



RAYADUUL HAKH RICE INDUSTRIES

Environmental Management Plan



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- Mr. Rayaadul Hakh (Developer/Owner, Rayaadul Hakh Rice Industries)
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CHAPTER 1: BACKGROUND



1 INTRODUCTION

1.1 Overview

Agriculture is a major contributor to employment, foreign exchange and economic growth in Guyana, and the sector provides employment for 33% of the labour force and accounts for 40% of all export earnings (Government of Guyana 2014). Rice production is a significant contributor to Guyana's economy and is vital element of national food security. Approximately 6,020 farmers produce rice in several regions throughout Guyana. There are 43 licensed rice millers and 22 registered exporters of rice. Rice accounts for 3.3% of Guyana's total Gross Domestic Product (GDP) and 20.5% agriculture GDP. (Ministry of Agriculture, 2019) The rice sub-sector, which occupies some 80,000 ha, is the largest user of agricultural lands, and is the primary source of income and employment for thousands of Guyanese. In 2016, rice export earnings amounted to US\$178.8 million, i.e., 19.0% below the 2015 level as a result of lower average export prices for commodity (Bank of Guyana 2016). Guyana exported 499,192 metric tonnes of rice which signifies 7.1% or 38,142 metric tonnes less than the 537,334 metric tonnes exported in 2015 (Bank of Guyana 2016). The European Union's (EU's) share of rice exported increased to 44.5% from 34.4% in 2015, along with CARICOM's share which increased to 22.2% from 18.9% in 2015 (Bank of Guyana 2016). Latin America and the rest of the world's share was 33.4% compared with 46.7% in 2015 due to the loss of the Venezuelan market. The average export price of rice decreased by 12.8% to US\$358.2 per metric tonne compared to US\$410.9 per metric tonne in 2015 (Bank of Guyana 2016).

Rice farming therefore impacts a larger proportion of the working population than any other economic activity in Guyana (ECLAC 2011). There are approximately 12,000 farmers directly involved in rice cultivation, with thousands more employed in milling, transporting and exporting the product, in addition to providing various other services to the sector. The rice industry also accounted for 11.6% of the country's export earnings in 2016 (OEC 2016). In Guyana, two rice crops are produced annually, with the first harvest (spring crop) typically occurring sometime between February and May and the second (autumn crop) during the period September to December. Production of two crops is possible because Guyana experiences two rainfall peaks, referred to as the Primary (May-June) and Secondary (November-January) rainfall seasons, respectively, during which time field preparation and sowing of seed normally takes place.

Minister of Finance Winston Jordan in his 2018 Budget Speech disclosed that the local overall rice production had increased over the years, and the industry is expected to record an output of 602,087 tonnes for the year 2017 (MoA 2017). This will serve as a 12.7% increase as compared to 2016 output due mainly to an additional 14,000 hectares planted for 2017 spring crop and a further 74,481 hectares planted in the autumn crop (MoA 2017). Minister Jordan also noted that this anticipated increased output can be linked to the fact that there was an improvement in rice yields. Minister of Agriculture Noel Holder in 2016 projected an increased production output in the rice industry (MoA 2017). Minister Holder indicated that rice production declined

significantly in 2016 due to Climate Change or more specifically El Nino weather conditions, further; he also noted that a number of farmers left the rice industry due to the loss of the Venezuelan market (MoA 2017). As such, efforts by government and private millers to support new rice markets in 2017 has contributed to improved rice production.

Minister Jordan also expressed that, “These developments stem from farmers’ renewed confidence in their ability to access new markets. The recent attendance by the private sector at the Havana International Fair, in Cuba, helped to stimulate further investment in the industry.” The government recognised that one important aspect of strengthening the stability and sustainability of Guyana’s rice sector is to increase productivity per unit area and to update the expertise and technology in rice production. The Bank of Guyana in its 2016 Annual Report noted that the agriculture sector (rice milling) is expected to rebound in 2017 and onwards with 2.5% growth as a result of estimated increases in output of rice by 10.4%.

Rice farming, and its associated activities, is the single most important economic pursuit in Burma, Mahaicony, East Coast Demerara. As such, Rayaadul Hakh Rice Industries located within the area has since earned a reputation for producing quality products, and has become one of the largest producers/exporters of rice in the country; however, opportunities exist to improve productivity to meet international trade requirements. The first step toward achieving those said opportunities is through the acquisition of an Environmental Authorisation (Operation Permit).

1.2 Background to the Environmental Management Plan

In response to conformity with Guyana’s International obligations with regards to trade in rice, the Director, Mr. Rayaadul Hakh, of Rayaadul Hakh Rice Industries responded by applying to the Environmental Protection Agency (EPA) for an Environmental Authorisation (Operation Permit for Existing/Registered Operation) on June 22, 2020, for the purpose of operating the Rayaadul Hakh Rice Milling Complex.

The application was processed by the EPA and subsequently a verification visit was conducted, by two (2) Officers of the Agency to verify the information submitted in the application as well as to determine whether an Environmental Authorisation (Operation Permit) should be granted for the Company. Based on the findings of the verification visit by the Officers, the Agency determined that an Environmental Authorisation is required for the operation of the mill. This decision by the EPA was communicated via letter. The Agency also determined that an Environmental Impact Assessment (EIA) is not required for the Operation, but the Company must prepare an Environmental Management Plan (EMP) and submit to the EPA for approval prior to the issuance of the Permit.

This Environmental Management Plan (EMP) 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 EMP has been prepared in accordance with the EPA Guidelines for the preparation of EMPs and was guided by the correspondence from the EPA to Rayaadul Hakh Rice Industries. The EMP outlines measures to address all the potential impacts of the project on the physical, biological and socio-economic environment. The Plan focuses specifically on the environmental and social components of the Operation. However, many of the activities also involve elements of occupational safety and health and quality management which are integrated, as far as is necessary, with environmental management. As such, these areas were also addressed where relevant. This EMP is designed to achieve appropriate standards and consistency in the Company's environmental performance and the document is also supported by other documentation.

This EMP is considered as a management tool which reflects the changes in industry best practices, technology, legislation, the economic climate and the current status of onsite activities. This EMP is prepared for the Rayaadul Hakh Rice Milling Complex as is currently constructed and operated. Any major changes will be communicated to the EPA. This EMP may also be updated from time to time based on any changes relating to the operation that have occurred or any evaluation done on the effectiveness of the mitigation measures.

The Environmental Engineering Solutions (EES) was contracted by Mr. Rayaadul Hakh to assist with the preparation of the EMP. A team was commissioned by EES to prepare the EMP.

The following tasks were performed by the EES Team in the preparation of the EMP:

- Identified the relevant legislative and institutional framework regarding the operation.
- Compiled the description of the Rice Milling Complex operation, the natural environment and the baseline information of the project area; this includes the climate, geology, hydrology, air quality, water quality, noise, biological environs.
- Identified and compiled the potentially adverse and beneficial effects the mill operation would have on the physical, biological and socio-economic environments.
- Identified feasible and cost-effective measures to reduce potentially significant adverse environmental impacts to acceptable levels.
- Prepared an Environmental Monitoring Plan for the operation.
- Prepared a Waste Management Plan, that clearly describes and identifies all waste streams, mechanisms of disposal and mitigation.
- Prepared an Emergency Response Plan and training schedule of employees of the operation.

1.3.2 Methodology

The consulting team during the preparation of the EMP applied a number of approaches to assemble information for the document. These include interviews with key resource personnel, the use of existing information, onsite field assessments and interviews with communities. These approaches are further described below:

1. *Interviews with Key Personnel/Stakeholders* – Interviews were conducted with key resource personnel and stakeholders associated with the Company and the Rice Milling Complex to gather specific information necessary for the preparation of the EMP and concerns that should be addressed by the document. Stakeholders consulted included individuals from the Company Office and the Rice Milling Complex. Stakeholders consulted outside from the Company included institutions such as the EPA and *Review of Existing Literature* – Desk review of any existing and available data on the Rayaadul Hakh Rice Industries. These include information from the Company website, Ministry of Agriculture (MoA), the EPA, all relevant legislation and institutions pertaining to Rice Mills.
2. *Site Visits* – Site visits were conducted at the Rice Milling and surrounding communities (Strangroen Village) to gather baseline data on the project environment and to conduct the environmental, biological and social assessments. These include:
 - The physical environment (geology and soils, current infrastructure in terms of roads, trails, hydrology and drainage density, meteorological data, and assessing the consequences of the physical attributes of the area for the project);
 - The biological environment (fauna and flora, ecological attributes of the vegetation etc.) and assessing the consequences of the Mill on the biological attributes of the area.
 - 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 Rice Milling Complex.
3. *Testing* – Surface water, air quality, noise and soil testing was conducted to determine the quality of water, air, noise levels and soil characteristics within the project environment.
4. *Developed* – an environmental management plan, emergency response and monitoring plan.
- 5.

1.4 Company Background and Profile

The Rayaadul Hakh Rice Industries Mill facility is located at Lot 5 Strangroen, West Mahaicony, East Coast Demerara, Region 5 (Mahaica-Berbice). Strangroen, Mahaicony is approximately 44

km (27.3 miles) from Georgetown (Capital City). The milling capacity of the Rice Mill is approximately 10 MT/h (Metric Ton per hour). The Company was established as a commercial business venture to process harvested rice paddy and provide edible rice products for retail to consumers. The operations undertaken at the site is licensed by the Guyana Rice Development Board (GRDB) and is currently seeking an issuance of an Environmental Permit by the Environmental Protection Agency.

In the year 2018, the Rayaadul Hakh Rice Industries total takings from commercial sale of the Company's products amounted to G\$ 6.5 Billion. The annual production for 2018 by Rayaadul Hakh Rice Industries totalled 55,950 tons comprising Cargo Rice (30,000 tons), White Rice (15,000 tons), Husk (9,000 tons) and Bran (1,950 tons).

Therefore, in keeping with our contribution to Guyana's economy and responsibility to the environment, the Rayaadul Hakh Rice Industries prides itself in producing quality products at reasonable competitive prices while ensuring compliance with Environmental standards and practices.

Table 1: Rayaadul Hakh Rice Industries Local Addresses

| | |
|--|---|
| <p>Office: Lot 5 Strangroen, West Mahaicony, East Coast Demerara, Guyana.</p> | <p>Company: <i>Rayaadul Hakh Rice Milling Complex</i> Lot 5 Strangroen, West Mahaicony, East Coast Demerara, Guyana.</p> <p>New rice mill section Lot 6 Strangroen, West Mahaicony, East Coast Demerara, Guyana.</p> |
|--|---|

Environmental Responsibilities and Implementation of the EMP

Mr. Rayaadul Hakh heads the onsite operation. He has the responsibility for the operational aspect of the Rice Milling Complex, including the implementation of the EMP and ensuring the conditions of the Environmental Permit are complied with. The Managers also oversee occupational health and safety. Environmental Engineering Solutions (EES), contracted by Rayaadul Hakh Rice Industries will provide technical expertise and assistance in establishing an environmentally sustainable operation. The organisational structure for the operation of the Rice Milling Complex is outlined in Figure 1 below:

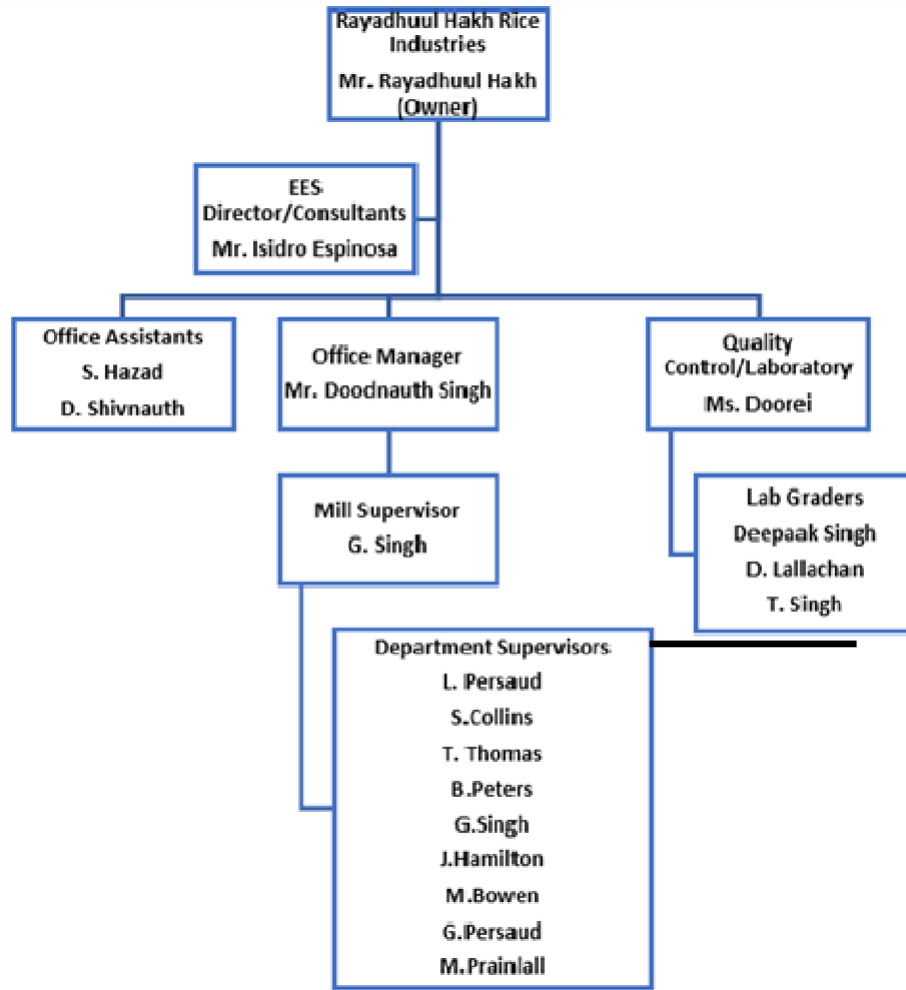


Figure 1: Organisational Structure of Rayaadul Hakh Rice Industries

1.5 Status of the Project

Rayaadul Hakh Rice Industries has since over the years earned a reputation for providing quality products, and has become one of the largest producers/exporters of rice in Guyana. Rayaadul Hakh purchases in excess of 500,000 bags of paddy per crop annually i.e., from approximately one hundred (100) rice farmers. Rayaadul Hakh Rice Industries currently employs 76 persons as main driving force to produce mainly white rice, cargo rice and rice bran, the company operates on a twenty-four (24) hours per day basis during the paddy purchasing, drying and the milling period. During the crop season storage of paddy at the operation are in excess of three hundred thousand (300,000) bags at any given time while the storage of the finished product (rice) is in excess of fifty-five thousand and nine hundred and fifty metric (55950) tonnes.

The mission of this company is “*through the use of modern technologies and empowerment of our employees, the Hakh Group can continue to reach new heights*”. Rayaadul Hakh Rice Industries takes pride in ensuring quality products, skilled personnel, and operating a state-of-the-art laboratory. The Company’s commitment to the rice industry includes farming assistance, drying and storage facilities and rice milling operations. Over the years the Company has been working in close association with rice farmers to grow more rice in a sustainable manner. This initiative resulted in substantial yields, better quality of rice and an improved standard of living for farmers. Other contributions of the Company towards the farming community in and around the region include financing, fertilizers, diesel, seed paddy and consultation.

CHAPTER 2: DESCRIPTION OF THE PROJECT



2 PROJECT DESCRIPTION

2.1 Project Location

The Rayaadul Hakh Rice Industries facility is located at Strangroen, Mahaicony, East Coast Demerara, Region 5 (Mahaica-Berbice). Strangroen, Mahaicony is approximately 44 km (27.3 miles) from Georgetown (Capital City). The Rice Milling Complex is in proximity to the Regent Back Housing Scheme (approximately over 500 m south-west of the operation). The Regent Back Road is located immediately east of the operation and there are vacant vegetated lands located immediately west. Figure 2 below illustrates the location of the Rayaadul Hakh Rice Industries.

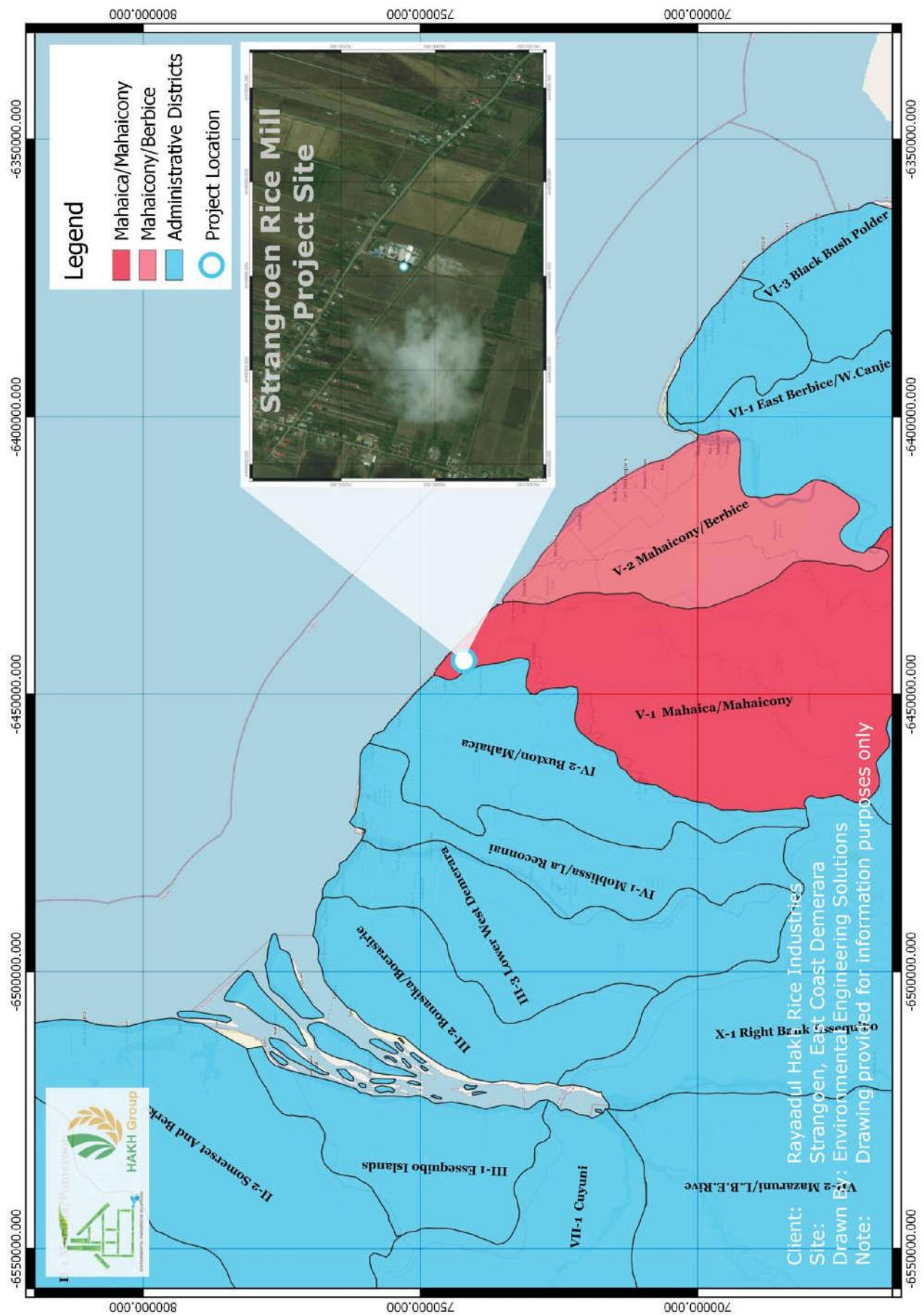


Figure 2: Location of Rayaadul Hakh Rice Industries Mill

2.2 Project Synopsis

Rayaadul Hakh Rice Industries Rice Milling Complex has been in operation midyear 2004. Built and established in 2004, Rayaadul Hakh Rice Industries was granted a one-hundred (100) years contracts by the Government to operate the Rice Milling Complex. Paddy is sourced from rice farmers in the Mahaica - Mahaicony Region Five (5) area and it is processed at the Mill. The products produced by the Rayaadul Hakh Rice Industries are Cargo Rice, White Rice and Rice Bran. The majority of the products produced are exported for commercial retail to Latin America, the Caribbean, and South America.

The Rice Mill comprises the following:

- An Office;
- A truck scale;
- Storage Bonds;
- A Mill;
- Column Dryers; Flat/Horizontal Dryers;
- Wet Bins;
- Tempering Bins;
- Rectangular and Circular Storage Bonds;
- Four (2) Fuel Tanks;
- Final Storage Facilities;
- Paddy Cleaner
- Three (3) Dryers (two (2) fueled by firewood, one (1) fueled by paddy shell)
- Mill Sheller (Cargo Mill)
- Polisher
- Trucks
- Forklifts
- Excavator
- Bulldozer
- Front end Loader
- Cyclones
- Three (3) Generators [750 KVA, 320 KVA and 500 KVA respectively]
- Thermoelectric Plant (Biomass Thermoelectric Plant-Rice Husk)

Rayaadul Hakh Rice Industries., operation currently employs approximately eighty (80) individuals. The staff complement, which span across the Rice Mill, work in administration, mill operation, packaging, transportation, and maintenance.

Staff consists of eighty (80) permanent employees and twenty (20) temporary employees) who work during crop season (purchasing, drying and milling period) and the facility operates on a twelve (12) hour basis every day during crop season, from 07:30 h – 19:00 h Monday to Friday and from 07:00 h- 16:00 h during the out-of-crop season (cleaning, maintenance and preparation for the crop). The operational activities and services provided by the Rayaadul Hakh Rice Industries takes place within normal working hours of 8:00 AM to 4:00 PM, Monday to Friday, and 8:00 AM to 12:00 noon on Saturday if required.

2.3 The Rice Mill

Rayaadul Hakh Rice Milling Complex has been functioning since 2004, with an operating capacity to produce ten (10) tonnes of Cargo Rice per hour. During times of production the Rice Mill operates 24 hours per day in an effort to satisfy the export market. The Rice Milling Complex produces White Rice, Cargo Rice and their by-products. The by-products of White Rice are Rice Bran and White Broken Rice, while the by-product of Cargo Rice is Cargo Broken Rice. There is no Parboiled Rice produced by this operation.

Ninety five percent (95%) of the produce from the Rice Milling Complex are exported (this also includes Rice Bran), the remaining five percent (5%) is sold locally i.e., small quantities of White Rice, Rice Bran and White Broken Rice. The Mill also produces packaged Rice of various sizes (i.e., 1 kg, 2 kg, and 5 kg in plastic packages as well as 10 kg, 25 kg, 45 kg and 50 kg in poly bags) from a range of machines. The Mill can produce extra good quality rice or quality as per request from Buyers i.e., 5% Broken with 40% Whiteness, therefore any rice specification that the Buyer may request, can be produced because the Rice Milling Complex comprise of two (2) Sortex Machines (which can sort the rice to bring from low quality to extra good quality).

The complex has of a fully equipped Laboratory to test for various specifications or grades of rice requested by the Buyer and this informs the milling operation of the standards to be met for producing quality rice. Currently, the Rayaadul Hakh Rice Industries Milling Complex is working towards loading the majority of export Rice in Containers (in bulk) at the Mill, in an effort to save time; minimize cost, shortage/tonnage and spillage of rice. Cargo Rice will be loaded in one (1) tonne sacks and offloaded into a Bin in bulk (approximately 25 tonnes go into bulk) by a Loading Belt into one container and then exported, Packaged Rice will also be loaded in containers for export. Also, the option is for loads in one (1) tonne sacks and transported directly to the Wharf and loaded in bulk and then into a Vessel to meet health and safety guidelines

2.3.1 Circular Economy Approach towards Sustainability

In efforts to adopt a circular economy approach to business, the Rice Mill has implemented a Thermoelectric Plant which utilises rice husk waste from the milling process to generate electricity for the powering the Rice Mill completely. The Circular economy is guiding the Rice Mill Operation through its three principles: Design out waste and pollution; keep products and materials in use; and regenerate natural systems. A circular economy does not only amount to adjustments aimed at reducing the negative impacts of the linear economy, but it also represents a systemic shift that builds long-term resilience, generates business and economic opportunities, and provides environmental and social benefits (The Ellen Macarthur Foundation, 2017: <https://www.ellenmacarthurfoundation.org/circular-economy/concept>)

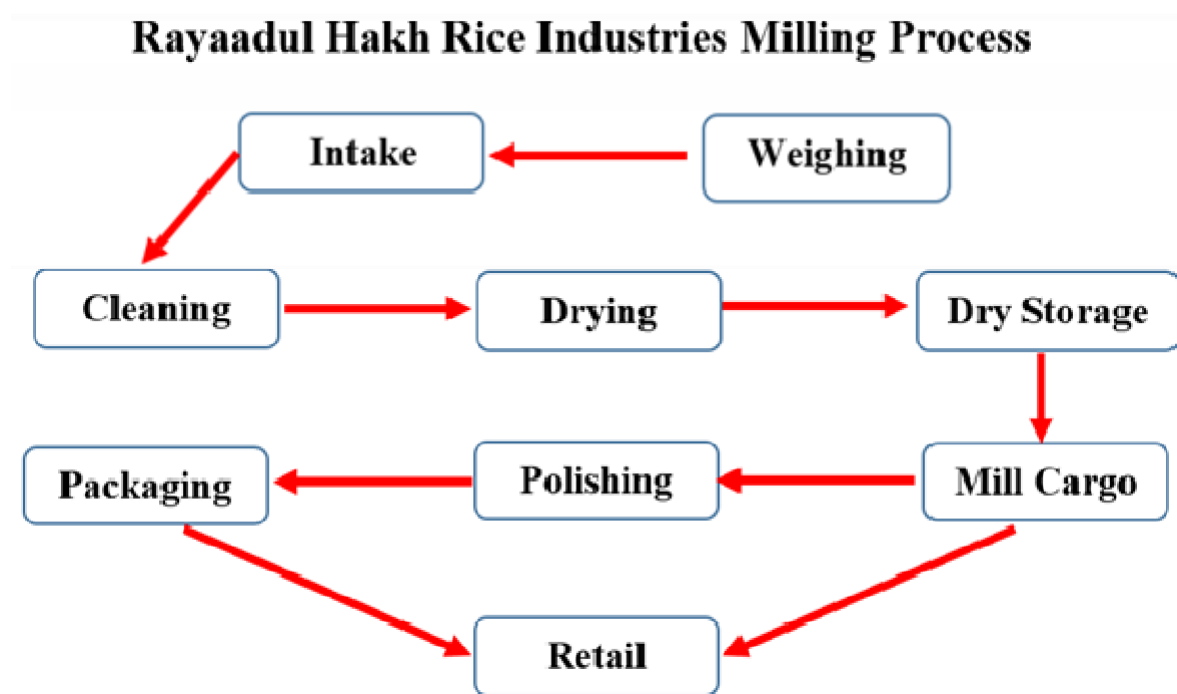


Figure 3: Rayaadul Hakh Rice Industries- Linear Process

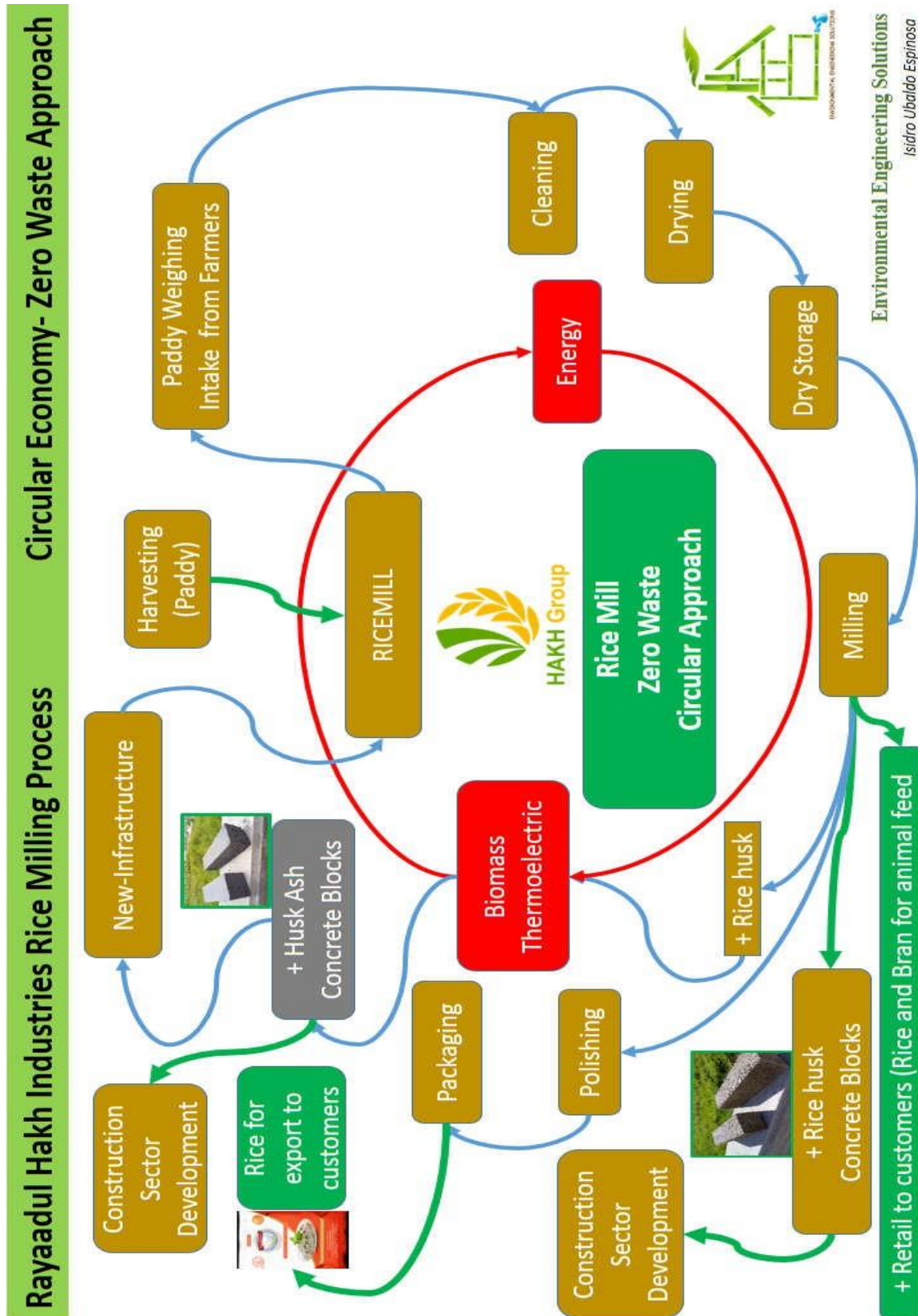


Figure 4: Rayaadul Hakh Rice Industries-Circular Process

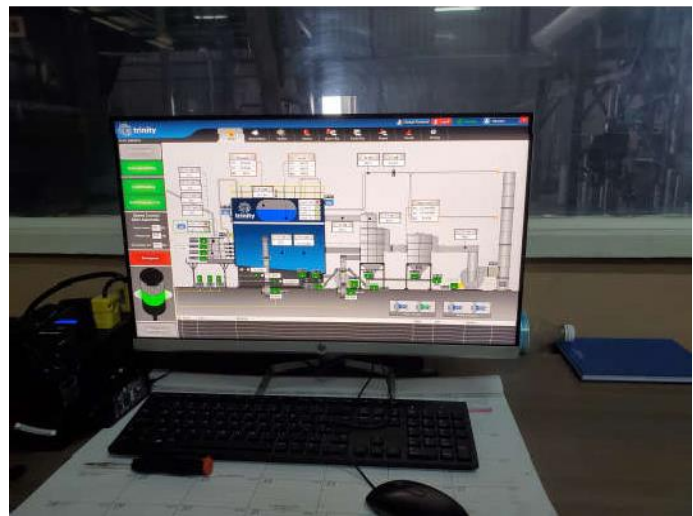




Figure 5: Pictures showing Setup of Thermal Plant Equipment

The Operation

2.3.1 The Process

1. *Harvesting*

When the paddy reached to maturity, collection take place from the fields. Harvesting at the righttime and in the right way maximizes grain yield, grain losses and quality deterioration. For Rayaadul Hakh Industries Rice Mill Operations at Strangroen, Mahaicony, paddy is often sourced from rice farmers around the area during the two (2) crop seasons (March to April and September to October) and brought to the facility. The milling season of rice lasts for approximately 2 months per crop.

2. *Weighing and Grading*

The paddy arrives to the Rice Mill. As the trucks come into the operation, they are met by a Security Officer who performs a security check and record of entry. After the security check, the truck is directed to a Weigh Bridge/Electronic Bulk Scale (there are two scales and trucks are directed to either scale), here a sample of the paddy is taken by officers from the Laboratory and graded or analyzed to determine the quality of the tonnage or baggage of paddy brought in.

Grading involves testing the moisture content of the paddy, checking dockage deduction and the quality of the paddy, grading is done according to the GRDB acceptable standards. Analysis usually determines if the company will accept or deny the quality of paddy. If the paddy sample is acceptable (good quality) approval is given to record the gross weight of the truck (i.e., truck and paddy weight) on the Bulk Scale. The Bulk Scales, Moisture Meters and Lab Scales are all verified by the Guyana National Bureau of Standards (GNBS). Moreover, farmers are also allowed the right to observe their paddy being weighed and graded and have the right to ask for are-examination of their paddy. After weighing, the truck is directed to a Hopper where paddy is offloaded.



Figure 6: The Bulk Scale/Weigh Bridge (I. Espinosa, 2020)

After weighing the truck is directed by employees of the Rice Mill to the Intake Dryer Area for discharge to temporary storage bins. After discharge the truck returns to the weigh bridge where

the tare weight or unladen weight of the truck is recorded and based on the quality of the paddy i.e., within A, B or C (standard or high quality). The weight of paddy brought in is done by a standard calculation i.e.,:

Gross weight – Tare weight = Net weight – Dockage Percentage (paddy impurities) / Moisture of Paddy = Metric Tonnes (paddy brought in)

The rice farmers are paid accordingly based on price per metric tonnes of paddy. If there is bad quality paddy, depending on the specification (i.e., if the quality is below A, B or C standard), the Company would usually negotiate with the Rice Farmer and pay accordingly of the quality of paddy.

3. *Cleaning*

After offloading at the Intake Dryer Area, the paddy goes through a Paddy Cleaner. Cleaning of the grains involve getting rid of all impurities, including insects, stones, straw, weeds, wind paddy, dust, etc. The cleaner the paddy is the better it dries. Paddy is often cleaned via a cleaner machine (80 to 90% cleaning); afterwards it is transported via a conveyor to a Wet Bin Storage (capacity of 100 metric tonnes average capacity). It is important to note that paddy obtained from a rice field contains a lot of moisture. From the Wet Bin where it stays for twenty-four (24) hours, paddy is then moved from to the Dryers via an elevator.



Figure 7: Paddy Cleaner Machine (S. Higgins, 2020)

4. Drying

Drying of paddy is done mechanically Column Dryers; this method involves drying the grains by ventilating heated air (produced by fire wood and paddy husk) through the grain mass to evaporate the moisture from it. Proper drying results in: increased storage life of the grains, prevention of deterioration in quality. Each Column Dryer can accommodate approximately

1000 bags of paddy. At the Column Dryer the paddy goes through a first drying pass (70°C to 75°C) to achieve a moisture content of 15%. The Column Dryer is a flow dryer where the paddy grains rotating as the heat passes through. Paddy is then transported from the Dryers to the Temperate Bin to cool for twelve (12) hours. After 12 hours of cooling, the paddy is transported back to the Dryers for a second pass (at 65°C to 70°C) to dry to moisture content of 12.5% before moving via elevators to the Storage Bins. The reason for 12-hour cooling in the Temperate Bin is to avoid stressing the rice grain i.e., if paddy is allowed to dry quickly from 15% or 20% moisture to 12 or 12.5% the rice grain would eventually be brittle during the milling process.

5. *Dry Storage*

There are several silos (each have a capacity of 325 metric tonnes) used as Storage Bins at the Rice Milling Complex. Paddy is stored in Storage Bins at 12% or 12.5% moisture content for approximately one (1) week or more until time for milling. Each Storage Bin is equipped with an aeration fan that is only used during hot days to allow free air flow to the paddy after drying. From the Storage Bin the paddy is moved by elevators and Conveyers to Paddy Bin 1 before processing at the Mill.



Figure 8: Storage Bins on Western Section (S. Higgins, 2020)

The cleaning process as well as passing paddy to the Wet Bin is the same as the process at Hopper 1, however, at Hopper 2 the paddy dries via a Flat/Horizontal Dryer and paddy is transported via conveyers to a Rectangular Compartmental Bed, here the paddy remains for sixteen to eighteen hours depending on the moisture content. The Flat/Horizontal Dryer has nineteen sections or compartments on each side of the Bed; each section is shaped like a triangle. Each compartment can accommodate approximately 220 bags of paddy. A Biomass Furnace (fed with paddy husk) is used to blow hot air (60°C to 65°C) through two tunnels fitted below the Flat Dryer to heat the paddy on the Triangular Compartmental Bed. After drying, paddy is transferred to a Silo for storage.

6. Moisture Content

Moisture meters are used to test the moisture content of the paddy on both Hopper 1 and Hopper 2 and during the drying process.

7. Storage 2

Paddy that goes through the dryer and furnace is usually stored in Silos after drying; however, when these Silos are filled to capacity they are usually transferred by a conveyer and elevator to a Triangular Storage Bond (7,800 metric tonnes or 120,000 bags capacity) where paddy is stored in bulk. In the Triangular Storage Bond paddy is stored in bulk on the floor i.e., there is a layer of approximately two (2) feet of paddy husk placed on the concrete floor before paddy is stored over it. The purpose of using a layer of paddy husk is to prevent moisture from the concrete floor to affect the paddy. From the Circular Storage Bond, the paddy (and the paddy husk) is transported by trucks back to either Hopper 1 or 2 to go through the cleaning process to remove the paddy husk that was used as bedding for the dried paddy. After cleaning the paddy is transported back to the Storage Bins or Silos and then travels by conveyors and elevators to a Paddy Bin 2 before processing at the Mill.



Figure 9: Storage Area (S. Higgins, 2020)

8. *Milling*

Milling is the process of separating the husk from the grain. Paddy enters the Mill by two (2) Storage Bins (Paddy Bins 1 and 2) each accommodating 100 metric tonnes of paddy. In the Mill the paddy is transferred from Paddy Bins 1 and 2 to a Paddy Cleaner Machine, afterwards the paddy is transported via elevators to the Paddy Husker Bin then to the Paddy Husker where the paddy or seed coat is separated from the rice grain. After de-husking the paddy husk is transferred into separate bins for disposal as waste, while un-husked paddy and rice is then moved from the Paddy Husker via elevators to a Paddy Separator Machine/Paddy Table. The Paddy Separator Machine/Paddy Table separates the paddy (un-husked) from the rice. The rice grains are then transferred to a Temporary Storage Bin and the paddy returns to the Paddy Husker for reprocessing or further shell removal. From the Temporary Storage Bin various by- products of rice are produced as follows:

i. Cargo Rice and Cargo Broken Rice

During the de-husking process some of the rice grains would usually break. Breakage is also due to the quality of the drying process. Rice is transferred from the Temporary Storage Bin to a Cargo Grader machine. From the Cargo Grader Machine broken Rice and whole grain rice is produced. After grading, the whole grain rice is transported via a conveyor to a Rice Bin, while the broken rice is moved via an elevator to a Broken Rice Bin. Depending on the requirements of the Client (i.e., cargo rice with a percentage of broken rice), the cargo rice (whole grain and

broken) is bagged from the Bins as per specific specifications by the buyer. The Cargo Rice is stored in one tonne sacks and these are either loaded in bulk in containers or sent to the wharf in Georgetown to load in bulk into ship vessels.

ii. Rice Bran, White Broken Rice and White Rice

After the Cargo Grader Machine as well as depending on the Client/Market, the cargo rice goes through two phases to produce Rice Bran, White Broken Rice and White Rice.

- Phase 1 – the cargo rice goes through two (2) Polisher Machines to get white rice. The rice normally passes through the Polisher Machine twice in an effort to avoid/prevent breakage of the grain during the first pass/one polish. The Polisher Machine rubs the brown colour off of the cargo rice and the particles that are rubbed off are transferred by conveyers and fans and packaged as Rice Bran in 70-pound bags or 1 tonne sacks.
- Phase 2 – the white rice then goes to two (2) Sifter Machines which eliminates or takes out the very tiny grains/chips from the White Rice. After the Sifter Machines the rice then goes to a Grader Machine which separates the whole grain white rice from the broken white rice. The whole grain white rice is then transferred via a conveyor to a Tank for bagging in 45 kg, 50 kg and 1250 kg tonne sacks, while the broken white rice goes to two sets of Grader Machines to further separate from short grains or $\frac{1}{2}$ grains and $\frac{3}{4}$ grains. $\frac{1}{2}$ grains are considered pure broken while the $\frac{3}{4}$ grains would be a blend of large broken grains with a few whole grains. After the Grader machine both the $\frac{1}{2}$ grains and $\frac{3}{4}$ grains go to Tanks and then to Bags upon buyers or market request i.e., 110 pounds bags, 100 pounds bags and 1 tonne sacks. Both whole grain white rice and broken white rice is either loaded in bulk in containers or sent to the wharf in Georgetown to load in bulk into ship vessels.

In the milling process is where the circular approach started, whereby actions are geared towards zero waste. In the milling process we have a sub product go to waste, specifically rice husk (RH). However, by adopting another perspective such as the circular economy, now the production of the rice husk is viewed as a raw material rather than waste to be treated. Therefore, in this process, there will be a value added to the rice husk from the rice milling processes.

Due to the environmental impact from the RH, Rayaadul Hakh Industries invested in a Biomass Thermoelectric Plant with the objective to use the RH in the Milling process and produce the additional power that is needed to operate the Mill. The company has future plans to sell electricity to the public grid at a much cheaper cost.

9. Packaging

For markets where clients require rice of extra good quality in 1 kg packages, the white rice is passed through two Raumak Multi Baler Machines and Selgron. Depending on requests from the

market or client, officers from the Laboratory of the Rice Mill would use a polishing meter that measures the whiteness of the rice. The meter indicates if the rice grain has been under polished or polished to the standard that the buyer may require. If the rice does not meet the standard some of the white rice stored in Tanks is transferred to two Raumak Multi Baler Machines which is responsible for separating any grain that is not white e.g. red, green, brown etc. from the pure white grains. The rejected grains are transferred to a separate Bin and is bagged and sold locally as pet food. After separation the pure white rice is transferred by elevators and conveyors to three (3) Package Machines. These automatic Package Machines comprise of ink and they are calibrated to provide the batch number, date of manufacture and expiration date of product. For 1kg bag production each Package Machine can produce sixty (60) 1 kg bags per minute and from the 1 kg bags the rice is packed according to the buyers' request, for instance, the 1 kg bags can be packed in 1 tonne sacks or bail plastic bags (i.e., twenty-four 1 kg bags into one bail bag) taped and packed into 1 tonne sacks.

There is also another section of packaging which comprises of two (2) machines that package rice in polyethylene bags of 10 kg, 25 kg, 45 kg and 50 kg. After they are filled, the polyethylene bags are sealed by a Stitching Machine packed onto pallets and loaded into containers or whatever the buyers' request.



Figure 10: Packaging Machines (S. Higgins, 2020)

10. Final Storage Bonds

Final products (cargo rice, cargo broken rice, white rice, white broken rice, rice bran or high-quality rice) stored in their respective sacks/bags/packages and do not require immediate shipping or export are usually stored in Storage Bonds located at the south western end of the Rice Milling Complex until time for transport and export. Each Storage Bond has the capacity to store 2100 metric tonnes (average) of finished product.



Figure 11: Inside the Storage Bond (S. Higgins, 2020)

11. Rice Husk

During the milling process, the Rice Husk (RH) is discarded. The RH (waste) travels by conveyer and elevator to a separate bin, then by blowers through a pipeline to a disposal site located south-west of the Rice Milling Compound. The RH is to be disposed by the following measures:

- Taken by farmers for use as poultry litter material in poultry pens or as a mulch for crop farms;

- Some of the paddy husk is used as fuel for dryers and it is used according to demand. Approximately 65,000 to 70,000 tonnes of the husk are generated. 70% is used for the thermometric plant and 10% is used for the driers. The ash generated is approximately 3000 tonnes which would be used for concrete blocks generation.
- Burnt by fire; burning the paddy husk heap, the ash is levelled by a bulldozer or a tractor with blades and taken to low lying areas as a means of land fill in an effort to prevent large unsightly heaps of paddy husk onsite.

The RH ash is further used by crop farmers or as land fill material for persons in the Strangroen Village and small amounts are utilized as land development material of the Rice Milling Complex.

12. Rice Husk- Circular approach to Zero Waste

For generations the Rice milling industry has had a challenge where the elimination of Rice Husk is concerned. RH proceeding from milling required tremendous amount of energy to manage it. Recently, the Hakh Group of Companies have been working with Environmental Engineering Solutions Inc (EES) to find solutions towards eliminating, at minimum, the environmental impacts of RH on water and air quality as well as the health of people living in close proximity to the Rice Mill. The technical collaboration brought to the table a proposed circular approach (Figure 3), where the intention is to utilize the RH and create sub-product that can be add to the rice mill infrastructure and also with potential public interest.

Normally in a circular approach, the waste or the remaining waste goes back to the process and in this particular case the RH goes back to the process in the form of energy having a residual as Rice Husk Ash (RHA). Therefore, there will be a reduced amount of RH and RHA that the Rice Mill will not be able to utilize in the milling process which can pose environmental impact in the long term especially with no alternative uses for the by-products.

Looking for alternatives, the collaboration today has two new product proposals that promise to improve the RH management and to help the construction sector. Since construction material from Rice Husk and Rice Husk Ash is not new, what represents the new works is on a practical and direct use of the RH and RHA in order to use it as a resource instead of waste.

The pictures below show a sample of the concrete block that can be produced by using the RH and RHA, the amount to be used will be proportional to the demand of both products.

With the circular approach we will be using the Rice Husk (RH) and Rice Husk Ash (RHA) with the following measures:

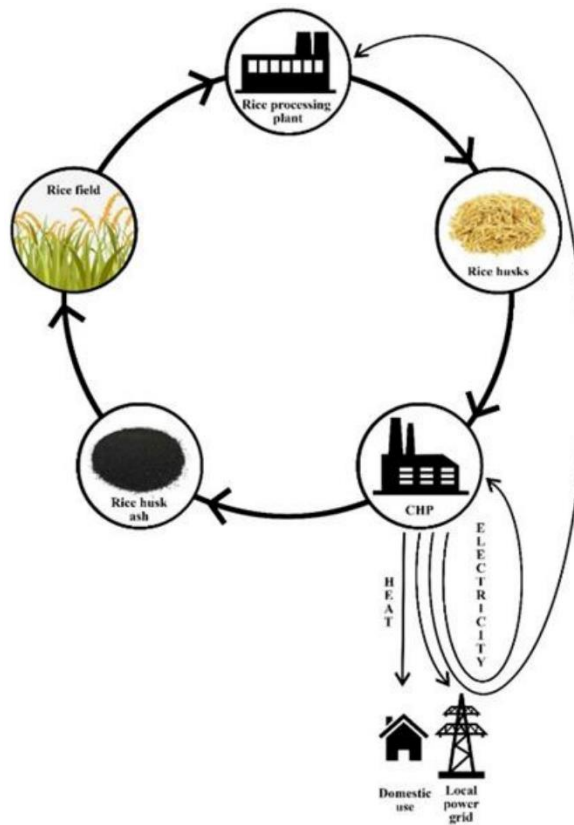
- The majority of the RH is used in the Biomass Thermoelectric Plant for electricity generation.
- RHA coming out from Thermoelectric plant will be used for concrete blocks for buildings, and other uses as soil improvement.

- And the RH not utilized will be used to build concrete blocks.

Rice Husk Management Mechanism

1. The Rice husk (RH) is produced by the milling process.
2. The Rice husk is sent it to the Biomass thermoelectric plant via Rice Husk Blower Air Conveyor.
3. The Rice husk is fed to the incineration chamber of the biomass thermoelectric plant via Rice Husk Blower Air Conveyor.
4. The rice husk ash (RHA) produced by the Thermoelectric plant is discharge in an area destined for stock pile by vacuum conveyor system.
5. Once the rice husk in in the stock pile area, the rice farmers collect the amount need to be distributed in the rice fields.
6. The remain amount of Rice Husk Ash will be utilizing for concrete hollow block production and other innovating ideas for its reuse same application apply to the Rice Husk in raw form. Currently the RHA and RH are disposed in land field for temporary storage until the block making project and testing are completed prior to its re-use.

Visual representation of the circular economy



Picture Source: I. Vaskalis et.al (2019) <https://www.mdpi.com/2071-1050/11/22/6433#>

It is important to mention that producing building material that partially uses a renewable feedstock (RH and RHS) will allow for the reducing of the impacts from sand mining; a raw material needed for concrete block production. The samples concrete blocks were tested for strength, and insulation properties. (See figures 12 and 13). The results from the testing of the concrete blocks verifies that RHA and RH can be used as a partial substitute for raw materials for the creation of concrete blocks. (See figure 15) There is intention for these blocks to be mass produced as a commercial product.



Figure 12: Sample of Rice Husk + Sand + Cement (I. Espinosa, 2020)



Figure 13: Sample of Rice Husk Ash + Sand + Cement (I. Espinosa, 2020)



UNIVERSITY OF GUYANA

NAME OF CLIENT: Isidro Espinosa

JOB NUMBER: 1

LOCATION: -

PROJECT: -

TYPE OF TEST: COMPRESSIVE STRENGTH

FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING
P.O. Box 1011110, Georgetown
Telephone No. 222-4928; Fax: 222-5491

TESTED BY: L. Brumell

DATE: 10/06/2022

COMPUTED BY: A. Sukha

| Specimen Type/Number | Sample Date | Test Date | Age (Days) | Dimensions (in) | Area (in ²) | Volume (ft ³) | Weight (lbs) | Density (lbs/ft ³) | Failure load (lbs) | Compressive Strength (lbs/in ²) | Remarks |
|----------------------|-------------|------------|------------|-----------------|-------------------------|---------------------------|--------------|--------------------------------|--------------------|---|----------------------------|
| Block 1 | - | 10/06/2022 | - | 12x4x3 | 48.0 | 0.08 | 7.40 | 92.50 | 32,000 | 667 | Rice Husk |
| Block 2 | - | 10/06/2022 | - | 12x4x3 | 48.0 | 0.08 | 7.30 | 91.25 | 35,000 | 729 | Rice Husk |
| Block 3 | - | 10/06/2022 | - | 12x4x3 | 48.0 | 0.08 | 7.60 | 95.00 | 35,000 | 729 | Rice Husk |
| Block 4 | - | 10/06/2022 | - | 12x4x3 | 48.0 | 0.08 | 9.80 | 122.50 | 40,000 | 833 | Cement and Sand |
| Block 5 | - | 10/06/2022 | - | 12x4x3 | 48.0 | 0.08 | 10.30 | 128.75 | 55,000 | 1146 | Cement and Sand |
| Block 6 | - | 10/06/2022 | - | 12x4x3 | 48.0 | 0.08 | 8.90 | 111.25 | 45,000 | 938 | Cement and Sand |
| Block 7 | - | 10/06/2022 | - | 12x4x3 | 48.0 | 0.08 | 7.80 | 97.50 | 20,000 | 417 | Cement, Sand and Rice Husk |
| Block 8 | - | 10/06/2022 | - | 12x4x3 | 48.0 | 0.08 | 7.70 | 96.25 | 15,000 | 313 | Cement, Sand and Rice Husk |
| Block 9 | - | 10/06/2022 | - | 12x4x3 | 48.0 | 0.08 | 7.80 | 97.50 | 20,000 | 417 | Cement, Sand and Rice Husk |

Figure 14: Results from Block testing

2.3.2 The Products

Paddy

Paddy is as it comes from the fields in its natural unprocessed state. The grains of rice are still within the protective husk and are not edible.



Figure 14: Paddy (Rayaadul Hakh Rice Industries, 2020)

White Rice

White Rice is the name given to milled rice that has had its husk, bran, and germ removed. This alters the flavour, texture and appearance of the rice.



Figure 15: White Rice (Rayaadul Hakh Rice Industries, 2020)

Rice Bran

Rice Bran is produced during the milling of whole grains; during milling, each kernel of rice is hulled and the hard-outer shell of the rice is separated from the rest of the kernel.

Cargo Rice

Cargo rice also known as Brown rice is unpolished rice retaining the yellowish-brown outer layer. It has a firmer texture than white rice and is also more nutritious.



Figure 16: Cargo Rice (Rayaadul Hakh Rice Industries, 2020)

Broken Rice

As a result of the milling processes, some kernels are broken down too small to be considered whole kernels. We offer both white broken and brown broken kernels.



Figure 17: Broken Rice (Rayaadul Hakh Rice Industries, 2020)

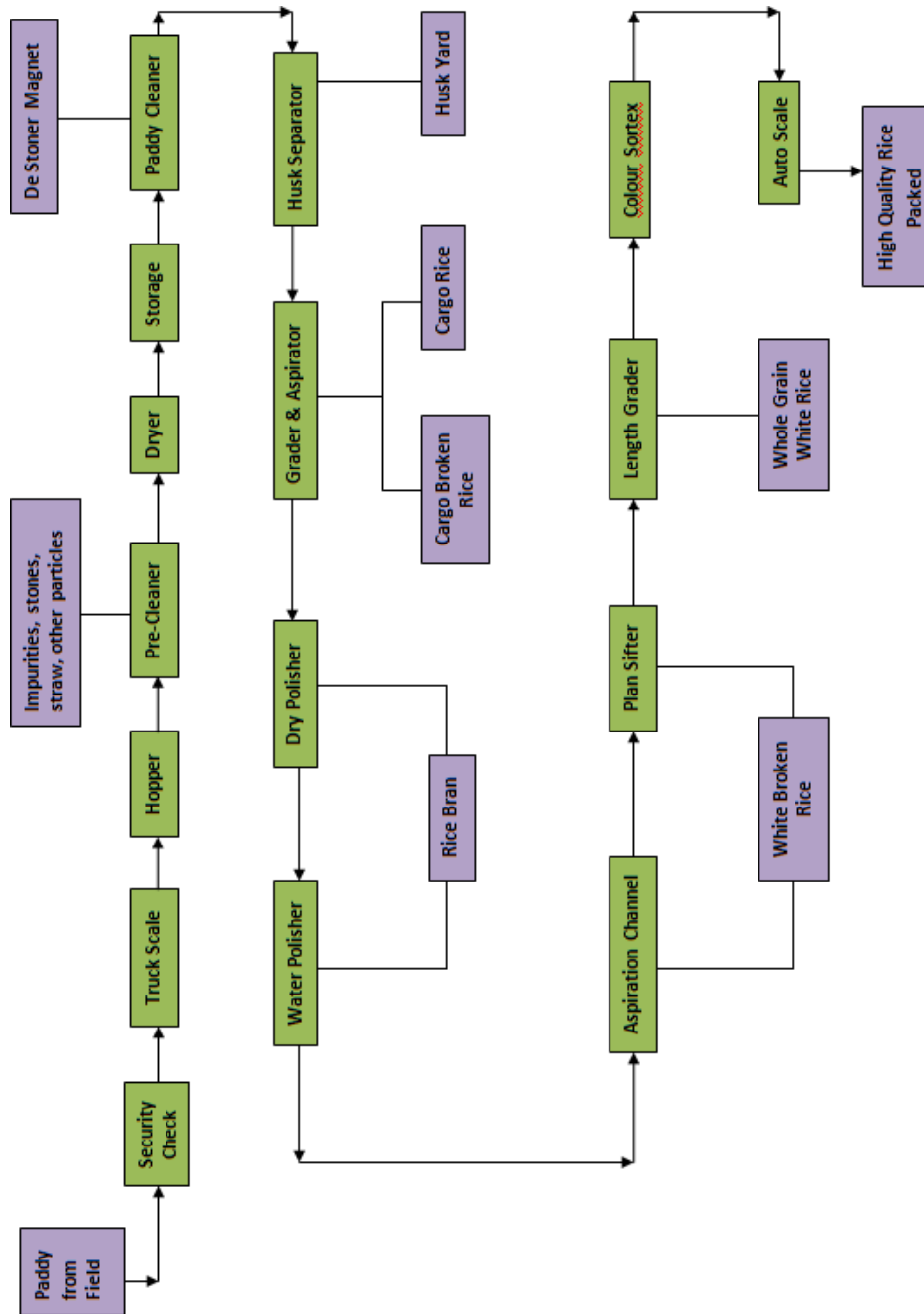


Figure 18: Flow Chart of the Rayaadul Hakh Rice Milling Operation Process

2.4 Infrastructure of the Rice Milling Complex

2.4.1 Water Supply

Rayaadul Hakh Rice Milling Complex sources its water from a groundwater well (in excess of 65 ft in depth) located on the southeast section of the complex. The well is used to supply fresh water to the complex, especially for washing and cleaning, also to provide services to the employees like washroom and restroom facilities.

Further, water from the well is also used for washing machines, vehicles, and equipment (moisture meter, trucks, forklifts, bobcats, frontend loaders etc.), clean the office as well as the laboratory. The groundwater well existed before the Rayaadul Hakh Rice Group Inc. was given permission by the Government of Guyana through a contract to operate the complex in 2004.

2.4.2 Power Supply

Rayaadul Hakh Rice Milling Complex sources its electrical power entirely from three (3) generators. Table below shows the capacities and use of these generators:

Table 2: Generators of the Rice Milling Complex

| Generators | | Capacity | Use |
|----------------------------------|------|----------|---|
| 1. Rayaadul Industries Generator | Hakh | 750 kVA | Generators used specifically for the drying and milling operation |
| 2. Rayaadul Industries Generator | Hakh | 320 kVA | |
| 3. Rayaadul Industries Generator | Hakh | 500 kVA | |

The Generators are serviced and maintained by the Maintenance Department of the Milling Complex. These three generators are fully computerized (equipped with breakers and buttons to start, and in cases of emergency they will automatically shut down) and are operated by trained personnel. The generators are enclosed by a generator house located in the northern section of the complex behind the Office. The generator house comprises of an impervious surface and wire lattice walls.



Figure 19: Generators within the Generator House (S. Higgins, 2020) Fuel Storage

The fuel for the generators and machines is normally sourced from fuel tankers and stored onsite into five (5) above ground storage tanks (capacity total – 24,000 litres) located on the eastern section of the complex; two of the tanks are used specifically for the generators while the third tank is used to supply fuel to the trucks.

About 24000 gallons of fuel were purchased every week during the cropping season (purchasing and milling which lasts approximately two months). During the off season the same amount of fuel (24000 gallons) is purchased every two or three weeks. Officers from the Guyana Energy Agency (GEA) usually visit the Rice Milling Complex on a regular basis during the crop and out-of-crop season to test fuel used on site. Since the waste to energy plant installed reduction of fuel consumption have benefit to the mill operation, with a reduction estimated up to 70 % by using rice husk to supply electricity to the Entire Milling Complex



Figure 20: Above Ground Fuel Storage Tanks (S. Higgins, 2020)

2.4.3 Waste Oil

The hazardous substances which are generated by the Rayaadul Hakh Rice Industries operational activities are from oil/lubricants and diesel fuel used for the functioning of the mechanical and motorized equipment. The oil/lubricants and diesel fuel utilised by the Mill are classified as flammable which are easily ignitable and can result in potential fire hazards.

In terms of oil usage, after the oil loses its viscosity, it is removed from the equipment and replaced with fresh oil. The used oil, which is removed and categorised as waste oil generated, is then carefully stored in 55-gallon drums on-site and sold to local farmers and other buyers. Additionally, on occasions some amount of waste oil is normally mixed with black paint and painted on the wooden fence around the perimeter of the Rayaadul Hakh Rice Mill compound. This process of applying the waste oil mixture to the fence acts as a wood preservative.

2.4.4 Wastewater and Surface Water Drainage

Wastewater (water from showering, washing, etc.) is normally disposed into septic tank systems, there are three (3) septic tank systems located on site i.e., near the Office, Paddy Purchasing Department, and the Milling Department. The septic tanks are accessible and whenever they are filled, vacuum trucks clean and de-sludge the septic tanks for safety disposal (mainly drying and landfilling material).

Surface water is normally drained by internal drains within the complex; these drains are connected to drainage networks within the compound that lead into a drainage canal located outside of the Eastern Boundary of the complex. There is a well-drained surface water drainage network within the Rice Mill complex and it is free of both debris and vegetation to allow the free flow of surface water into the south and southwest drainage canals.

2.4.5 Solid Waste

The main source of solid waste generated at Rayaadul Hakh Rice Industries Rice Mill site operation consists of husk. Therefore, the efficient management of the solid waste generated from operations at the Rice Mill entails the:

- Functioning cyclone extraction system which enables the collection of rice paddy husk removed/ shelled.
- Removed paddy husk transferred and stored in heaps within the landfill area immediately south of the Rice Mill.
 - Collected paddy husk is currently reused by the Rice Mill to facilitate the landfilling of the area immediately south of the facility, and also used as fuel for two of the functioning dryers.

- Disposal of other general waste generated from the facility in the landfill area south of the Mill.
- Rice Mill operation process of not milling the first crop (or not doing much milling) as the paddy is shipped (exported) without processing. This reduced processing by the Rice Mill facilitates low generation of rice paddy husk waste.



Figure 21: Paddy Deposal and Ash (S. Higgins, 2020)

2.4.6 Storage of Fertilizers

Fertilizers are purchased based on request by rice farmers and stored for short periods (approximately 2 - 3 months) in a Fertilizer Bond (on an impermeable surface) located in the southern section of the complex. The fertilizers that are stored include; Urea, Triple Super Phosphate (TSP), and Granular Potash.

2.4.7 Agrochemicals

Weedicides (Glyphosate) are stored in a cabinet at the complex and are given to rice farmers, while, Fumigants (Phostoxin and Weevil-Cide) are stored in seal caps at the complex and are used to fumigate containers and vessels for export.

2.5 Markets

At the Rice Milling Complex, various quantities of Finished Product (Cargo Rice, Cargo Broken Rice, White Rice, White Broken Rice and Rice Bran) are bagged and exported to Panama, Venezuela, Chile, Europe, the Caribbean and other parts of the world with minimum amounts sold on Guyana's local market.



Figure 22: Packaged Rice Prepared for Export (I, Espinosa, 2020)

2.6 Management and Staffing

Rayaadul Hakh Rice Milling Complex employs approximately one-hundred and twenty (120) persons who work during crop season and ninety-one (91) persons during the out-of-crop season. The facility operates on a twelve four (12) hour basis every day during the crop season, (07:00 h to 19:00 h), and from 07:00 h – 16:00 h Monday to Friday during the out-of-crop season. The operation requires a management complement of two (2) persons or Managers) who are responsible for the day-to-day operation of the operation complex. Further, it is important to note that during the cropping and out-of-crop season a number of employees (not including Supervisors and Laboratory Personnel) are assigned to each department of the Rice Mill to perform specific duties under the respective Supervisory Staff. There are eleven (11) departments under the operation complex namely:

1. Paddy Purchasing Department
2. Milling Department
3. Export Department
4. Electrical Department
5. Maintenance Department
6. Mechanical Department
7. Stores Department
8. The Office
9. The Quality Control/Laboratory
10. The Security Department
11. Power Department

1. Paddy Purchasing Department

This department is responsible for paddy purchasing, drying and storage. Under this department, a Supervisor (Mr. T Thomas) oversees the employees ensuring that paddy is received, cleaned, dried, stored and sent to the mill for processing.

2. Milling Department

This department is responsible for final processing of paddy to cargo or white rice. Under this department, there are two Supervisors (Mr. B. Peters) who oversee the working shift of employees (07:00 h – 19:00 h) as well as the milling of paddy to produce the final product.

3. Export Department

Within this department a Supervisor (Mr. G. Singh) records and oversees all containers received, loaded and transported to the wharf as well as all trucks loaded and transported to the wharf in

Georgetown. The Export Department is also responsible for all local sales to any other company within Guyana.

4. *Electrical Department*

The Electrical Department has a Supervisor (Mr. G. Persaud) who is responsible for overseeing all the electrical supply or power generation for the entire Rayaadul Hakh Milling Complex.

5. *Maintenance Department*

Within the Maintenance Department, a Supervisor (Mr. L. Persaud) is responsible for overseeing the work carried out by welders and fabricators that perform all repairs and fabrication of any small equipment as well as servicing of machines from the intake area to the mill processing area.

6. *Mechanical Department*

Under this department, a Supervisor (Mr. L. Persaud) is responsible for all the Generators and machines (the forklifts, front end loaders, bobcats, tractors etc.) of the operation. The department is equipped with the following numbers of machinery and equipment:

Table 3: Number of Machinery and Equipment

| Number | Machinery | Number | Machinery |
|--------|----------------------|--------------------|---|
| 8 | Forklifts | 4 | Paddy tables |
| 5 | Tractors | 6 | Polishers |
| 3 | Dryers | 4 | Furnaces |
| 2 | Front end Loader | 2 husks 2 woods | Bio-furnace Dryers (2 fueled by firewood and 1 fueled by paddy husks) |
| 6 | Trailers | 4 | Generators (750 KVA, 320 KVA and 500 KVA respectively) |
| 9 | Paddy Cleaners | 19 | 10 Tonne Trucks |
| 10 | Huskers | | |
| 3 | Bagging Machines | 6 | Welding Plans |
| 6 | Compressors | 2 | Rice Sifters |
| 4 | Sets of Rice Graders | 2 | Rollers |

| | | | |
|---|----------------------|---|--------------------|
| 2 | Telescopic Forklifts | 1 | Excavator |
| 2 | Bulldozer | 2 | Mini Excavator |
| 1 | Thermoelectric Plant | 7 | Fuel Storage Tanks |

7. Stores Department

In this department, a Supervisor (Mr. L. Persaud) is responsible for inventory of all equipment which includes all ordering, receipt and issuing of spare parts and tools. The department is also responsible for the safe keeping of all equipment in storage. Moreover, safety equipment is provided to all employees. Employees of various departments are mandated to wear the following protective equipment:

- Helmets, safety boots, respirators (heavy duty and disposable), safety goggles, harness belts, climbing belts, ear mufflers, long boots and fire boots.

8. The Office

A number of Senior Employees work in the Office, and are responsible for all office duties including the receiving of paddy, preparation of documents for paddy purchasing, preparation of delivery notes for the transport of trucks to the wharf to deliver cargo. A Janitor is also assigned to the Office to perform cleaning duties.

9. Laboratory/Quality Control Department

A number of Senior Employees (trained certified graders) work in the laboratory, and are responsible for purchasing, grading and overlooking all laboratory operations.

10. Security Department

In this department, a Supervisor (Mr. M Prainall) is responsible for overseeing security personnel at the operation.

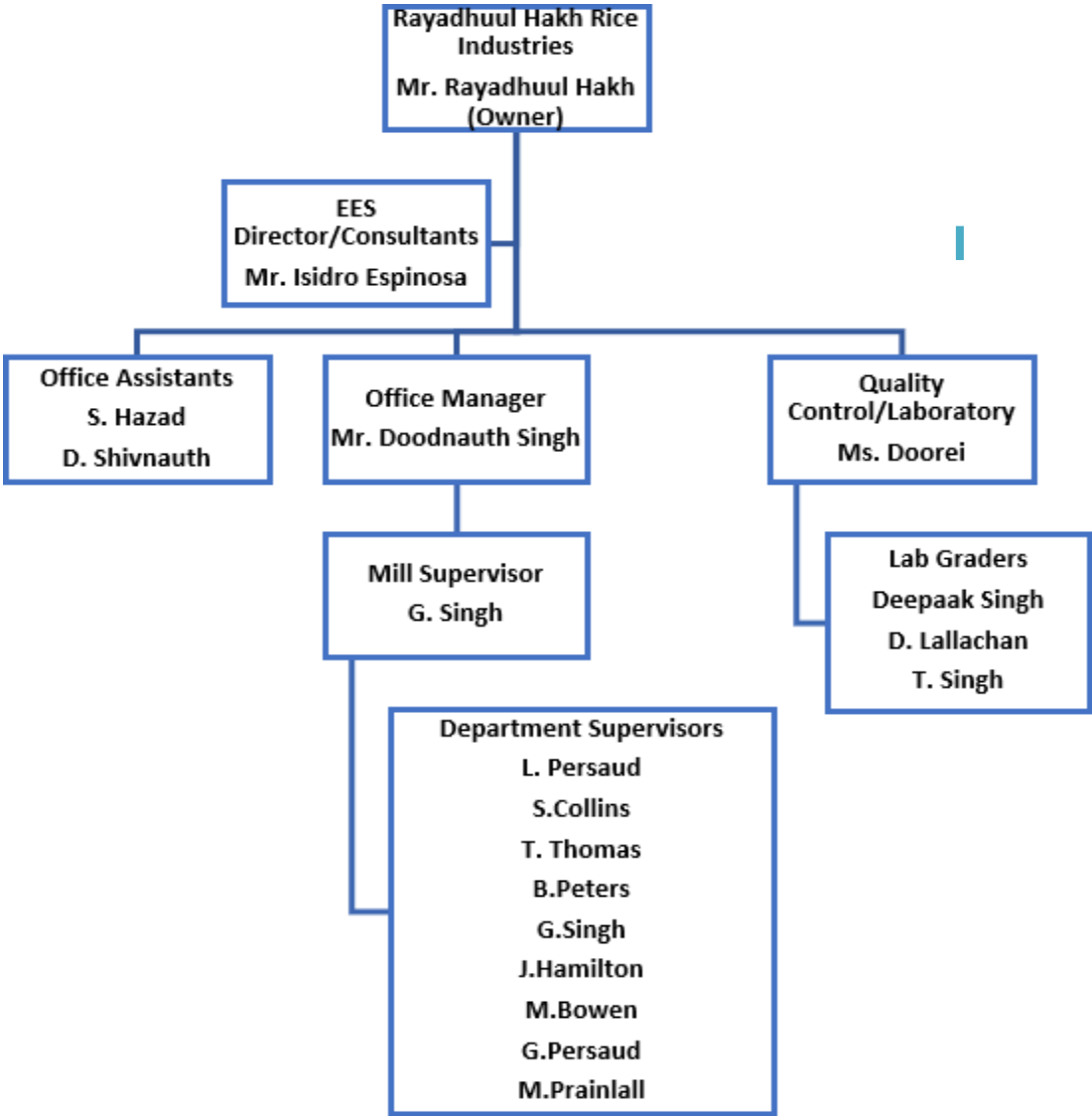


Figure 23: Rayaadul Hakh Rice Milling Complex Departments

2.7 Community Involvement

Rayaadul Hakh Rice Milling Complex over the years has been working hand in hand with rice farmers of the De Hoop Community to grow more rice by offering fuel, fertilizers as well as finance to assist in the planting of paddy fields and in turn upon harvest, these farmers would sell their paddy to the Company. Subsidizing farmers results in substantial yields, better quality of rice and an improved standard of living for rice farmers, and this is in sequence also secures paddy for the Mill. The more fertilizers, fuel and finance given to rice farmers, the more paddy is sequentially guaranteed, because of the farmers' commitment to the Company.

In terms of community relations, Rayaadul Hakh Rice Industries usually supports the farmers of the De Hoop Community by providing fertilisers. Further, a number of residents from the Strangroen, Regent Bank community are employed at the Milling Complex. With the circular economy, zero waste approach, the company soon hopes to distribute electricity to the public grid as well provide waste material (RH and RHA) for construction purposes.

CHAPTER 3: PROJECT ENVIRONMENT



3 PROJECT ENVIRONMENT

3.1 Physical Environment

To understand the possible environmental impacts that might occur due to the existing Rice Milling Operation it is essential to generate baseline data of the region to understand the environmental setting of the project site. The baseline data generated together with the process can give an insight to the critical impacts, which in turn will help in providing for adequate environmental management safeguards. In this study, the environmental characteristics of the project area were established through extensive literature research, field sampling/measurements, laboratory analysis, stakeholder consultation and data interpretation.

Data from literature research (topography, geology, climate etc.) were obtained from a number of existing sources. Fieldwork for the baseline was conducted on July 1, 2020 and March 21, 2018, by the Environmental Engineering Solutions (EES) team members. The environmental data covered the Rice Milling Complex during the crop season.

Sampling Methods and Field Measurement

Both International and Guyana National Bureau of Standards (GNBS) Guidelines and Standards were strictly adhered to in the cause of field sampling and measurement. A multi-disciplinary approach was adopted for the ecological characterisation and data acquisition. The environmental components covered include topography, climate/meteorology, air quality, noise, geology/geophysics/hydrogeology, socio-economics, health status assessment and waste management.

Sampling points were established and co-ordinates of the sampling points taken. Fast changing parameters were determined in-situ using calibrated instruments. The surveyors of the EES team coordinated field sample positions using Global Positioning System (GPS).

Quality Assurance/Control Procedure

Standard methods and procedures have been strictly adhered to in the course of this study. These procedures were implemented during sample collection, labelling, analysis and data verification. Chain of custody procedures including sample handling, transportation, logging and cross-checking in the laboratory have also been implemented.

All surface water quality analysis was carried out in Kaizen Environmental Services (Guyana) Inc. accredited laboratory. The methods of analyses used in this study were those specified by GNBS and other internationally accepted analytical procedures, in order to ensure the reliability and integrity of the data obtained. The Quality Assurance Procedure covers all aspects of the study, and includes sample collection, handling, laboratory analyses, data coding and manipulation, presentation and communication of results.

Environmental Field Data

Below is the description of the baseline status of environmental components of the Rayaadul Hakh Milling Complex.

3.1.1 General Geography

Guyana is located on the north-eastern coast of South America between 2⁰ and 9⁰ North latitude, and 56⁰ and 62⁰ West longitude (GUYSUCO 2009). The Atlantic Ocean lies to the North East, Suriname to the East, Brazil to the South and Southwest and Venezuela to the West. Guyana is approximately 216,000 km² and has a coastline that is approximately 434 km in length (GUYSUCO 2009). Guyana's coast has long been vulnerable to water level changes in the adjacent Atlantic Ocean on daily, seasonal and annual time scales because it is 1.4 m (4.5 ft) below sea level at high tide (Office of the President 2013). 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. The Rice Milling Complex is located within the Coastal Plain and the coastal environment is described below.

3.1.2 Coastal Environment

Rayaadul Hakh Rice Milling Operations is situated within the Coastal Plain. The Coastal Plain occupies less than 7% of Guyana's total land area, approximately 15,120 km². The Coastal Plain is a narrow belt (ranging between 8 and 65 km in width and 440 km in length) stretching from the Corentyne River in the east to Waini Point in the west (GoG, MNRE, and GL&SC 2013). The current plain occurs at elevations of 2 m below to 3 m above sea level with sandy old beach ridges forming higher ground while the older coastal plain lies at an altitude of about 3 - 9 m above sea level (GoG, MNRE, and GL&SC 2013). Guyana's coast experiences intense seasonal rainfall that is often associated with severe flooding (Leung 2010). The normal tidal range is about 3 m with resultant flooding (particularly sea invasion) especially during the wet seasons from April to August and November to January and during high tides (GoG, MNRE, and GL&SC 2013). Many areas of the coastal plain are below sea level while other areas are man-made and built-up to raise them above the surrounding land level. An elaborate system of sea defenses, along with irrigation and drainage canals, is required to protect the area from flooding.

Further, five of Guyana's towns namely - Anna Regina, Rose Hall, New Amsterdam, Corriverton and the capital city, Georgetown - are all located within the coastal belt. Moreover, approximately 90% of Guyana's population resides along the coast, which is also the location of

the country's major administrative and economic activities. East of the Essequibo River (where the Milling Complex is located) the plain consists of recent and old sediments with deltaic, fluvio-marine clays as well as silts occurring on the coast with silty clays and sand inlands (GoG, MNRE, and GL&SC 2013). Guyana's coast is rich in alluvial soils and agriculture is one of the dominant economic activities that take place almost entirely, on a commercial basis, along the coastal strip. West of the Essequibo River the coastal plain narrows with extensive organic wetland 'pegasse' deposits inland. While these are most extensive in the west of the country, (Regions 1 & 2) they also occur scattered between the Essequibo, Demerara and Berbice Rivers (GoG, MNRE, and GL&SC 2013). East of the Berbice River the pegasse area is small and the coastal 'frontland' and 'riverain' clays relatively wide.

3.1.3 Climate

Guyana coast normally experiences a tropical humid climate with uniformly high temperatures and rainfall humidity. Seasonal rainfall variability is generally the dominant characteristic of climate in Guyana as the coastal areas' experiences two distinct wet and two dry seasons. The annual rainfall in the Coastal zone is between 1500 mm – 3500 mm per year, the normal wet seasons are from mid-April to mid-August and from mid-November through January. Temperatures are quite constant, with an average high of 32⁰C and an average low of 24⁰C and humidity averages 70% annually. Overcast days are rare; most days include 4 to 8 hours of sunshine from morning through early afternoon.

Wind direction can be described as the direction of from which air is moving. The location of the rice mill in Strangroen wind direction from the North-West. Wind speed is the rate at which wind is moving or the velocity of the wind. According to the data collected during the air quality data collection period, the highest wind speed reading was 5.3 m/s which can be classified as a gentle breeze while the lowest reading was 0 m/s which can be classified as calm.

3.1.4 Geomorphology and Soils

Region 5 (Mahaica-Berbice) is located on the eastern section of the Coastal Zone of Guyana at approximately 57⁰ 36'' west longitude and 6⁰ 1'' north latitude. Elevations are usually between 48 and 65 feet (Georgetown Datum: 50 feet is equivalent to mean sea level). The rice soils are formed from silts and clays of recent alluvial deposits and sediments of the Demerara formation.

According to the Guyana National Land Use Plan of 2013, the soils consist of Low humic gleys of low base status, including groundwater laterites and planosols (Endoaquepts with Fluvaquepts, Sulfaquepts). These soils occur principally in the backlands of the Mahaica- Berbice (Region 5) area, between the Berbice River and Canje Creek, and in small patches between the Essequibo and Demerara Rivers. The Rayaadul Hakh Milling Complex is situated on these lands which represents a complex of different soils where Low Humic Gleys (Endoaquepts) are predominant (GoG, MNRE, and GL&SC 2013).

Often with a peat topsoil they are very poorly drained clays with better drained laterite 'islands' and planosols that show an abrupt silt pan. The agricultural limitations of these soils are poor drainage and there extremely low levels of fertility (often exhibiting acid sulphate and

aluminum toxicity) (GoG, MNRE, and GL&SC 2013). The land cover is mainly natural vegetation of scrub, waterlogged grassland/marsh and swamp forest.

3.1.5 Topography

Rayaadul Hakh Rice Milling Complex is generally flat and the topography within 2 miles of the Mahaicony Area is essentially flat, with a maximum elevation change of 66 ft and an average elevation above sea level of approximately 11 ft as previously mentioned. Within 10 miles Mahaicony is generally flat (151 ft) and within 50 miles the land contains only modest variations in elevation (400 ft).

3.1.6 Drainage

The Mahaicony River drains and irrigates the De Hoop and Regent Back Village. The De Hoop canal runs north to south along the Mahaicony Road.

3.1.7 Groundwater

The most important aquifers can be found in the unconsolidated, poorly sorted deltaic sands underlying the coastal lowlands (Spillman et al. 1998). Ninety percent (90%) of Guyana's population residing along the Coastal Plain receive their water supply from aquifers, while the remaining ten percent (10%) of the population receive water from surface water (Spillman et al. 1998). Groundwater exploration is concentrated in the towns and villages along the Coastal Plain. Groundwater is the most abundant, reliable and key source of fresh water for public use along the Coastal Plain. According to T. Spillman et al in 1998, in Guyana, approximately 60% of groundwater produced from wells is used for domestic purposes and it has become an increasingly important water source with a growing demand for surface water for agricultural and industrial needs.

For the last century within Guyana's coastal aquifer system, a series of three separate but hydro-geologically connected aquifers has been providing water for the coastal inhabitants of the country (Spillman et al. 1998).

3.1.8 Coastal Aquifer System

Large quantities of fresh water are available from Guyana's coastal aquifer system. This system occupies a subsurface area of about 20,000 km², extending about 250 km along the Atlantic coast and 40 to 150 km inland (Spillman et al. 1998). Sediments reach a thickness of 1,800 m onshore and become progressively thicker offshore and toward the east. The coastal aquifer system is composed of three connected but hydro-geologically distinct aquifers (Spillman et al. 1998). The lower two aquifers are confined by overlying layers of clays which protect them from

contamination by overlying sources. The three aquifers are named, from upper to lower, the Upper Sands, the A Sand, and the B Sand, with each capable of yielding large amounts of water (Spillman et al. 1998).

The *A Sand aquifer* was first developed in 1913 and is now considered the principal water source for Georgetown and the coastal lowlands region (Spillman et al. 1998). The Intermediate Clay Formation, which is about 90 m thick and composed of clay and shale, acts as an impermeable barrier between the Upper Sands and the A Sand aquifer (Spillman et al. 1998). The A Sand aquifer is composed of quartz sand and fine gravel, and ranges from 150 to 215 m deep and 12 to 27 m thick (Spillman et al. 1998). In general, the aquifer increases in thickness and depth south eastward from the village of Enterprise to Berbice. From Berbice to the Corentyne River, the A Sand aquifer decreases in thickness and depth (Spillman et al. 1998). This aquifer yields between 4,000 and 40,000 L/min year-round (Spillman et al. 1998). The quality of water withdrawn from this aquifer is good with a low chloride content; however, its high carbon dioxide and iron content can corrode ferrous and cement-based materials, with the excessive iron requiring treatment (Spillman et al. 1998). When this aquifer was first used, it had a piezometric head 4.5m above ground level. By 1993, dewatering of this aquifer caused the head to fall to 14 m below ground level (Spillman et al. 1998). Within the study area drinking water is supplied by Guyana Water Inc. from groundwater. According to Hydrometeorological service the number of private wells in the area is two (2) with an additional ten (10) wells in surrounding communities.

Surface and Groundwater Quality

Water samples were collected and analysed to determine the quality of surface and groundwater within and around the Rayaadul Hakh Rice Milling Complex. During the milling season three (3) water samples were collected and analysed within and around the Complex from the Eastern Surface Water Discharge area, the Groundwater Well and the Western Drainage Canal. Surface and groundwater samples were analysed to have a representative value of the water quality in and around the complex. Samples were collected on Enero 28, 2020. The sample locations were selected at the discharge points of the Rice Milling Complex to provide an indication of the baseline surface and groundwater quality.

The locations where the samples were collected are identified as the WQ locations and the test results are shown in the Table 4 below. These locations should also become permanent monitoring sites, since, if there are any impacts on water quality by the operation, the impacts can be detected by testing these locations. Further, no water samples were taken from the drains within the Rice Milling Complex because the drains were dry/or minimum amount of water levels. Analyses were conducted based on standard methods and compare with the GNBS Standards and Guidelines outlined in Table 5.

Table 4: Water Test Results, Standards and Guidelines

| 3. Test Results | | | | | | | | | | | | | |
|-----------------|------------|--------------------------------|----------|---------|-------------------|---------|------|--------------------------------------|---------------|-------|---------|---------------------|----------------------------|
| Sample ID | Date | Water Parameters/ Data Results | | | | | | | | | | | |
| | | BOD mg/L | COD mg/L | DO mg/L | Oil & Grease mg/L | Temp °C | pH | Conductivity $\mu\text{S/cm}$ 0-2000 | Turbidity NTU | TSS | TDS ppm | Total Nitrogen mg/L | Ammonia NH_3 mg/L |
| WQ-01 | 28/01/2021 | ND | 147.94 | 2.80 | 8.00 | 15.1 | 7.32 | 588.00 | 98.60 | 66.31 | 308.00 | 1.8 | < 1 |
| WQ-02 | 28/01/2021 | ND | 72.60 | 3.80 | 3.60 | 15.1 | 7.17 | 244.00 | 38.70 | 47.35 | 161.00 | 1.0 | 0.2 |
| WQ-03 | 28/01/2021 | ND | 79.51 | 4.70 | 2.80 | 15.1 | 8.41 | 429.00 | 37.20 | 50.34 | 273.00 | 1.1 | <1 |
| WQ-04 | 28/01/2021 | ND | 51.24 | 5.30 | 10.00 | 15.1 | 7.83 | 725.00 | 56.70 | 86.31 | 426.00 | <0.5 | <1 |



Description of sample points

WQ1: Internal Drain East of compound which collects rain water or washing done within the mill.

WQ2: Internal Drain West of building Structure in Compound collects run off water and drains into the external drain.

WQ3: Tap Water (Fe content testing)

WQ4: External Discharge point to Trench, South of the rice mill. This contains public water from different sources.

Table 5: Water Quality Standards and Guidelines (GNBS,2002)

| Parameter | Guideline | Below Guideline Test Value |
|--------------------------------|-----------|-------------------------------|
| Temperature (T) | <40 °C | |
| pH | 6.0-9.0 | |
| Total Suspended Solids (TSS) | <50 mg/L | Boundary Guideline Test Value |
| Chemical Oxygen Demand (COD) | <250 mg/L | |
| Biological Oxygen Demand (BOD) | <50 mg/L | |
| Ammonia (NH ₃) | < 5 mg/L | Above Guideline Value |
| Total Nitrogen (TN) | < 50 mg/L | |
| Oil and Grease | < 10 mg/L | |

Water quality testing were done to provide information on effluent discharge from the operation as well as how far downstream from the source of activity the quality of water changes, and to what extent it can affect the surrounding environment. Samples were also collected to the immediate discharge from the thermal plant to analyse for several parameters which are important and generally used to determine the quality of water, i.e., measurements of pH, Temperature, Biological Oxygen Demand (BOD), Total Suspended Solids, Chemical Oxygen Demand (COD), Oil and Grease, Turbidity, Electrical Conductivity, Total Nitrogen, were taken to assess the spatial changes of the quality of water.

Key

BOD - Biochemical Oxygen Demand, COD - Chemical Oxygen, TSS - Total Suspended Solids, ND - Not Detected

Results and Discussion

For the results of the surface and groundwater quality analysis conducted for Rayaadul Hakh Milling Complex, most of the parameters analysed were within the acceptable range. For the parameters that were analysed the results were as follows:

pH - The pH analysis of the surface and groundwater samples collected within and around the Rice Milling Complex ranged from 7.17 to 8.41 pH, indicating that water in the area is alkaline. The pH parameters were within the limits (5.0 - 9.0 pH) GNBS Interim Guidelines for Industrial effluent into the Environment.

Water temperature - The surface and groundwater temperature reading ranged from 27.8 to 29.4 °C (during time of collection in the field) and 15.1 °C (during time of laboratory analysis), this was within the GNBS accepted range of <40 °C, which is considered healthy for living organisms. It is expected that activities within the area should not change water temperatures beyond natural seasonal fluctuations.

BOD (Biochemical Oxygen Demand) - BOD levels of the water samples were not detected for this EMP, Dissolve Oxygen were measure as an approximation of DOB values.

Total Suspended Solids - TSS results of the water samples collected were 66.31 mg/l (WQ-01), 47.35 mg/l (WQ-02), 50.34 mg/l (WQ-03) and 86.31 mg/l (WQ-04), indicating that the surface water were within the GNBS (<50 mg/l) Interim Guidelines for Industrial effluent into the Environment for the WQ-02 and WQ-03. However, the TSS levels of WQ-01 and WQ-04 were slightly higher in compare with the guideline. The WQ-01 may be higher based on dust from operation settling on internal drain. WQ-04 may be higher, related to the flying ash over the public drain (outside drain).

COD (Chemical Oxygen Demand) - COD levels were detected below the guideline value. Due of absence of organic matter for all the samples; the values were accepted since the GNBS range is <250 mg/l. WQ-01 have the highest value with 147.94 mg/L.

Oil and Grease (OG) - OG levels were partially below the guideline (GNBS limit of <10 mg/l). The OG levels for WQ-01 (8.00 mg/l) and the WQ-04 (10.0 mg/l) were all above the GNBS (<10) Interim Guidelines for Industrial effluent into the Environment. The small increase above the guideline may be due of oil and grease leakage during maintenance program.

Turbidity - The turbidity level of the water samples ranged from 37.20 to 98.60 ntu. Therefore, the turbidity levels were above the accepted 10 ntu GNBS Interim Standards. High turbidity levels were expected due to the dust particles suspended in water discharges.

Electrical Conductivity - of the water samples within the area ranged from 244 to 725 $\mu\text{S}/\text{cm}$ and were within the WHO standards for drinking water i.e., 0 to 1500 $\mu\text{S}/\text{cm}$. Most streams range between 50 to 1500 $\mu\text{S}/\text{cm}$. Freshwater streams ideally should have electrical conductivity ranging from 150 to 500 $\mu\text{S}/\text{cm}$ to support aquatic life.

Total Nitrogen - Total Nitrogen levels were low in all the sample points ranging from < 0.5 to 1.8 mg/L in compared with 10 mg/l US EPA 1986 standard as the maximum contaminant level for nitrate - nitrogen in water.

The results of the analyses of surface water quality of the Rice Milling at all the main discharge points indicated that the existing water quality of the area is a characteristic of the water quality for similar types of areas within Guyana. The results also indicated very low levels of contamination or null.

3.1.9 Air Quality

Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere (World Health Organization 2012). The air pollutants of major public health concern include: particulate matter,

carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide and metals, such as lead (Hedges 2004) (World Health Organization 2012).

Particulate Matter (PM) - is the term for a mixture of solid particles (dust, dirt, soot, and smoke) and liquid droplets suspended in the air. These PM emissions originate from a variety of sources, such as vehicles, factories, industrial sites, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood (Hedges 2004, p.58). Particulate Matter comprises both coarse and fine particles. The coarse particles (PM_{10}) have an aerodynamic diameter between $2.5\mu m$ and $10\mu m$. They are formed by mechanical disruption (e.g., crushing, grinding, abrasion of surfaces); evaporation of sprays, and suspension of dust. Fine particles have an aerodynamic diameter less than $2.5\mu m$ ($PM_{2.5}$). These particles are formed from gas by chemical reactions; and condensation of high-temperature vapours during combustion (Fierro 2000).

Total Suspended Particulates (TSP) - refers to all particles in the atmosphere that are less than 100 micrometers. The amount of PM_{10} and $PM_{2.5}$ are related to the amount of total suspended particulates (TSP) in the air (Alias, Hamzah, and Kenn 2007). Particulate Matter guidelines and standards are instituted (Table 5) due to short term and long-term health effects including premature mortality, chronic respiratory disease, acute respiratory systems, decreased lung functions and aggravated asthma, persistent cough, phlegm, wheezing and physical discomfort (Fierro 2000, p.5) (Alias, Hamzah and Kenn 2007, p.258). These health effects are especially associated with PM_{10} and $PM_{2.5}$. The PM_{10} fraction from TSP is able to reach the lower regions of the respiratory tract. On the other hand, $PM_{2.5}$ is able to absorb more toxic and carcinogenic compounds than larger particles and penetrate more easily deep into the lungs (Alias, Hamzah and Kenn 2007, p.256). Additionally, there is increased harm to the environment as PM is a major source of haze that reduces visibility, causes changes to nutrient and chemical balance of the soil and aquatic environment, erosions and staining of structures (residential, commercial, or cultural monuments) (Hedges 2004, p.58).

The purpose of the ambient air quality standards is to establish maximum limits on parameters of air quality considered desirable for the preservation and enhancement of the quality of air resources and health (Mecklenburg County NC 2012). The WHO Air Quality Guideline (AQGs) are intended for worldwide use but have been developed to support actions to achieve air quality that protects public health. Air quality standards, are set by each country to protect the public health of their citizens and as such are an important component of national risk management and environmental policies. National standards will vary according to the approach adopted for balancing health risks, technological feasibility, economic considerations and various other political and social factors, which in turn will depend on, among other things, the level of development and national capability in air quality management (World Health Organisation 2006).

Air quality data in Guyana is extremely limited given the constraints relating to the unavailability of equipment and cost associated with this type of data collection. There was no historical air quality data for the area, however, the air quality within the operation area can be considered

good based on the results compared to the standard limits. As an indicator of Air Quality within the area, a preliminary assessment of Particulate Matter was done on Wednesday, March 21, 2018, and it reflected the Total Suspended Particles concentration of the Rayaadul Hakh Milling Operation.

Monitoring Procedure

The Total Suspended Particulate (TSP) measurements were taken using the Thermo pDR-1000AN personalDataRAMTM Particulate Monitor. TSP measurements recorded in milligrams per cubic meter (mg/m^3), were taken at twenty-one (21) sample sites after a log interval of 5 minutes (Thermo Electron Corporation 2005).

After the 5minute interval log time, the real time concentration value, the maximum concentration value and the time weighted average (TWA) concentration in milligrams per cubic meter (mg/m^3) were recorded from each sample site. The wind direction and temperature at time of monitoring at each site was recorded. Conversions from milligrams per cubic meter (mg/m^3) to micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) were done by taking the milligrams per cubic meter (mg/m^3) measurements x 1000 (Hedges 2004, p.23). As mentioned before in absence of a national Air Quality Standard or Guideline micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) results were then compared to the United States Mecklenburg County North Carolina Air Quality TSP Standard, as a current TSP limit permissible utilised by North Carolina State and OSHA Permissible Exposure Limits. Quality assurance and quality control (QA/QC) was practiced, as well as routine parts of the air quality monitoring during the calibration, operation and maintenance of the monitoring equipment.

Table 4: Air Quality Standards and Guidelines

| Air Pollutant | Mecklenburg County NC | NAAQS | OSHA | WHO (1999) | WHO (2006) | NHMRC (1996) | Malaysia |
|-------------------|---|--|---|------------|--|---|----------------------------------|
| PM _{2.5} | | 15 $\mu\text{g}/\text{m}^3$ annual mean | --- | --- | 10 $\mu\text{g}/\text{m}^3$ annual mean | --- | --- |
| | | 35 $\mu\text{g}/\text{m}^3$ 24-hour average concentration | --- | --- | 25 $\mu\text{g}/\text{m}^3$ 24-hour mean | --- | --- |
| PM ₁₀ | | 50 $\mu\text{g}/\text{m}^3$ annual mean | --- | --- | 20 $\mu\text{g}/\text{m}^3$ annual mean | --- | --- |
| | | 150 $\mu\text{g}/\text{m}^3$ 24-hour average concentration | --- | --- | 50 $\mu\text{g}/\text{m}^3$ 24-hour mean | --- | --- |
| TSP | 75 $\mu\text{g}/\text{m}^3$ annual mean | --- | Permissible Exposure Limits (PELs, TWA 8-hour exposure) | --- | --- | 90 $\mu\text{g}/\text{m}^3$ annual mean | --- |
| | 150 $\mu\text{g}/\text{m}^3$ 24- | --- | 15 mg/m^3 | 120 | --- | --- | 260 $\mu\text{g}/\text{m}^3$ 24- |

| | | | |
|----------------------------|--|---|----------------------------|
| hour average concentration | (total) 5 mg/m ³ (for respirable fraction) | µg/m ³ 24-hour average | hour average concentration |
|----------------------------|--|---|----------------------------|

Source: (World Health Organization 2006, p.10), (Mecklenburg-County-NC 2012), (Environmental-Protection-Authority 2001), (United-States-Environmental-Protection-Agency 2012), (Fierro 2000), (Alias, Hamzah and Kenn 2007, p.255), (Mecklenburg-County-Government 2012), (United-States-Department-of-Labour-OS&H 2012)



Figure 24: Thermo pDR-1000AN personalDataRAMTM Particulate Matter Monitor (I. Espinosa, 2020)

Data

The following table and map show the results of Total Suspended Particulates concentration taken within and around the Rayaadul Hakh Milling Complex. Table 7 contains the average concentration, Total Weighted Average (TWA) and maximum concentration of the air quality during the monitoring period.

Areas where air quality tests were carried out are shown in the figures below.



Figure 25: Front End Loader loading Paddy Shells to be disposed (I. Espinosa, 2020)



Figure 26: Mill House (I. Espinosa, 2020)

Table 5: Results of Total Suspended Particle (TSP) Measurement of the Rayaadul Hakh Milling Complex

| Sample | Time | Coordinates | | PM2.5 | PM10 | Avg. TSP | TWA | Max. | |
|--------|----------|-------------|---------|-------|------|----------|-------|-------|------------|
| ID | Start | N | W | | | Conc. | | Conc | Wind speed |
| 1 | 10:56 am | 0402038 | 0735466 | 6.0 | 8.8 | 0.013 | 0.017 | 0.03 | 1.2 |
| 2 | 11:08 am | 0402023 | 0735404 | 4.8 | 6.9 | 0.007 | 0.005 | 0.011 | 1.8 |
| 3 | 11:14 am | 0402034 | 0735315 | 5.2 | 7.2 | 0.004 | 0.008 | 0.025 | 0.8 |
| 4 | 11:19 am | 0402049 | 0735300 | 5.0 | 6.9 | 0.03 | 0.008 | 0.025 | 0 |
| 5 | 11:21 am | 0402022 | 0735283 | 5.3 | 7.3 | 0.009 | 0.014 | 0.048 | 0 |
| 6 | 11:26 am | 0402019 | 0735255 | 11.6 | 16.1 | 0.066 | 0.046 | 0.088 | 1.8 |

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| | | | | | | | | | |
|----|----------|-------------|-------------|-------|-------|-------|-------|-------|-----|
| 7 | 11:31 am | 04020 40 | 07352 44 | 6.7 | 9.8 | 0.017 | 0.016 | 0.3 | 3.7 |
| 8 | 11:37 am | 04020 59 | 07353 11 | 7.5 | 10.1 | 0.013 | 0.016 | 0.031 | 5.3 |
| 9 | 11:49 am | 04020 51 | 07352 27 | 8.2 | 10.9 | 0.023 | 0.022 | 0.028 | 2.4 |
| 10 | 12:00 am | 04020 78 | 07353 15 | 8.6 | 12.1 | 0.023 | 0.021 | 0.032 | 1.8 |
| 11 | 12:10 am | 04021 18 | 07354 54 | 8.6 | 11.4 | 0.024 | 0.021 | 0.029 | 2.8 |
| 12 | 12:35 am | 04018 55 | 07352 18 | 280.7 | 393.0 | 1.627 | 1.417 | 1.018 | 2.8 |
| 13 | 12:39 am | 04018 67 | 07353 07 | 119.3 | 167.1 | 2.84 | 0.604 | 2.903 | - |
| 14 | 12:52 am | 04019 25 | 07353 07 | 72.1 | 101.0 | 0.302 | 0.282 | 0.408 | 1.8 |
| 15 | 12:56 am | 04019 53 | 07353 14 | 37.1 | 51.9 | 0.013 | 0.645 | 0.876 | 2.2 |
| 16 | 11:17 am | 04020 26 | 07354 58 | 10.2 | 14.8 | 0.007 | 0 | 0.010 | 0 |
| 17 | 11:25 am | 04020 01 | 07354 00 | 9.7 | 14.7 | 0.004 | 0 | 0 | 2.2 |
| 18 | 11:30 am | 04019 89 | 07354 23 | 12.3 | 17.2 | 0.03 | 0.041 | 0.249 | 0 |
| 19 | 11:37 am | 04019 69 | 07353 63 | 73.6 | 103.1 | 0.009 | 0.350 | 1.396 | 0 |
| 20 | 11:43:am | 04019 60 | 07353 47 | 51.2 | 72.7 | 0.066 | 0.447 | 1.183 | 1.8 |
| 21 | 11:50 am | 04019 52 | 07353 50 | 12.7 | 18.5 | 0.017 | 0.030 | 0.075 | 0 |
| 22 | 11:53 am | 04019 12 | 07353 49 | 13.1 | 18.9 | 0.013 | 0.038 | 0.049 | 0 |
| 23 | 11:57 am | 04019 08 | 07353 44 | 24.8 | 34.3 | 0.049 | 0.080 | 0.368 | 0 |
| 24 | 12:00 pm | 04018 89 | 07354 25 | 17.5 | 23.2 | 0.000 | 0.037 | 0.142 | 0 |
| 25 | 12:05 pm | 04018 87 | 07354 03 | 10.9 | 15.3 | 0.058 | 0.013 | 0.045 | 0.9 |
| 26 | 12:20 pm | 04018 92 | 07354 34 | 189.7 | 232.3 | 0.331 | 1.229 | 7.330 | 0 |
| 27 | 12:25 pm | 04019 11 | 07354 77 | 1.4 | 14.8 | 0.000 | 0.000 | 0.009 | 0 |
| 28 | 12:29 pm | 04019 25 | 07355 21 | 9.4 | 13.2 | 0.001 | 0.007 | 0.221 | 1.4 |
| 29 | 12:34 pm | 04019 16 | 07355 68 | 14.3 | 19.7 | 0.002 | 0.000 | 0.017 | 2.6 |
| 30 | 12:35 pm | 04019 74 | 07355 73 | 11.4 | 15.5 | 0.003 | 0.006 | 0.035 | 0 |

| | | | | | | | | | |
|----|----------|-------------|-------------|------|------|-------|-------|-------|-----|
| 31 | 12:43 pm | 04020 05 | 07355 21 | 11.1 | 15.6 | 0.004 | 0.000 | 0.005 | 1.2 |
| 32 | 2:10 pm | 04006 43 | 07342 91 | 18.2 | 25.5 | 0.003 | 0.007 | 0.031 | 1.3 |

Other areas where air quality tests were conducted are shown in the figures below.



Figure 27: Mill Room (S. Higgins, 2020)



Figure 28: Mill Room (I. Espinosa, 2020)



Figure 29: Storage Bond (S. Higgins, 2020)



Figure 30: Packaging Area (S. Higgins, 2020)



Figure 31: Waste Disposal Area

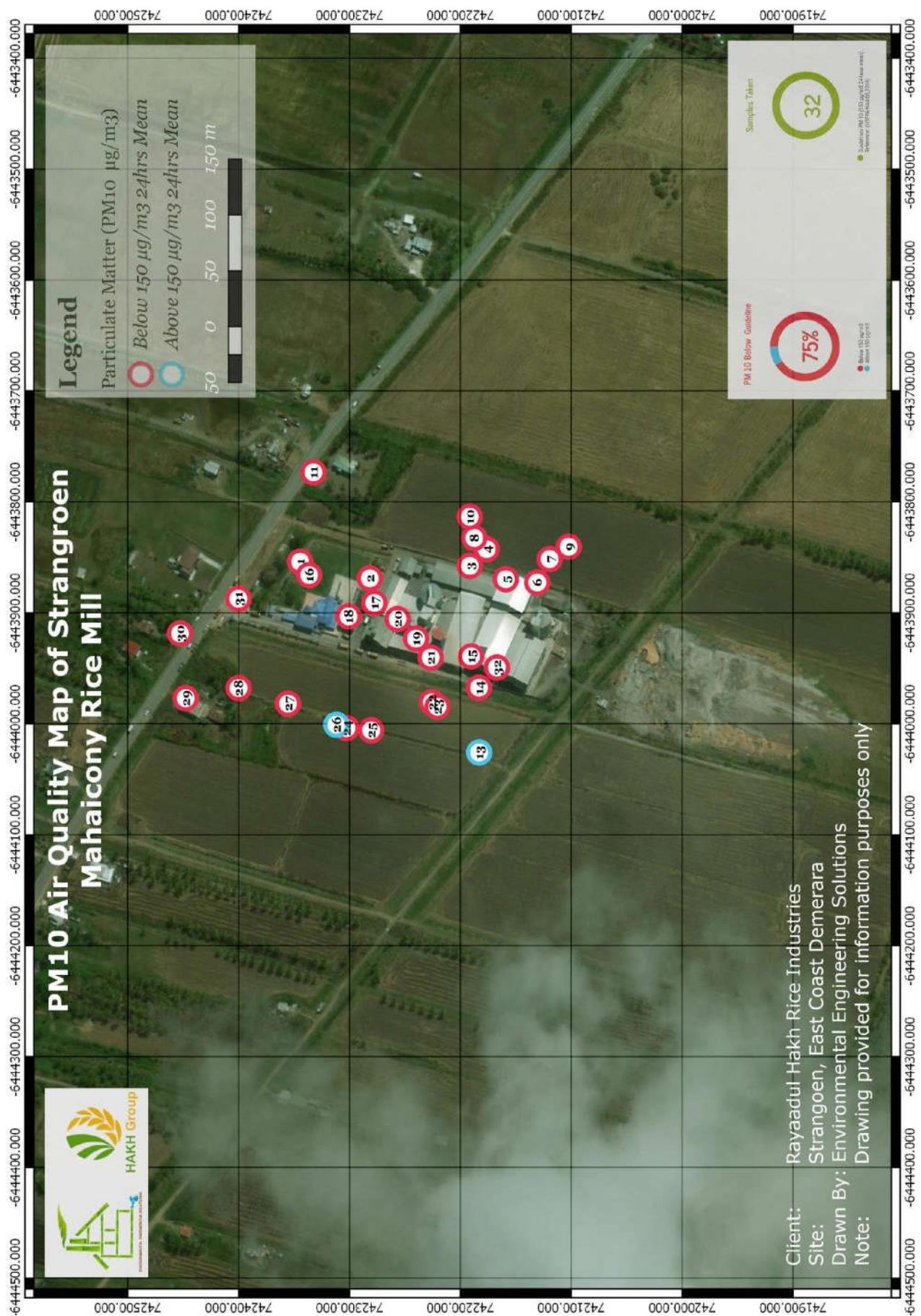


Figure 32-A: Air Quality Sample Points within and around the Rayaadul Hakh Milling Complex

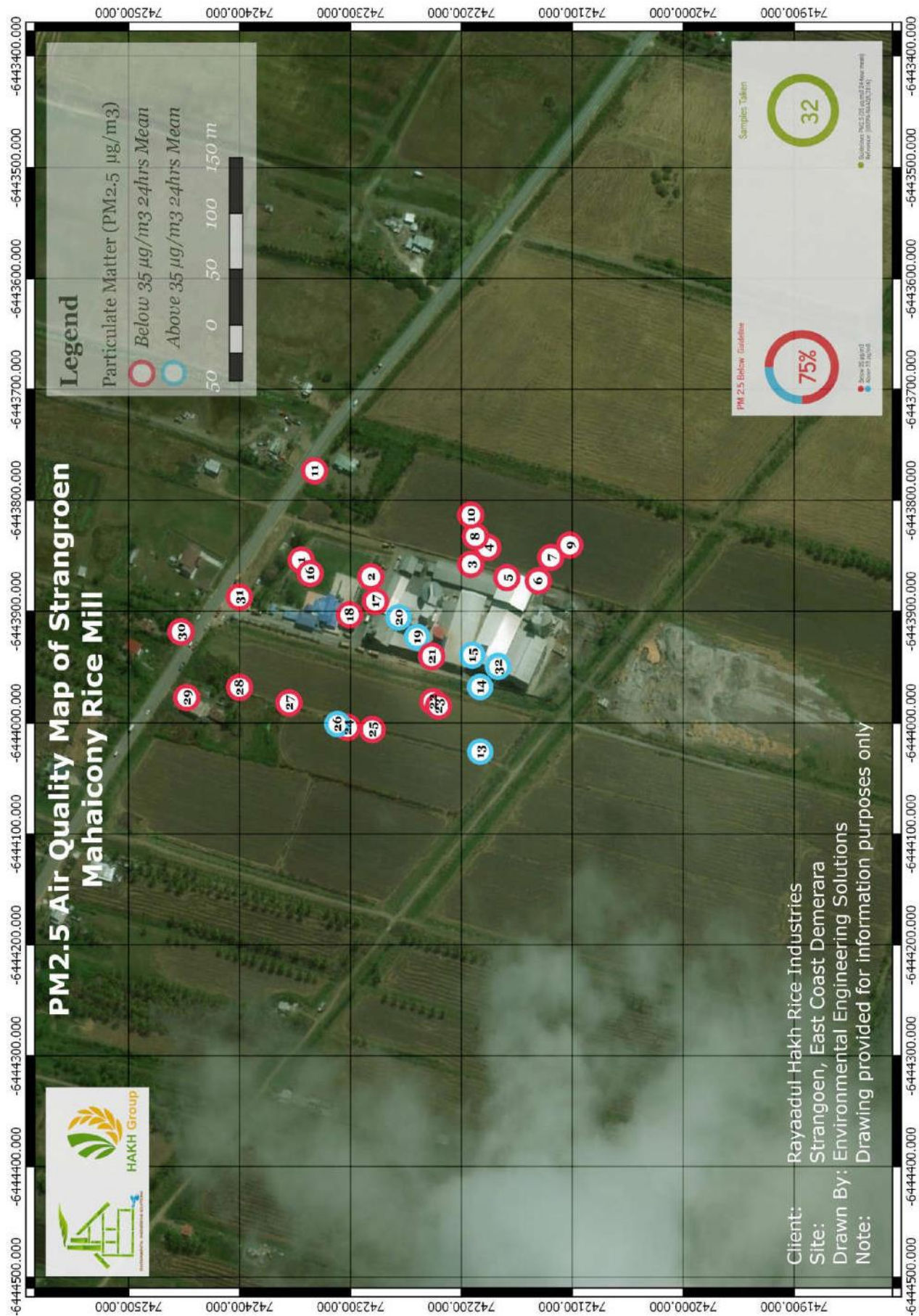


Figure 33-B: Air Quality Sample Points within and around the Rayaadul Hakh Milling Complex

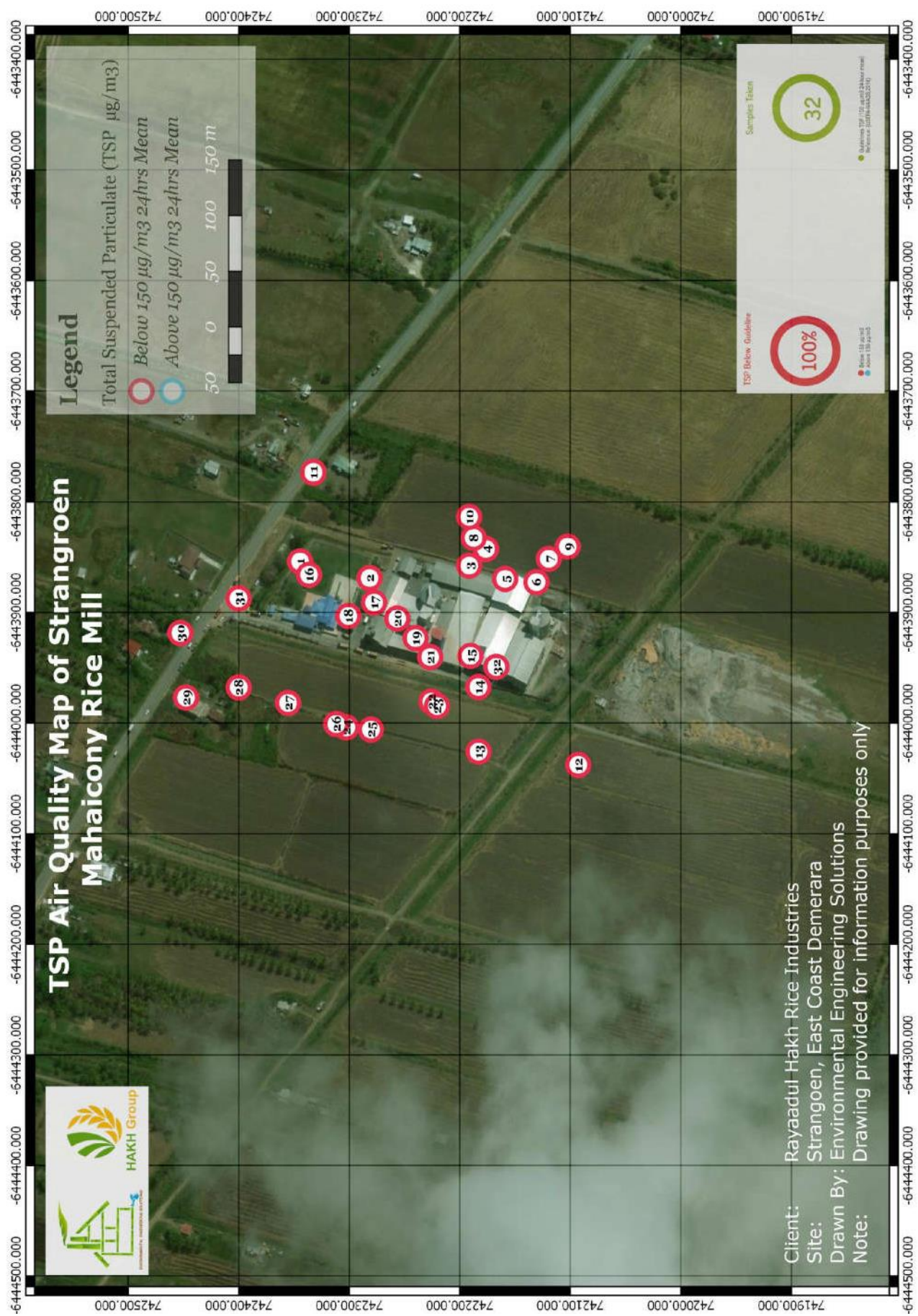


Figure 34-C: Air Quality Sample Points within and around the Rayaadul Hakh Milling Complex

Results and Discussion

Under clean atmospheric conditions; the TSP level can be as low as 0 – 10 $\mu\text{g}/\text{m}^3$. In a very dusty environment, TSP concentration can be as high as 1500 $\mu\text{g}/\text{m}^3$ (Alias, Hamzah and Kenn 2007, p.258).

Monitoring showed the TSP levels of the Total Weighted Average (TWA) and Maximum Concentration (Max. Conc.). TWA of the monitored area ranged from 0 - 1412 $\mu\text{g}/\text{m}^3$, while maximum concentration ranged from 0 – 7330 $\mu\text{g}/\text{m}^3$ respectively, during the monitoring period. The TWA readings varied among the thirty-two (32) sites, with the highest TWA concentration recorded at Sample 12 (1412 $\mu\text{g}/\text{m}^3$) and Sample 26 (1229 $\mu\text{g}/\text{m}^3$). In comparison with the WHO 1999 standard of 120 $\mu\text{g}/\text{m}^3$ 24-hours average, the values recorded at samples 12, 13, 14, 15, 19, 20 and 26 were above the TSP WHO guideline. TWA levels for the other eleven (25) sample points were all below the limit during the monitoring period.

The highest Maximum Concentrations were at Sample 26 (7330 $\mu\text{g}/\text{m}^3$). In comparison with the WHO 1999 standard of 120 $\mu\text{g}/\text{m}^3$ 24-hours average, measurements showed that Sample 12 (1018 $\mu\text{g}/\text{m}^3$), Sample 13 (2903 $\mu\text{g}/\text{m}^3$), Sample 14 (408 $\mu\text{g}/\text{m}^3$), Sample 15 (876 $\mu\text{g}/\text{m}^3$), Sample 18 (249 $\mu\text{g}/\text{m}^3$), Sample 19 (1396 $\mu\text{g}/\text{m}^3$), Sample 20 (1183 $\mu\text{g}/\text{m}^3$), Sample 23 (368 $\mu\text{g}/\text{m}^3$), Sample 26 (7330 $\mu\text{g}/\text{m}^3$), Sample 28 (221 $\mu\text{g}/\text{m}^3$) were all above the standard. The Maximum Concentration is the highest value detected by the sensor during the monitoring time (5 minutes); therefore, this does not represent the average maximum concentration.

The average concentration values recorded at the Rayaadul Hakh Milling Operation were generally below the WHO 1999 standard of 120 $\mu\text{g}/\text{m}^3$ 24-hours average with the exception of Samples 12, 13, 14, and 26.

The Total Suspended Particle (TSP) concentrations measured varied based on TWA and Maximum Concentrations at the 32 sites monitored within and around the Rayaadul Hakh Milling Operation. The TWA, Average and Maximum concentration readings were generally below the WHO 1999 standard of 120 $\mu\text{g}/\text{m}^3$ 24-hours average with the exception of Samples 12, 13, 14, 15, 18, 19, 20, 23, 26 and 28. The results reflect TSP values based on the technical capabilities of the equipment *pDR-1000AN personalDataRAM™*.

Descriptive reference for locations of high readings

| Location | Descriptive reference | Location | Descriptive reference |
|-----------|--|-----------|------------------------------------|
| Sample 12 | Field parallel to the rice husk and rice ash heaps | Sample 19 | Milling area |
| Sample 13 | Open field at the time of data collection | Sample 20 | Milling area |
| Sample 14 | Trench | Sample 23 | Just beyond the fence of rice mill |

| | | | |
|-----------|-------------------|-----------|--|
| Sample 15 | Storage | Sample 28 | Open field at the time data collection |
| Sample 18 | Rice milling area | | |

3.1.10 Noise Conditions

Noise pollution or sound pollution is a form and level of environmental sound that is generally considered likely to annoy, distract or even harm people or animals (BusinessDictionary 2015). Most industrial plants or operations located near a residential area should be considerate of others residing within earshot regarding their emission of noise (BusinessDictionary 2015). The existing sound environment throughout the Rayaadul Hakh Milling Operation was characterized almost completely as Industrial sounds within an agricultural community, and nearby roadway. Noise measurements were taken at various locations within and around the location of the operation.

Procedure

Noise levels were recorded at thirty-two (32) points within and around the Rayaadul Hakh Milling Operation (Figure 32) on June 21, 2020, using a calibrated Sound Level Meter (ExTech 407730). Noise decibel levels are not to be greater than the established permissible noise levels/limits of the Guyana National Bureau of Standards (GNBS) (Table 8) which have been adopted by the Environmental Protection Agency (EPA).

Table 6: Guyana National Bureau of Standards (GNBS) Guideline Values for Noise in Specific Environment
(Source: GNBS 2010)

| Categories | Daytime Limits in dB (06:00 – 18:00h) | Night time Limits in dB (18:00 – 06:00h) | |
|--------------------|--|---|-----|
| Residential | 75 | 60 | |
| Institutional | 75 | 60 | |
| Educational | 75 | 60 | |
| *Industrial | 100 | 80 | |
| Commercial | 80 | 65 | |
| Construction | 90 | 75 | |
| Transportation | 100 | 80 | |
| Recreational | 100 | 18:00- 01:00hr | 100 |
| | | 01:00- 08:00hr | 70 |

***Rayaadul Hakh Rice Industries is located in an Agricultural Area/Zone, however, since there is no Category for Agriculture the Area can be considered Industrial.**



Figure 35: Noise Reading taken in the Mill House (I. Espinosa, 2020)



Figure 36: Noise Reading taken at the Thermal Plant (S. Higgins, 2020)

*Data***Table 7: Noise Levels within and around the Rayaadul Hakh Milling Complex**

| Sample ID | Time | Coordinates | | Noise |
|-----------|----------|-------------|---------|-------|
| | Start | N | W | |
| 1 | 10:56 am | 0402038 | 0735466 | 67 |
| 2 | 11:08 am | 0402023 | 0735404 | 69 |
| 3 | 11:14 am | 0402034 | 0735315 | 73 |
| 4 | 11:19 am | 0402049 | 0735300 | 90 |
| 5 | 11:21 am | 0402022 | 0735283 | 90 |
| 6 | 11:26 am | 0402019 | 0735255 | 85 |
| 7 | 11:31 am | 0402040 | 0735244 | 81 |
| 8 | 11:37 am | 0402059 | 0735311 | 74 |
| 9 | 11:49 am | 0401953 | 0735314 | 78 |
| 10 | 12:00 am | 0402026 | 0735458 | 67 |
| 11 | 12:10 am | 0402001 | 0735400 | 79 |
| 12 | 12:35 am | 0401989 | 0735423 | 83 |
| 13 | 12:39 am | 0401969 | 0735363 | 86 |
| 14 | 12:52 am | 0401960 | 0735347 | 83 |
| 15 | 12:56 am | 0401952 | 0735350 | 90 |
| 16 | 11:17 am | 0401912 | 0735349 | 89 |
| 17 | 11:25 am | 0401908 | 0735344 | 89 |
| 18 | 11:30 am | 0401889 | 0735425 | 81 |
| 19 | 11:37 am | 0401887 | 0735403 | 81 |
| 20 | 11:43:am | 0401892 | 0735434 | 83 |
| 21 | 11:50 am | 0401911 | 0735477 | 68 |
| 22 | 11:53 am | 0401925 | 0735521 | 76 |
| 23 | 11:57 am | 0401916 | 0735568 | 62 |

| | | | | |
|----|----------|---------|---------|----|
| 24 | 12:00 pm | 0401974 | 0735573 | 72 |
| 25 | 12:05 pm | 0402005 | 0735521 | 63 |
| 26 | 12:20 pm | 0400643 | 0734291 | 68 |
| 27 | 12:25 pm | 0401911 | 0735477 | 68 |
| 28 | 12:29 pm | 0401925 | 0735521 | 76 |
| 29 | 12:34 pm | 0401916 | 0735568 | 62 |
| 30 | 12:35 pm | 0401974 | 0735573 | 72 |
| 31 | 12:43 pm | 0402005 | 0735521 | 63 |
| 32 | 2:10 pm | 0400643 | 0734291 | 68 |

Results and Discussion

Noise levels within the Rayaadul Hakh Industries operation ranged from 62 dB to 90 dB. The sampled areas never exceeded 100 decibels (dB). During the time of monitoring within the Rayaadul Milling Operation, the highest noise level recorded was at Sample 4, 5 and 15 (90dB - recorded directly at the generator room of the Complex) however; this was directly at the source (generators). Other high noise level measurements were:

1. Sample 3 (90.3 dB - recorded at the Paddy Cleaner machine),
2. Sample 17 (83.6 dB - recorded within the mill),
3. Sample 4 (83.1 dB - recorded at the paddy husk furnace),
4. Sample 9 (82.5 dB - recorded at the Horizontal Dryer), and
5. Sample 10 (81.5 dB - recorded at Dryer 2).

It is important to note that these noise measurements were high (i.e., above 80 dB) because they were recorded directly at the source of noise emission.

The noise measurements of the other areas recorded around the Rayaadul Rice Milling operation were all below 90 dB; these sample points showed small increments in noise levels and were as a result of sounds from high winds and noise emanating from the operation. However, these levels were all below the 100 dB Daytime (06:00 h - 18:00 h) Industrial limits of the Guyana National Bureau of Standards (GNBS) Guidelines for the Measurement and Assessment of Noise in the Environment.

Furthermore, the noise measurements of the 32 areas recorded within Rayaadul Hakh Milling operation were all below the 100 dB Daytime (06:00 h - 18:00 h) Industrial limits of the Guyana National Bureau of Standards (GNBS) Guidelines for the Measurement and Assessment of Noise in the Environment.

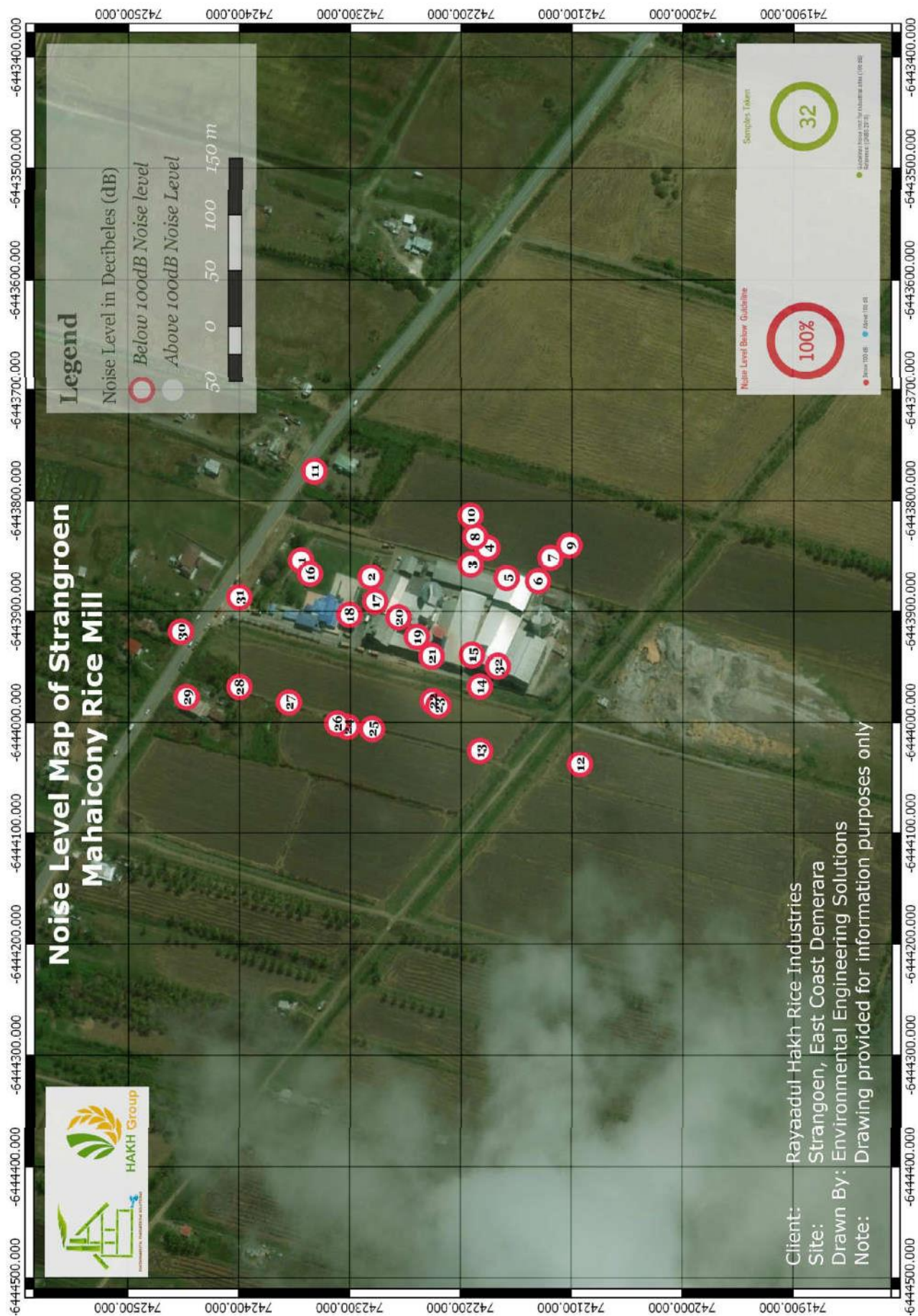
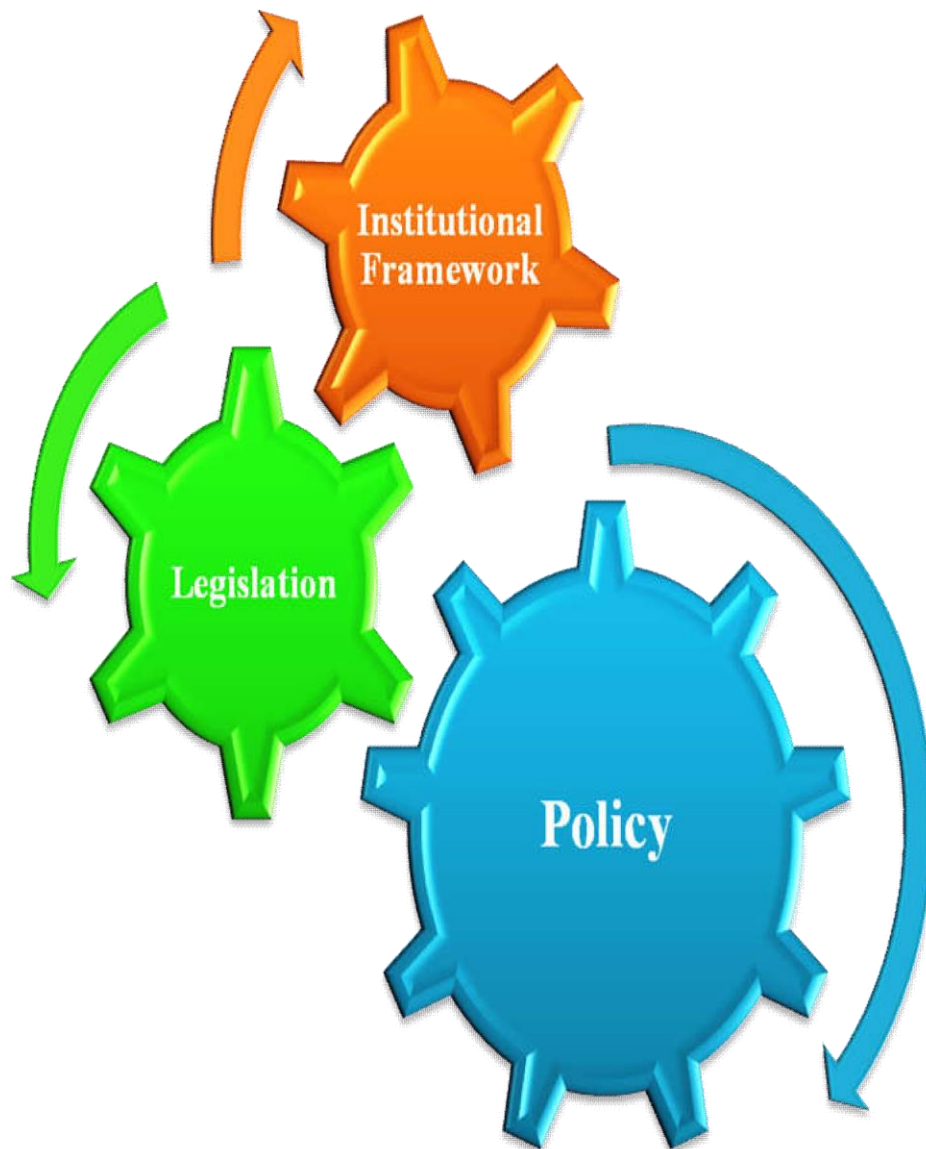


Figure 37: Noise Measurement Sample Points within and around the Rayaadul Hakh Milling Complex

CHAPTER 4: POLICY, LEGISLATION & INSTITUTIONAL FRAMEWORK



4 POLICY, LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

4.1 Overview

This section examines the policies, legislation and institutions that govern and regulate a project of this nature. It is important to note that the EPA has the overall responsibility of managing the environmental affairs of Guyana. The EPA was legally established in 1996 by the Environmental Protection Act, the Agency is responsible for the development of national environmental legislations as well as implementation of environmental policies and standards. The Agency is responsible for administering the environmental authorisation (permitting) process and undertakes the inspection and enforcement of matters relating to the environment as well as promoting the conservation of natural resources in Guyana.

4.2 National Policies

The Government of Guyana has developed a number of key policies to guide development activities in an effort to ensure that natural resources are sustainably utilized and environmental impacts minimized.

4.2.1 National Environmental Action Plan (NEAP) 1994:

The NEAP, which was developed in 1994, outlines the Government of Guyana's main environmental policy objectives for the sound management of the environment and natural resources. Twelve stated policy objectives were outlined, one of which called for the conduct of environmental assessments for proposed development activities that may significantly affect the environment. In keeping with this environmental policy objective, the Environmental Protection Act was enacted in June 1996 and includes the legal framework for undertaking an environmental impact assessment.

4.2.2 Low Carbon Development Strategy (LCDS) 2009:

In 2009, the former President of Guyana set out a vision to forge a new low carbon economy in Guyana. The vision was translated into a national low carbon development strategy, which aims to achieve two goals. These include the transformation of Guyana's economy to deliver greater economic and social development for the people of Guyana by following a low carbon development path; and the provision of a model for the world on how climate change can be addressed through low carbon development in developing countries, if the international community takes the necessary collective actions, especially relating to REDD Plus. Following the election of a new Government, steps have been taken to develop a Green State Development Strategy which will set out Guyana's path to achieving a green economy.

4.2.3 National Biodiversity Action Plan (NBAP) 2012:

The Government of Guyana adopted its first National Biodiversity Action Plan (NBAP I) in 1999, reviewed it in 2005, and developed its second NBAP in 2007 (NBAP II). The third NBSAP was later developed in 2012 and covers the period 2012-2020. This strategy and action plan which serves as the strategic framework for biodiversity management in the country, has nine strategic objectives. It also outlines key priority actions for implementation including the review of existing legislation and outcomes of EIAs and their roles in protecting biodiversity.

4.2.4 Green State Development Strategy Framework 2017:

The draft GSDS Framework provides an overview of the current economic, environmental and social context within Guyana. The document is a consolidation of the relevant goals and targets and an outline of the strategic areas to be developed with expert groups and through broad national multi-stakeholder consultations. The GSDS will be built on past strategies and lays out the elements to be examined and consulted upon and during the course of the GSDS's development. These include green infrastructural transformation; development of new climate resilient infrastructure, sustainable management of natural resources including establishment of conservation areas, renewable energy transition, capacity building for human development through the acquisition of green skills, and improved institutional governance and international cooperation for green trade and investment.

4.3 Legislation

Several legislations exist in Guyana that are considered relevant to the project. The main legislations are discussed as follows:

4.3.1 Environmental Protection Act 1996:

The EP Act under which the Environmental Protection Agency (EPA) was established provides for the management, conservation, protection and improvement of the environment. It also has provisions for the prevention or control of pollution, assessment of the impact of economic development on the environment and the sustainable use of natural resources. The Act mandates the conduct of Environmental Impact Assessments for projects with potential significant impacts on the environment. This Act was amended in 2005 and includes a section on record keeping and monitoring requirements. Under this section, the EPA requires that any person who releases or engages in the handling of hazardous substances or contaminants to:

1. Sample and analyse such contaminant or hazardous substance, or material contaminated by that person for specific constituents or characteristics;
2. Install, use and maintain monitoring equipment, and implement environmental audit procedures as may be specified in any environmental authorization issued pursuant to the Act;

3. Establish and maintain records regarding such sampling, monitoring, and environmental auditing activities;
4. Establish and maintain records regarding pollution control equipment on the premises (including records on control equipment parameters, production variables and other indirect data when direct monitoring is not required);
5. Submit reports including compliance reports; and
6. Provide such other information as the authority may require.

The EP Act also allows for the development of regulations to govern environmental protection in Guyana. In 2000, five different regulations were enacted under the Act as follows:

- Environmental Protection Authorisations Regulations
- Environmental Protection Water Quality Regulations
- Environmental Protection Air Quality Regulations
- Environmental Protection Hazardous Wastes Management Regulations
- Environmental Protection Noise Management Regulations
- Environmental Protection Litter Enforcement Regulations

4.3.2 Environmental Protection (Authorisation) Regulations 2000:

The Regulations outlines the procedure and requirements for issuing Environmental Authorisations (Permit) for any developmental activity which may have adverse impacts on the environment. Due to the nature of the proposed project and the potential negative impacts that the installation of transmission lines may have on the environment if not properly managed, Rayaadul Hakh Milling Complex was required to apply to the EPA for an Environmental Authorisation which will stipulate permitted conditions for ensuring and maintaining the environmental integrity of the area and throughout the life of the operation. The operation will be monitored by the EPA to ensure compliance.

4.3.3 Environmental Protection (Water Quality) Regulations 2000:

The Regulations was established to protect the country's inland and coastal water resources by controlling and managing effluent discharge. These regulations require that any developer who is desirous of commencing any operation, construction, modification and/or extension of a facility which discharges or has the potential to discharge effluent must first apply for an Environmental Authorisation. The regulations further state that effluents discharged in inland/ coastal water or land shall not exceed established discharge parameter limits set by the Guyana National Bureau of Standards (GNBS) as follows:

Table 8: General Environmental Guideline Values for Effluent Discharge (Source: GNBS 2002)

| CATEGORY | GNBS LIMITS | CATEGORY | GNBS LIMITS |
|---------------------------|-------------|------------------------------|-----------------------|
| pH | 5.0 – 9.0 | CN total (Cyanide) | < 1 free: 0.1 |
| Temperature | < 40 | Phosphate (PO ₄) | -- |
| BOD _{for 5 days} | < 50 mg/L | Chlorine (Cl) | < CL: 0.2 |
| COD | < 250 mg/L | Surfactant | -- |
| DO | -- | Phenols | < 0.5 mg/L |
| TSS | < 50 as TSS | Coliforms | < 400 MPN per 100 mls |
| N as NH ₃ | < 10 mg/L | Oil and Grease (O&G) | < 10 mg/L |
| Total N | -- | Metals | -- |
| Phosphorous (P) | < 2 mg/L | | |

The provisions reiterate that there must be the establishment of sampling points; effective record keeping, reporting on effluent discharges, water quality and biological integrity; management of spills/accidental discharges and encouragement of proper disposal/treatment of effluents discharge. This operation, therefore, will ensure that there is adherence to the water quality regulations through the implementation of appropriate measures to keep possible discharge within the prescribed limits set by the GNBS. This will not only help to safeguard the environment, but will also ensure that the activities are conducted in keeping with the legal requirements of the country.

4.3.4 Environmental Protection (Air Quality) Regulations 2000:

The Regulations outlines the allowable amount of air pollutants which may be emitted into the atmosphere. The regulations require that any developer involved in any construction, installations, operations, modification and/or extension of any facility that emits air contaminant must apply for an Environmental Authorisation. The regulations also include the air contaminants for which parameter limits are to be established.

Currently, no emission limits have been established in Guyana; nevertheless, this operation will seek to ensure that the air contaminants emitted during the operation of the Rice Milling Complex are controlled and restricted to a minimum value through the implementation of appropriate measures to protect the residents in proximity to the facility, the health of workers and the general environment. The operation will also be guided by the ambient air quality standards recommended and used by the EPA.

4.3.5 Environmental Protection (Hazardous Waste Management) Regulations 2000:

The Regulations was developed with the primary aim of protecting the environment by controlling the discharge of hazardous waste materials. The regulations require that any Developer involved in any operations that generates, transports, treats, stores or disposes of

hazardous waste must submit an application for an Environmental Authorisation. The regulations also outline the provisions for reporting, record keeping, emergency preparedness planning and transportation of hazardous waste, while at the same time encouraging that Developers utilise appropriate disposal and/or treatment mechanisms of hazardous waste identified in the regulations.

It is the intention of Rayaadul Hakh Group Inc. to ensure that all possible precautionary measures required for the safe handling and disposal of hazardous materials/substances are observed in the different stages of operation. This will be done in an effort to ensure that the integrity of the environment is protected and that all workers and nearby residents are protected from negative health-related implications.

4.3.6 Environmental Protection (Noise Management) Regulations 2000:

The Regulations seeks to manage and control noise emission levels within Guyana. According to these regulations, it is required that any Developer involved in any operations, construction, installations, modification and/or extension of a facility that emits noise must apply for an environmental authorisation from the EPA. The regulations also stipulate that noise decibel levels are not to be greater than the established permissible noise levels/limits of the GNBS which have been adopted by the EPA. Rayaadul Hakh Group Inc. will take all measures possible so as to ensure that there is adherence to the stipulated noise regulations by implementation of measures, where necessary, to maintain minimal noise levels to protect the environment, to safeguard the health of workers and residents around the Rice Milling Complex.

Table 9: Guyana National Bureau of Standards (GNBS) Guideline Values for Noise in Specific Environment (Source: GNBS 2010)

| Categories | Daytime Limits in dB (06:00 – 18:00h) | Night time Limits in dB (18:00 – 06:00h) | |
|-------------------|--|---|-----|
| Residential | 75 | 60 | |
| Institutional | 75 | 60 | |
| Educational | 75 | 60 | |
| Industrial | 100 | 80 | |
| Commercial | 80 | 65 | |
| Construction | 90 | 75 | |
| Transportation | 100 | 80 | |
| Recreational | 100 | 18:00- 01:00hr | 100 |
| | | 01:00- 08:00hr | 70 |

4.3.7 Environmental Protection (Litter Enforcement) Regulations 2013:

Under the Regulations, persons who are found guilty of littering will be charged. The Regulations are enforced by the EPA through its recently established Enforcement and Compliance Division. The Litter Regulations address among other aspects, litter offences,

penalties and the power of the local authority to enter premises and to remove derelict vehicles. Under the Litter Regulations, it is an offence to litter in a public place, particularly:

1. To deposit litter in a public place;
2. To deposit litter from a moving vehicle unto a public place; and
3. To cause or permit persons to commit offences 1 and 2 above.

Any person/persons found guilty of any of these offences under the Litter Regulations shall be liable to a fine of between fifty to one hundred thousand dollars (\$50,000 - \$100,000) or three months imprisonment. The absence of a waste receptacle is not an excuse under the law. Allowing litter to enter a public place from a vehicle whether it is a bus, car, truck or trailer is an offence and any person found responsible for such an act will be fined the sum of fifty thousand dollars (\$50,000). If the person that committed the offence cannot be determined, then the driver of the vehicle will be held responsible. If it is a company or organization committing such an offence then it shall be fined one hundred thousand dollars (\$100,000). Rayaadul Hakh Group Inc. will ensure that there is adherence to the stipulated litter enforcement regulations by implementation of measures where necessary to protect the environment from solid waste pollution at the Rice Milling Complex.

4.3.8 Pesticides and Toxic Chemicals Control Act 2000:

The Act, which established the Pesticides and Toxic Chemicals Control Board, is intended to regulate the manufacture, importation, transportation, storage, sale, use and disposal of pesticides and other toxic chemicals. In the Act, toxic chemicals are considered as “any disinfectant or any other substance known to be poisonous, corrosive, irritating, capable of causing a sensitive reaction or sensitive to man or animal that is used in agriculture, the arts, commerce or industry or for any domestic or other purposes”.

4.3.9 Pesticides and Toxic Chemicals Regulations, 2003:

4.3.10 Labour Act 1942:

The Act provides for the establishment of the Department of Labour, for the regulation of the relationship between the employer and the employees. The Act stipulates and establishes procedures regulating wages paid; minimum rate wages payable; hours of work; the rights and obligation of the employees; and provides for settlement of differences between employees and employers. Rayaadul Hakh Group Inc. intends to comply with Guyana labour laws and policies to protect and safeguard the welfare of all the staff employed by the operation (Labour Act 1942).

4.3.11 National Insurance and Social Security Act 1969:

The Act establishes the National Insurance and Social Security system, which covers and protects workers. The persons/individuals to be insured under this Act by payment of contributions are those persons who are sixteen (16) years and older, under sixty (60) years of age, self-employed, and gainfully employed. The National Insurance and Social Security system provides benefits for old age, invalidity, survivors' benefits, sickness, maternity, funeral and industrial benefit.

4.3.12 Occupational Safety and Health Act 1997:

The Act provides for the registration and regulation of industrial establishments/operations to ensure the occupational safety and health of all workers, and inevitably prevent, as far as possible, avoidable injuries due to negligence and/or oversights in safety. The Act stipulates that companies and employers must ensure that measures are implemented to ensure the safety of all operating facilities and machinery, the provision of sufficient ventilation, lighting, sanitary facilities and access to potable water; the identification of hazardous chemicals, physical and biological agents to be used during operations of the facility, and regulation of both the usage and storage of these (OS&H Act 1997).

4.4 Institutional Framework

4.4.1 Background of the Institutional Arrangements of the Rice Industry and the Rayaadul Hakh Rice Mill

The Guyana Rice Board (GRB) was established in 1946, this brought together both Government officials and farmers to develop policy for the rice sub-sector. After Guyana's Independence in 1966, farmer representation at GRB diminished and by 1973 there were no farmers on the Board. The GRB was then dissolved by the Rice Regulation of Manufacturing and Marketing Act of 1985 and in its place three separate entities were created i.e., the Guyana Rice Milling and Marketing Authority (GRMMA), the Guyana Rice Export Board (GREB) and the National Paddy and Rice Grading Centre (NPRGC).

The original purpose of the GRMMA was to purchase and sell paddy and rice and the GRMMA had its own Rice Mills from which it supplied rice for domestic and export markets. Local purchases of rice were made at prices fixed by Government according to a formula based on cost of production. From the early 1980s, private millers were authorised to purchase and sell rice to the local market at fixed prices, and from the mid-1980s, they were allowed to export. The GREB was charged with the regulation of exported rice and also arranged for the export of GRMMA rice. In 1985, the GREB was responsible for licensing exporters as well as approving the quality and price of each export transaction. The NPRGC was responsible for grading and certifying paddy and rice for both local use and export. The NPRGC established national standards for grading and personnel were assigned to Rice Mills in an effort to monitor the

grading process. The combined activities of these three (3) entities amounted to significant intervention by the Government of Guyana in the rice sector. In addition, there were restrictions on internal trade of rice, with farmers being constrained to sell rice only within certain geographical areas. Moreover, there were restrictions on the amount of paddy or rice which farmers could hold.

By the late 1980s, due to defective policy framework the Government began to dismantle its pricing and institutional structure and sold off almost all its Rice Mills (retaining only one complex under GRMMA). This drastically increased the competitiveness of the rice sector and once again gave rice farmers an incentive to invest in the industry and triggered a swift response in area planted. In 1994 the Rice Act streamlined the previous institutional arrangements. As a result, from 1990 to 1991 the area harvested increased by forty six percent (46%) and rice output increased by more than sixty percent (60%) to 151,000 metric tonnes. From 1991 to 1994 the area harvested increased by a further twenty nine percent (29%) and production by a further fifty five percent (55%), and the trend increase continued into 1995. In 1994 the Rice Act streamlined the previous institutional arrangements. The GRMMA was then dissolved and a small parastatal Rice Company was created to operate the Burma Mills which remained the only State-owned Rice Mill. Moreover, the GREB and the NPRGC merged to form the Guyana Rice Development Board (GRDB) which is known as it is today.

Moreover, the main Government Agencies that have some regulatory oversight for the Rayaadul Hakh Milling Operation are as follows:

4.4.2 Environmental Protection Agency

The Environmental Protection Agency (EPA), established under the EPA Act 11 of 96 is the principal authority for *environmental management* in Guyana. In Sec. 4 (1) (a), 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 *“co-ordinate the environmental activities of all persons, organizations and agencies”* [Sec. 4(1) (c)]; and is mandated *“to play a coordinating role in the preparation and implementation of cross-sectored programmes of environmental contents”* [Sec. 4(1) (1)]. The mandate to serve as the highest authority for granting Environmental Authorizations, where they are required, is supported by Sec. 5 which states that *“any person or authority under any other written law, vested with power in relation to the environment shall defer to the authority of the Agency and shall request an environmental authorization from the agency before approving or determining any matter...”*. This body is therefore in charge of granting environmental permits for projects, including those for ‘a Rice Milling Complex.’

Rayaadul Hakh Rice Industries. has applied to the EPA for Environmental Authorisation (Operation Permit). The EPA has determined that an EMP be prepared and submitted for approval. Once this EMP is approved the EPA will then issue the Operation Permit. The Agency

is then expected to conduct monitoring of the operation to ensure compliance with the conditions outlined in the Operation Permit. Rayaadul Hakh Group Inc. will also be responsible for conducting self-monitoring and submit monitoring reports to the EPA.

4.4.3 Ministry of Agriculture

The Ministry of Agriculture has direct oversight over the Rayaadul Hakh Milling Complex through its various Departments. The Departments that play a key role in regulating and supporting the Rice Mill are:

- Guyana Rice Development Board

4.4.4 Guyana Rice Development Board (GRDB)

The Guyana Rice Development Board, established under the GRDB Act of 1994, of the GRDB was designed to be involved in the policy making and regulatory role of the Rice Industry. As established, the GRDB is also a facilitator of selected activities within the rice industry that is now owned and operated by the private sector. In addition to its regulatory activities; GRDB works along with stakeholders in the following areas:

- *Export and Trade Facilitation*: Responsible for the preparation of all relevant documentation for the exporting of rice from Guyana. And also assist in the facilitation of Foreign Investors in the purchase of Guyana's rice or other rice products where necessary.
- *Quality Control*: Responsible for ensuring that the quality of rice for both local consumption and export meets the requisite specifications. Train Farmers, Millers Workers and Exporters in areas of Quality Management.
- *Research*: New varieties and strains of rice are developed, so that farmers can have access to plants that are more conducive to providing a better quality and higher volumes of grain.
- *Extension (Technology Transfer)*: Responsible for the transfer of technology from the Research Station to the farmer.

4.4.5 Ministry of Labour, Human and Social Security

The Ministry of Labour, Human and Social Security functions to regulate the relationship between the employers and employees, ensure OH&S standards in the workplace, provide public support programmes for suicide prevention, childcare protection, and human trafficking prevention, special cases such as disabilities, domestic violence, and rape, and provide old age pension for the elderly.

4.4.6 National Insurance Scheme (NIS)

The National Insurance Scheme (NIS) is a social security organisation, which maintains a system of social security by securing contributions from both employees and employers to generate benefits during sickness and accidents. NIS also provides other benefits for example old age, invalidity, industrial etc.

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;
- 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.

CHAPTER 5: IMPACTS AND MITIGATION MEASURES



5 IMPACTS AND MITIGATION MEASURES

5.1 Introduction

This section identifies the potential impacts of the Rice Milling Complex on the environment and the measures to be implemented to mitigate principal adverse effects of the operation. Mitigation measures are identified to prevent, minimize and manage the adverse potential environmental impacts of the Rice Mill Operation. A Monitoring Plan and an Emergency Response Plan were also developed to ensure the measures are implemented and are efficient in preventing and minimizing any impacts of the operation. Rayaadul Hakh Rice Industries will be responsible for the implementation of the EMP and other environmental requirements, such as those outlined in the EPA's Operation Permit. The Managers will have the direct responsibility of ensuring environmental compliance.

5.2 Potential Impacts and Mitigation Measures

Table 10: Potential Impacts of the Rayaadul Hakh Milling Complex and Mitigation Measures

| <i>Activities</i> | <i>Phase/Section of Rice Mill</i> | <i>Potential Environmental Impacts</i> | <i>Recommended Mitigation Measures</i> |
|--|-----------------------------------|--|--|
| Physical Environment | | | |
| 5.2.1 Environmental Aspect: Soil | | | |
| <ul style="list-style-type: none"> • Heavy Duty Vehicular Movement and Maintenance. • Storage of Hazardous Waste for Collection. | Operational | Soil contamination from improper handling and spillage of oils and lubricants, hazardous waste or chemicals. | <ul style="list-style-type: none"> • Spill containment equipment will be provided onsite for effective handling of fuel, waste oil, and other lubricants. • The amounts of fuel, oil, chemicals and pesticides that are stored onsite will be kept to a minimum. • Segregate hazardous waste at generation points and store at a confined and designated area. • Storage of waste oil, fuel and lube drums shall have restricted access. |
| Transporting paddy from farmers' rice fields to the mill and final product for export. | Operational | Risk of increase in road accidents resulting from the deplorable state of the Burma access road. | The company collaborates with the Government of Guyana (GoG) to pave the road or bear the full cost of the project. |
| Disposal of paddy husk | Operational | Risk of increased clearing of land to accommodate waste, which will leave the soil exposed to the elements (wind and rain) of erosion. | <p>The company will develop a long-term solution/ infrastructure to properly accommodate the paddy husk waste. An area that the Company can consider is to purchase a Combined Rice Husk Gasifier Thermoelectric Generator.</p> <p>All paddy husks produced by the operation can be re-used as biomass fuel for a Combined Rice Husk Gasifier Thermoelectric Generator that will power the entire Rice Mill Operation providing electricity.</p> |

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| Rice planting and harvesting | Soil biological degradation | <ul style="list-style-type: none"> • Risk of depleting key soil biological components. • Soil fertility deterioration | <ul style="list-style-type: none"> • Management of Rayaadul Hakh Rice Industries. will, preferentially, use selective pesticides with low environmental impact quotient (EIQ) where appropriate, rather than broad-spectrum products, to minimize impacts on flora and fauna. • With the exception of major land preparation to be carried out at the onset of the farm, Rayaadul Hakh Rice Industries will encourage local farmers to adopt minimum/reduced tillage for the subsequent planting seasons. This will minimize impacts on soil fauna. • Rice stocks after harvesting and some rice straw will be tilled into the soil by local farmers to improve soil organic matter which will improve soil biological conditions. |
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5.2.2 Environmental Aspect: Water Resources

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| Cleaning and maintenance of machinery and vehicles | Operational | <ul style="list-style-type: none"> • Risk of contamination of groundwater/well water by generated wastewater from the Rice Mill and by waste oil from the maintenance of the machinery. • Effluent generated from mixture of water with chemical lubricants might contain COD and Suspended Solids (SS) which will impact adversely on the water quality of the area. | <ul style="list-style-type: none"> • Spill areas will be cleaned immediately using appropriate equipment/materials to prevent contamination of water ways. • Sediment basins will be constructed where discharges from the premises are likely to occur. • Silt fencing/trenching/beaming will be placed to decrease erosion and sedimentation. • Fuel stored onsite is stored in three (3) above ground fuel tanks (Capacity total: 24,000 litres) with a bond that has an impervious surface and 110% containment (currently being constructed) of the 3 storage containers. • Waste piles will not be stored close to waterways. |
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5.2.3 Environmental Aspect: Fuels, Lubricants and Chemicals

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| <ul style="list-style-type: none"> • Vehicle, Generator and other Machinery Maintenance. • Rice Packaging. | Operational | <ul style="list-style-type: none"> • Fuel, lubricants and chemicals, if not properly managed, can spill which can result in soil or water contamination. • 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 to fumigate containers for the finished product (cargo rice etc.). | <ul style="list-style-type: none"> • Waste oil would be collected and stored in a contained area with an impervious surface. The company has a system of used oil storage at the site and collection (sealed in metal barrels) to be given to farmers and operators of other old Rice Mills. Excess waste oil, if any, will be stored in metal drums on an impervious surface. • Oil spill kits will be kept on site and all waste oils will be removed from the site for proper reuse/recycling as appropriate. • Implementation of chemical storage and treatment sites and tanks in containment areas, and ensuring that they are properly covered to prevent spillage of these materials. • Designing of the containment area to be so that leaks can be easily detected and spills are not able to further infiltrate, the containment area will be located in a designated section of the mill on an impervious surface. • Regular monitoring of sewage (septic tanks) and grey water treatment facilities, and • Surface runoff will be directed to the Eastern Discharge Area that leads to the Strangroen Canal. |
| 5.2.4 Environmental Aspect: Waste Management | | | |
| Dryer Operations | Operational | <ul style="list-style-type: none"> • Paddy ash emanating from the furnace (through combustion of paddy husk) used to dry paddy. • Ashes and burnt husks. | <ul style="list-style-type: none"> • Multi dust cyclone or a dust collector system for collecting particulate matter should be installed at paddy husk offloading areas for the biomass furnace as well as on the column dryers to reduce the emissions from dryers and the furnace. • The disposed ash from the biomass furnace is discharged at an area on the south-western section of the complex. Ash is also used as fertiliser material by farmers on the western lands of Rayaadul Hakh Rice Industries. |

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| | | | <ul style="list-style-type: none"> • Ash and burnt husk are also given to residents of De Hoop Housing Scheme and crop farmers as landfill material and as mulch for the soil. • Paddy husk can also be used to make bio-char or compost as bio-fertilizer. |
| Solid Waste Generation | Operational | <ul style="list-style-type: none"> • The disposal of solid waste, which includes the husk from the paddy as well as other waste generated from the cleaning process, is another major environmental problem associated with rice milling. • Pollution risks to water and soil may arise from spillage of solid waste and burnt husks. | <ul style="list-style-type: none"> • Currently, solid waste and paddy impurities are disposed of at the dumpsite west of the Rice Mill. • It was advised by the EPA that (a) the burning of waste is ceased, (b) the paddy chaff heap is not stock-piled more than 5ft high and (c) the burning of paddy is immediately extinguished for spontaneous ignitions. • Garbage receptacles of good and long-lasting quality should be installed at various strategic locations to collect organic, plastic, glass and other garbage separately. • All workers shall be instructed to put garbage in designated bins as per segregation. • Metals, plastics, paper and glasses in the garbage is buried in the back fields of the rice mill. • Used tyres are sold • No open burning of waste shall be carried out at the site. • All hazardous waste collected at site shall be disposed of within a defined time period. • The company will enlist a suitable entity to prepare procedures of good practices of rice storage and milling to accompany the implementation of activities (quality, hygiene and safety measures in the operation of the rice processing plant; etc.). |
| 5.2.5 Environmental Aspect: Air | | | |

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| <ul style="list-style-type: none"> • Offloading the paddy at the Hoppers and paddy husks at the Biomass furnace. • Lifting and discharge of paddy or rice through bucket elevators. • Pre-cleaning of rice, paddy cleaning in paddy cleaner/vibrating screen. • De-stoner machine, Paddy separator, de-husking in rubber roll, aspirator used for husk removal, polishing of rice and grading of rice in rice grader. | Operational | <ul style="list-style-type: none"> • Release of dust to the atmosphere from handling or processing of the paddy or its by-products. This is the major environmental concern for rice mills. • High dust levels may endanger rice mill workers and employees' health and safety. Dusts inhaled by the workers might affect the lungs and lung cancer might be developed due to prolonged exposure. | <ul style="list-style-type: none"> • Dust extraction provision will be made by placing cyclones or dust collection systems at required points. • The process equipment like bucket elevators, conveyers, screening equipment (rotary/vibratory), milling equipment etc, should be adequately enclosed with galvanised zinc material. • The Company will be advised to introduce mask or a thin piece of cloth for the workers. The workers should be motivated to realize the consequence of inhaling dusts and therefore, to use mask or thin layer of cloth to protect their nose and mouth. • The use of appropriate procedures and personal protective equipment, for example, to reduce employee inhalation of dust. • Exhaust fans may be installed in the mill house to expel air carrying fine particles of dust and rice bran. |
| Vehicular movement | Operational | <ul style="list-style-type: none"> • Currently, dust is usually generated by vehicle traversing the roads passing through the property. Vehicular emissions will affect quality of air. | <ul style="list-style-type: none"> • To prevent fugitive emissions, all roads and vehicle parking areas must be paved (concrete, asphalt, etc.) and properly cleaned. In addition, surfaces should be grassed where possible. • Speed breaks should be introduced at specific intervals and wetting of the road must be done regularly, especially during the dry season. • Road signs indicating the speed limit should be erected at particular sections of the road. |

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| Generators | Operational | • | • All generators are not used at the same time and only used when necessary. |
| Vehicle Exhaust | Operational | • Heavy duty trucks are used to transport produce which releases SO _x , NO _x and CO into the atmosphere due to incomplete combustion | • Turn off idling engines within the compound |
| 5.2.6 Environmental Aspect: Noise | | | |
| • Operation of Machinery (Milling, De-husking, | Operational | • Heavy traffic of vehicles off-loading and loading raw | • All noise emitting equipment should be fitted with exhaust mufflers. |

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| <p>Polishing and Drying)</p> <ul style="list-style-type: none"> • Movement of vehicles (Transporting of paddy) | | <p>materials and finished products; generators; and other machinery will increase noise levels within and in the vicinity of the Milling Complex.</p> <ul style="list-style-type: none"> • Other sources of noise include vibratory screen for sorting; fans; de-husking; polishing; blowing, paddy cleaning; packaging etc. • High internal or external noise levels may generate a health hazard to employees or a nuisance to the local community. • Mechanical devices, if not maintained properly, may cause severe noise. • There was noise pollution from huller and separating units as well as the moving belts. The engine or the moving belts of the mechanical separator in the mill house were found to produce irritating noise. | <ul style="list-style-type: none"> • Noise levels should comply with the Industrial limit prescribed by Guyana National Bureau of Standards. • If the permanent noise level is continuously above 85 dB, Rayaadul Hakh Rice Industries must provide employees with ear protection to prevent hearing disorders (especially in the generator room). Workers operating heavy-duty machines or equipment should be equipped with earplugs and ear muffs. Workers will interchange four hour shifts to minimize exposure to noise levels. • The noise could be reduced to a safe level by maintaining the mechanical devices on regular basis. Regular maintenance of equipment including lubricating moving parts, tightening loose parts and replacing worn out components should be conducted. • Workers working near high noise generation shall be provided with ear plugs/ear muffs to limit exposure to occupational hazards. • All enclosures shall be well maintained and kept closed at all times. • The generators should be housed in a fully enclosed room, which should be properly equipped with exhaust ducts and sound attenuating measures (e.g., silencers, mufflers, etc.). |
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Biological Environment

5.2.7 Environmental Aspect: Flora

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| <p>Discharge of waste water into drainage canal.</p> <p>Disposal and burning of paddy husks.</p> | Operational | <ul style="list-style-type: none"> • Contamination of surface water and groundwater from chemical effluents. • Poor and untidy environment. • Risk and impairment of the ecosystem. • Removal of vegetation for dumping and burning of paddy husks. • Loss of original vegetation cover. | <ul style="list-style-type: none"> • A vegetative buffer will be established and maintained along the boundaries of the complex. • Trees can arrest dust circulation and deposition by slowing windspeed. Plant tissues absorb Gaseous pollutants primarily within leaves, and are adsorbed at leaf surfaces. • The particles suspended per litre of air in areas without tree cover are 4 times that of tree covered areas. • Trees can funnel air out to protect from cyclonic winds. • Trees also remove heavy metals from air, such as cadmium, chromium, Nickel and lead. • Light intensity under trees with dense canopy can be reduced by 75%. • Trees canopy can guide the wind upwards decreasing the speed and lowering the temperature, this minimizing the loss of moisture from the soil through evaporation. • Noise Pollution – Comfortable, natural and acceptable sound level of 30 decibels is exceeded to a level of 120 decibels near airport and to 80 decibels by noisy trucks and motorcycles. Trees are endowed with the capability to mitigated and reduce this noise level by their leaf area. |
| 5.2.8 Environmental Aspect: Fauna | | | |
| <p>Disposal and burning of paddy husks.</p> <p>Drainage of waste water into canal system.</p> | Operational | <ul style="list-style-type: none"> • Migration to a new habitat where it is possible to adapt. • Reduction in the population of micro fauna. | <ul style="list-style-type: none"> • Waste water should be treated before it is discharged into the canal. • Employees should be advised to use appropriate waste receptacles and to stop indiscriminate waste dumping. • There will be minimal use of agrochemicals that are harmful to fauna. As much as possible, agrochemicals used would be of types that are not persistent in the environment and the correct dosage will be |

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| | | | applied. |
| 5.2.9 Environmental Aspect: Bio-safety and Bio-security | | | |
| Storage of Rice (Storage Bonds, Silos) | Operational | Risk of diseases being spread by rodents or avian species | The company will prepare procedures of good practices of rice storage and milling to accompany the implementation of activities (quality, hygiene and safety measures in the operation of the rice processing plant). |
| Socio-Economic Environment | | | |
| 5.2.10 Social Aspect: Safety and Security | | | |
| <ul style="list-style-type: none"> • Areas assigned for paddy cleaning, de-husking, polishing, grading and riceproduct packing (Hoppers, Cleaner Machines) • Milling | Operational | <ul style="list-style-type: none"> • Risk of rice contamination. • Occupational Health and Safety Issues. | <ul style="list-style-type: none"> • Areas shall be designed to have adequate working spaces and clearly separated from one another which are able to prevent contamination from pests and disease carrier animals. • In-house training for staff will be conducted in safety and security procedures and emergency response. • Rayaadul Hakh Rice Industries will adopt Guyana's Health and Safety Policy to guide the activities. The company will also provide and enforce the use of appropriate Personal Protective Equipment (PPE) such as safety boots, reflective jackets, hand gloves, earplugs and dust masks. Sanctions will be implemented where employees do not use the PPEs provided. • Rayaadul Hakh Rice Industries will regularly maintain and service its generators, trucks and tractors to ensure they are in good condition. Good conditioned and well-maintained equipment will reduce frequent breakdowns, noise nuisance and smoke emissions which could affect the operator's and other workers health and safety. • Experienced (licensed) machine operators with requisite skills will be employed to operate the machines. |

| 5.2.11 Social Aspect: Security | | | |
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| Machinery and Vehicle Movement and Operation | Operational | Misuse of machinery and other equipment. | <p>The company shall:</p> <ul style="list-style-type: none"> • Maintain a security presence onsite; • Have a staff register and staff medical record. • Have a workplace accident record and safety register; • Provide PPEs; • Develop a security plan; • Set up a traffic plan within the complex and ensure that traffic rules are defined; • Training of drivers; • Provide communication equipment; and • Ensure maintenance and regulatory and/or preventive inspections of gear, equipment and site facilities. |
| 5.2.12 Social Aspect: Community Relations | | | |
| <p>Jobs and Special Skills Training (Mill, Rice fields, Workshop)</p> <p>Water supply to Burma Community</p> | Operational | <ul style="list-style-type: none"> • Community relations can be compromised. • Lack of Employment opportunities. • Mill Compound/Reservoir Quality of Well Water | <ul style="list-style-type: none"> • Rayaadul Hakh Rice Industries. can implement monthly workshops, inviting various institutions such as the National Agricultural Research and Extension Institute (NAREI), GRDB, and the Guyana School of Agriculture (GSA) to have dialogue with residents of Strangroen and De Hoop Housing Scheme on how they can utilize their land more. • Workshops can be held to form a small business alliance for residents not interested in developing the land. • The relevant authorities will be notified of any emerging problems and the Company will work with these authorities to address any |

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| | | | <p>issue.</p> <ul style="list-style-type: none"> • The water reservoir should be cleaned regularly. • The Company should employ residents from the community. • Recreational facilities will be provided onsite for workers. • The Company will continue to contribute in a meaningful and practical manner to the development of the Burma community. |
| Training | | | |
| Rice Mill Operations (Operation of various machines) | Operational | Loss of life and mishandling of machinery | <ul style="list-style-type: none"> • Regular training on standard operational procedures and occupational health and safety and the use of PPE will be provided for machine operators and workers at Rayaadul Hakh Rice Industries. • 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 include: <ul style="list-style-type: none"> • Company environmental requirements and environmental management measures; • Worker's role and responsibilities in environmental management; and • Emergency response measures. • Rayaadul Hakh Rice Industries will provide first aid training for its workers and provide first aid kits to treat minor ailments. However, major cases will be referred to the Mahaicony Hospital or Health post. |
| Community Relations | | | |

- Complaints can be sent in a written form and delivered to the office of the rice mill. The letter must have contact information to receive a response from the rice mill.
- The receiving staff will share the letter with the management of the rice mill.
- Management will review the letter and acknowledge receipt through a call or email.
- An investigation into the complaint will be conducted to resolve the issue and gather solutions.
- A report for the conclusion will be prepared and further contact is made with the individual via the contact information presented.
- The actions are implemented upon feasibility and continuous monitoring of the solution is conducted.

CHAPTER 6: MONITORING AND MITIGATION PLAN



6 MONITORING PLAN AND MITIGATION BUDGET

6.1 Monitoring Plan

Environmental parameters will be monitored during the project implementation. The parameters are based on the main impacts relating to an operation of this nature. The plan also takes into consideration the roles and responsibilities of key organisations/institutions during the operation of the Rice Milling Complex.

The Managers/or Environmental Management Representative of the Company will inspect the sites on a regular basis. Monthly Environmental Reporting will be carried out at the operation. An Environmental Incident Report will be used as a means of identifying and rectifying existing or potential environmental issues. All areas of concern would be investigated once per week, or more frequently, if necessary. External environmental audits may also be conducted by a third party if required to ensure compliance with all the environmental requirements and the effective implementation of the mitigation measures.

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

It should be noted that the Company will facilitate monitoring activities to be conducted by regulatory bodies such as the EPA, GRDB and the Ministry of Labour, Human Services and Social Security by providing personnel, internal transportation and accommodation during these exercises.

This Monitoring Plan has focused on the social and environmental parameters to be monitored during the operation of the Rice Milling Complex. An indicative annual budget of estimated costs for mitigation and monitoring activities is also included in Table 13.

Table 11: Monitoring Strategy and Mitigation Cost

| Parameter | Responsible Institution | Frequency | Location of Monitoring | Monitoring Costs |
|---|---------------------------|----------------------|--|------------------|
| Physical Environment | | | | |
| Noise <ul style="list-style-type: none"> Decibels | Rayaadul Hakh./EES EPA | Biannually | <ul style="list-style-type: none"> Boundaries of the Compound. | \$65,000.00 |
| Air <ul style="list-style-type: none"> Particulate Matter - PM_{2.5} & PM₁₀ SO₂ NO₂ CO | Rayaadul Hakh./EES EPA | Biannually | <ul style="list-style-type: none"> Within the Project Area. Boundaries of the Compound. | \$450,000.00 |
| Surface Water Quality* <ul style="list-style-type: none"> pH Temperature Biological Oxygen Demand Chemical Oxygen Demand Total Suspended Solid Oil & Grease Conductivity Turbidity Total Nitrogen Nitrate Phosphate | Rayaadul Hakh./EES EPA | Biannually | <ul style="list-style-type: none"> See water sampling map in report Three samples | \$540,000.00 |
| Waste Management <ul style="list-style-type: none"> Compliance with waste management plan. Waste Accumulation. | Rayaadul Hakh/EPA | Weekly Biannually | <ul style="list-style-type: none"> Waste receptacles and large storage container, waste disposal pits and general project area. | \$650,000.00 |
| Socio-Economic Environment | | | | |

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| Health and Safety | Ministry of Labour. | Biannually | | \$1,400,000.00 |
|--------------------------|---------------------|------------|--|----------------|

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| <ul style="list-style-type: none"> • Use of protective gear by staff. • Condition of firefighting stations and equipment. • Adequate and appropriate signage for emergencies. • Location of Emergency procedures. • In house training to keep employees up to date with various safety procedures. • Health conditions of the staff. | University of Guyana- Training Bureau of Standards Rayaadul Hakh./EES | Daily/weekly | <ul style="list-style-type: none"> • Project Area. | |
| - Adherence to GRDB Code of Practice for Rice Milling Facilities | GRDB | Weekly | <ul style="list-style-type: none"> • Rice Milling facility | |
| Total Annual Monitoring Cost (G\$) | | | | \$3,105,000.00 |

**For the water quality monitoring plan in particular, it is recommended that the areas where samples were taken for this report, be made permanent monitoring sites and be monitored by the Company on a quarterly basis and by EPA biannually.*

CHAPTER 7: EMERGENCY RESPONSE PLAN



7 EMERGENCY RESPONSE PLAN

7.1 Introduction

The Emergency Response Plan has been prepared to provide employees at the Rayaadul Hakh Rice Milling Complex with the necessary information to respond to potential emergency situations in an expedient and safe manner to prevent harm/impairment to employees, local residents, or the natural environment. This plan provides response procedures to incidents that may be encountered during operations at Rayaadul Hakh Rice Industries. The procedures were developed to ensure that personal safety is not compromised, responsibilities are assigned, the emergency is mitigated, the public and environment are protected, and that follow-up monitoring and reporting are performed when incidents occur at the Mill. Incident response contacts and telephone numbers, both on-site and off-site are presented at the beginning of this plan to facilitate a rapid response to incidents. Detailed incident response procedures are presented and emergency contact information will be updated as needed on all copies of this plan and at all posted locations to ensure rapid response to incidents. Posted locations of plans will include:

- The Office
- Storage Department
- Mechanical Department
- Maintenance Department
- Security Department
- Workers Quarters
- Generator House
- Laboratory

The Emergency Response and Incident Management Plan will define the methods of intervention and required resources to be implemented by Rayaadul Hakh Rice Industries in the event of an accident to protect staff and property and to prevent harmful effects on the local population and the environment. As part of the plan, Rayaadul Hakh Rice Industries will facilitate the alert of rescue services and inform the competent relevant authorities. As such, the detailed Emergency Response Plan includes:

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

- Incident Reporting Formats

7.1.1 Emergency Response Principles

The emergency response procedures involve the following priorities for action:

- Protection of human health and safety;
- Contain the threat/hazard;
- Neutralize and render safe any noxious or hazardous materials; and
- Commence clean-up activities and site remediation efforts.

Emergency response procedures manage events that are not anticipated, almost totally unlikely to occur or reasonably anticipated. It is therefore imperative to plan for worst case scenarios or adopt general procedures. It is also important to recognize that although highly unlikely, an emergency can have serious impacts well beyond the individual or the operation involved.

7.1.2 Identification of an Environmental Emergency

According to the UNEP's Governing Council, an environmental emergency is defined as, "sudden-onset disasters or accidents resulting from natural, technological or human-induced factors, or a combination of these, that causes or threatens to cause severe environmental damage as well as loss of human lives and property." (UNEP 2002). Therefore, in event of an occurrence this would call for immediate action. However, given the nature of the operation, no major emergency situation is foreseen. Some examples of events that would require the initiation of an emergency response procedure and reporting at Rayaadul Hakh Rice Industries include:

1. A fire (within the mill house, at the dryers, generator house etc.);
2. Flooding
3. A fuel spill or releases of hazardous chemicals or wastes to the groundwater or surface water;
4. Structure climbing/descending;
5. Medical emergencies; and
6. Minor and major accidents.

7.1.3 Authority of Control

The Managers of the Rice Mill have the overall authority to take control of any incident within any department of the operation, and they can also, depending on the severity of the situation make a decision to cease all or any part of the operation following an incident. The Managers will also decide on the category and level of response required for a particular emergency incident.

7.1.4 Minor or Major Incident/Accident

There are no foreseen major incidents/accidents due to the nature of the Mill operation. Prompt and effective communication after the occurrence of an accident or emergency to personnel within the operation is vital to reduce the amount loss/damage that is observed as a result. Additionally, prompt notification of an emergency will allow for adequate time for the Managers to execute corrective systems, mitigate the hazard or, in extreme cases, evacuate the premises. In the event of a major incident/accident, the Managers of the Rice Milling Complex will be immediately informed. In case of an injury, the Managers (who are first aid trained) will apply first aid treatment. In the case of a bone fracture or if the employee or person is in an unconscious state the Mahaicony Hospital will be alerted and the Managers will arrange transportation to the Hospital, which is some 15.13 km or 45 minutes driving distance away.

In the event of a minor accident or emergency, the Managers will be notified verbally. Managers will be notified for emergencies pertaining to personnel related accidents/emergencies, the Department Supervisors will be consulted for equipment or machinery malfunctions and the Managers will be conducted for emergencies threatening environmental systems. The project site will have a clearly displayed directory located in a location which contains the contact details for the Managers and Department Supervisors. Therefore, they can be alerted via telephone if an emergency occurs. The relevant personnel, when notified, would take responsibility for on-site response to the event utilizing available tools, equipment and/or mechanisms. Importantly, each emergency which occurs at the Rayaadul Hakh Rice Industries will be documented in an Accident and Emergency Record Book, which would be useful in monitoring as well as emergency systems enhancement. As operations intensify during the crop seasons, an onsite Medic will be employed. During the off-season, staff trained in First Aid Emergency Response will attend to the injured and make the required entries into the Accident and Emergency Record Book. Bells, whistles or blow horns will be used for emergency communication the employees should also be made aware of this.

7.1.5 Internal and External Emergency Contact Details

Rayaadul Hakh Rice Industries, in an effort to ensure a safe work environment for all employees and visitors of the Rice Mill will disseminate and post on the Notice Boards at the Security entrance of the Mill, the list of External Emergency Contacts alongside the Internal Company emergency contact list. In the event of a serious emergency at the operation, key officials of the Rayaadul Hakh Rice Industries who may not necessarily be based at the site, must be contacted and duly informed of the situation. The external emergency contact list will consist of a list of emergency contact numbers for the relevant external agencies. These agencies are to be contacted in the event of an emergency when the said emergency has gone beyond the control of the Managerial staff. Henceforth, in an event when an emergency has gone beyond the control of internal company emergency response actions; or requires further attention. The Managers will contact the following relevant key agencies and institutions whose mandates are relevant to the

operations at the Rice Milling Complex and that may need to be contacted in the event of an emergency. These institutions and their respective contact details are listed below:

Table 12: Internal and External Emergency Contact Information

| Organization | Telephone Number |
|--|---|
| Rayaadul Hakh Rice Industries | (592) 227-6127, 691-0504 |
| Mahaicony Hospital | (592) 221-2209 |
| Georgetown Public Hospital | (592) 227-8204 |
| Mahaica Fire Station | (592) 229-2921 |
| Environmental Protection Agency | (592) 225-5467-69, 225-5471-72, 225-6044/48, 225-0506 |
| Guyana Police Force 'C' Division (East Coast Demerara) Sub-Division Office | (592) 221-1281, 655-1099 |
| Guyana Police Force G/town | (592) 227-2128 |
| Air Services Ltd | (592) 222-4368 |
| Guyana Rice Development Board | (592) 232-1020, 232-1395, 232-1301 |

7.1.6 Emergency Equipment

Rayaadul Hakh Rice Industries will have several key equipment on site that will be utilised in the event of an emergency, these equipment are fire extinguishers, spill kits and first aid kits.

1. Fire Extinguishers and Sand Buckets

The Rayaadul Hakh will ensure that the Rice Milling Complex will be equipped with functional fire extinguishers. These extinguishers will be located at strategic points within the following departments and will be clearly labelled for easy identification: i.e., Paddy Purchasing, Milling, Export, Electrical, Maintenance, Mechanical, Stores, the Office, the Security and the Kitchen. These strategic points will be clearly marked and accessible to employees who will have knowledge of their position. Fire extinguishers will be inspected on a monthly basis by the Managers of the site. Moreover, the extinguishers will undergo an official inspection by an officer of the Guyana Fire Service (GFS), Mahaica, on a bi-annual (six months) basis to ensure that they are functioning effectively and are in accordance with recommendations of the GFS with regards to the maintenance of fire extinguishers. Additionally, all employees of the Milling Complex are required to undergo basic training in the utilisation of a fire extinguisher. Further, sand buckets will be located at strategic locations throughout the site. These will be used to supplement the extinguishing actions in the event of a fire, especially if a fire extinguisher is not immediately available at the point. Moreover, in the event of a fire, employees will initiate the following procedure as a result of fire drills:

- Sound alarm to immediately notify all employees to evacuate building or area and organize first aid equipment.
- Contact the Mill Managers.
- Address the fire hazard with provided firefighting equipment if practicable to do so, without taking personal risks.
- If not practicable alert the Mahaica Fire Station and evacuate the premises.
- Make entry into the Accident and Emergency Record book.

2. Spill Kits

Fuel for the generators and machines are normally sourced from fuel tankers and stored onsite in three (3) above ground storage tanks (capacity total – 24,000 litres) located on the eastern section of the complex; two of the tanks are used specifically for the generators while the third tank is used to supply fuel to farmers. Each fuel tank is surrounded by an impervious/concrete containment bond, however; efforts are currently being made by the company to construct an oil water separator and a larger containment bond that will have 110% containment capacity in event of a spill. Rayaadul Hakh has recognised that spills - relating to fuel, oil and other lubricants - may emanate from the operation. If this occurs it can pose a great threat and cause adverse impacts, especially since the Complex is in such close proximity to watercourses. In this regard, the company will acquire spill kits to be used for remedial actions against any spills occurring onsite.

Clearly labelled kits will be strategically placed in the Generator House, fuel tank refueling points and the Mechanical Department each where oil, fuel, or any other lubricants are utilised. Key personnel whose duties include constant contact with these materials (such as drivers etc.) will be identified and trained in the use of these kits. In the unlikely event of a spill beyond or outside the containment area the following action will be taken:

- Provide specific training guidelines and procedures for personnel to ensure a safe and effective response to potential spill events.
- Provide training guidelines for recovery and disposal of all materials contaminated in the event of a spill.
- Alert the Mill Managers.
- If practical employees should utilise Spill Kits to address the spill.
- Treat spill with absorbent materials such as sand or paddy husk and if possible, create a bund to prevent the spread of the spill and contaminating the waterways and soil.
- Make entry into the Accident and Emergency Record book.
- Inform EPA.

3. First Aid Kits

By definition First Aid is the immediate and temporary care/help given to the victim of an accident and sudden illness until professional medical treatment and help can be obtained. First aid response is important in an emergency because quick first aid response:

- Could mean the difference between life and death.
- Can reduce the severity of a particular injury obtained/or illness.

The Rayaadul Hakh Rice Milling Complex will have equipment which can sometimes be dangerous and cause harm, especially if carelessness and/or negligence on the part of employees occur. As such, Rayaadul Hakh Rice Milling Complex will have numerous well-stocked First Aid Kits on site within the departments. The company will ensure that each kit is clearly labelled and easily identifiable. There should also be instruction guidelines on the utilisation of the kit's contents. Rayaadul Hakh Rice Milling Complex will be responsible for the establishment, maintenance, and to visibly post all information regarding adequate first aid supplies, providers, equipment and location in the event of an onsite injury.

The Company will take all necessary precautions to designate first aid attendants or Medics. The name and contact number of the trained first aid attendants will be posted alongside the first aid kits sufficient for the number of employees within the operation. The first aid kits will be regularly inspected and replenished as need requires by Managers and Supervisors. Records will be kept by Managers and Supervisor on what has been used from the first aid kit at each point location, by whom, and the reason for its use. This will be done in order to keep an inventory record of the first aid supplies.

It is the responsibility of all managers, supervisors and staff to be familiar with the contents of the first aid kit and have basic first aid knowledge to assess an injured person and provide any immediate medical assistance; such as CPR (if qualified), maintain open airways if breathing is an issue, prevent heavy blood loss; while awaiting a trained first aid attendant. Hence, in the event of an accident or emergency, staff must immediately alert and summon the first aid attendant or Medic and provide as much information as possible. The injured party must not be moved unless it is of necessity to protect their lives or to prevent further injury from occurring.

First aid attendants or Medics will be qualified health care professionals trained in first aid for:

- Respiratory arrest, cardiac arrest (CPR), hemorrhage, lacerations/abrasions,
- Amputations, musculoskeletal injuries, shock, eye injuries, burns,
- Loss of consciousness, extreme temperature exposure (hypothermia/hyperthermia),
- Paralysis, poisoning, loss of mental functioning, and drug overdose.
- Application of dressings and slings.
- Treatment of strains, sprains, fractures, bites, stings, contact with poisonous plants/animals/ material.
- Immobilization, handling and transporting injured persons.
- First Aid Content

The acceptable quantity of first aid kits/materials to number of workers will be determined by the Environmental/Occupational Safety and Health Department. The Environmental Department will also be responsible through the first aid attendants/supervisors to maintain the contents of each first aid kit/materials. The first aid kit and materials should be stored in a dust/water proof appropriate container. Each first aid kit shall contain but not limited to the following items:

Table 13: Contents of the First Aid Kit

| Contents of the First Aid Kit | |
|---|---|
| Gauze pads | Tweezers |
| Large gauze pads (at least 8" x 10") | Adhesive tapes |
| Box adhesive bandages (Band-Aids) | Latex gloves |
| Package gauze roller bandage at least 2" wide | Resuscitation equipment such as resuscitation bag, airway, or protective facemask |
| Triangular bandages | Elastic wraps |
| Rubbing alcohol / alcohol wipes | Splint |
| Scissors | Directions for requesting emergency assistance |
| Burn cream | Snake bite kit |
| Ammonia inhalants | Cold packs |
| Butterfly closures | Eye wash kit |
| Hand mirror | Cotton balls |
| Limacol | Anti-diarrhea Medicine |
| Ibuprofen, Panadol (Pain tablets) | Hand Sanitizer |
| Antiseptic Cream | Antibiotic Ointment |

Additional first aid materials needed but not limited to the following are:

- Two (2) clean acceptable Blankets
- Rigid stretcher

7.1.7 Training

Rayaadul Hakh Group Inc. has recognised the great need for personnel employed at the Milling Complex to be knowledgeable and adequately prepared to respond to incidents that may have adverse impacts on human health and safety, infrastructure, equipment, environmental resources, or a combination of these. As such, the company will ensure that staff is provided with a Manual (Environmental Management System of Rayaadul Hakh Industries.) that will provide guidance and direction for the implementation and operation of the Complex to all personnel. Apart from this, Rayaadul Hakh Rice Milling Complex will organize regular drills and exercises to test the response procedures to emergencies, and to enhance the preparedness and capacity of workers to effectively respond to the above-mentioned situations if/when they do occur.

| TRAINING | TIMELINE |
|--|----------|
| Mill procedures and Health and Safety training | Annually |

| | |
|---|----------|
| Fire drill exercise/ emergency preparedness | Annually |
|---|----------|

7.1.8 Emergency Evacuation Routes

Evacuation route maps will be posted in each Department. The following information will be marked on evacuation maps:

- Emergency exits
- Primary and secondary evacuation routes
- Locations of fire extinguishers
- Fire alarm pull stations' location
- Assembly points
- Site personnel should know at least two evacuation routes.

7.1.9 Incident Reporting Document Formats

After every incident/accident a report will be required. The Managers of the Rice Milling Complex will have direct responsibility for the preparation of such a report. The following formats will be applied for various incidents:

EMERGENCY PERSONNEL NAMES AND PHONE NUMBERS

DESIGNATED RESPONSIBLE OFFICIAL (Highest Ranking Manager at

_____ site, such as _____, _____, or _____):

Name:

Phone: (_____)

EMERGENCY COORDINATOR:

Name:

Phone: (_____)

AREA/FLOOR/ROOM MONITORS (If applicable):

Area/Floor:

Name:

Phone: (_____)

Area/Floor:

Name:

Phone: (_____)

ASSISTANTS TO PHYSICALLY CHALLENGED (If applicable):

Name:

Phone: (_____)

Name:

Phone: (_____)

Date_____/_____/_____

MEDICAL EMERGENCY

Call medical emergency phone number (check applicable):

- ☐ Paramedics
- ☐ Ambulance
- ☐ Fire Department
- ☐ Other

Provide the following information:

- a) Nature of medical emergency,
- b) Location of the emergency (building, room number), and

- Do not move victim unless absolutely necessary.
- Call the following personnel trained in CPR and First Aid to provide the required assistance prior to the arrival of the professional medical help:

Name: _____

Phone: _____

Name: _____

Phone: _____

If personnel trained in First Aid are not available, as a minimum, attempt to provide the following assistance:

1. Stop the bleeding with firm pressure on the wounds (note: avoid contact with blood or other bodily fluids).
2. Clear the air passages using the Heimlich maneuver in case of choking.

In case of rendering assistance to personnel exposed to hazardous materials, wear the appropriate personal protective equipment. Attempt first aid ONLY if trained and qualified.

Date ____/____/____

FIRE EMERGENCY

When fire is discovered:

- Activate the nearest fire alarm (if installed)
- Notify the local Fire Department by calling .
- If the fire alarm is not available, notify the Managers/Supervisors about the fire emergency.

Fight the fire ONLY if:

- The Fire Department has been notified.
- The fire is small and is not spreading to other areas.
- Escaping the area is possible by backing up to the nearest exit.
- The fire extinguisher is in working condition and personnel are trained to use it.

Upon being notified about the fire emergency, occupants must:

- Leave the building using the designated escape routes.
- Assemble in the designated area (specify location)
- Remain outside until the competent authority (Managers) announces that it is safe to re-enter.

Managers or Supervisors must (underline one):

- Disconnect utilities and equipment unless doing so jeopardizes his/her safety.
- Coordinate an orderly evacuation of personnel.
- Perform an accurate head count of personnel reported to the designated area.
- Determine a rescue method to locate missing personnel.
- Provide the Fire Department personnel with the necessary information about the facility.

Area/Floor Monitors must:

- Ensure that all employees have evacuated the area/floor.
- Report any problems to the Managers or Supervisors at the assembly area
- Assistants to Physically Challenged: Assist all physically challenged employees in emergency evacuation.

Date___/___/___

CHEMICAL SPILL

The following are the locations of:

Spill Containment and Security Equipment: _____

Personal Protective Equipment (PPE): _____

When a Large Chemical Spill has occurred:

- Immediately notify the Managers or Supervisors.
- Contain the spill with available equipment (e.g., pads, booms, absorbent powder, etc.).
- Secure the area and alert other site personnel.
- Do not attempt to clean the spill unless trained to do so.
- Attend to injured personnel and call the medical emergency number, if required.
- Call a local spill cleanup company or the Fire Department (if arrangement has been made) to perform a large chemical spill cleanup.

Name of Spill Cleanup Company: _____

Phone Number: _____

- Evacuate building/area as necessary

When a Small Chemical Spill has occurred:

- Notify the Managers and/or supervisors.
- If toxic fumes are present, secure the area (with caution tapes or cones) to prevent other personnel from entering.
- Small spills must be handled in a safe manner, while wearing the proper PPE.
- Review the general spill cleanup procedures.


Date ____/____/____

8 REFERENCES

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9 APPENDIX A – EMP LETTER FROM EPA AND RECEIPTS



**Environmental
Protection
Agency**

Ganges Street, Sophia,
Georgetown, GUYANA.
Tel.: (592)-225-5467 / 5468 / 5469
Fax: (592) 225-5481
Email: epa@epaguyana.org

Environmental Permit

(Issued under the Environmental Protection Act, No.11 of 1996, the Environmental Protection (Amendment) Act, 2005, and Environmental Protection Regulations, 2000)

| | |
|----------------|--|
| Reference No.: | 20110923-RHRIM |
| Actual Fee: | Large (C1) US\$ 7,500 (5 years) i.e. US\$ 1,500 per year |
| Paid: | US\$ 7,500 (May, 2012 to April, 2017) |

Addressee(s): Mr. Rayaadul Hakh
Strangroen,
West Mahaicony,
East Coast Demerara.

Activity: Operation of a Rice Mill

Rayaadul Hakh, hereinafter referred to as the "Permit Holder", is hereby authorized in accordance with the Environmental Protection Act, 1996, the Environmental Protection (Amendment) Act, 2005, and the Environmental Protection Regulations, 2000, to operate a Rice Mill, located at Parcel 190, Lesbeholden, South Black Bush Polder, Corentyne, Berbice, hereinafter referred to as the "Project", in a manner indicated in the Application submitted on September 23, 2011, and subject to the terms and conditions set forth herein and any forthcoming regulations and standards relevant to this project.

Terms and Conditions for Operation:

The Permit Holder shall:

1.0 CONSTRUCTION AND OPERATION

- 1.1 Provide advance notice to the EPA of significant construction, alteration, expansion, or replacement of any plant, structure, equipment, apparatus, mechanism or thing that may discharge, or from which may be discharged, a contaminant into the environment for timely approval from the Agency before implementation.
- 1.2 Equip the processing facility, storage bins as well as machinery/equipment with environmental management systems that will have minimal impact to public health and the environment.
- 1.3 Ensure that good house-keeping, sanitary and hygienic practices and the aesthetic quality of your surroundings are maintained at all times.

2.0 WATER QUALITY MANAGEMENT

- 2.1 Ensure that paddy husks or paddy ash do not escape into the surrounding waterways.
- 2.2 Maintain the Integrity of the existing waterways at all times. Discharges into the environment should be in accordance with the *Guyana National Bureau of Standards Interim Guidelines for Industrial Effluent Discharge into the Environment*. The following are the allowable limits and should not be exceeded: pH 5.0-9.0; Temperature < 40 °C; Total Suspended Solid (TSS) <50 mg/L; Oil and Grease < 10 mg/L; Biological Oxygen Demand (BOD) < 50 mg/L. Further, monitor the parameters on a biannual basis and submit the results to the Agency.

Handwritten: 2012-05-16
2012-05-18

Page 1 of 5

Invoices for approval of site plan: NDC and CH&PA

WOODLAND FARM NEIGHBOURHOOD
DEMOCRATIC COUNCIL 182331

Date: 2021/01/15

Received the sum of ONE THOUSANDdollars

On account ONE BUILDING FORM SOLD

Full payment of rates for the year ending 31st December 20.....due on

On Lot No STRANGREONin the Village District of WOODLAND FARM
appraised as the property of RAYADAL & BIBI HAKH
CODE # 1011
1000.00

Collector of Rates
ASST. OVERSEER

Head of Receipt: [Signature]

4 No 778132 B

Received from: [Signature] the sum ofdollars

Being: [Signature]

\$ 30.00

Initials of Officer
Preparing Receipt

FINANCE DEPARTMENT
for Accountant General

T. 5 GNPL-LAP-38691-97

10 APPENDIX B – SURFACE WATER ANALYSIS REPORT FROM KAIZEN

ENVIRONMENTAL ENGINEERING SOLUTIONS (EES)

| 3. Test Results Report | | | | | | | | | | | | | |
|--------------------------------|------------|----------|----------|---------|-------------------|---------|------|---------------------------|---------------|-------|---------|---------------------|------------------------------|
| Water Parameters/ Data Results | | | | | | | | | | | | | |
| Sample ID | Date | BOD mg/L | COD mg/L | DO mg/L | Oil & Grease mg/L | Temp °C | pH | Conductivity µS/cm 0-2000 | Turbidity NTU | TSS | TDS ppm | Total Nitrogen mg/L | Ammonia NH ₃ mg/L |
| WQ-01 | 28/01/2021 | ND | 147.94 | 2.80 | 8.00 | 15.1 | 7.32 | 588.00 | 98.60 | 66.31 | 308.00 | 1.8 | <1 |
| WQ-02 | 28/01/2021 | ND | 72.60 | 3.80 | 3.60 | 15.1 | 7.17 | 244.00 | 38.70 | 47.35 | 161.00 | 1.0 | 0.2 |
| WQ-03 | 28/01/2021 | ND | 79.51 | 4.70 | 2.80 | 15.1 | 8.41 | 429.00 | 37.20 | 50.34 | 273.00 | 1.1 | <1 |
| WQ-04 | 28/01/2021 | ND | 51.24 | 5.30 | 10.00 | 15.1 | 7.83 | 725.00 | 56.70 | 86.31 | 426.00 | <0.5 | <1 |

4. Standards and Guidelines

Guyana National Bureau of Standards Interim Guidelines for Industrial Effluent Discharge in to the Environment.

| Parameter | Guideline | Below Guideline Test Value |
|--------------------------------|-----------|---------------------------------|
| Temperature (T) | <40 °C | |
| pH | 6.0-9.0 | |
| Total Suspended Solids (TSS) | <50 mg/L | |
| Chemical Oxygen Demand (COD) | <250 mg/L | Boundary Guideline Test Results |
| Biological Oxygen Demand (BOD) | <50 mg/L | |
| Ammonia (NH ₃) | < 5 mg/L | Above Guideline Value |
| Total Nitrogen (TN) | <50 mg/L | |
| Oil and Grease | < 10 mg/L | |

5. Test Methods

Biological Oxygen Demand (BOD): SMEWW 5210 B
Chemical Oxygen Demand: Dichromate/H₂SO₄
Oil & Grease: USEPA 1664, Gravimetric
Total Suspend Solid (TSS): Photometric
Total Nitrogen: Digestion Method
Ammonia: ~~Titrimeter~~
pH, Conductivity, Turbidity, Temperature, TDS: Optical Sensor

ENVIRONMENTAL ENGINEERING SOLUTIONS (EES)- Guyana

Environmental Assessment/Air Lab/Water Lab

eesguyana@gmail.com

650-0373

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11 APPENDIX C – WATER QUALITY STANDARDS

11.1GNBS Standards for Industrial Effluent Discharge

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

Table 14: 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 | N as HN3 | Total N | P | CN (Tol.) | P04 | C1 | Surfactant | Phenols | Coliform | O &G | Other and/or Comments |
|---|---------|------|-----------------|------|------|----------------------------|----------|----------|---|-----------|-----|----|------------|---------|----------|---------------|---|
| Breweries | 5.0-9.0 | < 40 | <100 (t.v.<50) | <250 | | <100 (t.v.<50) | <50 | N as NH3 | | | | | | | | 10 | |
| Cement bagging, manufacturing | 5.0-9.0 | <40 | | | >4.0 | 50 | | | | | | | | | | | WHO Standards for Industries Manufacturing 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 –(b) Fermentation/Distillation units | 5.0-9.0 | <40 | <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 finishers | 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 | 5.0- | | <100 | | | <100 | | | | | | | | <1.0 | | <30 | Cu:<3.0; Ph:<1.0; Cr: <2.0; Cr VI: |

HAKH GROUP - EMP-RAYADUUL HAKH RICE INDUSTRIES

| | | | | | | | | | | | | | | | | | |
|--|-------------|------|-----------------------|------|------|-----------------------|------------------|-------------|----|--------------------|---|----------------------|------------------|------|----------------------------|---------------|--|
| manufacturing | 9.0 | | | | | | | | | | | | | | | (t.v. <10) | 0.5; Ni: <3.0; Zn: <3.0; Hg:<1.0 |
| Pharmaceutical/chemical production | 5.0- 9.0 | | | <150 | >4.0 | | | | | | | | <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,.1 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 | | | | | | | | | | |
| Breweries | 5.0- 9.0 | < 40 | <100 (t.v<50) | <250 | | <100 (t.v. <50) | <50 | N as NH3 | | | | | | | | 10 | |
| Sugar factories | 5.0- 9.0 | <40 | <250 t.v.<10 0 | <250 | >4.0 | <250 (t.v.<10 0 | <250 t.v.<100 | | | | | | | | | | |
| Textiles | 5.0- 9.0 | | | <250 | >4.0 | <500 (t.v. 100) | | | | | | 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 | 5.0- 9.0 | <40 | | | | | | | | | 5 | <fre e 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 Sir Lanka. |
| General environmental guidelines | 5.0- 9.0 | <40 | <50 | <250 | | <50 as TSS | <10 | | <2 | <1 Free: 0.1 | | <Cl: 0.2 | | <0.5 | <400 MPN per 100 mls | <10 | WB Std: Fluorine: 20; No limits given for metals. |

11.2 US EPA Standards and World Health Organization Guidelines

Table 15: Florida USEPA standards for Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife

| Florida USEPA standards for Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife | | |
|--|--------------|---------------|
| Parameter | Fresh | Marine |
| Phosphorous (mg/L) | | ≤ 0.1 |
| pH | 6.5-8.5 | 6.5 |
| Faecal Coliform (CFU/100ml/day) | 800 | 800 |
| Dissolve Oxygen (mg/L) | < 5 | <5 |

Table 16: WHO Drinking Water Guidelines

| WHO Drinking Water Guidelines | |
|--------------------------------------|------------------|
| Parameter | Guideline |
| pH | 6.5-8.5 |
| Turbidity (NTU) | <5 |
| Conductivity (μ S) | 1500 |
| Sulphates (mg/L) | 500 |
| Nitrate (mg/L) | 10 |
| Total Dissolved Solids (mg/L) | 1000 |
| Faecal Coliform (CFU/100ml) | 0 |

12 APPENDIX D: ISO 14001 MANUAL FOR RAYAADUL HAKH GROUP INC.



Hakh Group Inc.

Revision No. : 1

Date : 08- 03 - 2018

Template Prepared by :

EES Team

Approved by :

Dimitri Gabriel -Director

11.2.1.1.1.1 Revision History

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0.0 TERMS AND DEFINITIONS

| | |
|--|--|
| Auditor | Person with the competence to conduct an audit |
| Continual improvement | Recurring process of enhancing the environmental management system in order to achieve improvements in overall environmental performance consistent with the organisation's environmental policy. |
| Corrective action | Action to eliminate the cause of a detected nonconformity. |
| Document | Information and its supporting media |
| Environment | Surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation. |
| Environmental aspect (EA) | Elements of an organisation's activities or products or services that can interact with the environment. |
| Environmental impact | Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects. |
| Environmental management system (EMS) | Part of an organisation's management system used to develop and implement its environmental policy and manage its environmental aspects. |
| Environmental objective | Overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve. |
| Environmental performance | Measurable results of an organisation's management of its environmental aspects. |
| Environmental policy | Overall intentions and directions of an organisation related to its environmental performance as formally expressed by top management. |
| Environmental target | Detailed performance requirement applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives. |
| Interested party | Person or group concerned with or affected by the environmental performance of an organisation. |
| Internal audit | Systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the environmental management system audit criteria set by the organization are fulfilled. |
| Nonconformity | Non-fulfilment of a requirement. |
| Organisation | Rayaadul Hakh Group Inc. |
| Preventive action | |

Action to eliminate the _____ cause of a potential nonconformity.

| | |
|--------------------------------|---|
| Prevention of pollution | Use of processes, practices, techniques, materials, products, services or energy to avoid, reduce or control (separately or in combination) the creation, emission or discharge of any type of pollutants or waste, in order to reduce adverse environmental impacts. |
| Procedure | Specified way to carry out an activity or a process. |
| Record | Document stating results achieved or providing evidence of activities performed. |

1.0 GENERAL

1.1 Company Profile

Rayaadul Hakh Rice Industries has been operating the rice complex located in Strangroen, Guyana since 2006. Rayaadul Hakh takes pride in ensuring quality products, skilled personnel, and improved infrastructure. Rayaadul Hakh's commitment to the rice industry reaches farming assistance, as well as drying and storage facilities.

This complex houses a rice mill with a capacity of 20 tons per hour, the two (2) intake hoppers capacity is 100 tons per hour and storage for over 30,000 tons of paddy.

Products

1. Paddy

Paddy is as it comes from the fields in its natural unprocessed state. The grains of rice are still within the protective husk and are not edible.

2. White Rice

White Rice is the name given to milled rice that has had its husk, bran, and germ removed. This alters the flavour, texture and appearance of the rice.

3. Rice Bran

Rice Bran is produced during the milling of whole grains; during milling, each kernel of rice is hulled and the hard outer shell of the rice is separated from the rest of the kernel.

4. Cargo Rice

Cargo rice also known as Brown rice is unpolished rice retaining the yellowish-brown outer layer. It has a firmer texture than white rice and is also more nutritious.

5. Broken Rice

As a result of the milling processes, some kernels are broken down too small to be considered whole kernels. We offer both white broken and brown broken kernels.

1.2 Purpose of this Manual

This Manual defines the Environmental Management System (EMS) of Hakh Group Inc.'s activities and contains:

- a. The Environmental Policy;
- b. Statements of responsibility and authority;
- c. An overview of the company's environmental procedures and controls;
- d. The identification of the resources and training allocated to management, performance of work and verification activities including internal audit;
- e. The appointment of the Environmental Management Representative (EMR); and
- f. The arrangement for periodic management reviews.

The purpose of this Manual is to demonstrate that this EMS meets all *ISO 14001:2004* requirements and provide guidance and direction for the implementation and operation of the EMS to all personnel including all relevant documents.

1.3 Scope of EMS

The scope of the EMS applies to the rice milling operations related to the products of paddy, white rice, rice brand, cargo rice and brown rice provided undertaken by Hakh Group Inc.

2.0 POLICY

Hakh Group Inc. Environmental Policy

The Company is committed to protect the environment.

To minimize environmental impacts concerning our activities, products and services, we shall:-

- *Comply with applicable legal requirements and other requirements to which the Company subscribes which relate to its environmental aspects.*
- *Prevent pollution, reduce waste and minimise the consumption of resources.*
- *Educate, train and motivate employees to carry out tasks in an environmentally responsible manner.*
- *Encourage environmental protection among suppliers and subcontractors.*

The Company is committed to continual improvement of environmental performance. This Policy will be communicated to all staff, contractors and suppliers, and be available for the public.

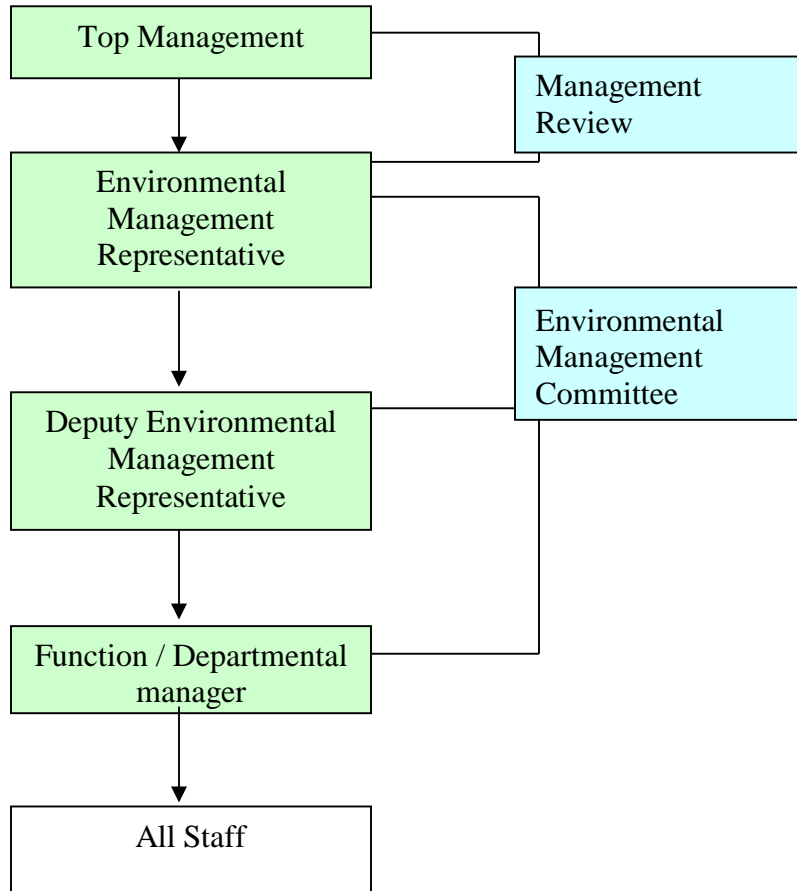
Endorsed by

Rayaadul Hakh –Director

Date :

3.0 Organisation

Hakh Group Inc. Proposed Environmental Organisation Chart



3.2 Responsibility

The description of the role and responsibilities of the staff / function / department involved in the EMS such as the Director, Environmental Management Representative, Deputy Environmental Management Representative, Environmental Management System Committee and Management Review Committee.

3.2.1 The Director

The Director is responsible for:

- endorsing the environmental policy;
- ensuring appropriate resource allocation to enable the effective operation and continual improvement of the EMS.

3.2.2 Environmental Management Representative (EMR)

The (Position) is the appointed EMR and has the responsibility and authority for:

- a) ensuring that EMS requirements are established, implemented and maintained in accordance with the ISO 14001 standard;
- b) ensuring that sufficient resources are allocated for the proper implementation of the environmental policy and the EMS;
- c) regularly reviewing the policy and the effectiveness of the EMS, and ensuring that the necessary changes are made.

EMR is also the Chairman of the EMS Committee and has the responsibility and authority for :

- a) leading the EMS Committee to establish and implement the EMS according to ISO 14001 standard, and monitoring the performance of the EMS;
- b) coordinating internal EMS audits to ensure the EMS has been properly implemented and maintained;
- c) handling and investigating nonconformity and ensuring corrective and preventive action has been taken to mitigate any impacts caused;
- d) reporting on the performance of the EMS to the top management for review and as a basis for improvement of the EMS.

The EMR, the DEMR, the EMS Committee and the Director shall undertake the EMS management review annually to ensure top management commitment and integration of the EMS with business strategies for its implementation and continual improvement.

3.2.3 Deputy Environmental Management Representative (DEMR)

The (*Position*) is the appointed DEMR and has the responsibility and authority for:

- a) assisting the EMR to ensure the EMS is effectively implemented and maintained in accordance with ISO 14001 standard;
- b) assuming the responsibility and action of the EMR when the EMR is unavailable.

3.2.4 Environmental Management System Committee (EMS Committee)

This committee is responsible for:

- a) the establishment and implementation of the EMS;
- b) the establishment and review of objectives, targets, and programmes;
- c) ensuring the effective implementation of environmentally-related operational controls and programmes;
- d) the internal communication of environmental matters between management and employees; and promoting environmental awareness among company staff;
- e) the review of complaint records, nonconformity, corrective action and preventive action reports and the adoption of preventive actions as necessary;
- f) providing leadership in the pursuit of environmental issues;
- g) any other EMS activities that are assigned by the EMR;

- h) holding regular meeting (at approximately three-month intervals).

3.2.5 Management Review Committee

The Committee systematically examines the EMS to ensure the suitability, adequacy and effectiveness of the EMS. The Committee comprises of the Director, EMR, DEMR, and designated Function / Departmental Managers.

3.2.6 Function / Departmental Manager

The Function / Departmental Managers are responsible for :

- a) establishing controls for the identified significant environmental aspects for his/her function team / department according to procedures and instructions;
- b) ensuring that the EMS is properly implemented and that environmental matters are properly handled at all stages;

3.2.7 All Employees

All employees are responsible for:

- a) working in accordance with the documented environmental procedures and instructions, specific responsibilities defined in individual procedures and instructions; and
- b) reporting problems or deviations associated with environmental issues and the EMS to the EMS Committee.

4.0 ENVIRONMENTAL MANAGEMENT SYSTEM REQUIREMENTS

The EMS of Hakh Group Inc. is developed to manage significant environmental aspects so as to limit their impacts on the environment. The EMS is established in accordance with ISO 14001:2004, and is described in this section. Procedures for each component is given in the relevant Environmental Procedures (EPs) listed in Annex A.

4.1 Environmental Management System Documents

The purposes of these EMS documents are as follows:

| | |
|--|--|
| Environmental Policy | Describes the intention and principles to be adopted in relation to environmental performance, including but not limited to legal compliance, continual improvements and pollution prevention. |
| Environmental Management System Manual (EMS Manual) | Describes the environmental management system and outlines how the requirements of the International Standard (ISO 14001) are achieved. A cross-reference of the ISO 14001 clauses to the sections of this Manual is listed in Appendix A. |

| | |
|---|---|
| Objective(s) * | The overall environmental goals that Hakh Group Inc. set to achieve. |
| Target(s) * | The set of measurable performance requirements that Hakh Group Inc. establishes to achieve the objectives. |
| Programme(s) * | The programme and schedule which Hakh Group Inc. implements to achieve the objectives and targets. |
| Environmental Procedures (EPs) | Define the roles, responsibilities, and actions to be taken to ensure that activities are performed and the EMS implemented in accordance with the environmental policy and the requirements of ISO 14001. A cross-reference of the ISO 14001 clauses to the EPs is listed in Appendix A. |
| Register of Environmental Aspects | Compiles the environmental aspects that are derived from the activities and services of Hakh Group Inc.. The register also denotes the significance of the environmental aspects and the respective operational controls for significant environmental aspects. |
| Register of Legal and Other Requirements | Compiles the legal and other requirements, which include legislation, codes of practice, regulatory and non-regulatory guidelines that are applicable to Hakh Group Inc. |
| Environmental Instructions (EIs) | Describe which and how activities should be performed to manage significant environmental aspects and to achieve the EMS ISO 14001 requirements. |
| Environmental Forms/Records | Record information for the audit trail and the assessment of environmental conditions and performance. |

* Objectives and Targets, and associated Programmes are provided as a single document.

4.2 Environmental Policy

(ISO 14001 Standard Clause 4.2)

The environmental policy of Hakh Group Inc. is included in Section 2 of this document. It outlines the environmental commitments of Hakh Group Inc. with respect to its operations, activities, and overall environmental performance. During the development of this policy, the appropriateness to the nature, scale and environmental impacts of Hakh Group Inc. activities, products and services has been considered. The policy is endorsed by The Director and the policy shall be reviewed during the management review meeting.

The policy shall stipulate the commitments of Hakh Group Inc. to continually improve its environmental management and prevention of pollution. Hakh Group Inc. is also committed to comply with applicable legal requirements and other requirements to which Hakh Group Inc. subscribes which relate to its environmental aspects. The environmental policy shall provide a

framework for setting and reviewing objectives and targets, and must be maintained, implemented and communicated to all employees of Hakh Group Inc. and its contractors.

This policy shall be available to the public.

4.3 Planning

Hakh Group Inc. shall follow a “plan-do-check-act” process to facilitate continual environmental performance improvements. The planning process includes the identification and updating of Hakh Group Inc.’s Register of Environmental Aspects, and the Register of Legal and Other Requirements. Together with Hakh Group Inc.’s environmental policy, Hakh Group Inc.’s objectives and targets are established, and appropriate programmes are formulated to achieve the objectives and targets.

4.3.1 Environmental Aspects

(ISO 14001 Standard Clause 4.3.1)

The planning process commences with the identification and updating of environmental aspects. In order to evaluate the impacts of its activities to the environment, Hakh Group Inc. shall establish, implement and maintain a procedure to identify the environmental aspects of its activities, products or services that it can control and those that it can influence taking into account planned or new developments, or new or modified activities, products and services. These aspects, inclusive of those arising from works carried out by contractors, are registered in the "Register of Environmental Aspects".

Hakh Group Inc. shall ensure that all environmental aspects that may pose significant impacts to the environment are under control and prioritised for improvements.

Hakh Group Inc. shall keep this information up-to-date.

Relevant procedure: EP-01 Identification of Environmental Aspects and Significance Evaluation.

4.3.2 Legal and Other Requirements

(ISO 14001 Standard Clause 4.3.2)

Hakh Group Inc. shall establish, implement and maintain a procedure to identify and maintain access to legal requirements that are relevant to the company, as well as other requirements that the company subscribes to which relates to the company’s environmental aspects

Hakh Group Inc. shall identify all relevant regulations, codes of practice and guidelines that are applicable to the environmental aspects of its activities, products and services, and record this information in the Register of Legal and Other Requirements.

Hakh Group Inc. shall keep this information up-to-date.

Relevant procedure: EP-02 Review of Legal and Other Requirements

4.3.3 Objectives, Targets and Programme(s)

(ISO 14001 Standard Clause 4.3.3)

Based on the environmental policy and significant environmental aspects, environmental objectives and targets shall be established, implemented and maintained at each function and level within Hakh Group Inc. Programmes are established, implemented and maintained for achieving its objectives and targets.

When establishing and reviewing its objectives, Hakh Group Inc. shall take into consideration the legal and other requirements, significant environmental aspects, technological options, financial/operational/business requirements, and the views of interested parties, and ensure that the objectives and targets are consistent with the environmental policy, including commitment to pollution prevention, to compliance with applicable legal requirements and other requirements, and to continual improvement.

The programmes designate the responsibility for achieving objectives and targets at each function and level of the company, together with the means and time frame by which they are to be achieved.

The Director shall approve the objectives, targets and programmes proposed by the EMS Committee before implementation. The EMR shall ensure that the objectives and targets are measurable if possible, and that the progress towards achieving the objectives and targets is continually monitored and reviewed.

The achievement of objectives, targets and programmes shall be reviewed by the EMS Committee every 3 months. The EMR shall lead the EMS Committee in revising the objectives, targets and programmes as necessary.

Hakh Group Inc. shall ensure that the programmes are amended as appropriate for new projects and new or modified activities, products or services in order to ensure that environmental management applies to such projects and activities.

In the event that objectives and targets in the programmes are not met, the EMR shall revise the programme as necessary and maintain documented evidence / records for the actions taken to mitigate the problems.

The EMR shall also maintain obsolete objectives, targets and programmes as an EMS record for three years.

4.4 Implementation and Operation

The implementation of the EMS requires Hakh Group Inc. to clearly define roles, responsibilities and authorities of key personnel, commit to staff training, maintain effective communication channels, adopt effective document and operational controls, and maintain sufficient awareness on emergency preparedness among the staff.

4.4.1 Resources, Roles, Responsibility and Authority

(ISO 14001 Standard Clause 4.4.1)

Top management of Hakh Group Inc. shall commit to provide resources (including human resources and specialized skills, organizational infrastructure, technological and financial resources) essential to the implementation and control of the EMS. The roles, responsibilities

and authorities of key personnel shall be defined, documented, and communicated in order to facilitate effective environmental management.

Hakh Group Inc. has appointed the (*Position*) as the Environmental Management Representative (EMR), and the (*Position*) as the Deputy Environmental Management Representative (DEMR) for the implementation and maintenance of the EMS. Their EMS responsibilities are described in section 3 of this manual.

4.4.2 Competence, Training and Awareness

(ISO 14001 Standard Clause 4.4.2)

Hakh Group Inc. shall ensure all persons performing tasks for it or on its behalf, whose work may have a significant impact on the environment, are competent on the basis of appropriate education, training and/or experience, and shall retain associated records.

Hakh Group Inc. will need to ensure that all people performing tasks for or on behalf of the organization, which includes contractors, sub-contractors, temporary staff and remote workers, have had an appropriate assessment for their potential to cause a significant environmental impact and the associated competence required.

Hakh Group Inc. shall establish, implement and maintain procedures to identify the training needs associated with its environmental aspects and its EMS, and develop programmes to ensure awareness and competence, at each relevant function and level, by addressing:

- the roles and responsibilities in achieving conformity with the environmental management system;
- the importance of conformity with the environmental policy, the procedures and the requirements of the structured EMS;
- the significant environmental aspects and related actual or potential impacts associated from their work activities and the environmental benefits of improved personal performance;
- the potential consequences of departure from specified operating procedures;

Relevant procedure: EP-03 Training

4.4.3 Communication

(ISO 14001 Standard Clause 4.4.3)

For internal communication, the EMR shall ensure information regarding the EMS (such as the policy, objectives, targets and programmes) and environmental performance is readily available to employees on notice board, or is published on the intranet or newsletters.

Employees with enquiries / complaints regarding to the EMS and/or environmental issues of Hakh Group Inc. shall inform their Function / Departmental Manager. The designated member of EMS Committee representing each division shall maintain a log for the relevant enquiries / complaints. Depending on the nature and scope of the enquiry / complaint, the EMR shall determine the corresponding action and maintain relevant records to demonstrate the response / corrective actions taken.

For external communication, the environmental policy is available at the office and *company web page* (<http://www.sajrice.com/>). All internal and external enquiries / complaints / communications shall be discussed and reviewed during the EMS Committee meeting and the decision shall be recorded on meeting minutes.

The EMS Committee may discuss and decide whether to communicate externally about its significant environmental aspects, the decision shall be documented in the meeting minutes. If the decision is to communicate, the EMS Committee shall establish and implement a method(s) for this external communication, e.g. publish environmental report.

Relevant procedure: EP-07 Enquiry / Complaint / Nonconformity Handling

4.4.4 Documentation

(ISO 14001 Standard Clause 4.4.4)

The Environmental Management System documentation encompasses four levels as described below:

The first level is the *Environmental Management System Manual* (this document) which includes Hakh Group Inc.'s environmental policy (specifying the principal objectives and environmental commitments of Hakh Group Inc.), and a broad description of how Hakh Group Inc. addresses the ISO 14001 requirements. The EMS Manual serves as an interface to interpret the relationship between Hakh Group Inc. EMS and the ISO 14001 Standard. An individual document of *Objectives, Targets and Programmes* is developed based on the company's environmental policy. It demonstrates the company's environmental commitment on continual improvement in environmental performance.

The second level is the *Environmental Procedures (EPs)*, which include all procedures that Hakh Group Inc. shall follow as specified in the ISO 14001 Standard. These procedures provide a detailed description of the EMS elements and define who should do what, how and when. Appendix A shows the relationship between various environmental procedures and the ISO 14001 Standard clauses. Register of Environmental Aspects, and Register of Legal and Other Requirements are derived from the procedures and act as the foundation of the EMS which the company subscribed to.

The third level is the *Environmental Instructions (EIs)*, which are operational control procedures or instructions, with defined responsibilities, to control the identified significant environmental aspects associated with Hakh Group Inc.'s operations and activities.

The fourth level is *Environmental Records*, which arise from the implementation of the Environmental Management System Manual, Environmental Procedures and Environmental Instructions. Environmental Records include various checklists, reports and meeting records, etc, as defined in each Environmental Procedure and Environmental Instruction.

4.4.5 Control of Documents

(ISO 14001 Standard Clause 4.4.5)

The essences of EMS documentation controls are:

- they shall be reviewed, revised as necessary and approved for adequacy by authorized personnel;
- that current version of relevant documents shall be available at all locations where operations essential to the effective functioning of the environmental management system are performed;
- that documents of external origin determined by the organization to be necessary for the planning and operation of the EMS are identified and their distribution controlled;
- obsolete documents shall be promptly removed from all points of issue and use, or are otherwise assured against unintended use; and
- any obsolete documents retained for legal and / or knowledge preservation purposes shall be suitably identified.

Hakh Group Inc. shall ensure that documentation is legible, dated (with dates of revision) and readily identifiable, maintained in an orderly manner, and retained for a specified period. Hakh Group Inc. shall establish, implement and maintain a procedure for the creation and modification of the various types of documents and the respective responsibilities for such creation and modifications.

Relevant procedure: EP-04 Control of Documents

4.4.6 Operational Control

(ISO 14001 Standard Clause 4.4.6)

Hakh Group Inc. shall establish, implement and maintain operation control procedures to manage its significant environmental aspects.

Hakh Group Inc. shall ensure that all operations and activities, carried out by Hakh Group Inc.'s employees or contractors that are associated with the significant aspects are properly controlled, and that appropriate operational control procedures, in terms of Environmental Procedures (EPs) and Environmental Instructions (EIs), are communicated to personnel whose tasks may result in significant environmental aspects. Hakh Group Inc. shall influence its staff and contractors by communicating its environmental policy and other relevant EPs and/or EIs to them.

4.4.7 Emergency Preparedness and Response

(ISO 14001 Standard Clause 4.4.7)

Hakh Group Inc. shall establish, implement and maintain a procedure to identify potential emergency situations and responses to such situations in order to prevent and/or mitigate environmental impacts that may associate with them.

Hakh Group Inc. shall review and revise its emergency preparedness and response procedures, in particular after the occurrence of accidents or emergency situations.

Hakh Group Inc. shall also periodically test the procedure and the preparedness where practicable.

Relevant procedure: EP-05 Environmental Emergency Preparedness and Response

4.5 Checking

While implementing the EMS, Hakh Group Inc. shall monitor and measure the key characteristics of its operations and activities on a regular basis. These results shall be recorded together with nonconformity and the corrective action and preventive action. As part of the checking process, a periodic audit on the EMS shall provide a basis for management review.

4.5.1 Monitoring and Measurement

(ISO 14001 Standard Clause 4.5.1)

Hakh Group Inc. shall establish, implement and maintain procedures to monitor and measure, on a regular basis, the key characteristics of its operations and activities that have significant impacts on the environment. This shall include procedures for tracking of performance, applicable operational controls and conformity with the company's objectives and targets, as well as the calibration and maintenance of monitoring equipment. The information of environmental monitoring shall be documenting.

Relevant procedure: EP-06 Environmental Monitoring and Evaluation of Compliance

4.5.2 Evaluation of Compliance

(ISO 14001 Standard Clause 4.5.2)

To meet the company's commitment to compliance, Hakh Group Inc. shall regularly monitor and evaluate the compliance status of the applicable environmental legal requirements and other requirements that the company subscribes to. The records of the results of the periodic evaluations shall be retained.

Relevant procedure: EP-06 Environmental Monitoring and Evaluation of Compliance

4.5.3 Nonconformity, Corrective Action and Preventive Action

(ISO 14001 Standard Clause 4.5.3)

Continual improvement of the EMS can be achieved by identifying nonconformity, correcting nonconformity, and preventing nonconformity from occurring again. Regarding nonconformity and its subsequent corrective / preventive action, Hakh Group Inc. shall establish, implement and maintain a procedure which defines the responsibilities and authorities to:

- handle and investigate nonconformity;
- take action to mitigate the impacts caused;
- initiate and complete corrective and preventive actions;
- ensure that the corrective or preventive actions taken to eliminate the causes of actual and potential nonconformity are appropriate to the magnitude of problems and commensurate with the environmental impacts encountered;
- record the results of corrective and prevention actions taken;

- review the effectiveness of corrective action and preventive action taken;
- implement and record any changes in the documented procedures resulting from corrective and preventive action; and

Hakh Group Inc. shall also ensure that any necessary changes are made to environmental management documentation.

Relevant procedure: EP-07 Enquiry / Complaint / Nonconformity Handling

4.5.4 Control of Records

(ISO 14001 Standard Clause 4.5.4)

Records shall be maintained to keep track of Hakh Group Inc.'s environmental performance, to demonstrate conformity to the requirements of the EMS, legal compliance, and to maintain audit trails in accordance with the requirements of ISO 14001 Standard, and the results achieved.

Hakh Group Inc. shall establish, implement and maintain a procedure to denote the identification, storage, protection, retrieval, retention and disposition of environmental records, to ensure that such records are legible, identifiable, and traceable to the activity, product or service involved, and that they are stored and maintained in such a way that they are readily retrievable and protected against damage, deterioration or loss. The retention period of each type of environmental records shall be specified.

Relevant procedure: EP-08 Control of Records

4.5.5 Internal Audit

(ISO 14001 Standard Clause 4.5.5)

Hakh Group Inc. shall plan, establish, implement and maintain a programme and procedures to carry out periodic environmental management system audits to:

- a) determine whether or not the environmental management system:
 - conforms to planned arrangements for environmental management including the requirements of ISO 14001; and
 - has been properly implemented and maintained;
- b) provide audit results and information for management review for environmental improvement.

The audit programme, including the schedule, shall be based on the environmental importance of the activities concerned and results from previous audits. The audit procedures cover the audit criteria, scope, frequency and methods, as well as responsibilities and requirements for conducting audits and reporting results and retaining associated records.

Hakh Group Inc. shall conduct EMS audits on a regular basis. Timely site environmental audits are required to ensure appropriate preventive actions being taken as planned, and corrective actions being carried out on a timely basis.

Relevant procedure: EP-09 Internal Audit

4.6 Management Review

(ISO 14001 Standard Clause 4.6)

The “plan-do-check-act” cycle shall require the top management of Hakh Group Inc. to act and review the environmental management system periodically to ensure its suitability, adequacy and effectiveness.

Before the Review, the EMR shall schedule for the management review and inform all the participants, and gather all relevant records/requirements (such as change in legal requirements) and prepare a summary report (if necessary) for discussion.

The Director, EMR and DEMR together with the EMS Committee shall take part in the annual management review. They shall assess the work done in the past year in environmental management and evaluate the existing EMS with respect to changes in legislation, concerns of interested parties, rice milling process, technology and product requirements, and lessons gained from previous experience, etc.

Topics to be discussed in the management review shall include but not be limited to:

- review of the environmental policy, objectives, targets, and programmes;
- review of legal compliance and compliance with other requirements (including contractor compliance on Hakh Group Inc. 's activities);
- environmental aspects of activities and their disclosure to public;
- findings of the internal audits;
- review of nonconformities and the status of corrective/preventive actions;
- communications from external interested parties, including complaints;
- areas for improvement with respect to environmental performance;
- adequacy of emergency preparedness and response;
- changing circumstances, including developments in legal and other requirements related to its environmental aspects,
- identify the need for modification of the existing EMS in light of the above items, and
- follow-up action from previous management reviews.

The review shall initiate a new “plan-do-check-act” cycle with improvements in Hakh Group Inc 's environmental performance and further enhancement of the EMS.

Findings from the management review shall be recorded in the meeting minutes and the EMR shall retain it as an EMS record. Maintenance of the records shall be in accordance with EP-08.

Annex A. Cross Reference of ISO 14001 Requirements* and Sections in the EMS Manual and Environmental Procedures.

| ISO Clause | EMS Manual Section No. | EP Ref. No. |
|--|------------------------|-------------|
| 4.1 General Requirements | 4.1 | — |
| 4.2 Environmental Policy | 4.2. | — |
| 4.3 Planning | 4.3 | — |
| 4.3.1 Environmental Aspects | 4.3.1 | EP-01 |
| 4.3.2 Legal and Other Requirements | 4.3.2 | EP-02 |
| 4.3.3 Objectives, Targets and Programme(s) | 4.3.3 | — |
| 4.4 Implementation and Operation | 4.4 | — |
| 4.4.1 Resources, Roles, Responsibility and Authority | 4.4.1 | — |
| 4.4.2 Competence, Training, and Awareness | 4.4.2 | EP-03 |
| 4.4.3 Communication | 4.4.3 | — |
| 4.4.4 Documentation | 4.4.4 | — |
| 4.4.5 Control of Documents | 4.4.5 | EP-04 |
| 4.4.6 Operational Control | 4.4.6 | All EIs |
| 4.4.7 Emergency Preparedness and Response | 4.4.7 | EP-05 |
| 4.5 Checking | 4.5 | — |
| 4.5.1 Monitoring and Measurement | 4.5.1 | EP-06 |
| 4.5.2 Evaluation of Compliance | 4.5.2 | EP-06 |
| 4.5.3 Nonconformity, Corrective Action and Preventive Action | 4.5.3 | EP-07 |
| 4.5.4 Control of Records | 4.5.4 | EP-08 |
| 4.5.5 Internal Audit | 4.5.5 | EP-09 |
| 4.6 Management Review | 4.6 | — |

* ISO 14001:2004 is referred.

* ISO 14001 Environmental Management Standard (www.nsai.ie)

* http://www.epd.gov.hk/epd/misc/env_management_sme/e_e/eng/um_main3.htm

Annex B Controlled Document List

| Document No. | Document/Form Name |
|---------------------|---|
| CP-01 | Environmental Policy |
| O&T-YYYY | Objectives, Targets and Programmes |
| EAR-01 | Register of Environmental Aspects |
| LR-01 | Register of Legal and Other Requirements |
| EM-01 | Environmental Management System Manual |
| EP-01 | Identification of Environmental Aspects and Significance Evaluation |
| EP-02 | Review of Legal and Other Requirements |
| EP-03 | Training |
| EP-04 | Control of Documents |
| EP-05 | Environmental Emergency Preparedness and Response |
| EP-06 | Environmental Monitoring and Evaluation of Compliance |
| EP-07 | Enquiry / Complaint / Nonconformity Handling |
| EP-08 | Control of Records |
| EP-09 | Internal Audit |
| EI-01 | Environmental Office Practices |
| EI-02 | Green Procurement |
| EI-03 | Environmental Practices for Using Company's Car |
| EI-04 | Waste Management |
| EI-05 | Air Pollution Control |
| EI-06 | Water Pollution Control |
| EI-07 | Noise Pollution Control |
| EI-08 | Resource Conservation |
| EI-09 | Handling and Storage of Chemicals |

13 SITE PLANS



Rayaadul Hakh Rice Industries

Existing Layout of Rice Factory on
Plot 1 and Plot 2, Pln. Strangroen
Mahalacony, E. C. Demerara

