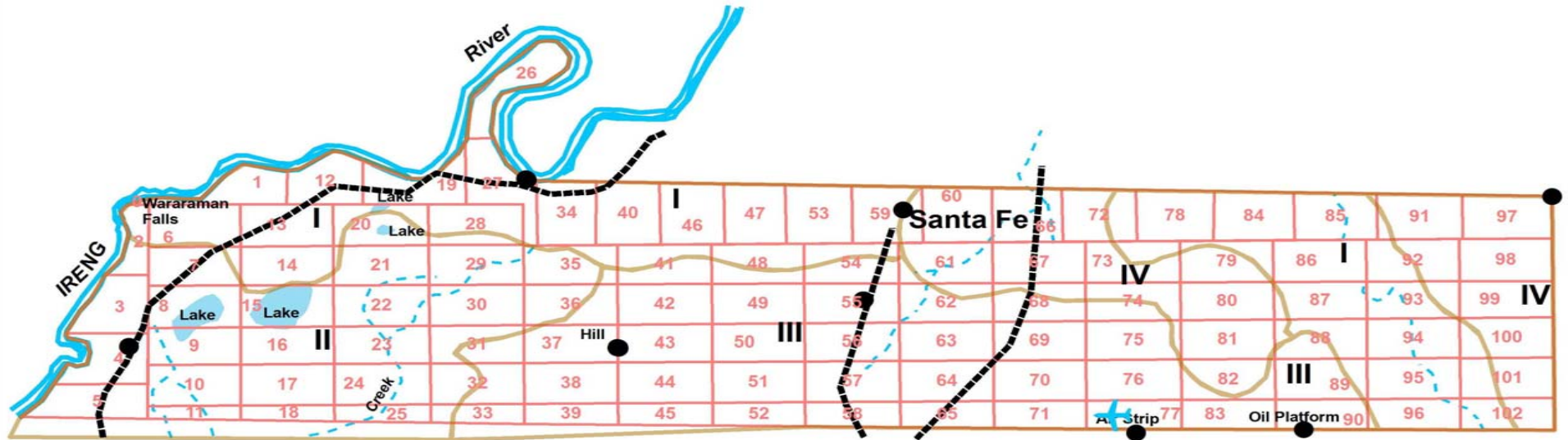
- Greyish brown sandy clay over brown to yellowish brown sandy clay loam soils with reddish yellow and yellowish red mottles.
- Greyish brown to dark gray sandy clay loam over light yellowish brown to reddish brown sandy clay soils with brownish yellow mottles.
- Grey to dark grey clay over yellowish red to reddish yellow clay soils with strong brown mottles.
- Light brownish grey to very dark grey over light olive grey to grey clay soils with reddish yellow mottles.

The figure below shows the distribution of the four soil types within the property.

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<sup>6</sup> Taken from the Management Plan for the Iwokrama Forest, June 2009

## Soil Types within the Project Area



### Soil Units of the Santa Fe Holdings Rupununi Savannahs

- I-Grayish brown sand clay over brown to yellowish brown sandy clay loam soils with reddish yellow and yellowish red mottles.
- II-Grayish brown to dark gray sandy clay loam over light yellowish brown to reddish brown sandy clay soils with brownish yellow.
- III-Gray to very dark gray clay over yellowish red to reddish yellow clay soils with strong brown mottles.
- IV-Light brownish gray to very dark gray clay over light olive gray to gray clay soils with reddish yellow mottles.

#### **Legend**

- Tracks\_Road
- Soil Units
- Soil Class
- Main River
- Creek
- Lake

*Note: Topography for the Santa Fe area can be seen on 1:50,000 Map Sheets 59NE&SE*

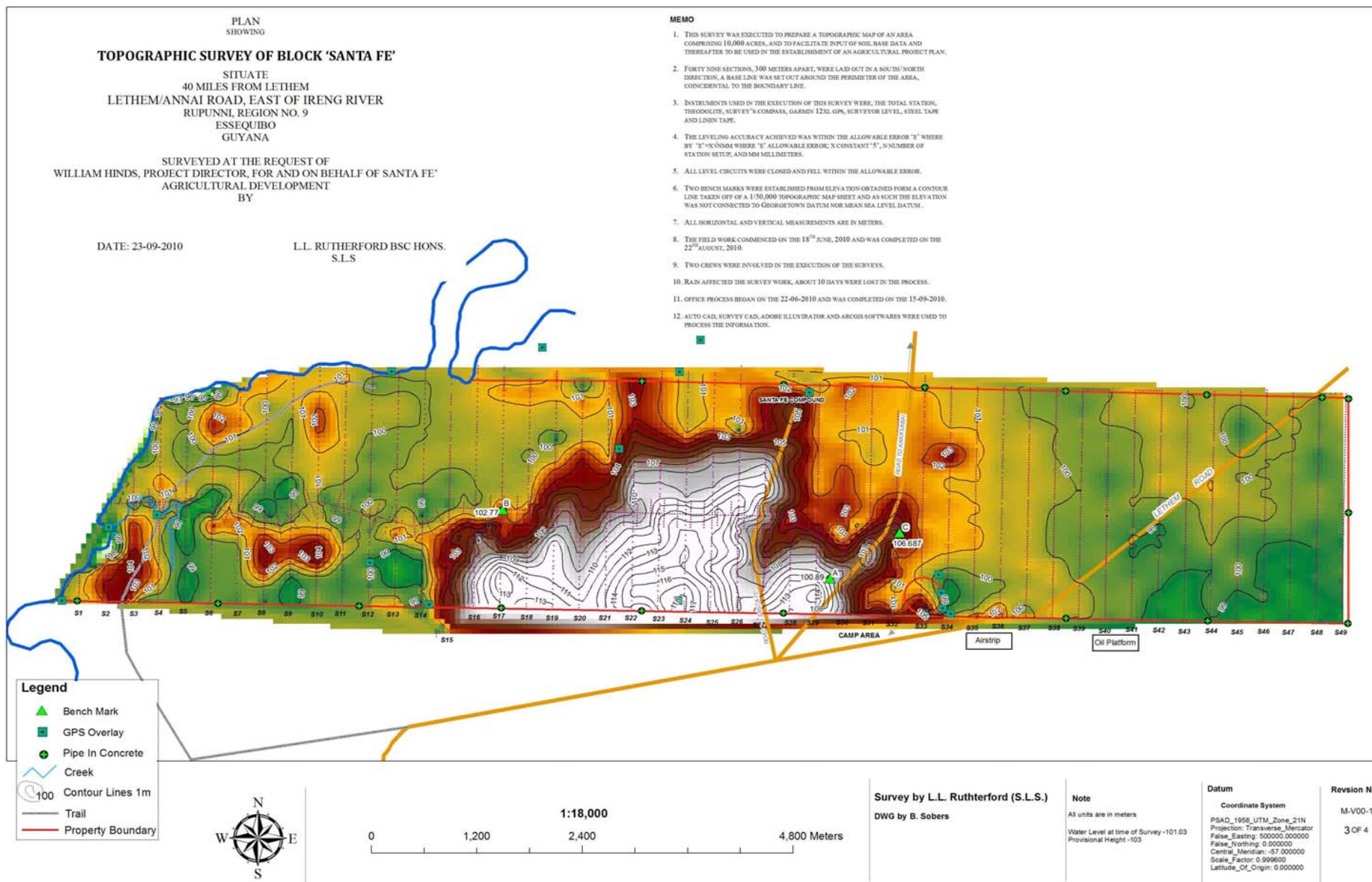


**Figure 24: Soil type within the Project Area**

### **3.1.4 Topography**

Santa Fe Inc. commissioned a detailed topographic survey to determine the topography of the project area. This survey was conducted in June to August 2010 and covered the entire property. The topography of the project area based on the survey conducted can be observed in Figure 25 below.

The project area is generally flat, with some slightly undulating sections. The central areas, especially to the south of the property are highest. There are a few additional high portions, especially on the western section. The eastern section of the property is slightly lower. Some of the lowest sections are usually flooded during the rainy seasons while some are flooded all year round. The farm plan will be developed based on the topography of the area, with activities occurring where it is more suitable.



### 3.1.5 Climate

To gain an understanding of the climate experienced by the project area weather data from the Hydrometeorological Division were utilised. Data from stations at Lethem, Pirara and Annai was reviewed and analysed. Data from the Lethem station available is for the period 1974 to 2009 while at Pirara is from 1995 to 2008 and at Annai from 1996 to 2003.

In contrast to central and north Guyana which experiences two dry and two wet seasons, the Rupununi area experiences only one wet and one dry season. The annual rainfall in the Rupununi Savannah is between 1500-2000 mm per year, of which 70-80 % falls during the wet season from May-August. Rainfall increases towards the south because of the orographic uplift caused by the Acarai Mts.

The savannah areas have the highest amount of sunshine hours of the country, experiencing 8 hours per day.

The mean annual daily temperature is 27.5 °C. The average minimum temperature is 23.8 °C and the maximum average is of 33.2 °C.

### 3.1.6 Hydrology and Drainage

A series of creeks and rivers drains the North Rupununi Savannahs. These include the Rupununi, Rewa, Essequibo, Ireng and Takutu Rivers. However, the drainage system of the Rupununi Savannahs is unable to carry a high volume of surface runoff. As a result most rivers flood in the wet season. In a few places ground water drainage is impeded by clay, and ponds and lakes persist for several months (Hills 1969).

At Santa Fe, the project area consists of both lowlands and higher areas. Some of the lowland areas are usually flooded during the rainy season while some areas remain flooded during the dry season. As a result, there are a few ponds and small lakes within the project area. During the wet season the seasonal ponds are fully extended and they dry up during the dry season. The permanent ponds have water all year round but there is a gradual decline in the volume of water. One of these ponds can be observed in Figure 30 below.

The project area is drained westward into the Ireng River. This River in the vicinity of the project site can be observed in Figure 28 and 29. Drainage is facilitated by the Passarina Creek. This is a small seasonal creek which drains the western section of the property, including some of the wetlands, into the Ireng River. The creek can be observed in Figures 26 and 27.



**Figures 26 and 27: Passarina Creek**



**Figures 28 and 29: Ireng River**



**Figure 30: A Pond within the Property**

The general drainage pattern of Santa Fe and the surrounding areas can be observed in the figure below.

## Map Showing Drainage Pattern of Santa Fe Area

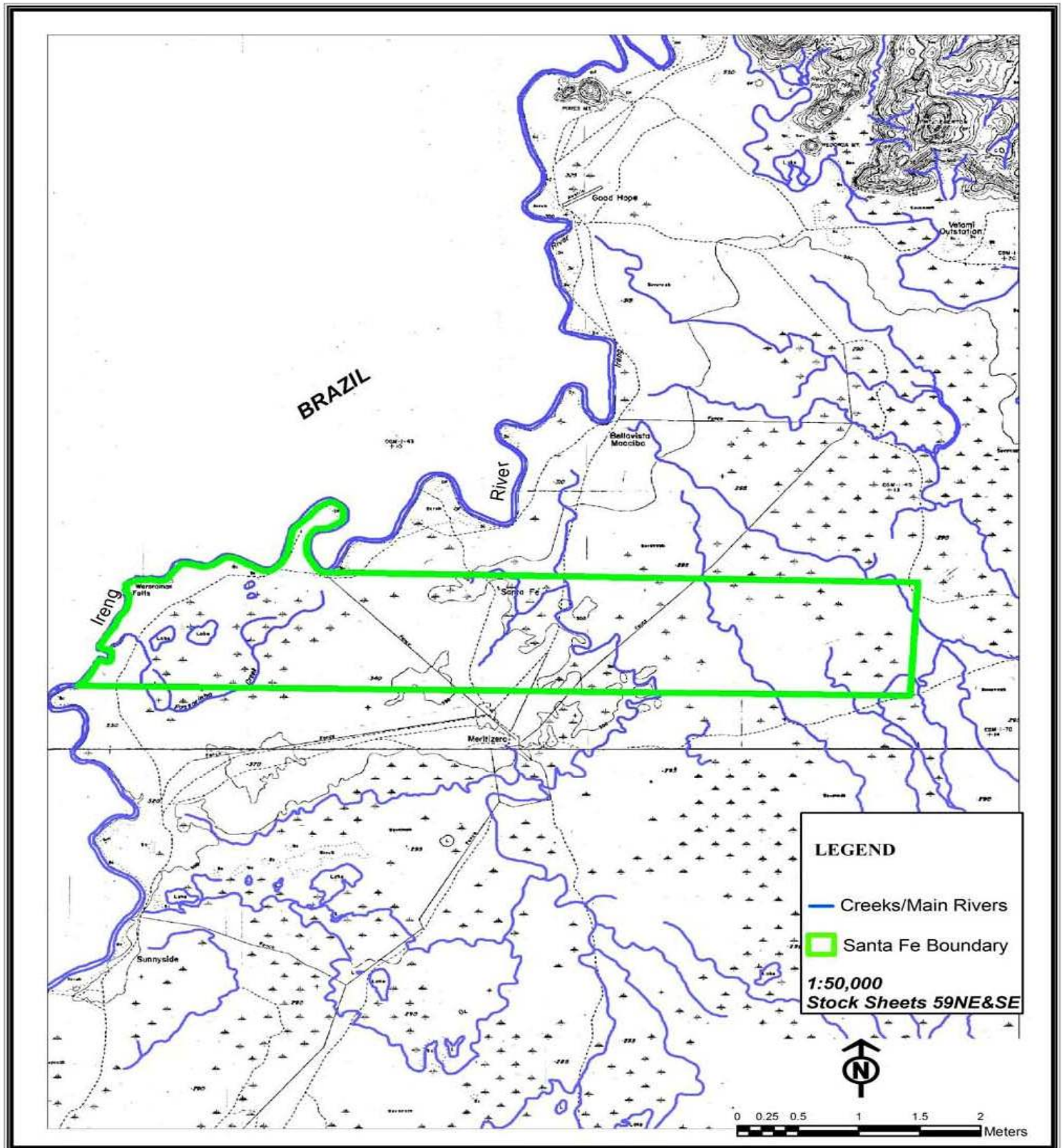


Figure 31: Drainage Pattern around the general project area

### 3.1.7 Surface Water

Surface water were collected and analysed to determine the quality of surface water within the project environment. Three (3) samples were collected. These samples were collected from the Passarina Creek which drains the property and from the Ireng River, upstream and downstream of the property. The locations where the samples were collected are identified on the map below as the SW locations. These locations were chosen since, if there any impact on water quality by the project during operation, the impacts can be detected by testing these locations. As such, it was important to confirm the background quality of water. These locations should become permanent monitoring sites during project implementation. A description of the surface water sample locations is included in the table below. At the time of sampling the weather condition was fine, with no rainfall.

**Table 2: Description of surface water sample locations**

Sample ID	Coordinates	Location	Date Sampled	Time Sampled
SW1	21N 0210586 UTM 0420401	Ireng River close to the northern boundary of the property	January 06, 2011	13:30 hrs
SW2	21N 0203618 UTM 0416834	Ireng River close to the southern boundary of the property	January 06, 2011	11:05 hrs
SW3	21N 0204141 UTM 0417106	Passarina Creek upstream of the mouth	January 06, 2011	11:20 hrs

The map below identifies the locations from where the surface water samples were collected.

## Map Showing Surface Water Sampling Locations

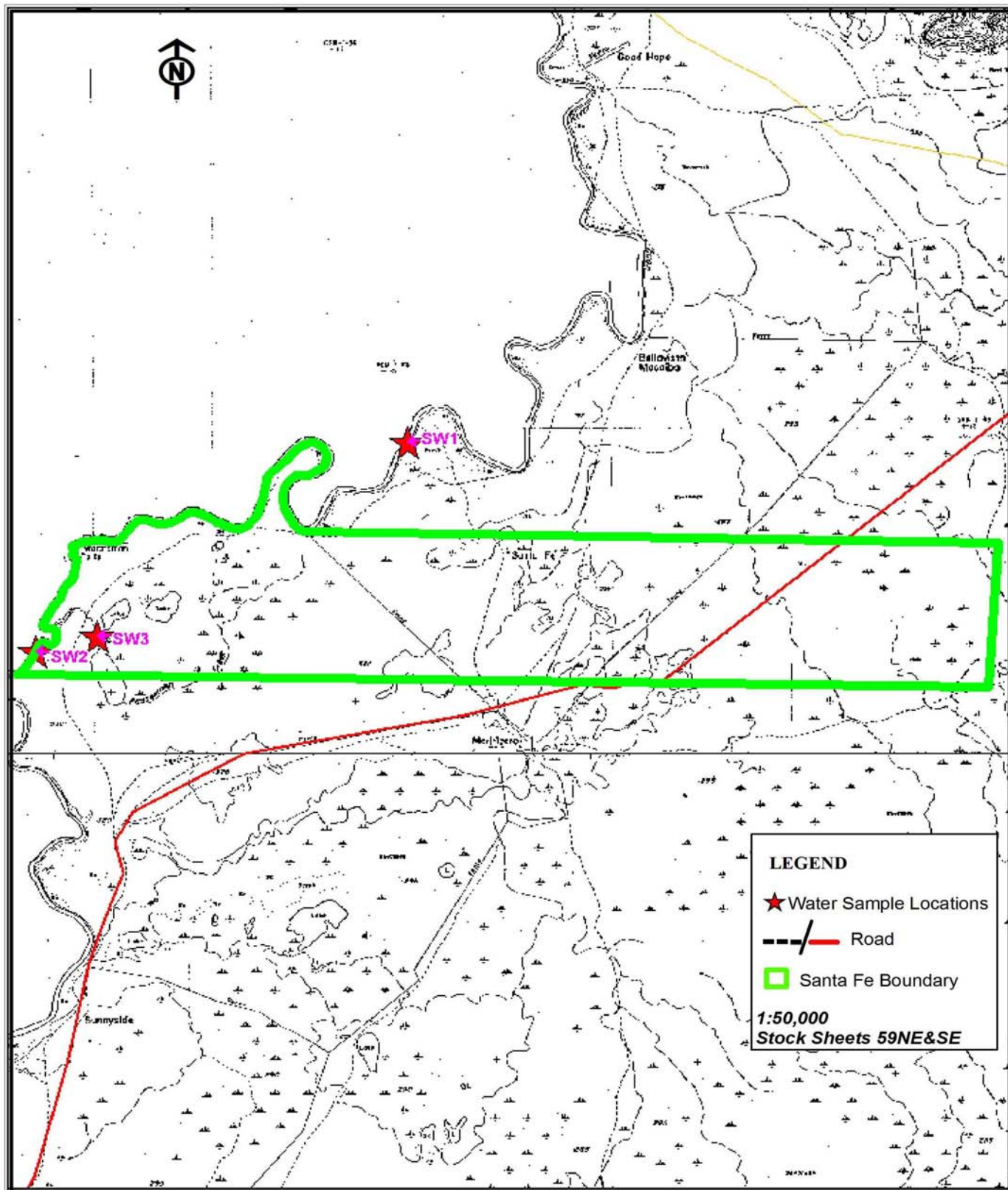


Figure 32: Surface water sample locations

One sample was collected for each location. Activities to severely affect the water quality within the Santa Fe area were limited. As such, the quality of water draining off the property via the Passarina Creek was expected to be good. The Ireng River forms the border between Guyana and Brazil. On the Guyana side, activities to affect the water quality are again limited. However, on the Brazilian side there is large scale commercial agriculture which can contribute to a decrease in the quality of the water in the River. The samples collected were analysed for several parameters which are important and generally used to determine the quality of water such as turbidity, total metals, conductivity, total suspended solids, dissolved oxygen, total dissolved solids and oil and grease. In the absence of a national standard on background water quality comparison was made with the GNBS, GYS 262:2004 Specification for Drinking Water and internationally acceptable limits from the United States Environmental Protection Agency, 1985 and the World Bank, 1984. These limits are included in the results table. No nitrates, total suspended solids or oil and grease were detected. All the other parameters were well within the acceptable range. For the SW 3 location the turbidity level was just 1.6 NTU above the acceptable level for drinking water and is not a concern. This slightly elevated level may have been a result of sampling close to the River Bank. Turbidity levels for the same water body further downstream were 8.7 NTU, within the recommended limit.

The results of the analysis indicated that the existing water quality of the area is typical of the water quality for similar type of areas within Guyana. The results indicated very low level of contamination and the quality reflected the natural water quality of similar environments across Guyana. Recent activities by Santa Fe Inc, including the establishment of the base camp and surveying activities have resulted in minimal disturbance/effects on the water quality. In addition, the analysis conducted indicated that the water quality of the Ireng River is good, which suggests that the agricultural activities currently being conducted in Normady, Brazil, for in excess of twenty (20) years, and which is similar to the activities proposed by SFI, has not negatively impacted the water quality in the River. As was previously stated, the Ireng River is also used by farmers engaged in similar activities in Brazil.

Table 3 below outlines the water quality in the project environment. The water quality analysis certificate is attached as Appendix D.

**Table 3: Results of the surface water quality analysis**

Sample ID	Parameters													
	pH 6.5-8.5	EC <sub>w</sub> mS/cm	DO (mg/l) ≥ 5.0	TDS (mg/l) 200	TSS (mg/l)	SO <sub>4</sub> <sup>2-</sup> (mg/l) 400	Cu (mg/l) 1.5	Fe (mg/l) 1.0	NO <sub>3</sub> -N (mg/l) 100	Zn (mg/l) 15	Al (mg/l) 0.2	Oil & Grease 0.03	COD (mg/l) < 250	Turbidity (ntu) 10
SW 1	6.18	0.02	7.26	12.0	ND	0.89	0.019	0.15	ND	0.016	0.154	ND	8	2.8
SW 2	6.58	0.02	7.19	10.7	ND	1.18	0.017	0.15	ND	0.015	0.230	ND	24	8.7
SW3	6.48	0.03	7.47	17.7	ND	0.83	0.014	0.09	ND	0.020	0.220	ND	8	11.6

**Key**

EC<sub>w</sub> - Conductivity

SO<sub>4</sub><sup>2-</sup> - Sulphates

Fe – Iron

ND –Not Detected

DO - Dissolved Oxygen

NO<sub>3</sub>-N - Nitrates

Zn – Zinc

TDS - Total Dissolved Solids

COD – Chemical Oxygen Demand

Al – Aluminum

TSS - Total Suspended Solids

Cu – Copper

O&G - Oil & Grease

**3.1.8 Noise**

Noise measurements were taken within the property to determine the current decibel levels. Readings were taken at two (2) locations. The location referred to as N1 is around the central area of the property while the location referred to as N2 is within the western portion of the property, close to the Ireng River. The noise levels recorded were relatively high for an undisturbed environment. This high decibel level was a result of strong wind which caused the rustling of tress and grasses. The location and noise levels are outlined in the table below.

**Table 4: Noise levels within the Santa Fe Property**

Location ID	Coordinates	Date Sampled	Time Sampled	Decibel Level
N1	21 N 0209007 UTM 0417136	January 06, 2011	10:30 hrs	50-75
N2	21 N 0212641 UTM 0417705	January 06,2011	11:00 hrs	47-65

The noise measurement locations are shown on the map below.

# Map Showing Noise Measurement Locations

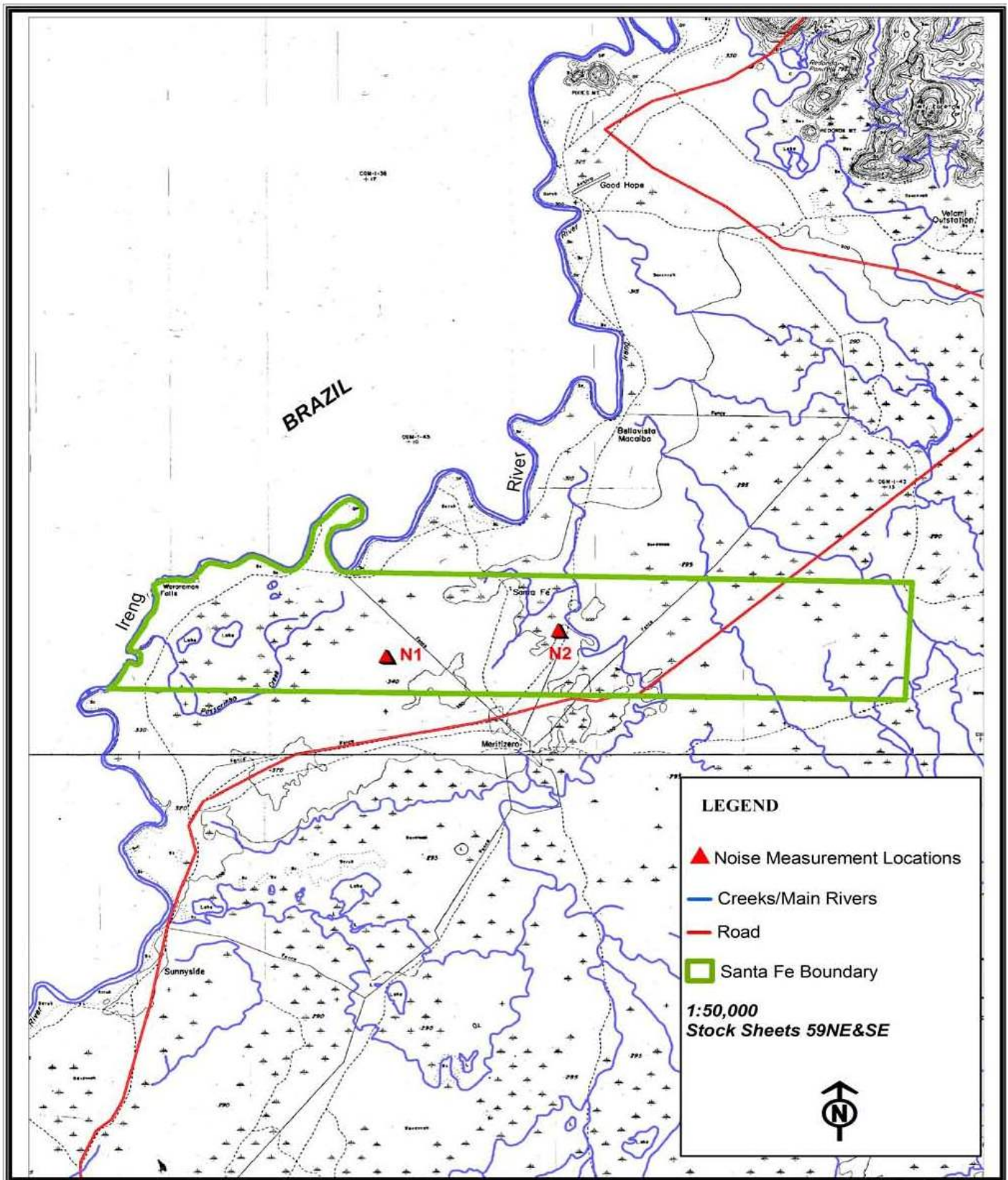


Figure 33: Location of the Noise Measurement Points

### 3.2 Biological Environment

To understand the biodiversity of the project area a rapid biodiversity assessment was carried out. The purpose of the assessment was to:

- Conduct a Baseline Assessment of the Biodiversity of the area and assist in the preparation of an Environmental and Social Management Plan for the proposed operations.
- Collect biodiversity information on the proposed project site.
- Prepare a Biodiversity Assessment Report for Santa Fe. Inc.

#### 3.2.1 Methodology

A site visit was undertaken to the Santa Fe. Location to observe the existing situation and a visit was made to Normandy in neighbouring Brazil to observe a similar operation. This site visit was undertaken to obtain information and field data to conduct a biodiversity assessment and a visual Impact Assessment.

In conducting the analysis to identify potential environmental impacts on the existing biodiversity this exercise was guided by the proposed activities outlined in the project summary and discussions with various project personnel. In an effort to determine the level and significance of any identified impact a number of factors were considered. These included, but were not limited to the following:

- Likelihood of the potential impact occurring
- The magnitude of the potential impact
- The temporal variation of the potential impact
- The level of reversibility or irreversibility of the potential impact
- The potential for the mitigation of the potential impact

##### 3.2.1.1 Impact Assessment Descriptors

Both direct and indirect impacts were considered. Potential impacts before, during construction and during the operation of the project were considered. During these phases the potential exists for some activities to impact negatively on the biota of the environment. Here the relevant environmental components were examined. In the assessment of potential impacts the following were useful terms and criteria that were used for the description of the outcome of the assessment of the criteria. Table 5 below gives the impact descriptors used.

**Table 5: Impact Descriptors**

DESCRIPTOR	REPRESENTATION
Likelihood of an impact occurring	High (H) Medium (M) Low (L)
Spatial impact and influence	Local (Lo) Regional (Re) National (Na)
Temporal influence and significance	Short Term (ST) Medium Term (MT) Long Term (LT)
No potential impacts	None (N)
Impact resulting from project operation	Direct (D) Indirect (ID) Direct impacts were considered to be of greater significance
Availability of mitigation measures	Mitigation measure available (MA) Mitigation measure not available (MNA)
Possibility of mitigating impact over time	Reversible (R) Irreversible (IR)
Significance of impact determined as a	

### 3.2.1.2 Biological assessment

The biological assessment was conducted in stages:

- |         |  |
|---------|--|
| Stage 1 | A field reconnaissance visit was conducted to understand and become familiar with the project site and to make field observations regarding biodiversity and ecosystem components. |
| Stage 2 | A desktop review and analysis of the available literature was undertaken to better understand the existing ecosystem and biodiversity components.                                  |
| Stage 3 | Analysis of the data collected to determine the potential impact on existing flora and fauna.  |
| Stage 4 | Preparation of the Biodiversity Assessment report  |

### 3.2.2 Results of Investigation

#### 3.2.2.1 Flora

Tables 6 – 9 gives a summary listing of some of the main floral species that are present in an around the project area. It was observed that the species present were typical of flora found in savannah areas.

Based on the types of floral species that were observed it was determined that the major sphere of influence of the project will be in the savannah grassland environment, the 'bush islands' and with very little (minimal) influence on the riverine environment.

A regular activity observed in the savannah is the burning of grass to enhance growth for grazing cattle. Fanshwa (1952) classified the fire-climax savannah vegetation of the savannah as the *Curatella-Brysonima* association, which contains characteristic species such as: *Curatella americana*, *Byrsonima crassifolia*, *Byrsomia coccolobifolia*, *Antonia ovata*, *Palicourea rigida*, *Tibouchina aspera* and *Amasonia campestris*.

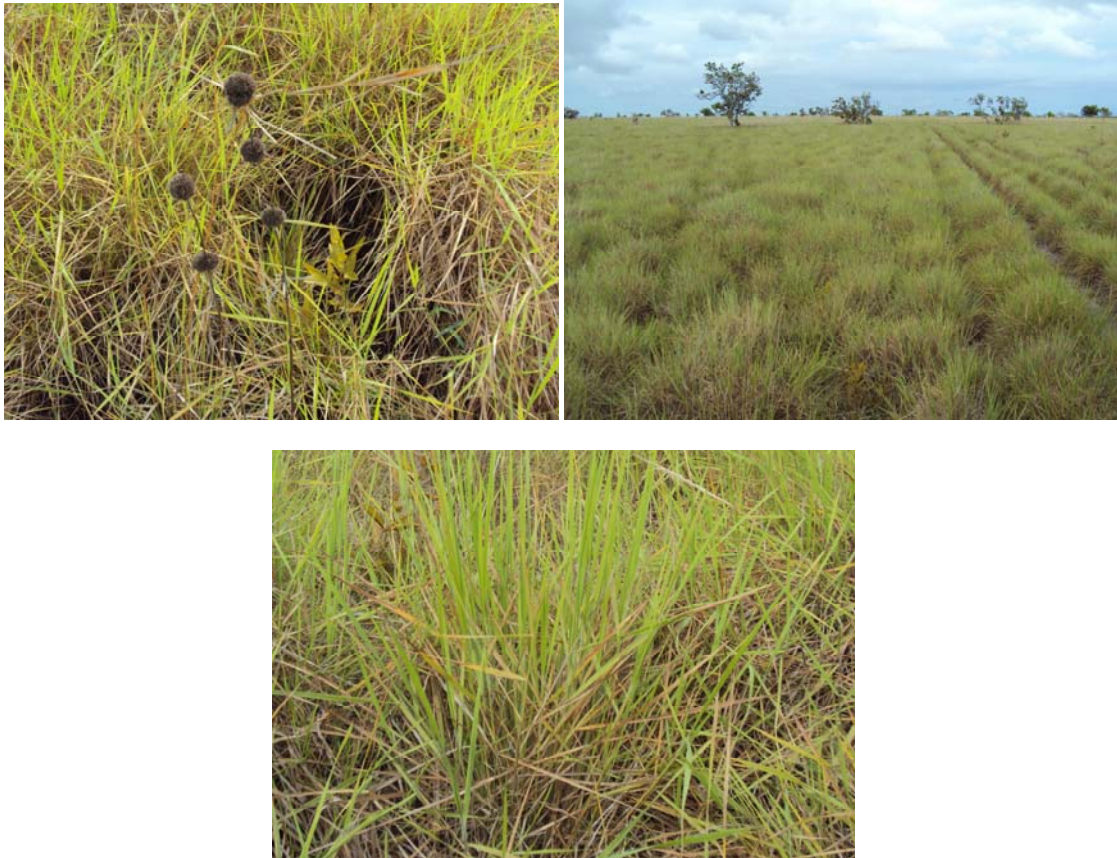


**Figure 34: Emerging flora in burnt out savannah**

The main grasses present in the project area belong to the genera *Trachypogon*, *Paspalum*, *Axonopus* and *Andropogon*. The main sedges in the project area belong to the genera *Rhynchospora* and *Bulbostylis*.

**Table 6: Grass species present at the project location**

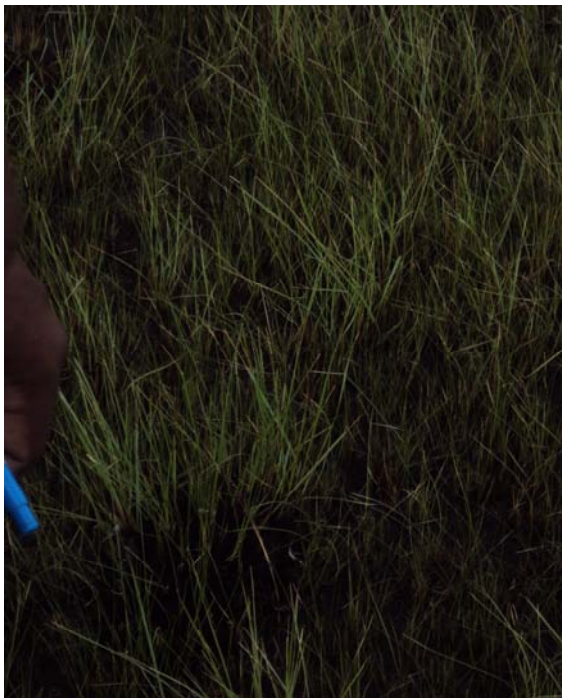
<b>FAMILY</b>	<b>GENUS</b>
Poaceae	<i>Trachypogon</i>
Poaceae	<i>Paspalum</i>
Poaceae	<i>Axonopus</i>
Poaceae	<i>Andropogon</i>
Poaceae	<i>Rhynchospora</i>
Poaceae	<i>Bulbostylis</i>



**Figures 35 - 37: Grass in savannah at Santa Fe**

The area also has a number of herbs (Savannah herbs) which tend to grow and flower after substantial rainfall. These include *Schultesia benthamiana*, *Schiekia orinocensis*, *Polygala spp.* *Abolboda pulchella*, *Curculigo scorzonnerifolia*, *Alophia drummondii* and *Cipura paludosa*. Some of the other herbs present in the area have their flowering period induced by fire. These species include *Byrsonima verbascifolia*, *Clitoria guianensis* and *Cissampelas ovalifolia*. A very common parasitic species present in the Savannah area in the project area is *Cassytha filiformes*. Table 7 lists some of the non-grass and sedge species found in the project area. Pictures below show some of the flora at the project environs.





Figures 38 - 47: Flora in the environs of the project site

Table 7: Non-grass and sedge species

FAMILY	SCIENTIFIC NAME
Amarylidaceae	<i>Curculigo scorzonerifolia</i>
Caesalpiniaceae	<i>Chamaecrista hispidula</i>
Convolvulaceae	<i>Merremia aturensis</i>
Fabaceae	<i>Clitoria guianensis</i>
Fabaceae	<i>Indigofera lespedunculatum</i>
Fabaceae	<i>Macroptilium longepedunculatum</i>
Gentianaceae	<i>Schultesia benthamiana</i>
Haemodoraceae	<i>Schiekia orinocensis</i>
Iridaceae	<i>Alophia drummondii</i>
Iridaceae	<i>Cipura paludosa</i>
Lythraceae	<i>Cuphea antisyphilitica</i>

FAMILY	SCIENTIFIC NAME
Orchidaceae	<i>Galeandra stylomisantha</i>
Polygalaceae	<i>Polygala longicaulis</i>
Polygalaceae	<i>Polygala trichosperma</i>
Rubiaceae	<i>Diodia apiculata</i>
Rubiaceae	<i>Sipanea pratensis</i>
Rubiaceae	<i>Perama hirsuta</i>
Scrophulariaceae	<i>Buchnera rosea</i>
Sterculiaceae	<i>Waltheria indica</i>
Turneraceae	<i>Turnera guianensis</i>
Verbenaceae	<i>Lippia origanoides</i>
Xyridaceae	<i>Abolboda pulchella</i>

### 3.2.2.1.1 Bush Islands

Small forest patches, locally called 'bush islands' are found in the project area. These vary in size and are usually found on the more elevated portions of the property. The vegetation types present in the bush islands are typically more woody plant species. Some of the tree species that are found in the bush islands can also be found to a lesser extent in the open savannah but these often occur as solitary trees such as: *Himatanthus articulatus*, *Curatella americana*, *Humiria balsamifera*, *Byrsonima* spp., *Palicourea rigida*, *Tocoyena neglecta* and *Vitex schomburgkiana*. Table 8 lists some of the species associated with the 'bush islands' in the project area.

**Table 8: Vegetation on bush islands in the project area**

FAMILY	SCIENTIFIC NAME
Annonaceae	<i>Guatria schomburgkiana</i>
Annonaceae	<i>Xylopia aromatica</i>
Apocynaceae	<i>Himatanthus articulatus</i>
Boraginaceae	<i>Cordia curassavica</i>
Caesalpiniaceae	<i>Peltogyne paniculata</i>
Caesalpiniaceae	<i>Senna multijuga</i>
Chrysobalanaceae	<i>Hirtella racemosa</i>
Connaraceae	<i>Rourea grosourdyana</i>
Dilleniaceae	<i>Curatella americana</i>
Erythroxylaceae	<i>Erythroxylum suberosum</i>
Fabaceae	<i>Clitoria brachycalyx</i>
Flacourtiaceae	<i>Casearia sylvestris</i>
Humiriaceae	<i>Humiria balsamifera</i>
Malpighiaceae	<i>Byrsonima coccolobifolia</i>
Malpighiaceae	<i>Byrsonima crassifolia</i>
Malpighiaceae	<i>Byrsonima schomburgkiana</i>
Mimosaceae	<i>Pithecellobium roseum</i>
Myrtaceae	<i>Eugenia puniceifolia</i>
Rubiaceae	<i>Isertia parviflora</i>
Rubiaceae	<i>Palicourea rigida</i>
Rubiaceae	<i>Tocoyena neglecta</i>
Sapindaceae	<i>Cupania hirsute</i>
Sapotaceae	<i>Pouteria surumuensis</i>
Verbenaceae	<i>Vitex schomburgkiana</i>

### 3.2.2.1.2 Flora in Ponds and Lakes

There are a number of ponds and lakes in the project area. Some are seasonal while others are permanent. During the wet season the seasonal ones are fully extended and they dry up during the dry season. The permanent ones have water all year round but there is a gradual decline in the volume of water. Except for real aquatic plants there are a number of plants associated with this area. The vegetation in the wet savannahs and in and around these lakes and ponds are typical of vegetation in such environments. Table 9 lists some of the types of vegetation in the lakes and ponds at the project site.



Figures 48 - 51: Some vegetation associated with ponds and lakes in the project area

Table 9: Vegetation associated with the ponds and lakes in the project area

FAMILY	SCIENTIFIC NAME	FAMILY	SCIENTIFIC NAME
Alismataceae	<i>Echinodorus subalatus</i>	Lentibulariaceae	<i>Utricularia foliosa</i>
Alismataceae	<i>Sagittaria rhombifolia</i>	Lentibulariaceae	<i>Utricularia gibba</i>
Burmanniaceae	<i>Burmannia bicolor</i>	Lentibulariaceae	<i>Utricularia simulans</i>
Cyperaceae	<i>Lagenocarpus rigidus</i>	Melastomataceae	<i>Acisanthera uniflora</i>
Euphorbiaceae	<i>Caperonia castanefolia</i>	Melastomataceae	<i>Comolia villosa</i>
Euphorbiaceae	<i>Phyllanthus stipulatus</i>	Menyanthaceae	<i>Nymphoides indica</i>
Euphorbiaceae	<i>Phyllanthus caroliniensis</i>	Onagraceae	<i>Ludwigia inclinata</i>
Mimosaceae	<i>Neptunia plena</i>	Onagraceae	<i>Ludwigia sedoides</i>
Fabaceae	<i>Aeschynomene paniculata</i>	Onagraceae	<i>Ludwigia octovalvis</i>
Lentibulariaceae	<i>Utricularia myriocista</i>	Scrophulariaceae	<i>Benjaminia reflexa</i>
Lentibulariaceae	<i>Utricularia foliosa</i>	Xyridaceae	<i>Xyris jupicat</i>

FAMILY	SCIENTIFIC NAME	FAMILY	SCIENTIFIC NAME
Lentibulariaceae	<i>Utricularia gibba</i>	Xyridaceae	<i>Xyris savanensis</i>

### 3.2.2.1.3 Savannah Fires

The vegetation of the savannah is mostly burned once a year to promote the growth of pasture grasses for cattle and also to keep vegetation around dwellings short. Most of the fires are of human origin. Fire is thus important in the maintenance of the savannahs – it enables fire resistant plants (pyrophytes) to grow and increase in numbers (Jansen Jacobs and ter Steege).



Figure 52: Burnt savannah at Santa Fe

### 3.2.2.2 Fauna

Tables 10 –13 list some of the common fauna found in the project area and environs. The fauna that was identified in the proximity of the project site was typical of those normally associated with savannah type environments. The fauna observed is also typical of areas where human disturbances are evident. Among the fauna present are representatives from the following groups: avifauna, amphibians, reptiles, fishes and invertebrates.

Like the flora, the fauna that was observed was very common and can be found throughout the savannahs. The fauna observed consisted primarily of highly mobile and migratory species. It is therefore important to note that these are species which will adapt easily to changing environments and which will be able to find suitable alternative habitats in close proximity.

Most avian species observed were transient, with a home range spanning the project site and beyond given the similarity of the environment and presence of similar habitats as were observed at the project site.

Table 10: Invertebrates

COMMON NAME	ORDER	FAMILY	SCIENTIFIC NAME
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Agraulis vanillae maculosa</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Anartia jatrophae</i>
Butterfly	LEPIDOPTERA	Pieridae	<i>Apnrisa statira statira</i>
Butterfly	LEPIDOPTERA	Lycaenidae	<i>Arawacus aetolus</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Archaeoprepona demophon</i>
Butterfly	LEPIDOPTERA	Papilionidae	<i>Battus polydamas polydamas</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Biblis hyperia</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Caligo brasiliensis sulanus</i>

COMMON NAME	ORDER	FAMILY	SCIENTIFIC NAME
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Caligo idomeneus idomeneus</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Caligo illioneus oberon</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Callicore astarte</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Dryas iulia</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Eryphanis automedon</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Eueides aliphera</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Historis odius odius</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Junonia evarete zonalis</i>
Butterfly	LEPIDOPTERA	Pieridae	<i>Phoebis argante argante</i>
Butterfly	LEPIDOPTERA	Pieridae	<i>Pyristia venusta</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Taygetis echo</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Taygetis laches</i>
Butterfly	LEPIDOPTERA	Nymphalidae	<i>Tigridia acesta tapojopna</i>
Beetles	COLEOPTERA	Coccinellidae	<i>Adalia sp.</i>
Wasps	HYMENOPTERA	Pompilidae	<i>Cryptocheilus sp.</i>
Ants	HYMENOPTERA	Formicidae	<i>Pheidole sp.</i>

**Table 11: Some avifauna found at the project area**

COMMON NAME	FAMILY	SCIENTIFIC NAME
Great blue heron	ARDEIDAE	<i>Butorides virescens</i>
Black-crowned night heron	ARDEIDAE	<i>Nycticorax spp</i>
White necked heron	ARDEIDAE	<i>Ardea cocoi</i>
Cattle egret	ARDEIDAE	<i>Bulbucus ibis</i>
Blue saki or Blue-grey Tanager	THRAUPIDAE	<i>Thraupis episcopus</i>
Black vulture	CATHARTIDAE	<i>Coragyps atratus</i>
Blue-Grey Tanager	THRAUPIDAE	<i>Thraupis episcopus</i>
Greater Kiskadee	TYRANNIDAE	<i>Pitangu sulphuratus</i>
Crested Bobwhite	ODONTOPHORIDAE	<i>Colinus cristatus</i>
Sharp-tailed Ibis	THRESKIORNITHIDAE	<i>Cercibis oxycerca</i>
Maguari stork	CICONIIDAE	<i>Ciconia maguari</i>
Jabiru stork	CICONIIDAE	<i>Jabiru mycteria</i>
Turkey vulture	CATHARTIDAE	<i>Cathartes aura</i>
Lesser Yellow-Headed Vulture	CATHARTIDAE	<i>Cathartes burrovianus</i>
King Vulture	CATHARTIDAE	<i>Sarcoramphus papa</i>
Pearl Kite	ACCIPITRIDAE	<i>Gampsonyx swainsonii</i>
White tailed hawk	ACCIPITRIDAE	<i>Elanus leucurus</i>
Bicoloured hawk	ACCIPITRIDAE	<i>Accipiter striatus</i>
Savannah hawk	ACCIPITRIDAE	<i>Buteogallus meridionalis</i>
White tailed hawk	ACCIPITRIDAE	<i>Buteo albicaudatus</i>
Yellow headed caracara	FALCONIDAE	<i>Milvago chimachima</i>
American kestrel	FALCONIDAE	<i>Falco sparverius</i>
Common ground dove	COLUMBIDAE	<i>Columbina passerine</i>
Eared Dove	COLUMBINA	<i>Zenaida auriculata</i>
Plain crested elaenia	TYRANNIDAE	<i>Elaenia cristata</i>
Lesser elaenia	TYRANNIDAE	<i>Elaenia chiriquensis</i>
Black-faced tanager	THRAUPIDAE	<i>Schistochlamys melanopsis</i>
Red-shouldered tanager	THRAUPIDAE	<i>Tachyphonus phoenicius</i>
Burnished-buff tanager	THRAUPIDAE	<i>Tangara cayana</i>
Grassland sparrow	EMBERIZIDAE	<i>Ammodramus humeralis</i>
Gray Seedeater	EMBERIZIDAE	<i>Sporophila intermedia</i>
Red-breasted Blackbird	ICTERIDAE	<i>Sturnella militaris</i>
Buff-necked Ibis	THRESKIORNITHIDAE	<i>Theristicus caudatus</i>

COMMON NAME	FAMILY	SCIENTIFIC NAME
Straited Heron	ARDEIDAE	<i>Butorides striata</i>
Lined Seedeater	EMBERIZIDAE	<i>Sporophila lineola</i>
Pinnated Bittern	ARDEIDAE	<i>Botaurus pinnatus</i>
Ruddy-breasted Seedeater	EMBERIZIDAE	<i>Sporophila minuta</i>
Yellow Oriole	ICTERIDAE	<i>Icterus nigrogularis</i>
Yellow-hooded Blackbird	ICTERIDAE	<i>Chrysomus icterocephalus</i>
Orange-backed Troupial	ICTERIDAE	<i>Icterus croconotus</i>
Bearded Tachuri	TYRANNIDAE	<i>Polystictus pectoralis</i>
Black-collared Hawk	ACCIPITRIDAE	<i>Busarellus nigricollis</i>
Burrowing Owl	STRIGIDAE	<i>Athene cunicularia</i>
Eastern Meadowlark	ICTERIDAE	<i>Sturnella magna</i>

**Source of information:** Direct observations and confirmation from “A Field Checklist of the Birds of Guyana” by Michael J. Braun, Davis W. Finch, Mark B. Robbins, and Brian K. Schmidt (Biological Diversity of the Guianas Publication Number 41, 2007)

Most of the animal species that were identified as being present in the area are mainly nocturnal while there are some that are diurnal.

**Table 12: Amphibians, Mammals and Reptiles**

COMMON NAME	FAMILY	SCIENTIFIC NAME
Crapaud	BUFONIDAE	<i>Bufo marinus</i>
Frog	HYLIDAE	<i>Hyla sp</i>
Lizard	TEIIDAE	<i>Tropidurus hispidus</i>
Mongoose	HERPESTIDAE	<i>Herpestes auropunctatus</i>
Ameiva Lizard	TEIIDAE	<i>Ameiva ameiva</i>
Tegu / Salipenta	TEIIDAE	<i>Tupinambis negropunctatus</i>
Red-footed Tortoise	TESTUDINIAE	<i>Geochelone carbonaria</i>
Whip-tailed Lizard	TEIIDAE	<i>Cnemidophorus sp.</i>
Spectacled caiman	ALLIGATORIDAE.	<i>Caiman crocodilus</i>
Black Caiman	ALLIGATORIDAE.	<i>Melanusuchus niger</i>
Green Anaconda	BOIDAE	<i>Eunectes murinus</i>
Neotropical Rattlesnake	VIPERIDAE	<i>Crotalus durissus</i>
Savanna Fox	CANIDAE	<i>Cerdocyon thous</i>
Crab-eating Raccoon	PROCYONIDAE	<i>Procyon cancrivorus</i>
Four-eyed Opossum	DIDELPHIDAE	<i>Metachirus nudicaudatus</i>
Giant Anteater	MYRMECOPHAGIDAE	<i>Myrmecophaga tridactyla</i>
Pygmy anteater	CYCLOPEDIDAE	<i>Cyclopes didactylus</i>
Oncilla	FELIDAE	<i>Leopardus tigrinus.</i>
Ocelot	FELIDAE	<i>Leopardus pardalis melanurus</i>
Proechimys Rats	ECHIMYIDAE	<i>Proechimys hoplomysoides</i>
Capybara	CAVIIDAE	<i>Hydrochoerus hydrochaeris</i>
Agouti	DASYPROCTIDAE	<i>Dasyprocta leporina</i>
Common opossum	DIDELPHIDAE	<i>Didelphis marsupialis</i>
Gracile mouse opossum	DIDELPHIDAE	<i>Gracilinanus emiliae</i>
Brown four-eyed opossum	DIDELPHIDAE	<i>Metachirus nudicaudatus</i>
Woolly mouse opossum	DIDELPHIDAE	<i>Micoureus demerarae</i>
Bush dog	CANIDAE	<i>Speothos venaticus</i>
Jaguarundi	FELIDAE	<i>Herpailurus yaguarondi</i>
Tayra	MUSTELIDAE	<i>Eira barbara</i>
Grison	MUSTELIDAE	<i>Galictis vittata</i>
Olingo	VIVERRIDAE	<i>Bassaricyon beddardi</i>
Kinkajou	PROCYONIDAE	<i>Potos flavus</i>

COMMON NAME	FAMILY	SCIENTIFIC NAME
Coati	PROCYONIDAE	<i>Nasua nasua</i>

**Table 13: List of fishes found in seasonal and permanent lakes and ponds**

The species listed below are species that have been observed and also reported to be present in the seasonal and permanent ponds in the project area. .

COMMON NAME	FAMILY	SCIENTIFIC NAME
Gold Tetras		<i>Hemmigrammus armstrongi</i>
Marble Hatchets		<i>Carnegiella strigata</i>
Geophagus Species		<i>Geophagus jurupari</i>
Harrisoni Pencil fish		<i>Nannastomus harrisoni</i>
Marginatus Pencilfish		<i>Nannastomus marginatus</i>
Anomalus Pencilfish		<i>Nannastomus anomalus</i>
Dwarf Cichlids		<i>Nanacara anomala</i>
Ortmanni Cichlids		<i>Apistogramma ortmanni</i>
Pike Cichlids		<i>Crenicichla lepidota</i>
Red Pike Cichlids		<i>Crenicichla sp.</i>
Festivum Cichlids		<i>Cichlasoma festivums</i>
Keyhole Cichlids		<i>Aequidens maroni</i>
Black Acara Cichlids		<i>Aequidens portalegrensis</i>
Splash Tetras		<i>Copella arnoldi</i>
Red Spotted Copeinas		<i>Copella guttata</i>
X/Ray tetras		<i>Pristilla riddlei</i>
Sailfin tetras		<i>Crenuchus spilurus</i>
Weitzmani tetras		<i>Poecilocharax weitzmani</i>
Lukunani		<i>Cichla ocellaris</i>
Houri		<i>Hoplias malabaracus</i>
Glow Line Tetras		<i>Hyphessobrycon heterorhabdus</i>
Warbray or Silver Dollars		<i>Metynis schreitmueelleri</i>
Flat Head Hassar		<i>Callichthys callichthys</i>

### 3.2.2.3 Sensitive ecosystems and environments

For the project area it was determined that the savannah ecosystem is the main sensitive ecosystem or environment with a terrestrial component and influence.

### 3.2.2.4 Rare, Endangered and Threatened Species

Appendices I, II and III to the CITES Convention are lists of species afforded different levels or types of protection from over-exploitation.

Appendix I lists species that are the most endangered among CITES-listed animals and plants. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial (see Article III), for instance for scientific research. In these exceptional cases, trade may take place provided it is authorized by the granting of both an import permit and an export permit (or re-export certificate). Article VII of the Convention provides for a number of exemptions to this general prohibition.

Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. It also includes so-called "look-alike species", i.e. species of which the specimens in trade look like those of species listed for conservation reasons. International trade in specimens of Appendix-II species may be authorized by the granting of an

export permit or re-export certificate. No import permit is necessary for these species under CITES (although a permit is needed in some countries that have taken stricter measures than CITES requires). Permits or certificates should only be granted if the relevant authorities are satisfied that certain conditions are met, above all that trade will not be detrimental to the survival of the species in the wild.

Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation. International trade in specimens of species listed in this Appendix is allowed only on presentation of the appropriate permits or certificates (<http://www.cites.org/eng/app/index.shtml>).

There are no rare, threatened or endangered species in the proposed project area in terms of conservation status as determined by population studies in Guyana. The giant anteater is one species that is found in proximity to the project area. This species is listed on the CITES I Appendix. Based on the assessment it is determined that disturbances during construction and operation will not have any significant major impact on this species. This species is highly migratory like the other faunal species that are present in the savannah habitat. Its presence around the project area is solely due to its migratory habit. It is not anticipated that there will be any significant major impact on this species because the project area does not have adequate vegetation cover for this species to spend much of its time. Being a transient species in the project area it is anticipated that the animals will be able to find suitable alternative habitats in the nearby savannah. No permanent negative impact on this species is foreseen.

### **3.3 Socio-Economic Environment**

Data was collected from various sources and by different method to adequately determine the socio-economic environment within the project area and the wider North Rupununi Savannah.

#### **3.3.1 Historical Overview and Development**

The Rupununi Savannah has a rich history stretching into historic times with existing documents dating to the legend of “El Dorado”. The legend of El Dorado that describes a great king who is daily covered in gold dust so that he shines like a god before cleansing himself in a sacred lake, is in fact based on Chibcha rituals, which is a tribe currently living in Columbia. Sir Walter Raleigh in his explorations of this region in search of the legendary kingdom discovered gold in 1595. Raleigh was the first European on record to connect “El Dorado” to the land or city of “Manoa” located somewhere within the *Guianas*.

Sir Robert Schomburk in his expeditions (1835 to 1844) described a lowland which is seasonally flooded at the southern foot of the Pacaraima (now Pakaraima) Range extending through the great savannahs of the Rupununi, Takutu, and Rio Branco or Parima. This area according to Schomburk was about 14,400 square miles with an average height of 400 feet above sea level.

The Rupununi is historically the home of the Macushi people with their settlements being described by the Europeans as early as the 1740s. The Wapisiana people are believed to be a more recent arrival to the South with some settlements spreading into parts of the North Rupununi. The European culture completely changed the lifestyles of the Macushi by establishing church missions, cash economies, and schools at permanent locations. Consequently, the once migrant Macushi communities became settled around these centres into permanent villages. The Macushi continued to farm in the forest areas, with short term camp sites established in the forests, but lost much of their mobility and independence under these new socio-economic conditions.

The Macushi established a land claim in 1969 through the Amerindian Land Commission. The lands under the claim are known traditional as the Piyakīta, which means “the place of landings” and are important sources of Curari-Iwokramî (*Strychnos toxifera*) and Kata yé (*Ocotea rodiei*)

both integral in trade relations with the Brazilian Macushi<sup>7</sup>. The Amerindian Lands Commission recommended the establishment of this broader area as Macushi lands, but the consequent Amerindian Act only apportioned smaller savannah areas around the existing villages reflecting the current Macushi populations.

The Wapishana people settling further south of the Macushi have also been influenced by European culture. According to the Farabee(1918), cattle ranching was a very important outside influence pioneered by the Scotsman Harry Melville who settled in the area in 1891, marrying two daughters of an Atorai chief. Melville not only developed his herd but also served as a mediator between the inhabitants of the south savannas and the colonial regime. His mediation and influence with the British Government served to hinder the permanent establishment of traders and missionaries within the South Rupununi.

Noted historian of Guyana Walter Roth, first visited and documented his observations on the village of Sand Creek in 1925, a decade later he noticed a dramatic drop in living standards, manifest in the prevalence of alcoholic drinks<sup>8</sup>, neglect of agriculture, adoption of European-style dress, and declines in standards of personal hygiene. Roth believed this decline to be a consequence of growing involvement in the cash economy, particularly the balata industry (Roth 1929). By 1952, both Macusi and Wapishana were reported to have abandoned many of their traditional activities opting for a more European Christian culture although the native languages had been largely retained (Evans and Meggers, 1960).

The Rupununi entered into the national political scene as an “*Independent*” Guyana began to pave its own developmental destiny. It would seem as though the Rupununi was neglected in the national process, a fact not strange to rural communities. History reveals further support for this claim in the fact that the ranchers’ failed to obtain titles to almost five thousand square miles of savannah.

Amerindians from Pirara, Sante Fe, Musu, Mandakiru, Waruma, Mureru, Jewaree, Tabatinga and Meritezerio formed the major contingent of the rebellion know as the Rupununi Uprising and fled into Brazil and Venezuela as the rebellion was squashed. Local law enforcement officers and the rebellious faction lost lives in the process. Lands were abandoned and many deemed “Enemy of the State” thereby loosing the right to resettle in their ancestral lands. This situation was referred to as the Rupununi Uprising. Santa Fe was largely abandoned for over forty years, until a small family was found squatting on the state lands and identified themselves as a relative of the Harts.

Economic conditions in the Rupununi continued to decline with public expenditure freeze following the uprising coupled with rising fuel prices that made trade with Georgetown more costly. Over the next four decades trade relations will increase with Brazil culminating with the opening of the Takutu River Bridge in 2009. The development of the Georgetown-Lethem road facilitated a rapid turnaround of conditions in the region as more vehicles could access the region. In addition, growth in ecotourism fueled by investments of Iwokrama, Rock View Lodge and Karanambo Trust saw a return to employment and sale of services by the local communities.

The Macushi took the initiative to be involved in the shaping of development in their ancestral lands by forming the North Rupununi District Development Board which negotiates as a united

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<sup>7</sup> [http://www.rupununi.org/Rupununi\\_people.html](http://www.rupununi.org/Rupununi_people.html)

<sup>8</sup> Amerindian culture integrates alcoholic beverages in social and spiritual practices. However, the distilled alcohol being marketed in the settlements were much stronger than local beverages and not dependent on seasonality or labor intensive production methods.

front on developmental issues. Bina Hill Institute facilitated the training of youths in four technical areas relevant to community natural resource management.

### **3.3.2 Land Use**

Santa Fe Inc. has established a based camp to support its development and surveying activities within the area. Most of the project area is largely unutilised. The property is located in close vicinity to Groundstar Resources/Canacol petroleum drilling operations. Drilling is currently ongoing and the Company has established a compound for its workers. The Meritezerio Airstrip is also located adjacent to the property and is sometimes used by Santa Fe Inc. The Meritezerio Ranch, an outstation of Pirara Ranch, is also located adjacent to the property. Some stray cattle that were once domesticated roam the area. These cattle belong to the Meritezerio Ranch. None were observed during the visits although tracks were found on many parts of the land. A few small herds have been spotted during the land surveys.

A small homestead was found within the old Santa Fe compound occupied by two elderly persons and their young grandchildren. The couple is in their sixties and their two (2) grandchildren are between the ages of 10-14 years old. They occupied a small hut made of wood, mud and leaves with an adjoining kitchen. Fruit trees are found scattered around the domicile. The children are with the grandparents only on weekends since they attend school in Brazil. They indicated that they have moved to the area within the last four years and claimed that the land was once owned by their grandparents who fled the country after the failed Rupununi Uprising. The couple farms the surrounding areas for food and livelihood. The RDC had indicated that these persons are squatters and facilitated their relocation to an area outside of the property boundary, closer to their farmlands (See Section 5.2.3.1)

There is a small patch of cassava cultivation on the property. The management of the Pirara Ranch has commenced this cassava growing as an experiment. This plot will be cleared after the crop is harvested.

The Georgetown Lethem Road passes through the property. Also, the access road to the Amerindian Village of Karasabai passes through the property. The map below shows Santa Fe and the surrounding communities.

## Location of Santa Fe & Surrounding Communities

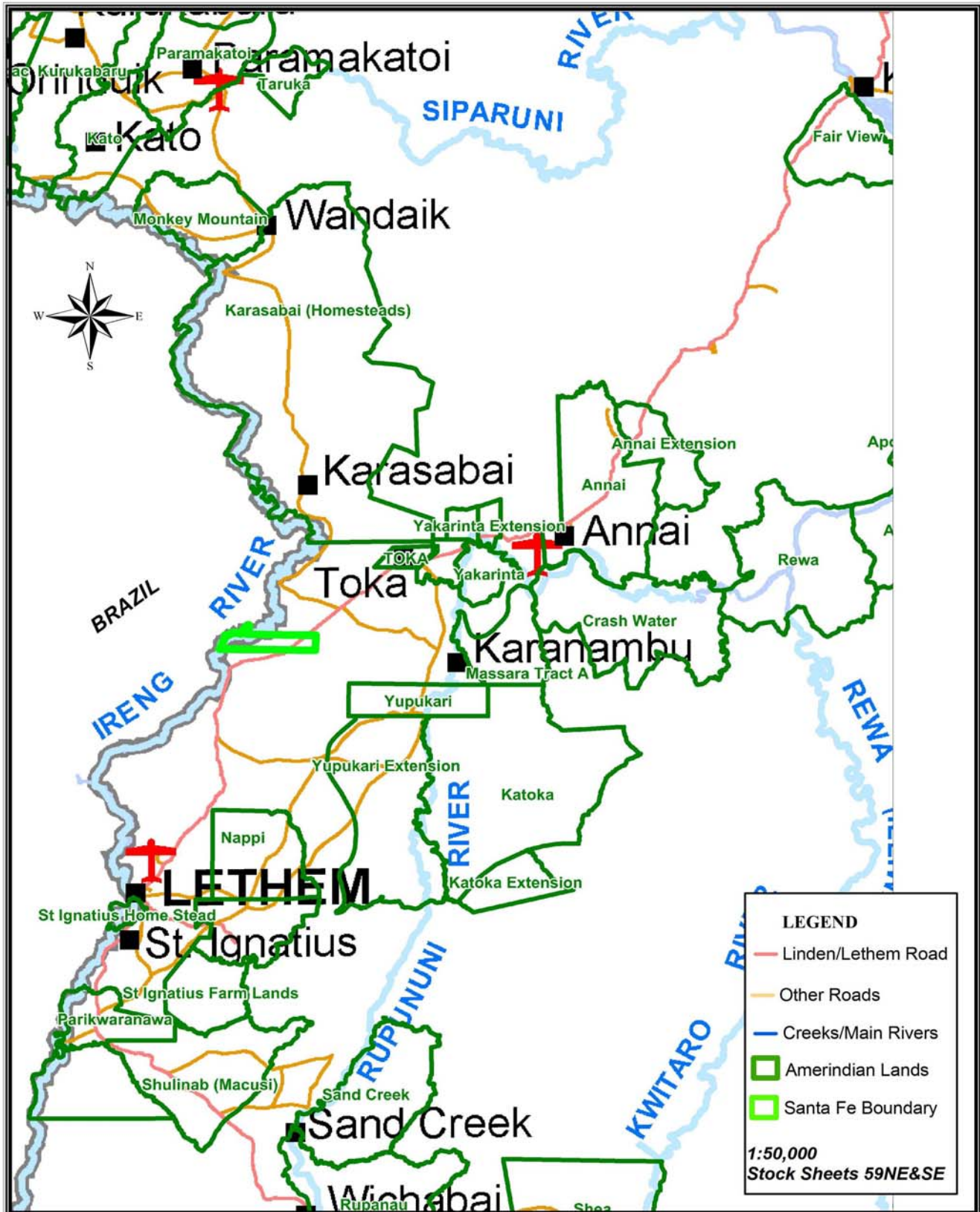


Figure 53: Santa Fe and Surrounding Communities

### 3.3.3 Connectivity

The area can be accessed by air and land. Scheduled flights operate out of the Ogle Airport to Annai and Lethem. From Annai an overland journey of 1 ½ hr is then required. From Lethem an overland journey of 45 minutes is required. Chartered flights can also be arranged from Ogle to the Meritzerio Airstrip which is just adjacent to the property.

The area can be accessed overland by road from Georgetown and Lethem. Buses traverse this route on a daily basis and these include large buses operated by a bus service (Intraserv), as well as smaller buses operated by private persons. The overland route goes through the town of Linden, the Iwokrama forest and into the savannahs taking approximately 12-15 hours.

### 3.3.4 Socio-economic Conditions

Since there is no Amerindian community within or in close proximity (within 5 km<sup>9</sup>) of the property boundary, in order to understand the socio-economic conditions of the wider project area, a group of five (5) communities closest to the project site were selected for study. The communities selected are Karasabai, Toka, Yupukari, Yakarinta and Massara.

A rapid rural appraisal of the area was conducted and brief interviews were held with persons found within the area. Previous studies relating to the area were consulted including the published Government of Guyana's 2002 Census. Key stakeholders were consulted to gather their input on the positive and perceived negative impacts of the proposed development. The stakeholders consulted are listed in Appendix C.

#### 3.3.4.1 Population Distribution

The Macushi people have permanent domiciles but have undertaken significant temporary migration to other villages and neighbouring Brazil. Family ties are significant amongst the Macushi and many relatives are found scattered as remnants of migration after the Rupununi Uprising and the decline of the cattle and balata industries. In some cases migration is a necessity in the hunt for prospective mates seeking intermarriage by blood cousins.

The five selected villages have a total of 2087 persons of whom 50% is male and 49% female. The gender distribution is not consistent with the national average and therefore increases the validity of the argument that males migrate in search of females.

**Table 14: Gender distribution amongst selected stakeholders**

Gender/ Village	Male	Female	Total
Karasabai	492	461	953
Toka	109	97	206
Yakarinta	202	212	214
Massara	167	142	309
Yupukari	200	205	405
<b>Total</b>	<b>1170</b>	<b>1117</b>	<b>2087</b>

Source: Bureau of Statistics, 2002 Household Census

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<sup>9</sup> 5km is identified as a reasonable distance for a day's walk to fish, hunt or gather food by an Amerindian. Areas further away are still considered to be traditional lands but may not be traversed on a daily basis to have a more significant impact on everyday livelihoods of the village.

### 3.3.4.2. Ethnic Composition of the Study Area

There are approximately 9,000 Makushi in Guyana and can be found in 27 communities, mainly in the Rupununi. Makushi speakers make up 77% of the population of the North Rupununi; the remaining inhabitants are 11% Wapishana, 9% mixed, and 3% Arawak<sup>10</sup>.

In the villages under study the population remained almost purely Amerindian at over 97% of all residents. Of the 3% remaining, over half of the residents are of mixed decent. This is consistent with the village policy of only Amerindians or persons married to Amerindians can be legally settled residents. A settlement for non-Amerindians within the North Rupununi is found at Aranaputa, a village just outside of Annai. Other ethnic groups are found settled at Lethem as well however; both settlements are dominated by Amerindians with the mixed<sup>11</sup> group being the largest people group at Lethem.

**Table 15: Ethnic composition of selected stakeholders**

Village	African/ Black	Amerindian	Indian	Chinese	Mixed	Portuguese	White	Other	Not stated	Total
Karasabai	0	929	2	0	21	1	0	0	0	953
Toka	5	186	1	0	14	0	0	0	0	206
Yakarinta	1	413	0	0	0	0	0	0	0	414
Massara	1	297	0	0	10	1	0	0	0	309
Yupukari	2	399	1	0	3	0	0	0	0	405

Source: Bureau of Statistics, 2002 Household Census

### 3.3.4.3 Educational Status

From the survey conducted by the Bureau of Statistics it is evident that the communities are participating in education opportunities offered up to the secondary level. A total of 44% percent of the residents attended secondary school as opposed to 43% who attended primary school.

The odd factor is probably explained by the fact that the younger generation attended both primary and secondary schools whereas the mature villagers had a little primary education or none at all. Of the five villages, a further thirteen persons had a post secondary education with three persons attending university. A few privileged youths are fortunate to attend school in Brazil paving the way for a higher qualification.

**Table 16: Education status of selected residents**

Education / Village	None/ Nursery	Primary	Secondary	Post Secondary	University	Other	Not Stated	Total
Karasabai	88	334	377	1	1	1	0	802
Toka	18	78	75	0	1	0	0	172
Yakarinta	45	144	148	2	1	0	0	340
Massara	29	105	115	0	0	2	2	253
Yupukari	41	171	123	0	0	0	2	337

Source: Bureau of Statistics, 2002 Household Census

<sup>10</sup> [http://www.rupununi.org/Rupununi\\_people.html](http://www.rupununi.org/Rupununi_people.html)

<sup>11</sup> Mixed peoples are not considered an ethnic group by many social scientists. If this is an accepted fact defining a group then Amerindians will be the dominant people in Lethem.

### 3.3.4.4 Age Distribution

The population distribution by age group for the villages identified is consistent with the general trend for an Amerindian community. This bottom of the population pyramid is largest consistent with a steady decrease as age increases. Population growth is highest for Amerindians in Guyana as opposed to the other ethnic groups.

**Table 17: Population by age distribution for selected villages**

Age Group/ Village	< 5	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Total
Karasabai	151	147	126	112	70	74	44	48	46	33	68	23	13				953
Toka	34	34	41	23	11	12	9	16	7	2	13	3	1				206
Yakarinta	74	69	62	33	26	18	17	21	14	20	42	11	7				414
Massara	56	51	39	32	33	18	10	14	13	6	28	4	5				309
Yupukari	68	76	64	34	22	20	27	24	16	15	24	9	6				405

Source: Bureau of Statistics, 2002 Household Census

### 3.3.4.5 Income Distribution

Unemployment is highest amongst the Amerindians as opposed to all other people groups in Guyana. This is due to a combination of cultural and economic factors. Amerindians continue in their cultural practices which cannot always be integrated into the modern world particularly in the case of formal full time employment. Fathers and mothers have to leave their families for long periods seeking employment and this absence is not always best for the nurturing of their children or the overall family health. It would be a positive benefit to the communities if employment opportunities are closer to home and for those employed not to be away from home for long periods.

**Table 18: Employment status of selected stakeholders**

Village/ Activity	Worked	Had worked	Looked for work	Wanted work	School	House work	Retired	Disabled	Other	Not Stated	Total
Karasabai	286	0	5	2	37	173	9	6	1	10	529
Yakarinta	123	0	1	1	13	59	8	3	0	1	209
Toka	60	0	0	0	13	19	4	0	1	0	97
Massara	62	0	17	13	11	49	6	4	1	0	163
Yupukari	74	1	4	59	20	24	9	0	1	5	197

Source: Bureau of Statistics, 2002 Household Census

Amerindians earn significantly less than the other ethnic groups because they are generally not integrated into society. In the villages under study, a larger percentage is currently unemployed, providing for their families at a substance level.

**Table 19: Occupation by major industry for selected stakeholders**

Industry/ Village	Agri & Forest	Fishin g	Mines & Quarry	Manufactur e	Electricit y Gas Steam	Constructio n	Wholesal e Trade Vehicle	Hotel & Rest.	Trans. & Comms	Financ e	Other	Not Stated
Karasabai	240	3	0	4	0	3	5	1	1	0	0	236
Yakarinta	115	0	0	0	0	1	0	0	0	0	9	85
Toka	34	0	0	1	0	6	4	0	0	0	15	37
Massara	35	4	0	6	0	5	2	1	0	0	10	100
Yupukari	150	0	0	0	1	0	0	0		0	15	122
	547	7	0	11	1	15	11	2	1	0	49	580

Source: Bureau of Statistics, 2002 *Household Census*

Table 19 provides occupation information on selected villages in the North Rupununi. From the table it is evident that the category of agriculture and forestry employs the majority of Amerindians in forms of hired labor or on a self employment basis. This is consistent with the wealth of knowledge the Amerindians possess of the natural environment.

### 3.3.4.6 Utility Services

In 2002, the villages under study did not have piped running water, electricity, sewage systems, or garbage collection systems. Villages had standing pipes with few residents having a water pump system linked to a tank storage system. A total of 57% of the residents relied on unprotected sources for their drinking water. This often leads to many health complications in these poor communities.

**Table 20: Water supply for selected residents in the Rupununi**

Region 9 NDC/ Drinking water	Piped to Home	Piped to Yard	Public Stand pipe	Tube well & pump	Secure well	Secure Spring	Bottle	Rain Water	Unprotected pond, lake, well	Other	Total
Yarong Paru - Good Hope	0	0	33	0	159	7	1	0	177	2	379
Toka - Jakaretinga	0	3	19	35	78	2	1	2	152	0	292

Region 9 NDC/ Drinking water	Piped to Home	Piped to Yard	Public Stand pipe	Tube well & pump	Secure well	Secure Spring	Bottle	Rain Water	Unprotected pond, lake, well	Other	Total
<b>Yakarinta - Wowetta, Surama</b>	2	7	34	1	95	0	0	1	322	1	463

Source: Bureau of Statistics, 2002 Household Census

**Table 21: Sewerage and Garbage Disposal**

Region 9 NDC/ Toilet	W.C. sewer	Septic	Pit latrine	Other	None	Not Stated	Total
<b>Yarong Paru - Good Hope</b>	0	0	231	0	148	0	379
<b>Toka – Jakaretinga</b>	0	2	201	0	89	0	292
<b>Yakarinta - Wowetta, Surama</b>	0	6	308	0	149	0	463

Source: Bureau of Statistics, 2002 Household Census

No public transportation system exists within these villages and transportation is in the form of bicycle or private vehicles. Villagers rely mainly on walking as their major means of mobility.

**Table 22: Transportation for North Rupununi Residents**

Village/ Transportation	Transportation to Work				Transportation to School	
	Home	Walk	Bicycle	Vehicle / Boat	Walk	Bicycle
<b>Yuppukari</b>	1	12	21	35	132	19
<b>Toka</b>	11	30	16	0	79	12
<b>Yakarinta</b>	1	81	24	14	135	3
<b>Karasabai</b>	6	195	37	1	265	43
<b>Massara</b>	3	12	9	26	97	3

Source: Bureau of Statistics, 2002 Household Census

### 3.3.4.7 Health Conditions

Health conditions can be evaluated from an analysis of many factors including, but not restricted to the health services offered in the region and the longevity of its populations. Health posts are the most prevalent institution found in the interior locations with a total of sixty eight found in Regions 8 and 9. These offer the very basic medical treatment to their patients. Hospitals are located at Annai and Lethem in Region 9, accessible to the villages in the Rupununi. Serious or emergency cases are sometimes transferred to Boa Vista in Brazil.

**Table 23: Health Institutions in Regions 8 & 9**

RDC/ Institution	RDC 8	RDC 9
Health Posts	16	52
Health Centers	5	3
District Hospitals	2	2
Regional Hospital	0	0
Specialist Hospitals	0	0
Private Hospitals	0	0
National Hospitals	0	0
Company Hospitals	0	0
Rehabilitation Centers	0	0
Geriatric Hospitals	0	0
Total	23	57

Source: *Statistical Bulletin*, December 2009

### 3.3.4.8 Administration and Governance

The villages of the Rupununi are grouped into NDCs which then constitute the RDC. The RDC of Region 9 is governed by a Regional Chairman who reports to the Ministry of Local Government and Regional Development. At the village level, local councilors and a touchau are elected to office for a period of two years. The RDC also administers health care and local governmental functions at the village level. The RDC instructs on how its school and other facilities are to be utilized in all villages.

The administration of the lands leased to the Santa Fe Inc. falls directly under the jurisdiction of the RDC. Specific issues relating to land management are administered by various government agencies including the EPA and GL&SC. The Ministry of Agriculture will play an important role in supporting the operations of the investors.

There are local police stationed in Annai and Lethem. Lethem also has a military base and a Customs & Trade administration centre. The touchaus are sworn to act as Supernumerary constables and assist in the maintenance of law and order in their villages.

### 3.3.5 Cultural and Anthropological Environment

The areas are rich with remains of a migrant people. Pottery among other artifacts is most frequently found at various sites. Evans and Meggers associated the Rupununi inhibition with the Macushi and Wapishana in agreement with historic distributions based on maps by Horstman

(1748), Olmedilla (1771-75) and Surville (1778)<sup>12</sup>. Historic population distributions based on the named maps all place the Macushi in the North Rupununi with the Wapishana to the south nearer Brazil, save in the case of Surville who does not identify the presence of the Wapishana.

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<sup>12</sup> Evans and Meggers (1960)

## **4.0 POLICIES, LEGISLATIONS AND INTERNATIONAL CONVENTIONS**

### **4.1 Overview**

This section examines the policies and legislation governing the project, as well as, the institutions that have regulatory oversight. Administration of environmental affairs is the responsibility of the EPA of Guyana. The Agency was established in 1996 by the Environmental Protection Act and is responsible for the development of national environmental legislations and advises the GoG on the development and implementation of environmental policies and standards. It also undertakes the inspection and enforcement of matters dealing with the environment, conservation and natural resources and administers the environmental permitting process in Guyana.

### **4.2 National Policies**

The GoG has developed a number of key policies to guide development activities to ensure natural resources are sustainably utilized and environmental impacts minimized.

#### **4.2.1 National Environmental Action Plan**

In the National Environmental Action Plan (NEAP), 1994, the GoG has outlined its environmental policy objectives for the sound management of the environment and natural resources. The NEAP outlined several policy objectives. One of the policy objectives calls for the GoG to ensure that environmental assessments of proposed development activities which may significantly affect the environment are undertaken. In keeping with this environmental policy objective, the Environmental Protection Act was introduced in June 1996 and the legal framework for authorizing development activities was outlined. Further, the Act established the EPA and outlines the legal process for undertaking sustainable and effective management of the environment and its natural resources.

#### **4.2.2 Low Carbon Development Strategy**

The GoG, in 2009, launched a Low Carbon Development Strategy (LCDS). The LCDS aims to transform Guyana's current economy to that of a "low carbon economy" while addressing issues related to climate change through a compensatory scheme by marketing Guyana's standing forest. The strategy is built on Guyana's vision to encourage investments/economic development while protecting and maintaining its forest cover. The strategy has three pillars: (i) investment in low carbon economic infrastructure; (ii) investment and employment in low carbon economic sectors; and (iii) investment in communities and human capital. Mining activities will be highly regulated to ensure compliance with national requirements.

This project fits well within the LCDS. The LCDS promotes investment in high potential-low carbon sectors. The LCDS also promotes the use of non-forested arable lands for agricultural purposes such as lands in the Central Rupununi District.

#### **4.2.3 National Biodiversity Action Plan II**

The GoG, through the EPA, prepared a second National Biodiversity Action Plan (NBAP II). This plan was prepared for the period 2007 to 2011 and its implementation is being coordinated by the EPA. This plan followed from the first NBAP 1999 – 2004 which was prepared to integrate the implementation of the United Nations Convention on Biological Diversity (UNCBD) into national development.

The NBAP signifies Guyana's commitment to implement measures to conserve and protect the country's biodiversity. NBAP II identifies twelve (12) programme areas for action. Agriculture is one of the four thematic areas of the NBAP II and one of the programme areas is directly related

to this project since it focuses on the promotion of sustainable initiatives within the agriculture sector. The Santa Fe Project is planned to be sustainable and intends to serve as a model for similar type of developments within the region.

### **4.3 Legislation**

Several pieces of legislations exist in Guyana which are relevant to the proposed project. The main legislations are discussed below.

#### **4.3.1 Environmental Protection Act 1996**

The Environmental Protection Act, No. 11 of 1996 outlines the Environmental Authorisation process. Part IV of the Act requires all developers of any project listed in the fourth schedule or other projects that may significantly affect the environment to apply to the EPA for an Environmental Authorisation. The application form, which must be accompanied by the prescribed fee, must include a description of the project as well as information regarding location, size, duration of the project, and potential environmental impacts. The EPA will review the application and assess whether or not the project should be exempted from the EIA process. Once a decision has been made, the EPA will publish a notice to the public in at least one daily newspaper informing them of EPA's position, thereby allowing the public review of the decision. It is under this process that the EPA decided that an EIA is not required for this project, but requested that an ESMP be prepared and approved before the Environmental Permit is issued.

#### **4.3.2 Environmental Protection Regulations 2000**

Regulations on Hazardous Waste Management, Water Quality, Air Quality and Noise Management were established under the Environmental Protection Act in 2000. These pollution management regulations were developed to regulate and control the activities of developmental project during construction and operation phases. Standards establishing the permissible parameters under these regulations are being developed.

Santa Fe Inc. was required to apply to the EPA for an Environmental Permit to The Environmental Permit would outline conditions the Company will have to comply with to ensure that the negative impacts on the environment are minimised. The conditions of the Permit will be in accordance with the requirements of these regulations and standards. The project will be monitored by the EPA to ensure compliance.

#### **4.3.3 National Environmental Standards**

The Environmental Protection Regulations requires the EPA to develop limits for various parameters. The EPA has so far, in collaboration with the Guyana National Bureau Standards (GNBS), developed the following standards and which are applicable to this project and should be complied with:

- Interim Guideline for Industrial Effluent Discharge into the Environment. (Water Quality Standard); and
- Guideline for Noise Emission into the Environment. (Noise Standard); and

The limits prescribed in the Interim Guidelines for Industrial Effluent Discharge in the Environment are outlined in Appendix E. However, there are no specific limits for farming activities. Only processing activities are covered. However, general limits are included which can be applicable. The noise limits for industrial activities as outlined by the standard are 100 dB during the day and 80dB during the night.

#### **4.3.4 Pesticides and Toxic Chemicals Act, No. 13 of 2000**

This was promulgated primarily to regulate the manufacture, importation, transportation, storage, sale, use and disposal of pesticides and toxic chemicals and to provide for the establishment of the Pesticides and Toxic Chemicals Control Board which falls under the Ministry of Agriculture. The Pesticides and Toxic Chemicals Board has a number of functions, one of which is to consider and determine applications made pursuant to the Act and to deal with all aspects of the importation, manufacture, transportation, storage, packaging, preparation for sale, sale, use and disposal of pesticides and toxic chemicals and to advise the Minister on all matters in relation thereto. The Regulations require the Board to approve all imports of pesticide or toxic chemicals in Guyana. As such, the Department of Customs and Trade Administration shall not allow imports that are not authorized by the Board.

#### **4.3.5 Pesticide and Toxic Chemicals Regulations, 2003**

The Pesticides and Toxic Chemicals Regulations were established in 2003 to supplement the provisions in the Pesticides and Toxic Chemicals Act 2000. The Regulations deem pesticides or toxic chemicals as prohibited if they are a contravention of any known requirement of the laws of the country in which it was manufactured or produced or banned by the United Nations Food and Agriculture Organisation (FAO) or is listed as one that should be banned or severely restricted in the International Register of Potentially Toxic Chemicals, Prior Informed Consent, the United Nations Environment Programme (UNEP) or the World Health Organisation (WHO). As such, the Regulations expressly state that a prohibited pesticide or toxic chemical is prohibited from importation, manufacture, distribution, use or sale in Guyana. After consultation with the Board, the Minister may also specify the prohibited pesticides which shall not be brought into or used in the country. For other pesticides and toxic chemicals, all importers must maintain appropriate records and inventories.

Part IV of the Act restricts a person from manufacturing, importing, advertising, selling, using, storing or transporting any controlled substance unless it is registered in the prescribed manner and that a licence is obtained for the manufacturing and importing, and all conditions in the licence are complied with. Additionally, a person transporting 100kg or 100L or more of pesticide or toxic chemical whether by air, land or water must inform the Registrar, police and fire services of the type and amount of pesticide or toxic chemical transported, time, route, destination and vehicle / vessel number before commencing transportation. It is also required that in the case of any accident or spillage involving an individual transporting pesticide or toxic chemical, he must immediately inform the nearest police authority, fire officials, Registrar, EPA and health authorities, detailing the quantity and names of the pesticides or toxic chemicals involved.

Santa Fe Inc. may be required to import pesticides, especially from Brazil, given the similarity in farming models, as well as the close proximity as compared to Guyana's coast. In addition, given that the source would be some distance away, the Company may be required to store pesticides. As such, the Company will comply with the requirements of both the Pesticide and Toxic Chemicals Control Act and Regulations.

#### **4.3.6 Plant Protection Act 1942**

This Act focuses on plant health, plant quarantine and phytosanitary measures. Some of the requirements of this Act are outdated while some are still applicable. The Act prohibits the import of certain materials such as citrus, coffee and seed paddy, unless written authorization is granted by the Ministry of Agriculture. The requirement is very relevant to the project since it is intended that seeds will be imported from Brazil to facilitate cultivation.

#### **4.3.7 Animal Movement and Disease Prevention Act 2003**

This Act is being enforced by the Ministry of Agriculture and is aimed at monitoring the health and movement of animals including disease epidemics and quarantine procedures. The Act prescribes restrictions on import and export of animals and restricts the movement of animal and animal parts within the country. This is very relevant to the project since the Company may want to bring animals from Brazil to establish its herd. The general project area and some parts of Brazil are also not fully cleared of the foot and mouth disease, which results in restrictions in movement of animals. Any importation or movement of animals will follow the procedures outlined in the Act.

#### **4.3.8 Draft Aquaculture Act**

At present there is no legislation in force to manage the aquaculture sector specifically. However, there is a Draft Aquaculture Bill scheduled to be placed before the National Assembly. When approved, this bill will become part of the Fisheries Act (2002). The Draft Aquaculture Bill will govern licensing of farms, specification of rearing areas, specification of inputs to be used in the rearing process, waste disposal, movement of aquatic species and other measures absolutely necessary for the development of aquaculture in Guyana. Once the Company decides to proceed with aquaculture in the later phases of the project it will have to comply with the requirements of the Act, once the Bill is promulgated.

#### **4.3.9 Occupational Safety and Health Act 1997**

The identification of the health and safety hazards during the operation of the proposed development must be seen as a key element for assessment. The Occupational Safety and Health Act 1997 outlines the procedures for establishing project site, regulating it and mandates that health and safety facilities are provided, maintained and the establishment complies with the regulations under the Act.

In keeping with the laws and regulations a description of the established management procedures to monitor and manage occupational health and safety hazards is important for this project.

### **4.4 Institutional Framework**

The main Government agencies that have some regulatory oversight for the project are highlighted below.

#### **4.4.1 Environmental Protection Agency**

The EPA was established under the Environmental Protection Act of 1996. The Agency is governed by a Board of Directors, but falls under the direct supervision of the Office of the President. In Sec. 4 (1) (a), of the Act, the EPA is given the mandate to *“take such steps as are necessary for the effective management of the natural environment so as to ensure conservation, protection and sustainable use of its natural resources”*. In addition the Agency is given the overall responsibility to:

- Take necessary steps for effective management of the natural environment to ensure conservation, protection and sustainable use of its natural resources;
- Ensure that any developmental activity, which may cause an adverse effect on the natural environment, is assessed before such activity is commenced;
- Coordinate and maintain a programme for the conservation of biological diversity and its sustainable use; and
- Coordinate the establishment of national parks and protected areas system and a wildlife protection management programme.

Santa Fe Inc. has applied to the EPA for Environmental Authorisation to implement the project. The EPA has determined that an ESMP be prepared and submitted for approval. Once this ESMP is approved the EPA will then issue the Environmental Permit. The Agency is then expected to conduct monitoring of the operation to ensure compliance with the conditions outlined in the Environmental Permit. Santa Fe Inc. will also be responsible for conducting self monitoring and submit monitoring reports to the EPA.

#### **4.4.2 Ministry of Agriculture**

The Ministry of Agriculture will have will have direct oversight of the project through its various Departments. The Departments which would have a key role to play in regulating and supporting this project are:

- Guyana Rice Development Board
- National Agriculture Research Institute
- Pesticide and Toxic Chemicals Control Board
- Crops and Livestock Department
- Fisheries Department

#### **4.5 International Conventions**

In addition to the legislations, Guyana is also a party to several international conventions on the environment which have requirements the country is committed to comply with. These include:

- Convention on International Trade in Endangered Species of Flora and Fauna;
- United Nation Framework Convention on Climate Change;
- United Nations Convention on Biological Diversity;
- Vienna Convention of the Protection of the Ozone Layer;
- Montreal Protocol on Substance that Depletes the Ozone Layer;
- Basel Convention on the Trans-boundary Movement of Hazardous Waste;
- International Plant Protection Convention; and
- Convention on the Prevention and Control of Occupational Hazards Caused by Carcinogenic Substances and Agents.

In addition to the regulatory and legislative requirements above, self monitoring by the Company would also provide added assurance that potential environmental impacts are managed and mitigation measures are efficient.

## **5.0 IMPACTS AND MITIGATION MEASURES**

### **5.1 Introduction**

This section identifies the potential impacts of the project on the environment and the measures to be implemented to mitigate principal adverse effects of the project. Mitigation measures are identified to prevent, minimize and manage the adverse potential environmental impacts of the project. A Monitoring Plan, an Emergency Response Plan and a Closure Plan Concept were also developed to ensure the measures are implemented and are efficient in preventing and minimizing any impacts of the project. Santa Fe Inc. will be responsible for the implementation of the ESMP and other environmental requirements, such as those outlined in the Environmental Permit. As was indicated in Section 1.6, the Farm Manager will have the direct responsibility of ensuring environmental compliance.

### **5.2 Potential Impacts and Mitigation Measures**

#### **5.2.1 Physical Environment**

##### **5.2.1.1 Soil**

###### Impact

Given the nature of the project the soil within the project area may be disturbed. The removal of vegetation and soil preparation for cultivation will disturb the topsoil. The pH of the soil will be altered as well as the soil fertility. Soil disturbance can also lead to erosion and sedimentation.

###### Analysis

The removal of grasses and shrubs can disturb the topsoil and expose the area to the elements of erosion. The removal of grasses will in no way present a major impact to soil loss. The proposed drainage and irrigation measures as well as the fact that the area will be cultivated will result in measures that will lead to protection of the soil and hence negating the effect of the removal of some of the grass cover. Shrub clearing is a delicate exercise and due care will be taken during this process to minimize the disturbance of the top soils. This shrub clearing process has been developed to a highly scientific level by Brazilian farmers who clear these shrubs with minimal top soil disturbance. The general flat nature of the area will also minimize the possibility of soil erosion and sedimentation.

The Santa Fe farm will also employ minimal and no till soil preparation techniques in keeping with the technical advice offered by EMBRAPA and NARI. Given the low fertility nature of the soils every effort will be made to retain their natural, positive characteristics while reducing the need for artificial enhancements. It is established that varying levels of limestone must be applied to all cultivation areas in order to bring the soil pH to the desired levels for cultivation of the various crops and grasses. The tillage technique to be used is a part of a Brazilian soil conservation system which involves the planting of crops where soil movement is limited only to the crop row, without preparing the soil and is based on the addition of residues (coverage) and the adoption of a crop rotation system.

Since soil fertility in the project area is low the cultivation of soya bean and cow peas are intended to be cultures of soil improvement for later implantation of pasture for rearing of livestock. Both crops have the ability after harvest to increase soil fertility by increasing organic matter and incorporation of bacteria which increase the nitrogen content of the soil. The improved fertility would lead to better soil conditions and allows for successful development of pastures.

Testing by NARI of the soil on the property to date has indicated a pH range from 3.7 to 6.5 with an average in the region of pH 4.5. The acidity level of the soil will not support commercial crop

production without intervention. The consultants have concluded that lime and other nutrients need to be added to the soil to allow crop production. The same type of limestone currently being utilised by GUYSUCO is recommended for use by NARI. For cowpeas, soya and grass it is estimated that one (1) ton of lime will be added per hectare. For rice, it is estimated that 2.5 tons will be added per hectare. NARI has indicated that for liming to be effective it must be applied at least six months prior to cultivation. Other artificial fertilizers such as NPK will also be added to improve soil fertility.

The crop-livestock integration system consists of different production systems of grains, fiber, wood, meat, milk, etc., in the same area, through rotation or succession, involving the planting of grain, pastures or tree crops. The system enables the recovery of degraded areas through intensification of land use, leveraging the complementary or synergistic effects between the different plant species and livestock, thus providing a sustainable higher production per area. The system also optimizes the use of soil; grain yields in pasture land, and improves the productivity of pastures due to its renewal by the utilization of residual fertilizer from the crop, facilitating greater nutrient cycling and increasing soil organic matter. As such, there will be an improvement in soil fertility rather than a decrease.

#### Mitigation

Generally, the project will improve the condition of the soil making it more suitable for agricultural purposes. As such, limited mitigation is required. Nevertheless, some measure including the following will be implemented to ensure the soil resource is not degraded:

- The removal of vegetation would be limited to areas where it is absolutely necessary.
- Landscaping of the project site would be done to reduce sloping to facilitate irrigated rice. This measure would also minimize the potential for erosion to occur.
- Proper drainage will be constructed for disturbed areas.
- The method of vegetation removal (only shrubs) and land preparation (minimal or no tillage) recommended would be utilized to minimize damage to the soil.
- The type of lime and fertilizers recommended by NARI, or other types already tested and established in Brazil would be utilized.
- The exact quantity of fertilizer and lime recommended will be applied so as to not significantly alter the soil pH or fertility.
- Periodic testing of soil property would be done to ensure fertility is maintained.

#### **5.2.1.2 Water Resources**

##### Impact

The Ireng River is the main water body close to the project area. This river forms a part of the border between Guyana and Brazil. The Passarina Creek is the main stream which drains the property. This stream discharges into the Ireng River. The existing water quality in the streams is good as observed from the analysis conducted. These water bodies can be affected in several ways by the project including contamination, siltation from eroded materials, reduction in flow, etc.

##### Analysis

Agricultural activities usually have associated erosion issues associated with their undertaking. Clearing of the vegetation and tilling of the soil can make the soil susceptible to erosion and

eroded materials can be transported into the water ways via surface runoff and can increase the turbidity of surface water bodies and at the same time result in sedimentation. This can ultimately impact on the productivity of the aquatic environment and at the same time impact on the aquatic life, fishes especially. Runoff from the fields can also contribute to siltation from eroded materials. Runoff is expected to be limited based on the fact that, with rice cultivation, there will be channeling and managing of the water in the field thus the issue of sediment runoff is not anticipated to be a likely impact. In addition, there will be adequate time for sediments to settle in the field and not be carried in the flowing water when released into the river. The crop is usually under water for about 2 months. Further, the water in the rice field will not be released on a continuous basis but under a managed schedule. It may not even be necessary to release water back into the river since the water used for irrigation is sometimes evaporated or absorbed prior to harvesting. Drainage and irrigation systems will also serve to act as sediment traps before they discharge into the main waterway. As a result there is a reduced likelihood that there will be any significant impact on water quality due to sedimentation and increased turbidity. The general flat nature of the area will also serve to minimize this possibility.

As the project enters its preparatory and operational phases there is the likelihood that there will be waste disposal issues. The improper management of waste, including both solid and liquid waste can affect water quality. Solid waste can often end up in water bodies as a result of direct dumping resulting in contamination and blockages. As the project is implemented there will also be sewage waste which will require disposal. Sewage waste can also negatively affect water quality. In addition there can also be runoff from waste disposal areas may also contain materials that can contaminate water bodies and affect water quality and aquatic species. Options for waste management are discussed in Section 5.2.1.4.

Fertilizers and chemicals such as pesticides can affect water quality. Fertilizers can increase the nutrient content in the water ways thus fostering the growth of some aquatic species such as weeds which can in turn affect the flow of the river. Pesticides used in the operation can also affect the water quality. However, the Company would ensure best practices in the use of fertilizers and chemicals. The correct timings and dosage will be utilised to ensure the efficient use of agrochemicals and prevent wastage, while at the same time reducing the possibility for contamination. Based on the agricultural system to be practiced fertilizers would have been used up by the plant prior to any release of water into the environment. Pesticides would not be applied at the late stage of the crop, since water is released just prior to harvesting.

Fuel and waste oil, if not properly managed, can spill which can result in water contamination. Water can also be contaminated from fuel and waste oil from leakage that may occur. Therefore, it is necessary for measures to be implemented to prevent this occurrence, especially taking into consideration the soil type which would allow for the material to be dispersed easily. These measures are described in Section 5.2.1.3 below.

Water for irrigation would be taken mainly from the Ireng River. This is a flowing river with more than enough capacity to support such a venture. Extraction of water would have no negative effect on the water flow and water capacity of the river. Under the water management schedule noted above, water will be released in a controlled manner from the cultivated fields into the River, which will not cause any major impact to the receiving water body. It should be noted that this method of water supply and return to the river is practiced in Brazil where a similar operation is ongoing for number of years. To date there has been no negative impacts regarding water quantity and quality, as shown from the analysis in Section 3.1.7.

#### Mitigation

In addition to the measures discussed above to protect the quality and flow of water resources, the following would be implemented:

- Fuel, lubricants, waste oil and chemicals will be managed and stored as outlined in Section 5.2.1.3.
- All activities will be undertaken with the strictest of conformation to the recommended practices to prevent erosion and sedimentation.
- There will be minimal use of agrochemicals that are harmful to the aquatic environment. Agrochemicals chosen would not be of the type that is persistent in the environment.
- Fertilizers and pesticides will be applied in the recommended dosage and timings to ensure effectiveness while minimizing the possibility of contamination.
- Drainage and irrigation systems will be adequately maintained to reduce the likelihood of erosion and sediment runoff and increased turbidity of the waterway.
- Rainfall will be utilised for irrigation purposes as much as possible.
- Waste will be disposed of in a manner outlined in Section 5.2.1.4.

### **5.2.1.3 Fuel, Lubricants and Chemicals**

#### Impact

Fuel and lubricants are classified as hazardous materials and require special consideration in terms of transportation, storage and handling. Chemicals mainly in the form of pesticides will be utilized in the cultivation of crops. Improper management of these materials can result in spills and leakage which can contaminate soil and water resources.

#### Analysis

Fuel, lubricants and waste oil, if not properly managed, can spill which can result in water contamination. Water can also be contaminated from fuel and waste oil from leakage that may occur. Therefore, it is necessary for measures to be implemented to prevent this occurrence. Fuel will be transported to the site by fuel tankers and will be stored in above the ground tanks. The tanks will be built on concrete pads with the required containment berm to contain 110% of the capacity of the largest tank. These measures reduce the likelihood of contamination in the event of leakage from the tanks. Care would be taken during refueling exercise to prevent spillage. Employees would be properly trained in this regard. Spill kits should be provided onsite to assist in any clean up as a result of accidents. Fuel storage areas will have the necessary signs including 'no smoking' and 'flammable area'.

Waste oil will be collected in the workshop from the servicing of vehicles and equipment. Waste oil will be collected by the use of a drip pan and transferred to storage drums. These drums will be stored in a designated area with the necessary containment including an impervious surface and concrete berm.

Pesticides will be utilized to assist in the control of pests which can affect crops. Pesticides will be sourced from both Brazil and Georgetown and will be stored in small quantities onsite. Only pesticides approved by the Pesticide and Toxic Chemical Control Board will be utilized. Pesticides will be bought in small plastic bottles (1 liter) and stored in a designated area with an impervious surface. The containers will be elevated off the ground to detect any leakage that may occur. The area will be secured and warning signs indicating poisonous substance will be posted.

#### Mitigation

The following measures would be implemented to ensure the risks of contamination of soil or water from spillages are minimized:

- The diesel storage tank would be housed within an impervious area with a containment capacity of 110% of the capacity of the tank. A shed will be constructed over the tanks to keep out rainfall from entering the containment area.
- All 200 litres drums will be stored within a concrete floor and bunded with a spill holding capacity of 20% of the total hydrocarbon stored in the drums.
- All drums stored vertically will be held individually or by groups on crates over drip or spillage trays with a capacity to hold 220 litres (110% of the capacity of a drum).
- All drums stored horizontally will be located on suitable holding tables over a steel or plastic drip tray with a capacity of 220 litres; and
- Wherever possible, hydrocarbons will be purchased, stored and handled in bulk containers.
- Fuel storage areas will be sited at a safe distance from any stream, offices and work areas.
- Attendants and drivers will be trained regarding the proper use of the pumps to avoid overfilling and spillage.
- The fuelling area will be deemed a 'no smoking' zone and the area will have appropriate signage in conspicuous locations. All fuel storage containers will be labeled.
- Fuel dispensing areas will be checked weekly for leaks. Leaks will be immediately reported and corrected. All inspections and corrective action will be documented in an inspection log.
- Prior to refueling of fuel storage tanks, cross checks of fuel records (of tank capacity based in fuel used) will be completed. Additionally, the level of fuel will be manually checked, using a dip stick, so that there is clear indication of the capacity of the tank. This would prevent over filling and possible spillage.
- Care would be taken to prevent spillage and leakage of fuel during off loading and refueling. When refueling is completed, all nozzles, hoses and other materials would be stored in a proper manner to avoid spills.
- All fuelling records will be kept up to date and on site in the form of a fuel inventory.
- All used oil and grease would be collected and disposed of appropriately. Options for disposal are further described in Section 5.2.1.4. Waste oil drained from vehicles and machinery will be collected by pans and transferred to storage drums located in a designated area. Drums will be stored in an impervious and contained area.
- The flooring of the workshop area would be impervious to prevent contamination.
- Regular maintenance of machinery would be done to avoid leakages.
- Ground sheets or drip trays will be used in the servicing of vehicles to capture any spill that may occur.

- Spill kits would be made available in the event of spillages. The kits will be placed in strategic locations that are accessible to key personnel including drivers, security officers, and health and safety officer. Workers, mechanics and other staff will be trained in the proper use of these kits through the executions of drills.
- Adequate warning signage would be installed in the chemical storage area such as Poisonous Area.
- Chemicals would be securely stored in specialized containers which would be clearly labeled. These containers will be kept in a well ventilated area.
- The chemical storage containers will be elevated to detect any leaks and will be monitored on an ongoing basis.
- Material Safety Data Sheets would be made available for all chemicals that will be used.
- Any known hazards and health risks associated with the use/handling/disposal of or exposure to such chemicals would be clearly stated, and workers using such chemicals would be adequately trained on the proper handling procedures.
- Workers will be provided with the necessary personal protective equipment when applying chemicals.
- Chemicals will be applied as specified, and as required.
- A register will be maintained of all hazardous materials and chemical at the operation.

#### **5.2.1.4 Waste Management**

##### Impact

The project will generate waste which, if not managed properly, can result in soil and water contamination, contribute to ill health, and affect the aesthetic of the area.

##### Analysis

Waste piles often present an eye sore and can affect the aesthetic of any environment. The improper disposal of waste, especially kitchen and food waste can result in odour and attraction of vermin. Waste to be generated includes domestic garbage which usually consists of a mix of bottles, bags, cans, boxes, styrofoam, plant residues, excess food and kitchen scraps and old clothing and paper.

Liquid waste will also be generated including sewage waste and waste water from bathing and washing. A sewage system will be constructed to manage waste from sanitary facilities. Waste water from bathing and washing will be discharged via a soak away system.

Hazardous waste to be generated includes used batteries, waste oil, filters and oil containers. Hazardous waste will also include pesticide containers.

An unproductive area on the property will be designated for waste disposal. Existing laterite pits would be considered. Some level of burning in a controlled manner will take place within the pits. Once full the pits will be covered with soil.

##### Mitigation

The following table outlines the various types of waste that will be generated and their recommended disposal method.

**Table 24: Types of waste and recommended disposal methods**

Waste Category	Waste Type	Disposal Method
Solid Waste	Kitchen Waste	Kitchen waste would be buried in pits. Pits would be covered on a regular basis to avoid mal-odour and attraction to animals/vermin. Burial of waste would not be done within 100 metres from water courses.
	Cardboard/Paper	Since the volume is small these materials can be burned in a controlled manner or buried in pits. However, if large quantities are generated, the materials can be sold to Caribbean Containers Inc. (CCI) for recycling.
	Plastic Bottles/Cans	Plastic bottles and cans, if generated in large quantities, will be stored for recycling opportunities in the future. However, based on the proposed scale operation, the generation should be minimal and as such, this type of waste will be buried in a separate pit from the food waste.
	Scrap Metals	Scrap metal would be stockpiled and once a significant quantity is accumulated, it would be sold to scrap metal dealers. Scrap metal will also be reused where possible.
Liquid Waste	Waste Water from Kitchen/Bathing Facilities	Wastewater from these facilities would be channeled through a trap to capture the solid particles and fats. The water would then be drained into a soak away system. The traps would be cleaned regular and the materials recovered would be buried in the waste pits.
	Sewage	Sewage would be disposed of in a septic system. The septic tank would be constructed in accordance with the GNBS Code of Practice for the Design and Construction of Septic Tanks and Associated Secondary Treatment and Disposal Systems.
Hazardous Waste	Waste Oil	Waste oil would be collected and stored in a contained area with an impervious surface. Currently in Guyana, there is no facility to recycle waste oil. Most of the waste oil will be reused on field implements such as harrows and plough to prevent rusting while in storage.
	Used Tyres	Used tyres would be stored until an appropriate disposal method can be found.
	Used Batteries	Used batteries would be stockpiled and once a significant quantity is accumulated it would be sold for recycling. Currently, persons are buying these used batteries to be shipped overseas for recycling. Some distributors of batteries are also in the business of recollecting the batteries after use for recycling.
		The quantity of oily rags and fuel filters to be

Waste Category	Waste Type	Disposal Method
	Oily Rags/Filters	generated is expected to be minimal and will be burned in a controlled manner onsite. Filters will be drained of all oil before burning.
	Chemical Containers	Chemical containers will consist mainly of small plastic bottles. Triple washing of the bottles, which is the current recommended practice, will be done to remove all chemicals. These bottles will be punctured to prevent future use and buried in the waste dump. The option of returning bottles to the supplies for re-use would be explored.

In addition to the above listed measures that emphasize reuse and recycling, aimed at avoiding excess waste creation, the following measures will enhance further environmentally conscious waste disposal:

- Waste collection receptacles will be placed at strategic locations around the site and will be clearly labelled.
- No burning of waste would occur within the forest.
- Waste pits will be located away from waterways to prevent contamination.
- Storm water will be diverted from entering waste pit.
- Waste pits will be covered when filled with at least 1m of soil.
- Waste oil would be collected and stored in a manner outlined in Section 5.2.1.3.

#### 5.2.1.5 Dust

##### Impact

Dust nuisance as a result of the project should be very minimal. However, the project has the potential to generate some level of dust. Most of these impacts are expected to be localized and can either be prevented or reduced.

##### Analysis

Constant movement of equipment and machinery conducting land preparation during dry periods can generate some amount of dust. Construction material stockpiles and storage areas where materials such as sand and cement are stored can also generate some amount of dust. However, this would be restricted to the construction period. Dust nuisance can be further exacerbated by windy conditions. However, these impacts are expected to be localized and may not present any significant impacts to the surrounding areas. In addition, there are no communities within a 5 km radius of the project area. Currently, dust is usually generated by vehicles traversing the roads passing through the property. Nevertheless, measures will be employed to minimize the dust nuisance. Measures would be implemented to eliminate, or reduce further, the very low risk of the development of lung impregnated disease by employees exposed to dust. Workers will be exposed to dust being blown into the eyes and causing eye irritation and conjunctivitis. Dust suppression measures would include soaking of surfaces if feasible and enclosures while employees will be equipped with the necessary personal protective equipment (PPE).

##### Mitigation

The following measures would be implemented to reduce the impact of dust on the environment:

- Personnel working within dusty environments would be required to use dust masks or respirators.
- During dry periods, reduced-speed driving to minimize dust generation will be practiced on routes traversed by vehicles, and, in addition, these routes may be soaked if feasible.

#### **5.2.1.6 Noise**

##### Impact

Noise will be generated by the operation mainly from the use of generator, heavy duty equipment and machinery.

##### Analysis

Noise levels above the alert threshold of 86 decibels and hazard threshold of 95 decibels will be produced from heavy-duty equipment and machinery. Exposure to noise levels above the internationally accepted level of 90 decibels can cause noise induced hearing loss. Noise levels above the tolerable threshold of 72 decibels can result in fatigue, tiredness, low morale and decreased productivity. Heavy duty equipment usually generates significant levels of noise. The 500 kVa generator to be used to provide power will also generate high levels of noise. However, there are no immediate communities in close proximity to the project site that would be affected by noise. Nevertheless, measures would be implemented to reduce noise levels to that recommended by the GNBS Guidelines for Noise Emission into the Environment. The limit prescribed in the GNBS Standard for industrial operations is 100dB during the day and 80dB during the night at the property boundary or fifteen (15) meters from the source. Measures will include equipment enclosures and installation of mufflers. Careful siting of the noisy equipment and generators away from the housing facilities and base camp will reduce the nuisance to workers. Workers will also be equipped with the necessary PPE such as ear muffs. Noise levels will be monitored on a periodic basis.

##### Mitigation

The following are measures that would be implemented to reduce noise levels and nuisance:

- Generators and other noisy equipment will be sited at a distance away from the base camp and work areas and configured in a manner that does not present a noise nuisance to personnel.
- Noise levels will be controlled at the source via installation of silencers and mufflers on exhaust systems. Efforts will be made to ensure machinery and equipment are working efficiently and have installed the required muffler devices.
- Noisy equipment such as generator will be enclosed in sound proofing material, if necessary.
- Personal Protective Equipment will be provided to employees exposed to high noise levels.
- Warning signs would be erected in areas of high noise levels instructing employees to wear earmuffs or earplugs as required.

#### **5.2.2 Impacts on the Biological Environment**

Section 3.2 describes the flora and fauna found in and around the project area. The species identified represent those that have adapted to life in the savannah habitat. All of the species observed are common and are present throughout the savannah ecosystem in the both the north and south savannahs.

The savannah environment is a distinct environment in Guyana. The flora and fauna in the area is typical of savannahs. The area is within one of a large expanse of savannahs found in the Rupununi. Because of its unique composition of flora and its unique landscape, the savannahs have considerable conservation potential. If not properly managed there can be considerable potential conflicts between utilisation and conservation within the savannah area. Ensuring the environmental integrity of the area while engaging in the proposed project will have to be achieved by finding a good balance between protection and utilisation of the resources in the area by the project.

Recurrent fire is considered one of the most important threats of the savannah system, although paradoxically, it may also be necessary for the maintenance of that same savannah. The effect of fire on the savannah ecosystem and its surrounding forests should therefore be considered an important issue. Fire is also a threat to the forests surrounding the savannahs and considerable changes have already taken place at the forest-savannah interface. The project being located in the area will help to provide some protection and help reduce the threat of fires in the area.

#### **5.2.2.1 Flora**

##### Impact

The flora in the area of influence is very typical of the vegetation found in savannahs in Guyana. It should be noted that the area will undergo changes in the vegetation since areas will have to be cleared and leveled to facilitate preparation of land for the cultivation of the different crops that are proposed. This will result in direct loss of vegetation. In the areas where cultivation would be undertaken much of the savannah vegetation will be removed. However, the existing bush islands will not be removed. These will remain intact. Vegetation from the edge of waterways and in the ponds, lakes and seasonal and permanent wetlands will be maintained as far as is practical. To facilitate the cultivation of rice there will be a change in the ecosystem from usually dry areas to one of seasonal wetlands for rice cultivation.

##### Analysis

##### *Terrestrial vegetation*

Clearance of vegetation in the targeted areas will be necessary during land preparation. Selective removal of individual trees as is currently being done in Brazil will be the method of tree removal. Mainly natural shrubs which currently grow on the targeted cultivation areas will be removed. These shrubs commonly referred to as “wild cashew” and “sand paper” are not present on all the targeted sections of the land, and in the areas where they are present they exist in varying degrees of density. Shrub clearing is a delicate exercise and due care will be taken during this process to minimize the disturbance of the top soils. This shrub clearing process has been developed to a highly scientific level by Brazilian farmers who clear these shrubs with minimal top soil disturbance. This will be a manageable operation and one that will have little impact on the soil itself since tree population is very sparse hence the amount of tree removal is minimal. It must be noted that no vegetation will be removed from the bush islands and other areas not used.

Most of the vegetation in the proposed project area is savannah grass and small herbs. The savannahs of Guyana in both the north and the south are extensive and the varieties of grass species are similar in all of these areas. The area is not used for any other purpose and as such the grass and herbs are considered weed species and perform a basic ecological function of soil stabilization.

No natural rainforests are present in the proposed project area that the Project may encroach upon, thereby reducing the natural habitat for terrestrial wildlife and flora. The terrestrial flora

present in the project area is mainly composed of species that are highly migratory and which are found in the extensive savannahs around the project area.

The vegetation in the Bush Islands will, as much as possible, not be impacted since the Company has committed to leave all 'bush islands' intact and untouched to the extent practical as a voluntary conservation effort. This deliberate decision taken by the Company is to ensure that the vegetation which is characteristic of such 'bush islands' in the savannah is preserved to continue to provide ecological functions. The bush islands are located on slightly higher elevations and have representative samples of most of the vegetation types that are present in the savannahs and the project area. Hence retaining the vegetation in these areas will ensure that there are representative samples of typical savannah vegetation in these locations. In addition the vast areas of savannahs that exist in the north and south Rupununi will still allow for other areas with representative vegetation to still be present. An area of reserve exists along the bank of the Ireng River and the vegetation will be maintained.

#### *Aquatic Flora*

Regarding aquatic flora there is very little aquatic flora species recorded for the project area when compared to the terrestrial species. There are no recorded species that are endemic or threatened in any of the temporary or permanent water bodies. Some of the water bodies will be incorporated into the cultivation area for rice. There will be no anticipated impact through the loss of vegetation in these areas.

The drainage and irrigation system that will be put in place and the cultivation of rice will lead to the creation of a larger seasonal wetland. This will in no way affect the aquatic vegetation species since vegetation in the drainage and irrigation waterways will monitored and managed to ensure a free flow of water. As such there are no anticipated impacts due to the proposed work.

#### Mitigation

Overall, the species that are present in the project area does not include any that are rare, threatened or endangered. The species that will be lost as a result of clearance for land preparation and cultivation will not result in the loss of any rare, threatened or endangered. The loss of vegetation and habitat would not have a major impact on the survival of wild flora and faunal species and biodiversity in general. The impact of the loss of vegetation will be minimal and will not constitute a significant impact. The impact is also considered to be reversible. However, the following measures will be implemented to reduce any impact on the flora within the project area:

- The vegetation on the 'bush islands' would be retained so their ecological function can be maintained. This vegetation on the bush islands is of great importance and retaining it will provide a very good mix of conservation practice while engaging in productive agriculture activities.
- Clearing would be limited to areas where it is absolutely necessary.
- A vegetative buffer will be maintained along the bank of the Ireng River.

#### **5.2.2.2 Fauna**

##### Impact

Transformation of the terrestrial area for rice and other crop cultivation will bring about some changes that may have minimal impact on the faunal species in the project area. The major impacts on the faunal species that can arise in the project area are habitat loss, destruction and fragmentation.

## Analysis

### *Wildlife*

Clearing and transforming the area will result in minimal effects that will not be limited to the specific area only with regards to faunal species. When an area is cleared the effects are not limited to that area only. The fact that the area will be transformed into a seasonal wetland for rice cultivation will result in the altering of the area and the offering of a different set of habitat options for different species.

The removal of savannah vegetation within the project area will result in some amount of habitat loss for species that inhabit primarily low grass type areas. This loss will likely affect those species that depended on these species and may lead to migration of the species. Transformation of the habitat will result in some amount of fragmentation of the habitat for some species in the surrounding areas of savannah and 'bush islands'. Ultimately species will migrate away from the area and will find suitable alternative habitats nearby.

Wildlife may be lost as a result of hunting and trapping by workers at the project site during preparatory and operational phases. Only some species may be affected by this aspect. During the implementation phase disturbances noise will not have any significant impact on existing fauna.

The faunal species are highly migratory and will be able to migrate from areas of undue influence to other suitable similar areas. The fauna that was observed were all highly mobile and migratory species that easily adapt to changing environments. Given the highly migratory potential of the faunal species it is determined that overall the direct impact of the project on these species will be of no significant impact to the species at the site locally or nationally.

### *Avifauna*

One of the observations made was that there was not a visible presence of flocks of birds. Many of the species that were identified were based on individuals rather than flocks being observed. This may be as a result of the area having the resources to support the identified species at any one time. Another reason could be that the species are transient and highly mobile and migratory.

The proposed development is not expected to have any significant impact on the avifauna in the area. These species are highly migratory and will find suitable alternative flyover routes and will also be able to find suitable feeding and nesting areas. In addition, the 'bush islands' and other areas which will be retained will provide normal habitat services for species that currently inhabit these areas. During the visit to farming areas in Brazil, a significant number of species of birds were observed around the farming areas since the agricultural activities provides good food source. Birds would usually feed on the grain crops and on pests associated with those crops. This situation is very similar to rice cultivation areas in coastal Guyana.

### *Aquatic Fauna*

The majority of fish fauna found in the aquatic environments – ponds, lakes, rivers – are common in the savannah seasonal and temporary water bodies. Fishes represent an important source of food and livelihood for communities. On the proposed property there are some seasonal water bodies that will be incorporated into land areas for rice cultivation. However, there are other permanent water bodies which, to the extent possible, will not be affected by the activities, including the pond that is located near the current project base. These water bodies (ponds) will be retained and should allow fish species that are present to continue to thrive.

No major negative impact is anticipated on the fauna in the riverine system that adjoins the property. This impact is not anticipated in addition to the fact that there will be water off-take from the Ireng River to irrigate the cultivated areas. The water irrigation system that is proposed will return water to the river system. This water would have been circulating and settling out and so pose no threat to resident fauna and no threat in terms of increasing the turbidity of the river water.

The Project is not likely to create any disturbance to the aquatic environment. The increased capacity for drainage will be met by drainage and irrigation systems that will be put in place to facilitate the crop cultivation process. The project will create enlarged aquatic habitats which will be seasonal, especially in the areas where rice cultivation will be undertaken. Water retention structures will also expand water body areas and create enlarged habitats that may facilitate feeding of some faunal species.

During implementation some construction works may cause erosion thereby increasing the turbidity in adjacent waters. However, fish species are generally adapted to such conditions. Further, disturbance from construction may cause fish to migrate away from the sites. However, these disturbances will be temporary and reversible. The negative impact is assessed to be only minor and temporary.

#### Mitigation

Loss of fauna during the preparatory and implementation phases of the project will neither be significant nor major. The faunal species identified in the area are highly migratory and will find suitable alternative habitats. Direct habitat loss cannot be fully mitigated and as such there may be some residual effect. However, with the appropriate mitigation measures in place, little or no residual effect is anticipated. In this regard, the following measures will be implemented:

- Trees and vegetation removal will be undertaken in areas where only absolutely necessary.
- All necessary precautions will be taken to ensure that the 'bush islands' and other vegetated areas remain intact.
- There will be minimal use of agrochemicals that are harmful to fauna.
- As much as possible, agrochemicals to be used would be of types that are not persistent in the environment and the correct dosage will be applied.
- Hunting of wildlife or trapping of faunal species by workers would be prohibited, unless necessary for the protection of crops and livestock. However, other environmentally sound best practices will first be considered to chase off any unwanted wildlife from the property.

#### **5.2.2.3 Sensitive Species and Environments and Protected Areas**

##### Impact

Given the location of the proposed project, there is the possibility of sensitive species or habitats being affected.

##### Analysis

There are no protected areas present within the project site and therefore there are no foreseeable impacts. The Iwokrama Forest is located further north while the proposed Kanuku Mountain area is further south.

Regarding sensitive species the anteaters are considered sensitive species found within the area. The proposed project area is known to have a few sightings of anteaters. These will not be adversely affected since they have many alternative savannah areas nearby. The area that will

be utilized for the project will be transformed into a seasonal wetland for rice cultivation, thus removing it as a habitat for anteaters. However, the loss will not be very significant since there will be other similar habitat areas for the anteaters to traverse and use as corridors during their migratory movements. Hence the impact is expected to be minimal and not significant.

#### Mitigation

Despite the limited impacts anticipated on sensitive species and habitats the following measures will be implemented:

- All necessary precautions would be taken to ensure that activities associated with the utilization of the area and the cultivation of crops are undertaken with the strictest of conformation to the specific area that is demarcated for such purposes.
- Leaving the 'bush islands' and other vegetated areas intact will present a suitable habitat for the sensitive species.

#### *General Biodiversity Impacts*

The project is not expected to have any significant impact on the biological, terrestrial or aquatic environments. There are no rare, threatened or endangered species present in either the terrestrial or the aquatic environment

The savannah environment is considered a sensitive environment and the anteater is considered a sensitive species. However the proposed project is not anticipated to significantly impact on either the sensitive savannah ecosystem or the sensitive anteater species.

Loss of vegetation from the savannah ecosystem during preparation phases will not have any major significant impact because the vegetation types present is common in the savannah area and this area is very extensive in the Rupununi. As a result, the species that will be removed or lost are found elsewhere and so will not constitute a major species and or ecosystem loss.

The faunal species in the area are very mobile and will find suitable alternative habitats in nearby areas. Terrestrial species and avian species are also common species found in the area and general savannah ecosystem. These species will adapt to the changes that the project will bring.

The creation of seasonal wetlands areas for rice cultivation will provide additional wetland areas for some wetland avifaunal species. In addition the cultivated fields will provide feeding areas for some seed eating and other foraging species. Thus the project has the potential to increase the diversity of species in the area and also to provide suitable habitat areas for some species.

Overall, the potential impacts are determined to be very minimal, reversible and low impacting. In an effort to reduce the likelihood of any negative impacts it is recommended that the developer should adhere to proposed mitigation measures.

In terms of residual effect it is noted that while there may be some residual effect, with the appropriate mitigation measures in place, no residual effect is anticipated.

#### **5.2.2.4 Bio-safety and Bio-security**

##### Impact

Since the Company intends to conduct farming in a manner similar to what is currently being conducted in Brazil there is a possibility of activities occurring which can compromise Guyana's bio-security situation through the introduction of new or restricted species and varieties.

##### Analysis

Santa Fe Inc. intends to farm a similar variety of crops to what is currently being grown in Brazil. This includes the Roraima variety of rice. Cow peas and soya seeds will also have to be brought from Brazil since commercial quantity is not available in Guyana. The process will have to be managed carefully and will have to involve the Ministry of Agriculture through the NARI and the GRDB. Currently, there are no legislation of bio-safety and bio-security in Guyana. However, the Ministry of Agriculture does have mechanisms in place to regulate this kind of activity. This includes an approval process and quarantine facility at ports. If any material will be brought to Guyana from Brazil it will be done via Lethem. NARI has a presence in Lethem, including a quarantine facility. Santa Fe Inc. intends to work with NARI to ensure compliance with all the necessary requirements are complied with. NARI has recommended that the varieties of rice and peas currently being grown in Brazil should be utilized for the project since these were already evaluated in Guyana, especially in the Savannah areas.

At the moment no movement of live animals is allowed to across the border between Guyana and Brazil. The Rupununi region was recently declared free of the foot and mouth disease. However, the northern area of Brazil still is a concern regarding the disease. Also, no movement of live animals is allowed from the Rupununi to the coastal areas of Guyana. The unauthorized movement can result in the introduction of parasites and diseases which can affect local animal populations. The Company intends to comply with all regulations by the Ministry of Agriculture on the movement of live animals.

#### Mitigation

To ensure the bio-safety and bioi security situation of the Rupununi region and the country is complied with the following measures will be taken:

- Santa Fe Inc. will consult with NARI on the introduction of any new species or varieties.
- The Company will comply with all national requirements/mechanisms on the importation of new varieties, including quarantining.
- The Company will not undertake any movement of live animals across the border or to the coast unless the movement is authorised by the Ministry of Agriculture.

### **5.2.3 Impacts to the Socio-Economic Environment**

#### **5.2.3.1 Relocation of Residents**

##### Impact

The proposed project has resulted in the relocation of a family currently residing on the property.

##### Analysis

A small homestead was located within the old Santa Fe compound occupied by two elderly persons and their young grandchildren. They occupied a small hut made of wood, mud and leaves with an adjoining kitchen. Fruit trees were found scattered around the domicile. Farming is done by the couple in the neighbouring areas to provide food and income. Figure 54 below shows the homestead and one of the persons who were living there at the time. The individuals indicated that they had resettled on the property within the last four (4) years and claimed that the land was once a part of their grandparents' ranch. Their grandparents were a part of the Rupununi Uprising and fled the country after the uprising failed. The land was repossessed by the Government at the time. The area that was occupied by the couple, which was the compound of the former Santa Fe Inc., is where the Company is interested in utilising the same area to establish its compound. During the consultations the Regional Democratic Council (RDC) Region

9 had indicated that these persons were squatters and will have to relocate. The GLSC has also indicated that these persons were squatting on the land. As such, the couple was relocated.



**Figure 54: The Homestead located on the Property**

Since then, the RDC has facilitated the relocation of the family. Santa Fe Inc. has covered the cost of the relocation. A new home consisting of two bed rooms was provided with the necessary amenities. The home was constructed on a portion of land outside of the property boundary and closer to the area farmed by the couple, and as a result, has made the lives of the couple more comfortable.

There is a small patch of cassava cultivation on the property. The management of the Pirara Ranch has initiated this cassava growing as an experiment. GLSC has indicated that, since the plot is on Santa Fe Inc. property, the person conducting the cultivation has agreed that he will remove from the area once the crop is harvested. This plot is shown in the figure below.



**Figure 55: The Cassava Plot on the Property**

The Georgetown Lethem Road passes through the property as well as the access road to the Amerindian Village of Karasabai and the Pakaraima Mountain villages. These accesses will not be disrupted by the Company's operation.

#### Mitigation

In order to ensure that the relocation is done in a manner acceptable to all parties and to prevent and dislocation the following measures will be adopted:

- The RDC and GLSC would be engaged to facilitate the relocation of the residents.

- The affected parties would be informed well in advance of the relocation.
- Relocation would be done prior to construction.
- Relocation options will be discussed with the residents, including the possibility of being employed by the Company.
- The access roads passing through the property will not be disrupted.

### **5.2.3.2 Health and Safety**

#### Impact

The health and safety of workers can be affected by the project if established guidelines and practices are not complied with. Accidents and injuries to the workforce can easily occur from such an operation. Heavy equipment from the Company utilizing the Georgetown to Lethem roadway and the Karasabai access road presents a health risk to other road users.

#### Analysis

Health and safety is a concern from this operation since workers can be exposed to situations which can result in accidents or which can compromise their health. The Santa Fe farm operations will entail the use of heavy duty machinery, equipment and vehicles of all types. While training and monitoring will seek to reduce the risk of any serious accidents, incidents can still occur. Risks include accidents from the use of heavy duty equipment, exposure to noisy equipment, improper use of equipment, etc. These exposures can result in physical injuries such as cuts, bruises, loss of limbs or can even be fatal. Exposure to high noise levels can result in increased stress levels. The risks can be significantly minimized by the use of PPE or complying with basic rules.

Workers would also be exposed to chemicals such as pesticides which can affect their health. Workers will be trained in the handling and application of pesticides. The guidelines of the Pesticide and Toxic Chemical Control Board (PTCCB) will be complied with and the necessary PPE will be provided. The Material Safety Data Sheet (MSDS) for each chemical used will be available onsite in case of an emergency. Cleaned empty chemical containers will be punctured to prevent future uses by persons.

Since heavy duty equipment and vehicles will be traversing the roads passing through the property the safety of other road users can be endangered. Appropriate signage will be posted providing adequate warning to other road users on the potential dangers. Vehicles and equipment will comply with the traffic rules while traversing the main road.

Health and safety impacts could be exacerbated taking into consideration the access to immediate emergency and proper health care within the area. However, proper safety procedures and guidelines will be followed. The emergency response system will ensure proper health care is accessed in a timely manner. Workers will also be equipped with the appropriate PPE so as to minimize any potential for injuries.

Emergency response measures are discussed in Section 7. A Medex will be employed once the operation progresses. In the meanwhile the Company will utilize the services of the Medics from the nearby communities.

#### Mitigation

The following are measures to be implemented to ensure the operation is safe to both the workers and other users of the area:

- All hazardous areas will be secured.
- Warning signs will be installed in dangerous areas such as fuel and chemical storage areas.
- Smoking will not be permitted anywhere in or near the workshop, generator, and fuel storage area or in any other designated non-smoking area.
- All vehicle and machinery will be checked to ensure they are in a full functional state prior to usage.
- Proper skills set would be promoted among drivers and operators through training.
- Operators of heavy duty machinery must be licensed in accordance with the Laws of Guyana.
- Traffic warning signs will be erected along the main access roads.
- The Company will abide by the guidelines set out in the Occupational Health and Safety Act.
- All employees will be properly oriented to safety and health practices consistent with operation.
- All workers will wear the necessary protective gear and attire (overalls, gloves, respirators, hard hats, protective glasses and safety boots) as required, in particular the workers involved construction and in the application of pesticides.
- First Aid Kits with the requisite drugs and equipment to cater to emergencies or occurrences will be available at all times.
- Workers will be trained to use emergency response equipment such as fire extinguishers.
- Essential facilities for employees will be available which include drinking water, toilet and wash station.
- All chemical containers will be appropriately labeled.
- MSDS will be strategically located for use if necessary.
- Employees will be adequately trained in the handling and application of pesticides.
- The guidelines of the PTCCB will be complied with.
- An Emergency Response Plan is prepares of for the operation and will be implemented.

#### **5.2.3.3 Archaeological Deposits**

##### Impact

The project area has been occupied by Amerindians for centuries and as a result there is the likelihood of artifacts being present. Artifacts present within the project area can become damaged or loss as a result of the project activities, especially land clearing and preparation.

##### Analysis

The Rupununi is historically the home of the Macushi people with their settlements being described by the Europeans as early as the 1740s. The Wapishiana people are believed to be a more recent arrival to the South with some settlements spreading into parts of the North Rupununi. The Makushis and Wapishianas drifted from Brazil into Guyana from the beginning of the eighteenth century. They crossed in the area of the Ireng River and began settling in the north part of the Rupununi savannahs. Later, the Wapishianas began to migrate to the south of the Kanuku Mountain.

The project area was also utilised for large scale cattle ranching activities previously, serving as an outstation for the Pirara Ranch.

Given the above, there is always a possibility of finding some form of artifacts within the area. If unnoticed, activities such as vegetation clearing and land preparation can easily damage these materials.

#### Mitigation

The following procedure will be followed in the event that archaeological materials or site is discovered within the project area:

- All activities in the immediate vicinity of the remains will cease immediately;
- The find location will be recorded, and all remains will be left in place;
- Santa Fe Inc. will contact with the Walter Roth Museum and the National Trust of Guyana immediately;
- The Company will coordinate with the relevant personnel to determine the significance of the findings and assess appropriate mitigative options;
- If the significance of the remains is judged to be sufficient enough to warrant further action which cannot be avoided, the Company, in coordination with the National Trust of Guyana and the Walter Roth Museum, will determine the appropriate course of such action. Relocation of the artifact for preservation and security reasons may be determined as an appropriate action;
- In the case of human remains, the appropriate authority will be contacted. In addition, a coroner and/or physical anthropologist may be involved if the remains are classified as an artifact. Options for removal and burial will be considered if the location must be disturbed; and
- The National Trust of Guyana will inform the Company of when work may recommence in the specific area.

#### **5.2.3.4 Security**

##### Impact

The establishment of a project of this nature in the proposed location can result in the presence of unfavourable elements who can threaten the integrity and safety of the operations. In particular, the security can be of a concern regarding livestock, equipment and machinery and spares and parts for machinery. Absence of adequate security can result in robberies, loss of equipment and lowering of morale of workers which can affect productivity.

##### Analysis

In the context of the remoteness of the Santa Fe Inc. farm site, safety and security are paramount in the planning and implementation of the project. The rearing of several hundred heads of cattle and small ruminants on the farm in a border area poses several security challenges. The experience of the existing cattle farmers in the region points to a real threat of rustling by cross border rustlers. The Company will engage the relevant authorities for their full cooperation in addressing this threat in a practical committed manner. The security of the Company's other assets will be dealt with in a manner consistent with standard corporate operating procedures.

#### Mitigation

The following measures will be taken of ensure security of the site is maintained:

- The Company will maintain a security presence onsite, including patrol around the property.
- Livestock areas will be fenced.
- There will be close liaison with the Police Authorities to ensure collaboration.
- In-house training for staff will be conducted in safety and security procedures and emergency response.
- Movement in and out of the compound will be restricted to staff and authorized personnel.
- Communication equipment will be provided.

#### **5.2.3.5 Community Relations**

##### Impact

Community social values and relations can be compromised by the introduction of a project of this magnitude within the region.

##### Analysis

The Company will have a major presence in the North Rupununi District which would include a significant workforce. Workers can interfere with local communities including introducing STDs and illegal drugs. The Company will, as much as possible, employ persons from surrounding areas. Located in close proximity are the oil exploration joint venture and the Mertizerio Ranch. The Company will continue to build on the relationship with these entities. Santa Fe Inc. is fully aware of the economic and other developmental aspirations of the Region 9 community. The Company will ensure that, beyond its role as an investor and employer within Region 9, it will be recognized as a good corporate citizen, supportive of the educational and cultural activities within the Region. The Company will work closely with the RDC and other government agencies to transfer technology, share experience and contribute to developing the region. The Company's vision encompasses the transfer of technology used in its farm project to the wider agricultural communities within Region 9.

##### Mitigation

Several social issues can arise as a result of the implementation of the project which can affect the Company's relations with surrounding communities. As such, steps would be taken to prevent these issues from arising and include:

- The RDC will be kept abreast of the development plans of the project once the plans are finalised.
- The relevant authorities will be notified of any emerging problems and the Company will work with these authorities to address any issue. .
- As much as possible the Company will employ workers from surrounding communities.
- Workers interference with the local communities will be minimal.
- Drugs and alcohol use by workers would be prohibited.
- Recreational facilities will be provided onsite for workers.
- Santa Fe Inc. will establish good relationship with its neighbours.
- The Company will contribute in a meaningful and practical manner to the development of the region, including the sharing of knowledge and the transfer of technology.

### **5.3 Training**

Since this type of agricultural development is new to Guyana it is important that training be provided. Technical guidance is currently being provided by the CAMPO consultancy group from Brazil. For project implementation this group will also provide technical training. Campo will provide a resident farm manager initially for the first year of project implementation. This person will be supported by a team of consultants. Technical guidance and supervision will also be provided by EMBRAPA.

In addition to the technical training, for effective implementation of the mitigation measures and for a safe and healthy work environment, other training will be provided to workers. These training will include, but will not be limited to, the following:

- The Company environmental requirements and environmental management measures;
- Workers role and responsibilities in environmental management;
- The 'no hunting' policy of the Company and the need to be alert for the presence of native fauna;
- Importance of archaeological sites and responses in case of a discovery;
- Occupational safety and health measures and the use of PPE; and
- Emergency response measures.

## 6.0 MONITORING AND MITIGATION

### 6.1 Monitoring Plan

A number of parameters will be monitored during the project implementation. The parameters are based on the main impacts relating to a project of this nature. The Plan also takes into consideration the roles and responsibilities of key institutions during the implementation of the project.

**Table 25: Monitoring Strategy**

Parameter	Institution Responsible	Frequency	Location of Monitoring
<b>Physical Environment</b>			
<b>Noise</b> <ul style="list-style-type: none"> <li>Decibels</li> </ul>	Santa Fe Inc.  EPA	Quarterly  Biannually	<ul style="list-style-type: none"> <li>Boundaries of the Compound</li> </ul>
<b>Surface Water Quality</b> <ul style="list-style-type: none"> <li>pH</li> <li>Conductivity</li> <li>Turbidity</li> <li>Dissolved Oxygen</li> <li>Total Dissolved Solids</li> <li>Total Metals</li> <li>Total Suspended Solids</li> <li>Sulphates</li> <li>Nitrates</li> <li>Oil and Grease</li> <li>Biological Oxygen Demand</li> <li>Biological Oxygen Demand</li> </ul>	Santa Fe Inc.  EPA	Quarterly  Biannually	<ul style="list-style-type: none"> <li>Ireng River Upstream of the property</li> <li>Ireng River Downstream of the property</li> <li>Passarina Creek Mouth</li> </ul>
<b>Waste Management</b> <ul style="list-style-type: none"> <li>Compliance with Waste Mang't Plan</li> <li>Waste Accumulation</li> </ul>	Santa Fe Inc.  EPA	Weekly  Biannually	Waste receptacles and large storage container, waste disposal pits and general project area
<b>Wildlife</b> <ul style="list-style-type: none"> <li>Hunting</li> <li>Trapping</li> </ul>	Santa Fe Inc.	On Observance	General Project Area
<b>Socio-Economic Environment</b>			
<b>Health and Safety</b> <ul style="list-style-type: none"> <li>Use of protective gear by staff</li> <li>Condition of fire-fighting stations and equipment</li> <li>Adequate and appropriate signage for emergencies</li> </ul>	Ministry of Labour  Santa Fe Inc.	Biannually  Daily/Weekly	Project Area

Parameter	Institution Responsible	Frequency	Location of Monitoring
<ul style="list-style-type: none"> <li>Location of Emergency Procedures</li> <li>In house training to keep employees up to date with various safety procedures.</li> <li>Health conditions of staff.</li> </ul>			

The General Manager would inspect the sites on a regular basis. Monthly Environmental Reporting will be carried out. An Environmental Incident Report will be used as a means of identifying and rectifying existing or potential environmental problems. All areas of concerns would be visited once per week, or more frequent, if necessary. External environmental audits may also be done by a third party if required to ensure compliance with all the environmental requirements and to ensure the mitigation measures are implemented effectively.

Records of monitoring will be kept by Santa Fe Inc. on-site and made available to EPA or other regulatory authorities upon request. Monitoring results, which exceed national standards, will be immediately reported to EPA. Monitoring reports will also be submitted to the EPA on an annual basis.

It should be noted that for monitoring activities to be conducted by regulatory bodies such as the EPA, Ministry of Agriculture institutions and the Ministry of Labour, the Company will facilitate these exercise by providing personnel, internal transportation and accommodation.

This Monitoring Plan has focused on social and environmental parameters to be monitored during the implementation of the project. There will be a routine schedule for equipment monitoring and maintenance in keeping with equipment and machinery design standards and specification.

## 6.2 Mitigation and Monitoring Costs

Table 26 below provides an indicative annual budget of estimated costs for mitigation and monitoring activities for the first year of operation. Santa Fe Inc. will maintain this annual budgetary allocation and at the end of each year revise the budget based on previous year's experiences and price/cost changes. It is expected that some of these costs, which are indicated in US dollars, may already be catered for from other operational budget lines.

**Table 26: Budgets for Mitigation and Monitoring**

Environmental Component/ Impacts	Action	Equipment/ Personnel/Activities	Annual Cost US\$	Frequency
Waste	Collection and disposal of garbage	Bins and garbage receptacles Disposal of Waste Creation/managing of waste pits	2,500	Monthly
Water Quality	Water quality tests such as pH, Turbidity, COD, Oils/Grease, TSS,	Samples collected and outsourced to Lab for analysis	3,000	Quarterly

Environmental Component/ Impacts	Action	Equipment/ Personnel/Activities	Annual Cost US\$	Frequency
	etc.  Building of a berm around the fuel storage tanks and maintenance.	Procuring materials and labour	2,000	Month 1
Noise Pollution	Maintenance of generator		3,000	Biannually
	Routine maintenance of equipment and machinery, in particular muffler devices		5,000	Biannually
	Monitoring		1,000	Quarterly
Health and Safety	First Aid Kits	Procure kits	1,000	Month 1
	Protective gear for workers e.g. gloves, overalls, respirators, safety boots and ear piece.	Procure equipment	5,000	Month 1
	Warning signs within key buildings and work site areas	Prepare and erect signs	2,500	Annually
Emergency Response	Fire Extinguishers and Spill Kits.	Procure equipment	4,000	Month 1
Training	Training of personnel e.g. in Environmental Responsibilities, First Aid, Health and Safety, Emergency Response, etc.	Conduct training	3,000	Annually
Incidentals and Emergencies	Response needed in event of accidents and emergencies.		10,000	Annually
<b>TOTAL</b>			<b>USD\$ 42,000</b>	<b>Annually</b>

## **7.0 EMERGENCY RESPONSE PLAN**

Santa Fe Inc. will comply with all the environmental and occupational health and safety requirements to ensure a safe and healthy work environment. However, although all reasonable steps would be taken to protect the environment and minimize risks, occasions can arise when an environmental emergency can occur. In the event of an emergency, the objectives are to ensure a prompt and effective response, and to minimize the effects.

### **7.1 Introduction**

This Emergency Response Plan (ERP) describes the general types of emergency and actions to be followed, should an emergency occur during the mobilization and operational phases of the project. The ERP includes:

- Emergency Contact Details;
- Emergency Procedures;
- Description of an Emergency;
- Authority of Control;
- Scenario Description and Response;
- Materials Inventory; and
- Incident Reporting.

The above information will be provided to employees and placed at strategic locations within the project compound. Such locations will include the office, workshop and storage bonds.

In any ERP, It is critical that the workers be adequately trained on safety and there should be detailed emergency procedure, including frequent emergency drills, etc. The Farm Manager would take responsibility for the coordination and execution of actions as they relate to the environment and health and safety.

### **7.2 Emergency Response Philosophy**

The emergency response procedure involved the following priorities for action:

1. Protection of human health and safety;
2. Protect and minimize the effect to the health and safety of animals;
3. Contain the spread of material;
4. Neutralize and render safe any noxious or hazardous materials; and
5. Commence clean-up activities and site remediation.

By their very nature, emergency response procedures deal with events either not foreseen or almost totally unlikely. It is necessary therefore to plan for worst case scenarios or adopt general procedures, as normally anything that can be covered by a specific plan is not an emergency. It is important to recognize that, although highly unlikely, an emergency can have serious impacts well beyond the individual operation immediately involved.

### **7.3 Identification of an Environmental Crisis**

An environmental emergency would involve widespread actual or potential destruction or contamination of the environment that calls for immediate action. Given the nature of the proposed project, no major emergency is foreseen. Some examples of events that would require the instigation of an emergency response procedure at Santa Fe include:

1. A fuel spill;
2. A fuel tanker rollover involving the spillage of large quantities of fuel;
3. A savannah fire; and

4. Minor and major accidents.

#### **7.4 Emergency Contact Details**

The table below outlines the contact information in a case of emergency.

**Table 27: Emergency Contact Information**

<b>Organisation</b>	<b>Telephone Number</b>
SFI. G/town Office	226 2676
SFI Lethem Office	686 5765
EPA	225 0506
Regional Democratic Council Region # 9	772 2018/772 2021
Ministry of Agriculture	225 5973
Pesticide and Toxic Chemical Control Board	220 7887
Lethem Hospital	772 2206
Guyana Police Force Lethem	772 2005
Guyana Police Force G/town	225 6411
Guyana Defence Force G/town	226 4664
Air Services Ltd	222 4368
Roraima Airways	225 9648
Georgetown Hospital	227 8204

#### **7.5 Authority of Control**

The Farm Manager has the authority to take control of any incident and can make a decision to close down all or any part of the operations following an incident. The Farm Manager will also decide on the type and level of response required for a particular emergency.

#### **7.6 Minor Incident/Accident**

In the event of a minor accident, the Farm Manager will be informed and who then takes the responsibility for on-site treatment utilizing First Aid facilities. An entry will be done into the Accident and Emergency Record book. As the operation progress, an onsite Medics will be employed.

#### **7.7 Major Incident/Accident**

The following outlines the emergency response procedures for several types of emergencies that may occur during the construction and operation phases of the project. As was previously indicated, no major emergency is expected, given the nature of the operation.

The closest hospital to the site is the Lethem Hospital, which is some 55 km, or 45 minutes drive away. A medical emergency plan will be developed by SFI in conjunction with the Lethem Hospital authorities to cater for any situations that will require medical attention at that facility or need to be referred to a medical institution in Georgetown. The farm site's proximity to the Meritzero airstrip will also enable medical evacuations by aircraft to Georgetown or Boa Vista if required.

##### **7.7.1 Accident**

1. Inform the Farm Manager (and Medics).
2. In the case of injury, First Aid treatment to be applied.
3. Assess type of injury, i.e. broken leg, conscious or unconscious.
4. Arrange transportation to Lethem Hospital or Medivac.

5. Make entry into the Accident and Emergency Record book.

#### **7.7.2 Fire**

Firefighting equipment such as fire extinguishers and sand buckets will be located at strategic points within the project area such as fuel storage areas with instructions on their usage. These strategic points will be clearly marked, be visible and employees should have knowledge of their position. In the event of a fire, employees will initiate the following procedure which that they would be familiar with as a result of fire drills:

1. Immediately warn others and evacuate buildings or area.
2. Attack the fire if safe to do so, with firefighting equipment provided, but without taking personal risks.
3. Contact the Environmental Farm Manager.
4. Take decisions on containment. If it is a small fire, use fire extinguisher (Dry chemical such CO<sub>2</sub> or Halon). In the event of a larger fire, employ water spray. In the event of a fuel fire, move container from fire area if possible without risk, cool containers that are exposed to flames with water from side until well after fire is out and stay away from ends of tanks. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.
5. Make entry into the Accident and Emergency Record book.

#### **7.7.3 Fuel Spills**

Fuel will be stored on-site for the generator and refuelling of equipment. This will be done in above ground storage tanks located within a containment area with adequate capacity to contain any spill. However, in the unlikely event of a spill beyond or outside the containment area the following action will be taken.

1. Inform the Farm Manager.
2. With the use of on-site Spill Kits stop the flow if possible.
3. Prevent the movement of people or vehicles into restricted area.
4. Treat spill with absorbent materials such as sand or sawdust and a bund formed if possible to prevent the spill spreading and contaminating the waterways and soil.
5. Collect absorbent materials and place in a secured area with an impervious base at a restricted zone.
6. Make entry into the Accident and Emergency Record book.
7. Inform EPA ( for spills less than 2m x 2m the Agency will be informed Environmental Reports)

#### **7.8 Incident Reporting**

After every incident/accident a report will be required. The Farm Manager will have direct responsibility for the preparation of such a report. The following is a format, which would be used.

<b>Santa Fe Inc.</b> <b>Record of Accident/Incident</b>  <b>ENVIRONMENT, SAFETY &amp; HEALTH MANAGEMENT</b> <b>INFORMATION</b>	Type/Source: _____ / _____  Org. Code: _____
<b>TO BE COMPLETED BY FARM MANAGER</b>	
1. Reason for Record: <span style="margin-left: 100px;"><input type="checkbox"/> Accident</span> <span style="margin-left: 100px;"><input type="checkbox"/> Incident</span>	
2. Name: _____ 3. SSN: _____ <div style="text-align: center; margin-top: 10px;">(Last, First, M.I.)</div>	
4. Position: _____ 5. Phone: _____ <div style="text-align: center; margin-top: 10px;">_____</div>	
6. Date of Birth: _____ 7. Sex: <span style="margin-left: 20px;"><input type="checkbox"/> Male</span> <span style="margin-left: 20px;"><input type="checkbox"/> Female</span>	
8. Date/Time of Accident/Incident: _____ Time: _____ <span style="margin-left: 20px;"><input type="checkbox"/> AM</span> <span style="margin-left: 20px;"><input type="checkbox"/> PM</span>	
9. Duty Station Address: _____ <div style="height: 40px; border: 1px solid black; margin-top: 5px;"></div>	10. Location of Incident: _____ <div style="height: 40px; border: 1px solid black; margin-top: 5px;"></div>
11. Description of Accident/Incident	
12. Extent of injury or illness and Body Parts Affected:	
12. Medical Treatment? <span style="margin-left: 20px;"><input type="checkbox"/> Yes</span> <span style="margin-left: 20px;"><input type="checkbox"/> No</span> 13. Lost Time? <span style="margin-left: 20px;"><input type="checkbox"/> Yes</span> <span style="margin-left: 20px;"><input type="checkbox"/> No</span>	
Signature: _____ Date: _____	
14. Description of Treatment:	
15. Follow-up Acton:	
Signature: _____ Date: _____	
Title: _____	

**Figure 56: Suggested Format for Incident Reporting**

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## APPENDIX A – ESMP LETTER FROM EPA



### Environmental Protection Agency

December 03, 2010

Mr. William Hinds  
Project Director  
Santa Fe Inc.  
BB, Rome  
Agricola, Greater Georgetown.

Dear Mr. Hinds,

**Re: Environmental Impact Assessment Not Required for Santa Fe Inc. Integrated Farm Project**

The Environmental Protection Agency (EPA) acknowledges receipt of your Application for Environmental Authorization (Environmental Permit) dated November 03, 2010, for the construction and operation of the Santa Fe Inc. Integrated Farm Project, located at Santa Fe, North Rupununi Savannahs, Region 9. Please note that we have reviewed the information submitted and conducted a visit to the proposed site on November 18, 2010, and have concluded that an Environmental Impact Assessment (EIA) will not be required for the project. However, the Agency requires that you submit for approval, an Environmental and Social Management Plan (ESMP) for the proposed Project. The EMP should cover all phases of development and identify feasible and cost effective measures that may reduce potentially significant adverse environmental impacts to acceptable limits. The Plan should further address issues pertaining to conflicting land uses within the surrounding area and potential issues associated with Amerindian residents residing in the project site. Please find attached a copy of EPA's guidelines for the preparation of the ESMP.

In keeping with the Environmental Protection Act, 1996, the Environmental Protection (Amendment) Act, 2005, and the Environmental Protection Regulations, 2000, a Notice on the Agency's decision on your project will be published in the newspapers. Please be advised that within thirty days of the publication of the Notice, any person who may be affected by the project may lodge an appeal against the Agency's decision (EIA not required) with the Environmental Assessment Board (EAB). Once there are no objections from the public and all other permitting requirements are fulfilled, an Environmental Authorization with agreed conditions for construction and operation may be granted.

In the interim, you are required to submit the following information prior to the issuance of an Environmental Permit:

- No-objection letter from the Regional Democratic Council of Region No. 9;
- Site Plan showing the layout of all aspects of the operation, including drainage and irrigation plans;
- Copy of lease issued by the Guyana Lands and Surveys Commission; and
- Types and quantities of pesticides to be stored on site.

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Ganges Street, Sophia, Georgetown, GUYANA  
Tel.: (592)-225-5467-69 Fax: (592)-225-5481  
Email: [epa@epaguyana.org](mailto:epa@epaguyana.org)

*"The Environment is Everybody's Business"*



**Environmental  
Protection  
Agency**

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Should you have any questions or need any clarification, feel free to contact our Office.

Yours sincerely

Geeta Devi Singh  
Director,  
Environmental Management Division  
For Executive Director

Attach: EPA's Guidelines for Preparing EMPs

- C. Dr. Dindyal Permaul, Permanent Secretary, Ministry of Agriculture  
Mr. Doorga Persaud, Commissioner, Guyana Lands and Surveys Commission  
Mr. Clarindo Lucas, Chairman, Regional Democratic Council, Region 9

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Ganges Street, Sophia, Georgetown, GUYANA  
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*"The Environment is Everybody's Business"*

## APPENDIX B – ESMP TEAM

The team commissioned by EMC to prepare the ESMP for the Project is outlined in the Table below.

Personnel	Area of Expertise
Mr. Shyam Nokta	Environment and Natural Resources Specialist
Mr. Khalid Alladin	Environmental Management Specialist
Mr. Lakshman Persaud	Socio-economic Specialist
Mr. Phillip DaSilva	Biodiversity Specialist

## APPENDIX C - STAKEHOLDERS CONSULTED AND SUMMARY OF DISCUSSIONS

Stakeholder	Date & Location	Contact	Objective of meetings/consultations	Findings of the Engagement
Residents at Santa Fe	January 06, 2011	Household members at the single domicile	To gather information on their occupancy and awareness and concerns regarding the project	<ul style="list-style-type: none"> <li>Resident was willing to be engaged in the initial process</li> <li>The household member present during this visit spoke only Portuguese.</li> <li>The resident was worried about being on the Company's land, especially given the aftermath the Rupununi Uprising.</li> </ul>
NARI	April 13, 2011	Dr. Oudho Homenauth	To discuss findings of soil survey conducted	<ul style="list-style-type: none"> <li>The location is suitable for a range of crops including those proposed by the company.</li> <li>Inputs in the form of lime and fertilizers will be required.</li> <li>Minimum of low tillage systems should be employed.</li> <li>Crop varieties already established in Brazil should be pursued.</li> </ul>
RDC - Region 9	January 05, 2011	<ul style="list-style-type: none"> <li>Mr. Clarindo Rudolph - Regional Chairman</li> <li>Mr. Ronald Harsaywack – Regional Executive Officer</li> <li>Ms. Singh – Regional Vice Chairman</li> </ul>	<p>To engage the RDC in discussions on the proposed project.</p> <p>To gather information on the concerns of the RDC and any perceived impacts.</p> <p>To discuss the issue of the current occupancy of the land be the residents.</p> <p>To identify areas for collaboration.</p>	<ul style="list-style-type: none"> <li>The RDC supports the project and welcomes the development to the region.</li> <li>Deemed anyone dwelling on the land as squatters and indicated that the persons will have to be relocated.</li> <li>Does not believe the project will have the any significant negative social impacts.</li> <li>The RDC plans to learn from the project and transfer the technology to other areas within the region, given the growing demand for food in the region.</li> </ul>
EPA - EMD	February 11, 2011	<ul style="list-style-type: none"> <li>Geeta Singh, Director</li> <li>Teijvarti Persaud, Senior Environmental</li> </ul>	To determine any specific concerns of the Agency that should be addressed in the ESMP	<ul style="list-style-type: none"> <li>EPA wishes to have an assessment of the biodiversity present within the area and deforestation issues.</li> <li>The assessment should examine restrictions to the movement of wild animals and cattle.</li> <li>Indicated that storage and disposal of chemicals and</li> </ul>

Stakeholder	Date & Location	Contact	Objective of meetings/consultations	Findings of the Engagement
		Officer <ul style="list-style-type: none"> <li>▪ Sonia Gomes, Senior Environmental Officer</li> <li>▪ Tashana Redmond, Senior Environmental Officer</li> </ul>		containers must follow approved safety standards (EPA's Hazmat Unit). <ul style="list-style-type: none"> <li>▪ Indicated that a plan should be in place to deal with the squatters, including possible compensation.</li> <li>▪ Indicated that the aquaculture aspect will require a separate permit.</li> </ul>
Selected Stakeholders	January – March 2011	Other Regional Stakeholders (NRDDB, BHI, Annai Residents, Lethem Residents)	To gather feedback from other stakeholders within the Region on the proposed project (includes technical and layman's perspective)	<ul style="list-style-type: none"> <li>▪ Stakeholders are not aware of the project in detail to make proper comments.</li> <li>▪ Agreed that development in the area will bring additional employment to the Region.</li> <li>▪ Wishes to learn farming techniques and transfer the technology in order to become more food secured.</li> <li>▪ Seeks formal employment opportunities with the project</li> <li>▪ Wishes to learn more of the project.</li> <li>▪ Wants the project to partner with existing organisations in the Region.</li> </ul>

## APPENDIX D – WATER QUALITY ANALYSIS CERTIFICATE



### GUYANA SUGAR CORPORATION INC

#### CENTRAL LABORATORY

Research Centre, Agriculture Department, LBI Compound, E.C.D, Guyana, S.A.

Telephone #: 592- 220-2601 Email: ganpatj@guysuco.com

Fax #: 592-220-3018

CAEMS SOP/RF No.: 013.1	Version: 2	Revision Status: 1	Date of Issue: September 6, 1996	Expiry Date:
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## Analysis Report

Report Number: W 03/2011—C

Date: 2011-01-26

**To:**  
Mr. Shyam Nokta  
Managing Director, Environmental Management Consultants  
60 Area H, Ogle  
East Coast Demerara

Tele: 222 4565

Fax: 222 3172

**From:**  
Mr. Ganpat Jafer  
Analyst

**Central Laboratory**  
**Agronomy and Analytical Services Department**

Date Sample Received: 2011-01-10

Date Analysis Completed: 2011-01-26

**SAMPLE TYPE: Water**

SAMPLE DESCRIPTION	PARAMETER (with permissible limits)								
	pH (6.5-8.5)	EC <sub>w</sub> mS/cm	DO (mg/L) ≥ 5.0	TDS (mg/L) 200	TSS (mg/L)	SO <sub>4</sub> <sup>2-</sup> (mg/L) 400	Cu (mg/L) 1.5	Fe (mg/L) 1.0	NO <sub>3</sub> - N (mg/L) 100
SW 1	6.18	0.02	7.26	12.0	Nd	0.89	0.019	0.15	Nd
SW 2	6.58	0.02	7.19	10.7	Nd	1.18	0.017	0.15	Nd
SW 3	6.48	0.03	7.47	17.7	Nd	0.83	0.014	0.09	Nd
	Zn (mg/L) 15	Al (mg/L) 0.2	Oil & Grease 0.03	COD (mg/L) < 250	Turbidity (ntu) 10				
SW 1	0.016	0.154	Nd	8	2.8				
SW 2	0.015	0.230	Nd	24	8.7				
SW 3	0.020	0.220	Nd	8	11.6				

Nd = Not Detected

Checked by:

Mr. G. Jafer

Copied to: Mr. G. Ramnarain – Head, Agri Research Department  
Mr. Ashley Adams, Manager Soils and Plant Nutrition, Guysuco Inc

## APPENDIX E – GNBS LIMITS

### Point source discharge Limits for Industrial Effluent for Operations other than Mining, Forestry and Agriculture

Table 1

#### Parameter and Maximum Allowable Limits

(All values expressed as mg/L except pH, temperature and as otherwise noted)

Sector	pH	Temp.	BOD5	COD	DO	TSS	Nas NH3	Total N	P	CN (Tot)	PO4	Cl	Surfactants	Phenols	Coliforms	O&G	Other and/or Comments
Breweries	5.0-9.0	<40	<100 (t.v <50)	<250		<100 (t.v<50)	<50									10	
Cement Bagging, Manufacturing	5.0-9.0	<40			>4.0	50											WHO Stds for Ind. Manuf. Operations. Turbidity NTU: Max.dy: <150
Citrus Processing Plants	5.0-9.0	<40	<50	<250		<50	<50									<10	
Distilleries – (a) Blending Halls and Wineries	5.0-9.0	<40	<50			<50	<50										
Distilleries – (a) Fermentation/Distillation Units	5.0-9.0	<40	<500 (t.v.100)			<500 (t.v<100)											
Edible Oils	5.0-9.0	<40	<50	<250		50		<10								<10	
Meat and Seafood Processing	5.0-9.0		<100 (t.v<50)	<250		<100 (t.v<50)	<50									<30 (t.v<10)	
Metal Finishes	5.0-9.0	<40				(100 as settle- able solids			<0.5	< 10							CD:2.0; Cr(tot):2.0; Hg:1.0; Cu:3.0; Pb:0.1; Zn:3.0; Ni:3.0; Fe:5.0; Ba:10; Cr VI: 0.5
Milk Based Industries	5.0-9.0	<40	<100 (t.v<50)	<250		<100 (t.v<50)	<50									<30 (t.v<10)	
Paint and Ink Manufacturing	5.0-9.0		<100			<100								<10		<30 (t.v<10)	Cu:<30; Pb:<10; Cr:<20; Cr VI:0.5; Ni:<3.0; Zn:<3.0; Hg:<1.0

Sector	pH	Temp.	BOD5	COD	DO	TSS	Nas NH3	Total N	P	CN (Tot)	PO4	Cl	Surfactants	Phenols	Coliforms	O&G	Other and/or Comments
Pharmaceutical/ Chemical Production	5.0-9.0			<150	>40								<0.2	<0.5		<10	Secondary parameters: No3:40; SO4-2:1000; Cl:-300; NH4 as N:1.0
Petroleum Bulk Terminal	5.0-9.0	<40	<50	<250		<100										TPH<40	Pb:0.1; Cr GT 0; Cr)+A) 05
Printeries and photo- processing establishments	5.0-9.0	<40	<30	<150		<50										<10	Ag:0.5; Cd:0.1; Cr VI:0.1; Cr(tot):0.5; Cu:0.5; Zn:2.0
Soft Drinks Plants	5.0-9.0	<40	<100 (t.v<50)	<250		<100 (t.v<50)	<50										
Sugar Factories	5.0-9.0	<40	<250 (t.v<100)	<250	>4.0	<250 (t.v<100)											
Textiles	5.0-9.0			<250	>4.0	<500 (t.v100)						300	<0.2 detergts	<0.5	400 MPN per 100 mls	<10	Cr(tot):0.5; Cu:0.5; Ni:0.5; Zn:2.0; Co:0.5
Thermal Power Plants	5.0-9.0	<40				<100					5	Free CL 0.5				<20	WB Stds for metals: Cr(tot):0.2; Fe:1.0; Zn:1.0; Cu:1.0; New units are to meet these stds. Old units will be phased out within 3 yrs or pollution equipment will be installed. New WB stds available. No WB std for phosphate, limit taken from India and Sri Lanka
General Environmental Guidelines	5.0-9.0	<40	50	250	50 BS TSS	10			2	1 Free:0.4		Cl:0.2		0.5	400 MPN per 100 mls	10	WB STd: Flourine:20: No limits given for metals

Source: Guidelines for Industrial Effluent Discharge into the Environment