

ENVIRONMENTAL IMPACTS

4 ENVIRONMENTAL IMPACTS

Direct negative impacts to the natural resources, and the man made environment in general by the proposed construction of RDA 5 during pre-construction, construction and operational phases have been determined to be minimal.

This determination arises from the fact that the proposed construction represents basically no net change in land use for the area and will not introduce any situation or constituent that will bear negatively on the surrounding community. It is the expressed intention of Jamalco to proceed with decommissioning of completed RDA as soon as possible. This rehabilitation exercise will essentially result in a reduction in the overall exposed surface area of the disposal areas. In fact the existing operations at the existing RDAs have been in place for over 20 years and provide an excellent baseline for assessing the potential impacts of the proposed development.

No cultural heritage monuments, archaeological artefacts or articles of historical significance have been identified within the project area or its surroundings.

The potential environmental impacts which will be occasioned by the construction of RDA 5 will be addressed in terms of the various phases of the proposed project, these are as follows:

4.1 POTENTIAL IMPACTS & PROPOSED MITIGATIVE STEPS

4.1.1 PRE-CONSTRUCTION & CONSTRUCTION ACTIVITIES

4.1.1.1 FUGITIVE EMISSIONS

Potential fugitive dust problems may occur during site clearance activities such as vegetation removal and excavation. Other activities may also contribute to this potential, especially when it is windy, such as:

- Vehicular traffic
- Spillage on access ways
- Stockpiles (overburden)

Other sources of air emissions in the area include:

- Monymusk Sugar Factory
- New Yarmouth Sugar Factory
- Jamaica Public Service Company (power generation)
- Jamaica Energy Partners (power generation)
- Sugar cane field burning
- Coal burning
- Motor vehicles

4.1.1.1.1 MITIGATION

Standard and appropriate mitigative measures inclusive of an irrigation regime and in some cases totally eliminate potential environmental impacts for all phases of the development.

4.1.1.2 NOISE

There may be the potential for noise being generated during pre-construction and construction activities, and as heavy equipment moves around the proposed RDA site.

An audiometric survey was conducted at the proposed RDA boundaries to establish a baseline for the area and to assess the potential for noise impacts on the adjoining communities. This assessment is included as section 3.8.1, of this report.

4.1.1.2.1 MITIGATION

Noise levels from usage of heavy equipments will be minimised by proper maintenance, equipment muffling and regular vehicular monitoring. Background noise levels will also be monitored and compared with existing decibel ratings measured for the baseline conditions. This will be assessed to determine compliance with accepted standards. In the event of non-compliance, corrective action will be taken, such as removal of the equipment from the fleet.

Should it become necessary to conduct blasting activities, the communities will be notified through appropriate signage and communication. Blasting will be performed using high precision blasting techniques, at times least likely to affect and disturb surrounding communities. All rules and regulations governing the use of explosive materials will be adhered to.

4.1.1.3 LOSS OF BIODIVERSITY

There will be no significant impact associated with biodiversity during pre-construction and construction activities. There will be no net change in land use for the project area. The area comprises four existing RDAs. Vegetation loss will be confined to the designated project area and will not involve any identified rare, endemic or endangered species of flora or fauna. The site is a brownsite area.

4.1.1.3.1 MITIGATION

Jamalco has a very proactive and successful program of mine rehabilitation. Jamalco has signed a memorandum of understanding with the Forestry Department to develop revegetation and habitat creation through technologies involving creative conservation. Aspects of this MOU that applies here are:

- During land clearing, utilisation of existing resources on the site must be maximized. These may include timber, buildings and produce.
- If the existing vegetation can assist in the rehabilitation process it should be harvested and redistributed in a timely manner on the areas being rehabilitated.

- Burning as a means to remove vegetation should be used as a last resort and should be considered only after harvesting, habitat and burial options have been considered.
- Land area cleared should be the minimum.
- Topsoil and remaining vegetation debris must be harvested from the entire area to be used and either stored where it can be recovered or utilized immediately on other areas being rehabilitated.
- Whenever topsoil is stored it should be done so for the least possible time to minimize the loss of biological activity and nutrients.
- If there are potentially toxic substances in the overburden they should be handled in such a way as to minimize the impact on the rehabilitation and surrounding areas.
- Clearing of additional vegetation for storage of topsoil and/or overburden should be minimized.
- Finished slope angles in reshaping will depend on aesthetics, final land use, soil characteristics and safety. Reshaped terrain should conform to the natural landscape as much as possible.
- All slopes must be stable. If erosion is likely to occur then erosion control works should be put in place.
- Soil nutrient and pH levels must be adjusted where this is necessary to achieve rehabilitation objectives.
- Topsoil must be replaced as the final soil profile. The thickness and area to which the topsoil is returned must provide the maximum value to the end use of the rehabilitated area.

4.1.1.4 WATER QUALITY

The RDAs have a significant potential for impacting on the groundwater resources of the area. The majority of potable water utilized at the Jamalco facility and those communities around that have piped water comes from wells located in the vicinity of the plant. The methods and type of construction of the new RDA take into consideration the potential for groundwater impacts.

Potential impacts to surface water may arise from increased sediment loads caused by the removal of trees, shrubs and grass during clearing activities. This is not envisaged to be a significant concern as no excavation will have begun during this phase of operation. The receiving body of any significant volumes of surface run-off would be the Rio Minho River to the northwest of the project area. However, as indicated in the hydrology segment of this report, rainfall will have to be in excess of 203mm, just below the 25 year rainfall of 227mm.

Potential impacts on the associated groundwater in the area will be negligible as no situation with the potential to generate toxic or hazardous materials capable of impacting groundwater is anticipated. This is demonstrated by the baseline water quality with the existing RDAs.

4.1.1.4.1 MITIGATION

All boulders removed from the proposed site will be placed along the banks of the river and sand borrow area. This will serve as a means of erosion control.

Precautionary measures will be taken during construction to ensure that there are no major adjustments to the common dike wall shared by RDAs 4 and 2. The civil/structural engineering principles used for the construction of all previous RDAs will facilitate this process and detailed monitoring of the entire construction period will therefore be critical.

Mitigative actions for ground water resources involve lining the RDA with a competent hydraulic barrier of compacted clay with a permeability of 10^{-9} cm/sec.

4.1.1.5 WASTE MANAGEMENT

There will be various types of waste materials that may be generated that must be properly managed. Waste generated may include, hazardous waste (chemicals, lubricants), vegetative matter (land clearing waste), and garbage. Potential impacts stem from the collection, handling and disposal of these waste materials.

4.1.1.5.1 MITIGATION

Jamalco has existing programmes and protocols in place to deal with all types of waste generated there. All waste generated during the construction and commissioning of the RDA will be handled based on these established protocols. The refinery has a landfill facility which includes a sealed area for disposal of certain hazardous materials. All identified waste management impacts can be successfully mitigated.

Solid waste generated during site clearance in the form of stumps, brush roots, trees and miscellaneous concrete structures will be removed to an approved dump site.

4.1.1.6 SEWAGE

During construction, there will be an anticipated 250 temporary employees.

4.1.1.6.1 MITIGATION

Portable chemical toilets will be utilized to meet the demands of this increased capacity. These toilets will be sourced from a reputable licensed company, who will treat and dispose of the contents.

4.1.1.7 VIBRATION

Vibration in and around the RDA will be a potential impact of heavy equipment (bulldozers, excavators, trucks). Depending on the duration and proximity of the mining activity to residents and structures, this impact may be major or minor.

4.1.1.7.1 MITIGATION

No new vibration related impacts are anticipated. If excessive vibration is pre-empted, assessments are done prior to and during the activities to verify levels.

4.1.1.8 AESTHETICS

Aesthetics in the area will be impacted. The removal of vegetation and soils will cause a distinct change in the appearance of the land and land use. This is a major reversible impact, which is addressed in rehabilitation and revitalization of the area when the RDA is decommissioned.

4.1.1.8.1 MITIGATION

Aesthetics in the area will be restored through Jamalco's rehabilitation and revitalization program.

4.1.1.9 ARCHAEOLOGICAL AND HISTORICAL HERITAGE

No new impacts are anticipated at the proposed site.

4.1.1.9.1 MITIGATION

For any archaeological or historical heritage item that may be impacted during pre-construction and construction activities, the Jamaica National Heritage Trust (JNHT) approved guidelines for managing archaeological and historical heritage items discovered during such activities will be utilized by Jamalco. It includes specific methods of operation including the necessary contacts and procedures to follow.

4.1.2 OPERATION ACTIVITIES

4.1.2.1 WATER QUALITY

Potential impacts to the water quality within the project and surrounding areas will be addressed in two segments, as it relates to:

- i. Surface water
- ii. Groundwater

4.1.2.1.1 IMPACTS ON SURFACE WATER

The potential impacts to surface water quality will be negligible or non-existent, as the operation of the RDA will not contribute to the constituents of surface water runoff. The completed cell will have a designed freeboard capacity suitable for the containment of a typical flood event. In addition overflow contingencies will be in place to eliminate the potential for overflow to ground surface.

4.1.2.1.2 IMPACTS ON GROUNDWATER

Potential impacts on the associated groundwater in the area are possible if a design flaw or liner failure results in the permeating of the clay seal and the release of liquor and caustic compounds into the subsurface soils.

4.1.2.1.3 MITIGATION

The effectiveness of the design of the liner and collection systems together with the quantities of the materials pumped into and extracted from the proposed RDA are integral as mitigative measures to water quality in the operational phase of the project. The baseline established over the past 20 years has shown that the use of a clay hydraulic barrier together with the sandy/gravel layer is effective in the prevention of liner failure which could contribute to groundwater contamination.

The sandy/gravel layer along with the liquid recovery system creates a zero hydrostatic head and lessens the load on the underlying clay zone minimising the potential for liner failure.

Wells located within proximity of the existing RDAs show no sign of direct contamination that can be linked to the disposal areas.

Maintaining the freeboard capacity in the RDAs is crucial as excessive influent levels can lead to overflow and affect water quality. Monitoring the volumetric capacity of the RDA with appropriate level indicators will mitigate the potential for spillages.

RISK ASSESSMENT

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5.1.1 EMERGENCY RESPONSE PLAN

5.1.1.1 GENERAL OVERVIEW

The following is taken from pertinent sections of Jamalco's Emergency Response Plan.

1. The emergency response procedures included in the following sections are designed as guidelines to follow when a spill, fire, explosion, or other catastrophic event causes a release of oil or other hazardous material to the environment. The procedures presented in this document are intended for use by Jamalco personnel responding to emergency situations at the refinery (including the Residue Disposal Areas). In general, the following types of emergency scenarios are covered by the plan:

- Storage unit leaks and/or rupture,
- Levee failures,
- Leaks/spills during loading/unloading operations,
- Pipeline failures,
- Releases due to catastrophic events (e.g., fires, explosion, earthquakes, floods, and hurricanes).

2. The emergency response procedures are intended to be the primary document that provides the procedures to be followed during a spill event.

3. These procedures will be reviewed annually and amended as needed to address changes or additions to facilities, processes, operations, hazardous substances, and personnel which would adversely impact their effectiveness.

4. Following the occurrence of a spill, release, fire, or explosion that requires implementation of this plan, the Primary Emergency Coordinator should immediately notify the proper regulatory agencies and follow-up with a written Spill Report which will be submitted within the time frame requirements of the applicable regulations.

5.1.2 ALERT PROCEDURES

If a minor leak, spill, release, or fire occurs, the individual discovering the incident should attempt to locate and eliminate the source. If possible, he/she should try to stop or at least contain the release. This can involve closing valves, turning drums upright, activating emergency pumps, using absorbent materials, or extinguishing the fire. These measures should only be undertaken if they can be accomplished without any risk to the individual. If the source is not immediately obvious or if these measures are not effective and the situation is beyond his/her control, then the discoverer should initiate the following emergency procedures using the telephone & radio listing included in this Plan.

5.1.3 FIRST PLANT CONTACT RESPONSIBILITIES

1. Contact the shift supervisor with responsibility over the affected department or area, who has been designated as the First Plant Contact.
2. Pass along the following information:
 - a) Exact location of the emergency event;
 - b) Type and description of the emergency;
 - c) Estimate of the amount of material released, or the size of the fire;
 - d) Extent of injury or property damage incurred;
 - e) Extent of the actual and potential environmental damage; and
 - f) Remedial action taken, if any.

If significant spill conditions exist to the extent that assistance from outside the department is needed, the First Plant Contact should immediately contact the following individuals and communicate the information listed above.

- Security
- Area Superintendent
- Department Manager

It will be Security's responsibility to then contact one of the Emergency Response Coordinators.

5.1.4 EMERGENCY NOTIFICATION PROCEDURES

The Emergency Response Coordinators will provide on-site coordination of safety, emergency response, and remedial measures taken. Responsibilities will also include initial and follow-up notification of spill conditions to government authorities, if required.

This information could include the following:

- Time of the spill;
- Identity of material spilled
- Approximate quantity spilled;
- Location and source of spill;
- Cause and circumstances of spill;
- Potential hazards (e.g., fire, explosion, etc.)
- Personal injuries or casualties, if any;
- Corrective action being taken and an appropriate timetable to control, contain, and clean up spill;
- Name(s) and telephone number(s) of individual(s) who discovered and/or reported the spill; and
- Other unique or unusual circumstances.

5.1.5 REQUIRED ALCOA NOTIFICATIONS

The Environmental Affairs Department in the Pittsburgh Office must be notified after every release or emergency response event that requires notification of local government agencies. An Environmental Event/Procedure Report should be completed and mailed to **Ms. I. J. Soukup** in the Pittsburgh Office.

5.1.6 EMERGENCY RESPONSE PROCEDURES

Based on information obtained from the First Plant Contact, department personnel, and emergency response guidance materials, the Emergency Response Coordinator will develop an initial response plan. At a minimum, the response plan should accomplish the following:

- Determine the classification of the material (e.g., flammable, poison, corrosive or otherwise);

- Determine the level of protection required (e.g., type, level and availability of breathing and skin protection);
- Discuss the hazards (e.g., specific to the material and danger from terrain, ruptures, leaks, falling objects, etc.);
- Direct the staging of response equipment;
- Determine if assistance from agencies outside the facility are needed; and
- Initiate the immediate steps necessary to contain or divert releases away from surface water bodies and other sensitive receptors.

The Emergency Response Coordinator will direct response personnel to obtain the necessary absorbents, barrier materials, or pipe plugging devices that are required to contain the spill and prevent it from reaching surface water bodies or drains that cannot accept the material.

The following information provides general response guidance for spills in specific areas.

1. Spills in Dike Areas

Absorbent material or booms will be placed to contain the spill within the dike area, if possible. If the spilled material is pumpable, portable pumps and/or the suction truck from the Clarification Department will be used to remove as much of the spilled material as possible. The material will be transported to an appropriate disposal site or placed in proper containers for later shipment. All attempts will be made to prevent the released material from entering surface water systems or associated storm drains. Acidic materials may be neutralized with material from the limestone storage pile.

2. Spills in Un-dike Areas

Every attempt will be made to contain the spill as rapidly as possible to prevent runoff from reaching surface water bodies or a storm drain system. If necessary, earthen materials will be used to construct temporary dikes or berms around the spilled material for placement in proper containers. Construction equipment may be used to build diversionary structures to divert or block releases from contaminating soils and/or

surface waters. Acidic materials may be neutralized with material from the limestone storage pile.

3. Spills to On-Site Lakes/Lagoons

Every attempt will be made to limit the amount of spilled materials that could enter lakes/lagoons at Jamalco. In the event that a large spill enters these areas, floating booms will be used to restrict the release to a limited area, if possible. Absorbent material and/or skimming equipment may be used to remove floating materials (e.g. oils and other petroleum products). If the spilled material is one that will mix with water, attempts will be made to isolate the lake/lagoon to keep contaminated material from entering other containment systems. If the released material is compatible with materials already present in lakes/lagoons at the site, those systems may be used for spill containment at the discretion of the Emergency Response Coordinator.

4. Spills on Soil

An attempt will be made to minimize the surficial area of the spill. Earthen dikes or berms will be used to provide containment for the spill. If possible or as practicable, absorbent materials will be placed on the spill area in an attempt to absorb freestanding material from the soil surface. Contaminated soil will be excavated and disposed or containerized for later disposal. Acidic materials may be neutralized in place with limestone.

5. Spills to Receiving Streams

An attempt will be made to contain spilled material at the source of the release, if possible. If the spilled material is moving across land, diversionary dikes, ditches, or berms will be placed using construction equipment to contain or divert the material prior to its reaching surface water bodies or other sensitive receptors.

If the spilled material reaches surface water, absorbent materials or booms will be used to control the material on the water (e.g., petroleum products). If the released material can be controlled, an attempt will be made to remove the material using portable pumps, skimmers, or the suction truck from the Clarification Department. If the spilled material cannot be controlled, other response measures may be taken at the direction of the

Emergency response Coordinator including in situ treatment (e.g., neutralization of acidic materials) and diversion to less sensitive containment areas.

5.2 PREVENTATIVE MEASURES LOADING/UNLOADING OPERATIONS

The following information provides a description of the spill preventative measures employed at loading/unloading operations.

5.2.1 RED MUD LAKE SYSTEM

The Red Mud Lake System incorporates:

- Plant runoff from Storm lake to Mud Lake 1
- Caustic/Mud from the plant to the Mud Lakes
- Cooling water from the Clear lake to the process

To facilitate sound management and operational integrity,

- i. Pumping operations are conducted by trained personnel
- ii. Liquid levels in the receiving impoundments are monitored
- iii. Equipment inspections are performed including pre-pump checks to ensure proper operation, moisture levels in pumps, pump packings, weekly pressure checks and motor control center cleanings

5.2.2 AIR EMISSIONS

The potential sources that would be the likeliest contributors to air emissions are:

- Excavation and stockpiling of soil material during pre-construction and construction activities
- Excavation and stockpiling of sand for use during the construction phase of the project
- Haul road traffic
- Engine emissions from heavy equipment

Practical measures will be utilized during periods of excavation and earth movement to reduce the levels of air emission. Equipment emissions will be controlled through comprehensive maintenance and overhaul programs to ensure that equipment is in sound operational condition.

Dust control on haul roads will be accomplished through applications of calcium chloride to the road surface. Maintenance applications will be made as necessary to maintain the integrity of the roadway. Calcium chloride attracts moisture from the air and binds with the limestone chips used to construct the roads effectively forming a low grade pavement.

5.3 CONTINGENCY PLAN

Preparedness and Prevention

The following information describes the actions and equipment that are available and maintained for immediate use in the event of an emergency release situation.

5.3.1 PLANT COMMUNICATION SYSTEMS

An extensive communications network is maintained at Jamalco for accessing necessary emergency personnel during an emergency situation. Relevant components of the overall communication system are briefly described below.

- a) Telephone system - an external telephone system connects each operation of Jamalco including the refinery, Woodside Land Office, Breadnut Valley Mines and Rocky Point Port.

An internal system extends throughout the refinery and is connected to the Woodside Land Office and Breadnut Valley mines.

- b) Radio System - a radio communication system is in place and is an effective method for communicating emergency messages throughout the refinery/chemical plant and especially areas out of reach of the telephone system.

Radio communication equipment includes hand-held units and mobile radio units installed in facility vehicles. During emergencies, limited communications can be maintained on F-1 frequency.

- c) HAM radio system - A HAM radio system is in place to provide long-range communication support in the event normal communication systems are inoperable due to an extreme emergency (e.g. hurricane, earthquake, etc.). The HAM radio system is maintained at the Powerhouse Control Room, Building 110.
- d) Alarm system - A plant emergency siren is maintained for immediate warning to facility personnel in the event of an emergency. In an emergency situation, security personnel will sound the siren with 2 blasts of 10 seconds each.

5.3.2 OUTSIDE AGENCY SUPPORT

- a. May Pen Fire Brigade: The plant Fire Brigade Leader will notify the May Pen Fire Brigade in the event of an emergency and will provide an estimate of additional services needed.
- b. May Pen Hospital/Lionel Town Hospital/University of the West Indies Hospital: Jamalco maintains its own medical staff (doctors and nurses) as well as ambulances located at the refinery, Breadnut Valley Mines, and Rocky Point Port.

The facility will normally transport their own injured personnel to the hospital. However, if conditions warrant, medical staff/security will notify the appropriate hospital in the event of an emergency and will provide an estimate of additional services needed.

5.3.3 EVACUATION PLAN

If it has been determined by an Emergency Response Coordinator that an emergency evacuation is required, employees will be notified via the facility communication system (e.g., emergency siren, telephone system, radio system or directly).

Evacuation from facilities operated by Jamalco, including the refinery, Woodside Land Office, Breadnut Valley Mines and Rocky Point Port will be conducted according to the following procedure:

- a. At the sound of the evacuation announcement, work will be stopped in an orderly manner and preparations made to evacuate the area immediately.
- b. Upon receiving notification of an impending evacuation, each department supervisor will report to their respective department/area and direct their employees to the nearest safe exit route (if this is feasible). After observing that all employees have evacuated the area, the supervisor will exit the area in question. All facility personnel will relocate to the company parking lot. Upon arrival at the parking lot, the emergency coordinator or his designee (e.g. each department supervisor) will take roll call.

If it is necessary to relocate at a greater distance from the facility, the decision for the required relocation will be made by the emergency coordinator or his designee.

- c. Plant Security and Fire Brigade personnel, when designated by the emergency coordinator to be traffic controllers, will position themselves in proper areas to direct traffic exiting the facility. Traffic controllers may also have the responsibility of escorting emergency vehicles to the incident location.
- d. Personnel designated by the emergency coordinator, as necessary, will be expected to search and assure that the area is clear of employees and that all equipment is turned off that is not absolutely necessary.
- e. Maintenance personnel will see that utilities are turned off and/or controlled to minimize the potential for secondary fires, explosions, electrical shocks, etc.
- f. Once the evacuation is complete, it will be at the discretion of the emergency coordinator as to whether additional tasks are considered safe and/or necessary. Additional tasks could include minor fire fighting assistance, removal of materials or equipment to safe locations, and proper operation/shutdown of plant processes.

5.3.4 EMERGENCY RESPONSE PARTICIPATION IN THE COMMUNITY.

If called upon, Jamalco will donate and use whatever communications and emergency response equipment it has at its disposal to assist during a community wide emergency.

5.3.5 EFFECTS OF EXTERNAL FACTORS ON EMERGENCY RESPONSE PROCEDURES

Certain catastrophic events (e.g., hurricanes, earthquakes, power failures, fires, flood, worker strikes, etc.) could occur that would limit the ability of Jamalco to implement the emergency response procedures contained in this plan. In this event, Jamalco's Emergency Response Coordinators will quickly assess the situation and make the modifications necessary to ensure the success of response efforts.

The following information is provided to identify the adverse effects associated with catastrophic events that have the potential for occurring at Jamalco:

- Disruption of telephone communication;
- Loss of lighting;
- Loss of computer support affecting process equipment and information services;
- Immediate shutdown of spill control sumps, process equipment, and air control devices;
- Disruption of evacuation procedures;
- Limitations on emergency response and/or vehicle access
- Loss of electrical power
- Loss and/or contamination of water supply (both potable and for fire response)
- Complications resulting from levee failure
- Releases resulting from levee failures

5.4 LANDSLIDE RISK ASSESSMENT

While no detailed assessment of the landslide risk has been carried out in southern Clarendon to date, the landslide inventory map of Jamaica (see Appendix B) shows no record of landslide events for the southern Rio Minho flood plain. The landslide hazard zonation map of Jamaica (see Appendix B) therefore shows this area to be at low risk of landslides (Area No. 1 on the map). The low landslide risk can be attributed to the flat lying nature of the topography, the presence of fairly easily drained alluvial soils, and the relative dry climate.

5.5 LOCAL AND REGIONAL TECTONIC ACTIVITY

An investigation of the historical records of seismic activity in this area has shown that the adverse effects of earthquakes have been experienced. The well-documented 1692 Port Royal earthquake had disastrous effects in the Lower Vere Plains, with modified Mercalli intensities (Appendix B) of MM(X) being experienced in Alley and Salt River, both of which lie at about a 10 km radius from the study area.

The following quote from a newspaper clipping written by the local Rector illustrates: all brick and stone building were thrown down and water spewed out of the chasms opened in the ground by the earthquake so that even dry gullies ran water". The St. Peters Anglican Church in Alley built in 1671 was destroyed beyond repair. However, the Halse Hall Great House, where alluvial thicknesses are comparatively low, survived the 1692 earthquake, as well as subsequent ones. The Great House is situated approximately about 6 km to the north of the JAMALCO alumina plant.

Subsequent damaging earthquakes are, most notably, those of 1907 and 1957. The 1907 earthquake appears to have caused some damage in the Vere Plains. Intensities of MM (VII) were reported in Alley with incidence of damage to chimneys and buildings (Tomblin & Robson, 1977). The 1957 earthquake had intensities of MM(CIV) to MM (V) in the Lower Vere Plains (Robinson et al., 1962).

In each 50-year period, starting with 1991 and counting backward for four 50-year cycles, at least one damaging earthquake, i.e. MM (VI) or higher, has occurred in the area. Shepherd (1971) reported that Lower Vere had a frequency of 5-9 damaging earthquakes per century on average.

The map of epicenters in the study area (see Appendix B) represents data gathered between 1981 and 1995 by the national seismograph network. It shows a scatter of small earthquakes around the site. It must be pointed out here that the error in these locations could be up to +1- 5km. The earthquakes shown have magnitudes of between 1.9 and 3.6.

Compared to the rest of Jamaica, the study area is not in a very active zone. However the Vere Plain is largely built up of alluvial clays, sand and gravel, and in the presence of ground water, this material will be susceptible to liquefaction in an earthquake of high

enough intensity. Thus, the height of the water table will be an important factor in determining the area's earthquake risk.

In the borehole data produced by JENTECH, none of the holes encountered the water table during drilling. Maximum depth drilled was 41 feet, where the limestone basement was encountered. This would suggest that the water table in this area is not near the surface, which means that the risk of liquefaction would be reduced. Also, the level of compaction was measured to be >90%, which would again reduce the risk. On the map of Soil and Liquefaction Potential (see Appendix B).

Halse Hall falls within the area designated 'PC' - soils on old alluvium. While there is a high potential for liquefaction along the coastal sections of the Rio Minho alluvial plain, the area inland does not fall into that category. This is due to the fact that the coastal sediments would have a greater percentage of water contained within them, and also the coastal sediments would be more recently deposited and therefore less compacted than those inland.

Figure 9 (Appendix B) gives an indication of regional tectonic activity by displaying earthquake epicenters in relation to major faults, and their correlation with landslide activity. The Halse Hall area is well away from zones of high activity.

SOCIO-ECONOMIC ANALYSIS OF PROJECT IMPACTS

6 SOCIO-ECONOMIC ANALYSIS OF PROJECT IMPACTS

6.1 INTRODUCTION

This report presents the findings of a survey conducted among residents within the radius of influence of the project, in Southern Clarendon between May and June 2004. While this survey was not conducted to solicit views and opinions solely for the construction of RDA 5, it was designed to address the wider issue of the modification of RDA#1, and the Efficiency Upgrade/Expansion of the entire operations which included the Residue Disposal Areas (by Conrad Douglas & Associates Limited - 2004).

Additionally, meetings have been held with community council groups, a major public meeting has been held and other community consultations have taken place in recent times to address various issues related to Jamalco's operations, including the Residue Disposal Areas. Also, a review of the concerns and opinions of the residents from the earlier EIA study for the construction of RDA# 4 completed by Conrad Douglas & Associates Limited (1996) was conducted to revisit the issues at that time.

6.2 SOCIO-ECONOMIC SURVEY

The objective of the survey was to determine the level of knowledge of the population of the existing and proposed operations, to ascertain their views on the perceived or known impacts of the operations as well as to solicit their perceived solutions to existing problems.

6.2.1 METHODOLOGY

The survey was based on a 5 per cent sample of households from the enumeration districts in the study area (as defined by the Statistical Institute of Jamaica) for the 2001 Population Census. The households for administration of the questionnaire were selected at random by the interviewer, within the enumeration districts. The respondent in all instances was the household head.

The information collected through the questionnaire included the following:

1. Personal Characteristics
 - Age and Gender
 - Number of Years Lived in the Community
2. Opinions on the community
 - Factors most preferred
 - Factors least preferred
 - Benefits of large scale development to the community
3. Awareness and Opinions on Existing Bauxite Operations
 - Perceived negative impacts
 - Perceived positive impacts

Knowledge of and Views on Upgrade Plans as they relate to:

 - Economic Value of the Community
 - Pollution
 - The Local Environment generally
 - The Individual
 - Job Opportunities
4. Water Availability
 - Source of drinking water
 - Perception of water quality
5. Miscellaneous
 - Awareness of community activities by Jamalco
 - Working experience in bauxite industry
 - Receipt of compensation for pollution problems

In most instances the questions allowed for multiple responses. The responses were coded and the data captured. The findings as they relate to the two main areas of the parishes indicated are summarized below. The details of the specific findings related to the communities are presented elsewhere in this report.

6.2.2 THE SURVEY POPULATION

- Issues related to “quality of life and people” were viewed as the best things about the communities; the reasons people liked their communities. An equal percentage of the respondents, 44.4%, stated that what they liked most about

their communities was the “friendly people” and the quietness of the communities. The availability of farmland was the next highest ranked, selected by 15% of respondents.

- The factors, which were reported by most Clarendon respondents as the reason for not liking their community, were unemployment and poor roads. Unemployment was given as the reason by 41.4 per cent of respondents and poor roads by 33.3 per cent.
- More than 7 out of 10 (71.7 per cent) of Clarendon respondents viewed “large scale development as beneficial to the community. Job opportunities and the potential for development of skills were seen as the primary reasons for this view.
- Respondents who did not agree with the statement saw large-scale development as impacting negatively on the environment.
- No direct connection was made between negative impacts and the RDA’s, however, opinions related to water quality were mentioned on several occasions.

6.2.3 AWARENESS AND OPINIONS ON EXISTING BAUXITE OPERATIONS

- The majority of respondents (99. per cent) in the vicinity of the RDAs are aware of the existence of bauxite or alumina processing plant operations in the area
- Of these (84.8 per cent) said they personally experience negative impacts
- Dust, soot or gaseous emissions, odour and damage to property are the three factors identified by most of the respondents as the negative impacts. Forty six per cent identified dust etc., while odour and property damage were both identified by 25 per cent and 23 per cent respectively.
- Eight out of ten (83.8 per cent) of the respondents agreed that the bauxite facility has had negative impacts on the people in the community. The reason given by the majority of the respondents is that “the area smells like caustic soda more often than not”. Just about a half of the residents (51.5%) gave this response. Almost one fifth of the respondents noted an increase in the frequency of illness

(19%), while 14% of the residents chose “the area has widespread corrosion” and “plants are harder to grow” as reasons.

- Seventy –eight (78.8%) respondents agreed that the bauxite facility has had positive impacts on the people in the community. “Job opportunities” and ironically “environmental conditions” were the reasons given by the majority of the respondents: 51.5 per cent and 16.2 per cent respectively.

6.2.4 KNOWLEDGE AND VIEWS ON UPGRADE PLANS

- Nine out of ten (90.9 per cent) of the Clarendon respondents were aware of the upgrade plans.
- 79 persons felt that the proposed upgrade would affect them personally while 15 respondents felt that it would not affect them. Approximately 4 per cent were not sure while the remaining 1 per cent did not respond.
- While 47.5 per cent of respondents were of the view that the upgrade would have a positive impact on economic value of the community a higher 64.7 per cent saw the effect on job opportunities as positive. Less than 15% of respondents were of the view that there would be no change in relation to job opportunities (13 per cent) or on the economic value (9 per cent) of the community.
- Approximately 39 per cent of respondents were of the view that the proposed upgrade will impact negatively on pollution, 53.5 per cent saw a positive impact while 1 per cent saw no change. 3 per cent said they did not know what the impact on pollution would be.
- The responses to the question on the main impact overall of the proposed upgrade suggested positive as well as negative factors. The increased circulation of dust in the area emerged as the main impact seen by the respondents. More than half (53.5% per cent) of responses identified this as the main impact. 29.3 per cent) of the respondents indicated ‘more jobs’ as the main impact. More air pollution and noise (19 per cent) and more occurrences of diseases that affect breathing (6 per cent) were the next highest nominated.

- As reasons for the particular answers given, 32.3 per cent stated that ‘the present bauxite and mining and processing facilities have caused this already so it can only get worse’. Only 7 respondents felt that more jobs would be available.

6.2.5 AVAILABILITY OF WATER

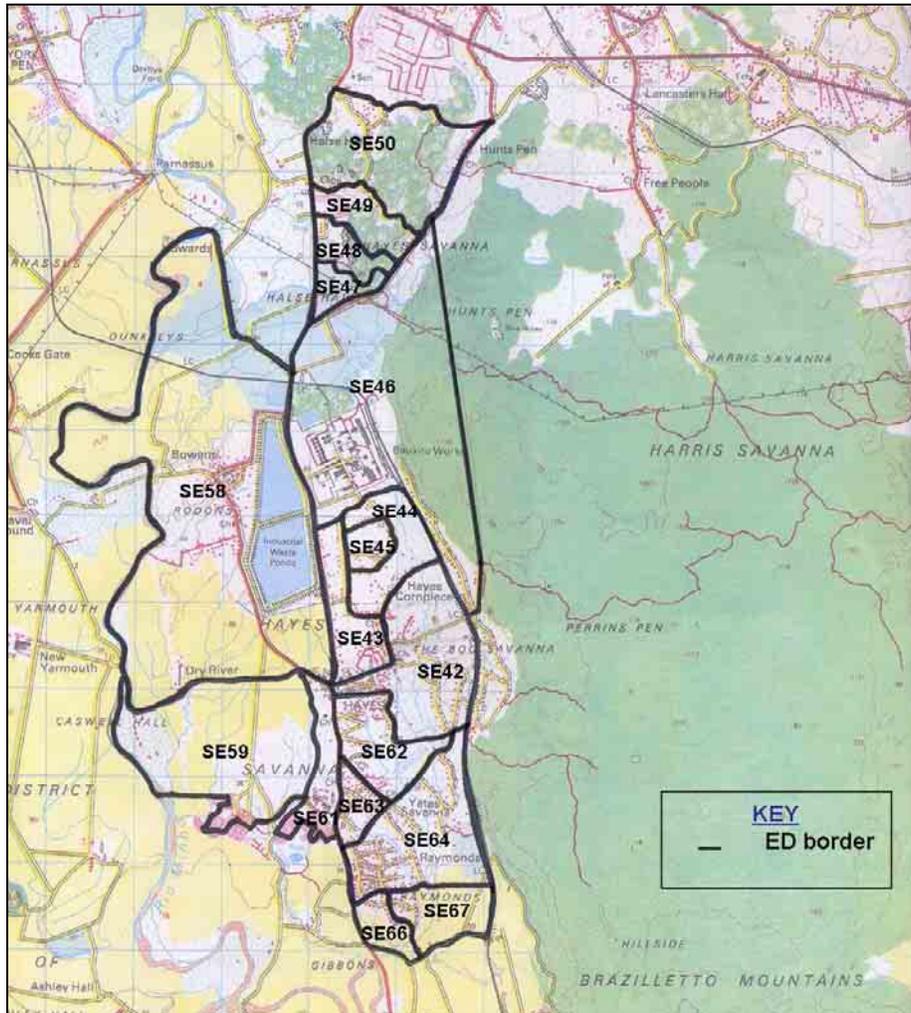
- (48.5 per cent) of respondents had water piped indoor available to them, while 47.5 per cent had water piped outdoor. The public standpipe was the source for 8.1 person. 3 people are unaccounted for.
- The National Water Commission was the original supplier for all the respondents.
- More than half of the respondents are of the view that the water is not safe to drink (51.5 per cent) while only 29.3% feel that the water is safe. The proportion that does not know or are not sure is 12 per cent.
- The main reason given for belief that the water was not safe by 94 per cent of the respondents who stated this view was that the water was affected by bauxite mining and other sources. Sixty nine per cent of the respondents, who felt that the water was safe to drink, felt this way because the National Water Commission tested the water frequently or that the water looked and or smelt clean.

6.2.6 SOUTHERN CLARENDON

6.2.6.1 THE COMMUNITIES

While the selection of the areas for interviewing were based on the enumeration districts as defined by STATIN, the communities as presented in this report were defined in the field by the interviewer and the respondent. Accordingly it is possible for a number of communities to cross Ed boundaries. The list of communities identified appears in Figure 6-1 below.

FIGURE 6-1: Enumeration Districts SURVEYED IN Southern Clarendon



6.2.6.2 DEMOGRAPHIC AND SOCIAL PROFILE

The total population identified for this area in the 2001 census was 24,100. Females were predominant, comprising 50.5 per cent of the total. The women were slightly older than the men with an average age of 27.5 years compared to 27 years for men. In relation to educational attainment approximately 65 per cent of the population 15 years and older had attained a secondary level education, while 7 per cent had attained tertiary level.

There were 5,567 housing units in the area, 90 per cent of which were of the separate-detached type. The main material used in the construction of the housing units was concrete. Average household size was 3.5. While approximately 55 per cent of units were owned, 42.4 per cent were occupied under lease and rent free arrangements.

Eighty-two per cent of the approximately 6100 households had access to piped water. Of this, 9 per cent was receiving the water from a private source. Less than a half (48 per cent) of households had access to water closets as toilet facilities.

6.2.6.3 FINDING OF THE STUDY FOR THE COMMUNITIES

Due to the small size of the community samples, the analysis will be presented on the basis of the absolute numbers and not on percentages.

6.2.6.3.1 MINERAL HEIGHTS

6.2.6.3.1.1 The Survey Population

A total of 17 respondents were covered in the survey, 10 men and 7 women ranging between 20 and 59 years old. The majority of persons (10) have lived in the community between 11-20 years. Two persons have been residents for more than 20 years.

6.2.6.3.1.2 Main Findings

6.2.6.3.1.2.1 Opinions on the Community

- Twelve persons reported that they liked the community because of the friendly people and because it was quiet and 4 persons liked it because of the clean environment.
- Crime and Violence (5) Unemployment (4) and poor roads (3) were the main reasons given for not liking the community.
- Fifteen of the 17 residents interviewed viewed "large scale development as beneficial to the community". Job opportunities and the potential for development of skills were seen as the primary reasons for this view

6.2.6.3.1.2.2 Awareness and Opinions on Existing Bauxite Operations

- Sixteen (16) persons said that they were aware of the existence of bauxite or alumina processing plant operations in the area and 12 of them said that they had not experienced any negative impacts from the operations.
- The 4 who reported that the operations had impacted negatively on them identified dust, soot and gaseous emissions and odour as the factors affecting them.
- Four persons agreed that the bauxite facility has had negative impacts on the people in the community. The reasons given were that, the area smells like caustic soda more often than not (2); the area has widespread corrosion (1); and you get sick more often (1).
- All 17 respondents agreed that the bauxite facility has had positive impacts on the people in the community because of the job opportunities (16); educational and social benefits (2); and improved community relations (1).

6.2.6.3.1.2.3 Knowledge and Views on Upgrade Plans

- Fifteen of the 17 persons were aware of the upgrade plans, 10 thought the impact on the economic value of the community would be positive and 14 saw the impact on job opportunities as positive.
- With regard to the impact on pollution, 9 persons saw it as negative, 5 as positive, 1 saw no change and 2 did not know.
- While 11 persons felt the upgrade will *not* affect them personally, 3 felt it would and 3 were not sure. One person did not respond.
- The responses to the question on the main impact overall of the proposed upgrade suggested positive as well as negative factors. The prospects of job opportunities emerged as the main impact seen by 10 of the respondents. More dust circulating in the area (5); loss of income (2); more air pollution and noise (1); less air pollution and noise (1); and more diseases affecting breathing (1); were the other reasons given.

- As reasons for the particular answers given, 11 stated that more jobs would be available. Presumably in relation to the circulation of dust and the existence of more pollution and noise, 3 respondents felt that the present bauxite and mining and processing facilities have caused this already so it can only get worse and this is something common to all bauxite operations (1). One respondent was of the opinion that the upgrade will add new equipment that will be cleaner to operate.

6.2.6.3.1.2.4 Availability of Water

- All 17 respondents had water piped indoor available to them with The National Water Commission as the original supplier
- Fourteen (14) persons were of the view that the water is safe to drink because it is tested frequently by the NWC (13) and it looks and smells clean (1).

6.2.6.3.1.2.5 Awareness and Solutions

- Only 4 of the 17 respondents stated that they had ever voiced an opinion on the pollution problem.
- Eight (8) persons said that they were satisfied with efforts to deal with the health problems in the community.
- No one had ever received compensation from Jamalco
- Four (4) persons reported that they or members of their household had worked in the bauxite industry.
- Six (6) of the 17 respondents indicated an awareness of programs or activities initiated by JAMALCO.
- While 7 persons said they did not know or were unsure of what should be done about the pollution problem, 5 responses suggested that the bauxite emissions should be controlled/ reduced and the air filtered, while 2 responses recommended a plant upgrade.

- In relation to the health problems, the responses were as follows; provide free/partially funded healthcare (2); build/expand clinic (1); and compensation for residents/discomfort allowance (1); upgrade plant (2).
- Eleven (11) persons did not know or did not respond.

6.2.6.3.2 BOWENS

6.2.6.3.2.1 THE SURVEY POPULATION

A total of 16 respondents were covered in the survey, 7 men and 9 women. Fourteen persons were between the ages of 20 and 59 years and 2 men were 60 years and over. The majority of persons (11) have lived in the community for more than 10 years, with 5, more than 20 years.

6.2.6.3.2.2 MAIN FINDINGS

6.2.6.3.2.2.1 *Opinions on the Community*

- Eight persons reported that they liked the community because it is quiet, 4 because of the friendly people and 3 because of the availability of farmland.
- Unemployment (6), poor roads (4) and the dirty environment (2) were the main reasons given for not liking the community.
- Ten of the 16 residents interviewed saw “large scale development as beneficial to the community”. Job opportunities (8) were seen as the primary reason for this view.

6.2.6.3.2.2.2 *Awareness and Opinions on Existing Bauxite Operations*

- All 16 persons said that they were aware of the existence of bauxite or alumina processing plant operations in the area and 14 of them said that they had experienced negative impacts from the operations.
- Odour (6), dust, soot and gaseous emissions (6) and damage to property (5) were the main factors identified.

- All but two persons agreed that the bauxite facility has had negative impacts on the people in the community. The reasons given were that, the area smells like caustic soda more often than not (8); you get sick more often (3); and plants are harder to grow (2).
- Twelve of the 16 respondents agreed that the bauxite facility has had positive impacts on the people in the community because of the job opportunities (7) and the environmental conditions (4).

6.2.6.3.2.2.3 Knowledge and Views on Upgrade Plans

- Fifteen of the 16 persons were aware of the upgrade plans, 5 thought there would be no change in the economic value of the community impact on the economic value of the community, while there were as many responses (4) for a positive impact as for a negative impact. In relation to job opportunities, while 7 persons saw a positive effect, 5 persons saw no change, 2 saw a negative effect and 2 did not know.
- With regard to the impact on pollution, 10 persons saw it as positive, 5 as negative, and 1 did not know.
- While 14 persons felt the upgrade will affect them personally, 2 felt it would not.
- The responses to the question on the main impact overall of the proposed upgrade suggested negative factors. More dust circulating in the area (8) and more air pollution and noise (6) were the main reasons given.
- As reasons for the particular answers given there were 13 responses stating that the present bauxite and mining and processing facilities have caused this already so it can only get worse.

6.2.6.3.2.2.4 Availability of Water

- Fourteen respondents had water piped indoor available to them and 2 had outdoor pipe. The National Water Commission was the original supplier

- Only 1 person was of the view that the water is safe to drink. Nine said it was not safe and 5 were not sure. Seven persons gave the reason for doubting the safety as 'bauxite mining affects the water'.

6.2.6.3.2.2.5 Awareness and Solutions

- Thirteen of the 16 persons said they had voiced their opinion on the health and pollution problems in the community
- Thirteen (13) persons said that they were not satisfied with efforts to deal with the health problems in the community.
- Six of the 16 respondents had received compensation in the past.
- Three (3) persons reported that they or members of their household had worked in the bauxite industry.
- Six (6) of the 16 respondents indicated an awareness of programs or activities initiated by JAMALCO.
- Regarding advice on solutions to the pollution problem, 5 persons suggested a relocation of the plant and 4 recommended control and reduction of bauxite emissions.
- In relation to the health problems, the responses were as follows; provide free/partially funded healthcare (5); build/expand clinic (2); and compensation for residents/discomfort allowance (4).

6.2.6.3.3 RAYMONDS

6.2.6.3.3.1 THE SURVEY POPULATION

A total of 17 respondents were covered in the survey, 8 men and 9 women. All except one man ranged in age between 20 and 59 years old. The majority of persons (9) have lived in the community between 11-20 years and 7 persons have been residents for more than 20 years.

6.2.6.3.3.2 MAIN FINDINGS

6.2.6.3.3.2.1 *Opinions on the Community*

- Twelve persons reported that they liked the community because of the friendly people and because it was quiet and 4 persons liked it because of the availability of farmland.
- Poor roads (6); unemployment (5); crime and violence (3); the dirty environment (2); and unfriendly people (1); were the main reasons given for not liking the community.
- Ten of the 17 residents interviewed saw “large scale development as beneficial to the community”. Job opportunities (8) were the primary reason for this view. One person indicated the opportunity for skills development and one person although seeing the benefits of large-scale development, thought that it would affect environmental quality, negatively.

6.2.6.3.3.2.2 *Awareness and Opinions on Existing Bauxite Operations*

- All 17 persons said that they were aware of the existence of bauxite or alumina processing plant operations in the area and all of them said that they had experienced negative impacts from the operations.
- Dust, soot and gaseous emissions (10); damage to property (5); and odour (2) were the main factors identified.
- All 17 also agreed that the bauxite operations have had negative impacts on the people in the community. The reasons given were that, the area smells like caustic soda more often than not (12); the area has widespread corrosion (1); you get sick more often (3); and plants are harder to grow (1).
- While 11 respondents agreed that the bauxite facility has had positive impacts on the people in the community, 6 said it did not. Job opportunities (8) and environmental conditions (3) were cited as the reasons.

6.2.6.3.3.2.3 *Knowledge and Views on Upgrade Plans*

- Fifteen of the 17 persons were aware of the upgrade plans. Ten persons thought the impact on the economic value of the community would be positive and 14 saw the impact on job opportunities as positive.
- With regard to the impact on pollution, 12 persons saw it as positive, 5 as negative.
- Most persons (16) felt the upgrade will affect them personally.
- The responses to the question on the main impact overall of the proposed upgrade suggested positive as well as negative factors. Most responses (8) related to 'more dust circulating in the area' while 7 responses indicated that job opportunities as the main impact. Loss of income (1) more air pollution and noise (6) were the other reasons given.
- As reasons for the particular answers given 10 stated that the present bauxite and mining and processing facilities have caused this already so it can only get worse. There were 7 responses stating that more jobs would be available.

6.2.6.3.3.2.4 *Availability of Water*

- The majority of respondents (14) received water from outdoor pipes. Only 2 had indoor pipes and 1 used a public standpipe. The National Water Commission was identified as the original supplier.
- Fourteen (14) persons were of the view that the water was *not* safe and 3 were not sure. The reason given by the 14 persons was that bauxite mining affects drinking water.

6.2.6.3.3.2.5 *Awareness and Solutions*

- All but one person indicated that they had voiced their opinion regarding health and pollution problems.

- Sixteen (16) of the 17 persons said that they were not satisfied with efforts to deal with the health problems in the community.
- Ten (10) persons had received compensation in the past.
- Four (4) persons reported that they or members of their household had worked in the bauxite industry.
- Only 3 of the 17 respondents indicated an awareness of programs or activities initiated by JAMALCO.
- Thirteen (13) persons suggested an upgrade of the bauxite plant as a solution to the pollution problem. Two (2) responses suggested that the bauxite emissions should be controlled/reduced and the air filtered.
- In relation to the health problems, the main responses were as follows; provide free/partially-funded healthcare (6); relocate JAMALCO farther away (5); and compensation for residents/discomfort allowance (2).

6.2.6.3.4 SAVANNAH

6.2.6.3.4.1 The Survey Population

A total of 15 respondents were covered in the survey, 8 men and 7 women. Twelve persons were between the ages of 20 and 59 years and 3 men were 60 years and over. The majority of persons (9) have lived in the community for more than 20 years. Six persons have been resident between 11 and twenty years.

6.2.6.3.4.2 MAIN FINDINGS

6.2.6.3.4.2.1 *Opinions on the Community*

- Six persons reported that they liked the community because it is quiet, 4 because of the friendly people and 3 because of the availability of farmland.
- Unemployment (9) and poor roads (5) were the main reasons given for not liking the community.

- Ten of the 15 residents interviewed saw “large scale development as beneficial to the community”. Job opportunities (7) were seen as the primary reason for this view.

6.2.6.3.4.2.2 Awareness and Opinions on Existing Bauxite Operations

- All 15 persons said that they were aware of the existence of bauxite or alumina processing plant operations in the area and all of them said that they had experienced negative impacts from the operations.
- Odour (5); dust, soot and gaseous emissions (5) and damage to property (5) were the factors identified.
- Fourteen persons agreed that the bauxite facility has had negative impacts on the people in the community. The reasons given were that, the area smells like caustic soda more often than not (7); and you get sick more often (3) ; the area has widespread corrosion (2) and plants are harder to grow.
- Thirteen of the fifteen respondents agreed that the bauxite facility has had positive impacts on the people in the community because of the job opportunities (5); environmental conditions (5); improved community relations (2) and educational and social benefits (1).

6.2.6.3.4.2.3 Knowledge and Views on Upgrade Plans

- Fourteen of the 15 persons were aware of the upgrade plans but not all thought the impact on the economic value of the community would be positive. While 6 persons thought the impact would be positive, 5 expressed the view that it would be negative, 1 thought there would be no change and 2 did not know. Ten of the respondents felt however that the impact on job opportunities would be positive.
- With regard to the impact on pollution, 10 persons saw it as positive and 5 as negative.
- Most persons (14) felt the upgrade will affect them personally.

- The responses to the question on the main impact overall of the proposed upgrade suggested more negative than positive factors. More dust circulating in the area (8) and more diseases affecting breathing (5) were the main reasons given. There were 4 responses for more job opportunities.
- As reasons for the particular answers given 12 respondents felt that the present bauxite and mining and processing facilities have caused this already so it can only get worse and this is something common to all bauxite operations (2).

6.2.6.3.4.2.4 Availability of Water

- Most persons (11) used outdoor pipes, and 4 had water piped indoors. The National Water Commission was the original supplier
- The respondents were equally divided on the question of the water safety; six persons were of the view that the water is safe to drink, 5 felt it was not safe and 4 were not sure. The water is tested frequently by the NWC (5) and it looks and smells clean (1); while bauxite mining affects the drinking water (4) were the responses regarding reasons for the opinions.

6.2.6.3.4.2.5 Awareness and Solutions

- Ten of the 15 persons said that they had voiced their opinion about the pollution and health problems in the past.
- All 15 respondents said that they were not satisfied with efforts to deal with the health problems in the community.
- Fourteen persons had received compensation in the past.
- Five (5) persons reported that they or members of their household had worked in the bauxite industry.
- Only 4 of the 15 respondents indicated an awareness of programs or activities initiated by JAMALCO.

- Suggestions regarding the solutions to the problem of pollution were as follows: relocate the plant (6); upgrade the plant and control/reduce bauxite air emissions.
- In relation to the health problems, the main responses was provide free/partially-funded healthcare (6).

6.2.6.3.5 HAYES CORNPIECE

6.2.6.3.5.1 The Survey Population

A total of 30 respondents were covered in the survey, 15 men and 15 women. The majority of persons (25) were between the ages of 20 and 49 years and 23 persons have lived in the community for more than 20 years.

6.2.6.3.5.2 Main Findings

6.2.6.3.5.2.1 Opinions on the Community

- Friendly people (11), quiet (5) and availability of farmland (4) were given as the main reasons for liking the community.
- Poor roads (14); unemployment (14); and the dirty environment (6) were the main reasons given for not liking the community.
- Twenty four of the 30 residents interviewed saw “large scale development as beneficial to the community”. Job opportunities (20) were seen as the primary reason for this view.

6.2.6.3.5.2.2 Awareness and Opinions on Existing Bauxite Operations

- All 30 persons said that they were aware of the existence of bauxite or alumina processing plant operations in the area and all of them said that they had experienced negative impacts from the operations.
- Dust, soot and gaseous emissions (25); noise (12) and odour (9) and damage to property (8) were the main factors identified.

- All persons agreed that the bauxite facility has had negative impacts on the people in the community. The reasons given were that, the area smells like caustic soda more often than not (22); too much noise (9); you get sick more often (9); plants are harder to grow (9) and area has widespread corrosion (6);
- The majority of respondents (21) agreed that the bauxite facility has had positive impacts on the people in the community mainly because of the job opportunities (15); educational and social benefits (5).

6.2.6.3.5.2.3 Knowledge and Views on Upgrade Plans

- The majority of respondents (27) were aware of the upgrade plans. Seventeen (17) thought there would be positive effects on the economic value of the community. In relation to job opportunities, while 20 persons saw a positive effect, while 5 persons saw no change.
- With regard to the impact on pollution, 15 persons saw it as negative while 12 persons saw it as positive.
- Twenty eight (28) persons felt the upgrade will affect them personally, 2 felt it would not.
- The responses to the question on the main impact overall of the proposed upgrade suggested negative factors. More dust circulating in the area (19) and more air pollution and noise (6) were the main negative reasons given while 8 responses indicated more jobs.
- As reasons for the particular answers given there were 23 responses stating that the present bauxite and mining and processing facilities have caused this already so it can only get worse.

6.2.6.3.5.2.4 Availability of Water

- The majority of respondents (20) had outdoor piped water available to them, 7 had indoor pipe with The National Water Commission being the original supplier

- Only 8 persons were of the view that the water is safe to drink. Nineteen said it was not safe because bauxite mining affects the water.

6.2.6.3.5.2.5 Awareness and Solutions

- Twenty three of the 30 persons said they had voiced their opinion on the health and pollution problems in the community
- All 30 persons said that they were not satisfied with efforts to deal with the health problems in the community.
- Twenty two (22) of the 30 respondents had received compensation in the past.
- Twenty one (21) persons reported that they or members of their household had worked in the bauxite industry.
- Twenty respondents indicated an awareness of programs or activities initiated by JAMALCO.
- Regarding advice on solutions to the pollution problem, 14 persons suggested a relocation of the residents and 6 recommended the relocation of the plant.
- In relation to the health problems, the responses were as follows; provide free/partially funded healthcare (14) and compensation for residents/discomfort allowance (5).

6.2.6.3.6 HAYES NEWTOWN

6.2.6.3.6.1 The Survey Population

A total of 4 respondents were covered in the survey, 1 man and 3 women all between the ages of 20 and 59 years. All 4 had lived in the community for between 11 and 20 years.

6.2.6.3.6.2 Main Findings

6.2.6.3.6.2.1 *Opinions on the Community*

- No one reason stood out as the main one for liking the community as each person had a different response; friendly people, availability of farmland, quiet and no crime and violence.
- Unemployment (3), poor roads (1) and more development needed (2) were given as reasons for not liking the community.
- The 4 respondents were divided equally on the issue of the benefits of large-scale development as 2 said it was beneficial while said it was not. The potential for skills development and the negative effect on the environment were given as the reasons for the respective answers.

6.2.6.3.6.2.2 *Awareness and Opinions on Existing Bauxite Operations*

- All 4 persons said that they were aware of the existence of bauxite or alumina processing plant operations in the area and all of them said that they had experienced negative impacts from the operations.
- Odour (3) was the main factor identified.
- All agreed that the bauxite facility has had negative impacts on the people in the community, because the area had widespread corrosion.
- The 4 persons also agreed that the bauxite facility has had positive impacts on the people in the community and interestingly identified environmental conditions as the reason.

6.2.6.3.6.2.3 *Knowledge and Views on Upgrade Plans*

- All 4 persons were aware of the upgrade plans and were not very positive about the impact on the economic value of the community. Two thought this would be negative and 2 thought there would be no change. In relation to job opportunities 3 persons thought there would be no change.

- All 4 persons did however see a positive effect on pollution.
- The 4 persons felt the upgrade will affect them personally as more dust would be circulating in the area. This was because this was common to all bauxite operations.

6.2.6.3.6.2.4 Availability of Water

- All 4 respondents had water piped indoor available to them .The National Water Commission was the original supplier
- No one was of the view that the water is safe to drink because bauxite mining affects drinking water.

6.2.6.3.6.2.5 Awareness and Solutions

- All 4 persons said they had voiced their opinion on the health and pollution problems in the community and all said that they were not satisfied with efforts to deal with the health problems in the community.
- Two of the 4 respondents had received compensation in the past.
- Two (2) persons reported that they or members of their household had worked in the bauxite industry.
- Two of the 4 respondents indicated an awareness of programs or activities initiated by JAMALCO.
- Regarding advice on solutions to the pollution problem, 1 person suggested an upgrade of the plant and 1 recommended control and reduction of bauxite emissions.

In relation to the health problems there were 3 responses recommending a relocation of people and 2 suggesting community meetings

IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

7 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

The following is a summary of the alternatives considered in this phase of Jamalco's Residue Management Plan:

- No Action
- Expand lifespan of existing RDAs by elevating perimeter dike walls
- Dredge existing RDAs and process residue through paste thickener
- Construct unsealed Red Mud Lakes in remote areas of the community
- Disposal of Red Mud at sea
- Reduce Production
- Construction of RDA 5 incorporating a combination of thickened tailings disposal and dry stacking technology. (selected alternative)

7.1 ANALYSIS OF ALTERNATIVES

7.1.1 NO ACTION ALTERNATIVE

The no action alternative would not be practical at this time as Jamalco has very limited capacity remaining at this time and does not foresee going beyond November of 2006 before additional residue storage will become an absolute necessity. When factors related to permitting, time of construction and time for proper commissioning of a quality residue disposal facility are considered it is absolutely necessary that decisions are made now and solutions are implemented.

Jamalco has had to implement a series of interim capacity building exercises over the last few years to provide a buffer while plans, designs and permission is sought for the construction of a new RDA. These included the raising of the dike walls on RDAs 3, and 4 and the construction of a Step-in-Dike within RDA 1 to test the combined technologies of thickened tailings disposal and dry stacking.

The No Action Alternative would result in the near term shut down of the Jamalco refinery, the abandonment of plans for upgrade and expansion and a serious economic blow to the surrounding communities and Jamaica at large.

7.1.2 INCREASE LIFESPAN OF EXISTING RDAs BY ELEVATING DIKE WALLS

This is a possible alternative, however, the dike walls on the RDAs 3 & 4 have been raised previously resulting in additional capacity but also increased the negative aesthetic impact on the surrounding communities. To further increase the height may not be the best long term solution.

7.1.3 DREDGE EXISTING RDAs AND PROCESS THROUGH PASTE THICKENER

This is a possible alternative that is being contemplated. However, this would only result in a small increase in capacity across the existing RDAs when compared to what is required and what could be gained from a new facility. Jamalco is always seeking to maximise the potential of the existing red mud disposal infrastructure, so this alternative will be seriously considered, however, it would not meet the needs of a plant that is seeking to increase its production output from 1.2 to 2.8 Mtpy. This is not the preferred alternative.

7.1.4 CONSTRUCT UNSEALED RED MUD LAKE IN REMOTE AREA OF COMMUNITY

Possible alternative that has been used extensively by other bauxite-alumina companies, but never by Jamalco. Jamalco is a zero discharge facility and this alternative would represent a step backward for the company as the technology they have pioneered in Jamaica, sealed impoundments is far superior in the protection of environmental and natural resources and by extension the well being of people. The potential negative impacts on groundwater are far reaching in unsealed impoundments. This is not a preferred alternative.

7.1.5 DISPOSAL AT SEA

Impractical alternative that is practiced in other countries. Jamaica relies heavily on the bounty and beauty of its coastal resources. Even if piped into deep water, it is uncertain and risky and provides no guarantees that near shore resources will not ultimately be impacted. The potential for environmental and socio-economic damage is significant and this alternative should not be considered further.

7.1.6 REDUCE PRODUCTION

Implementation of this alternative would result in increased lifespan of existing residue disposal solutions since less red mud would be produced. However, the world market for alumina is at its highest levels ever and Jamalco and its partner the Government of Jamaica want to be able to capitalize on this reality. In times when sales are slow and prices are sluggish, both Jamalco and the Government have a responsibility to meet obligations, provide employment and service the communities of the area. It is therefore not unreasonable for them to want to capitalize on the current growth of the industry. While this alternative is reasonable it is not the preferred alternative.

7.1.7 SITE RDA 5 AS PROPOSED

This is the preferred alternative.

Construction of RDA 5 using the technologies, designs and construction protocols that have been tried and tested since 1972 to present appears to be the least disruptive, most environmentally friendly and cost effective means of establishing the volume of storage required for Jamalco's upgrade and expansion of operations. The inclusion of thickened tailings, dry stacking technology and the now familiar under drain system for leachate collection to the designs of RDA 5 will allow the facility to hold more residue in a more environmentally friendly manner and enhance the ability of the area to be rehabilitated in a shorter timeframe due to the compacted nature of the residue, high shear strength and load bearing capacity. Interim steps implemented for additional capacity in existing RDAs will provide just enough time for a project of the scope of RDA 5 to be constructed and keep the refinery operating at full potential throughout.

It is noteworthy that of all the alternatives stated above, sealed impoundment disposal of red mud residue using thickened tailings and dry stacking technology is the most appropriate and acceptable method to meet Jamalco's operating procedures and long term goals.

ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN

8 ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN

8.1 MONITORING PROGRAMME

In keeping with its Environmental Health and Safety policies as well as the legislation and regulations of the Government of Jamaica, Jamalco has an extensive Environmental Monitoring Programme which is carried out on all aspects of its operations.

In respect of Section 17 of the NRCA Act of 1991 the company is required to and submits the results of its Monitoring Programme to NEPA on a quarterly basis.

Among the parameters reported to NEPA are:

- raw materials used
- water quality
- effluent quality
- hazardous materials used
- water consumption
- fuel specifications
- materials and chemicals consumption. This category includes:
 - solvents
 - flocculants
 - oils and lubricants
 - acids
 - refrigerants

Jamalco also provides monthly monitoring and reporting to the Jamaica Bauxite Institute (JBI). In addition to the above named, ongoing monitoring activities, Jamalco will implement a monitoring programme during this brown site efficiency upgrade, which will cover the pre-construction, construction and operations phases of the efficiency upgrade at the mines, the refinery the port and the transportation corridors.

These will be based on the potential impacts identified in the impact identification and impact mitigation actions documented in those sections of this report.

The objective is to insure that all potential impacts and the appropriate mitigation actions are taken.

Monitoring will be done at regular intervals as follows:

1. The conditions of the sites and transportation corridors will again be inspected and recorded two weeks before construction start-up
2. At start-up of construction all activities will be monitored every two weeks for the first three months.
3. Monitoring will take every month from month four to month six.
4. Monitoring will take place quarterly until completion of construction i.e. from month seven to twenty four.
5. Monitoring will be on a monthly basis for three months during commissioning and start-up.

Monitoring reports will be prepared and submitted to NEPA for each monitoring interval for 1 to 5 above.

8.2 ENVIRONMENTAL MANAGEMENT

Jamalco is an ISO 14001 and ISO 9000 certified facility. Jamalco's ISO 14001 Certification was issued by Det Norske Veritas (DNV) in November of 2002 and remains valid until November 2005. The associated Environmental Management System (EMS) is accredited by ANSI RAB.

The EMS covers Jamalco's operations and includes activities associated with the railway transportation system, the bauxite alumina refinery, plant waste storage and disposal sites and the port at Rocky Point.

In keeping with the mandates of its ISO 9000 quality certification, Jamalco abides by their Quality Policy, which states:

Jamalco is committed to being "The Alumina Supplier of Choice"

- "Jamalco will relentlessly pursue continual improvement in everything we do to:
- Consistently provide product that meets customer and other applicable requirements for quality
- Enhance customer satisfaction by consistently meeting and exceeding their expectations
- Be cost effective and remains competitive in the global market
- Operate in a safe and environmentally responsible manner"
- Excellence Through Quality

Jamalco has a highly qualified technical, administrative and support staff within its Environmental Management Department, many trained to the tertiary level. All employees within the Department report to the Manager, Environmental, Health & Safety, a senior manager in the company who in turn reports directly to the Managing Director.

All aspects of Jamalco's operations have an environmental management, health and safety component. Environmental Standard Operating Procedures, guidelines and instruction have been developed by Jamalco to govern operations in all areas. As a result, all technical and support staff have a responsibility to insure that they operate in a safe and responsible manner regardless of the task being undertaken.

Many aspects of environmental management at the facilities are monitored through the use of checklists, periodic reporting and internal audits. These provide timely indications as to the effectiveness of the procedures and provide indications as to the need for changes where applicable. The monitoring and checks also inform process operations and controls.

8.2.1 TRAINING

Jamalco has a commitment to the improvement and advancement of all its employees. A major component of this commitment is the provision and facilitation of training for employees at all levels.

Specific to environmental management, Jamalco provides training in the following areas, which are designed to keep relevant employees and contractors informed and ensures competence in performing their duties. The training program achieves the following:

- Conformance with Jamalco's EH&S policy
- Identifies significant actual and potential impacts of their work
- Defines associated benefits of improved personal performance
- Identifies the roles and responsibilities in achieving conformance with the EMS
- Relays proper environmental operating procedures for managing environmental related aspects of their duties
- Reinforces Jamalco's policy that only properly trained and experienced individuals are allowed to work unsupervised

ENVIRONMENTAL WASTE AND OCCUPATIONAL HEALTH AND SAFETY

9 ENVIRONMENTAL WASTE AND OCCUPATIONAL HEALTH AND SAFETY

9.1 RISK ASSESSMENT AND HUMAN HEALTH RISK

Four main categories of risk have been identified, which must be avoided or minimized in the efficiency upgrade for all aspects of the project. These are:

1. Natural Hazards
2. Manmade Hazards
3. Accidents
4. Structural Failure

The associated risks are described below and actions suggested for avoidance, minimization, prevention and solution are illustrated in the table below:

TABLE 9-1: Risks and their Preventative Actions

| Category | Risk | Source | Prevention | Solution | |
|-----------------|--------------------------------|--|---|--|--------------------------------|
| Natural Hazards | Hurricane | Nature | None | Implement 72 hour shutdown procedure; coordinate with ODPEM | |
| | Earthquake | Nature | None | Plant and facilities designed to withstand earthquakes greater than 7.0 on the Richter Scale | |
| | Flood | Rainfall | | Proper design, construction and maintenance | |
| | Lightning | Nature | None | Lightning arrestors | |
| Manmade Hazards | Fire | Various (electrical, mechanical, accidental) | Proper maintenance and monitoring | Employ state of the art fire fighting systems to control and extinguish | |
| | Explosion | Various (explosive environment, human error) | Proper maintenance, instrumentation and fail-safe systems | Continual training, audits, testing and monitoring | |
| | Equipment Failure | Various | Proper maintenance, instrumentation and fail-safe systems | Continual training, inspection, audits, testing and monitoring | |
| Accidents | Electrocution | Electrical contact | Training, education | Lock-out, tag-out procedures | |
| | Contravening Safety Procedures | Ignorance, negligence | Training, supervision and audits | Educative discipline | |
| | Falls | Structures | Training, education, with updates | Provision and use of proper equipment | |
| | Suffocation | Confined/poorly ventilated Space | Training, following standard procedures | Adequate ventilation, buddy system, signage | |
| | Spills | Vessels, pipeline | Implementation of Jamalco's spill management procedures | Implementation of Jamalco's spill management procedures | |
| | Structural Failure | Dike Failure | RDAs | Proper design and engineering | Inspection, corrective actions |
| | | Impoundment Liner | RDAs | Proper design and engineering | Inspection, corrective actions |

9.2 OCCUPATIONAL HEALTH AND SAFETY

9.2.1 JAMALCO'S OH&S POLICY

Jamalco's OH&S policy is based on the worldwide policy used by Alcoa at all their operations and as such is often more stringent in many respects than local OH&S requirements. All activities must be conducted in a safe manner with proper regard for the health of all concerned. No worker will be required to work in any area and to do any activity without adequate provisions being made to ensure that the health and safety of that worker is not compromised.

Jamalco has an organized, documented set of Standard Operating Procedures which govern employees' actions as they perform tasks at the facility. These procedures provide definitions of unfamiliar terms, outlines required safety equipment necessary to undertake the activity, provides direction and instruction on proper handling and management of associated waste streams and record keeping guidelines. This approach to worker safety is universal within Alcoa and Jamalco.

9.2.2 DRAFT OCCUPATIONAL HEALTH AND SAFETY ACT 2003

The Occupational Health and Safety Act, 2003, which is in Draft form makes provision for a safe and healthy working environment for all working persons and to provide for matters incidental thereto or connected therewith.

The objects of the Act are as follows:

- a. the prevention of injury and illness resulting from conditions at the workplace.
- b. the protection of the safety and health of workers.
- c. the promotion of safe and healthy workplaces.

As a good corporate citizen, Jamalco is committed to conducting its mining operation in a manner that complies with the requirements of this Act.

Some specific elements of these requirements are as follows:

- A joint committee of worker and management personnel shall be established at every workplace where twenty or more workers are regularly employed.
- An employer shall place in a conspicuous place in the workplace, a list containing the names and work locations of the members of the joint committee.
- Where fewer than twenty workers are regularly employed, the employer shall cause a safety and health representative to be selected.
- An employer shall make or cause to be made and maintain an inventory of all hazardous chemicals and hazardous physical agents that are present in the workplace.
- The employee shall make available to the workers the inventory of hazardous materials and pertinent Material Safety Data Sheets.
- Any worker who is likely to be exposed to hazardous chemical or physical agents must be provided with appropriate training and instruction.
- A worker has the right to refuse work if he has reasonable grounds for believing that his safety or health is endangered.

9.2.3 SOLID AND HAZARDOUS WASTE MANAGEMENT

The management of hazardous waste resulting from any aspect of the Mining Enterprise will be done in accordance with the Mining Regulations, 1991 of the Government of Jamaica as well as the applicable standards for Jamalco and the standards for Alcoa Operations worldwide. These include handling, segregation, storage and disposal considerations. If there are potentially toxic substances in the overburden and mine waste, they will be handled in such a way as to minimize the impact on rehabilitation and the surrounding areas.

The mining of bauxite and the processing of bauxite ore into alumina generates a wide variety of waste streams that must be properly handled and managed. Jamalco has very well defined procedures for the management of all waste streams generated at all its facilities.

Since the proposal for upgrade of the facility is one of “Brownsite” upgrade and no new or unfamiliar activities are proposed, the same time tested, high quality approach to waste collection, handling and management will be utilized. The following is an overview of how waste is managed at Jamalco presently and how it will continue to be managed after the upgrade.

9.2.4 SOLID WASTE MANAGEMENT

Solid waste generated at Jamalco includes, among other items:

- Used filters
- Empty drums
- Aerosol cans
- Garbage
- Boiler ash
- Demolition waste
- Medical waste
- Absorbents
- Office refuse
- Lime reject
- Waste Rags
- Sand

For each waste stream identified, there exists complete listing of tasks necessary for the collection, handling and management of that waste. The procedures identify sources of that particular waste stream, accumulation or storage locations and provides instruction on proper labeling, proper storage and individual responsibilities. The procedures are specific for all locations (plant, port, mines) and are comprehensive in its approach.

9.2.4.1 HAZARDOUS WASTE MANAGEMENT

Jamalco has strict requirements for the handling of hazardous waste materials. All waste streams considered hazardous waste are identified and listed by department and activity. As with all other waste streams at the facility, very specific tasks, procedures and instructions are provided. Jamalco utilizes satellite accumulation of its hazardous waste streams which are established based on international guidelines. These include:

- Waste collection containers must be located at or near the point of generation
- Waste containers must be in the control of the generator
- The collection station will be well marked and identified as “Satellite Collection Station”.
- The station shall be located in a secure and protected area. All waste must be labelled.
- Containers must be compatible with the waste being stored
- Container lids and bungs must be closed at all times
- Weekly inspections
- Container management

Examples of hazardous waste at JAMALCO include:

- PCB Waste
- Lead waste
- Spent solvents
- Sand blast residue
- Mercury Contaminated

9.2.4.2 LANDFILL MANAGEMENT PROGRAM

Jamalco owns and operates a landfill facility located in the northeast section of the refinery. This landfill is subject to the National Environment and Planning Agency’s Landfill Permit and License System and is operated within the local regulations and internal standards.

Jamalco has a complete list of items acceptable for disposal at the landfill site including special wastes such as regulated asbestos containing materials (RACM) which are deposited into an area within the landfill site that has been specially designed and sealed to accept these types of waste.

Specific internal rules and regulations govern the operation of the facility. Instructions on what type of waste is acceptable, mode of transportation, packaging, landfill maintenance, etc. are all specified in associated documentation. The landfill undergoes monthly inspections and specific forms designed for that purpose are used throughout the inspection process.

PUBLIC INVOLVEMENT

10 PUBLIC INVOLVEMENT

10.1 INTRODUCTION

Jamalco has an established record of consultation and cooperation with the communities, settlements and residents who are stakeholders in the area. This process of ongoing contact through meetings and activities provides Jamalco with an opportunity to understand and work with the communities expectations of the community.

During communication with the community, Jamalco provides information to the residents on ongoing activities and initiatives and coordinates mutually accepted solutions to address areas of concern. Jamalco intends on continuing this level of communication and dialogue with the communities throughout the entire upgrade process primarily through the five (5) Community Council groups with which they meet on a regular basis. These groups are:

- Port Community Council
- Refinery Community Council
- Railroad Community Council
- Pleasant Valley Community Council
- Havana Heights Community council

These community groups comprise influential citizens, area leaders, community activists and individuals who have the best interest of the communities at heart.

10.2 COMMUNITY CONTRIBUTIONS

Over the years, Jamalco has played a major role as a good corporate citizen in the community. The company has been involved in the daily life and development of these communities in many ways, these include:

10.2.1 EDUCATION

- Established computer labs in six (6) High Schools, three (3) Primary Schools and Five (5) Basic Schools
- Cafeteria and bathroom expansion – Vere Technical High School
- Nutrition Programme – Daily supply of milk to 26 Basic Schools
- New bathrooms – Hayes
- Construction of a block of classrooms (Alcoa Block) including a Physics Lab
- Refurbished Vocational Department and upgraded electrical work in all classrooms – Lennon High School
- Back-to-school assistance for tertiary and high school students – annually
- Summer employment – students in tertiary institutions
- Support for the University of the West Indies – Labs, UWICED, distribute over 15,000 books annually for the past 14 years
- Skills training – sponsor students for HEART/NTA programmes and 4H clubs
- Developing skills training centre with HEART/NTA at Jamalco's Breadnut Valley facility

10.2.2 HEALTH

- Supply of medical supplies for clinics and hospitals – Islandwide
- Wellness programme – hypertension and diabetes checks – Mitchell Town, Hayes and Mocho
- Support – University Hospital Sickle Cell Unit, Kidney Unit, Cardiac Emergency Unit and Burn Unit

10.2.3 INFRASTRUCTURE UPGRADE

- Pave roads - Cornpiece
- Street lights improvements - Cornpiece
- Clean and construct new drains on a regular basis to alleviate flooding
- Constructed new Postal Agency – Mitchell Town
- Constructed new Post Office – Hayes
- Constructed Police Station – Hayes
- Expanded Health Center – Mitchell Town
- Constructed Community Center – Hayes
- Provided water supply system – Top Hill, Hayes

10.2.4 SPORTS

- Sponsor – Jamalco Community Netball Team
- Sponsor – Clarendon Netball League
- Sponsor – Various football teams

10.3 COMMUNITY CONSULTATION ON EFFICIENCY UPGRADE

Jamalco has consulted with members of the community on the proposed upgrade of the facility through their regular Community Council meetings and one specially arranged meeting. At the regular Community Council meetings, general information of the proposed upgrade was presented to the community representatives by Jamalco personnel. At the specially arranged meeting, the entire focus was on the upgrade project and details of the proposed upgrade were presented by the consultants conducting the EIA (Conrad Douglas & Associates Limited).

The meeting was attended by approximately 25 residents of surrounding communities. At this meeting, the details of the upgrade were presented by the consultant and any concerns or issues raised were noted and where possible, responses were provided.

Among the concerns raised were:

- Noise and vibration
- Atmospheric pollution
- Matters concerning transportation corridors
- Upgrade of community facilities
- Water Quality
- Employment

These concerns will be assessed for validation and engineering designs and management procedures, in keeping with Jamalco's ISO 14001 Certification will be used to address these concerns.

APPENDICES

11 APPENDICES

APPENDIX I: TERMS OF REFERENCE

ENVIRONMENTAL IMPACT ASSESSMENT
FOR
THE DISPOSAL OF BAYER PROCESS RESIDUE IN RDA #5
FOR JAMALCO

Conrad Douglas & Associates Limited (CD&A) has been contracted to conduct the Environmental Impact Assessment for the construction and operation of the proposed Residue Disposal Area #5 at JAMALCO, Clarendon.

Background

Jamalco is proposing to create a new Dry Bauxite Residue Disposal Area (DRDA #5) of approximate plan area 100 hectares, to the north of existing Residue Disposal Area (RDA) #4 and to the west of RDA #2. The project will continue to provide an environmentally friendly sound disposal method for bauxite residue.

The new DRDA will provide additional storage volume and surface area to accept bauxite residue from the Jamalco Refinery. Using Thickened Tailings Disposal with Dry Residue Stacking, this facility will provide capacity for storage of 8.0 million cubic metres of residue over six (6) years at current/projected production rates of 1.27/1.32 Mt/ya.

The new RDA will be created by constructing a base layer incorporating seal and under-drainage over an area already partly excavated towards the probable DRDA #5 base level, during the 2002/2003 Jamalco RDA #3 & #4 Expansion Project.

The scope of the DRDA #5 Project will include, but is not limited to:

- Excavation of 80-100Ha base to design profile;
- Installation of geosynthetic liner on top of clay liner to base and embankments.
- Installation of under drainage system with probable 800-1000mm sand layer;
- Construction of perimeter drains and run-off pond;

- Installation of mud distribution piping;
- Installation of lake water return system;
- Installation of dust suppression sprinkler system;
- Provision for storage of rainfall run-off.

DRAFT TERMS OF REFERENCE**ENVIRONMENTAL IMPACT ASSESSMENT****FOR****THE DISPOSAL OF BAYER PROCESS RESIDUE IN RDA #5****FOR JAMALCO**

Conrad Douglas & Associates Limited will conduct an Environmental Impact Assessment, which will detail the pre-construction, construction and operational aspects of the proposed Residue Disposal Area, in accordance with the requirements, standards and regulations of the National Environment and Planning Agency (NEPA) and Jamalco's Environmental, Health and Safety Policy and Procedures.

In the EIA, **CD&A** will:

1. Provide a comprehensive description of the existing site proposed for the development of the facility to store bauxite residue – detailing the elements of the project, highlighting areas to be reserved for construction and the areas which are to be preserved in their existing state and thoroughly reviewing the bauxite residue to be stored at the proposed site and the chemical processes (direct and incidental) involved. Detailed design calculations and drawings for the facility, including base and embankments will be presented. Seismic vulnerability assessment will be conducted and outlined.
2. Identify the major environmental issues of concern through the presentation of baseline data, which should include social and cultural considerations. An assessment of the public perception of the proposed development will also be done, utilizing information gathered from consultations with the local community. A Public Meeting will be conducted in support of the EIA Report.
3. Outline the Legislations and Regulations relevant to the project.
4. Predict the likely impacts of the proposed development on the described environment, including, direct, indirect and cumulative impacts – indicating their relative importance to the design of the development's facilities.

5. Identify mitigation action to be taken to minimize adverse impacts and quantify associated costs where applicable.
6. Design a monitoring plan, which should ensure that the mitigation plan is adhered to.
7. Describe the alternatives to the project that could be considered at the site.

CD&A will also provide full and detailed accounts in the following areas, prior to construction, during construction and the operational phases of the project:

1. Description of the Project:

- Description of the area proposed to store bauxite residue in detail.
- Description of detailed element of the project – highlighting areas to be reserved for construction as well as areas to be preserved in their existing state and, activities and features which will introduce risks or generate impact (negative and positive) on the environment.
- Detailed design calculations and drawings for the facility, including base and embankments.
- Seismic vulnerability assessment.
- Use of maps, site plans and other graphic aids as appropriate.
- Information on location, general layout and size of the project area.
- Description of pre-construction, construction and post construction plans.

2. Description of the Environment

Presentation of baseline data, which is to be used to describe the study area in respect of the following:

- i. Physical environment inclusive of geology, hydrology (include impact of the modification of the topography on the hydrology of the area of the influence of the project).
 - a. Determination of storm water run-off, drainage patterns and effect of the project on ground water.
 - b. Slope stability issues.
 - c. Water quality issues, leachate management.
 - d. Climatic conditions and air quality in the area in the area of influence, including particulate emissions from stationary and mobile sources, NO_x, SO_x, wind speed and direction, precipitation, relative humidity and ambient temperatures.
 - e. Noise levels at the undeveloped site and ambient noise in the area of influence.
 - f. Obvious sources of pollution existing and the extent of contamination, including identification of any additional services that may arise from this project.
- ii. Biological environment
 - a. Description of any flora or fauna in the sphere of influence of the proposed project with special emphasis on rare, endemic or endangered species.
 - b. Species dependence, niche specificity, community structure, population dynamics, carrying capacity, species richness and evenness (measure of diversity).
- iii. Socio-economic and cultural constraints
 - a. Present and projected population
 - b. Present and projected land use

- c. Planned development activities
- d. Community structure
- e. Employment
- f. Distribution of income, goods and services
- g. Recreation
- h. Public health and safety
- i. Cultural peculiarities
- j. Aspirations and attitudes
- k. Historical importance of the area
- l. Public perception.

3. Policy, Legislations and Regulations:

- An outline of all pertinent policies, regulations and standards in keeping with the nature of the project will be provided. The examination of the legislation should include at a minimum, legislation such as the NRCA Act, legislation from the Solid Waste Management Authority (SWMA), Mining Act and as appropriate, international conventions, protocols, treaties, etc.

4. Determination of Potential Impacts:

- An identification of any major environmental issues of concern, and an indication of their relative importance to the design of the project with the intended activities.
- Determination of potential impacts related, but not limited to, the following:
 - a) Change in the drainage pattern and storm water management;
 - b) Flooding potential;
 - c) Landscape impacts of excavation and construction;
 - d) Loss of any natural features by construction activities;
 - e) Pollution of surface and ground water;
 - f) Solid waste disposal;

- g) Air pollution;
 - h) Socio-economic and cultural impacts;
 - i) Risk assessment/Natural Hazard Vulnerability;
 - j) Noise;
 - k) Change in soil pH;
 - l) Waste disposal via recycling;
 - m) Accidental discharges into water bodies;
 - n) Impact of leachate;
 - o) Distinguish between positive and negative impacts.
 - p) Avoidable as well as irreversible impacts.
- Cumulative impacts.

5. Mitigation

- Preparation of guidelines for avoiding, as far as possible or eliminating, any adverse impacts due to proposed activity at the site while utilizing existing environmental attributes for optimum development. Where possible, quantification and the assignment of financial and economic values to impacts and mitigating methods will be done.

6. Monitoring

- Suggestion of a plan to monitor implementation of mitigation or compensatory measures and project impacts during construction and operation.
- Preparation of an Environmental Management Plan for the long-term operations of the site.

An outline of the monitoring program will be included in the EIA report and a detailed version will be submitted to NEPA after the granting of the permit and prior to the

commencement of the proposed development. The monitoring program will include the following, at a minimum:

- Introduction outlining the need for a monitoring program and the relevant specific provisions of the permit license granted;
- The activity being monitored and the parameters chosen to effectively carry out the exercise.
- The methodology to be employed and the frequency of monitoring.
- The sites being monitored, stating any outer boundary where no impact from the development is expected if stated by NEPA or other local agencies;
- A summary of data collected. Tables and graphs are to be used where appropriate;
- Discussion of results with respect to the development in progress, highlighting any parameter(s), which exceed(s) the standard(s).
- Frequency of reporting to NEPA.
- Recommendations;
- Appendices of data and photographs.

7. Project Alternatives

- Examination of alternatives to the project including the no-action alternative. (Project alternatives should incorporate the use history of the overall area in which the site is located and previous use of the site itself.)

CD&A will present all findings in the Environmental Impact Assessment, reflecting the headings in the body of the approved Terms of Reference, as well as other references.

Eight hard copies and one electronic copy of the report will be submitted to NEPA. It will include an appendix with items such as maps, site plans, the study team, photographs and other relevant information.

APPENDIX II: SURVEY INSTRUMENT

Socio-Economic Survey for JAMALCO’s Mining and Transport Operations in South Manchester

Community Name _____ Community Code

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

SECTION 1 PERSONAL CHARACTERISTICS

- 1) Gender
 - 1. Male
 - 2. Female

- 2) Age Range
 - 1. Under 20
 - 2. 20 – 39
 - 3. 40 – 49
 - 4. 50 – 59
 - 5. 60 – over
 - 6. Not Stated/No Response

- 3) How many years have you been living in the community?
 - 1. 0 – 5 Years
 - 2. 6 – 10 Years
 - 3. 11 – 20 Years
 - 4. more than 20 Years
 - 5. Not Stated/No Response

- 4) How is the traffic on the roads in your community?
 - 1. Too much traffic
 - 2. Not bad/ ok traffic
 - 3. More in the morning/ afternoon/ night
 - 4. Other _____

SECTION 2 OPINIONS ON THE COMMUNITY

- 5) What do you like most about the community? (**ASK & WAIT FOR RESPONSE**)
 - 1. Friendly people
 - 2. Clean environment:
 - 3. Availability of farmland
 - 4. Quiet
 - 5. No crime & violence
 - 6. Other, (specify) _____
 - 7. Not Stated/No Response

- 6. What don't you like about the community? **ASK & WAIT FOR RESPONSE**
 - 1. Poor roads
 - 2. Lack of Utilities
 - 3. Crime & violence
 - 4. Unemployment
 - 5. Dirty environment
 - 6. Other, (specify)_____
 - 7. Not Stated/No Response

SECTION 3

AWARENESS & OPINIONS ON EXISTING BAUXITE FACILITIES

- 7. Are you aware that there are bauxite lands in your community?
 - 1. Yes
 - 2. No

- 8. Are you aware that there is bauxite mining operations in your area?
 - 1. Yes
 - 2. No (Go to Q 11)
 - 3. Not Stated/No Response

- 9. What are your experiences with mining in your area?
 - 1. Negative
 - 2. Positive
 - 3. No impact

- 10. a) If negative, what? **(ASK AND WAIT)**
 - 1. Odour
 - 2. Traffic
 - 3. Dust, soot or gaseous emissions
 - 4. Noise
 - 5. Damage to your property
 - 6. Water quality
 - 7. Not stated/ No response
 - 8. Other _____

- b) How do you think this could be addressed? _____

- _____

- _____

11. Do you lease or use any bauxite lands?
1. Yes
 2. No
12. If this land is needed for bauxite mining, what will you do?
- _____
- _____
- _____
13. How do you think the bauxite should be transported from the mines to the processing plant? (**ASK AND WAIT FOR RESPONSE**)
1. Truck
 2. Conveyor
 3. Train
 4. Other _____
14. Would you say that bauxite mining operations have had negative impacts on the people in this community?
1. Yes
 2. No (Go to Q 16)
 3. Not Stated/No Response
15. If **YES, ASK** - WHY WOULD YOU SAY THAT?
1. The area has widespread corrosion
 2. The area smells like caustic soda more often than not
 3. You get sick more often
 4. Plants are harder to grow
 5. Too much noise
 6. Other (specify)
 7. Not Stated/No Response
16. Would you say that bauxite mining operations have had a positive impact on this community?
1. Yes
 2. No
17. What positive impacts do you think bauxite mining operations have had on the community?
1. Improved community relations
 2. Job opportunities
 3. Educational and social benefits
 4. Amenities – roads, lights, water supply
 5. Environmental conditions
 6. None of the above
 7. Other (specify)_____

8. Not Stated/No Response

SECTION 4

KNOWLEDGE AND VIEWS ON UPGRADE PLANS

18. Are you aware that JAMALCO proposes to expand their bauxite mining operations in or near your area?

1. Yes
2. No
3. Not Stated/No Response

19. What effect do you think the proposed expansion of JAMALCO's bauxite mining operations in or near your area will have on the following: (**Answer in terms of positive, negative, no change, don't know. ASK AND WAIT**)

i) Income/ Economic value of the community

1. Positive
2. Negative
3. No Change
4. Don't Know
5. Not Stated/No Response

ii) Job Opportunities

1. Positive
2. Negative
3. No Change
4. Don't Know
5. Not Stated/No Response

iii) Pollution

1. Positive
2. Negative
3. No Change
4. Don't Know
5. Not Stated/No Response

20. Do you think the proposed upgrade will affect you personally?

1. Yes
2. No
3. Don't Know/Not Sure
4. Not Stated/No Response

SECTION 5

AVAILABILITY OF WATER

21. What is your main source of drinking water?

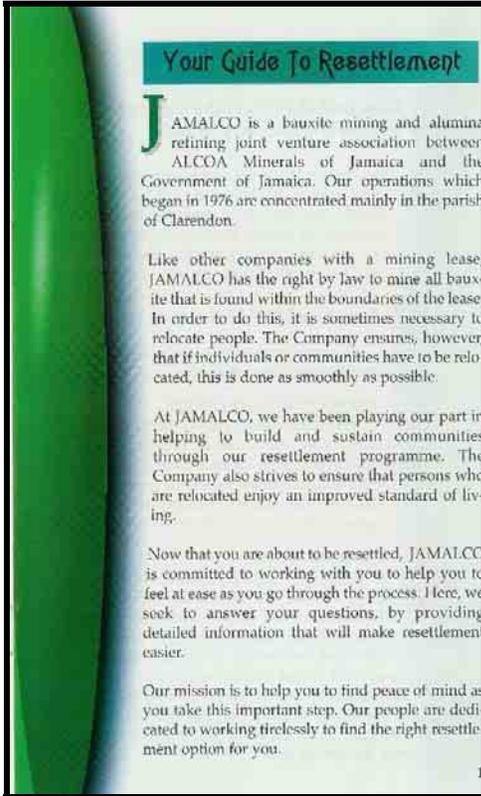
1. Indoor tap/pipe
 2. Outdoor private tap/pipe
 3. Public standpipe
 4. Spring, pond, river
 5. Rainwater (tank or drum)
 6. Trucked water (NWC)
 7. Other (specify)
 8. Not Stated/No Response
22. "In this community, I think that we have access to safe water to drink" Do you agree?
1. Yes
 2. No
 3. Don't Know/Not Sure
 4. Not Stated/No Response
23. Why do you think so?
1. bauxite mining affects the drinking water
 2. Sources (not bauxite mining or alumina processing related) affect the drinking water quality
 3. The water is tested frequently by the N.W.C.
 4. The water looks and/or smells clean
 5. Other, please specify
 6. Not Stated/No Response
24. Have you or any member of your household ever worked for a bauxite company or in the bauxite industry?
1. Yes
 2. No
 3. Don't Know/Unsure
 4. Not Stated/No Response
25. Are you aware of any programs or activities initiated by bauxite companies in your community?
1. Yes
 2. No
 3. Don't Know/Unsure
 4. Not Stated/No Response

Name of interviewer:

Signature of interviewer:

Date of interview:

APPENDIX III: 'JAMALCO AND YOU' Q & A BOOKLET



THE COMPANY'S POLICY

Q Does JAMALCO have the right to mine bauxite wherever it is found?

A Yes. The law of Jamaica says wherever bauxite is found, mining should be done. JAMALCO therefore has the right to acquire all the land that is needed for mining, building haulroads to the ore deposits, relocating public roads within the area and resettling land owners.

Q How does JAMALCO acquire land?

A The Company can acquire land using any combination of four methods.

DIRECT PURCHASE OPTION

I. This creates an opportunity for the land owner to be paid in cash for his/her property, existing buildings, structures and crops. An independent valuator values the property and this forms the basis for negotiations. The agreed price is then paid to the vendor.

LAND EXCHANGE

II. In this method, land is offered in exchange for the land that will be acquired by JAMALCO. The amount of land given in exchange, is determined by the amount and quality of land that the vendor had. For example, one (1) acre of arable land in the mining area is given for one (1) acre of arable land in the resettlement area OR half an acre of arable land in the resettlement area can be exchanged for one (1) acre of non-arable or rocky land in the mining area.

RESETTLEMENT

III. This method is used where the land owner is resettled in another community or developed subdivision.

SURFACE LEASE OR NON-TRANSFER OF TITLE

IV. This method is used where JAMALCO does not purchase the property but is given access to the land for the purpose of mining the bauxite found there. In this method, JAMALCO mines and restores the property to the level where it is certified by the Ministry of Mining. The land owner is compensated for loss of use of his property and crops during the period that JAMALCO had possession of the property.

Q What is the Company's approach to resettlement?

A JAMALCO has a mining lease that gives the Company the right to mine all bauxite that is found within the boundaries of the lease. Some of this land is owned by government, while a large portion of the land on which bauxite is found is often privately owned. Whenever we decide to mine in an area, we must purchase the property that is privately owned. Many discussions are then held between Company representatives and the residents of the community. JAMALCO works with the Jamaica Bauxite

Institute (JBI) and the Ministry of Mining to value the properties of land owners. We also make sure that the community is involved in the change process.

Q If my property is surrounded by bauxite and JAMALCO wants to buy it but I do not want to sell, is there any action that the Government or the Company can take?

A Under the law, if you own land that is required for mining and you refuse to sell, Government has the right to value the property, acquire the land, and lodge the money with the court. Fourteen (14) days notice is then given to you, after which the Company moves on to the property. However, this method of operation is a last resort for JAMALCO. We prefer to meet and to negotiate with you concerning purchasing the land and arriving at a settlement that benefits both you and the Company.

Q Where does JAMALCO get the land on which people are resettled?

A JAMALCO acquires large pieces of land for resettling land owners. We then sub-divide these pieces of land and put in the necessary

infrastructure such as water, electricity and roads.

HELPING YOU TO MAKE THE MOVE

Q If I occupy leased land and JAMALCO targets this land for mining, do I have to continue to pay the lease?

A Yes. If the land is leased property, you must continue to pay the lease until you have been served notice terminating the lease.

Q If I am to be relocated, do I have a choice about where I will be resettled?

A JAMALCO tries to give everyone a choice when they are about to be resettled. We identify land that will allow people to return to as normal a life as possible. You can choose, however, to sell your property to the Company, take the money and purchase land wherever you wish. The Company will then re-build your house on the property of your choice.

Q Can entire districts be removed?

A Sometimes it becomes necessary to re-locate whole districts. JAMALCO informs residents in good time so that proper arrangements can be

made for their resettlement. We also ensure that all social facilities (e.g. schools and churches) are replaced.

Q If twelve families, for example, live in a small community, will all the members be relocated to the same area?

A Yes, but only if they wish for this to be done. Family members, however, generally have the option to go wherever they choose as long as the land selected is of equal value and the new area is not targeted by the Company for mining.

SOLVING THE TITLE PROBLEM

Q What happens if I want to sell but I do not have a title for the land that JAMALCO wants to buy?

A JAMALCO will assist you to use whatever documents you may have providing that you are the owner of the land to get a registered title for the land.

Q If I do not have a title, what other papers can I use to show proof of ownership and help to secure the title?

A Some of the documents you may use to prove ownership, include tax receipts, land receipts, deeds of gift and wills to assist you to get a title.

Q What happens if there are various family members living on the land who have a claim but no title?

A If family members can prove their claim, JAMALCO will assist them to use whatever documents are available to get a registered title for the land. This is done with the help of our lawyers and the Titles Office but each case will be handled separately.

Q Who pays the lawyer?

A While it is the land owner's responsibility to have a registered title, JAMALCO, as a public service, will assist in paying the lawyer where there are cases of need.

Q When I am resettled, will I get a title for the land?

A Yes. As a land owner, when you are re-located, JAMALCO works with the Titles Office to provide a registered title for the new piece of land on which you are resettled.

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| <p>Q What if I live in a community where some persons are being resettled but I am not because my land is not required for mining?</p> <p>A JAMALCO acquires only those lands that are required for mining. If your land is not required and you will not be affected by the mining activities you will not be resettled.</p> <p>Q If I have to be resettled, what will happen to the graves of my loved ones?</p> <p>A When graves are found on land that the Company acquires, they are removed and re-located to a cemetery in the presence of loved ones and under the supervision of the Ministry of Health. The laws of Jamaica are discouraging the burial of the dead on private property, however, and people are being asked to bury their dead in cemeteries. At JAMALCO, we make it our policy to show respect for the dead.</p> <p style="text-align: center;">GIVING YOU THE HOME ADVANTAGE</p> <p>Q What happens if I had a house on land that was bought by the Company?</p> <p>A JAMALCO will build a house for you on the land on which you are to be resettled.</p> | <p>Q What type of building will JAMALCO put on the new land?</p> <p>A JAMALCO generally replaces the old building with a new structure. We build all new structures of concrete with at least one indoor bathroom and a kitchen.</p> <p>Q If I lived in a board house, what type of new structure will the Company build for me?</p> <p>A JAMALCO will build a concrete structure of similar size with enclosed kitchen and bathroom for you, after the Company's land agent measures your existing house to get the total value.</p> <p>Q What if my house is built on leased land, how will I be compensated?</p> <p>A Your house will be valued and you will be compensated according to its value.</p> <p>Q What if my house is unfinished, how will I be compensated?</p> <p>A At JAMALCO, our objective is to give each house owner a finished building. We will value the existing structure and apply this value to the structure that you eventually receive. If you</p> |
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| <p>also own the land, you may choose to put a part of the value of the land towards completing your new house.</p> <p>Q If I have both a large house and a small house on the same property, can both be combined?</p> <p>A Yes. The houses will be measured and the square footage of each determined. If you wish, both will then be combined to make one house.</p> <p>Q Can the square footage of an outbuilding be transferred to my house?</p> <p>A No. However, the value of the building can be used to increase the square footage of your new house.</p> <p>Q What if I am a shopkeeper and I am to be resettled, what will happen to my shop?</p> <p>A The Company will replace your shop in the area of your choice.</p> <p>Q Will I be compensated for other structures such as fowl coops and pig pens?</p> <p>A Yes. These will be valued by the Company's</p> | <p>land agents and you will be paid for the structures.</p> <p>Q What will happen to those persons who own livestock?</p> <p>A JAMALCO will make every effort to relocate people to areas where they can continue to raise their livestock.</p> <p>Q If I had crops on the land, will I be compensated for them?</p> <p>A Yes. Our land agent counts each tree, assesses the economic value of the crops and compensates you accordingly. The assessment is done using rates established by the Jamaica Bauxite Institute and the Ministry of Agriculture. In the case of cash crops, you will be allowed up to six months to reap your crops.</p> <p>Q What if I have established tree crops such as ackee, or citrus? How will I be compensated?</p> <p>A If these crops are found on land bought by JAMALCO, they will be valued and you will be compensated for the amount that you would have earned from the crops. The Company will also provide similar tree crops for</p> |
|---|--|

the land on which you are to be resettled and assist you to care for them for approximately three years until they are fully established.

Q **If I owned a water tank, will it be replaced by the Company?**

A Yes. Depending on the site chosen for your resettlement, JAMALCO will re-build a tank of equal capacity.

AFTER MINING, WHAT NEXT?

Q **After the Company completes its mining activities in an area, what happens to the land in that area?**

A After JAMALCO completes its mining operations in an area, the land is re-filled, reshaped and restored and people may return to occupy the land.

Q **Can former residents return to live on mined out land that has been reclaimed?**

A Yes, but certain conditions apply. Once land is sold, it becomes the property of the Company. People who previously lived on the land, however, can make special arrangements with the Company to purchase the land for resettlement.

If you have other questions, or require further information, please do not hesitate to call or write to us. At JAMALCO, we provide quality service to improve the quality of life for all.

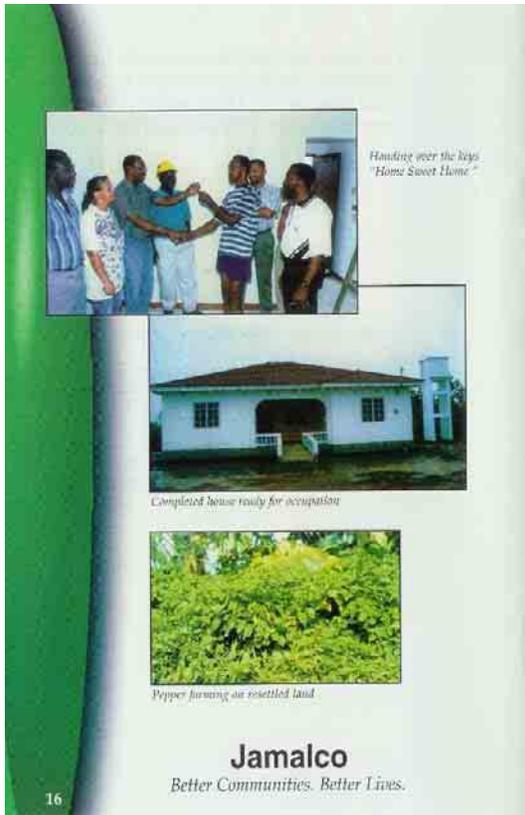


We welcome your questions and comments at:

| | |
|------------------------------|-----------------------|
| JAMALCO | Tel: (876) 986-2561-4 |
| Clarendon Alumina Works | (876) 986-2028 |
| Halse Hall, Clarendon | (876) 986-2573 |
| or | |
| JAMALCO Lands Department | Tel: (876) 902-3233 |
| Woodside, May Pen, Clarendon | Fax: (876) 902-3234 |

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Handing over the keys.
"Home Sweet Home."

Completed house ready for occupation

Pepper farming on resettled land

Jamalco
Better Communities. Better Lives.

16

APPENDIX IV: REFORESTATION PLAN IN JAMAICA – MEMORANDUM OF UNDERSTANDING BETWEEN MINISTRY OF AGRICULTURE- FORESTRY DEPARTMENT AND ALCOA.

CLARENDON, JAMAICA -- Alcoa and Jamaica's Forestry Department have signed an agreement to work together to rehabilitate reclaimed mined-out lands through reforestation on the island. The five-year accord includes developing a public education program, planting of suitable trees, and a research program aimed at enhancing the development and reforestation of the lands

JAMALCO and the Forestry Department in the Ministry of Agriculture (GOJ) have signed a memorandum of Understanding (MOU), to establish a framework for collaboration for the successful rehabilitation of reclaimed mined-out lands through reforestation of these areas.

This five year accord, signed recently by Jerome Maxwell, JAMALCO'S Managing Director and Marilyn Headley, Conservator of Forests, at the Halse Hall Great House in Clarendon, will see the Forestry Department and JAMALCO partnering to effect this restoration of adequate plant cover.

Guided by the 'no-net-loss' policy, the two organizations will work to compensate for the loss of forest cover due to mining operations. This move will see the establishment of new forests on selected reclaimed bauxite mined out areas as well as the protection and preservation of existing forests.

Under the MOU, the Forestry Department will utilize its skills for the establishment and management of forests, along with a forest research program aimed at enhancing the development and reforestation of the lands.

According to Miss Headley, this is in keeping with the Forestry Department's mandate outlined in the Forest Act of 1996 and which includes privately owned properties such as the JAMALCO lands.

At the signing, Mr. Maxwell, described the MOU as “timely and reflective of JAMALCO’s environment protection policies and Alcoa’s worldwide ‘One Million Trees’ project.”

Specific areas of cooperation agreed on in the MOU include the development of a public education program for farmers and students to improve understanding of the contribution of forests to local and national well-being and economic development. Provisions have also been made for other areas of collaboration to be explored.

The agreement also specifically mandates the planting of suitable ornamental and lumber tree species such as cedar, ficus, acacia, wild tamarind, blue mahoe, mahogany, bitter wood, bitter damson, and spanish elm along with fruit trees such as mango, orange, avocado, breadfruit and ackee.

Appendix IV – Forest Reserves of Jamaica

Forest Reserves of Jamaica

- conservation of naturally existing forests
- as a source of forest products
- for the conservation of soil and water resources
- to provide parks and other recreational facilities for public use
- as a habitat for the protection and conservation of endemic flora and fauna
- the forest reserve areas shown in the Gazette are estimates, based on descriptive, not surveyed, boundaries

A programme of surveying forest reserve boundaries is underway and survey data are being digitised which will produce more accurate maps. In the years since the Forestry Department was established in 1937, the government has set aside a significant portion of its land for forest

reserves. They now amount to over 111,000 hectares or over 10 percent of the country’s total area. These protected areas provide us with a be cared for so that their benefits

can be enjoyed by future generations. The 1996 Forest Act provides for the creation and protection of forest reserves for the following purposes:

Most of the country's forest reserves are located in areas of rugged terrain such as the John Crow Mountains, Blue Mountains and Cockpit Country as well as the dry, hilly uplands in the south, west and north-west portions of the country. Despite their remoteness, serious encroachment has taken place. The 1998 analysis of forest cover and land use in Jamaica, carried out by the Forestry Department, shows that more than 20 percent of land within forest reserves has been impacted by human activity such as conversion to agricultural and/or residential use, mostly without Forestry Department permission.

Under the Forest Act, the Minister may declare to be forest reserves any Crown land, or private land if the owner requests such a declaration.

Further, the Minister may order or declare any land not in a forest reserve to be a forest management area, including private land if he is satisfied that the use of the land should be controlled for the protection of the national interest. Crown lands may be declared a protected area if required for a number of purposes specified in the Forest Act, including flood and landslide .Further, the Minister may order or declare any land not in a forest reserve to be a forest management area, including private land if he is satisfied that the use of the land should be controlled for the protection of the national interest.

Crown lands may be declared a protected area if required for a number of purposes specified in the Forest Act, including flood and landslide protection, soil preservation, erosion, maintenance of water supply and protection of amenities, flora and fauna. On protected areas cultivation, grazing, burning and clearing of vegetation is prohibited or strictly regulated.

The forest reserve areas listed in the following table are garnered from The Jamaican Gazette. The records show that the area of forest reserves and Crown lands managed by the Forestry Department is 109,514 hectares, of which 98,962 hectares are forest reserves and 10,552 hectares are Crown lands. These figures from the Gazette show a variation from those compiled by the Forestry Department in its recent assessment of forest cover and land use. The reasons for the difference are:

· the forest reserve areas compiled by the Forestry Department during its assessment were digitised from 1:250 000 maps and not from actual surveyed forest reserve boundaries.

Parish Remarks

Forest Reserves of Jamaica by Parish

Forest Reserve/

Crown Land Name

Area (ha) Reference in the

Manchester Denham Farm 20.00 27-09-1956 486 Part of Devon Land Settlement

Gourie 141.65 Crown

Hudson's Bottom 226.63 Crown

John Anderson 121.40 Crown

New Forest 160.78 01-12-1950 432 Part of New Forest Land Settlement

Oxford 133.55 Crown

Ramble 48.18 01-12-1950 435

St. Jago A 163.90 09-10-1969 654 Plan A, Vol 1030 Fol 433

St. Jago B 66.00 09-10-1969 654 Plan B, Vol 1030 Fol 433

Virginia 13.03 01-12-1950 434 Part of Virginia Land Settlement

Total Manchester 472 623

Clarendon Bull Head 220.06 01-12-1950 417

Kellets-Camperdown 1497.79 01-12-1950 417

Kellits Stream A 8.30 01-12-1950 425 Block A (Miller's Spring)

Kellits Stream B 1.62 01-12-1950 425 Block B (Mosquito River)

Peace River 116.70 25-06-1959 423

Peak Bay A 302.72 01-12-1950 433 Block A

Peak Bay B 152.57 01-12-1950 433 Block B

Peak Bay C 60.70 01-12-1950 433 Block C

Peckham 70.89 01-12-1950 426 Prev. 06-09-1945 (part of Peckham Land Sett.)

Pennants A 169.19 01-12-1950 437 Block A (part of Pennants Land Sett.)

Pennants B 59.40 01-12-1950 438 Block B (part of Pennants Land Sett.)

Pennants (Douces) A 26.42 01-12-1950 438 Block A (part of Pennants Land Sett.)

Pennants (Douces) B 3.07 01-12-1950 438 Block B (part of Pennants Land Sett.)

Pennants (Douces) C 2.55 01-12-1950 438 Block C (part of Pennants Land Sett.)

Portland Ridge 5612.30 Crown Vol 403 Fol 40

Teak Pen A 532.99 01-12-1950 439 Block A (part of Teak Pen Land Sett.)

Teak Pen B 149.74 01-12-1950 440 Block B (part of Teak Pen Land Sett.)

Total Clarendon 3375 5612

St. Catherine Dawson Mountain 1 55.04 Crown Lot 101, Mount Dawson Land Settlement

Dawson Mountain 2 75.86 Crown Lot 104, Mount Dawson Land Settlement

Harkers Hall 6.82 01-12-1950 425 Prev. 06-09-1945 (Harkers Hall Land Sett.)

Healthshire Hills 4856.40 01-12-1950 422

Treadways 26.39 01-12-1950 422 Part of Treadways Land Settlement

Troja 18.86 21-07-1955 362 Lot 41, Troja Land Settlement

Twickenham Park 2.06 Crown

Little Goat Island 6.00 30-06-1960 278 2.4 km south of the mainland

Great Goat Island 188.00 30-06-1960 278 2.0 km south of the mainland

Total St. Catherine 5102 133

APPENDIX V: TEAM MEMBERS

Project Team

- Dr. Conrad Douglas
- Mr. Paul Thompson
- Dr. Art Reid
- Prof. Edward Robinson
- Ms. Winsome Young
- Orville Grey
- Mr. Burklyn Rhoden
- Mr. Noel Watson
- Geomatrix Ltd.
- Ms. Dahlia Bean
- Deonne Caines
- Mr. Vance Johnson

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