ENVIRONMENTAL IMPACTS

4 ENVIRONMENTAL IMPACTS

4.1 POTENTIAL IMPACTS & PROPOSED MITIGATIVE STEPS

TABLE 4-1: IMPACT AND MITIGATION TABLES

Action		Potential Impact	Mitigative Steps
Sedimentation	Mining	Minor Negative	Channel run-off to storm water ponds for sedimentation
	Construction Activities (Loading Station, road and railroad)		Channel run-off to storm water ponds for sedimentation and regular road maintenance
	Rehabilitation	Major Positive	Rehabilitation will be done to off-set any potential sedimentation problems through the use of contouring and revegetation.
Conclusion: With proper systems and monitoring in place this potential impact can be kept at a minor negative should it occur.			
Leaching	Mining	Minor Negative	Minimize exposed stockpiles; construct Storm Water Run-off Collection Pond. Collected pond water will be used for dust suppression.
	Rehabilitation	Major Positive	Rehabilitation will be done to off-set any potential leaching.
Conclusion: Bauxite is a chemically stable soil of neutral pH. Therefore will be no exposure of any mineral substance which will be dissolved by rain to critically change the soil pH			

Action		Potential Impact	Mitigative Steps
Fugitive Emissions	Mining	Minor Negative	Fast cleaning up of spilled bauxite, limiting stockpile time at mine site and sprinkling with water if necessary. This is not an expensive mitigation that is already practiced
	Transportation of ore, spillage on roadways, unattended stockpiles, blending activities	Minor Negative	Properly maintain and irrigate haul roads, cover trucks on public roads, limit time stockpiles are unattended, establish weather stations. Standard procedures at Jamalco that are included in the designs and costing for the project
	Construction Activities	Minor Negative	Properly plan and coordinate activities, use contractors who are aware and respect Jamalco's principles and standards, monitor activities closely Monitoring of contractors is ongoing and incurs no new costs
	Rehabilitation	Major Positive	Rehabilitation activities including recontouring of mined out areas and revegetation will significantly reduce, if not eliminate the potential for emissions. Haul roads (where practical) may be converted to parochial roads or will be rehabilitated also.
Conclusion: With proper systems and monitoring in place this potential impact can be kept as a minor negative. It is practically impossible to eliminate this impact and Jamalco will conduct periodic monitoring of the ambient air quality throughout the mining area and surrounding communities for particulate matter.			

Action		Potential Impact	Mitigative Steps
Noise & Vibration	Mining	Minor Negative	Mining activities will be primarily away from major residential areas and settlements. Where blasting will be required, proper procedures for clearance, warning, etc will be followed. Monitoring of noise levels will be done from time to time to verify maintenance of standards.
	Transportation by Truck, Conveyor and Rail	Minor Negative	Implement and enforce truck speeds to minimize potential for noise and vibration. Train and monitor truck drivers in maintaining speed limits, use of compression, horns, etc. Utilise dedicated haul roads as much as possible. The RopeCon system will not contribute to major noise formation as it rolls on Teflon rollers for minimal noise impact. The RopeCon system is budgeted for in the upgrade project and the other items are standard procedures for Jamalco and will not incur much cost to implement.
	Loading Station Operations	Minor Negative	Remote location of load station will offer buffer from communities and settlements. Monitoring of closest communities will be conducted. Equipment will be designed and sourced to limit the impacts of noise and vibration.
Conclusion: It is practically impossible to eliminate impacts related to noise and vibration from occurring. However, based on implementation of procedures, protocols, proper planning, design of equipment, training and monitoring of employees and their activities, this impact can be maintained easily as a minor negative.			

Action		Potential Impact	Mitigative Steps
Loss of Biodiversity	Mining and Load Station Siting	Major Negative	Jamalco has a MOU with the Forestry Department to develop revegetation and habitat creation through technologies involving creative conservation. Jamalco is committed to maintaining the guidelines from the Bauxite Mine Rehabilitation Standards & Guidelines (1994). While cost has not yet been fully determined, the expansion budget of Jamalco has made accommodation for implementation of this MOU.
	Rehabilitation	Major Positive	Through the MOU with Forestry and the rehabilitation principles of Jamalco, mined areas will be rehabilitated and where possible work will be done to revive the same or similar biodiversity as existed prior to mining Jamalco will establish nurseries, etc and this is also considered in the budget for the project.

Conclusion:

The loss of biodiversity is an unavoidable negative impact of mining activities. Systems must be put in place to assess, identify and preserve any rare, endemic or otherwise valuable species that may be found in the mine areas. While it is agreed that bauxite soils do not support high levels of diversity in vegetation because of its infertility, care must be taken to complete the necessary assessments and to identify and preserve all valuable features of the lands biodiversity.

Jamalco has significant experience in rehabilitation and revitalization of mined out areas and has developed and continues to conduct research and development work on its science & technology.

Action		Potential Impact	Mitigative Steps
Subsistence Farming	Mining	Major Negative	Farmers who leased lands from Jamalco or the Government will be relocated to other available lands and assistance will be provided by Jamalco in re-establishing their plots. The replacement situation will be the same or better than before.
	Rehabilitation	Major Positive	In many cases, affected lands will be returned to a condition where it can be used for various types of farming activities. Animal husbandry and tree crops may be two of the more suitable options.
Conclusion: The displacement of farmers is an unavoidable impact. Jamalco has always worked with the people of the communities in which they operate to ensure that any negative impact caused by the operation has a suitable remedy or solution. This situation will be no different.			
Loss of natural features such as habitats, niches and species	Site Clearance and Preparation	Major Negative	Bauxite is found in the open fields between the hillocks. Areas to be cleared will therefore be kept to the open fields. All precautionary measures will be put in place to ensure habitats on hillocks are not affected.
	Mining Operations	Major Negative	During mining operations all steps will be put in place to ensure heavy machinery and workers do not damage the hillocks and the habitats therein. This may include at a minimum red tagging at foot of hillocks.
	Rehabilitation	Major Positive	Jamalco has signed a Memorandum of Understanding with the Forestry Department to develop a land cover revegetation and habitat creation plan through technologies involving preservation and creative conservation. Jamalco is committed to maintaining the guidelines from the Bauxite Mine Rehabilitation Standards & Guidelines.

Action	Potential Impact	Mitigative Steps
Conclusion: The loss of biodiversity is an unavoidable negative impact of site clearance and mining activities. Systems have been put in place to assess, identify and preserve any rare, endemic or otherwise valuable species that may be found in the mine areas. While it is agreed that bauxite soils do not support high levels of diversity in vegetation because of its infertility, care has been taken to complete the necessary assessments and to identify and preserve all valuable features of the lands biodiversity. The biological diversity of the hillocks will be maintained at all cost, as these areas hold the major floral and faunal species of the region, as well as providing niche communities for the various species known to inhabit the area. Jamalco has significant experience in rehabilitation and revitalization of mined out areas and has developed and continues to conduct research and development work on its science & technology.		
Water Supply	Mining	Minor Negative	While a few areas have piped water, water from catchment such as tanks and drums are the primary sources. To protect these water sources from dust, Jamalco is aware that it must exercise due care in its haul road maintenance program to limit the amount of dust that gets entrained and may end up in the drinking water of residents.
	Potable Consumption	Major Positive	Jamalco is always willing to work with the relevant Authorities to seek out solutions to benefit the communities in which they work.
Conclusion: While mining activities may have a potential minor negative impact (dust) on water supply in catchment, Jamalco is committed to the vigilant and aggressive monitoring and management of its mining operations and haul roads to minimize fugitive dust formation. Mobile sprinklers and proper stockpile management should go a long way in containing this impact.		

Action		Potential Impact	Mitigative Steps
Waste Management	Mining	Minor Negative	Waste materials will be sorted and managed in keeping with Jamalco standards. Certain vegetative matter and mining rejects will be used as backfill. Vehicle maintenance waste from mining equipment will be managed in keeping with Jamalco standards and procedures and will be taken to the refinery for inclusion in the waste streams there.
	Loading Station	Minor Negative	Defined waste collection areas with proper labelling and instructions will be located at the mining offices. Jamalco will utilize its existing waste collection protocols and will continue to manage and dispose of all grades of waste in keeping with its current standards and procedures. Proper training and direction will be provided to all employees in waste handling and management at the site. Sensitive waste streams (used oil, batteries, etc.) will be taken to the refinery for proper management.

Conclusion:

Generation of solid waste is unavoidable. The quality of the systems, standards, procedures and training in place is the determining factor in how well the management programme works. Jamalco has a solid reputation for proper handling and management of all varieties of waste materials at all its operations in Jamaica. This project will be managed no differently.

Action		Potential Impact	Mitigative Steps
Sewage	Mining	No Impact	Sewage generated at the mines will be managed through the use of portable chemical toilets or the construction of temporary facilities. These will be managed using Jamalco's time tested approaches and within the regulations. Licensed sewage handling contractors will be hired to properly dispose of waste generated. Minimal Cost and recognised aspect of the mining operation
	Loading Station	No Impact	A tertiary level sewage treatment system will be designed and constructed at the loading station. The proven SRC BST system is proposed. Details are provided in the body of the report. Cost – approx. JA$ 4M – 6M
Conclusion: Sewage handling, treatment and disposal resulting from Jamalco's operations will not present any negative impacts to the environment or communities within the project area.			
Labour	Mining	Major Positive	Increased employment will be welcomed in the communities. Satellite business opportunities will benefit. No mitigation required.
	Loading Station	Major Positive	Increased employment opportunities and support for satellite businesses.
Conclusion: The proposed hiring of approximately 200 temporary employees during construction activities and approximately 50 permanent employees for mining and load station positions represents a major positive impact to these communities. Additional employment in areas of transportation (consideration is being given to the utilization of smaller over-the-road trucks rather than large 100 tonne trucks sub-contracted from the surrounding areas) to move bauxite from mines to load station among other informal job and opportunity creation will be important to the communities in the area.			

Action		Potential Impact	Mitigative Steps
Aesthetics	Mining	Major Negative	Aesthetics in the mining areas will be affected significantly. Mitigation involves minimize the clearance of areas only to what is absolutely necessary. Jamalco's track record and commitment to a proper rehabilitation and revitalization program along with their MOU with the Forestry Department demonstrates their commitment.
	Bauxite Transportation	Minor Negative	The proposed RopeCon conveyor will be visible and may detract from the natural look of the area. However, 70% of the structure is reusable and will be removed from the landscape upon completion of mining activities.
	Rehabilitation	Major Positive	Through the MOU with Forestry, Jamalco will work to rehabilitate the mined areas with a view to restore them to a similar look as existed prior to mining.
Conclusion: All impacts related to aesthetics are unavoidable, but reversible. Jamalco's commitment to rehabilitation and revitalization will ensure that the mined out areas are returned to a visual and physical usefulness in keeping with local and their own guidelines.			
Archaeological & Historical Heritage	Mining	No Impact	All known and identified archaeological or historical heritage resources will be avoided or preserved. Any unknown resources or artefacts unearth will be managed as directed by the Jamaica National Heritage Trust (JNHT) approved guidelines for managing archaeological and historical heritage items discovered during such activities, It includes specific methods of operation including necessary contacts and procedures to follow. Jamalco will notify the JNHT immediately of any such occurrence.
Conclusion: A lot of work has gone into the identification of heritage resources in the mining areas. Jamalco is committed to the preservation of all such items and will work with the JNHT to this end.			

Action		Potential Impact	Mitigative Steps
Residential Relocation	Mining	Minor Negative/ Minor Positive	Dislocation can result in a negative as well as a positive impact. Housing solutions provided by Jamalco have been consistently of high quality, cost and standard and will remain so. In most cases relocated individuals are placed in similar or better living conditions than before. Illegal squatters will be managed through legal means.
	Transportion upgrade (RopeCon)	Minor Negative/ Minor Positive	Dislocation can result in a negative as well as a positive impact. Housing solutions provided by Jamalco have been consistently of high quality, cost and standard and will remain so. In most cases relocated individuals are placed in similar or better living conditions than before. Illegal squatters will be managed through legal means.
	Rehabilitation	Major Positive	Upon completion of rehabilitation activities, many of the rehabilitated lands will be suitable for residential developments and will be a benefit to the development of the communities.
Conclusion: Circumstances will occur that require relocation of residents of the various communities impacted through mining and railroad upgrade. The best possible situation is for dialogue and implementation of Jamalco's proven relocation programme. This may be an unavoidable impact in some cases, however, suitable mitigation is readily available. Depending on the individual situation, this impact could be positive or negative.			
Utility Relocation	Mining	Minor Negative	Displaced utilities will be replaced in a timely manner, with service that is the same or better than before. This includes potential electricity, water and road impacts. All efforts will be made to minimize disruption to the communities. Where possible the replacement will be put in place before the existing is impacted.
	Transportation Upgrade (RopeCon)	Minor Negative	Displaced utilities will be replaced in a timely manner, with service that is the same or better than before. This includes potential electricity, water and road impacts. All efforts will be made to minimize disruption to the communities. Where possible the replacement will be put in place before the existing is impacted.

Action		Potential Impact	Mitigative Steps
Conclusion: In many cases this is an unavoidable impact. Where service can be maintained or restored with the least amount of discomfort it shall be done. If managed well, this impact may not be realized as a negative.			
Natural and Stormwater Drainage	Mining	Major Negative	Natural drainage regimes will be impacted during mining. This is unavoidable and through Jamalco's mine rehabilitation programme the mined out areas will be restored to a usefulness incorporating both natural and stormwater drainage.
	Transportation Upgrade (RopeCon)	Minor Negative	Very slight potential for a negative impact since minimal soil movement or excavation is anticipated. Where it occurs, it will be an unavoidable impact. However, care will be taken to ensure that new drainage regimes are designed into the work and that the solutions are suitable for the areas of interest.
	Loading Station Construction	Major Negative	Many areas of natural drainage will be modified to construct the station. This is unavoidable. The comprehensive plans and designs will take drainage into consideration as it is important to the stability of the areas and to the protection of surrounding communities.
	Rehabilitation	Major Positive	Rehabilitation plans will incorporate designs for natural drainage and stormwater management.
Conclusion: While It will be impossible to eliminate impacts related to drainage, Jamalco possesses the technology and know-how to properly design and construct alternative drainage solutions that will serve to eliminate potential problems. In some cases, flood prone areas can be alleviated through this process.			

Action		Potential Impact	Mitigative Steps
Transportation and Travel Disruption	Mining	Minor Negative	Mining areas are usually away from public roadways and where necessary bypass roads are always constructed to service the surrounding communities. Mines will be serviced by dedicated haul roads.
	Transportation Upgrade (RopeCon)	Major Positive	The implementation of the RopeCon system will keep the equivalent of 48 dump trucks (25 tonnes capacity) per hour off the roadway throughout the communities and with that the associated stresses on environment, communities and infrastructure.
Conclusion: Minimal transportation disruption will occur with this project, however, all systems are in place from the early planning stages to limit this disruption. Constructing bypass roads, constructing solutions fully before making changes, implementing RopeCon and limiting the number of trucks on the roads will go a long way towards limiting transportation and travel disruptions.			
Socio-Economic Benefits	Permanent Employees	Major Positive	Jamalco will employ approximately 50 permanent employees at the Mt. Oliphant Loading Station and mining operations. Many will come from the surrounding communities. A positive impact, no mitigation required.
	Truckers	Major Positive	Private truckers will be hired for hauling bauxite from the mines. Many operators will be from local communities. No mitigation required.
	Temporary Workforce	Major Positive	Jamalco will hire approximately 200 temporary employees during preparation and construction activities to provide various services. Many employees will be sourced from local communities for these positions. Positive impact, no mitigation required.
Conclusion: There are positive impacts associated with the project which need to be mentioned. In many ways, the implementation of this project is a win-win situation.			

SOCIO-ECONOMIC ANALYSIS OF PROJECT IMPACTS

5 SOCIO-ECONOMIC ANALYSIS OF PROJECT IMPACTS

5.1 OBJECTIVE

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 impact of the operations as well as to what they perceived as solutions to existing problems.

5.2 SURVEY POPULATION

The Enumeration Districts (EDs) to be surveyed were chosen based on their locations relative to those areas in South Manchester, which were identified by Jamalco as areas of Bauxite extraction and disturbed Broadleaf Forest or which were identified as locations for proposed loading or transportation facilities. A map showing the population density of the SM 130 is shown in **Error! Reference source not found.**. The ED's surveyed are illustrated in Figure 5-2, Figure 5-3, and Figure 5-4.

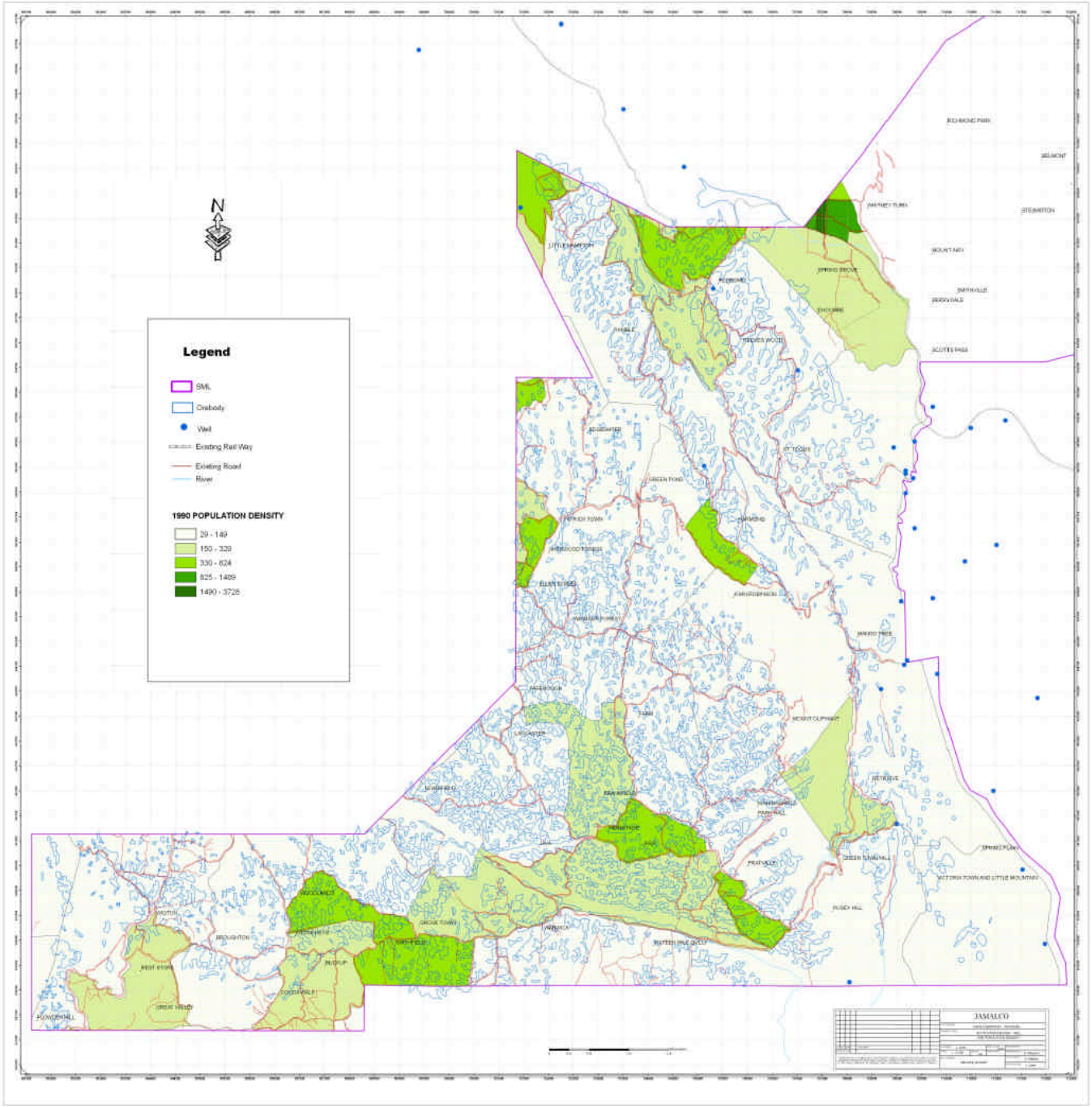

FIGURE 5-1: POPULATION DENSITY OF SML 130

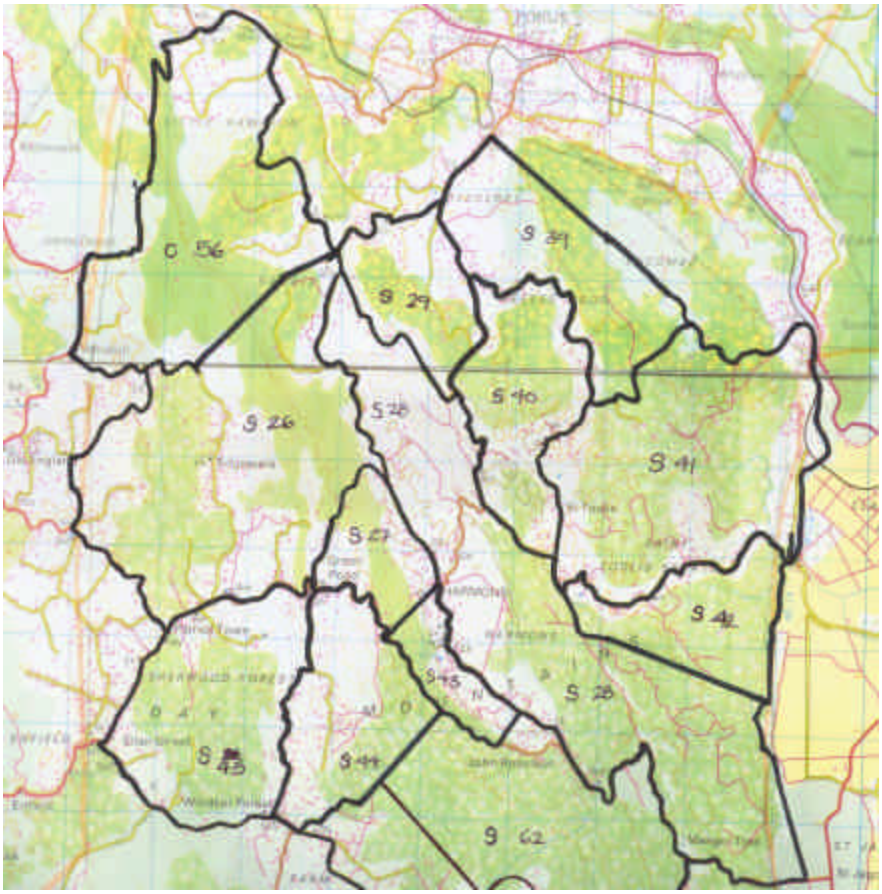

FIGURE 5-2: ENUMERATION DISTRICTS SURVEYED WITHIN EDS S28-S62

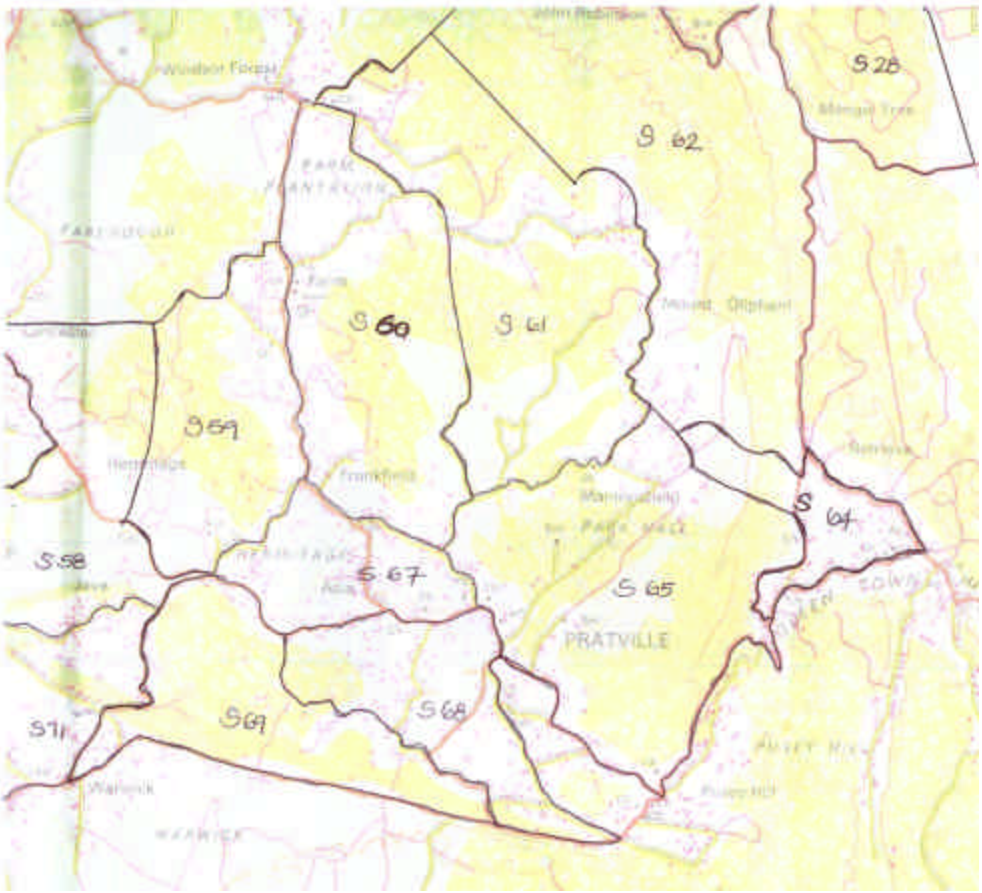

FIGURE 5-3: ENUMERATION DISTRICTS SURVEYED WITHIN EDS S28-S71

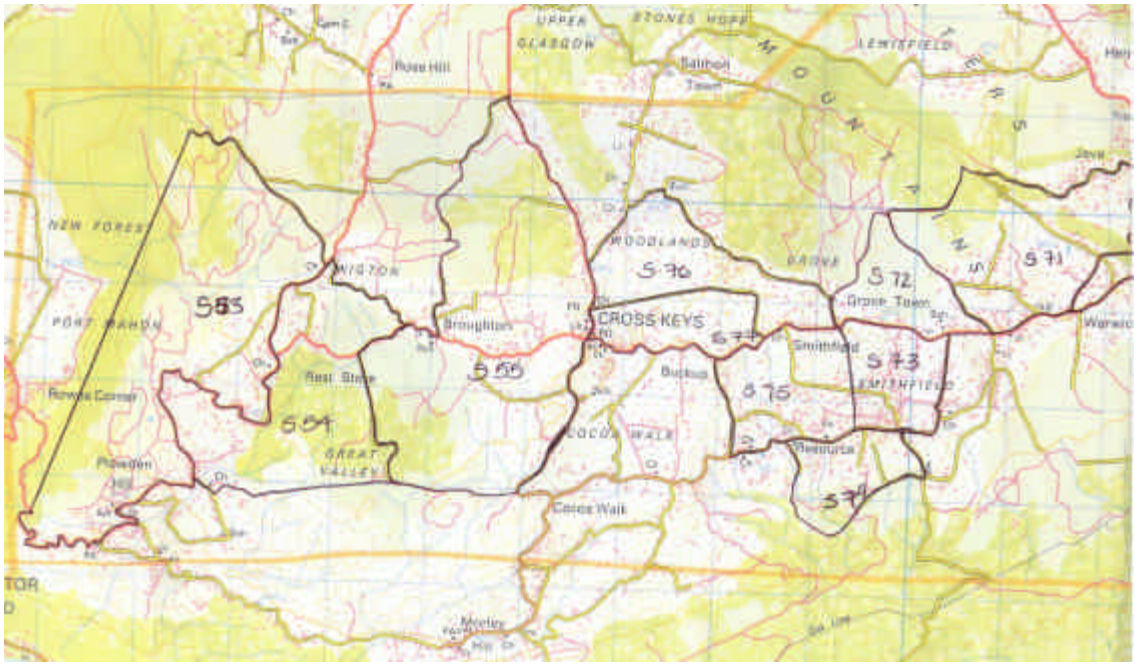

FIGURE 5-4: ENUMERATION DISTRICTS SURVEYED WITHIN EDS S53-S76

To determine how many survey instruments to issue, 4.5% of the Total number of Housing Units (THU) in each ED was calculated. To ensure that the final figure would be representative, it was ensured that no two respondents to the surveys were from the same household.

The table below shows the EDs surveyed and their corresponding THUs.

TABLE 5-1: TOTAL HOUSING DEVELOPMENTS IN THE ENUMERATION DISTRICTS SURVEYED

ED CODE	THU	SURVEY POPULATION (4.5% THU)
S26	171	8
S27	97	4
S28	182	8
S40	86	4
S41	136	6
S44	94	4
S45	92	4
S46	64	3
S53	156	7
S54	151	7
S55	152	7
C56	77	3
S57	82	4
S58	134	6
S59	157	7
S60	160	7
S61	93	4
S62	114	5
S64	96	4
S65	138	6
S67	151	7
S69	110	5
S71	166	7
S72	62	3
S73	112	5
S74	60	3
S75	163	7
S76	111	5
S77	55	2
Total	3422	152

5.3 SURVEY ANALYSIS

5.3.1 DEMOGRAPHIC

142 questionnaires were issued. There were 77 male respondents and 65 female respondents. The following diagram shows the distribution in the respondents' ages.

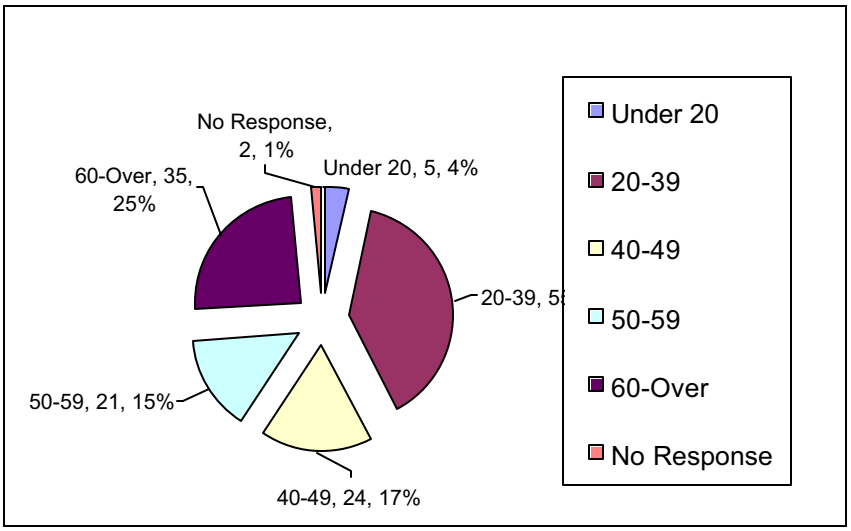

FIGURE 5-5: AGE DISTRIBUTION OF SURVEY RESPONDENTS

The majority of respondents have been living in the community for over 20 years and it is assumed that their views as resented are credible. The table below shows the distribution.

TABLE 5-2: NUMBER OF YEARS OF RESIDENCE IN THE RESPONDENTS' RESPECTIVE COMMUNITIES

Number of years residing in the community	%
0-5	6
6-10	8
11-20	18
20+	56
No response	12
Total	100

5.3.2 COMMUNITY OPINION

The table below shows the aspects of the community nominated by the respondents as their personal likes and dislikes.

TABLE 5-3: RESPONDENTS PERSONAL OPINIONS OF THEIR COMMUNITIES

Community likes	%	Community dislikes	%
Friendly people	26	Poor roads	25
Clean environment	5	Lack of utilities	14
Availability of farmland	9	Crime/violence	2
Quiet	31	Unemployment	36
No crime/violence	18	Dirty environment	2
Other	4	Other	11
Not stated	7	Not stated	10
Total	100	Total	100

5.3.3 AWARENESS AND OPINION ON EXISTING BAUXITE FACILITIES AND OPERATIONS

89% of respondents to this section were aware that bauxite lands existed in or around their communities and 72% knew of bauxite mining operations. However, 33% of respondents were not aware that there were bauxite mining operations in their area.

55 persons were able to say that they had experienced either negative or positive impacts from mining operations. Of that number, 62% had experienced negative effect, and 38% positive. The negative impacts identified are shown in the figure below.

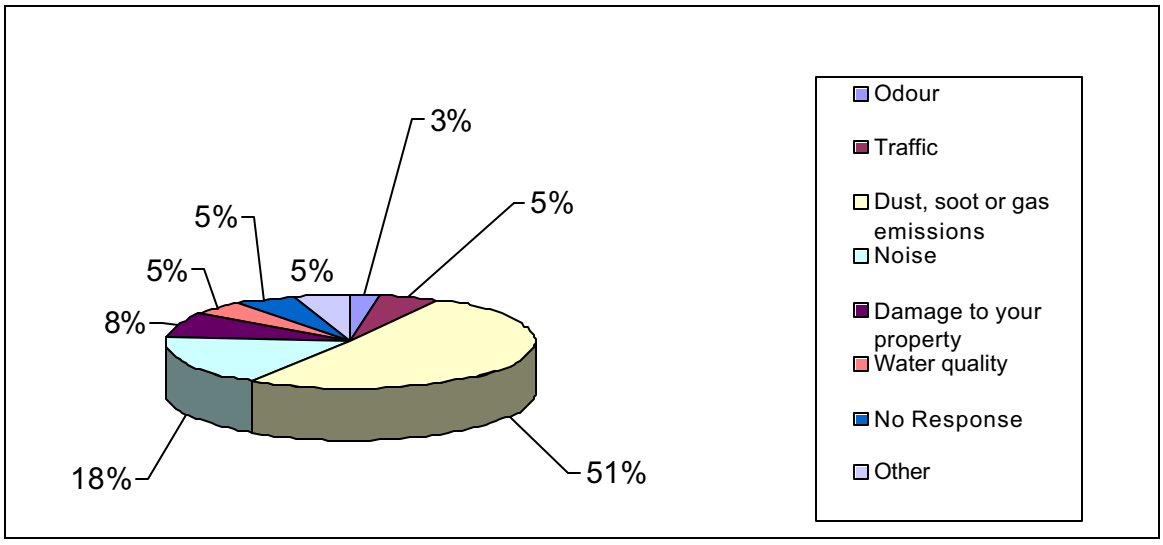

FIGURE 5-6: NEGATIVE IMPACTS EXPERIENCED FROM EXISTING BAUXITE MINING AND PROCESSING OPERATIONS

30 people gave their opinions as to what they thought should be done to improve the impacts. Their suggestions are shown below:

TABLE 5-4: RESPONDENTS SUGGESTIONS ON HOW TO DEAL WITH NEGATIVE IMPACTS OF BAUXITE MINING AND PROCESSING OPERATIONS

Addressing the negative mining experiences	#	%
Discussions	6	20
Stop mining	5	17
Don't know	5	17
Cover tanks, provide paint	3	10
Eliminate loud horns, other truck noises	3	10
Provide alternative farming lands	2	8
Relocate	1	3
Eliminate community segregation	1	3
Can do nothing	1	3
Cannot explain	1	3
Fill up holes after mining	1	3
Legal action	1	3
Total	30	100

53 respondents lease or use bauxite lands. When asked what they would do if the lands became necessary for mining, 36 persons responded as follows:

TABLE 5-5: REACTIONS OF RESPONDENTS IF THEIR LANDS BECOME NECESSARY FOR MINING

Reaction	#
Don't know what to do	17
Relocate	15
Would not move	4
Total	36

Only 4 of the 36 respondent said that they would not be willing to move for the sake of mining.

On the matter of bauxite transport between mines and the plant, 46% agree that trucks should be used. 27% did not have a suggestion. The other opinions are below:

TABLE 5-6: SUGGESTED METHODS FOR TRANSPORT OF MATERIALS BETWEEN THE MINES AND THE PLANT

Conveyance of bauxite	%
Truck	46
Conveyor	15
Train	12
Other	27
Total	100

The opinions regarding transport of the bauxite ore can be borne in mind, along with the community opinions on traffic, since trucking will impact traffic. The opinions on traffic are shown in the table below.

TABLE 5-7: RESPONDENTS' OPINIONS OF THE TRAFFIC CONDITIONS IN THEIR COMMUNITIES

Opinion	%
Too much traffic	10
Not bad/ok	82
More at various times	7
Other	1
Total	100

The residents also had concerns regarding the negative impacts of mining operations on their respective communities. This is illustrated below.

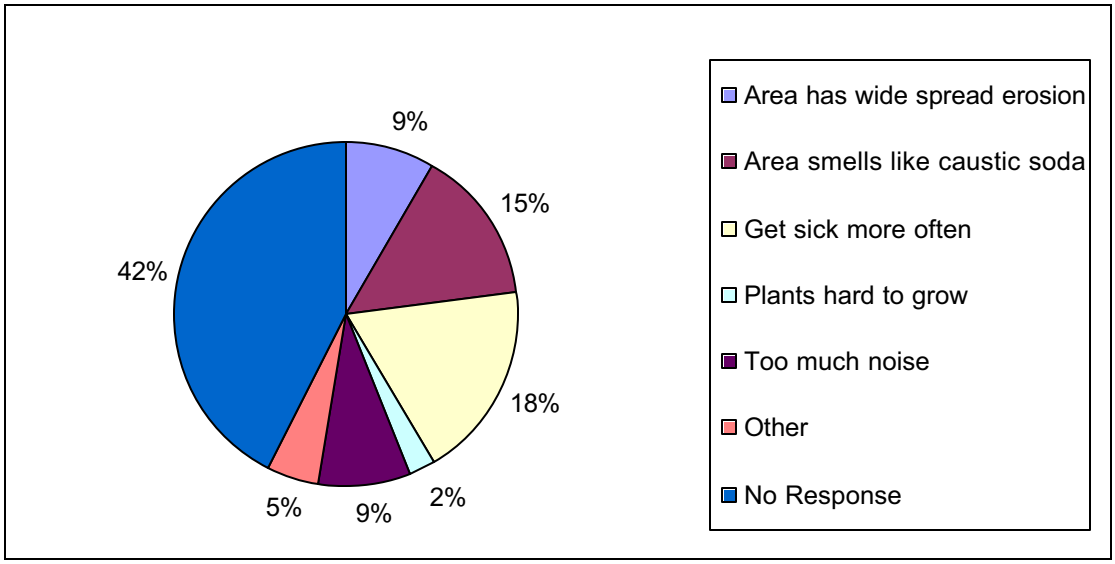

FIGURE 5-7: NEGATIVE IMPACTS OF BAUXITE MINING AND PROCESSING OPERATIONS ON THE COMMUNITIES

Positive impacts were also experienced.

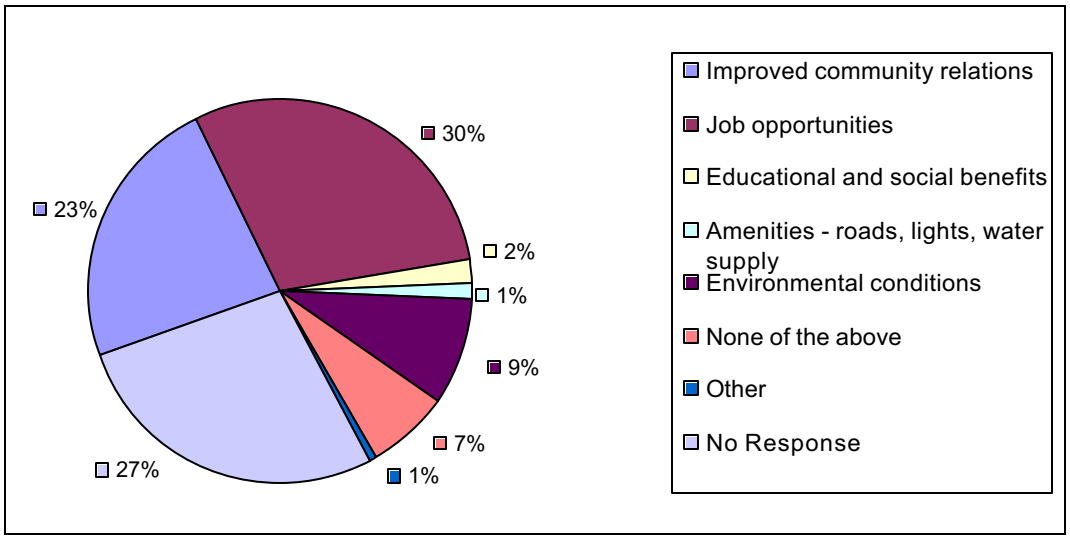

FIGURE 5-8: POSITIVE IMPACTS OF BAUXITE MINING AND TRANSPORT OPERATIONS ON THE COMMUNITIES

5.3.4 AWARENESS OF THE EXPANSION PLANS BY JAMALCO

The following tables show the percentages of respondents who were aware that JAMALCO planned to expand its activities. It also gives their views on how they believe it will impact the economic, employment and pollution levels of their communities.

TABLE 5-8: NUMBER OF RESPONDENTS AWARE OF JAMALCO'S PLANNED EXPANSION OF OPERATIONS

Awareness of JAMALCO expansion	#
YES	66
NO	20
Not stated	2
Total	88

TABLE 5-9: RESPONDENTS VIEWS ON THE POTENTIAL IMPACTS OF JAMALCO'S PLANNED EXPANSION ON THEIR COMMUNITIES

	Percentage of Respondents		
Impact	**Income/economic Value of Community**	**Job Opportunities**	**Pollution**
Positive	42	66	28
Negative	18	17	43
Don't know	5	5	10
Not stated	35	12	19
Total	100	100	100

Respondents were also asked about the anticipated personal impact of the expansion of operations. 26% said it would not impact them personally, while 54% said it would. The remaining 20% either did not know, or gave no answer.

5.3.5 AVAILABILITY OF WATER

The pie chart below shows the sources of drinking water for those surveyed.

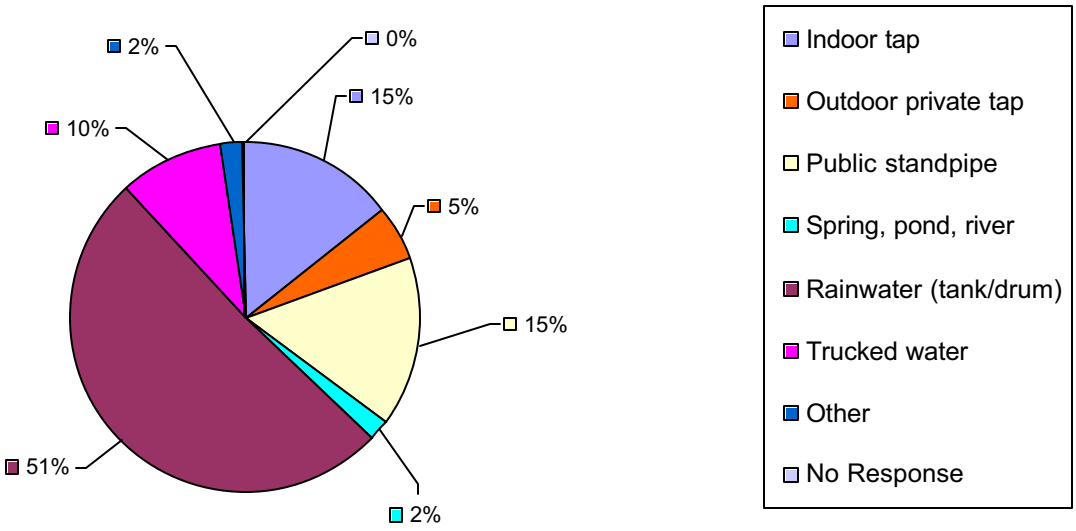

FIGURE 5-9: RESPONDENTS' MAIN SOURCES OF DRINKING WATER

Water quality is usually a major concern for residents close to bauxite processing facilities. It was therefore, very important to get the residents' opinions of the water quality in their areas. The majority of respondents thought that their water was safe, while 12% either did not know, or did not answer. The table below shows the responses.

Do you think you have access to safe drinking water in your community?	#	%
YES	79	56
NO	46	32
Don't know	7	5
Not stated	10	7
Total	142	100

The reasons for their various responses are shown below:

TABLE 5-10: REASONS BEHIND RESPONDENTS' OPINIONS OF THE WATER QUALITY IN THEIR AREAS

Reason	%
Water looks and/or smells clean	28
Water tested frequently by NWC	26
Bauxite mining or processing operations affects drinking water	16
Not stated	15
Other	9
Sources (not related to bauxite mining or alumina processing) affect water quality	6
Total	100

5.3.6 INTERACTIONS WITH BAUXITE COMPANIES

Most of the residents surveyed in South Manchester (56%) say that they are not aware of community programmes or activities in their communities, initiated by the bauxite companies. 29% were aware, while 15% were either not sure or did not answer.

Comparable figures were obtained regarding employment by a bauxite company. Only 32% of the respondents either worked in the industry or had family members who worked in the industry. 62% were not associated with any bauxite companies.

The survey that was administered is included in the report as Appendix IV

IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

6 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

6.1 ANALYSIS OF ALTERNATIVES

6.1.1 MINING ALTERNATIVES

6.1.2 NO ACTION ALTERNATIVE

With the "No Action" Alternative, the situation would be grave for Jamalco and the economy of local communities the operations service and ultimately, that of Jamaica. Based on the available reserves and quality of bauxite available to Jamalco at this time, the plant cannot operate much beyond early 2006 without having to cease operations. The plans for expansion of Jamalco's operations would have to be put on hold.

The additional bauxite from South Manchester is needed to ensure that the Jamalco refinery can meet its upgraded capacities and for blending with bauxite being mined in North Manchester. If nothing is done the limited resources left in South Manchester will quickly be depleted and the operation will have to source bauxite elsewhere, or shutdown.

Jamaica would miss the opportunity for the major expansion investment of over US$1.25B (the single largest investment in its history) of which US$300M would go towards purchasing Jamaican goods and services and additional income to the country of US$77M per year, the loss of approximately 200 permanent jobs (from mining activities alone) and approximately 2,500 temporary jobs during construction.

6.1.2.1 MINE BAUXITE FROM AREAS OTHER THAN AREAS PROPOSED

Possibility, however it may be impractical at this time since mining areas are determined by location of bauxite deposits suitable for processing in the plant and leases/licenses that require lengthy processing and negotiation periods. Additionally, much of the lands identified in the South Manchester SML are owned by Jamalco or Government and are zoned and reserved just for the purpose of bauxite mining.

6.1.2.2 MINE BAUXITE IN THE SOUTH MANCHESTER SML AS PROPOSED

This is the preferred alternative.

Jamalco already has a license to mine bauxite in this area and much of the land is either owned by Jamalco or government owned and has been set aside for the purpose of bauxite mining. Additionally, the ore is of a quality that is complementary of that existing in North Manchester which Jamalco hopes to mine in the near future. It has been found that when blended, the two ore types make a better feed stock for the refinery and results in improved efficiency and product quality. Implementation of this alternative will also provide the planners of the expansion of the plant the level of comfort that comes from knowing that suitable quantities and quality of ore will be available for the expanded operations.

Many of the communities within the SML are centralized with a low ratio of homes located in prime bauxite deposits. Notwithstanding, there may be the need for relocation of both homes and subsistence farms. With the low impact mining operations planned for the area, Jamalco will be able to mine the bauxite and rehabilitate these areas quickly so that they will be available for future growth and development of these communities.

6.1.3 TRANSPORTATION ALTERNATIVES-MINES TO ST. JAGO

6.1.3.1 ROPECON CONVEYOR SYSTEM

This alternative involves the installation of the latest innovation in bulk material handling. RopeCon is a lon-distance continuous cable belt conveyor system suitable for the transportation of bulk materials and unit loads of any kind. RopeCon is the result of many decades of experience in this field and is the preferred alternative for the following reasons:

- Occupies a small footprint, only 10 towers will be required to extend the system over the approximately 3.2 km between the Mt. Oliphant loading station and the railhead in St. Jago.

- A regenerative system, RopeCon will generate electricity from a turbine that is turned by a combination of the weight of the bauxite, the slope of the lines and gravity to produce 1.1 MW of power for use at the site.
- System will transport ore at an average rate of 1200 tph. It would take 48 dump trucks (25 tonne capacity) to deliver the same volume in one hour. System reduces the potential negative impacts associated with trucking of bauxite through the communities to the railhead.
- The RopeCon equipment is modular and 70% of the conveyor structure can be reused elsewhere once mining is concluded. The structures will not remain on the landscape indefinately.
- Low chance of vandalism and low security risk due to the aerial installation
- Reasonably high capital costs, but would have low maintenance costs when compared to other bulk handling equipment or transportation alternatives.
- Environmentally friendly and quiet operation due to materials of construction (Teflon rollers vs metal).

This is the preferred alternative and represents the most environmentally friendly, people friendly alternative that can get the job done to the satisfaction of Jamalco.

6.1.3.2 USE TRUCKS ON EXISTING ROADS BETWEEN MINES AND ST. JAGO RAILHEAD

This is a possible alternative, however, it is anticipated that mining will be ongoing in the South Manchester area for several years and it is impractical or would require significant investment in the infrastructure to maintain roadways and limit the impacts to community residents for such an extended period. Also, there are high safety risks due to the narrow winding roads and steep slopes that are in place now.

Advantages of using existing roadways would be significantly lower capital costs, limited specific environmental impacts and the shortest implementation period of any alternative reviewed. Disadvantages include high operating costs (road maintenance), traffic issues and serious safety risks for residents in the various communities.

Not a preferred alternative primarily for the safety and potential for creating traffic bottlenecks.

6.1.3.3 USE TRUCKS ON A NEW HAUL ROAD BETWEEN MINES AND ST. JAGO RAILHEAD

This is a possible alternative. However, the nature of the existing terrain from the escarpment down to St. Jago would make construction activities challenging.

Advantages of constructing a new haul road directly to St. Jago include, reasonably low capital cost, relatively short implementation period, a proven technology that is widely sed in the industry. Disadvantages include, high operating costs, environmentally unfriendly due to additional land clearing and the potential for dust creation, safety issues related to slopes and grades, difficult to rehabilitate when mining operations end.

Not a preferred alternative primarily for the operating costs, environmental unfriendliness and safety issues associated with the steep slopes trucks would have to travel under load.

6.1.3.4 EXTEND RAIL LINES BETWEEN MINES AND ST. JAGO RAILHEAD

This is a possible alternative. However, it represents a costly and environmentally unfriendly solution to the problem. The negative impacts (environmental, socio-economic, etc.) will be great for the following reasons:

- New rail lines will have to be laid because there is no existing Jamalco or JRC railway corridor
- It carries greater potentially negative impacts on the communities and environment than the preferred alternative. Large cuts would be required through the dry limestone forests and numerous areas of natural drainage would be impacted.
- Although it moves large quantities of ore in less time and at less cost than trucking, it requires considerable fuel oil inputs. The conveyor system is one that requires minimal maintainance, and generates its own energy, which is clean.
- Though proper training and monitoring issues related to noise and vibration can be minimised, the conveyor system is yet safer for the communities and the environment.

MEMORANDUM OF UNDERSTANDING BETWEEN JAMALCO AND FORESTRY DEPARTMENT OF JAMAICA

7 MEMORANDUM OF UNDERSTANDING BETWEEN JAMALCO AND FORESTRY DEPARTMENT OF JAMAICA

The purpose of this memorandum is to establish the framework for collaboration between the parties to carry out the successful reclamation and rehabilitation of certain mined-out lands via the reforestation and / or afforestation of these lands.

It seeks to address the concern of the Forestry department that the reduction and degradation of forests as a result of bauxite operations should be guided by the No-Net-Loss Policy which would result in the compensation for the loss of forest cover from one site via the reforestation of another area of equivalent proportion.

The MOU (Appendix III) became effective on 29 August 2002 and has a tenure of 5 years.

The parties will review the Reforestation strategy after two years to determine whether the objectives are being met and whether the strategy needs to be reassessed.

Trees that have been selected for use in the programme are as follows:

- **ORNAMENTAL/ LUMBER TREES**
    - Cedar
    - Ficus
    - Acacia
    - Wild Tamarind
    - Blue Mahoe
    - Mahagony
    - Bitterwood
    - Bitter Damson
    - Spanish Elm

- **FRUIT TREES**
    - Mango
    - Orange
    - Avocado
    - Breadfruit
    - Ackee

7.1.1.1 EMERGENCY RESPONSE

Jamalco has an excellent well documented procedure for handling natural disasters such as hurricanes, fires, earthquakes and the like. This includes an Early Warning System for responding to process emergencies and a 72 hour shut down procedure if this becomes necessary.

All new facilities and operations will be incorporated into the emergency response programmes of Jamalco.

ENVIRONMENTAL MANAGEMENT AND TRAINING

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 brownsite 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

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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 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 maintenance	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

Category	Risk	Source	Prevention	Solution
	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	Cable/Tower failure	RopeCon System	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 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.

The following is an overview of how waste is managed at Jamalco presently and how it will be managed at South Manchester.

9.2.3 SOLID WASTE MANAGEMENT

Solid waste generated at Jamalco includes, among other items:

- Used filters
- Waste Oil
- Empty drums
- Aerosol cans
- Garbage
- Medical waste
- Absorbents
- Office refuse
- Waste Rags

For each waste stream identified, there exists a 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. The South Manchester operations will be included in this list.

9.2.3.1 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.

Applicable waste from the South Manchester operations will be transported to the refinery for disposal in the landfill.

PUBLIC INVOLVEMENT

10 PUBLIC INVOLVEMENT

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

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 SML in South Manchester as long as the company maintains a presence there.

10.1 COMMUNITY CONSULTATION ON MINING PROJECT

Jamalco has consulted with communities throughout Manchester to provide details and information on the proposed mining project. At these meetings, community members and stakeholders are briefed on the project, provided with information on the potential impacts and how the negative impacts will be mitigated. The residents and stakeholders are allowed to voice their concerns which are taken into consideration and addressed as appropriate.

At the June 23, 2005 meeting held at the Mile Gully Community Center, the following issues were raised as major concerns:

- Supply of water to the communities
- Traffic on roadways
- Dust from stockpiled soils
- Use/access to bauxite lands
- Employment

At the July 28, 2005 meeting held at the Mt. Oliphant Church of God, the following major issues were raised:

- Dust
- Land acquisition and compensation
- Relocation
- Employment
- Community benefits

All concerns raised are important to Jamalco and concerted effort is being made to address these concerns in keeping with Jamalco's corporate policy.

These community groups comprise influential citizens, area leaders, community activists and individuals who have the best interest of the communities at heart. Their interests and comments have been reviewed in a complementary manner along with the findings of the socio-economic survey.

10.2 COMMUNITY CONTRIBUTIONS

Over the years, Jamalco has played a major role as a good corporate citizen in the communities they conduct operations. The company has been involved in the daily life and development of many communities and intends to continue this involvement as best as possible in the South Manchester area. Activities undertaken in various communities worked, 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

APPENDICES

APPENDIX I

APPENDIX I: APPROVED TERMS OF REFERENCE

TERMS OF REFERENCE FOR
CONDUCTING THE ENVIRONMENTAL IMPACT ASSESSMENT FOR
MINING IN SOUTH MANCHESTER BY
JAMALCO

In the Environmental Impact Assessment Report, **Conrad Douglas & Associated Limited** will give full and detailed accounts in the following areas, during the pre-mining, mining and the operational phases of the project:

1. DESCRIPTION OF THE PROJECT:

Conrad Douglas & Associates Limited will:

a. Describe in detail, the area proposed for bauxite mining operations, storage and processing, services and amenities, transportation corridors and systems.

b. Detail the elements of the project, highlighting areas to be reserved for construction, areas to be preserved in their existing state as well as activities and features which will introduce risks or generate impact (negative and positive) on the environment.

c. Use maps, site plans and other graphic aids as appropriate. We will include the overall plan, which will delineate mining areas, transportation corridors, load out stations and buffer zones.

d. Include information on location, general layout and size

e. Describe proposed blasting operations in the mining areas and Jamalco's approaches and methodologies to guarantee public health, and safety.

f. Pre-mining, mining and post- mining plans inclusive of closure and rehabilitation plans.

Description of the Environment

Baseline data will be generated and 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 influence of the project).
   a. Determination of storm water run-off, drainage patterns, effect on ground water and availability of potable water.

   b. Assessment of methods for sediment control at the mines and rail head storage areas.

c. Water quality issues.

d. Climatic conditions and air quality in the area of influence, including particulate emissions from stationary and mobile sources, NOx, SOx, 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 extent of contamination.

g. Availability of solid waste management facilities.

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. As appropriate determine any micro-organisms and the existence of micro-habitats to obtain an accurate baseline assessment.

c. 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 proposed land use

c. Planed 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

m. Administration of questionnaires as appropriate.

2. Policy, Legislations and Regulations:

All pertinent policies, regulations and standards in keeping with the nature of the project will be outlined. The examination of the legislation will include at a minimum, legislation such as the NRCA Act of 1991, The Public Health Act of 1926, The Water Resources Guidelines, The Mining Act, The Wild Life Act, legislation from the Solid Waste Management Authority (SWMA), and as appropriate international conventions, protocols, treaties etc.

3. Determination of Potential Impacts:

We will identify any major environmental issues of concern and indicate their relative importance to the design of the project and the intended activities. We will also determine potential impacts as they are related to, but not limited to the following:

a. Change in drainage pattern

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 / Emergency Response *(liaise with the Office of Disaster Preparedness and Emergency Management)*

j. Noise inclusive of impact from blasting operations

k. Comment on soil pH in relation to the nature of the project.

l. Waste disposal via recycling

m. Capacity and design parameters of proposed development

n. Distinguish between positive and negative impacts, direct and indirect, long term and immediate impacts.

o. Avoidable as well as irreversible impacts.

p. Present project activities and impacts in matrix form, with separate matrix for pre and post mitigation scenarios.

4. Mitigation

We will prepare guidelines for avoiding, as far as possible, any adverse impacts due to proposed activity at the site whilst utilizing existing environmental attributes for optimum development. Where possible, financial and economic values will be quantified and assigned to impacts and mitigating methods.

6. Monitoring

A plan to monitor implementation of mitigatory or compensatory measures and project impacts during construction and operation will be suggested. An Environmental Management Plan for the long-term operations of the proposed project area will be prepared.

EIA report will include an outline of the Monitoring 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, including tables and graphs where appropriate.
- Discussion of results with respect to the development in progress, highlighting any parameter(s), which exceeds the standard (s).
- Frequency of reporting to NEPA.

- Recommendations
- Appendices of data and photographs.

7. Analysis of Alternatives

CD&A will examine alternatives to the project including the no-action alternative. Project alternatives will incorporate the use history of the overall area in which the project is located and previous use of the site itself.

All findings will be presented in the EIA report and will reflect the headings in the body of the TOR, as well as other references. We will submit twelve hard copies and an electronic copy of the report to NEPA. The report will include appendices with items such as maps, site plans, the study team, photographs and other relevant information.

APPENDIX II

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

Your Guide To Resettlement

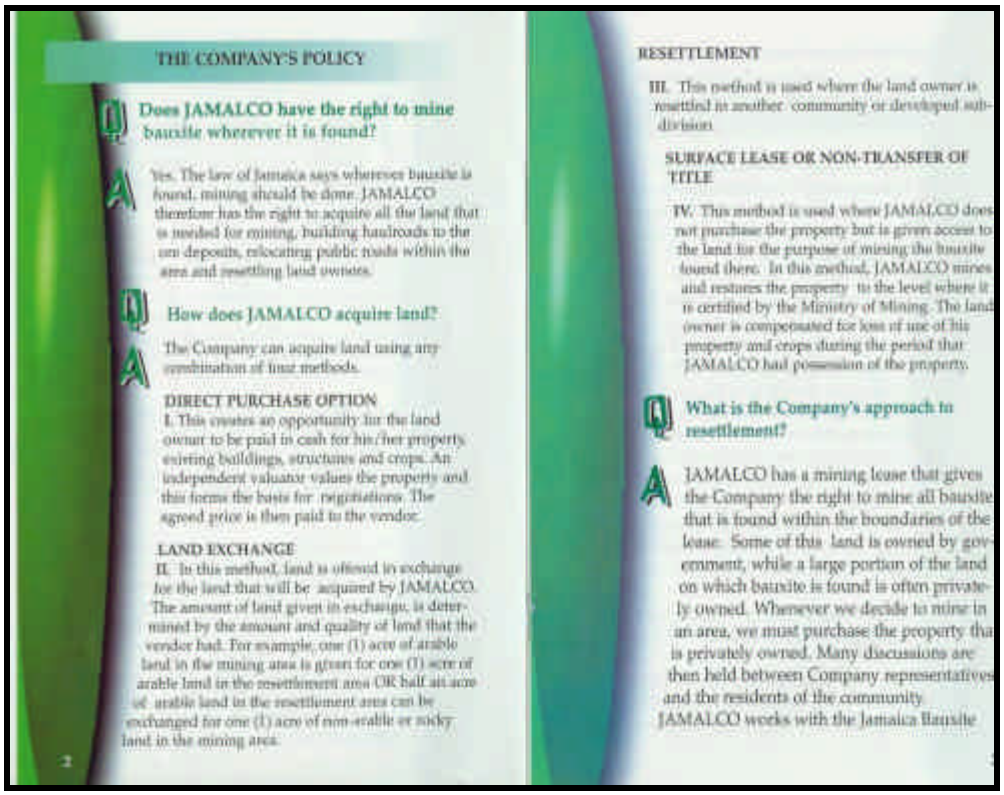
JAMALCO is a bauxite mining and alumina refining joint venture association between ALCOA Minerals of Jamaica and the Government of Jamaica. Our operations which began in 1976 are concentrated mainly in the parish of Clarendon.

Like other companies with a mining lease, JAMALCO has the right by law to mine all bauxite that is found within the boundaries of the lease. In order to do this, it is sometimes necessary to relocate people. The Company ensures, however, that if individuals or communities have to be relocated, this is done as smoothly as possible.

At JAMALCO, we have been playing our part in helping to build and sustain communities through our resettlement programme. The Company also strives to ensure that persons who are relocated enjoy an improved standard of living.

Now that you are about to be resettled, JAMALCO is committed to working with you to help you to feel at ease as you go through the process. Here, we seek to answer your questions, by providing detailed information that will make resettlement easier.

Our mission is to help you to find peace of mind as you take this important step. Our people are dedicated to working tirelessly to find the right resettlement option for you.



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.

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RESETTLEMENT

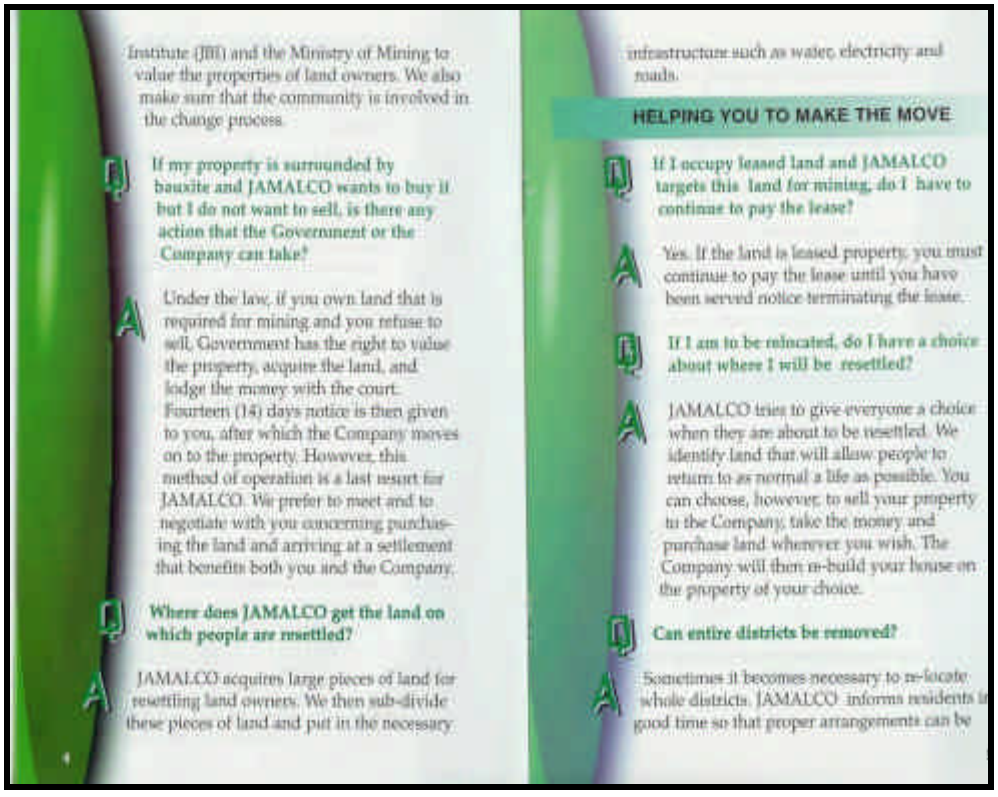
III. This method is used where the land owner is resettled in another community or developed sub-division.

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. Wherever 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

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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?

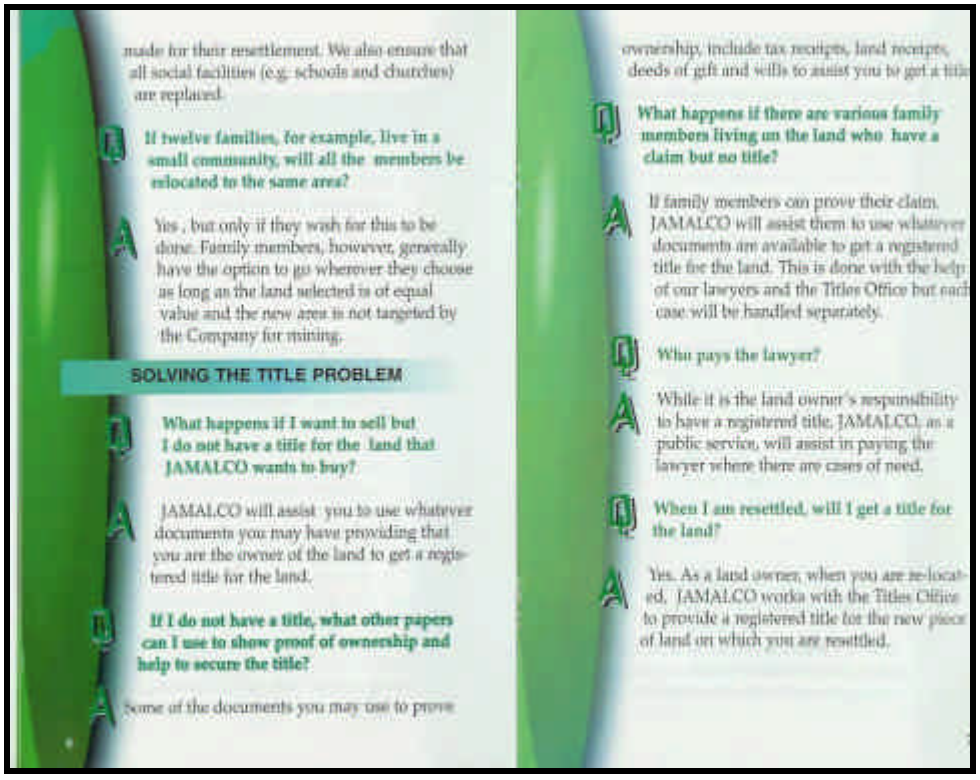
A Yes. If the land is leased property, you must continue to pay the lease until you have been served notice terminating the lease.

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?**

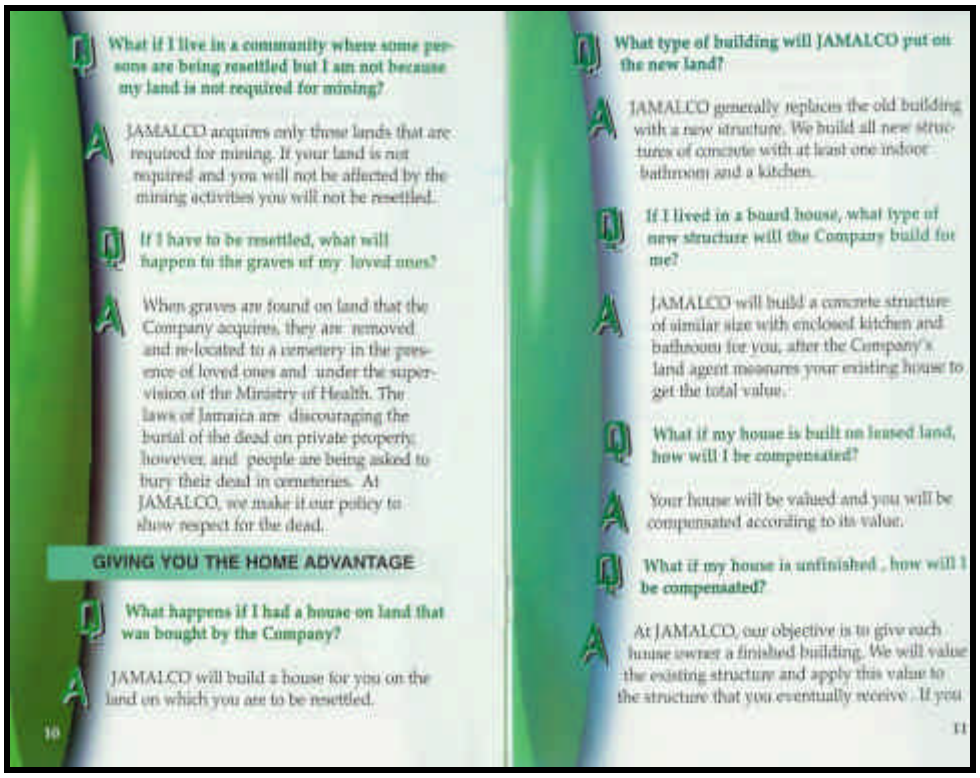
A If family members can prove their claim, JAMALCO will assist them to use whatever documents are available to get a registered title for the land. This is done with the help of our lawyers and the Titles Office but each case will be handled separately.

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.



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?

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.

Q If I have to be resettled, what will happen to the graves of my loved ones?

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.

GIVING YOU THE HOME ADVANTAGE

Q What happens if I had a house on land that was bought by the Company?

A JAMALCO will build a house for you on the land on which you are to be resettled.

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Q What type of building will JAMALCO put on the new land?

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.

Q If I lived in a board house, what type of new structure will the Company build for me?

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.

Q What if my house is built on leased land, how will I be compensated?

A Your house will be valued and you will be compensated according to its value.

Q What if my house is unfinished , how will I be compensated?

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

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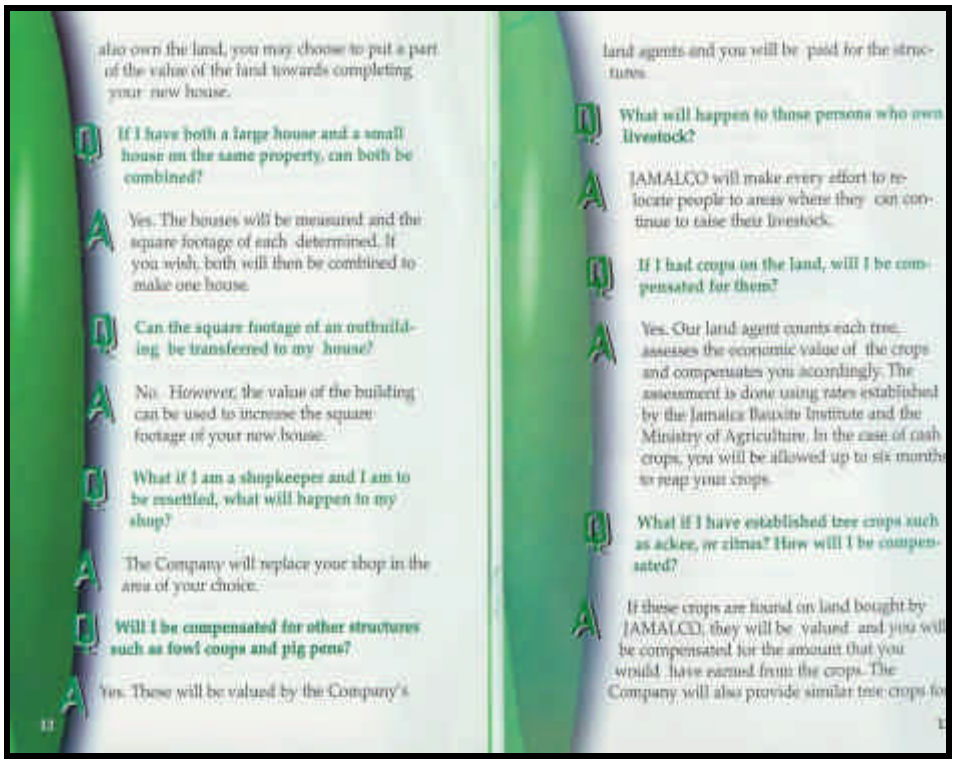

also own the land, you may choose to put a part of the value of the land towards completing your new house.

Q If I have both a large house and a small house on the same property, can both be combined?

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.

Q Can the square footage of an outbuilding be transferred to my house?

A No. However, the value of the building can be used to increase the square footage of your new house.

Q What if I am a shopkeeper and I am to be resettled, what will happen to my shop?

A The Company will replace your shop in the area of your choice.

Q Will I be compensated for other structures such as fowl coops and pig pens?

A Yes. These will be valued by the Company's

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land agents and you will be paid for the structures.

Q What will happen to those persons who own livestock?

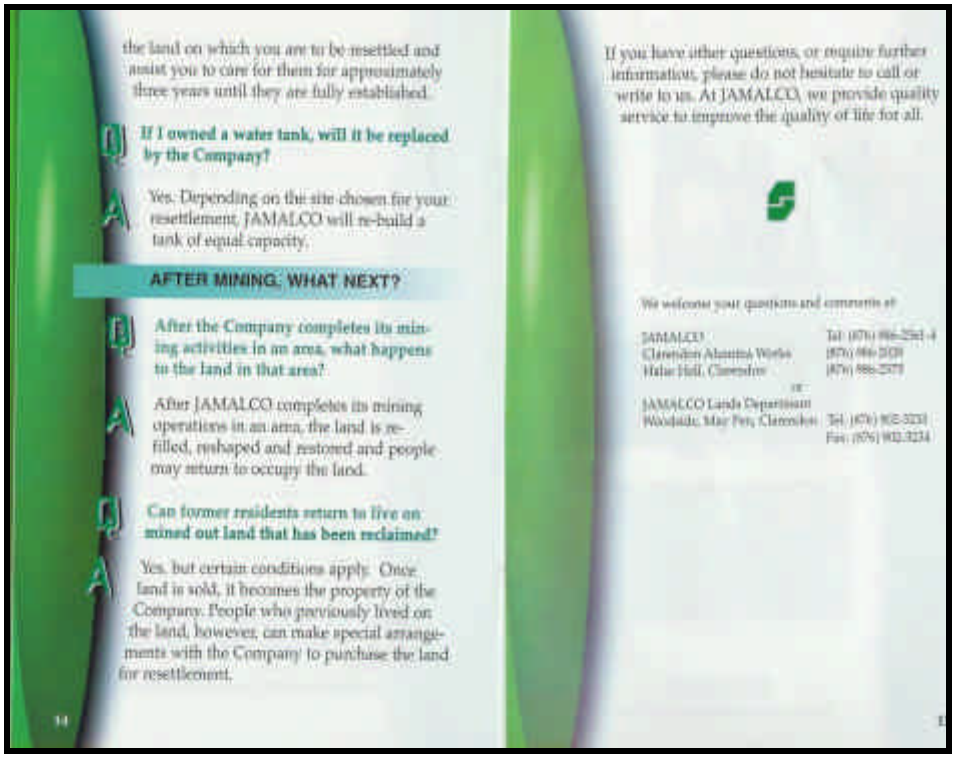
A JAMALCO will make every effort to re-locate people to areas where they can continue to raise their livestock.

Q If I had crops on the land, will I be compensated for them?

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.

Q What if I have established tree crops such as ackee, or citrus? How will I be compensated?

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 fo



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.

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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
Clarendon Alumina Works
Halse Hall, Clarendon
Tel: (876) 986-2561-4
(876) 986-2559
(876) 986-2575

or

JAMALCO Lands Department
Woodside, May Pen, Clarendon
Tel: (876) 902-3233
Fax: (876) 902-3234


Jamalco
Better Communities. Better Lives.
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APPENDIX III

APPENDIX III: 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 residental 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 IV

APPENDIX IV: 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:

TEAM MEMBERS

APPENDIX V: TEAM MEMBERS

Project Team

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