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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

INTRODUCTION

An Environmental Impact Assessment (EIA) for the proposed construction of a bauxite reside disposal area (RDA 5) to be located adjacent existing RDAs at Halse Hall, Clarendon, was undertaken by Conrad Douglas & Associates Limited on behalf of Jamalco, the project proponent.

Essentially the proposed project is to facilitate additional residue disposal storage capacity since the present capacity can only accommodate approximately 18 months storage at the present production rate.

The proposed construction will utilise technologies that will significantly enhance the ability of the structure to withstand seepages or failure of the clay seal that is included in the design. In addition to the clay seal, the proposed disposal area will use a leachate collection system embedded in a layer of sand to collect and remove liquids before they can penetrate the clay seal.

The leachate system causes a zero hydrostatic head to be effected on the clay seal, thus minimizing the possibility of liner failure. Various approaches and methodologies were used in carrying out the study, consistent with and in addition to the requirements of the Terms of Reference, to ensure adequacy and completeness in addressing the potential impacts f the project.

These involved field and literature surveys including:

- Detailed reviews of the civil/structural components of the study,
- Alternative analyses of residue disposal methods considered by Alcoa and the bauxite/alumina industry in general,
- The environmental baseline setting, and
- Interviews and interactions with the members of the population within the sphere of influence of the study area.

TERMS OF REFERENCE

The Environmental Impact Assessment for the proposed construction of RDA 5 was conducted according the scope detailed a Terms of Reference (See Appendix I) which was approved by the National Environment and Planning Agency (NEPA).

REGULATORY FRAMEWORK

The policies, legislations and regulations as well as the permitting procedures and administrative framework relevant to the project were researched and analysed. The overriding legislation is the Natural resources Conservation Authority (NRCA) Act of 1991.

The objective was to ensure that the project complies with all policy, legal and regulatory requirements. The study therefore examined those policies, legislations and regulations governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, site selection and land use control.

ENVIRONMENTAL SETTING & BASELINE

In describing the environment of the proposed project, the specific location as well as the regional setting were studied and assessed.

The region was described in respect of its:

- biophysical resources
- socio-economics,
- cultural heritage resources, and
- future developments.

The topography of the region is predominantly flat and is characterised by low rainfall, low level biodiversity, possessing no identified rare or endemic species and no significant cultural heritage resources.

PROJECT DESCRIPTION

INTRODUCTION

Jamalco has received blanket approval from NEPA for its proposed upgrade to 2.8 Mtpy. However, Jamalco has been asked to provide additional information in support of specific aspects of the upgrade. This EIA report seeks to provide details and specific information in support of the establishment of a new Dry Bauxite Residue Disposal Area (RDA) that will be required to accommodate the residue from the upgraded refinery. Additionally, this EIA seeks the approval of NEPA so that the project can be implemented in a timely manner.

The construction of a new RDA represents a "Brown Site" expansion of the over 210 hectares (519 acres) of land designated to the sole purpose of residue disposal. RDA 5 will be located on approximately 100 hectares of land to the North of the existing RDA 4 and to the West of the existing RDA 2. It will provide additional storage volume and surface area to accept bauxite residue from the refinery. Using Thickened Tailings Disposal with Dry Residue Stacking technology, Jamalco will be able to maximize the capacity of RDA 5 and will be able to provide capacity for storage of 8.0 million cubic metres of residue.

The basic principles of Jamalco's residue plan are to firstly, maximize the storage of residue on the areas already used for this purpose (dike walls have been increased in height to increase volume), and secondly, to increase efficiency while utilizing the best available technology.

BASIS OF DESIGN

This project entails the preliminary engineering design and documentation of Dry Residue Disposal Area 5 covering approximately 100 Ha and associated works comprising of:

- Carrying out geotechnical investigations to determine the foundation conditions over the new RDA footprint.
- To identify possible sources of borrow material for the civil construction works.

- Base seal (to extend also within perimeter embankments and possibly under new embankment where adjoining RDAs are planned) likely to be a composite seal including a synthetic membrane and a clay layer.
- Under drain system on top of base seal likely to be made up of a sand layer with a grid of collection pipes for the purpose of collecting liquor as the residue above consolidates; also provision of recovery sumps.
- Surface decant system likely to be provision for mud deposition to profiles such that liquor separating from residue during deposition may be collected at a low point(s) from where it may be pumped to another location.
- Interior embankments or dikes (if required) to facilitate pipeline routes, drainage and deposition of residue to the required profiles.
- Storm drainage to accommodate run off from the mud surface recognizing that Jamalco is a zero discharge facility and that all run-off must be collected in existing sealed lakes.
- Perimeter embankments although likely to be of an initial lesser height to be designed such that they may be later raised to an elevation matching those of the surrounding RDAs, constructed of compacted locally excavated borrow material. Top of dyke to be suitable for two way traffic.
- Access ramps in the south west corner to service the Under Drain Sump and in the north east corner to replace the existing ramp included within RDA 5.
- Provision of an embankment for a future Residue Neutralisation Plant or additional Paste Thickener with the same plan area at RL 195' as the existing thickener embankment.
- Provision of a 90,000 m^3 final capacity Oxalate Storage Area in the north east corner of RDA 5.
- Installation of dust suppression sprinkler system
- Area roads, including a service road around the perimeter of the new West and North dykes, and vehicle access ramps to embankment crests; likely to be of simple crushed limestone construction with side drains.
- Foundations and support trestle for lake water recovery station(s).
- Foundations for any tanks or mechanical equipment.
- Miscellaneous small buildings – possibly an electrical substation and several offices.

- Early warning system monitoring well system for leakage through the sealing membrane.
- Protection of the dyke from flooding

DESIGN CRITERIA

The design criteria to be used for the preliminary design of RDA 5 is summarised below.

- Storage of 8 million cubic metres of bauxite residue dry stacked at 3% sloping up from the new west perimeter dyke to a maximum level of 190 feet.
- Provision of approximately 100Ha of surface drying area of bauxite residue at the 190' RL residue level.
- Storage of storm water runoff from RDA 5 only, for the 1 in 100 year rainfall event.

Table 1-1, provides key quantities and capacities of the proposed RDA 5.

The project will provide jobs for a variety of workers since the labour force at the peak of construction is expected to be approximately 250 workers (operators, foremen, general labour) with supervisory staff at 25.

THE RDA SYSTEM

RDA 5 is proposed for lands adjoining the existing RDA 4 (to the south) and RDA 2 (to the east). Figure 1-1 depicts the location plan of the proposed residue disposal area and Figure 1-2 shows the details of the general plan layout. Construction activities are anticipated to last for an estimated 14 months from start of construction.

The major components of the RDA 5 include:

- A Seal Layer
- An Under-DrainSystem
- Embankments

The above components represent the integral components of RDA 5, and have been designed to promote and effect the safe and efficient physical storage and processing of bauxite residue.

Other components of RDA 5 include:

- A lakewater return system
- An oxalate Storage Cell
- Stormwater Storage
- Stromwater Drainage

PROJECT DESCRIPTION

1 PROJECT DESCRIPTION

1.1 GENERAL DESCRIPTION OF PROJECT

1.2 INTRODUCTION

Jamalco has received blanket approval from NEPA for its proposed upgrade to 2.8 Mtpy. However, Jamalco has been asked to provide additional information in support of specific aspects of the upgrade. This EIA report seeks to provide details and specific information in support of the establishment of a new Dry Bauxite Residue Disposal Area (RDA) that will be required to accommodate the residue from the upgraded refinery. Additionally, this EIA seeks the approval of NEPA so that the project can be implemented in a timely manner.

The construction of a new RDA represents a “Brown Site” expansion of the over 210 hectares (519 acres) of land designated to the sole purpose of residue disposal. RDA 5 will be located on approximately 100 hectares of land to the North of the existing RDA 4 and to the West of the existing RDA 2. It will provide additional storage volume and surface area to accept bauxite residue from the refinery. Using Thickened Tailings Disposal with Dry Residue Stacking technology, Jamalco will be able to maximize the capacity of RDA 5 and will be able to provide capacity for storage of 8.0 million cubic metres of residue.

The basic principles of Jamalco’s residue plan are to firstly, maximize the storage of residue on the areas already used for this purpose (dike walls have been increased in height to increase volume), and secondly, to increase efficiency while utilizing the best available technology.

1.3 BACKGROUND

Jamalco produces 1.1 tons of residue for every ton of alumina produced and presently has four active residue disposal areas (RDAs) covering 214 hectares. RDA 1 was commissioned in 1972, RDA 2 in 1980, RDA 3 in 1990, and RDA 4 in 1997. RDAs 1 and 2 are simple clay lined impoundments. The construction of RDAs 3 and 4 included an under−drainage system to improve the rate of consolidation of the residue and to reduce the hydrostatic pressure on the clay seal at the base of the deposits. RDA 1 is now being used as a cooling water pond, and a project is being commissioned in October 2005 to convert 20 hectares of its area to a Thickened Tailings Disposal Area. RDA 2 has been filled with wet residue and is currently being used for the Paste Thickener overflow and lake water storage. The embankments of RDAs 3 & 4 were raised in 2003. The resulting expanded area RDA 3/4 is an active RDA into which all residue produced by the refinery is being discharged as thickened tailings.

Jamalco is a zero discharge facility, in that all water collected from the plant site or the residue system is impounded within the disposal area for reuse in the process. In addition to residue disposal, RDAs 1,2 and 3/4 are currently used to store accumulated rainfall runoff during the year.

Allowing for the current production rate (1.27 Mtpa) and sufficient capacity to store rainfall run off collected in a wet year (equivalent to 1979), it is anticipated that RDA 3/4 will reach capacity by November 2006. At that time additional residue storage capacity will be required. Needless to say, the refinery cannot operate without proper residue disposal solutions.

The area currently set aside for future expansion is bounded by RDAs 1&2 to the east, RDA 4 to the south, the Rio Minho River to the west and Webber's Gully to the north. It is intended that RDA 5 be constructed in this area.

1.3.1 BASIS OF DESIGN

This project entails the preliminary engineering design and documentation of Dry Residue Disposal Area 5 covering approximately 100 Ha and associated works comprising of:

- Carrying out geotechnical investigations to determine the foundation conditions over the new RDA footprint.
- To identify possible sources of borrow material for the civil construction works.
- Base seal (to extend also within perimeter embankments and possibly under new embankment where adjoining RDAs are planned) likely to be a composite seal including a synthetic membrane and a clay layer.
- Under drain system on top of base seal likely to be made up of a sand layer with a grid of collection pipes for the purpose of collecting liquor as the residue above consolidates; also provision of recovery sumps.
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- Foundations and support trestle for lake water recovery station(s).

- Foundations for any tanks or mechanical equipment.
- Miscellaneous small buildings – possibly an electrical substation and several offices.
- Early warning system monitoring well system for leakage through the sealing membrane.
- Protection of the dyke from flooding

1.3.2 DESIGN CRITERIA

The design criteria to be used for the preliminary design of RDA 5 is summarised below.

- Storage of 8 million cubic metres of bauxite residue dry stacked at 3% sloping up from the new west perimeter dyke to a maximum level of 190 feet.
- Provision of approximately 100Ha of surface drying area of bauxite residue at the 190' RL residue level.
- Storage of storm water runoff from RDA 5 only, for the 1 in 100 year rainfall event.

Table 1-1, provides key quantities and capacities of the proposed RDA 5.

TABLE 1-1: KEY QUANTITIES AND CAPACITIES OF THE PROPOSED RDA 5

Item	Quantity
In service:	
Tailings Storage Volume	8,200,000 cu m
Water Storage Volume	560,000 cu m
Oxalate Storage Volume	50,000 cu m
Surface Area (when full)	99 Hectares
Construction:	
Sand (under drain layer)	620,000 cu m
Clay (seal layer)	460,000 cu m
General fill	1,340,000 cu m
Total fill quantities:	**2,420,000 cu m**

The project will provide jobs for a variety of workers since the labour force at the peak of construction is expected to be approximately 250 workers (operators, foremen, general labour) with supervisory staff at 25.

1.4 THE RDA SYSTEM

RDA 5 is proposed for lands adjoining the existing RDA 4 (to the south) and RDA 2 (to the east). Figure 1-1 depicts the location plan of the proposed residue disposal area and Figure 1-2 shows the details of the general plan layout. Construction activities are anticipated to last for an estimated 14 months from start of construction.

FIGURE 1-1: MAP OF THE PROPOSED SITE

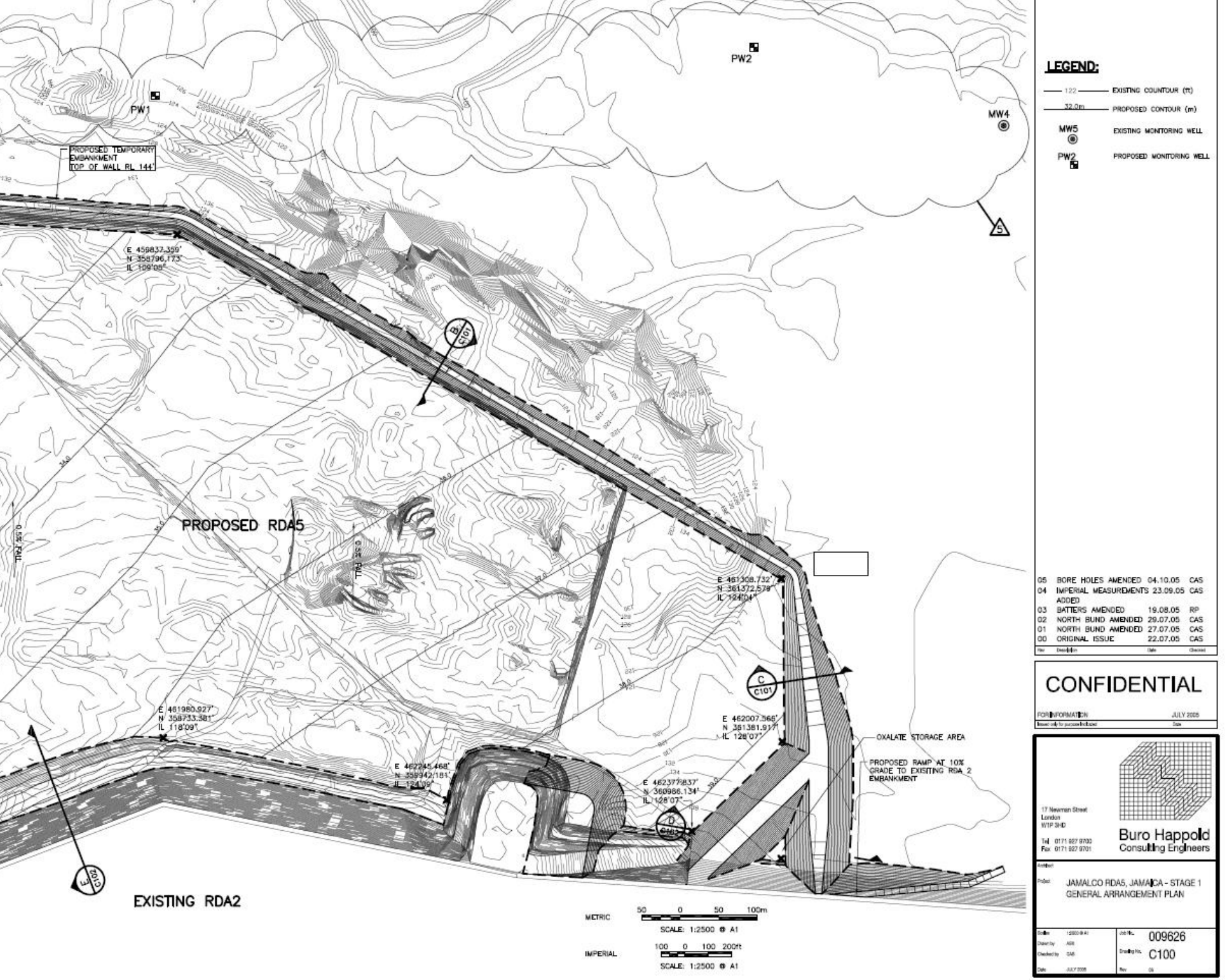

FIGURE 1-2: RDA 5 GENERAL PLAN LAYOUT DETAIL

1.4.1 MAJOR COMPONENTS

1.4.1.1 SEAL LAYER

The preservation of the valuable groundwater resources of the Vere Plains is of significant importance to Jamalco. For this reason, they pioneered the use of sealed residue disposal impoundments in Jamaica. The concept is relatively straightforward and involves the use of an impermeable liner between the residue and natural ground. In the past, thick clay liners have been used which were made from select clays and compacted for maximum protection against failure. To date, Jamalco has not experienced any significant liner failures at the residue disposal area and through extensive preliminary works, safety oriented designs and high quality construction works, will continue to do so with the construction of RDA 5.

RDA 5 will be constructed with a composite liner system comprising an 18" thick compacted clay liner with a 0.75mm thick PVC geomembrane on top of the clay. The geomembrane's mechanical protection on the internal slopes will be provided by compacted layers of soil. On the base, a 2'6" thick sand layer will be placed on top of the geomembrane.

The PVC geomembrane liner will further increase the impermeability of the liner system and act as a first line of defence in the protection of the clay liner. This system of liners coupled with a proven under-drain system will provide a factor of safety greater than in any other RDA unit constructed at Jamalco to date.

To maintain the integrity of the combined liner system, the works will be sequenced so that the clay is not left exposed to drying or wetting conditions and that the PVC be covered by the sand drainage blanket to protect it from the elements and construction activities, as soon as practically possible. Installing the drainage system progressively with the drainage blanket will reduce the impact on the liner of vehicle passes over the completed surface.

The geomembrane will be covered early in the construction process for the following reasons:

- To provide protection from puncturing by mechanical means.
- To provide protection from the environment, including protection from UV light.
- To prevent rucking, caused by downslope creep, being “locked-in” by deposition of residue.
- To avoid long term drying out and possible shrinkage cracking of the underlying clay liner.

A cover of fill will provide the required protection for geomembrane on the internal slopes of RDA 5 with the following details applied:

- The fill placed immediately over the geomembrane will not contain particles coarse and sharp enough to puncture PVC; as such 300 mm or finer material will be used for this purpose.
- The cover should be thick enough to be placed by conventional earthmoving and compaction equipment over the existing outside slopes of RDA 2 and RDA 4 (after removal of topsoil).
- The cover should not be so thin that it would become saturated during heavy rainfall events and slough-off, as infiltration will not be able to pass through the PVC liner.

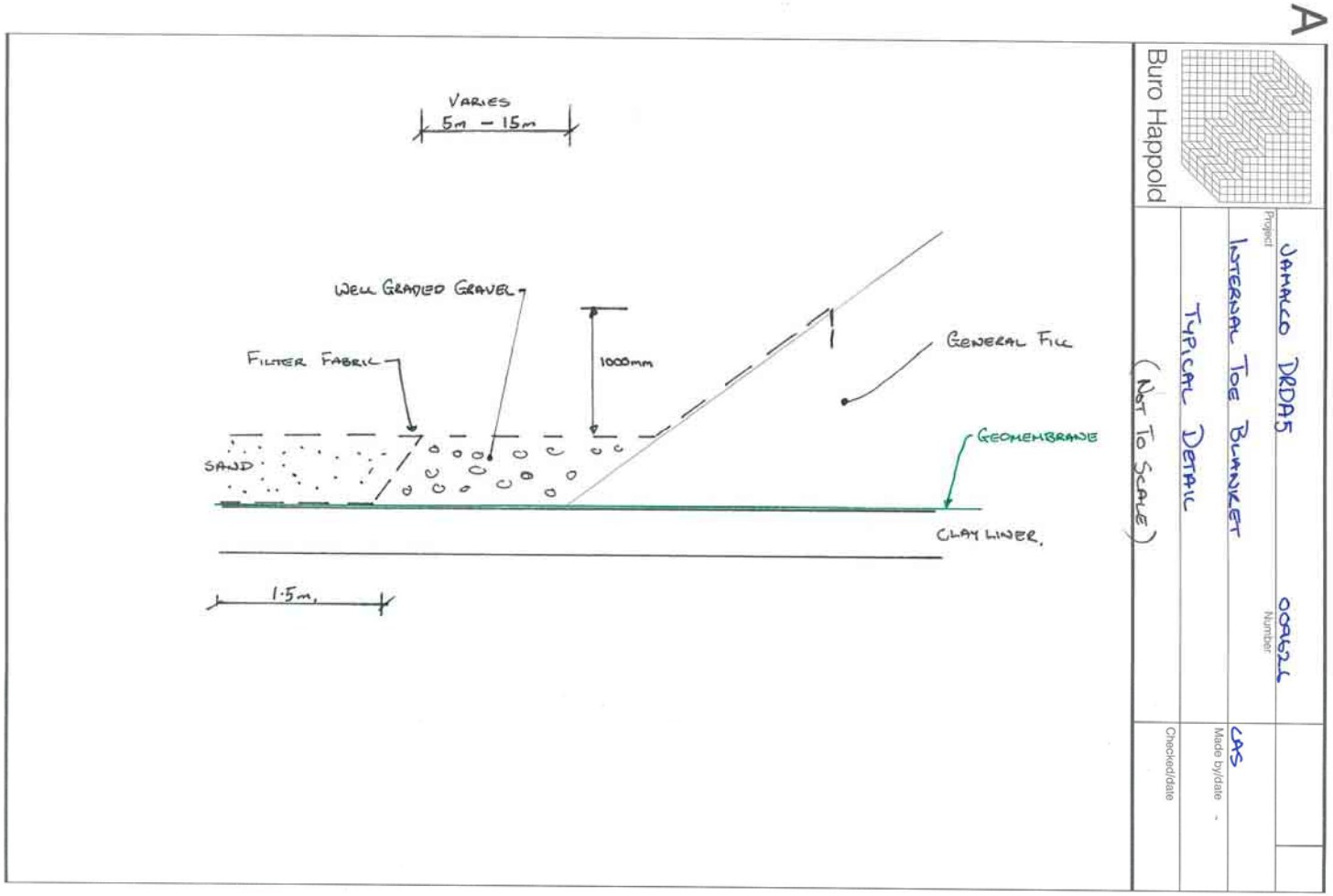

FIGURE 1-3: INTERNAL TOE EMBANKMENT

1.4.1.2 UNDER-DRAIN SYSTEM

The preliminary design for the under drainage system has been based on perforated, dual wall and ribbed polyethylene pipes with a tubular, seamless filter sock. The proposed pipes are N12 pipes as supplied by Advanced Drainage Systems.

The under drainage layout and pipe design was based on an assumed tailings permeability of 10-7 metres per second, and the pipes sized using the Colebrook White Equation for pipes flowing full. The under floor drainage network is a simple herringbone system with a primary collection main, secondary mains at generally 150m centres and 100mm lateral mains generally at 50m centres. The collection main drains to a reinforced concrete under floor drainage sump that has been located in the Western Embankment towards the south west.

A section through the composite liner would show the compacted clay layer overlain with the PVC geomembrane. Over the PVC liner, there would be a shallow sand layer to protect the liner with the pipes bedded on this sand. Protecting the pipes and providing the required haunch support and filtration of fines is a further sand layer. The overall sand thickness is currently proposed to be approximately 750mm.

The selection of the suitable pipes was based on the ultimate perimeter embankment height of 195 feet and a design tailings slope of 5% rising from the 190 foot level on the western embankment to the middle of RDA5 and then falling at 5% back to the 190foot level on the Western RDA 2 embankment. This provided an ultimate design overburden pressure equivalent to approximately 50m. Single wall, flexible pipes were considered, however they are unlikely to be satisfactory due to their inability to withstand the ultimate, proposed overburden pressures that will be exerted.

To accommodate for the possible need for draining the embankment slopes, drainage pipes have been allowed around the inside toe in lieu of extending the herringbone system up the embankment slope.

FIGURE 1-4: PROPOSED DRAINAGE LAYOUT – RDA 5

For the sand drainage layer, a permeability of at least 1*10 -5 m/sec is required to limit water pressure between laterals at 50 metre intervals. To achieve this target permeability of 1*10 -4 m/sec for sand from the borrow area will be applied to allow for variation, unless processing of the sand is provided. A geofilter fabric has been allowed as a separator between the sand drainage layer and the tailings.

The under floor drainage sump is currently proposed to be a 5m diameter, cast insitu concrete structure. It is proposed to be located within the outer slope of the western embankment. The foundations and structure have been designed based on the assumption that it will be eventually raised to the 195foot level with a short access bridge from the crest to the top of the sump.

1.4.1.3 EMBANKMENTS

The embankments of RDA 5 will be similar to those presently used at the other 4 RDAs. In this case, the clay and geomembrane liners extend beneath the embankment, which will be constructed of general fill materials compacted to desired specifications. The porous filter fabric will extend up the embankment. (See Figure 1-3).

1.4.1.3.1 EMBANKMENT PROFILE AND MODEL GEOMETRY

The overall embankment shape will vary along its length to suit the existing topographical conditions.

The schematic cross-section of the dyke that was modeled as part of the stability analyses is geometrically similar to those used in the previous studies. The generalized design profile comprises:

- A 12.5 m high (41.0 ft) compacted earthfill bund with upstream/downstream batter side slopes both at 1V:2H and a 8m wide crest (26.25 ft) at an elevation of +44.0 m above mean seal level (approx.144.00 ft amsl). Granular and cohesive engineering fills will be used to form the earthworks materials.
- A 1.25 m thick (4.10 ft) liner cover system on the upstream side, consisting of a 0.75m thick (2.46 ft) granular layer overlying a 0.50m thick (1.64 ft) compacted clay layer. This external cover system also extends over the entire RDA floor.

In terms of the underlying design ground model, a horizontal stratum interface was introduced at 5.0 m (16.4 ft) beneath the embankment. In addition, no internal or basal drainage control measures were incorporated into the design model as it is assumed that the compacted clay layer on the upstream slope is impermeable and will not leak.

1.4.2 CONCEPT DESIGN AND ANALYSIS

1.4.2.1 DESIGN METHOD AND CRITERIA

The Stage 1 embankment design was undertaken in accordance with the Minimum Factor of Safety failure criteria summarized in Table 1-2. These adopted minimum required factors of safety against slope instability are based on Alcoa's "Bauxite Residue Management Standards & Guidelines" (2004) and generally accepted US/UK geotechnical engineering practice.

TABLE 1-2: SUMMARY OF ADOPTED SLOPE STABILITY DESIGN CRITERIA

Design Loading Case	Seismic/Dynamic Condition	Minimum Factor of Safety	
		Downstream Slope	***Upstream Slope***
Short Term (ie. end of construction)	Static	1.5	1.5
Long Term (ie. operational, full reservoir, design freeboard)	Static	1.3	1.3
Earthquake	Pseudo-static	1.0	1.0

The analyses were performed using the SLOPE/W computer program (version 6.14) developed by GEO-SLOPE International Ltd, Canada which employs the two-dimensional limit equilibrium method of slices. The minimum factors of safety for the most critical circular slip surface were computed by the Morgenstern-Price (M-P) method that satisfies both moment and force equilibrium static conditions. A half-sine force function was also defined for characterising the normal and shear interslice forces used by the M-P method.

In general, the M-P method tends to produce slightly less conservative results compared with the different analysis methods used by others during the previous stability studies (namely, Bishops modified and Janbu methods).

For assessment of the seismic stability, the horizontal and vertical inertial forces created by earthquake ground shaking were defined as:

F = aW/g = kW

where

a = pseudostatic accelerations

g = gravitational acceleration constant

W = weight of failure mass or interslice

k = seismic coefficient of acceleration

The dynamic loading conditions applied was a horizontal inertial force (Fh_h) acting upstream and positive vertical inertial force (Fv_v) acting downwards in the direction of gravity, to reduce the embankment's mass and stability. In addition, the vertical seismic coefficient (kv_v) was taken as 50% of the horizontal seismic coefficient (kh_h).

1.4.2.2 MATERIAL DESIGN PARAMETERS

Due to the unavailability of site-specific geotechnical data for the proposed embankment and its underlying ground conditions, an upper and lower bound set of material parameters were generally used in the stability analyses, as summarised in Table 1-3. The effective stress (shear strength) parameters adopted for the granular and cohesive soils were both unfactored.

TABLE 1-3: SUMMARY OF ADOPTED SLOPE STABILITY DESIGN SOIL PARAMETERS FOR PROPOSED RDA5

Soil Model	Material Type	Material Property (Lower & Upper Bound)		
		Bulk Unit Weight, γ (kN/m3)	***Effective Cohesion, c' (kN/m2)***	***Effective Angle of Friction, ϕ' (°)***
EMBANKMENT FILL	Cohesive (upstream zone only)	20.0	10 & 5	26 & 30
	Granular	18.0	2.5 & 0.0	34 & 40
EMBANKMENT COVER LAYER (UPSTREAM)	Cohesive	20.0	5	28
	Granular	18.0	0	30
FOUNDATION	Cohesive	20.0	15 & 5	26 & 30
	Granular	18.0	2.5 & 0.0	34 & 40
	Bedrock (impenetrable layer)	N/A	N/A	N/A

1.4.2.3 DESIGN GROUNDWATER CONDITIONS

A design piezometric surface at approximately 23 m (75 ft) depth was generally used in the analyses to represent the regional ground water table in the underlying limestone aquifer.

Furthermore, a typical range of pore water pressure coefficients (Ru values) from 0.0 to 0.2 were applied to determine the sensitivity of pore water pressures changes being generated:

- Within the saturated upstream cohesive embankment fill due to construction processes or reservoir water impoundment variations;
- Within the near surface downstream granular embankment fill as a result of extreme seasonal precipitation effects.

1.4.2.4 DESIGN SEISMIC CONDITIONS

Horizontal pseudostatic accelerations ranging from between 0.0g and 0.25g were also adopted in the dynamic stability analyses to model potential earthquake ground shaking effects (ie. horizontal seismic coefficient kh_h = 0.0 to 0.25).

The design methodology/approach and range of values used are similar to those employed in the previous “non-complex” seismic studies undertaken.

1.4.2.5 CONCLUSION

For the design long term and seismic conditions modelled, the proposed RDA5 perimeter embankment has satisfactory factors of safety.

1.4.2.6 RESIDUE DEPOSITION

All mud slurry will be routed through the existing Paste Thickener, dewatered to between 31-34% solids and pumped to RDA 5 by means of the existing centrifugal underflow mud slurry pumps.

Residue will be deposited from the existing RDA 2 West embankment i.e. from the East side of the proposed RDA 5 and will naturally slope from East to West. There will also be a facility to discharge from the North (part only) and South edges of the proposed RDA 5. There will be no central discharge points.

The work shall include the fabrication and installation of approximately 4,000'-0" of 16" diameter piping from the discharge flange of the existing Paste Thickener mud slurry pumps and along the circumference of RDA 5. A new 16" line will be installed along the West and North (part only) embankments of RDA 5. The existing line along the North of RDA 4 will be utilised by turning alternate mud droppers to discharge into RDA 5. In addition, the work shall further include the fabrication and installation of approximately forty (40) mud droppers along the circumference of RDA 5.

The advantages of thickened tailings disposal coupled with dry stacking, is that it offers

- a stable mass during the life of the facility
- a higher storage density per unit area than wet disposal
- high shear strength
- high bearing capacity

The high bearing capacity offered by this technology is of importance during the rehabilitation and closure of a storage area as it facilitates early rehabilitation after closure, allows access to the disposal area for pipe installation or modification during the operating life of the area.

This technology will make possible the storage of an additional 19 million tonnes of residue in RDAs 2, 3 and 4 over and above the wet storage capacity, and 14 million tonnes of residue in a 100 hectare facility such as RDA 5. This will be accomplished without having to construct larger dikes for RDA 5.

1.4.3 OTHER COMPONENTS

1.4.3.1 LAKEWATER RETURN SYSTEM

The RDA 5 Lakewater Return System will be similar to the existing system in RDA 3 / 4. Pumps will be located on a pontoon to be located in the SW corner of RDA 5, and lakewater pumped to RDA 2.

1.4.3.2 OXALATE STORAGE CELL

An Oxalate Storage Cell is required within RDA 5. The Oxalate Storage Cell is to be in the NE corner of RDA 5, and to be of a similar general arrangement as the existing Oxalate Cells in the corners of RDA 3 and RDA 4.

The Oxalate Storage Cell is to provide 90,000 m^3 final storage capacity. The Stage I Oxalate Storage Capacity is 50,000m^3 (i.e. prior to raising the embankment to design final level +195 ft.) The splitter embankment will be raised and the North embankment locally raised, as appropriate, to achieve this Stage I capacity. The concept design considers a wide base to the splitter embankment reducing at constant side slope of 1.75H : 1V to the design final crest level.

1.4.3.3 STORMWATER STORAGE

RDA 5 is designed to accommodate surface run-off from rainfall falling on RDA 5 only and the design case is 100% run-off from a single 1 in 100 year rainfall event. It is intended that immediately after this rainfall event, storm water would be transferred by pumping rapidly to RDA 2. The sizing of this pumping system is part of the detailed mechanical design, it is proposed for the pumping system to be designed to allow removal of this storm water to RDA 2 within 3-5 days. The run-off storage capacity of RDA 5 will become critical only towards the end of its Stage I life. It may make sense to upgrade the pumping system only at this time, or to raise the perimeter embankments before this time.

It is often preferable for water to run off by gravity to a local storm pond, and to be pumped away from there. There is no provision for this in the design of RDA 5. It is accepted that part of RDA 5 will remain flooded for a short time as water is pumped off. Jamalco's present strategy is to have sufficient storm water surge capacity available to contain all rainfall events and with zero discharge.

Jamalco’s plan is to dredge 2.0 million m3 from RDA 2 and dewater to this dredged level, to provide further storm water surge capacity. Milestones will be to create an additional 1.0 million m3 water storage capacity by the end of November 2006, and the full amount of 2.0 million m3 by the end of 2007.

Implicit in this strategy for RDA 5 is maintaining a minimum pool level before rain and to have sufficient pumping capacity to raise excessive stormwater runoff up into RDA 2.

1.4.3.4 STORMWATER DRAINAGE

Rip rap and gravel in wire wrapped mattresses will be required to avoid erosion due to stormwater runoff at select locations on both the inside and outside embankment slopes.

Stormwater run-off from the embankments will run over the protective cover to the liner and collect at the base of the slopes. Particularly on the existing RDA 2 and RDA 4 slopes, there is considerable catchment and during heavy rainfall events, there is the potential for the exposed sand drainage blanket to be washed away by the accumulation of rainfall runoff flowing along the toe towards the south west corner sump. Rip rap with a width of 15m with a depth of rip rap of 0.75m will be placed over the sand layer and geofilter fabric along the toes of the internal slopes.

On the outside slopes of the new perimeter embankments, there will be surface channels at select locations allowing controlled stormwater discharge downslope from the crest. The external earth embankments will be hydro-seeded, with maintenance watering carried out to establish adequate vegetation cover.

1.4.4 EXTENSION TO PASTE THICKENER EMBANKMENT

The existing Thickener Embankment Platform will be extended, as part of the RDA 5 project. This is for the purpose of possible future installation of a second Paste Thickener and/or Residue Neutralisation Facility. The extension of the existing Embankment is required on the north side of the existing platform, and will result in a doubling of the existing level platform at RL 195 ft.

The earthworks would involve taking the existing "rectangle" of level platform at approximately RL 195 ft, adjoining the RDA 2 West Embankment, and constructing an embankment extension that would give another "rectangle" of the same level platform area adjoining the existing platform and the RDA 1 W embankment.

The existing Access Ramp is constructed to the same specification as the existing embankment, and may be retained as part of the Embankment Extension. The part of the access ramp not in the new works will be removed as a source of material and to increase tailings storage. A new Access Ramp in the north east corner of RDA 5 will be required.

1.4.4.1 CONSTRUCTION PHASES

As with all major construction projects, this project will be implemented in phases. Activities proposed for RDA 5 encompass the following 3 basic phases:

1. Pre-construction
2. Construction, and
3. Operational phases

1.4.4.1.1 PRE-CONSTRUCTION PHASE

Pre-construction will involve the following activities:

a) Demolition and removal of interferences other than earthen structures enclosed within the exterior toe lines of the new dikes. The area proposed for location of RDA 5 is relatively bare and has no major interferences.
b) Removal of any boulders that may be in the area and cannot be used in the project.
c) Clearing and grubbing of all vegetation such as brush roots, stumps and bushes within the specified project area, including clay and sand borrow areas.
d) Stripping of approximately 4 to 18 inches of top soil which will be stockpiled and stored for landscaping and revegetation of the external dike walls.

1.4.4.1.2 CONSTRUCTION PHASE:

Construction activities will involve the following:

a) Excavation and stockpile of materials (area has good quality clay deposits).
b) Loading, hauling and unloading of excavated material for use in the construction of the ramp for the dike areas and for the actual dike construction. The areas

where this material will be used include the sloped dike clay seal, the bottom areas to be clay sealed and intermediate stockpiling areas within the interior dike toe lines for later use in dike and bottom construction.

c) Excavation of sand and clay from borrow areas located in proximity to the proposed RDA. Approximately 620,000 m^3 of sand and 460,000 m^3 of clay will be required to complete the RDA.
d) Spreading and compaction of materials in the bottom of the lake and dike areas. Spreading of materials will be uniform to ensure that a homogenous thickness is achieved. The materials will be compacted and brought to suitable moisture content levels which will be achieved through aeration and spraying. These activities are necessary to facilitate proper compaction levels.
e) Installation of drainage piping network.
f) The outer slopes will be stabilised after compaction with the placement of top soil and hydroseeding. Slopes will be maintained at 2:1, so that proper drainage will occur protecting slopes from erosion caused by water run-off.

The sand and clay borrow areas will be graded, capped with topsoil and allowed to undergo natural re-colonisation.

1.4.4.1.3 OPERATIONAL PHASE:

During this phase, residue slurry from the plant will be pumped to the paste thickener from which the paste will be pumped to the stacking areas, allowed to drop onto the existing stack where it will lose additional moisture and stabilise in the RDA. Collected leachate will flow to a collection sump from where it will be pumped into a storage area.

Regular observation, maintenance and verification of the integrity of the RDA will be conducted, the same as is done for the other 4 RDAs at the Jamalco facility.

1.5 SOURCES OF CONSTRUCTION BORROW MATERIAL

1.5.1.1 GENERAL

Suitability of the borrow materials will be assessed from the ground investigation results during the detailed design. Materials compliance testing will be ongoing during construction, and a suitably qualified geotechnical engineer will be on staff to undertake inspections during the earthworks.

Ground water is not generally present in the clay borrow area. However, a water management strategy will be put in place for stormwater runoff and collection in the clay borrow pit. Groundwater is expected, dependant on the flow in the river, in the sand borrow area located in the flood plain. Temporary stockpiling of sand may be required, should it be feasible to place the sand drainage blanket during periods of high river flow.

1.5.1.2 RESERVOIR FLOOR

To level the reservoir floor about 550,000 cubic metres (720,000 cubic Yards) of material will be excavated. Most of this will be suitable for Type B fill material and can either be used to fill the lower areas of the reservoir floor or in embankments.

1.5.1.3 CLAY BORROW AREA

The electrical resistivity survey to the north of the proposed RDA5 footprint revealed the presence of a clay unit that could provide suitable material for the RDA5 basal and side clay liner. Ten boreholes were constructed with a Dando cable-percussive rig to a maximum depth of 15.5m BGL (51ft BGL) to verify the presence of the clay and to provide samples for confirmatory laboratory testing. About 800,000 cubic metres (1,050,000 cu. yds) of clay have been located in this area. Overburden above the clay would be suitable for Type B fill. The quantity of this overburden is about 250,000 cubic metres (330,000 cu. yds).

1.5.1.4 SAND BORROW AREA

An area of sand in the flood plain of the Rio Minho, which was previously exploited during the construction of RDA's 3 and 4, was investigated as a potential source of material for the drainage blanket at the base of RDA5. Fifty machine excavated trial pits were dug to identify the nature of the material and the likely quantities available. This work was carried out in a number of phases, to locate sand with a low fines content which tended to be present closer to the Rio Minho.

1.5.1.5 GENERAL FILL BORROW AREA

There is a shortfall of about 900,000 cubic metres (1.200,000 cu. yds) of general fill (Type B) required for the proposed construction after excavation for the RDA 5 floor. Material which is not suitable for Type C drainage sand from the area investigated for sand would be suitable for Type B. Another area north west of RDA5 (adjacent to the clay borrow area described in Section 6.3) was investigated with 13 machine dug trial pits and large quantities of silt/clay were found which would be suitable for Type B. At least 800,000 cubic metres (1,050,000.yds) have been found in this area.

Together with the 250,000 cubic metres (330,000 cubic yards) of overburden in the clay borrow area and material unsuitable for Type C in the sand borrow area, enough Type B material is available. The general fill borrow area could be extended, subject to geotechnical investigation, if a shortfall in Type B material is expected towards the end of construction.

1.6 EQUIPMENT LIST

Jamalco RDA 5 Project **Rev 2**
Plant & Equipment List **Revised 31-Aug-05**
COMBINED LOCAL & OVERSEAS HIRE

TABLE 1-4: PLANT AND EQUIPMENT LIST

Item	Model (or similar alternative)	Rating	No. to be mobilised
Imported Earthworks			
Dump Truck	Cat D400E ADT	36.5te 22.0 m3 6x6 ADT	**24**
Dozer	Cat D6R LGP	123kw, 18te	**2**
Dozer	Cat D6R Regular	123kw, 18te	**1**
Dozer	Cat D7 or similar	To push out soil tipped by ADTs	**3**
Water Bowser	Cat D400E ADT	36.5te 22.0 m3 6x6 ADT	**4**
Grader	Cat 16H	205kw, 27.3te, 4.88m blade	**2**
Soil Dozer / Compactor	Cat 815F SP padfoot	164kw	**2**
4WD Tractor + plough	Case MX270	300HP	**2**
Tyre Service Truck	with Hi-ab crane boom	6x4 Dropside truck , 12.6te	**1**
Fuel Bowser	Bedford 6x4 16m3		**1**
Excavator	Cat 365BME	287Kw / 385 HP, 2.3-3.5m3	**3**
Excavator	Cat 345		**1**
Service Truck		16te GVW 4x4	**1**
13t SP Vibratory Roller	Smooth Drum	Smooth Drum	**3**
19t SP Vibratory Roller	Bomag BW219 SP	Smooth Drum with padfoot shells	**3**
Subtotal			**53**
Local Hire Earthworks			
Motorscraper	Cat 631E	365 kw 21 / 31 yd3	**8**
Dozer	Cat D9R	302kw, 48te	**2**
Dozer	Cat D8	212kw, 37te	**1**
Dozer	Cat D6R LGP	123kw, 18te	**1**

Item	Model (or similar alternative)	Rating	No. to be mobilised
Dozer	Cat D6R Regular	123kw, 18te	**1**
Grader	Cat 16H	205kw, 27.3te, 4.88m blade	**2**
Excavator	Cat 330	166 kw, 34t, 1.1-2.1m3	**2**
Tipper (general)		6x4 16.5m3 / 25te	**9**
Tipper (earthworks)		6x4 16.5m3 / 25te	**8**
Water Bowser		6x4 16m3	**2**
13t SP Vibratory Roller	Smooth Drum	Smooth Drum	**1**
Subtotal			**37**

1.7 CIVIL AND GEOTECHNICAL ENGINEERING

Extensive civil and geotechnical assessments were conducted in support of this project. A wide cross-section of professionals, technologies and techniques were brought together to generate data and information to verify the capacity of the selected area to house the RDA and to insure that if constructed to the appropriate factors of safety, it would be unlikely that the RDA would experience a major failure.

As well as boreholes and test pits, a geophysical investigation method was employed incorporating Resistivity imaging using a CAMPUS Tigre 64 system. This was used to map the depth to the Limestone Subcrop and to characterize the materials in this zone.

Resistivity imaging methods were used to perform this task. The survey consisted of 6 (no.) profiles orientated north-south over the survey area, with 12 (no.) traverses orientated east-west. These were spaced at approximately 150 m centres. Analysis of the results produced a cross-section along each resistivity line, which highlighted the vertical and lateral changes in the subsurface layering. Depth to the Limestone Subcrop was highlighted in the sections as a continuous layer at depth, and this was transferred into a contour map over the survey areas.

Resistivity data was collected and found to be of good quality with similar values being observed across all the survey areas. The geological interpretation of the resistivity surveys is based on the four categories of subsurface materials identified (three categories of Alluvium and one of Limestone). Generally the near surface resistivity values display values that have been attributed to the Rio Minho alluvium identified in the boreholes. Lower than average values are associated with clay-rich or saturated deposits and high values with dry deposits or gravels.

The majority of the surveys also displayed a sharp increase in resistivity at depth, which through correlations with boreholes has been identified as underlying weathered limestone of the Newport Formation.

The geological interpretations presented have been based on correlation with borehole data, which together with the extensive nature of the site dictates that the ground model presented in the drawings is general.

The results of the geotechnical field investigations to date (geophysical and borehole) indicate that the area is suitable for the installation and operation of the intended RDA. Given that the site is underlain by Newport Formation Limestone that is reported to be karstic and to contain cavities elsewhere in Jamaica, a micro-gravity study has been scheduled to confirm/deny the possibility of there being large sinkholes under the site sufficiently close to the surface to present potential stability problems to the RDA.

Review of currently available GI information on sinkholes leads us to the conclusion that an approach to consider them as part of the construction works is required. It is emphasised that risk from a sinkhole cannot be completely removed; an approach to reduce risk to a level acceptable to Jamalco is summarised below:

1. Microgravity survey the whole plan area of RDA 5 to look for large (say > 10 m across sinkholes). Review results and proof drill (rotary percussive rock drill) as necessary.
2. Microgravity survey of the site area where the limestone is close to the proposed floor level (say within 5 m depth) to look for smaller sinkholes up to about 5 m across. Review results and proof drill as necessary to identify areas suitable for dynamic compaction.
3. Options to consider for remediation of a large sinkhole include drilling and filling the hole with a low mobility grout, and where feasible not constructing the RDA over the sinkhole.
4. Identified areas of shallow, smaller sinkholes where the limestone is closer to the floor should be treated with dynamic consolidation.
5. Reinforcement of the underside of the liner with geogrid. The extent is not easy to quantify at this stage and further work will be required once the size and nature of any sinkhole identified is better understood.

1.7.1 EARTHWORKS

Various compaction tests are ongoing to demonstrate that Standard Proctor may be used as a reference for all materials. Some modifications to the earthworks specification used for RDA 3 & 4 are anticipated, with some of the changes resulting from proposed trials described below. For continuity, the categorisation of materials used for the raising of RDA's 3 and 4 will be adopted for RDA 5, which was:

Type A – Impervious fill with k < 10 x 10-9 m/s (0.1 ft/yr). These soils can be defined under the Unified Soils Classification System (USCS) as CH, CL, MH or ML materials. In other words it has more than 50% passing No.200 sieve.

Type B – General fill needs to have sufficient shear strength to form the embankments and where used to regulate the reservoir base it must be relatively incompressible. Our current understanding is that most of the material found within RDA 5 above the formation level will be suitable (other than those which can be used as Types A & C).

Type C – Drainage material. This will have a relatively low coefficient of uniformity. It will be fine gravel and sand, hopefully with less than 5% fines.

Excavation methods will be selected to mix the excavated material vertically and in so doing minimise the requirement for any subsequent blending, sorting or mixing.

It is intended to provide a statistically based requirement for compaction in the specification for earthworks. This will allow a percentage of results below the required average and (similar to concrete testing) will require the plotting of moving averages. Action will be needed if the results show sudden changes or an adverse trend. This method allows much more flexibility in assessing compaction test results than a fixed cut-off value.

The aims of the compaction trial for each material category are:

- Type A - to determine the compactive effort to achieve 95% Standard Proctor Maximum Dry Density (SMDD) at Standard Optimum Moisture (SOMC) to SOMC + 2.5%, and that the resulting material has a permeability less than 10 x10-9 m/s (0.1 ft/yr).
- to demonstrate that the Material Type B can be compacted using reasonable compactive effort to 100 % SMDD at SOMC +or - 1.5%. Field permeability tests will be undertaken to assess the permeability of Type B materials.
- to confirm that Material Type C has adequate permeability for a drainage blanket when compacted in field conditions. The compaction target is 70% relative dry density. (ASTM D4254)

- to calibrate the nuclear densimeter and hand penetrometer with the materials to be used.

The testing done has demonstrated that relatively light equipment is adequate to achieve the required compaction. During the construction works further trials may be used to demonstrate that heavier plant working on thicker layers can achieve the same density with greater cost efficiency. It is also intended to demonstrate in the compaction trials that materials can be adequately moisture conditioned in the works. At this stage it is estimated that between 5 and 8% moisture will have to be added.

1.8 DUST SUPPRESSION SYSTEM

1.8.1 GENERAL

A Dust Suppression System will be installed suitable to provide adequate sprinkler dust suppression over the entire plan area of the proposed RDA 5.

The work shall include the installation of one (1) new Water Production Well and one (1) new submersible pump at a location to be determined. The work will also include the fabrication and installation of approximately 7500' of 16" Dia. pipe at RDA 5 along a path of its circumference. The work will also include the fabrication and installation of a grid of 12" dia., 10" dia., 8" dia., and 6" diameter piping at various locations along RDA 5. In addition, the work will further involve the installation of approximately 300 Nelson Big Gun Type F100T sprinkler heads at strategic points over the plan area of RDA 5. This work shall serve as the basis of water supply for new dust suppression system at RDA 5.

1.8.2 MECHANICAL

One (1) 20" NPS standard weight casing will be installed to a depth of approximately 230' below the earth surface. One (1) submersible pump will be installed for water supply. Perimeter fencing will be installed for protection of the new submersible well pump station.

1.8.3 PIPING

A16" diameter header, approximately 7500' of fabricated 16" diameter piping from the new well location along RDA 5 will be installed and 12", 10", 8" and 6" diameter piping along with approximately 300 Nelson Big Gun type F100T (Full) sprinkler heads, will also be fabricated and installed.

1.8.4 STRUCTURAL

A concrete foundation and supports for the new submersible pump will be fabricated and installed. Various pipe supports and guides as per specifications set out in drawings will be fabricated and installed.

1.8.5 DUST MONITORING STATIONS

Two new Dust Monitoring Stations will be supplied and installed at locations to be determined on the perimeter embankments of RDA 5

1.9 MONITORING WELLS

A series of wells will be installed to allow monitoring of the groundwater quality, as follows:

- Two new monitoring wells (Ref PWI and PW2) to supplement the existing wells (Ref MW4 and MW5) will be located between RDA 5 and the Rio Minho to meet NEPA monitoring requirements.
- Up to eight new monitoring wells, positioned along the proposed toe of the new perimeter embankments, are also proposed. These would extend to a depth of about 120 feet to intercept the upper levels of the limestone aquifer, where any contamination due to leakage would first be encountered. Testing of recovered groundwater samples will be to NEPA requirements.

1.10 CLOSURE AND REHABILITATION STANDARDS

Jamalco is currently undertaking developmental work to streamline its rehabilitation plan. The current plan involves the minimization of operations in the selected disposal areas targeted for rehabilitation. This will allow the surface to be kept almost free of additional moisture while allowing for normal evaporative processes to take place.

The plan primarily involves three basic activities:

- Dewatering,
- capping and
- grading re-vegetation

1.10.1 DEWATERING

Dewatering is required to lower the phreatic line in the residue to facilitate draining and to allow an increase in shear strength and bearing capacity of the residue. These activities are necessary for subsequent capping.

The dewatering programme will be initiated after the last bauxite residue is deposited in the area, the extent of which will depend on existing or future water levels in the residue disposal area.

At the outset, the liquor level in the area will be lowered to allow rainfall and liquor generated from consolidation to flow out of the area. In addition pumping and other passive dewatering methods will be used to convey accumulated liquor off the lake. By achieving an increased and acceptable level of the solid content at the surface of the residue more *extensive* dewatering methods will be applied.

It is proposed to construct a ditch around the perimeter (inner) of the area to be decommissioned. This will be initiated once the residue has developed sufficient strength to support a ditch without failing. Periodic deepening of the perimeter ditches is critical to the dewatering activities since the residue surface needs to develop the strength to support the ditch geometry.

The deepening of the ditch is dependent on the rate of desiccation which will be accelerated by the use of standard and proven techniques. Once the dewatering activities are sufficiently achieved and the load bearing capacity is developed, capping of the facilities will be initiated.

1.10.2 CAPPING/GRADING AND RE-VEGETATION

Capping the residue with suitable material signals the second phase of the closure operations. Potential capping materials will constitute reject low grade bauxite materials and adjacent native overburden soils; these will be used to accomplish the following main objectives:

- provide a surcharge stress that will cause additional consolidation of the residue,
- reduce or eliminate potential dust emissions,
- provide a growing medium for the re-vegetation phase,

The capping material will be systematically pushed onto the desiccated, dewatered residue surface. The capping activities will sequentially and progressively proceed towards the centre of the residue area from the embankment; this will allow areas that are mud waved to be left unworked to undergo further desiccation.

Initially a thin layer of capping material will be placed on the residue surface and will be followed by further addition of material to achieve a given target thickness and reclaimed topography.

Once the required thickness and topographic characteristics capable of conveying run-off from the reclaimed-lake are in place, the area will be ready for re-vegetation. Materials capable of preventing wind and soil erosion are proposed for the re-vegetation of the rehabilitated areas.

It should be noted that it may be necessary to install a residue stabilization system to assist the dewatering activities and potential problems due to dust emissions.

1.10.3 JAMALCO RESIDUE MANAGEMENT PLAN

Jamalco has initiated a red mud disposal and management plan spanning the period 1995 to 2020 (25 years). This plan will essentially form the base-line against which future disposal of red mud will be assessed and evaluated, in addition, detail plans and strategies for the closure and rehabilitation of the residue disposal facilities are addressed.

A constant production rate of 849,000 tonnes of alumina per annum and a residue to alumina factor of 1.08 tonne/tonne forms the basis of the residue management plan. It is proposed that at the end of the planning period a total of 34 million tonnes of residue will be stored in five residue deposits covering approximately 400 hectares of land (including the existing RDAs). The fundamental principles captured by the residue disposal plan intend to achieve two major objectives, these being:

- to maximise the storage of residue in areas already allocated for this purpose.
- to utilize the best available technology for residue management. This technology should minimise negative environmental impacts, co-exist and comply with tightening governmental regulations while meeting community expectations and Alcoa's residue standards.

The objectives itemised above formed the basis for the analysis of alternatives considered by Jamaica.

1.11 NATURAL HERITAGE RESOURCES

The Company's activities take a particular interest in preserving existing and potential historical sites within the project area. The operations are guided by and must comply with the Jamaica National Heritage Trust and Alcoa's World Alumina strict Environment, Health and Safety Standards. In addition to any resource already identified, every effort will be made to further identify, locate and document anything that can be considered significant from a cultural or natural heritage perspective. Pre-construction through the operational phases of the project will be managed to avoid or handle appropriately (through direction from the Jamaica National Heritage Trust all such features that may be encountered.

Policy, Legislation and Regulations

2 POLICY, LEGISLATION AND REGULATIONS

2.1 POLICY, LEGAL & ADMINISTRATIVE FRAMEWORK

This section provides a background on Alcoa's (Jamalco) Environmental Policy and International & National Policies, Legislation and Regulations applicable to the proposed expansion of the Jamalco facility (Residue Disposal Areas).

2.1.1 ALCOA'S POLICIES, PRINCIPLES AND GUIDELINES

2.1.1.1 ALCOA'S ENVIRONMENTAL POLICY

The Jamalco facility, under the management of Alcoa, strives to meet or exceed all environmental policies and regulations locally and within its corporate structure. As such, the facility is operated under strict guidance and guidelines to insure compliance at all levels of operation. The following information is derived from the existing Jamalco Environmental Policy Document.

It is Alcoa's policy to operate world-wide in a manner which protects the environment and the health of our employees and of the citizens of the communities where we have an impact.

- ✓ We will comply with all applicable environmental laws, regulations and permits, and will employ more restrictive internal standards where necessary to conform with the above policy.
- ✓ We will anticipate environmental issues and take appropriate actions which may precede laws or regulations.
- ✓ We will work with government and others at all levels to develop responsible and effective environmental laws, regulations and standards.
- ✓ All Alcoans are expected to understand, promote and assist in the implementation of this policy.

2.1.1.2 ALCOA'S ENVIRONMENTAL PRINCIPLES

In support of Alcoa's Environmental Policy, the following principles have been developed to provide additional direction on specific issues. The implementation plan, which follows, provides details on how the Policy and Principles will be carried out.

- ✓ *We will support Sustainable Development*
- ✓ Alcoa will incorporate sustainable development into our operations by integrating environmental considerations into all relevant business decisions. We will achieve cleaner production through programs of waste minimization and pollution prevention with specific and measurable reduction targets.
- ✓ *We will practice responsible use of natural resources*
- ✓ Alcoa will utilize the best available information to plan and execute all projects that involve extraction of raw materials, or which may restrict the use of natural resources or impact ecosystems.
- ✓ *We will utilize techniques accepted as best practices on a worldwide basis for resource extraction, resource use, waste management, and rehabilitation of ecosystems disturbed by our activities.*
- ✓ *We will use energy wisely*
- ✓ Alcoa will strive to maximize efficient energy use, conserving non-renewable resources.
- ✓ *We will practice sound environmental management*
- ✓ Alcoa will integrate environmental management fully with business and operating management to ensure that long-term and short-term environmental issues are considered together with market and economic aspects when decisions are made about new and existing facilities, processes, products, services, acquisitions and divestitures.
- ✓ *We will provide training and information*

- ✓ Alcoa will sponsor training in the environmental area. We will also provide employees, suppliers, customers and neighbours with information needed to understand and help us achieve the goals of our environmental policy.

- ✓ *We will audit our operations and report findings*

- ✓ Alcoa will audit each of its operations on a regular basis to identify strengths and weaknesses of the location's environmental management process and to identify actions that need to be taken to prevent environmental problems or correct environmental deficiencies. Appropriate management, including the Alcoa Board of Directors, will be informed of the audit findings.

- ✓ *We will sponsor activities to improve the science of environmental protection.*

- ✓ Alcoa will sponsor and conduct research and development (including application of emerging technologies) to improve our ability to predict, assess, measure, reduce, and manage environmental impacts of our operations. We are committed to continuous improvement in all aspects of our environmental performance.

- ✓ *We will develop and adhere to high standards.*

- ✓ Alcoa will develop and implement worldwide environmental standards and best practices with emphasis on areas that are unique to our business.

- ✓ *We will report on our activities*

- ✓ Alcoa will communicate promptly and openly with individuals and communities regarding the environmental aspects and impacts of our operations, as well as with concerned parties who request such information. Alcoa will also provide an annual Environmental Health and Safety report that describes our programs, plans and performance. The report will be made available to shareholders and the public.

2.2 LOCAL POLICIES, LEGISLATION AND REGULATIONS

2.2.1 POLICY, LEGISLATION, REGULATIONS & STANDARDS

The following represents descriptions of applicable legislative requirements with which activities of this proposed upgrade must comply:

- Agenda 21
- Natural Resources Conservation Authority (NRCA) Act, 1991
- Wildlife Protection Act, 1945
- Watershed Protection Act, 1963
- Town & Country Planning Act, 1987
- Forestry Act, 1937
- Water Resources Act/Underground Water Control Act, 1959
- Jamaica National Heritage Trust Act, 1985
- Public Health Act, 1985
- Disaster Preparedness & Emergency Management Act, 1993
- National Solid Waste Management Authority Act, 2001
- Occupational Safety & Health Act, 2003 (DRAFT)
- Clarendon Parish Provisional Development Order, 1982

2.2.1.1 AGENDA 21

In June 1992, Jamaica participated in the United Nations Conference for Environment and Development (UNCED) in Rio de Janeiro, Brazil. One of the main outputs of the conference was a plan of global action, titled Agenda 21, which is a “comprehensive blueprint for the global actions to affect the transition to sustainable development”

(Maurice Strong). Jamaica is a signatory to this convention. Twenty seven (27) environmental principles were outlined in the Agenda 21 document. Those relevant to this project, which Jamaica is obligated to follow are outlined below:

The United Nations hosted the EARTH SUMMIT '92 and from this conference twenty - seven (27) environmental principles were outlined. Not all of these principles are applicable to the project but those deemed relevant and appropriate are outlined below.

2.2.1.2 NATURAL RESOURCES CONSERVATION AUTHORITY ACT, 1991

The Act is the overriding legislation governing environmental management in the country. It also designates National Parks, Marine Parks, Protected Areas and regulates the control of pollution as well as the way land is used in protected areas.

This Act requires among other things, that all new projects or expansion of existing projects which fall within a prescribed description or category must be subjected to an Environmental Impact Assessment (EIA).

The regulations require that eight (8) copies of the EIA Study Report must be submitted to the Authority for review. There is a preliminary review period of ten days to determine whether additional information is needed. After the initial review the process can take up to ninety days for approval. If on review and evaluation of the EIA the required criteria are met, a permit is granted.

Specifically, the relevant section(s) under the Act which addresses the proposed mining activities are:

s.10: (1) Subject to the provisions of this section, the Authority may by notice in writing require an applicant for a permit of the person responsible for undertaking in a prescribed area, any enterprise, construction or development of a prescribed description or category-

(a) to furnish the Authority such documents or information as the Authority thinks fit; or

(b) where it is of the opinion that activities of such enterprise, construction or development are having or are likely to

have an adverse effect on the environment, to submit to the Authority in respect of the enterprise, construction or development, an EIA containing such information as may be prescribed, and the applicant or, as the case may be, the person responsible shall comply with the requirement.

s.12: Licenses for the discharge of effluents etc.

s.17: Information on pollution control facility

s.18: Enforcement of Controls – threat to public health or natural resources

s.32-33: Ministerial Orders to protect the environment

s.38: Regulations

2.2.1.3 WILDLIFE PROTECTION ACT, 1945

This act involves the declaration of game sanctuaries and reserves, game wardens, control of fishing in rivers, protection of specified rare or endemic species. The Act also provides for the protection of animals and makes it an offence to harm or kill a species which is protected. It stipulates that, having in one's possession "whole or any part of a protected animal living or dead is illegal.

This Act has to be considered for the proposed project, ecological assessments will determine if rare or endangered species will be impacted.

2.2.1.4 WATERSHED PROTECTION ACT, 1963

This Act governs the activities operating within the island's watersheds, as well as, protects these areas. The watersheds which are designated under this Act include Rio Minho, Cane River and Rio Nuevo watersheds areas.

Determinations will be made to identify any potential impacts that this project may have on the various watershed areas and will propose mitigative actions where impacts are identified.

2.2.1.5 TOWN & COUNTRY PLANNING ACT, 1987

This Act governs the development and use of land. Under this law the Town Planning Department is the agency responsible for the review of any plans involving industrial development. The law allows for specific conditions to be stipulated and imposed on any approved plans. This planning decision is based upon several factors, these include;

- the location of the development
- the nature of the industrial process to be carried out
- the land use and zoning
- the effect of the proposal on amenities, traffic, etc.

This Act is applicable to the proposed plant and port upgrades and mining activities.

2.2.1.6 3.2.1.6 FORESTRY ACT, 1937

This Act provides for the management and the declaration of Forest Reserves on Crown Lands and regulates activities in Forest Reserves. This Act will be reviewed to determine if the upgrade activities (particularly mining) will impact on Forest Reserves and to what extent.

2.2.1.7 3.2.1.7 WATER RESOURCES ACT; THE UNDERGROUND WATER CONTROL ACT, 1959

The Underground Water Control Act of 1959 is the legal instrument and is enforced by the Water Resources Authority (WRA). The Water Resources Act is expected to provide for the management, protection, controlled allocation and use of water resources of Jamaica. Thus the water quality control for both surface and ground water are regulated by this Act.

If the proposed facility intends to utilize any existing ground water, permission would be needed, in the form of an issued license for this activity. Under this Act exploratory activities such as the boring/drilling of wells for the purpose of searching for underground water without the written consent would be a violation.

In addition, any activity which negatively influences the quality of existing water, whether ground or surface, would be relevant to this Act.

The proposed project will impact on:

- Ground water resources as it proposes, to increase ground water extraction rates.

2.2.1.8 3.2.1.8 JAMAICA NATIONAL HERITAGE TRUST ACT, 1985

The Act is administered by the Jamaica National Heritage Trust, formerly the Jamaica National Trust. This Act provides for the protection of important areas, including the numerous monuments, forts, statues, buildings of historic and architectural importance in Jamaica.

In the approved mining area (SEPL 530), several historic sites and buildings have been identified within the general area of this project; these include several churches, schools, Great Houses and natural features of significant importance to our heritage.

During this project, an Archaeological and Heritage Retrieval Plan will be implemented to protect any historical or archaeologically significant item encountered.

2.2.1.9 3.2.1.9 THE PUBLIC HEALTH ACT (1974)

This Act controls and monitors pollution from point sources. Any breaches of this Act would be sent through the Central Health Committee which takes action through the Ministry of Health, Environmental Control Division (E.C.D.). The ECD has no direct legislative jurisdiction, but works through the Public Heath Act to monitor and control pollution from point sources. Action against any breaches of this Act would be administered by the Central Health Committee. The functions of the department include:

- The monitoring of waste water quality, including regular water quality analysis, using water standards published by NEPA;
- Monitoring of occupational health as it relates to industrial hygiene of potentially hazardous working environments;
- Monitoring of air pollutants through its laboratory facilities.

In addition, there are various sections of this legislative instrument which governs and protects the health of the public. Relevant sections under the Public Health Act of 1985, are Sections 7.- (1) *A Local Board may from time to time, and shall if directed by the Minister to do so, make regulations relating to (o) nuisances* and 14.- (1) *The Minister may make regulations generally for carrying out the provisions and purposes of this Act, and in particular, subject to section 7, but without prejudice to the generality of the foregoing, may make regulations in relation to (d) air, soil and water pollution.*

Aspects of the project related to odour have been considered since odour is a part of the Air Emissions regulations to be promulgated in 2004.

2.2.1.103.2.1.10 DISASTER PREPAREDNESS AND EMERGENCY MANAGEMENT ACT, 1993

The principal objective of the Act is to advance disaster preparedness and emergency management measures in Jamaica by facilitating and coordinating the development and implementation of integrated disaster management systems. Jamalco has established procedures and guidance documents in place in terms of disaster preparedness and emergency management.

2.2.1.113.2.1.11 NATIONAL SOLID WASTE MANAGEMENT AUTHORITY ACT, 2001

The National Solid Waste Management Authority (NSWMA) under this Act has the responsibility to manage and regulate the solid waste sector. It includes requirements for licences for operators and owners of solid waste disposal facilities (in addition to permit requirements of NEPA).

2.2.1.123.2.1.12 OCCUPATIONAL SAFETY & HEALTH ACT, 2003 (DRAFT)

This Act oversees the prevention of injury and illness resulting from conditions at the workplace, the protection of the safety and health of workers and the promotion of safe and healthy workplaces.

Sampling of sections from the Draft Act that are relevant to this project, include:

4. (1) This Act applies to all branches of economic activity and to all owners, employers and workers in all such branches.

5. (1) The owner of every industrial establishment or mine which carries on business on or after the appointed day shall, subject to subsection (8), apply to the Director in the prescribed form to be registered under this Act.

18. (1) Provides a description of the duties of employers, outlining the need for quality work areas and work environments, procedures and guidelines that will result in safe and healthy workplaces.

19. (1) discusses the duties of employers at construction sites in terms of employee safety and health during work activities.

25. (1) an employer shall make or cause to be made and shall maintain an inventory of all hazardous chemicals and hazardous physical agents that are present in the workplace.

26. (1) this section provides guidelines and procedures for employers to follow in terms of identification of hazardous chemicals. This includes labeling and identification protocols.

30. (1) Basically, this section of the Act requires an employer to provide training of its employees with a potential for exposure to hazardous chemicals or physical agents.

It is expected that this Draft Act will be Gazetted in the near future. As such, it is important that Jamalco have an understanding and appreciation for its contents.

2.2.1.13 Clarendon Parish Provisional Development Order, 1982

This document provides the development plan for the Parish of Clarendon. It clarifies the role and responsibility of the local planning authority and provides guidance on how development of the parish should proceed. All activities in this proposed upgrade of the Jamalco operations that requires local planning authority approval will be properly identified and the appropriate permits and licenses will be secured.

Special note: The Jamaica Bauxite Institute (JBI) is the regulatory agency monitoring the bauxite industry, and as such their policies will extend to any development on bauxite owned lands.

2.2.2 SUMMARY OF THE LEGISLATION AND RESPONSIBLE AGENCIES

TABLE 3-1: NATIONAL LEGISLATION AND RESPONSIBLE AGENCIES

LEGISLATION	INSTITUTION RESPONSIBLE
NRCA Act, 1991	Natural Resources Conservation Authority
Wildlife Protection Act, 1945	Natural Resources Conservation Authority
Watershed Protection Act, 1963	Natural Resources Conservation
Town & Country Planning Act, 1987	Town Planning Department
Forestry Act, 1937	Forestry Department
The Water Resources Act/UWC Act, 1959	Water Resources Authority
Ja. National Heritage Trust Act, 1985	Jamaica National Heritage Trust
Public Health Act, 1985	Ministry of Health/Environmental Control Division
Disaster Preparation & Emergency Management Act, 1993	Office of Disaster Preparedness and Emergency Management
National Solid Waste Management Authority Act, 2001	National Solid Waste Management Authority
Clarendon Parish Provisional Development Order, 1982	Town Planning Department