PART III: FEASIBILITY STUDY

D: OLD DUMP SITE SURVEY

PART III-D: OLD DUMP SITE SURVEY

1. Introduction

The old dump site is located in Barangay Balabag, which is situated on the northeastern side on Boracay Island. The MOM started dumping of waste at the dump site in 1996. The site is a privately-owned property leased to the MOM since 1997. In the area, hauled waste was burned to reduce the volume of solid waste but later stopped due to the effects of smoke coming from the site. Only residual waste has been allowed to be dumped in the site since 2002. As RA 9003 forced LGUs to close and rehabilitate all open dump sites in the Philippines, the MOM terminated dumping activities in January 2006. However, it has not taken adequate measures for rehabilitation of the dump site so far. Based on environmental and social perspectives and legislative requirements, it is an obligation for the MOM to implement proper closure measures immediately. In this context, the rehabilitation of the old dumping site has been proposed in the 10-year SWM Plan of the MOM and selected as one of the priority projects for which a F/S has been conducted. The JICA Study Team undertook the detailed site survey to actualize rehabilitation of the old dumpsite.

2. Objectives

The survey aimed to provide sufficient information and data necessary for planning and designing rehabilitation of the old dump site. Specifically, the objectives of the survey on the old dump site are:

- To generate topographic, cross-sections and longitudinal profiles on the dump site and immediate surrounding areas,
- To determine the thickness of wastes deposited at the site,
- To establish the geological setting of the site,
- To determine the nature and characteristics of the geological strata present beneath and adjacent to the site, both unconsolidated superficial materials and lithified bedrock materials,
- To determine the presence and depth of groundwater beneath and adjacent to the site,
- To obtain surface water quality upstream, downstream and within the site and groundwater quality at the site both during dry and wet seasons,
- To obtain the presence of landfill gases and record odor at and adjacent to the site,
- To document other relevant environmental conditions,
- To produce technical options for considerations of necessary rehabilitation work, and
- To estimate costs based on the bill of quantity and the unit cost received from relevant authorities.

3. Scope of Works

The survey covered four major components. These are: 1) Topographic Survey, 2) Geological, Geotechnical and Hydro-geological Survey, 3) Environmental Survey and 4) Desk Study. For the geological and environmental aspects, a desk-based study was initially undertaken to collate all available secondary information that could be used to direct the level of the succeeding field-based survey.

3.1 Topographic Survey

The survey consists of ground control survey and leveling survey, with sufficient data points acquired to prepare appropriate and accurate topographic maps, longitudinal profiles and cross-sections. Surveying of the entire area using a total station indicate all identifiable objects/structures on the ground like boreholes, groundwater wells, buildings, including the boundary of the dumped waste.

3.2 Geological, Geotechnical and Hydro-geological Survey

A desk-based study was conducted to acquire and collate relevant background information and a field based study included field reconnaissance was conducted to intrusive site investigations, sample recovery and laboratory testing. Investigation of all the available soil profiles and geological information of the site and conduct sufficient field reconnaissance. Borehole drilling, sample recovery and subsequent laboratory testing, and installation of ground water monitoring wells were also conducted.

3.3 Environmental Survey

A desk-based study was conducted to acquire and collate relevant background information and a field-based study includes laboratory testing of water quality of ground and surface waters, monitoring on landfill gas (H_2S, CH_4 and CO_2) by a portable gas detector at the site, and site investigations of current natural conditions such as flora and fauna and social conditions of surrounding residents, facilities, land use and water uses.

3.4 Desk Study

The desk study includes 1) estimation of the area and volume of dumped waste at the site, 2) development of technical options for the rehabilitation of the old dump site with due considerations of the following; slope stabilization, final soil cover, drainage facility and groundwater protection, 3) cost estimations for the different options based on bill of quantities.

4. Methodologies

4.1 Topographic Survey

(1) Reconnaissance Survey and Coordination

As an initial activity, to familiarize with the site condition as well as to ensure the safety of personnel and equipment, the survey team undertook a reconnaissance survey at the site. During the reconnaissance survey, locations of the control stations established by the National Mapping and Resource Information Authority (NAMRIA), Philippine Coast and Geodetic Survey (PCGS) or the Philippine Reference System (PRS) were also identified.

(2) Establishment of Horizontal and Vertical control

From the NAMRIA/PCGS control stations with known established positions and elevations, permanent bench marks were established around the area for horizontal and vertical control. From these secondary control stations, all the survey points (topographic and cross-section) were observed. .A high precision Global Positioning System (GPS) instrument was used to establish both the positions and elevations of the secondary control points that were used throughout the survey work. Using a total station instrument, oriented to a direction/data earlier from the GPS, all positions where the data points were observed and recorded in a data logger, the changes of the ground surface or landscape. In order to produce a planimetric and contour map with the required contour interval, the density and distribution of spot elevation were observed as many as possible.

All planimetric features and structures which are visible or identifiable or interpretable from the ground including land use features, trails, boundaries of wooded areas, fences, orchards, buildings, roads and other features were surveyed, measured and recorded. In addition, all boring locations and other in-situ tests like the movable stake monitoring and soil depth and strength were surveyed and located in the topographic map. Cross-section/profile survey was conducted across and along the slopes at 10 meters interval. The data collected in the memory of the total station instrument was downloaded to a computer to generate the contour map and cross-sections.

4.2 Geological and Geotechnical Survey

This Geological Geotechnical Survey involved the preparation of Engineering Geological Maps and Profiles which include 1) reconnaissance engineering geological mapping on 1: 50,000 scale, 2) semi-detailed engineering geological mapping on 1:5,000 scale, 3) detailed engineering geological mapping on 1:500 scale and 4) preparation of engineering geological profiles. Comprehensive geological, structural and geomorphologic studies coupled with interpretation and logging of borehole samples, and review of existing geotechnical studies were undertaken to produce an accurate results.

4.2.1 Desk Study

lnitial assessment was by literature research and review of previous works on the site including regional and local geological setting, existing geotechnical and drilling reports and other literature relevant to the geology of the area. Information from the Mines & Geo-Sciences Bureau regional offices and other offices/institutions were collected. Field regional structural geological mapping at the site and vicinity are as follows:

- This commences with a preliminary survey to confirm the basic geology of the region and the site including mapping of geological structures and lithology. The geomorphology of the site was also considered. Mapping was done on a regional scale (1:50,000).

  Geo-structural mapping focused more on areas where the following were initially observed.

- Faults, evidence of groundwater such as springs.
- Bare rock slopes, former landslides, unstable rock, wet superficial deposits, active river erosion, subsidence and flood risk, active deposition of sediment.

Detailed engineering geological mapping areas surveyed under semi-detailed scope was followed-up by detailed geo-structural mapping on a 1:500 scale. Mapping was carried out by compass and tape traverse, which also focused on structural weaknesses and geological structures such as beds, fractures and faults.

4.2.2 Subsurface Investigation, Sampling and Test

(1) Boring/Drilling

Borings were performed by rotary drilling method. After drilling, washing and circulation of water had come to a complete halt, a Standard Penetration Test (SPT) was performed. In case of hard core boring, each hole was drilled with a Wire Line Diamond Core Drilling Equipment using suitable sized diamond core bits acceptable to the proponent. Water table measurements were recorded for each borehole during the start and end of the eight (8) hours shift of drilling operation for each day.

(2) Sampling and Penetration Test

- General – described as the taking of soil sample and performing the SPT. The setting was performed for every meter of borehole. This applies the procedures to obtain records of the disturbed samples of the soil for identification purposes and the resistance of sub soils to penetration of a standard sampler.
- Sampling – Done by the conventional rotary wire line drilling and standard or hollow stem-type augers to produce a clean hole without necessary disturbance at the penetration samplers.
- In order to be sure that the bottom of the hole is not disturbed by circulation water, an initial 15 cm driving of the split spoon sampler was undertaken prior to the normal sampling procedure. Immediately after sampling, a representative portion of the soil core from both one foot of the drive was placed in an airtight container and properly labeled.
- Penetration Testing - The penetration resistance of the subsoil was expressed as the number of blows of a one hundred and forty (140) pounds hammer freely dropping thirty (30) inches to force the sampler thirty (30) cm into the soil. In case of fifty (50) or more blows per 30 cms, the penetration test was stopped and coring proceeded.

(3) Core Sample Box

The sample obtained were placed in hinged covered boxes with standard measurements of 1.10 m x 60 cm. x 6 cm. with wood dividers for the lateral separation of the core samples. The boxes were then properly marked/labeled indicating the name of the project, core box number, borehole number and location and extent of drilling. Furthermore, each core box must be provided with wood spacers of about 6 cm long where depth advance, length of run, length of core and percentage of recovery was reflected.

(4) Permeability Test

Immediately before the pressure testing of each stage of any hole begins, the hole is thoroughly washed under pressure. All intersected rock seams and crevices containing clay and other washable materials were washed out as directed by introducing water into the holes. The holes are washed out such time until the return water is clear and no fracture filling is recovered. Pressure testing is to be done immediately after completion of drilling using the double packer assembly or in stages done simultaneously as the hole is being drilled using the single packer assembly. All holes drilled at the project area were pressure tested in fractured / jointed rock formation. The static water level was determined before the start of the test. Water level was then measured inside the packer pipe after the packer has been set. Permeability test by the open-end constant-head method was performed for section which has not cemented yet or intensely weathered/or severely fractured formation to which the packer cannot be installed effectively. Field permeability test using a standard 8" diameter infiltrometer was also undertaken in four locations to determine the rate of infiltration at the soil surface that would help evaluate the kind of soil present in the area.

(5) Test Pitting

Test pits were dug manually with minimum size (area) of 1.2 x 1.2 x 3.0 meters. Materials from the pits were manually removed using shovel. During excavation, the bottom of the hole was kept fairly leveled. At the surface, the excavated material was placed around the pit in an orderly manner to allow logging by the geologist.

(6) Disturbed Sampling

From the test pit materials, soil samples were placed in a plastic bag not less than 10 kg each strata for the physical property test (Gradation test, Atterberg Limit, Specific Gravity test & Soil classification), 0.5 kg was placed in an airtight container for the natural moisture content determination and 50 kg of composite samples for the determination of the Mechanical property (compaction, consolidation, Permeability & Triaxial tests). All soil samples were properly labeled as to project name, test pit, etc.

(7) Drilling of Groundwater Well

Drilling of Pilot Hole

- It involves the drilling of hole with the use of smaller diameter drilling bits for easier and faster penetration.
- It involves the collection of slurry and drill cuttings for lithologic log evaluation.

Reaming of Hole

- It involves the enlarging of the pilot hole in to its final diameter which is 50 mm.

Well Cover

- The extended casing or pipe of the well with the height of about 200 mm above ground, was provided with a 4 inches diameter GI pipe to serve as cover and protection. A locking mechanism is also installed to protect the well from intentional contamination.

4.3 Environmental Survey

4.3.1 Water Environment

Water quality monitoring was programmed both for surface water including seawater and groundwater. Because no surface water was detected during dry season, only sea water taken for this survey. Standard volume of samples, types of containers and preservation were strictly followed. Detailed sampling procedures are as follows:

- In sea or river where water level is deep, a two (2) liter Van Dorn water sampler was used. The principle is to collect sample at known desired depth below the water surface.
- After sampling, the container of each sample was properly labeled/coded to identify the location, date and time of sampling.

The monitoring ponts are shown in Figure D.4.3-1 while the parameters monitored are summarized in Table D.4.3-1.

Table D.4.3-1 Parameters for Water Quality

1	Temperature (on-site observation)	14	Sulphate
2	pH (on-site observation)	15	Sodium
3	Color	16	Potassium
4	Turbidity	17	Calcium
5	DO	18	Magnesium
6	TSS	19	Iron
7	TDS	20	Lead
8	Conductivity (on-site observation)	21	Copper
9	Oil/Grease	22	Cadmium
10	BOD5	23	Chromium
11	COD	24	Total Mercury
12	Chloride as CL	25	Organo-Phosphate
13	Ammonia Nitrogen	26	Total coliform count

Source: JICA Study Team

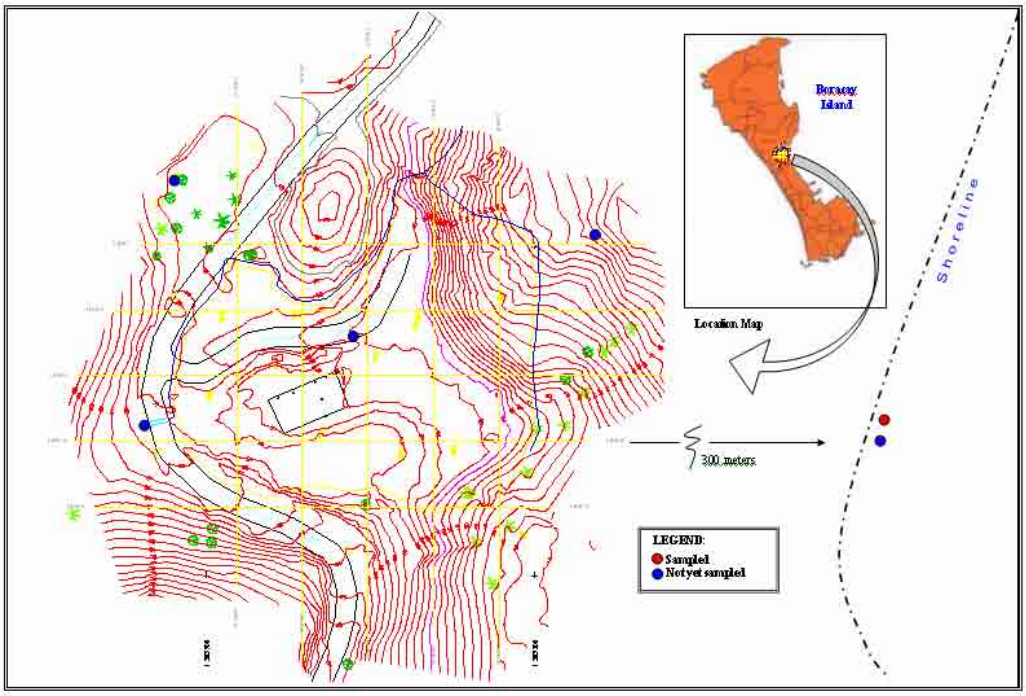


Figure D.4.3-1 Water Quality Sampling Points

Source: JICA Study Team

4.3.2 Air Environment

(1) Meteorological Characteristics

Analysis of hydrologic information was conducted to determine its potential impact by the old dump site. Hydrologic data was obtained from various government agencies and private institution. Most of the climatic and hydrologic data specifically the historical data were taken from PAGASA.

(2) Air Quality (Landfill Gas)

Landfill gas sampling was conducted by using a G450 Portable Gas Detector which is a sensor based instrument. Methane (CH_4), carbon dioxide (CO_2), nitrogen, hydrogen sulfide (H_2S) and ammonium (NH_3) were monitored. Fifteen stations (FigureD.4.3-2) were established for monitoring - the 13 boreholes on the dump site and 2 along the road within 500 meters from the dump site which is projected to fall within the radius..

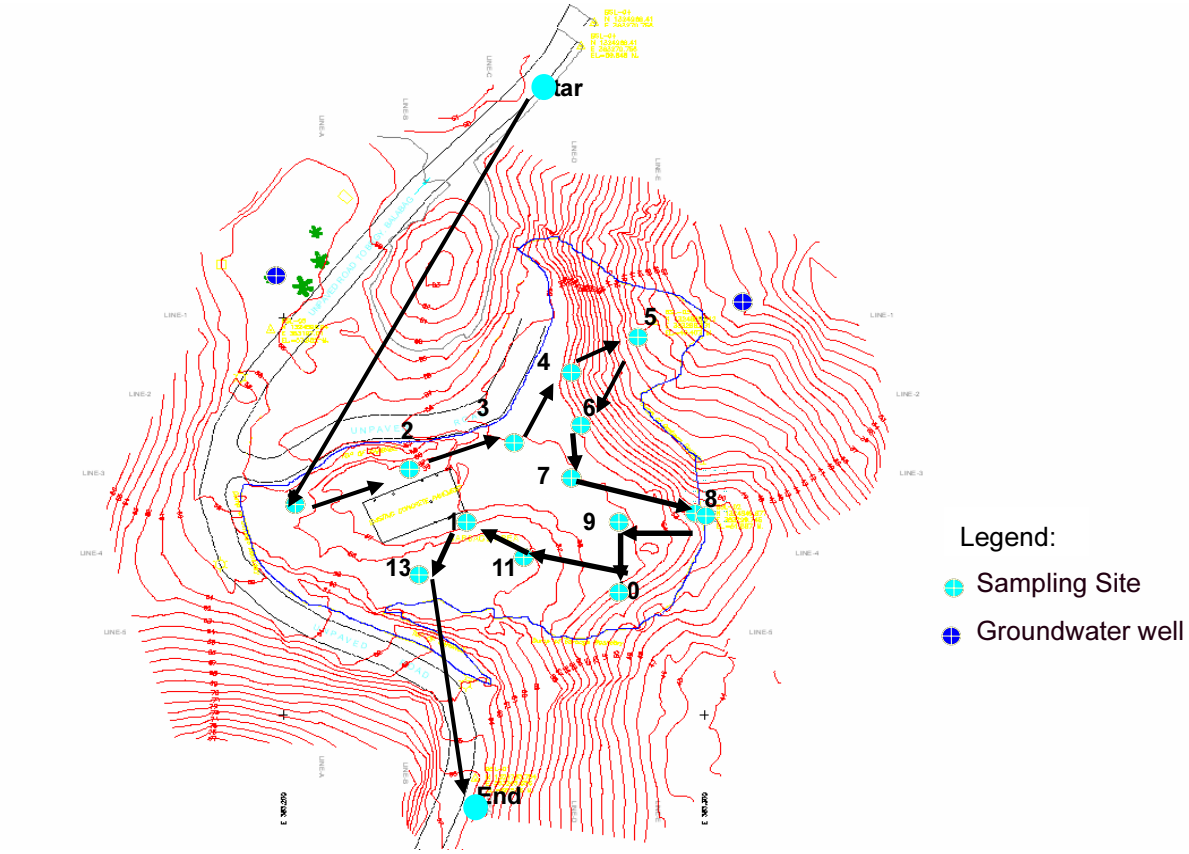


Figure D.4.3-2 Air Quality Sampling Points

Source: JICA Study Team

(3) Odor

The term "odor" refers to the perception experienced when one or more chemical substances in the air in contact with the various human sensory system. Odor is a human response, meaning degree of determining the odor level depends on the perception of the respondents. Two methods were adapted to determine the degree of odor from the solid waste, i.e. results of the natural survey and result form the Key Informant (KI) interviews.

4.3.3 Land Environment

Faunal and flora was surveyed in Sitio Lapus Lapus, Barangay Balabag, Malay, specifically in areas where the old dump site was located. The initial assessment/reconnaissance was conducted in June, 2007 and Natural Survey undertaken made use of a questionnaire that was divided into the present condition of the physical (air, ground water), biological (flora & fauna) and social/human environment (health, income sources, social acceptability of the plan) of the area within and adjacent to the dump site.

(1) Flora

Several secondary data on the vegetation were initially reviewed. These were included the Development Master Plan of Boracay Island which was prepared by the Planning Resource and Operation System (PROS) in March 1990; Environmental Impact Statement for Boracay

Eco-Village Resort, Barangay Yapak, Boracay Island, Malay Aklan, 2003; Comprehensive Land Use Plan for Malay Municipality 2000-2010, June 30, 2000.

In addition, field surveys were conducted on June 11-25, 2007 and July 23-26, 2007. The field survey was conducted by randomly establishing 1.0 km transect line in the study area. The observers walked through the entire transect length and noted the information such as species name, habitats and land use. Collected information was used as reference and/or points of comparison with field guides and other documentation. Since the survey did not take into account statistical information, simply focused on the inventory and identification of plant species, an informal type of meeting was initiated which led to a discussion type of information extraction.

(2) Wildlife/Fauna

The site was visited on June 11-13, 2007 to assess its wildlife habitat condition and biodiversity status, specifically relating to amphibians, birds, mammals and reptiles. This was supplemented by interview of several local informants as well as the result of the natural survey undertaken on July 23-26, 2007. The information recorded during the field observation of birds includes sightings and birdcalls. The utilization of wildlife by local inhabitants was also recorded.

4.3.4 Human Environment

The characterization of the existing socioeconomic condition of the old dump site primarily made use of the extensive data generated in the secondary information available from the MOM and local-based national agencies as well as related studies undertaken on the Boracay Island. With these available information, the human/social component of the survey focused on validation, updating and further expanding/strengthening the basis for the assessment with particular emphasis on some data gaps on the old dump site area and delving on key issues and concerns that may arise on its rehabilitation plan. Key Informant (KI) interviews were conducted including some unstructured group interviews. The KIs comprised of persons in the locality who are knowledgeable of the issues/concerns on hand. An environmental survey was likewise undertaken using a standardized questionnaire to elicit data on the acceptability of the project and to further identify additional issues and concerns related to the project.

A rapid appraisal was done in a span of two months employing both primary and secondary data collection methods. Data gathering and baseline characterization focused on the direct impact area covering the 2 sites of Boracay Island where the old dumpsite is located; the following were utilized for all areas:

- Perception survey using a structured questionnaire (Quantitative)
- Key Informants (KIs) (Qualitative)
- Unstructured group interviews (Qualitative)
- Secondary data (Qualitative and Quantitative)

The following were conducted showing the total number of participants in the survey:

- Natural Survey – 48 respondents : Sitio Bulabog- 11; Sitio Lapos Lapos – 33; sitio Pinaungon – 4
- Key Informants – 2 respondents

4.4 Desk Study

Desk study was conducted in accordance with the guidelines issued by the DENR and the NSWMC. There was an ocular inspection on the site to identify the general condition of the dump site and the environmental risks were evaluated. The engineering data needed in the development of the rehabilitation plan was gathered. Re-contouring the garbage area using the bottom elevation of borehole logs as spot elevations was carried out to have the original configuration of the site (before wastes were dumped). After reconstructing the original ground surface, sections of the waste area were presented by using the AutoCAD. Some portions of the generated sections show that the reconstructed ground surface is higher than the existing waste surface. Although this discrepancy occurred due to limited spot elevations, the profiles were prepared after editing. The volume and areas were calculated using the existing topography of garbage and the re-contoured topography. Area of generated sections showing the waste materials was measured with the computer using the AutoCAD. With these areas as inputs, the volume of wastes was calculated. Based on gathered information and in accordance with DENR and NSWMC regulations, rehabilitation options were formulated.

Various options were prepared based on the computer generated volumes and areas. The bill of quantities and unit costs were derived using the basic assumptions on the conceptual design and cost estimates with the condition that engineering service (E/S) cost is 5% of construction cost, that administration cost is 5% of total costs of construction and E/S and that physical contingency is 10% of total costs of construction, E/S and administration.

5. Results of the Survey

5.1 Topographic Survey

The topographic map of which the surveyed area is about 2.47 ha including the locations of the boreholes, groundwater monitoring wells and bench marks established are described in DWRG. No.O-01. Five cross-sections and five longitudinal profile were produced in a directions of West to East and North to South, respectively. The spacing of the sections is 5m. The sections are plotted in a scale of 1:500 m both for the horizontal and vertical in the Drawings.

5.2 Geological, Geotechnical and Hydro-geological Survey

5.2.1 General Geology of the Area

Boracay Island is part of the Libertad Formation (Pliocene to Pleistocene). Formation was originally designated by Cruz and Lingat (1966). Exposures of Cruz along the Pandan-Nabas road at the neck of the peninsula are also found. The formation consists of

conglomerates, mudstone, siltstone, shale and Pliocene-Pleistocene reefal limestone. The conglomerate is bedded, poorly sorted, poorly to fairly consolidated with subangular to subrounded granule to cobble size clasts of metamorphic rocks. The sequence unconformably overlies the Fragante.

5.2.2 Regional Geologic Structures

There are two major geologic structures that maybe influenced the stability of the site as shown in Table D.5.2-1. Francisco's Fault lines traced at a very acute angle in the vicinity of Culasi and diverging southward and northward very slightly. This lines cross the Buruanga penisula's neck along both sides of the valley. Just when the major structure now defined by the western Panay coastline started to form is not definitely known. Santos-Ynigo dates his overthrust movements, from late Miocene to Mio-Pliocene, emphasizing that these movements occurred along the old location.

Table D.5.2-1 Regional Stratigraphy of the Area

GEOLOGIC TIME					STRATIGRAPHY OF BURUANGA PENINSULA	
					LITHOLOGY AND FORMATION (Francisco, 1956 and Cruz & Lingat, 1966)	
MILLION YEARS	ERA	PERIOD	EPOCH	AGE		
.01	CENOZOIC	QUARTERNARY	HOLOCENE		ALLUVIUM	ALLUVIAL DEPOSIT
1.8			PLEISTOCENE	LATE	FLUVIAL GRAVEL	
				EARLY		STA. CRUZ SEDIMENTS
5.0		TERTIARY	PLIOCENE	LATE	CALCAREOUS SHALE , CONGLOMERATE, & CORALLINE LIMESTONE	
				EARLY		
22.5			MIOCENE	LATE	BASALTIC LAVA FLOWS, INTERCALATED WITH SHALE, CONGLOMERATE & LIMESTONE	FRAGANTE FORMATION
				MIDDLE		
				EARLY		
38			OLIGOCENE	LATE	‖‖‖‖‖‖‖‖‖‖	‖‖‖‖‖‖‖
				EARLY	‖‖‖‖‖‖‖‖‖‖	‖‖‖‖‖‖‖
55			EOCENE	LATE	‖‖‖‖‖‖‖‖‖‖	‖‖‖‖‖‖‖
				EARLY	‖‖‖‖‖‖‖‖‖‖	‖‖‖‖‖‖‖
65			PALEOCENE	LATE	‖‖‖‖‖‖‖‖‖‖	‖‖‖‖‖‖‖
				EARLY	‖‖‖‖‖‖‖‖‖‖	‖‖‖‖‖‖‖
141	MESOZOIC	CRETACEOUS		LATE	PATRIA QUARTZ DIORITE	‖‖‖‖‖‖‖
				EARLY		‖‖‖‖‖‖‖
195		JURASSIC		LATE	BURUANGA METAMORPHIC COMPLEX	‖‖‖‖‖‖‖
				MIDDLE		‖‖‖‖‖‖‖
				EARLY		‖‖‖‖‖‖‖
250	PALEOZOIC	TRIASSIC		LATE		‖‖‖‖‖‖‖
				MIDDLE		‖‖‖‖‖‖‖
				EARLY		‖‖‖‖‖‖‖
280		PERMIAN		LATE		PATRIA QUARTZ DIORITE
				MIDDLE		
				EARLY		BURUANGA METAMORPHIC COMPLEX
		CARBONIFEROUS				

Source : Geology of the Philippines , Vol. One, BMG

5.2.3 Surface Geologic Investigation

(1) General Description of the Area

Boracay Island is an oblong shaped island whose longer axis trend along northwest to southeast direction with estimated total land area of 1,039 ha. Generally the northern part of the island where the site is situated and within the southern part is characterized by a rolling to flat terrain with a topographic relief of 40 to 100 m above sea level of raised reefal/coralline limestone overlain by relatively thin to nil residual soil (terra rosa) as indicative of moderately to strong tropical weathering. Nesting at the central part of the island, is a wide coastal plain underlain by quaternary alluvium composed of unconsolidated limestone gravels, coral, sand and silt. Wide sand flat and beach zone along the western side of Boracay Island is veneered with white, fine coral sands. The area is classified as widest and longest white beach, which stretches from sitio Diniwid, Balabag to Sitio Angol, Manoc Manoc. At the northern coast of the Island along Yapak Beach, the sand flat is relatively narrower but teemed with "wash-out" pebbles and shells.

(2) Site Geology

The only rock formation exposed at the site is coralline limestone , this rock unit of Libertad/Sta Cruz Formation is light brown to buff in color and occasionally bedded in places, trending to northwest and dipping from 40 to 57 degrees to the Northeast. Bed spacing is measured from 0.2 to half a meter. Partings between beds of the rock unit were noted to be open and interconnected making this rock unit as very permeable and relatively very high percolation rate.

Careful examination of the limestone formation in the area show that aside from being coralline and calcitized, it is also composed of clastic materials such as fine to coarse sand, granules and few pebbles of limestone, probably derived from an older limestone formation. Weathering and disintegration of this limestone freed these clastics and finally deposited, through wave actions along the beach on Boracay Island.

5.2.4 Sub-surface Geologic Investigation

(1) Core Drilling exploration

Subsurface exploration by core drilling was undertaken to determine the thickness of the solid waste and engineering properties of underlying bedrock. A total of 26 bore holes with an aggregate depth of around 149 meters and two observation wells with a total depth of around 100 meters were drilled. The location map is also presented showing the boreholes drilled at the old dumpsite (Refer to DWRG. No. O-02).

(2) Drilling and Core Sampling Methodology

The drill hole is advanced through solid waste deposit by dry coring method. Firstly, short piece casing was driven into the ground to prevent the collapse of the solid waste deposit. The casing was cleaned up by means of a single core barrel with a chopping bit attached to the lower end of the drill string of rods. Drill rods were added to the drill string as the depth

of boring increases. Casing wire are also driven to prevent the collapse of the boreholes at sections of unstable solid waste is located.

When drilling is already encountered the weathered bedrock, normally rotary drilling /coring operation is conducted by using the conventional NQ series double tube type core barrel with impregnated core diamond bits. Extrusion of the core samples from the inner core barrel is made carefully. All core samples retrieved are carefully placed and arranged in standard, properly made wooden core boxes with cover according to depth provided with wooden spacers, to mark the beginning and end of each drill runs. The lengths of cores recovered are measured over the core run employed in order to come up with a recovery ratio expressed as Percentage Core Recovery.

(3) Standard Penetration Test Methodology

Standard Penetration Test (SPT) was conducted in soft overburden materials, at every one (1) m interval in soil and weathered rock layers. It was performed using a standard split-spoon sampler having 2" (50mm) OD and about 71 cm length. The split-spoon sampler is attached at the bottom of string of AW rods. It is driven into the entire depth of the sampling section (except when refusal is recorded within the section) by means of a 140 lb hammer free-falling along a guide rod from height of 76 cm onto a jar plate connected at the top of the string of AW rods. This procedure is carried out using automatic tripping mechanism. It is driven to an initial penetration of 6 inches to by pass the disturbed soil materials at the top of the sampling section. The number of blow counts for the seating drive is recorded. The sampler is then advanced another 12 inches and the corresponding number of blow counts for each 6 inches of penetration is recorded. The total number of blow counts for the last 12 inches of penetration is known as the standard penetration resistance (N-value) of the soil. Correlation has been developed between the SPT N-value and soil parameters, which can be used for bearing capacity estimation. Table D.5.2-2 and Table D.5.2-3 shows the correlation between the cohesive soil and the penetration resistance (N-value) recorded.

Table D.5.2-2 Correlation Between SPT and Soil Consistency of Granular Soil

Description	Very Loose	Loose	Medium	Dense	Very Dense
Relative Density Dr.	0-0.15	0.15-0.35	0.35- 0.65	0.65-0.85	0.85-1.00
Standard Penetration Test #N-Value	0-4	5-10	11-30	31-50	51 Up
Approx. Angle of Internal Friction Angle	25^0-28^0	28^0-30^0	30^0-35^0	35^0-40^0	40^0-43^0
Approx. Range of Moist Unit Weight, (KN/m^3)	11.0-15.7	14.1-18.1	17.3-20.4	18.3-22.0	20.4-23.6
Submerged Unit Weight (KN/m^3)	9.4	8.6-10.2	9.4-11.0	10.2-13.4	11.8

Source: JICA Study Team

Table D.5.2-3 Correlation Between SPT and Soil Consistency of Cohesive Soil

Description	Very soft	Soft	Medium	Stiff	Very Stiff	Hard
Unconfined Compressive Strength, Qu (KN/m2)	0-23.9	23.9-47.9	47.9-95.8	95.8-191.6	191.6-383.1	383 -UP
Standard Penetration Test #About a	0-2	3-4	5-8	9-16	17-32	33-UP
Approx. Range of Standard Unit Weight, Saturated (KN/m^3)	15.7-18.9		15.7-20.4		18.9-22.0	20.4 +

Source: JICA Study Team

After the conduct of the SPT on each test interval, the string of rods and split-spoon sampler are pulled out of the hole and the recovered disturbed sample is retrieved and placed in a moisture tight plastic bag for further visual examination and laboratory tests.

(4) Geologic Logs of Drill Holes

All recovered core samples were logged. BH-1 to BH-26 and GWD-1 reveals that the old dumpsite area is made of solid waste materials with a thickness range from 0.50 m to 7.50 m, underlain by thin soil and coralline limestone. The bedrock is moderately weathered to extremely weathered, medium hard, closely broken and with solution cavities. Light brown to buff color.

(5) Standard Penetration Test Results

The SPT results of all the boreholes conducted is shown in Table D.5.2-4. The SPT data reveals that there is an increase in bearing strength of the soil and deeply weathered rock in deeper portions. The overburden soils encountered across the site is made generally of reddish to yellowish gravelly silty / clayey silt and silty sand /sandy silt of medium - very low -no plasticity. The bedrock which encountered in the survey is medium-highly weathered and slightly hard. SPT was conducted to determine the overburden bearing capacity/strength based from resulting N-values.

Table D.5.2-4 Results of Standard Penetration Test

Borehole No.	Depth (m)		SPT			Total SPT	Relative Condition
	From	To	15 cm	15 cm	15 cm		
BH-2	1.05	1.50	5	10	15	25	Medium dense
BH-3	1.05	1.50	5	10	20	30	Medium dense
BH-4	2.00	2.20	5	50/05	-	>50	Very dense
BH-5	2.05	2.34	16	50/14	-	>50	Very dense
BH-6	7.00	7.25	21	50/4	-	>50	Very dense
BH-7	8.55	8.80	5	50/10	-	>50	Very dense
BH-11	1.05	1.28	26	50/08	-	>50	Very dense
BH-13	5.05	5.30	15	50/10	-	>50	Very dense
BH-14	6.05	6.35	25	50	-	50	Very dense
BH-15	-	-	-	-	-		Very dense

Source: JICA Study Team

Based on the standard penetration test (SPT) results, the foundation materials is covered with layers of medium dense to very dense residual and colluvial soils (25->50 N-value). The

highly compacted overburden materials produced high SPT blow counts (>51 N-value), revealing an increase in compaction, consolidation and higher amount of granular/or gravel fragments.

The typical soil and mechanical properties of strata estimated from the N-Value (SPT) undertaken from cohesive, non-cohesive and extremely to totally weathered bedrock are enumerated in Table D.5.2-5.

Table D.5.2-5 Soil Mechanical Properties

Borehole No.	Depth (M)	SPT (N) Value	Relative Density , %	Typical Range of Unit Weight ,KN/M^3		Typical Ultimate Bearing Capacity (qu)=kg/cm^2
				Moist	Submerged	
BH-2	1.50	25	65-85	18.3-22.0	10.2-13.4	>4
BH-3	1.50	30	35-65	17.3-20.4	9.4-11	2 - 4
BH-4	2.20	>50	85-100	20.4-23.6	11.8	>4
BH-5	2.34	>50	85-100	20.4-23.6	11.8	>4
BH-6	7.25	>50	85-100	20.4-23.6	11.8	>4
BH-7	8.80	>50	85-100	20.4-23.6	11.8	>4
BH-11	1.28	>50	85-100	20.4-23.6	11.8	>4
BH-13	5.30	>50	85-100	20.4-23.6	11.8	>4
BH-14	6.35	50	85-100	18.3-22.0	10.2-13.4	>4
BH-15	8.25	>50	85-100	20.4-23.6	11.8	>4

Source: JICA Study Team

5.2.5 Laboratory Tests and Results

Laboratory test results (Table D.5.2-6) indicates that the physical properties of the soil such as natural moisture content (NMC) have values that range from 5.80 % to 56.21 %. Grain size analysis reveals that soil layers belong to the SP- ML-SM group of granular soils characterized by no plasticity.

Uniaxial Compressive Strength test conducted on core samples taken from drill hole GWD-1, indicated that the strength of the coralline limestone is about 5.52 Mpa to 7.58 Mpa. The old dumpsite seated on a fair rockmass. These findings are supported by the following rock engineering calculations and geological field observation as shown in Table D.5.2-7.

Table D.5.2-6 Summary of Laboratory Test Results

Depth (m)	Borehole Number	Gradation Test , % Passing								NMC (%)	UCT (Mpa)
		3/4"	3/8"	No.4	N0.10	No.40	No.100	No.200	Pan		
1.05 - 1.50	BH2 - S1	-	-	-	-	-	-	-	-	28.26	-
8.55 - 8.80	BH7- S1	78.77	59.35	54.38	20.51	14.63	4.25	0.18	0	29.62	-
1.05 - 1.50	BH3- S1	100	90.64	82.62	31.15	23.13	7.09	0.4	0	31.09	-
1.05 1.78	BH11- S1	-	-	-	-	-	-	-	-	18.71	-
7.05 - 7.25	BH6-S1	100	77.59	63.28	27.99	22.27	7.49	0.33	0	6.69	-
8.05 - 8.25	BH15-S1	100	97.64	91.75	49.29	37.5	11.56	0.94	0	30.70	-
4.50 - 5.40	BH10-S2	100	96.54	91.7	28.03	20.42	7.27	0.35	0	37.81	-
6.50 - 8.00	BH16-C2	100	100	93.78	40.17	28.52	8.31	0.54	0	38.19	-
4.4	BH4-C2	-	-	-	-	-	-	-	-	5.80	-
7.0 - 8.40	BH18-C1	100	70.81	63.28	33.15	27.5	7.72	0.19	0	18.60	-
2.34 - 3.3	BH5-C1	100	97.92	93.07	18.17	12.62	4.3	0.14	0	56.21	-
15.0 - 15.13	GW-1	-	-	-	-	-	-	-	-	-	5.520
18.0 - 18.4	GW-1	-	-	-	-	-	-	-	-	-	6.890
21.0 - 21.12	GW-1	-	-	-	-	-	-	-	-	-	7.58
12.0 - 12.12	GW-1	-	-	-	-	-	-	-	-	-	6.21

NMC – Natural Moisture Content
UCT - Unconfined Compressive Strength
Source: JICA Study Team

Table D.5.2-7 Rockmass Rating – RMR Bieniaski, Z.T.

Parameter		Value	Rating (%)
1.0	Uniaxial Compressive Strength	5.52 - 7.58 Mpa	2
2.0	Rock Quality Designation (RQD)	0	3
3.0	Spacing of Discontinuities	< 6 cm	5
4.0	Condition of Discontinuities	Slightly Rough <1mm.Slightly Weathered Surfaces.	25
5.0	Groundwater	Completely Dry	15
6.0	Total Rating		50
7.0	Rockmass Class		Fair Rock

Source: JICA Study Team

5.2.6 Groundwater Occurrence

(1) Hydro-geological Setting

Surface mapping and reconnaissance along the immediate vicinity of the dump site indicates that the area is widely overlain by fractured coralline limestone where secondary porosity within the rock unit is relatively well developed. Under these condition the values of hydraulic conductivity and permeability is relatively high (10^{-7} to 10^{-3} cm/sec), this indicates that during rainy season surface run off along natural water ways is very low due to relatively high percolation rate of the coralline limestone. Only a proportion of this resource will be available to the aquifers, since the area is situated on an island, wherein direct infiltration coming from surface run off is directly discharge along coastal creeks or through springs.

(2) Aquifer

The interface between the porous coralline limestone bed and the mudstone/siltstone rock unit of the Libertad formation is the probable aquifer within the area of study. The mudstone/siltstone series underlying the limestone is impermeable enough with approximate hydraulic conductivity of (10^{-11} to 10^{-8} cm/sec) to prevent any downward migration or vertical leakage of groundwater, at this depth the permeability and possibly the porosity diminish due to increase silt/clay content and the absence of significant solution channels which serves as the migration path of groundwater.

(3) Recharge

Estimation of groundwater resources is generally based on the data of evapo-transpiration and on the detailed of representative catchments area. Recharge from rainfall in to the porous coralline limestone and younger strata is not defined based from the observation well (GWD-1), the depth of natural ground water level is 56.79M or sea water level. The host rock (coralline limestone) consist solution cavities.

5.2.7 Conclusion

Surface mapping conducted reveals that dumpsite area is underlain by coralline limestone. This rock unit is light brown to buff in color and occasionally bedded in places, trending to northeast and dipping from 40 to 57 degrees to the Northwest. Bed spacing is measured from 20 cm to half a meter. Partings between beds of the rock unit were noted to be open and interconnected making this rock unit very permeable and relatively very high percolation rate.

Core Drilling and in-situ test reveals that dumpsite area is covered with solid waste deposit of about 0.50 meter to 7.50 meters thick. It is made up of organic and inorganic materials. The solid waste is poorly compacted and unstable. Underneath is thin to nil gravelly clay layer of which is granular and pervious. Basement rock is coralline limestone.

The observation well reveals that whole dumpsite site area is made of more than 60 meters thick coralline/reef limestone. The rock is moderate to highly weathered with interconnecting solution cavities and cavernous. The groundwater level is about 56.59 meters depth which reveals that the dumpsite area is underlain of more than 60 meters very pervious coralline limestone. The present geological condition of the foundation rock indicated that leachate from the solid waste may flows freely into the basement rock.

5.3 Environmental Survey

5.3.1 Water Environment

(1) Water Quality Survey

Only sea water for surface water was sampled neither samples are taken on site and upstream of the site due to absence of runoff as a result of the extended dry season. Sampling was done in the sea, about 25 meters from the drainage outlet of the dump site. The results of

the laboratory analysis of sample in comparisons with the allowable standards (DAO 34) for various marine water categories are summarized in Table D.5.3-1.

Table D.5.3-1 Results of Surface Water Quality Survey and Allowable Limit Standard

ITEM NO.	PARAMETER	Unit	Method of Laboratory Analysis	Sampling Location/Results	Allowable Limit Standard (DAO No. 35)			
				Old Site-Sea	Class SA	Class SB	Class SC	Class SD
1	Temperature (Max. rise in °C)	°C	Water Quality Kit (On-site)	30.4	3	3	3	3
2	pH		Electrometry	8.0	6.5-8.5	6.0-8.5	6.0-8.5	6.0-9.0
3	Color	PCU	Visual Comparison	5	(b)	100	(c)	(c)
4	Turbidity	NTU	Nephelometry	0.02				
5	Dissolve Oxygen	mg/l	Azide Modification	5.8	5	5	5	2
6	Total Suspended Solids	mg/l	Gravimetry	8	(b)	50	150	(f)
7	Total Dissolved Solids	mg/l	Gravimetry	35,802	(b)	1000	-	-
8	Conductivity	μmS	Condctivity meter (On-site)	56.0				
9	Oil/Grease	mg/l	Partition/Gravimetry	4	(b)	5	10	15
10	BOD_5	mg/l	Azide Modification	<1	(b)	30	100	120
11	COD	mg/l	Open Reflux Dichromate	148	(b)	60	200	200
12	Chloride	mg/l	Titrimetry	19,195				
13	Ammonia Nitrogen	mg/l	Colorimetry	0.01				
14	Sulfate	mg/l	Turbidimetry	2,423				
15	Sodium	mg/l	AAS	57,000				
16	Potassium	mg/l	AAS	475				
17	Calcium	mg/l	AAS	523				
18	Magnesium	mg/l	AAS	940				
19	Iron	mg/l	AAS	ND				
20	Lead	mg/l	AAS	ND	0.05	0.05	0.05	-
21	Copper	mg/l	AAS	ND	-	$0.02^{(n0(o)}$	$0.05^{(o)}$	-
22	Cadmium	mg/l	AAS	ND	(b)	0.02	0.1	0.2
23	Chromium Hexavalent	mg/l	Colorimetry	ND	(b)	0.05	0.2	0.5
24	Total Mercury	mg/l	Cold Vapor-AAS	ND	(b)	0.005	0.005	0.01
25	Organo-Phosphate	mg/l	Gas Chromatography	ND	nil	nil	nil	-
26	Total Coliform Count	MPN/ 100ml	Multiple Tube Fermentation	<20	(b)	3000	-	-

Note: 1) ND = NOT DETECTABLE (Minimum detection limits are: Cadmium = 0.003, Copper 0.04, Iron = 0.06 Lead = 0.01, Mercury = 0.00045, Chromium VI = 0.005)
2) AAS – Atomic Absorption Spectrophotometry, ASV – Anodic Stripping Voltammetry

Legend: b) Discharging of sewage and/or trade effluents is prohibited or not allowed
c) No abnormal discoloration from unnatural causes
f) Not more than 30 mg/L increase (dry season)

Source: JICA Study Team

(2) Aquatic Flora and Fauna

Another important ecosystem that is a direct receptor of the impact of the old dump site is the marine ecosystem of Boracay. These marine organisms include: fishes, mollusks, corals, sponges, sea weeds, crustaceans. Information on some of the fishes caught (D.5.3-2) by the interviewed community members include: alipulos, sikad-sikad, bisugo, piyagot, muymoy, kitong.

Table D.5.3-2 List of fish catch at a depth of over 15 meters[1]

Common Name	Scientific Name	Common Name	Common Name
Goat fish	Parupeneus spilurus	Lubayon	Tamban-White Snapper
Chiton-mTwo-barred goatfish	Parupenus bifasciatus	Manambos	Parrot
Big-eyed snapper	Symphochthys spilurus	Alibangbang	Tiki-tiki
Philippine butterfly fish	Chaetodonadiergastos	Bansa	Moy-moy
Golden rabbitfish	Siganus guttatus	Bantol	Bulao/Dulao
Barong		Saguksok	Palata

Source: JICA Study Team

Corals are the most common type of coelenterates on Boracay Island and other reef in the Mainland of Malay. The hydrocorals-stony or hard corals come in various colors, shapes, sizes and forms. They are radically symmetrical and have tentacles usually with nematocyst. Corals provide shelter and breeding places for other ecologically important species in the reef. Because of their durability and aesthetic appeal, corals are now being harvested to be used as building, embankment and landscaping materials – *"igang"*. The sugarcane farmers use pulverized corals to modify soil pH. While collection activities offer additional income to the residents, the people have already recognized the ecological value of these resources in the survival of the island and the tourism industry. In addition, a local ordinance is enforced by the MOM and the three barangays of Boracay Island are prohibiting collection and selling of protected and endangered corals. Poster also indicated the prohibition of collection and sale of protected and endangered corals are posted in the field offices of the DOT and DENR and some strategic places in the island. Table D5.3-3 below are list of some coral observed near the site.

Table D.5.3-3 List of Corals observed at a depth of over 15 meters

Common Name	Scientific Name
Fire coral	Millepora tenella
Indo-pacific blue coralil	Heliopora coerculea
Pore coral	Montipora
Staghorn coral	Acropora
Double-star coral	Fungia
Brain coral	Diploastrea
Soft corals	*Sarcophyton sp.*

Source: DENR

5.3.2 Air Environment

(1) Landfill Gas

No landfill gas of Methane (CH_4), Carbon Dioxide (CO_2), Hydrogen Sulfide (H_2S) and Ammonia (NH_3) were detected in the old dump site.

[1] Rodolfo B. Polletes,Jr. , Allan Antonio Conda, Esteban Tajanlangit, Jr., Environmental Impact Statement for Boracay Eco-Village Resort, Barangay Yapak, Boracay Island, Malay Aklan, 2003

(2) Odor

The concerned area primarily focuses to Barangay Balabag, specifically to Sitio Pinaungon, Sitio Lapus Lapos, and Sitio Bulabog. The three sites potentially might suffer direct impact, which is about 1 km radius from the closed dumpsite.

The data shows that 100% of the respondent describes their surrounding as fresh and clean surroundings. During the operation of dumpsite 11% percent of the respondent smells their area as odorous like rotten egg and 40% experienced dirt and foul odor caused by garbage movement to the dumpsite. More than 57% experiences bad odor caused by garbage. In generally, the area near the dumpsite is a recipient of foul odor and polluted air environment.

After three year of closure of the dumpsite in 2003, more than 46% of the respondent slightly and slowly experiencing the fresh smell of the surrounding. However, the majority was still a recipient of bad odor caused by garbage (Table D.5.3-4).

Table D.5.3-4 Community Description of Odor in their Surroundings at Different Stages of Old Dump Site Operation

Location	Dumpsite Stages Operation						
	Before	During			After		
	Fresh	Decay	Dirt	Foul Odor	Foul Odor/ Decay	Slightly Fresh	Less Foul
Sitio Bulabog	10	1	6	3	4	4	2
Sitio Lapus Lapos	33	4	9	20	21	10	2
Sitio Pinaungon	4	0	4	0	4	4	0
Total	47	5	19	23	29	18	4

Source: JICA Study Team

Four sites were identified to be the location of the odor description and were conducted last July 27, 2007 at about 1-3 pm. The description was based on the qualitative measurement “light”, “medium”, “heavy” and “very heavy”.

The result of the two sites (Site 1 & 3, about 200 m from the dumpsite) smells good and fresh base on the description, while Site 2 (adjacent to the dumpsite), description is light odorous while Site 4 (within the dumpsite) is describe as medium. This observation was conducted at the middle of the day where air is not moving and sun is very hot. To validate these information, KI interviews was conducted and the respondent agreed that no foul odor was smelled even with heavy rain and wind. However, the driller attested that odor was below the surface when they encountered very heavy foul odor (describe as rotten salted fish) during their drilling activities.

Generally, the odor was depended on the location of the receptor and it was conclude that no foul odor was experience in the surface of the dumpsite. However, foul odor was experience under the surface.

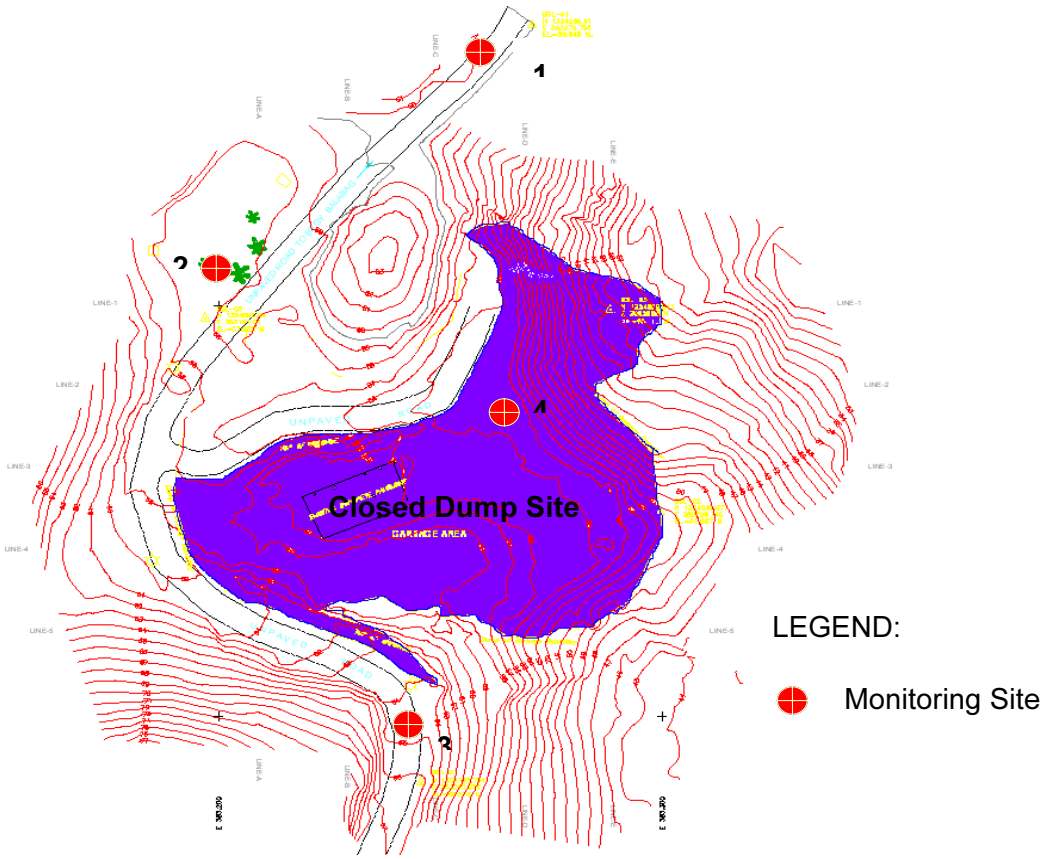


Figure D.5.3-1 Odor Monitoring Site

Source: JICA Study Team

5.3.3 Natural Environment

The old dump site is predominantly limestone forest with patches of secondary forest especially in mountains (Mt. Luho and nearby unnamed mountains), grassland and coconut plantation was observed in the slope and coastal area of the site. The secondary growth forest is covered by pioneer species while coconut areas on the other hand, are mostly interspersed with shrubs and tree vegetations. The low productivity of the coconut trees is apparently due not only to typhoon and old age but also attributed to destructive action of monkeys and rodents. Some portion of the project areas forms part of the habitat and refuge of hundreds of giant fruit bat.

(1) Flora

In general, the vegetation cover of the old dump site may be divided into the following categories: limestone forest, secondary forest, vegetation of cultivated and settlement areas, vegetation of non-cultivated open sites/grassland, waste land and coconut plantation (Figure D.5.3-2).

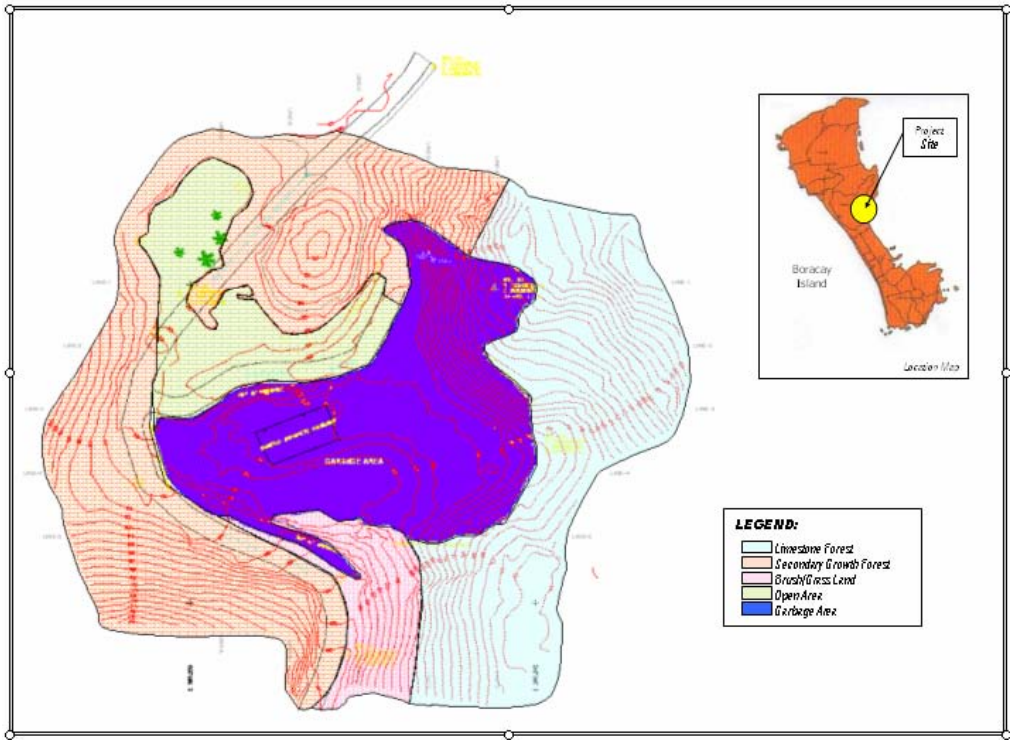


Figure D.5.3-2 Land Use of Old Dump Site

Source: JICA Study Team

In secondary forest area, abundant species of Macaranga tanarius (binunga), and Macaranga grandifolia (Blanco) Merr. (takip-asin) can be found in the secondary and lowland forest near the dump site. Among climbing plants, guhayan is undoubtedly the most abundant liana. Other species include: Alim (Melanopelis multiglandulosa), Balobo (Displodiscus paniculatus), Hamindang (Macaranga bicolor) and Hinlaumo (Mallotus mollissimus). At the ground layer, aside from seedlings and saplings of some of the trees and shrubs, the most commonly observed terrestrial herbs include Selaginella plana, and Pteris spp. which are pteridophytes (ferns and their allies).

In cultivated and settlement areas, cultivated crops include coconut (Cocos nucifera L.), Muell,-Arg.), gmelina (Gmelina arborea Roxb.), Nangka (Artocarpus heterophyllus Lam.) , santol (Sandoricum koetjape (Burm. f.) Merr.), limoncito (Triphasia aurantiola Lour.), cacao (Theobroma cacao L.), kape (Coffea arabica L.), papaya (Carica papaya), banana (Musa spp.), corn (Zea mays), and ornamentals such as Bougainvillea spectabilis Willd. and Hibiscus rosa-sinensis L. were conspicuously present near the settlement areas.

In no cultivated open areas or grass land, grasses (Saccharum spontaneum and Imperata cylindrical) occupy abandoned lots aespecially along road sides while Melanolepis multiglandulosa, Macaranga tanarius, Trema orientalis, Artocarpus blancoi, alagasi (Leocosyke capitellata (Poir.) Wedd.) and malatungao (Melastomata malabathricum L.) are the characteristic species in the open areas. Other vegetation present include the following: Hagonoy (Chromolaena odorata), Baho-baho (Lantana cammara), Duhat (Syzygium cumini).

The closed dump site can be classified as wasteland where there is an abundant growth of

pioneering species/ invading species. There are patches of coconut plantation recorded in the area even on the dump site. Most of the coconut plants are destroyed by typhoon and appear unproductive. At the time of the study however, the trees are showing new growth indicating recovery from the recent typhoon which hit the island in 2006.

Many of the plant species in the area of the dumpsite are of the flowering and fruit-bearing kind. The species composition indicates that the site is an attractive environment for different species of birds and insects as these offers good source of food for them. Any alteration of the vegetative cover therefore will mean a corresponding change of the faunal species of the area.

Based on the actual Natural Survey and reconnaissance, however, a smaller number of species have been recorded. Some species have been noted to be not seen any more, which are listed in Table D.5.3-5. It should be noted, however, that no endangered or rare species of plants was observed in the area. All plant species are usually common and associated with open or cultivated lands.

Table D.5.3-5 List of Plant Species No Longer Seen in the Old Dump Site

Plant Common Name	Importance
Kawayan Butong	House Construction
Giant Ipil Ipil (Leucaena leucocephala)	Lumber/Fuelwood
Agosip (Symplocos odoratissima)	Lumber
Alagau Laut (Premna odorata)	Medicine, fuelwood
Malakadios (Dehaasia cairocan)	Lumber
Balete (Ficus balete)	Shade
Binunga (Macaranga tanarius)	Lumber/ roosting place of birds/bats
Tamisan	Fuelwood/ Charcoal
Molawon (Vitex parviflora)	Lumber

Source: JICA Study Team

(2) Terrestrial Wildlife/Fauna

The data presented here are only partial and minimum estimates of diversity. Most of the animals recorded near and within the old dump site include species of birds, mammals, insects, amphibians, reptiles and rodents. Their presence in the area was validated through interview with the locales of the 3 sitios of Barangay Balabag.

Fruit bats commonly observed in the area according to the caretaker of the old dump site. This has been supported by the local residents in the natural survey. These bats are sighted at Mt. Luho especially in the afternoons. It is a large fruit-eating bat species of the family of Pteropodidae. These species preferred fruits of Bulabog (Parishia maingayi) and Bogo (Garuga floribunda) and as roosting trees in the area. Several species of fruit bats are found in the Panay Island, but only two species are found to roost on Boracay Island namely Acerodon jubatus and Pteropus vampyrus which have been listed as endangered and vulnerable , respectively[2].

[2] IUCN, 2002

Acerodon jubatus is commonly known as the Golden-capped fruit bat and locally known as Kabog. These species is similar with Pteropus vampyrus in size, external appearance and habits. The color varies a great deal especially on the extent of the yellow or buff and orange-buff patch on crown and back of neck and upper back. The Pteropus vampyrus is commonly known as Red-necked flying fox and locally known as Kabog to residents. It is a large bat with long ears which is pointed at the tip. The body covered with fur at different degree of thickness. Generally, the color is blackish brown with head, neck and mantle as black while the shoulder, neck and rump are colored rufous-brown. Its definite roosts are often found in some particular clump of trees where they usually stay until driven away by necessary disturbance. Both species produce a very strong peculiar musky odor characteristics of their roosting area and very different from the urine stench of other animals.

Monkey (Macaca fascicularis) - Unggoy, amo, in the area is commonly associated with many fallen young coconut fruits. Key informants stated that monkey was often cited in the forested areas of the site and even on their yards and in the dump site. There around 10-20 heads that are roaming around the areas. The members include both sexes and of all ages, headed by huge old male.

Table D.5.3-6 List of Animals/Birds that have not been/rarely Sighted in and around the Old Dump Site and Attributed Importance by the People*

Animals/ Birds	Areas Sighted	Importance
Monkey	Bolabog and Surroundings	Balance of nature and income
Tukmo/ Yaro	Bolabog and Surroundings	Balance of Nature
Bucao	Bolabog and Surroundings	Balance of Nature
Tikling	Bolabog and Surroundings	Balance of Nature
Tulihaw	Bolabog and Surroundings	Balance of Nature
Bangbangon	Bolabog and Surroundings	Balance of Nature
Saling	Bolabog and Surroundings	Balance of Nature
Punay	Bolabog and Surroundings	Balance of Nature
Jkabog	Bolabog and Surroundings	Balance of Nature and food
Kabog	Bolabog and Surroundings	Balance of Nature and food

* Environmental Survey, July 23-26, 2007, JICA Study Team
Source: JICA Study Team

There are many birds observed near the site. This was validated by interviews conducted with the local residents and from the findings of Alcala and Alviola on birds and mammals present on Boracay Island. Most of the birds are endemic species, with some of them breeding and residing near the area. Majority of the avian species found in the area are insectivores. This manifest that wide range of insect-prey is available in the area. Some are omnivorous bird species that feed on a variety of food such as such as insects, crustaceans, fishes, small lizard, fruit and seeds.

Fruit are also food source of birds. The presence of frugivores indicates that there are fruit bearing trees in the area. Frugivores birds are key stone species as they aid in the natural regeneration of an area. They serve as agents in seed dispersal and pollination of fruit bearing plant.

(3) Emergent Species

While some species, birds have specially become less conspicuous in the dump site, other species have been sighted by the local residents. They are rats, flies, dogs, monkeys, goat that have increased in number and visibility in the old dump site and its nearby vicinity.

Table D.5.3-7 Organisms Sighted in the Dump site not Sighted Before

Organisms	Number	%
Flies	47	98
Rats	42	88
Monkey	19	40
Dogs	14	29
Goat	9	19
Butterflies	9	19
Birds	9	19

Source: JICA Study Team

5.3.4 Human Environment

A part of the Environmental Survey for the Old Dump dealt on the human environment of the area. Areas of concern include: respondents' demographic profile; effect of the dumpsite to land, human health, flora and fauna, general environmental condition, social perception and acceptability of the proposed dumpsite closure. Data analysis is descriptive to determine emerging patterns from FGDs and KIs. The result of the perception survey was processed using the Statistical Package for Social Sciences to generate frequency counts and percentages.

(1) Direct Impact Area

The direct impact area of the closed dumpsite (CDS) is the area within the 1 km radius. Correspondingly, the environmental survey was concentrated in Barangay Balabag where the CDS was located. Specifically, the 48 respondents (3.5%) of the total households of Barangay Balabag were sampled from 3 sitios – Sitio Bulabog, Sitio Lapos Lapos and Sitio Pinaungon.

(2) Respondents' Profile

There are 29 Female and 19 Male respondents with age ranging from less than 25 years to 75 years old.

Table D.5.3-8 Age Distribution of Respondents

Age	Number	%
<=25	7	15
26-35	11	23
36-45	14	29
46-55	9	19
56-65	2	4
66-75	5	10
Total	48	100

Source: JICA Study Team

(3) Perceptions to Present Quality of Life

Most of the respondents (67%) perceived that they have a better quality of life now that the dumpsite had been closed than when it was operating. 29% on the other hand answered "No" it is not better and 4% did not have any idea. Reasons given of the positive perceptions are indicated in Table D.5.3-9.

Table D.5.3-9 Reasons for a Better Quality of Life

Reasons	No.	%
No more foul odor	16	40
Less Pollution	9	22
More Quiet Environment	6	15
No More Flies	5	13
Less Pollution/less dusty	4	10
Total	40	100

Source: JICA Study Team

Respondents who worked at the dumpsite before and those who used the dumpsite as a passage way felt that their quality of life now is worse than when the dumpsite was still operating.

(4) Perceptions to Present Quality of the Environment

Respondent's perception to the present quality of the environment reflected congruence to their perception to "quality of life". Ninety-four percent of them felt that the quality of the environment now is better than before and the remaining 4% felt that it is the same. Nobody responded that it is worse. The major reason given by 98% of those who answered positively is due to better air quality(less pollution as a result of lessened dust from passing dump trucks, stoppage of garbage burning activities, and stoppage of garbage dumping). On the other hand, the remaining 2% gave the lessened number of flies which were carrier of sickness as a reason for the better life quality. Those who felt that the environment has not at all changed are those who have been scavenging some bottles and cans from the dumpsite before and selling them for additional income.

Table D.5.3-10 Responses to Environmental Parameters

Parameters	Stages of Dumpsite Opeation		
	Before	During	After
1. Dust Quality			
• None	30		
• Occasional	17		
• Dusty		30	
• Dusty w/ trucks		6	
• More dust		10	
• Minimized			46
2. Waste on Roadsides			
• None	33		
• Some	12		
• Some waste droppings		43	
• lessened			43
3. Occurrence of Traffic			
• None	44	7	37
• No traffic but many trucks		7	
• Many trucks		33	9
• Lesser Vehicle			
4. Sporadic Explosion			
• None	39	14	
• Sporadic		32	26
5. Ground Water Quality			
• Not Applicable/NA	16	16	16
• None	12	6	
• Good Drink	28	30	12
• bland		1	
• Not good drink/saltybland			11
• Laundry/bath/washing			

Source: JICA Study Team

The worse quality of the environment during the dumpsite operation has been supported by the responses to selected environmental indicators: dust quality, traffic occurrence, presence of fugitive waste, occurrences of sporadic explosion; and ground water quality.

(5) Social Acceptability of the Rehabilitation Plan

The proposal of rehabilitation of the old dump site was positively received by 32 (66%) respondents, seven (14%) replied that they "had no idea" and four (8%) answered negatively of the closure plan because they are getting something from the garbage. The top most reason for the positive acceptance is the lessened air pollution in the area followed by lessened flies and impact of tourism.

The respondents also perceived several benefits and impacts of the closure plan as enumerated in Table D.5.3-12. The responses can be categorized into three major areas: Health considerations –which covers less polluted air, less noise, less scattered garbage; environmental considerations – peaceful nature; and economic considerations – loss of

income source for those who were getting something from the dumpsite, and the prospect of getting more income more tourist attraction with the rehabilitation of the old dump site.

Table D.5.3-11 Public Awareness of Rehabilitation Plan

Benefits/Impacts	Number	Rate [%]
Health	15	30
Less polluted air, less noise	6	16
No idea	6	16
Peaceful nature	3	8
nothing	3	8
No more scattered garbage	2	5
Loss of income source	2	5
Get more income	1	2
Total	38	100

Source: JICA Study Team

The respondents were also asked on their suggestions to make the old dump site more beneficial. This information can be an input to how the rehabilitation is designed.

Table D.5.3-12 Suggestions to Rehabilitation Plan

Suggestions	#	%
Clean and improve the area	13	32
Permanent closure/stop throwing garbage	11	27
Plant vegetation/trees	9	22
No idea	8	19
Total	41	100

Source: JICA Study Team

5.4 Desk Study

In developing the technical options for the rehabilitation of the dump site, DAO 09, IRR of RA 9003, Section 5 and the Guidebook for Safe Closure System Applied for Disposal Site, Section II-2 were followed. The following four options were discussed as part of the desk study.

5.4.1 First Option

The first option is to flatten the slopes. In this option the wastes will be graded and compacted. The side slopes will be re-graded to conform to the DENR Guidelines specifying a 3H: 1V as the maximum slope. Soil cover will be employed after re-grading. In this option, the dumped area is largest among other options and there is no dike. The drawing of first option is shown in DRWG. No. O-09 in the Supporting Report No. 2 – Drawings.

(1) Stabilization of Critical Slopes

The wastes will be leveled and compacted. The slopes will be re-graded to conform to the DENR guidelines specifying a 2 to 4% grade. The side slopes is set to 4H: 1V. Soil cover will be employed after re-grading. Top soil suitable for turfing and planting to protect from erosion will be provided. The wastes will be re-shaped to minimize soil covering.

(2) Final Soil Cover

The final cover soil will be made on top of the final waste layer. This is to provide improvement to sanitary condition, landscape, etc. and to reduce infiltration of water into the garbage heaps and to reduce gas migration. It also prevents burrowing animals from damaging the cover, prevent the emergence of insects/rodents from the compacted refuse and minimize the escape of odors. The soil cover will be graded so as to prevent water ponding in the area. The final cover will be 60 cm which include 15 cm top soil and 45 cm compacted soil. A vegetation cover/layer is applied after the final cover to improve the stability of slopes, reduce soil erosion and to beautify the area. To enhance the growth of turfings/grasses hydro seeding will be employed.

(3) Drainage Facility

Drainage facility will be constructed along the periphery of the closed disposal site to divert surface run-off away from the area. Surface water can cause erosion or scouring of the final cover. Thus, they should be controlled and diverted away from the disposal area. The total length of drainage is approximately 205 m.

(4) Fence and Signs

Signboards/billboards informing the public that the site is a former disposal area will be installed. The area will be fenced to control access and to prevent astray animals into the area. Length of the perimeter fence is 160m.

5.4.2 Second Option

The second option calls for the capping and reshaping of the wastes and providing an earth embankment along the bottom slope of the disposal site. In this option, the dumped area is second smallest one among other options and dike is made of earth material. The drawing of second option is shown in DRWG. No. O-10 in the Supporting Report No. 2 – Drawings.

(1) Slope Stabilization

The waste will be pushed and re-shaped forming a mound. The waste will be compacted so as to eliminate voids within the dumped wastes. An earth embankment will be constructed along the bottom slopes of the garbage area to prevent the waste from moving/sliding and spilling over.

(2) Final Soil Cover

The final cover will be a cover soil on top of the final waste layer. This is to provide improvement to sanitary condition, landscape, etc. and to reduce infiltration of water into the garbage heaps and to reduce gas migration. It also prevents burrowing animals from damaging the cover, prevent the emergence of insects/rodents from the compacted refuse and minimize the escape of odors. The soil cover will be graded so as to prevent water seepage in the area. The final cover will be 60 cm which include 15 cm top soil and 45 cm compacted soil. A vegetation cover/layer is applied after the final cover to improve the

stability of slopes, reduce soil erosion and to beautify the area. To enhance the growth of turfings/grasses hydro seeding will be employed.

(3) Drainage Facility

Drainage facility will be constructed along the periphery of the closed disposal site to divert surface run-off away from the area. Surface water can cause erosion or scouring of the final cover. Thus, they should be controlled and diverted away from the disposal area. The total length of drainage is approximately 150 m.

(4) Fence and Signs

Signboards/billboards informing the public that the site is a former disposal area will be installed. The area will be fenced to control access and to prevent astray animals into the area.

5.4.3 Third Option

The third option is to provide an inverted-T retaining wall at the waste boundary with critical slopes and to re-grade the wastes. In this option, the dumped area is large but the downside perimeter is protected by concrete embankment. The drawing of third option is shown in DRWG. No. O-11.

(1) Stabilization of critical slopes

Standard Inverted-T retaining wall will be constructed at the boundary of the wastes having critical slopes. Side Slopes is set at 4H: 1V. The wastes will be re-shaped and re-graded to minimize the area that needs soil cover.

(2) Final Soil Cover.

The final cover will be a cover soil on top of the final waste layer. This is to provide improvement to sanitary condition, landscape, etc. and to reduce infiltration of water into the garbage heaps and to reduce gas migration. It also prevents burrowing animals from damaging the cover, prevent the emergence of insects/rodents from the compacted refuse and minimize the escape of odors. The soil cover will be graded so as to prevent water seepage in the area. The final cover will be 60 cm which include 15 cm top soil and 45 cm compacted soil. A vegetation cover/layer is applied after the final cover to improve the stability of slopes, reduce soil erosion and to beautify the area. To enhance the growth of turfings/grasses hydro seeding will be employed.

(3) Drainage Facility.

Drainage facility will be constructed along the periphery of the closed disposal site to divert surface run-off away from the area. Surface water can cause erosion or scouring of the final cover. Thus, they should be controlled and diverted away from the disposal area. The total length of drainage is approximately 200 m.

(4) Fence and Signs.

Signboards/billboards informing the public that the site is a former disposal area will be installed. The area will be fenced to control access and to prevent astray animals into the area. Length of the perimeter fence is 160 m.

5.4.4 Fourth Option

The wastes will be pushed down the slope and an inverted-T retaining wall will be constructed at the lower end. In this option, disposal area is minimized. The drawing of fourth option is shown in DRWG. No. O-12.

(1) Stabilization of Critical Slopes

Option 4 is the version that be slightly modified from Option 3. Standard Inverted-T retaining wall will be constructed at the boundary of the wastes having critical slopes. Side Slopes is set at 7H: 1V. The wastes will be re-shaped and re-graded to minimize the area that needs soil cover. To stabilize the critical slopes, the amount of concrete material to be used is largest among these options.

(2) Final Soil Cover

The final cover will be carried out by soil covering on top of the final waste layer. This is to provide improvement to sanitary condition, landscape, etc. and to reduce infiltration of water into the garbage heaps and to reduce gas migration. It also prevents burrowing animals from damaging the cover, prevent the emergence of insects/rodents from the compacted refuse and minimize the escape of odors. The soil cover will be graded so as to prevent water seeping in the area. The final cover will be 60 cm which include 15 cm top soil and 45 cm compacted soil. A vegetation cover/layer is applied after the final cover to improve the stability of slopes, reduce soil erosion and to beautify the area. To enhance the growth of turfings/grasses hydro seeding will be employed.

(3) Drainage Facility

Drainage facility will be constructed along the periphery of the upper limit of the re-shaped waste area to divert surface run-off away from the dumped waste. Surface water can cause erosion or scouring of the final cover. Thus, they should be controlled and diverted away from the disposal area. The total length of drainage is approximately 92m.

(4) Fence and Signs

Signboards/billboards informing the public that the site is a former disposal area will be installed. The area will be fenced to control access and to prevent astray animals into the area.

5.4.5 Comparison of Options

The comparison of rehabilitation options (BOQs) of the old dump site is summarized in Table D.5.4-1.

Table D.5.4-1 Bill of Quantity of Each Rehabilitation Option

Description			Unit	Option 1	Option 2	Option 3	Option 4
				Est'd Qty	Est'd Qty	Est'd Qty	Est'd Qty
General Information:							
Estimated Volume of Garbage (Original)			m^3	14,880	14,880	14,880	14,880
Estimated Surface Area of Garbage (Original)			m^3	7,517	7,517	7,517	7,517
Revised Estimated Surface Area of Garbage (New)			m^3	5,149	3,472	5,417	2,537
Estimated Length of Inverted T-Retaining Wall			m	None	None	64	62
Estimated Length of Perimeter Fence			m	160	160	160	160
Assumed Average Hauling Distance (AHD)			m	15	15	15	15
Drainage Total Length			m	205	150	200	92
Compacted Soil before Top Soil			m^3	2,317	1,562	2,438	1,142
Top Soil			m^3	772	521	813	381
Hydro seeding			m^3	5,149	3,472	5,417	2,537
1	Preliminary Work						
	1.1	Mobilization/ Demobilization	L.S.	1	1	1	1
2	Earthworks						
	2.1.1	Embankment by Borrowed Material (Common Soil)	m^3	2,317	1,562	2,438	1,142
	2.1.2	Earth dike by Borrowed Material (Common Soil)	m^3	None	1,863	None	None
	2.2	Borrowed Materials (Top Soil)	m^3	772	521	813	381
	2.3	Leveling and Grading	m^3	5,149	3,472	5,417	2,537
	2.4	Vegetated Cover/Hydro-seeding	m^3	5,149	3,472	5,417	2,537
3	Concrete Works						
	3.1	Concrete (G200)	m^3	0	0	97	158
	3.2	Rebar (RSB)	kg	0	0	6,596	10,744
4	Miscellaneous Works						
	4.1	Gate, Fencing	m	160	160	160	160
	4.2	Drainage Gutter, 6 inch CHB wall	m	205	150	200	92
	4.3	Demolition of Existing Concrete Pavement	m^3	25	25	25	25
	4.4	Excavation of Dumped Garbage	m^3	6,367	8,070	3,025	8,475
	4.5	Embankment of Excavated Garbage	m^3	6,367	8,070	3,025	8,475
	4.6	Garbage Compaction	m^3	8,513	6,810	11,855	6,405

Source: JICA Study Team

Appendix

Appendix III-D Photos

North Side View at Old Dump Site

North Slope of Old Dump Site Covered by Garbage

East Side View at Old Dump Site

Boring of Groundwater Monitoring (No.1)

Boring for Groundwater Monitoring (No.2)

Boring for Grasping of Waste Layer Profile

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG , BORACAY ISLAND , MALAY, AKLAN

HOLE NO.: BH-1 COORDINATES N: 1324854.000 E: 383200.690 GROUND ELEVATION : 58.27M DIP : Vertical

BEGUN: 7/5/2007 FINISHED: 7/5/2007 DEPTH OF OVERBURDEN: 2.00M BEARING:

TOTAL DEPTH: 4.00M WATER TABLE E 0 LOGGED BY: WLLAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-1.20M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			1.20-2.00M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color.
						3	4	5	3			2.00-4.00M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
									4			
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation of joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND ,MALAY, AKLAN

HOLE NO.: BH-2 COORDINATES N: 1324863.620 E: 383222.310 GROUND ELEVATION : 57.0 M DIP : Vertical

BEGUN: 7/13/2007 FINISHED: 13-Jul-07 DEPTH OF OVERBURDEN: 2.0 M BEARING:

TOTAL DEPTH: 3.00M WATER TABLE EL.: 0 LOGGED BY: WLLAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE. LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-0.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
						3	3	5	2			0.50 - 2.00M; Silty clay. Medium plastic. Dark brownish color.
									3			2.00-3.00M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
									4			
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
- W-1 Sound
- W-2 Slightly Weathered (appreciable oxidation at joint)
- W-3 Minimum Weathered (matrix slightly weathered)
- W-4 Deeply Weathered (mutnl deeply weathered)
- W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
- J-1 1 Joint/m
- J-2 2 - 5 Joints/m
- J-3 6 - 10 Joints/m
- J-4 11 - 20 Joints/m
- J-5 >20 Joints/m

Hn Hardness Number
- H-1 Very Hard (hardly broken by hammer)
- H-2 Hard (edge hardly broken by hammer)
- H-3 Medium Hard (Easily broken by Hammer)
- H-4 Slightly Hard (easily squeezed by finger)
- H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND , MALAY, AKLAN

HOLE NO.: BH-3 COORDINATES N: 1324865.82 E: 383251.39 GROUND ELEVATION : 55.25M DIP : Vertical

BEGUN: 7/13/2007 FINISHED: 7/13/2007 DEPTH OF OVERBURDEN: 2.20M BEARING:

TOTAL DEPTH: 3.10M WATER TABLE EL.: 0 LOGGED BY: W.L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-0.60M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			
						3	3	5	3	0		0.60-2.20M; Gravelly clay. Medium plastic. Brownish color.
									4			2.20-3.10M; Coralline Limestone . Moderately weathered. Buff color.
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-4 COORDINATES N: 1324837.47 E: 383275.08 GROUND ELEVATION: 55.5M DIP : Vertical

BEGUN: 7/14/2007 FINISHED: 7/14/2007 DEPTH OF OVERBURDEN: 2.00M BEARING:

TOTAL DEPTH: 4.50M WATER TABLE E O LOGGED BY: W.L.LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAPHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-2.00M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			
						5	5	5	3			2.00-4.50M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
									4			
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-5 COORDINATES N: 1324831.72 E: 383229.1 GROUND ELEVATION : 58.47M DIP : Vertical

BEGUN: 7/14/2007 FINISHED: 7/14/2007 DEPTH OF OVERBURDEN: 3.30M BEARING:

TOTAL DEPTH: 4.00M WATER TABLE E 0 LOGGED BY: W.L.LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-1.40M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			1.40-3.30M; Gravelly clay. Medium plastic. Brownish color.
									3			3.30-4.00M; Coralline Limestone . Moderately weathered. Broken, ranging 2 to 3 cm rock fragments. Buff color.
						4	4	5	4	0		
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG , BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-6 COORDINATES N: 1324852.11 E: 383274.41 GROUND ELEVATION : 55.55M DIP : Vertical

BEGUN: 7/13/2007 FINISHED: 7/13/2007 DEPTH OF OVERBURDEN: 7.00M BEARING:

TOTAL DEPTH: 9.50M WATER TABLE E 0 LOGGED BY: WLLAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-7.00M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			
									3			
									4			
									5			
									6			
									7			
						4	4	5	8	0		7.00-10.00M;Coralline Limestone . Extremely weathered. Broken, ranging 2 to 3 cm rock fragments. Buff color.
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Werathered (matrix deeply weathered)
W-5 Totally Weathered, Argilled (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-7 COORDINATES N: 1324870.57 E: 383267.52 GROUND ELEVATION : 54.50M DIP : Vertical

BEGUN: 7/12/2007 FINISHED: 7/12/2007 DEPTH OF OVERBURDEN: 9.00M BEARING:

TOTAL DEPTH: 12.00M WATER TABLE E 0 LOGGED BY: WLLLAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-6.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			
									3			
									4			
									5			
									6			
									7			650-9.00M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color.
									8			
									9			
						3	4	5	10			9.00-12.00M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Agglitted (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE
LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-8 COORDINATES N: 1324878.89 E: 383264.62
GROUND ELEVATION : 54.20M
DIP : Vertical

BEGUN: 7/15/2007 FINISHED: 7/15/2007
DEPTH OF OVERBURDEN: 9.0M
BEARING:

TOTAL DEPTH: 10.00M WATER TABLE EL.: 0
LOGGED BY: W.L. LAYAOEN
CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAPHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1		#•#•#	0.00-6.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2		#•#•#	
									3		#•#•#	
									4		#•#•#	
									5		#•#•#	
									6		#•#•#	
									7			6.50-9.00M; Gravelly clay. Consist of highly weathered limestone fragments. Reddish color.
									8			
						3	4	5	9			9.00-10.00M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn	Weathering Number
W-1	Sound
W-2	Slightly Weathered (appreciable oxidation at joint)
W-3	Moderately Weathered (matrix slightly weathered)
W-4	Deeply Weathered (matrix deeply weathered)
W-5	Totally Weathered, Argilled (only traces of original structure)
Jn	Joint Number
J-1	1 Joint/m
J-2	2 - 5 Joints/m
J-3	6 - 10 Joints/m
J-4	11 - 20 Joints/m
J-5	>20 Joints/m
Hn	Hardness Number
H-1	Very Hard (hardly broken by hammer)
H-2	Hard (edge hardly broken by hammer)
H-3	Medium Hard (Easily broken by Hammer)
H-4	Slightly Hard (easily squeezed by finger)
H-5	Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE
LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-9
COORDINATES N: 1324845.36 E: 383236.38
GROUND ELEVATION : 56.92M
DIP : Vertical

BEGUN: 7/8/2007
FINISHED: 7/8/2007
DEPTH OF OVERBURDEN: 1.75M
BEARING:

TOTAL DEPTH: 3.00M
WATER TABLE E 0
LOGGED BY: W. L. LAYAOEN
CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-0.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			0.50-1.75M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color.
						3	4	5				1.75-3.00M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
									3			
									4			
									5			
									6			
									7			
									8			
									5			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation of joint)
W-3 Moderate Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillized (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG , BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-10 COORDINATES N: 1324836.43 E: 383259.09 GROUND ELEVATION : 58.17M DIP : Vertical

BEGUN: 7/15/2007 FINISHED: 7/15/2007 DEPTH OF OVERBURDEN: 5.40M BEARING:

TOTAL DEPTH: 5.90M WATER TABLE E 0 LOGGED BY: W.L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAPHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-3.40M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			
									3			
									4			3.40-5.40M; Gravelly clay. Medium plastic. Brownish color.
									5			5.40-5.90M; Coralline Limestone . Moderately weathered. Broken, ranging 2 to 3 cm rock fragments. Buff color.
						4	4	5	6	0		
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG , BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-11 COORDINATES N: 1324828.83 E: 383246.98 GROUND ELEVATION : 58.40M DIP : Vertical

BEGUN: 7/14/2007 FINISHED: 7/14/2007 DEPTH OF OVERBURDEN: 2.30M BEARING:

TOTAL DEPTH: 3.30M WATER TABLE I 0 LOGGED BY: W. L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RERTURN									1			0.00-0.60M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			
						3	4	5	3	0		0.60-2.30 M; Gravelly clay. Consist of highly weathered limestone fragments. Reddish color.
									4			2.30-3.30M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE

LOCATION. BALABAG , BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-12 COORDINATES N: 1324849.06 E: 383251.96

GROUND ELEVATION : 57.32M

DIP : Vertical

BEGUN: 7/16/2007 FINISHED: 7/16/2007

DEPTH OF OVERBURDEN: 4.10M

BEARING:

TOTAL DEPTH: 6.60M WATER TABLE E 0

LOGGED BY: W. L. LAYAOEN

CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE. LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-4.10M ; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc)
									2			
									3			
									4			
						4	3	5	5			4.10-6.60M;Coralline Limestone . Extremely weathered. Broken, ranging 2 to 3 cm rock fragments. Buff color.
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE

LOCATION: BALABAG , BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-13 COORDINATES N: 1324849.96 E: 383265.26

GROUND ELEVATION : 55.97M

DIP : Vertical

BEGUN: 7/14/2007 FINISHED: 7/14/2007

DEPTH OF OVERBURDEN: 4.00M

BEARING:

TOTAL DEPTH: 6.50M WATER TABLE I 0

LOGGED BY: W. L. LAYAOEN

CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1		#•#•#	0.00-4.00M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2		#•#•#	
									3		#•#•#	
									4		#•#•#	
						4	3	5	5			4.00-6.50M;Coralline Limestone . Extremely weathered. Broken, ranging 2 to 3 cm rock fragments. Buff color.
									6			
									7			
									8			
									5			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillized (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND , MALAY, AKLAN

HOLE NO.: BH-14 N: 1324855.22 GROUND ELEVATION : 55.78M DIP : Vertical

E: 383259.27

BEGUN: 7/14/2007 FINISHED: 7/14/2007 DEPTH OF OVERBURDEN: 5.00M BEARING.

TOTAL DEPTH: 7.50M WATER TABLE EL.: 0 LOGGED BY: W. L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE LEVELS , WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1 2 3 4 5 6 7			0.00-5.00M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.) 5.00-7.50 M; Gravelly silty clay. Consist of highly weathered limestone fragments. Reddish color.
									8 9 10 11 12 13 14 15 16 17 18 19 20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argilized (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND ,MALAY, AKLAN

HOLE NO.: BH-15 COORDINATES N: 1324864.33 E: 383276.66 GROUND ELEVATION : 53.50M DIP : Vertical

BEGUN: 7/15/2007 FINISHED: 7/15/2007 DEPTH OF OVERBURDEN: 9.25M BEARING:

TOTAL DEPTH: 10.50 M WATER TABLE E 0 LOGGED BY: W. L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-7.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			
									3			
									4			
									5			
									6			
									7			750-9.25M; Gravelly Clay. Consist of highly weathered limestone fragments. Reddish color.
									8			
									9			9.25-10.50M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
						3	4	5	10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Moderate Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argilized (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG , BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-16 COORDINATES N: 1324838.84 E: 383289.23 GROUND ELEVATION : 54.17M DIP : Vertical

BEGUN: 7/17/2007 FINISHED: 7/17/2007 DEPTH OF OVERBURDEN: 5.50M BEARING:

TOTAL DEPTH: 8.00M WATER TABLE I 0 LOGGED BY: W. L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1		#•#•#	0.00-5.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2		#•#•#	
									3		#•#•#	
									4		#•#•#	
									5		#•#•#	
									6		#•#•#	5.50 -8.00M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
						3	4	5	7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE:

PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE

LOCATION: MALAY, AKLAN

HOLE NO.: BH-17

COORDINATES N: 1324842.89 E: 383282.22

GROUND ELEVATION : 55.120M

DIP : Vertical

BEGUN: 7/17/2007

FINISHED: 17-Jul-07

DEPTH OF OVERBURDEN:

BEARING:

TOTAL DEPTH: 8.50M

WATER TABLE EL.:

LOGGED BY: W. L. LAYOEN

CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
									1			0.00-6.00M; Solid waste materials . Made of organic and non-organic materials.
									2			
									3			
									4			
									5			
									6			6.00 -8.50M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
						3	4	5	7			
									8			
									5			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-18 COORDINATES N: 1324850.25 E: 383287.13 GROUND ELEVATION: 55.47M DIP: Vertical

BEGUN: 7/17/2007 FINISHED: 7/17/2007 DEPTH OF OVERBURDEN: 7.00M BEARING:

TOTAL DEPTH: 9.50M WATER TABLE E 0 LOGGED BY: W. L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1			0.00-7.00M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			
									3			
									4			
									5			7.00 -9.50M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
									6			
						3	4	5	7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn	Weathering Number
W-1	Sound
W-2	Slightly Weathered (appreciable oxidation at joint)
W-3	Minimum Weathered (matrix slightly weathered)
W-4	Deeply Weathered (matrix deeply weathered)
W-5	Totally Weathered, Argillied (only traces of original structure)
Jn	Joint Number
J-1	1 Joint/m
J-2	2 - 5 Joints/m
J-3	6 - 10 Joints/m
J-4	11 - 20 Joints/m
J-5	>20 Joints/m
Hn	Hardness Number
H-1	Very Hard (hardly broken by hammer)
H-2	Hard (edge hardly broken by hammer)
H-3	Medium Hard (Easily broken by Hammer)
H-4	Slightly Hard (easily squeezed by finger)
H-5	Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-19 COORDINATES N: 1324829.07 E: 383287.28 GROUND ELEVATION : 51.00M DIP : Vertical

BEGUN: 7/19/2007 FINISHED: 7/19/2007 DEPTH OF OVERBURDEN: 1.20M BEARING:

TOTAL DEPTH: 2.50M WATER TABLE I 0 LOGGED BY: W. L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE: LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
									1		#∘#∘# #∘#∘# #∘#∘#	0.00-1.20M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			1.20-2.50M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color.
									3			
									4			
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argilized (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE:

PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE

LOCATION: BALABAG , BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-20

COORDINATES N: 1324845.29 E: 383295.08

GROUND ELEVATION : 53.50M

DIP : Vertical

BEGUN: 7/19/2007

FINISHED: 7/19/2007

DEPTH OF OVERBURDEN: 3.00M

BEARING:

TOTAL DEPTH: 3.00M

WATER TABLE E 0

LOGGED BY: W. L. LAYAOEN

CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
									1		#•#•# #•#•# #•#•# #•#•#	0.00-1.20M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			2.00-3.00M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color.
									3			
									4			
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argilled (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE:

PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE

LOCATION: BALABAG , BORACAY ISLAND , MALAY, AKLAN

HOLE NO.: BH-21

COORDINATES N: 1324864.77 E: 383290.45

GROUND ELEVATION : 48.02M

DIP : Vertical

BEGUN: 7/20/2007

FINISHED: 7/20/2007

DEPTH OF OVERBURDEN: 2.50M

BEARING:

TOTAL DEPTH: 2.50M

WATER TABLE E 0

LOGGED BY: W. L. LAYAOEN

CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
									1		#o#o# #o#o# #o#o#	0.00-1.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			1.50-2.50M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color.
									3			
									4			
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillized (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-22 COORDINATES N: 1324880.37 E: 383283.33 GROUND ELEVATION : 44.0M DIP : Vertical

BEGUN: 7/20/2007 FINISHED: 7/20/2007 DEPTH OF OVERBURDEN: 2.50M BEARING:

TOTAL DEPTH: 2.50M WATER TABLE E 0 LOGGED BY: W. L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
									1		#•#•# #•#•# #•#•#	0.00-1.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			1.50-2.50M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color.
									3			
									4			
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE

LOCATION: BALABAG, BORACAY ISLND , MALAY, AKLAN

HOLE NO.: BH-23 COORDINATES N: 1324903.83 E: 383290.84

GROUND ELEVATION : 38.17M

DIP : Vertical

BEGUN: 7/20/2007 FINISHED: 7/20/2007

DEPTH OF OVERBURDEN: 2.50M

BEARING:

TOTAL DEPTH: 2.50M WATER TABLE I 0

LOGGED BY: W. L. LAYAOEN

CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
									1		#•#•# #•#•# #•#•#	0.00-1.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.)
									2			1.50-2.50M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color.
									3			
									4			
									5			
									6			
									7			
									8			
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Moderate Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argilized (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger)

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE

LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-24 N: 1324895.05 COORDINATES E: 383266.01 GROUND ELEVATION : 54.50M DIP : Vertical

BEGUN: 7/20/2007 FINISHED: 7/20/2007 DEPTH OF OVERBURDEN: 7.00M BEARING:

TOTAL DEPTH: 9.50M WATER TABLE E 0 LOGGED BY: W. L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN									1		#o#o#	0.00 - 7.00M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc)
									2		#o#o#	
									3		#o#o#	
									4		#o#o#	
									5		#o#o#	
									6		#o#o#	
									7		#o#o#	
						3	4	5	8			7.00 - 9.50M; Coralline Limestone . Moderately weathered. Broken ranging 2 to 3 cm rock fragments. Buff color.
									9			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									18			
									19			
									20			

EXPLANATION:

Wn	Weathering Number
W-1	Sound
W-2	Slightly Weathered (appreciable oxidation at joint)
W-3	Minimum Weathered (matrix slightly weathered)
W-4	Deeply Weathered (matrix deeply weathered)
W-5	Totally Weathered, Argilized (only traces of original structure)
Jn	Joint Number
J-1	1 Joint/m
J-2	2 - 5 Joints/m
J-3	6 - 10 Joints/m
J-4	11 - 20 Joints/m
J-5	>20 Joints/m
Hn	Hardness Number
H-1	Very Hard (hardly broken by hammer)
H-2	Hard (edge hardly broken by hammer)
H-3	Medium Hard (Easily broken by Hammer)
H-4	Slightly Hard (easily squeezed by finger)
H-5	Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE:

PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE

LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-25

COORDINATES N: 1324876.61 E: 383214.81

GROUND ELEVATION : 56.87M

DIP : Vertical

BEGUN: 7/19/2007

FINISHED: 7/19/2007

DEPTH OF OVERBURDEN: 4.00M

BEARING:

TOTAL DEPTH: 4.00M

WATER TABLE E 0

LOGGED BY: W. L. LAYAOEN

CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
									1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20		#•#•# #•#•# #•#•#	0.00 - 1.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc.) and inorganic materials (plastics, glass, etc.) 1.50-4.00M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color.

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Medium Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE:

PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE

LOCATION: BALABAG , BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: BH-26

COORDINATES N: 1324847.94 E: 383219.54

GROUND ELEVATION : 56.92M

DIP : Vertical

BEGUN: 7/20/2007

FINISHED: 7/20/2007

DEPTH OF OVERBURDEN: 3.50M

BEARING:

TOTAL DEPTH: 3.50M

WATER TABLE : 0

LOGGED BY: W. L. LAYAOEN

CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
									1 2 3		#•#•# #•#•# #•#•#	0.00 - 1.50M; Solid waste materials . Made of decaying mixture of organic materials (leaves, grass, etc) and inorganic materials (plastics, glass, etc.) 1.50-3.50M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color.
									4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20			

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Moderate Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: GWD-1 COORDINATES N: 1324902.94 E: 383196.14 GROUND ELEVATION : 57.65M DIP : Vertical

BEGUN: 6/25/2007 FINISHED: 6/25/2007 DEPTH OF OVERBURDEN: BEARING:

TOTAL DEPTH: 60.00M WATER TABLE E 56.59M LOGGED BY: W.L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN						3	4	5	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20			0.0-20.00M; Coralline Limestone . Moderately weathered. Closely broken; with solution cavities. Buff color.

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger)

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND , MALAY, AKLAN

HOLE NO.: GWD-1 COORDINATES N: 1324902.94 E: 383198.14 GROUND ELEVATION : 57.65M DIP : Vertical

BEGUN: 6/25/2007 FINISHED: 6/25/2007 DEPTH OF OVERBURDEN: BEARING:

TOTAL DEPTH: 60.00M WATER TABLE E 56.59M LOGGED BY: W.L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE. LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S.P.T. DEPTH FROM	S.P.T. DEPTH TO	S.P.T. N VALUE 20 40 60 80	W.P.T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN						3	4	5	21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40			20.00-40.00M; Coralline Limestone . Moderately weathered. Closely broken, with solution cavities. Buff color.

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soil (easily broken by finger

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG , BORACAY ISALND , MALAY, AKLAN

HOLE NO.: GWD-1 COORDINATES N: 1324902.94 E: 383156.14 GROUND ELEVATION : 57.65 DIP : Vertical

BEGUN: 6/25/2007 FINISHED: 15-Jul-07 DEPTH OF OVERBURDEN: BEARING:

TOTAL DEPTH: 60.00M WATER TABLE I 56.59M LOGGED BY: W.L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN						3	4	5	41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60			40.00 - 60.00M; Coralline Limestone . Moderately weathered. Closely broken, with solution cavities. Buff color.

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Argillied (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger)

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND, MALAY, AKLAN

HOLE NO.: GWD-2 COORDINATES N: 1324903.88 E: 363316.1 GROUND ELEVATION : 32.12M DIP : Vertical

BEGUN: FINISHED: DEPTH OF OVERBURDEN: BEARING:

TOTAL DEPTH: 36.00M WATER TABLE EL.: LOGGED BY: W.L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN						3	4	5	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20			0.0 -0.50M; Clayey gravel. Consist of highly weathered limestone fragments. Reddish color. 0.50 -20.00M; Coralline Limestone . Moderately weathered. Closely broken, with solution cavities. Buff color.

EXPLANATION:

Wn Weathering Number
W-1 Sound
W-2 Slightly Weathered (appreciable oxidation at joint)
W-3 Minimum Weathered (matrix slightly weathered)
W-4 Deeply Weathered (matrix deeply weathered)
W-5 Totally Weathered, Agglified (only traces of original structure)

Jn Joint Number
J-1 1 Joint/m
J-2 2 - 5 Joints/m
J-3 6 - 10 Joints/m
J-4 11 - 20 Joints/m
J-5 >20 Joints/m

Hn Hardness Number
H-1 Very Hard (hardly broken by hammer)
H-2 Hard (edge hardly broken by hammer)
H-3 Medium Hard (Easily broken by Hammer)
H-4 Slightly Hard (easily squeezed by finger)
H-5 Soft (easily broken by finger)

GEOLOGIC LOG OF DRILL HOLE

FEATURE: PROJECT: REHABILITATION OF BORACAY OLD DUMP SITE LOCATION: BALABAG, BORACAY ISLAND ,MALAY, AKLAN

HOLE NO.: GWD-2 COORDINATES N: 1324503.88 E: 383316.1 GROUND ELEVATION : 32.12M DIP : Vertical

BEGUN: FINISHED: DEPTH OF OVERBURDEN: BEARING:

TOTAL DEPTH: 36.00M WATER TABLE EL.: LOGGED BY: W.L. LAYAOEN CONTRACTOR: GRS SURVEY & DRILLING SPECIALIST

NOTES ON WATER TABLE, LEVELS WATER RETURN, CHARACTER OF DRILLING, ETC.	CORE RECOVERY (%) 20 40 60 80	S. P. T. DEPTH FROM	S. P. T. DEPTH TO	S. P. T. N VALUE 20 40 60 80	W. P. T. LUGEON VALUE	Weathering Number	Hardness Number	Joint Number	DEPTH (M)	R.Q.D. (%)	GRAHIC LOG	DESCRIPTION OF ROCK OR SOIL
NO WATER RETURN						3	4	5	21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36	0		20.00-36.00M; Coralline Limestone . Moderately weathered. Closely broken, with solution cavities. Buff color.
									37 38 39 40			

EXPLANATION:

Wn	Weathering Number	Jn	Joint Number
W-1	Sound	J-1	1 Joint/m
W-2	Slightly Weathered (appreciable oxidation at joint)	J-2	2 - 5 Joints/m
W-3	Minimum Weathered (matrix slightly weathered)	J-3	6 - 10 Joints/m
W-4	Deeply Weathered (matrix deeply weathered)	J-4	11 - 20 Joints/m
W-5	Totally Weathered, Argillized (only traces of original structure)	J-5	>20 Joints/m
		Hn	Hardness Number
		H-1	Very Hard (hardly broken by hammer)
		H-2	Hard (edge hardly broken by hammer)
		H-3	Medium Hard (Easily broken by Hammer)
		H-4	Slightly Hard (easily squeezed by finger)
		H-5	Soft (easily broken by finger

NATURAL MOISTURE CONTENT

PROJECT : Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

LOCATION: BORACAY

DATE:

OLD LANDFILL

SAMPLE NO.	BH2 ~ S1	BH7 ~ S1	BH3 ~ S1	BH11 ~ S1	BH6 ~ S1
DEPTH m	1.05 ~ 1.50	8.55 ~ 8.80	1.05 ~ 1.50	1.05 ~ 1.78	7.05 ~ 7.25
CONTAINER NO.	A8	A1	A11	A25	A26
CONT. + WET SAMPLE g	317	359	275	226	324
CONT. + DRY SAMPLE g	252	282	215	194	305
WT. OF CONTAINER g	22	22	22	23	21
MOISTURE LOSS g	65	77	60	32	19
WT. OF DRY SAMPLE g	230	260	193	171	284
MOISTURE CONTENT %	28.26%	29.62%	31.09%	18.71%	6.69%

SAMPLE NO.	BH15 ~ S1	BH10 ~ S2	BH16 ~ C2	BH4 ~ C2	BH18 ~ C1
DEPTH m	8.05 ~ 8.25	4.50 ~ 5.40	6.50 ~ 8.00	4.40	7.00 ~ 8.40
CONTAINER NO.	A22	A21	A27	A15	A20
CONT. + WET SAMPLE g	172	297	221	332	175
CONT. + DRY SAMPLE g	137	221	166	315	151
WT. OF CONTAINER g	23	20	22	22	22
MOISTURE LOSS g	35	76	55	17	24
WT. OF DRY SAMPLE g	114	201	144	293	129
MOISTURE CONTENT %	30.70%	37.81%	38.19%	5.80%	18.60%

SAMPLE NO.	BH5 ~ C1				
DEPTH m	2.34 ~ 3.3				
CONTAINER NO.	A17				
CONT. + WET SAMPLE g	286				
CONT. + DRY SAMPLE g	191				
WT. OF CONTAINER g	22				
MOISTURE LOSS g	95				
WT. OF DRY SAMPLE g	169				
MOISTURE CONTENT %	56.21%				

LIQUID AND PLASTIC LIMIT TEST

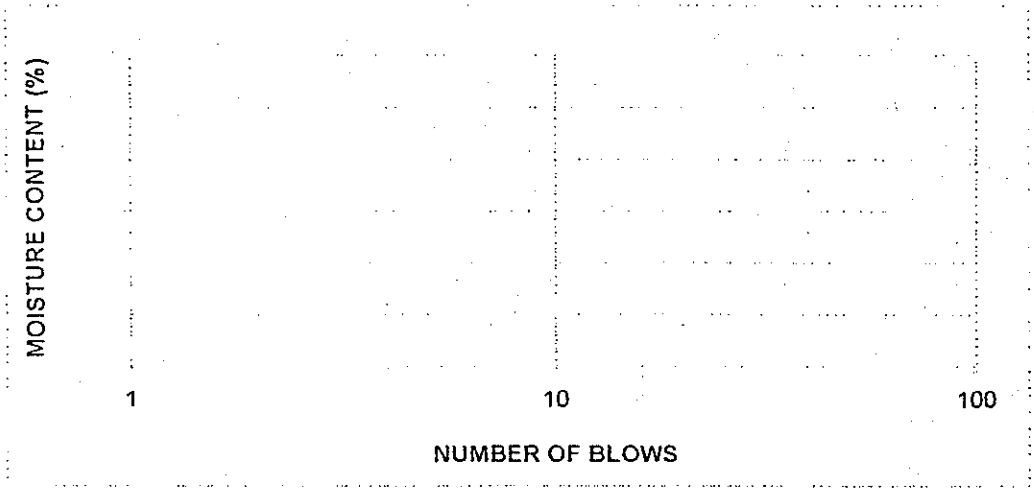
PROJECT : Geological Study and Soil Investigation for the Old and New Proposed Landfill Site
LOCATION: BORACAY

SAMPLE NO.: BH2 ~ S1 (old landfill)

	LIQUID LIMIT				PLASTIC LIMIT	
DETERMINATION NO.	1	2	3	4	A	B
Container Number						
Container + Wet Soil (g)						
Container + Dry Soil (g)						
Moisture Loss (g)						
Container (g)						
Dry Soil (g)						
Moisture Content (%)						
Number of Blows						

NP

FLOW CURVE



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GROUP INDEX:

LIQUID AND PLASTIC LIMIT TEST

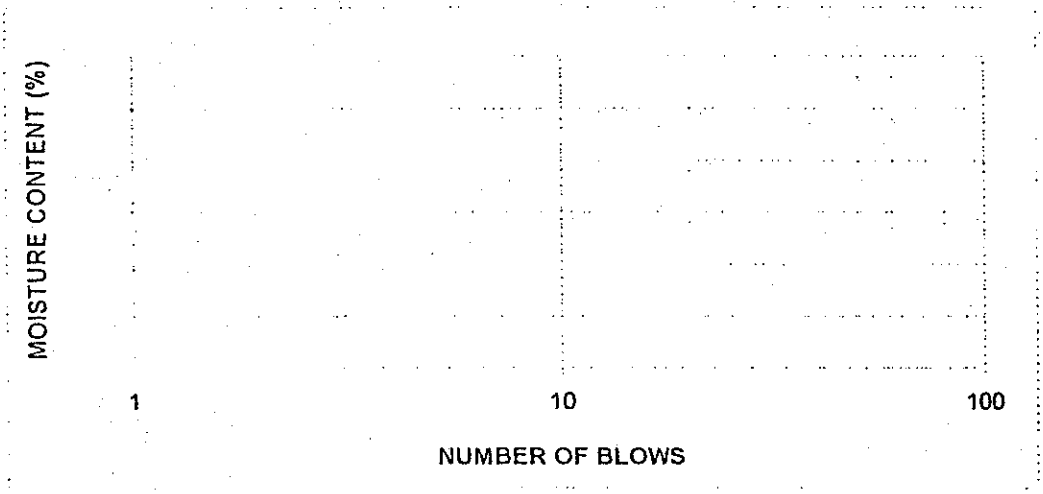
PROJECT : Geological Study and Soil Investigation for the Old and New Proposed Landfill Site
LOCATION: BORACAY

SAMPLE NO.: BH4 ~ C2 (old landfill)

	LIQUID LIMIT				PLASTIC LIMIT	
DETERMINATION NO.	1	2	3	4	A	B
Container Number						
Container + Wet Soil (g)						
Container + Dry Soil (g)						
Moisture Loss (g)						
Container (g)						
Dry Soil (g)						
Moisture Content (%)						
Number of Blows						

NP

FLOW CURVE



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PLASTIC INDEX: NP
GROUP INDEX:

LIQUID AND PLASTIC LIMIT TEST

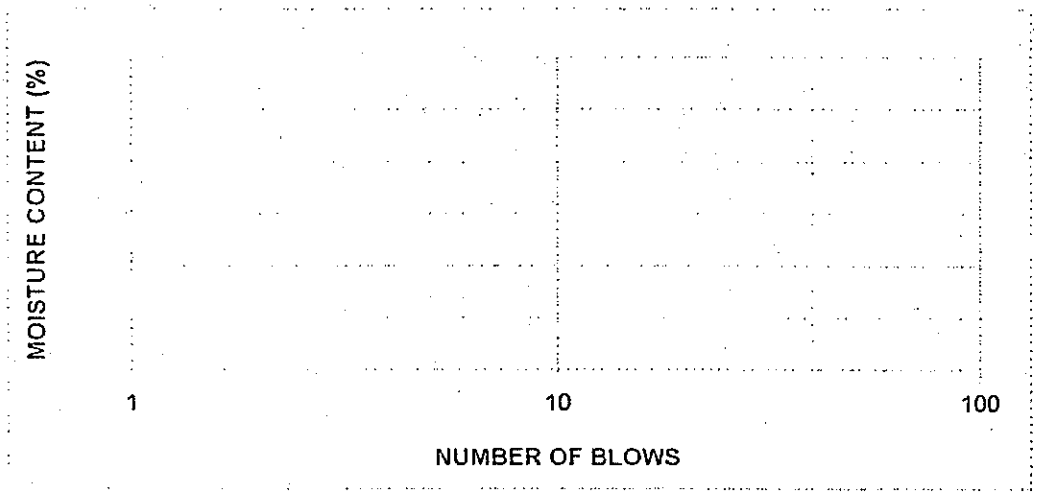
PROJECT : Geological Study and Soil Investigation for the Old and New Proposed Landfill Site
LOCATION: BORACAY

SAMPLE NO.: BH10 ~ S2 (old landfill)

	LIQUID LIMIT				PLASTIC LIMIT	
DETERMINATION NO.	1	2	3	4	A	B
Container Number						
Container + Wet Soil (g)						
Container + Dry Soil (g)						
Moisture Loss (g)						
Container (g)						
Dry Soil (g)						
Moisture Content (%)						
Number of Blows						

NP

FLOW CURVE



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PLASTIC INDEX: NP
GROUP INDEX:

LIQUID AND PLASTIC LIMIT TEST

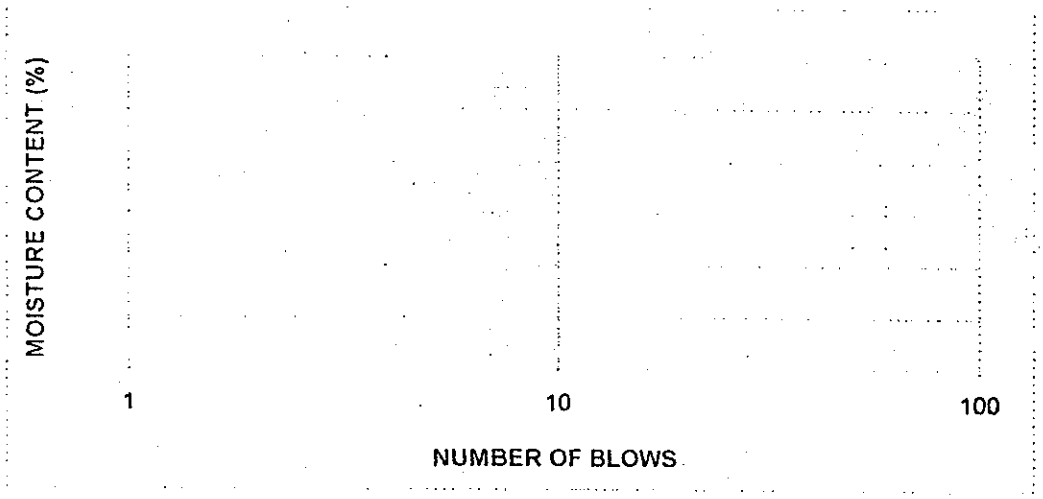
PROJECT : Geological Study and Soil Investigation for the Old and New Proposed Landfill Site
LOCATION: BORACAY

SAMPLE NO.: BH15 ~ S1 (old landfill)

	LIQUID LIMIT				PLASTIC LIMIT	
DETERMINATION NO.	1	2	3	4	A	B
Container Number						
Container + Wet Soil (g)						
Container + Dry Soil (g)						
Moisture Loss (g)						
Container (g)						
Dry Soil (g)						
Moisture Content (%)						
Number of Blows						

NP

FLOW CURVE



LIQUID LIMIT: NP
PLASTIC LIMIT: NP
PLASTIC INDEX: NP
GROUP INDEX:

Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old Landfill Site

Location: BORACAY

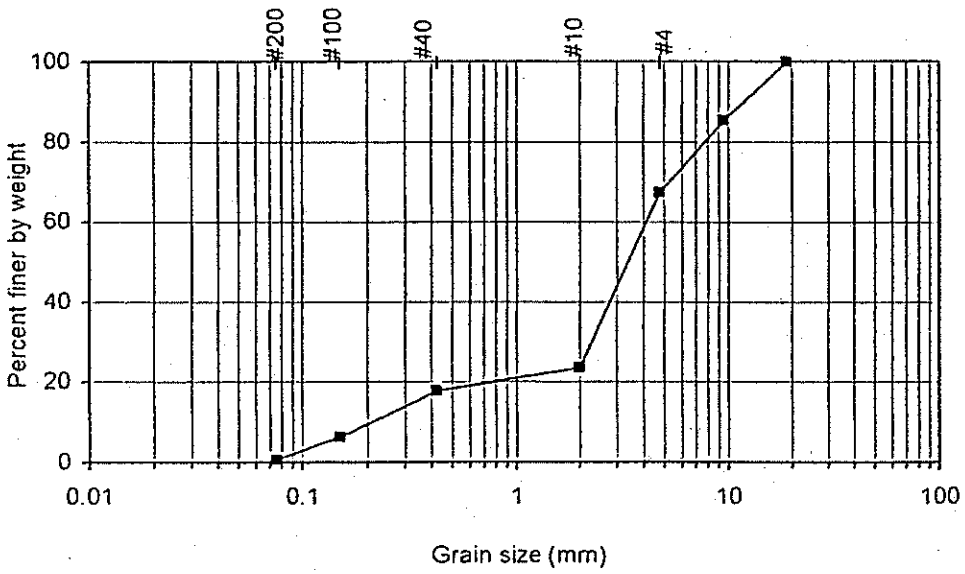
Boring number: BH 2 Sample number: S1

Analyst name: Test date:

Sample description:

Sample mass M_0 = *168.70* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	0.0	168.7	100.00
3/8"	9.500	8.0	160.7	95.26
4	4.750	11.0	149.7	88.74
10	2.000	78.0	71.7	42.50
40	0.425	15.0	56.7	33.61
100	0.150	35.0	21.7	12.86
200	0.075	21.0	0.7	0.41
pan		0.7	0.0	0.00



Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

Location: BORACAY

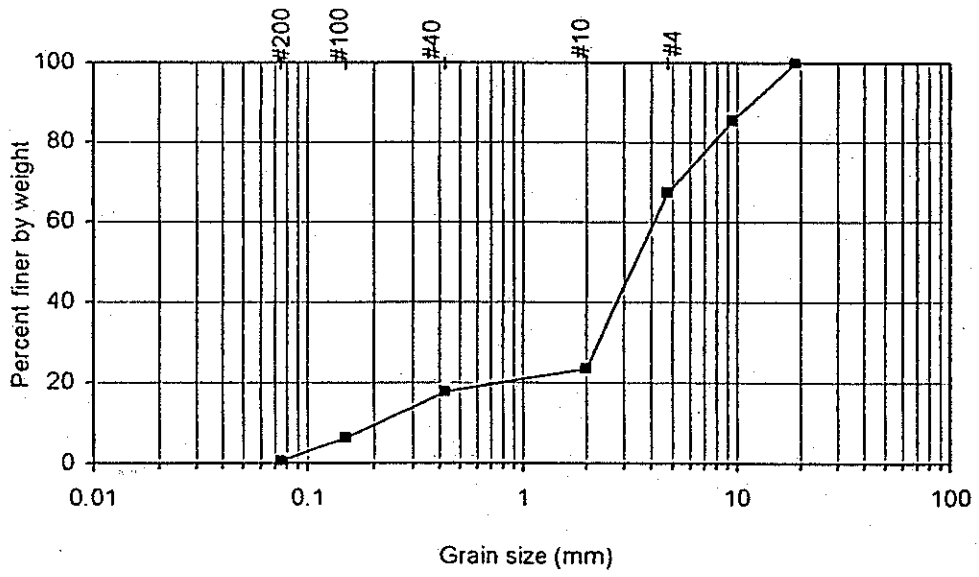
Boring number: BH 3 Sample number: S1

Analyst name: Test date:

Sample description:

Sample mass M_0 = *149.60* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	0.0	149.6	100.00
3/8"	9.500	14.0	135.6	90.64
4	4.750	12.0	123.6	82.62
10	2.000	77.0	46.6	31.15
40	0.425	12.0	34.6	23.13
100	0.150	24.0	10.6	7.09
200	0.075	10.0	0.6	0.40
pan		0.6	0.0	0.00



Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

Location: BORACAY

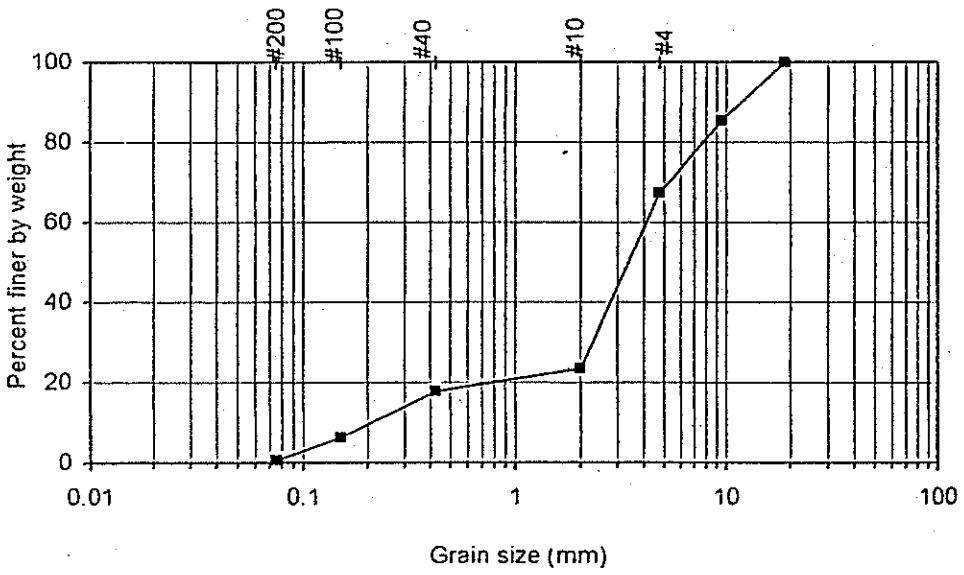
Boring number: BH 4 Sample number: C2

Analyst name: Test date:

Sample description:

Sample mass M_0 = *239.50* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	137.0	102.5	42.80
3/8"	9.500	4.0	98.5	41.13
4	4.750	9.0	89.5	37.37
10	2.000	47.0	42.5	17.75
40	0.425	9.0	33.5	13.99
100	0.150	22.0	11.5	4.80
200	0.075	11.0	0.5	0.21
pan		0.5	0.0	0.00



Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

Location: BORACAY

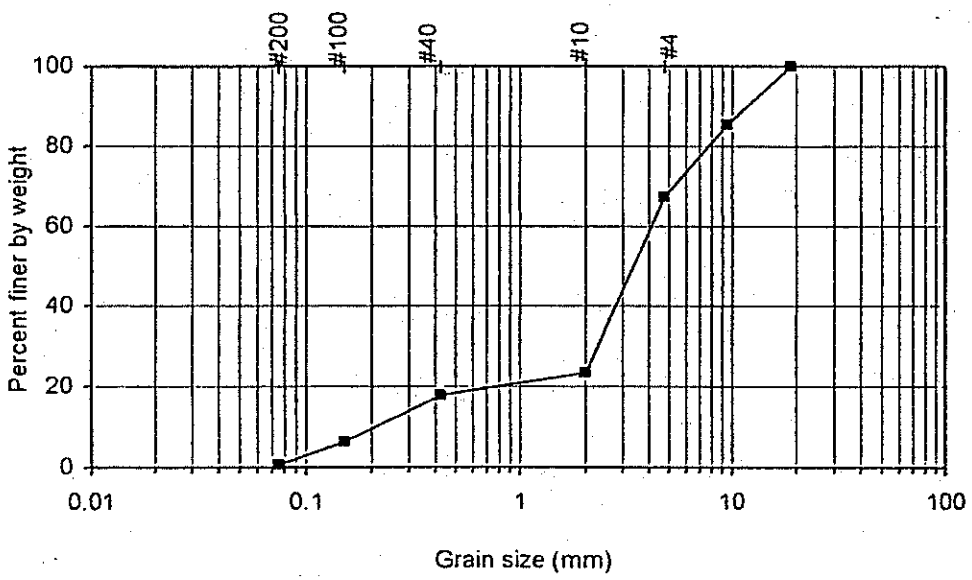
Boring number: BH 5 Sample number: C1

Analyst name: Test date:

Sample description:

Sample mass M_0 = *144.20* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	0.0	144.2	100.00
3/8"	9.500	3.0	141.2	97.92
4	4.750	7.0	134.2	93.07
10	2.000	108.0	26.2	18.17
40	0.425	8.0	18.2	12.62
100	0.150	12.0	6.2	4.30
200	0.075	6.0	0.2	0.14
pan		0.2	0.0	0.00



Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

Location: BORACAY

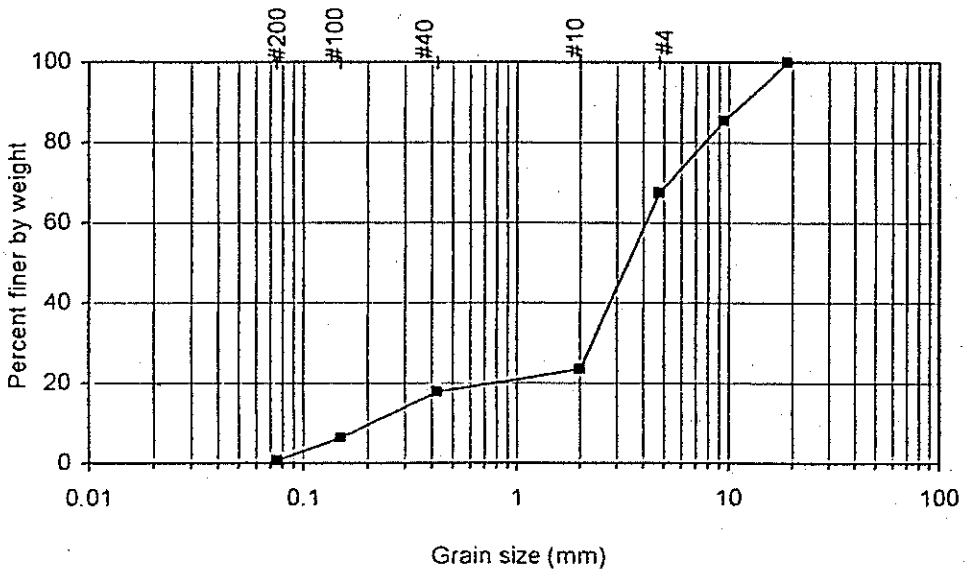
Boring number: BH 6 Sample number: S1

Analyst name: Test date:

Sample description:

Sample mass M_0 = *209.70* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	0.0	209.7	100.00
3/8"	9.500	47.0	162.7	77.59
4	4.750	30.0	132.7	63.28
10	2.000	74.0	58.7	27.99
40	0.425	12.0	46.7	22.27
100	0.150	31.0	15.7	7.49
200	0.075	15.0	0.7	0.33
pan		0.7	0.0	0.00



Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

Location: BORACAY

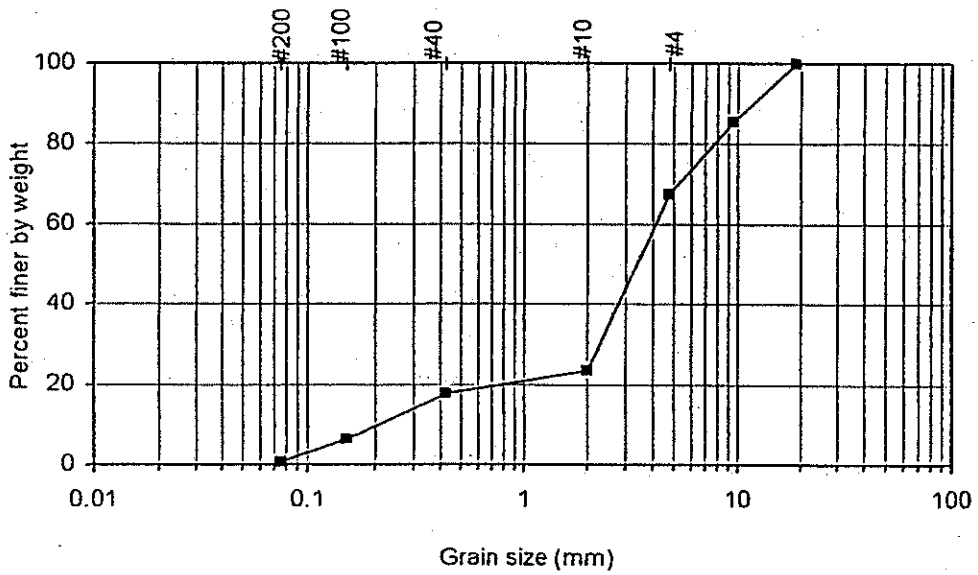
Boring number: BH 7 Sample number: S1

Analyst name: Test date:

Sample description:

Sample mass M_0 = *221.40* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	47.0	174.4	78.77
3/8"	9.500	43.0	131.4	59.35
4	4.750	11.0	120.4	54.38
10	2.000	75.0	45.4	20.51
40	0.425	13.0	32.4	14.63
100	0.150	23.0	9.4	4.25
200	0.075	9.0	0.4	0.18
pan		0.4	0.0	0.00



Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

Location: BORACAY

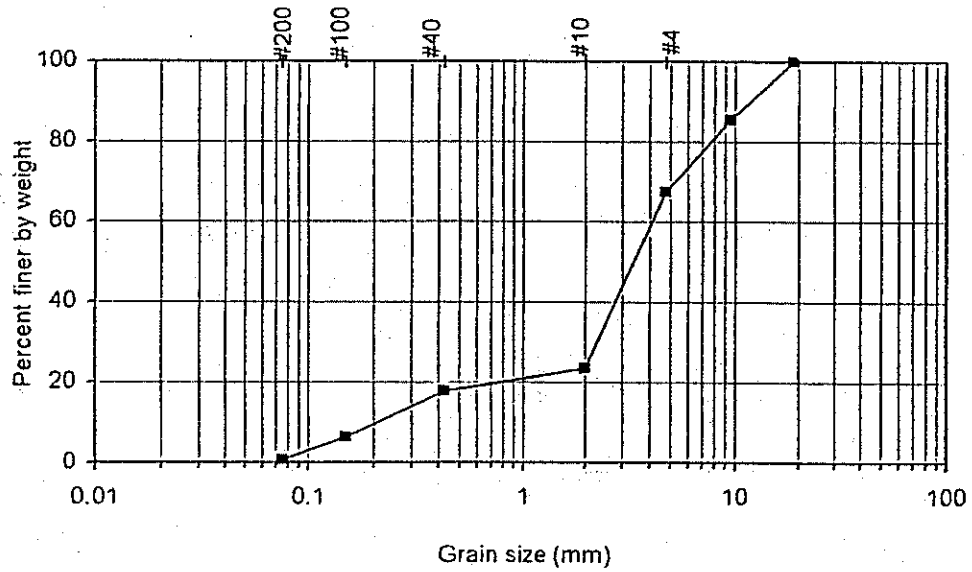
Boring number: BH 10 Sample number: S2

Analyst name: Test date:

Sample description:

Sample mass M_0 = *144.50* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	0.0	144.5	100.00
3/8"	9.500	5.0	139.5	96.54
4	4.750	7.0	132.5	91.70
10	2.000	92.0	40.5	28.03
40	0.425	11.0	29.5	20.42
100	0.150	19.0	10.5	7.27
200	0.075	10.0	0.5	0.35
pan		0.5	0.0	0.00



Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

Location: BORACAY

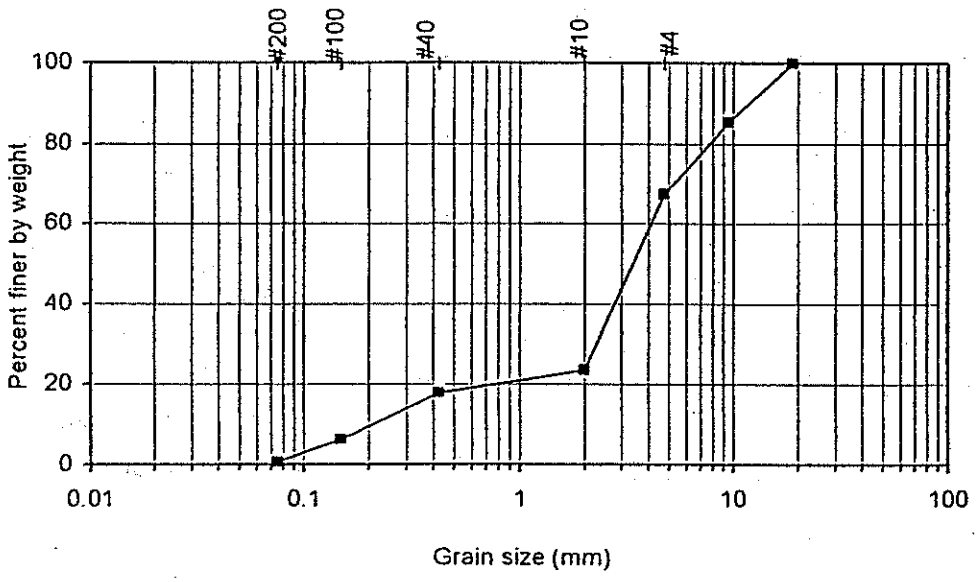
Boring number: BH 11 Sample number: S1

Analyst name: Test date:

Sample description:

Sample mass M_0 = *122.80* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	0.0	122.8	100.00
3/8"	9.500	18.0	104.8	85.34
4	4.750	22.0	82.8	67.43
10	2.000	54.0	28.8	23.45
40	0.425	7.0	21.8	17.75
100	0.150	14.0	7.8	6.35
200	0.075	7.0	0.8	0.65
pan		0.8	0.0	0.00



Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

Location: BORACAY

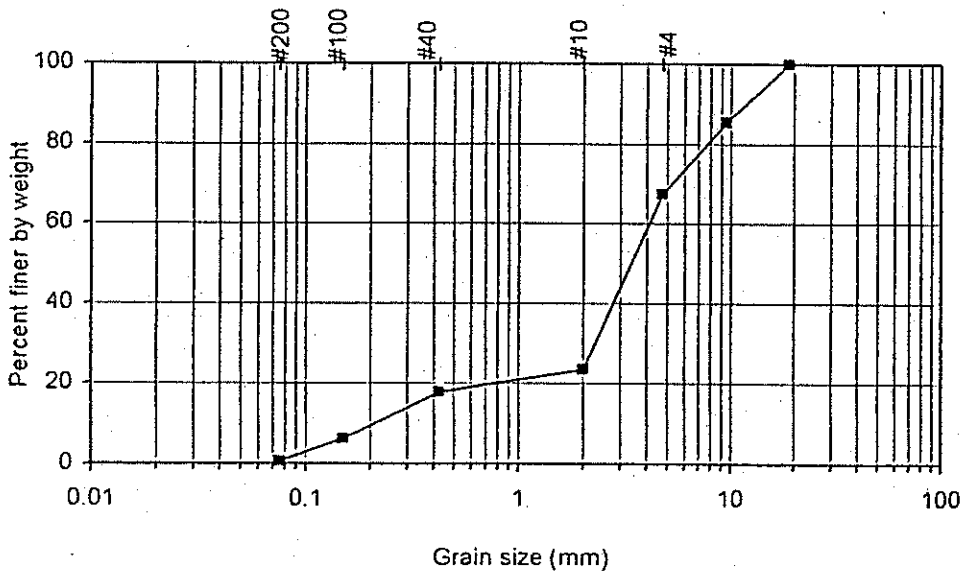
Boring number: BH 15 Sample number: S1

Analyst name: Test date:

Sample description:

Sample mass M_0 = *84.80* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	0.0	84.8	100.00
3/8"	9.500	2.0	82.8	97.64
4	4.750	5.0	77.8	91.75
10	2.000	36.0	41.8	49.29
40	0.425	10.0	31.8	37.50
100	0.150	22.0	9.8	11.56
200	0.075	9.0	0.8	0.94
pan		0.8	0.0	0.00



Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

Location: BORACAY

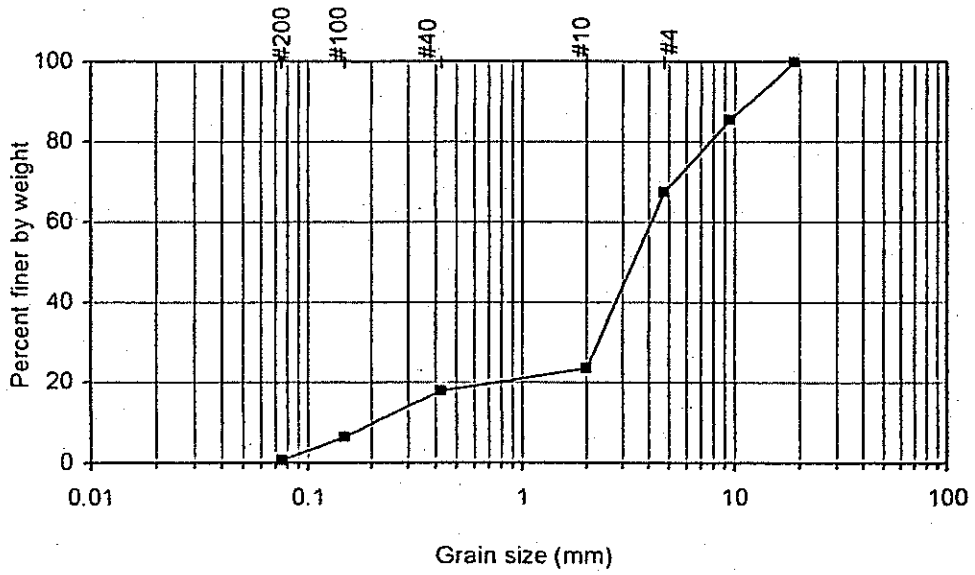
Boring number: BH 16 Sample number: C2

Analyst name: Test date:

Sample description:

Sample mass M_0 = *128.70* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	0.0	128.7	100.00
3/8"	9.500	0.0	128.7	100.00
4	4.750	8.0	120.7	93.78
10	2.000	69.0	51.7	40.17
40	0.425	15.0	36.7	28.52
100	0.150	26.0	10.7	8.31
200	0.075	10.0	0.7	0.54
pan		0.7	0.0	0.00



Sieve Analysis

ASTM D 422

Project: Geological Study and Soil Investigation for the Old and New Proposed Landfill Site

Location: BORACAY

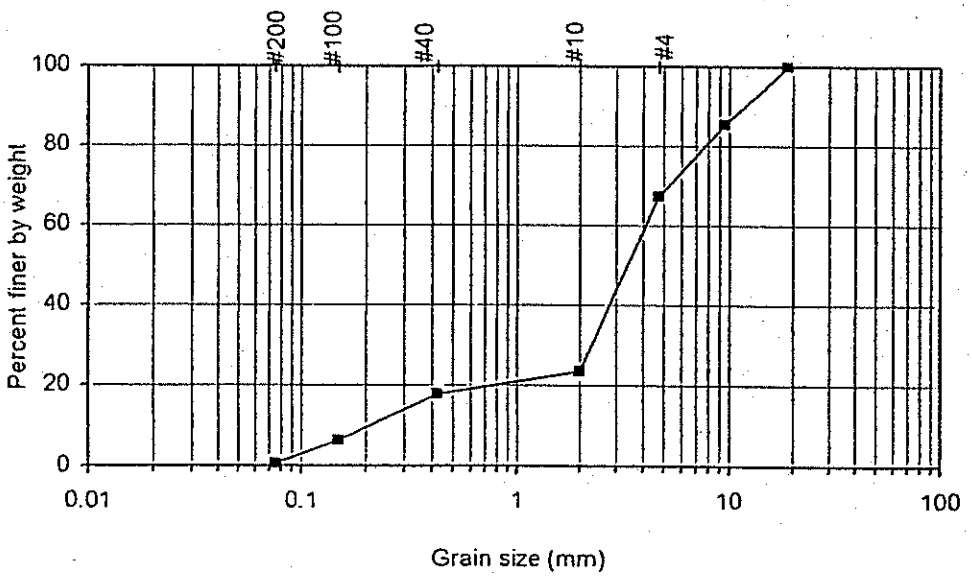
Boring number: BH 18 Sample number: C1

Analyst name: Test date:

Sample description:

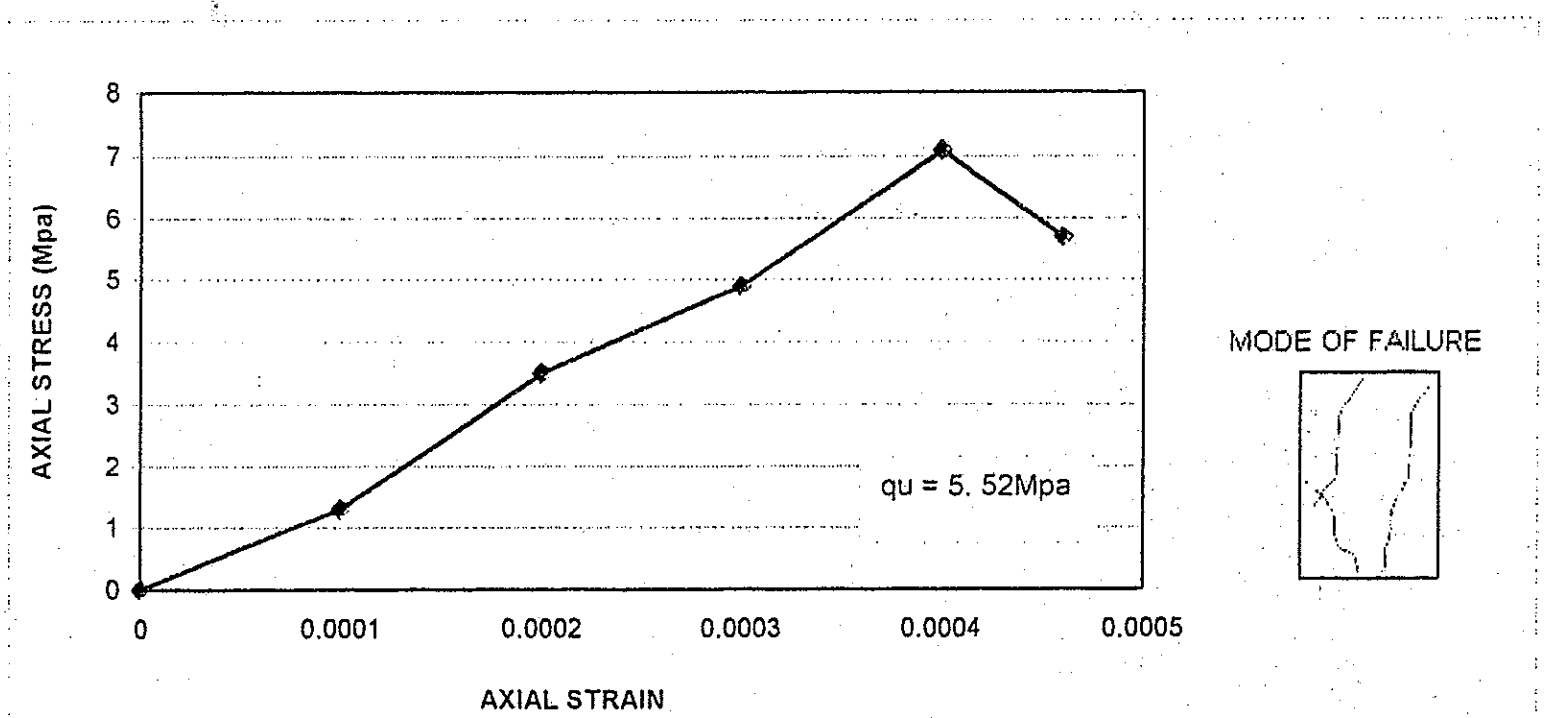
Sample mass M_0 = *106.20* g

US sieve number	Sieve opening (mm) d	Mass retained (g) M	Mass passing (g) M_p	Percent finer by weight p
3/4"	19.000	0.0	106.2	100.00
3/8"	9.500	31.0	75.2	70.81
4	4.750	8.0	67.2	63.28
10	2.000	32.0	35.2	33.15
40	0.425	6.0	29.2	27.50
100	0.150	21.0	8.2	7.72
200	0.075	8.0	0.2	0.19
pan		0.2	0.0	0.00



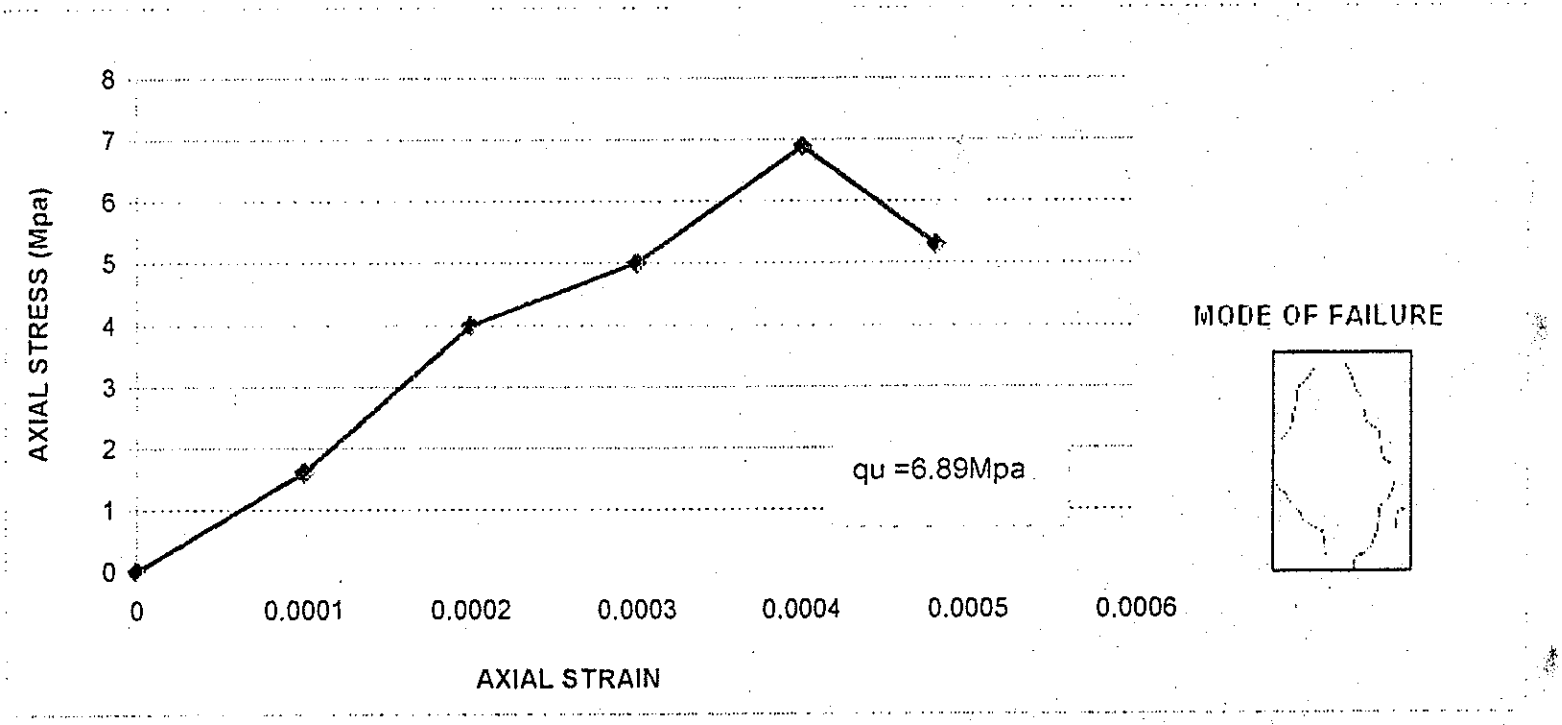
UNCONFINED COMPRESSION TEST

PROJECT	Geological Study and Soil Investigation for the Old and New Proposed Landfill Site	
LOCATION	BORACAY	
BOREHOLE NO.	GW ~ 1	
DEPTH	15.0 ~ 15.13m	
DIAMETER	4.75	cm
HEIGHT	9.5	cm



UNCONFINED COMPRESSION TEST

PROJECT	Geological Study and Soil Investigation for the Old and New Proposed Landfill Site
LOCATION	BORACAY
BOREHOLE NO.	GW~ 1
DEPTH	18.00 ~ 18.4m
DIAMETER	4.7 cm
HEIGHT	9.4 cm



PART III: FEASIBILITY STUDY

E: CENTRALIZED MATERIAL RECOVERY FACILIY SITE SURVEY

PART III-E: CENTRALIZED MRF SITE SURVEY

1. Introduction

On Boracay Island, there are three MRFs, one for each barangay. The operational condition of them is different from barangay to barangay and it is necessary to improve the condition of each MRF to segregate recyclable and biodegradable wastes properly and effectively. In terms of collection and transport of the waste to the MRFs, it has been identified that as the collection coverage area of each MRF is small and the boundary of the collection coverage area of the each MRF is not suitable for establishing appropriate collection routes. Consequently, working staff and collection vehicles are not utilized effectively. In this context, it is recommended that the current three MRFs on Boracay Island should be centralized to a MRF. As for site of the centralized MRF, the location of the centralized MRF was determined at the current Manoc-Manoc MRF and its adjacent site. To develop the centralized MRF, the site survey was implemented for conceptual design for the feasibility study.

2. Objectives

The site survey aimed to provide sufficient information and necessary data for planning the centralized MRF. Especially, the objectives of the survey on the centralized MRF were

- To provide the necessary topographic, cross-sections and longitudinal profiles to prepare site development plan and drainage plan, and
- To prepare conceptual design of the centralized MRF including facility and drainage plans.

3. Scope of Works

3.1 Topographic Survey

The survey consists of ground control survey and leveling survey, with sufficient data points acquired to prepare appropriate and accurate topographic maps, longitudinal profiles and cross-sections. The legend and symbols used in the map follow National Standard. National coordinates and an elevation system referenced to mean sea level was also applied to the survey and mapping. Four permanent bench marks were established at the site, which were constructed to ensure permanency and referenced to national grid and mean sea level. A total station survey was undertaken for the whole of the currently designated project site and for adjacent contiguous areas. For the conceptual design, the survey covered 1.2 ha including the existing Manoc-Manoc MRF. Mapping was done to a scale of 1/500 and sufficient survey points were recorded in order to establish accurate contours of the surface of the site and survey area, at intervals of not greater than 1.0 m vertical spacing and existing features were picked up and delineated on the plans and sections to be prepared. These include any physical structures such as buildings, inner roads, adjacent roads, culverts, trees composting pit and recyclable and other waste storage areas.

3.2 Conceptual Design

The overall design of the proposed centralized MRF consist of material flow and system flow by three phases as well as design capacity based on the future framework of the 10-year Solid Waste Management Plan.

The storm drainage system for the proposed centralized MRF aimed to drain the storm run-off collected from the structures within the vicinity bounded by the perimeter of the MRF site and the adjacent lots that contributes to the drainage catchments area. The scheme makes use of interconnected circular concrete pipes from the building structures and discharges to the open canal which serves as the main drainage line. Storm water is finally conveyed towards a collector pond before it reaches to its final outfall or to the lower ground. According to the topographic map and rainfall data, the drainage plan was prepared.

4. Methodology

4.1 Topographic Survey

As an initial activity, to familiarize with the site condition as well as to ensure the safety of personnel and equipment, the survey team undertook a brief reconnaissance survey in each site. Coordination with the local officials of the nearest barangay was undertaken. During the reconnaissance survey, locations of the control stations established by the National Mapping and Resource Information Authority (NAMRIA), Philippine Coast and Geodetic Survey (PCGS) or the Philippine Reference System (PRS) were also identified.

From the NAMRIA/PCGS control stations with known established positions and elevations, permanent bench marks were established around the area for the horizontal and vertical control. From these secondary control stations, all the survey points (topographic and cross-section) were observed. A high precision Global Positioning System (GPS) instrument was used to establish both the positions and elevations of the secondary control points that were used throughout the survey works.

4.2 Conceptual Design

The concept design was conducted based on the waste quantity and its physical composition of each type of waste to be collected, recycled, sold, composted and treated at the proposed centralized MRF. Topographic survey of the site was conducted after which sections were generated on the topographic map using the AutoCAD. Profiles were also generated using the computer on selected locations deemed ideal by the designer/engineer for the landfill site. Key points considered were the estimated capacity of equipment as well as the operation areas of the equipment and facilities.

5. Result

5.1 Topographic Survey

The locations of the Bench Marks established are described in the document of Photos. The proposed site of centralized Manoc-Manoc MRF is gently slopes south to north and there is a small hill at the east side. The land has a gradual gradient from south to north, i.e. the elevation of northern part of the site is lower than the southern part. The result of the topographic survey is shown in DRWG. No.P-01 as topographic map and its cross section of topographic map are shown in DRWG.No.P-02 to DRWG.No.P-07 respectively.

5.2 Conceptual Design

5.2.1 Overall Design

(1) Phase I

1) Development Concept of Phase I

- To utilize the equipment of the existing Manoc-Manoc MRF
- To develop areas and facilities and procure equipment in consideration of the future development plan for Phase II
- To utilize current available land for effective operation of the centralized MRF
- To allocate the facilities and equipment in consideration of minimum transfer during the transition period from Phase I to Phase II

2) Design Condition

- Location : Manoc-Manoc MRF, Barangay Manoc-Manoc
- Area : 0.37 ha
- Collection Service Coverage Area : Barangay Manoc-Manoc
- Estimated waste quantity and characteristics: As shown in Tables E.5.2-1 and Table E.5.2-2.

Table E.5.2-1 Estimated Waste Quantity in Phase I

[ton/day]

Type of Waste	2010	2011
Biodegradable waste	1.8	1.9
Recyclable waste	1.6	1.8
Residual waste	1.3	1.4

Source: JICA Study Team

Table E.5.2-2 Estimated Waste Characteristics in Phase I

[wt%, wet basis]

Physical Composition	Biodegradable waste	Recyclable waste	Residual waste
Kitchen	49%	1%	3%
Grass, wood	32%	0%	0%
Paper	15%	30%	23%
Plastic	1%	20%	61%
Textiles and Leathers	1%	2%	3%
Glass	0%	39%	8%
Metal	0%	7%	1%
Others	2%	1%	1%
Total	100%	100%	100%

Source: JICA Study Team

3) System Flow

The waste collected from Barangay Manoc-Manoc is transported into the Manoc-Manoc MRF and handled in each waste handling area there. The over all system flow is described in Figure 5.2-1 and the operation plan of Phase I is described in DRWG.No.P-21.

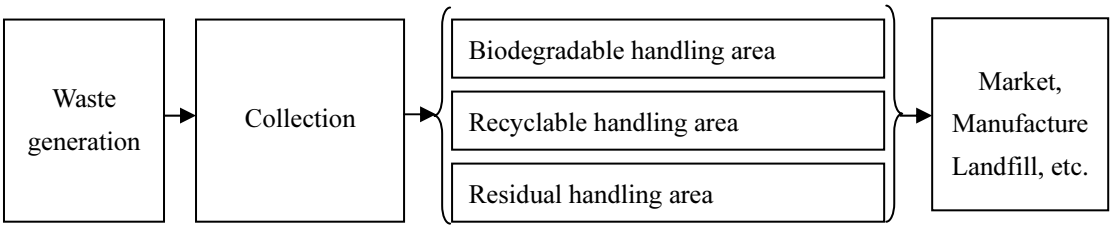


Figure E.5.2-1 Overall System Flow of the MRF

Source: JICA Study Team

(i) Biodegradable Handling

A biodegradable handling area is to be prepared for unloading, sorting out impurities or unsuitable material, composting by bioreactor, curing, maturing, packing and storage for sale as compost. To combat fluctuations in the market, adequate storage area is to be secured along with fields or gardens for compost utilization to make the facilities self-sustaining in this regard and also for demonstration purposes.

The biodegradable waste is to be unloaded in an unloading area and carried into a sorting area. The plastic, cord, metals and broken glass are sorted out in the sorting area before shredding. After shredding of the biodegradable waste, the biodegradable waste is composted in a bioreactor. Regarding kitchen waste and animal waste, composting is to be adopted. After fermentation of 8 hours in the bioreactor at less than 65 degrees C, biodegradable waste is cured in the curing area for 20 to 30 days at around 40 degrees C.

The system flow is shown in Figure E.5.2-2.

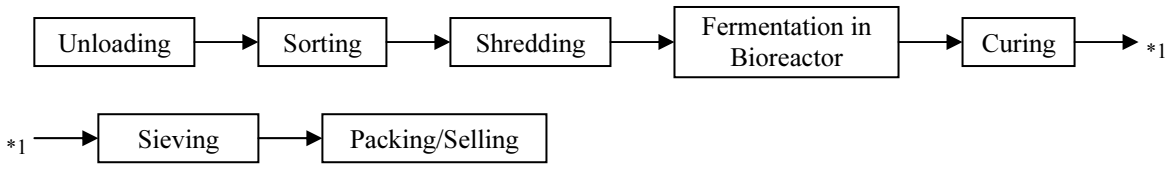


Figure E.5.2-2 System Flow of the Biodegradable Waste

Source: JICA Study Team

(ii) Recyclable Handling Area

A recyclable handling area is prepared for sorting the recyclable waste for selling to junkshops and to sort out the residual waste included in the waste collected as recyclable waste. The sorting activities are carried out manually in Phase I with a more systematic manner in a larger sorting area than the current sorting activities.

A table is provided in the handling area upon which to place the unsorted recyclable waste in order to facilitate the sorting process. Each sorter sorts the recyclable waste and divides it into the three separate categories. The sorted recyclable waste is to be transported by hand cart to a storage area and stored temporarily. Glass cullet products and molded products are to be produced on a small scale or at the pilot level. The system flow is shown in Figure E.5.2-3.

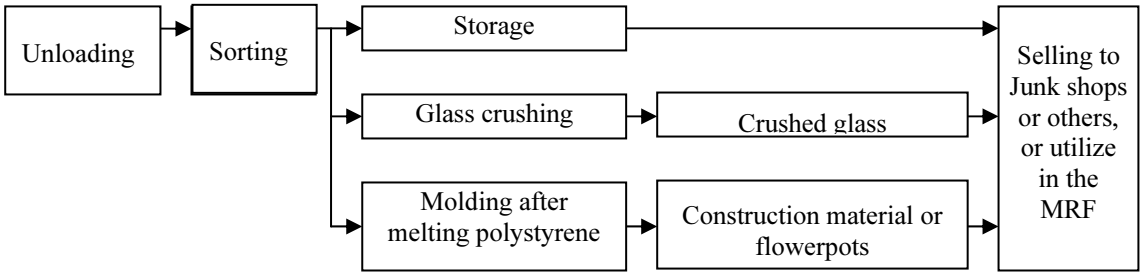


Figure E.5.2-3 System Flow of the Recyclable Waste

Source: JICA Study Team

(iii) Residual Waste Handling Area

Residual waste is handled by utilizing the existing sorting area. The unloaded residual waste and the residual waste sorted out from the waste collected as recyclable or biodegradable waste is packed into sacks for transporting to the new SLF. The system flow of the residual waste is shown in Figure E.5.2-4.

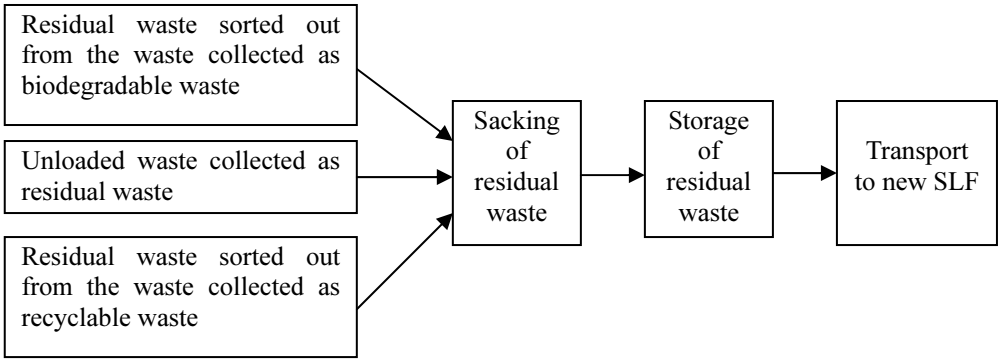


Figure E.5.2-4 System Flow of the Residual Waste

Source: JICA Study Team

(2) Phase II

1) Development Concept of Phase II

- To utilize the equipment used in Phase I and also the existing MRFs for the new Centralized MRF
- To develop and improve the existing Manoc-Manoc MRF into a new Centralized MRF
- To utilize current available land for effective operation of the Centralized MRF
- To allocate the facilities and equipment with consideration of minimum transfer during the transition period of Phase I to Phase II

2) Design Condition

- Location : Manoc-Manoc MRF
- Area : 0.7 ha
- Service Area : Barangay Manoc-Manoc, Barangay Balabag, Barangay Yapak
- Estimated waste quantity and characteristics

Estimated waste quantity and characteristics are described in Table E.5.2-3 and Table E.5.2-4.

Table E.5.2-3 Estimated Waste Quantity in Phase II

[ton/day]

Type of Waste	2012	2013	2014
Biodegradable waste	6.5	6.9	7.1
Recyclable waste	6.1	6.5	6.7
Residual waste	4.9	5.2	5.4

Source: JICA Study Team

Table E.5.2-4 Estimated Waste Characteristics in Phase II

[wt%, wet basis]

Physical Composition	Biodegradable waste	Recyclable waste	Residual waste
Kitchen	51%	1%	2%
Grass, wood	33%	0%	0%
Paper	13%	31%	23%
Plastic	1%	19%	62%
Textiles and Leathers	0%	1%	3%
Glass	0%	40%	8%
Metal	0%	7%	1%
Others	2%	1%	1%
Total	100%	100%	100%

Source: JICA Study Team

3) Overall System Flow

Though overall system flow is similar to Phase I, a segregated collection system is to be introduced in Phase II and a belt conveyor system for sorting of recyclable waste is also to be introduced. The sorting activity will be remarkably improved. The schematic flow is described in Figure E.5.2-5. The operation plan of Phase II is described in from DRWG.No.P-22 to DRWG.No.P-24 for each type of waste.

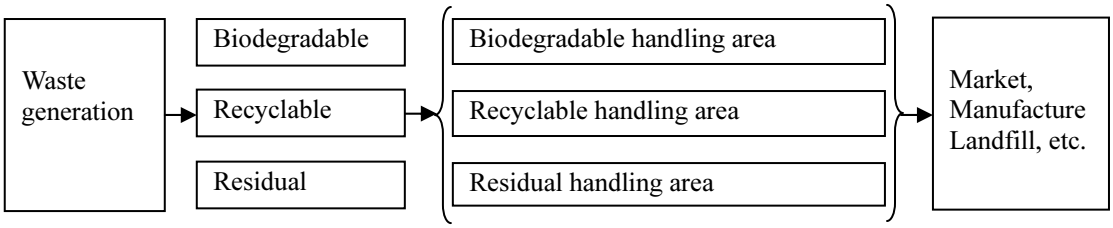


Figure E.5.2-5 Overall System Flow of the MRF

Source: JICA Study Team

(i) Biodegradable Handling Area

The biodegradable handling area is for unloading, sorting impurities or unsuitable material, composting in a bioreactor, curing, maturing, packing and storage for sale as compost. To combat fluctuations in the market, adequate storage area is to be secured along with fields or gardens for compost utilization to make the facilities self-sustaining in this regard and also for demonstration purposes.

The biodegradable waste is to be unloaded in the unloading area and carried into the sorting area. The plastic, cord metal and broken glass are to be sorted out in the sorting area before shredding. After shredding of the biodegradable waste, the biodegradable waste is composted in a bioreactor or recycled in the form of charcoal by the charcoal system. Regarding kitchen waste and animal waste, composting is adopted, after fermentation of 8 hours in a bioreactor at less than 65 degrees C, the biodegradable waste is cured in the curing area for 20 to 30 days. The carbonization system as well as composting is shown in Figure E.5.2-6.

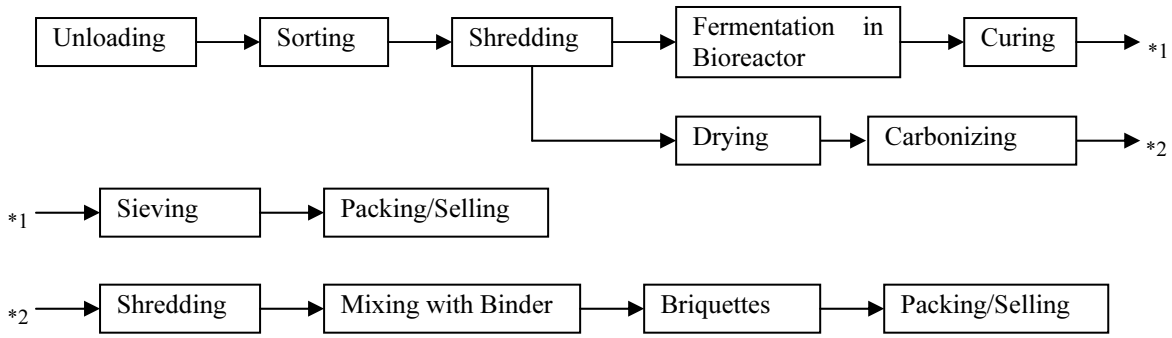


Figure E.5.2-6 System Flow of the Biodegradable Waste

Source: JICA Study Team

(ii) Recyclable Handling Area

In Phase II, a belt conveyor system for sorting of recyclable waste is to be introduced. In addition, the area of glass crushing and molded product system for polystyrene foam is to be introduced. The system flow is shown in Figure E.5.2-7.

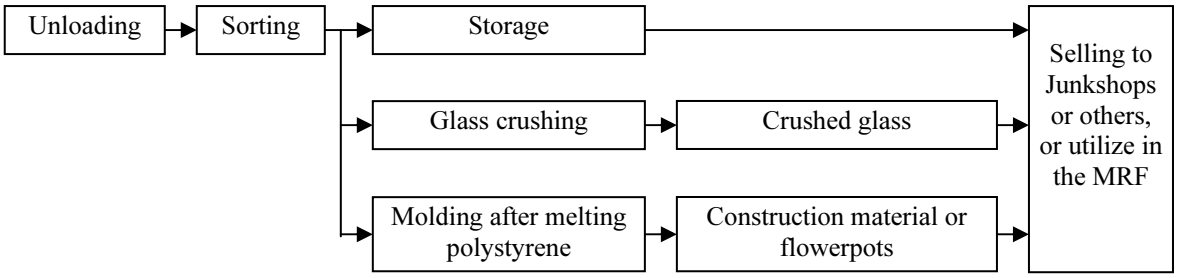


Figure E.5.2-7 System Flow of the Recyclable Waste

Source: JICA Study Team

(iii) Residual Handling Area

In the residual handling area, a baling machine is to be introduced for baling the residuals to minimize the volume during transportation as well as in landfilling. The main handling procedure is to pack residual waste into sacks after baling. In addition to the baling machine, a hollow block making system will be introduced to divert the residual. The system flow of the residual handling is described in Figure E.5.2-8.

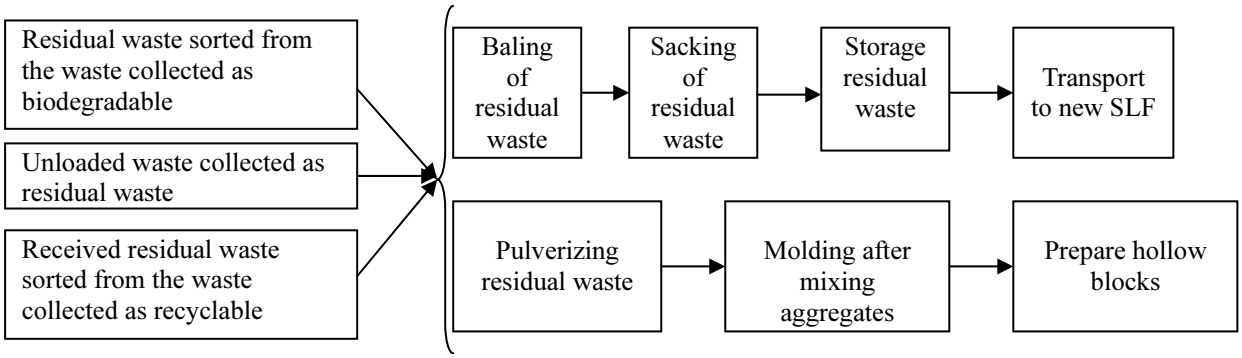


Figure E.5.2-8 System Flow of the Residual Waste

Source: JICA Study Team

(3) Phase III

1) Design Condition

- Location: MRF Manoc-Manoc, Barangay Manoc-Manoc
- Area: Around 0.7 ha
- Service Area : Barangay Manoc-Manoc, Barangay Balabag, Barangay Yapak
- Estimated waste quantity and characteristics

Estimated waste quantity and characteristics are described in Tables E.5.2-5 and E.5.2-6.

Table E.5.2-5 Estimated Waste Quantity in Phase III

Type of Waste	2015	2016	2017
Biodegradable waste	7.4	7.6	7.9
Recyclable waste	7.0	7.2	7.4
Residual waste	5.6	5.8	6.0

Source: JICA Study Team

Table E.5.2-6 Estimated Waste Quality in Phase III

Physical Composition	Biodegradable waste	Recyclable waste	Residual waste
Kitchen	54%	0%	1%
Grass, wood	37%	0%	0%
Paper	8%	32%	23%
Plastic	1%	19%	62%
Textiles and Leathers	0%	0%	4%
Glass	0%	41%	8%
Metal	0%	7%	1%
Others	0%	1%	1%
Total	100%	100%	100%

Source: JICA Study Team

2) Overall System Flow

Overall system flow is the same as Phase II. The operation plan of Phase III is described in from DRWG.No.P-22 to DRWG.No.P-24 for each type of waste. In addition to Phase II, a recycling promotion center is proposed to be developed for promotion of sales of recyclables and for development of new recycling technologies, together with the gardens or flowerbeds.

5.2.2 Drainage

Drainage facilities are needed for prevention of flooding in the rainy season. The storm drainage system for the proposed MRF aims to drain the storm run-off collected from the structures within the vicinity bounded by the perimeter of the MRF site and the adjacent lots that contribute to the drainage catchment area. The scheme makes use of interconnected circular concrete pipes from the building structures and discharges to the open canal which serves as the main drainage line. Storm water is finally conveyed towards a collector pond before it reaches its final outfall or to the lower ground. The location and cross section of drainage is described in DRWG. No.P-09 to DRWG. No.P-11.

(1) Design Considerations

In the process of drainage design, the following matters were considered.

- Conveyance of storm run-off will be by gravity flow as permitted by the site grading elevation.
- All drainage pipes around the facilities are designed with an inside diameter of 0.90 m for the pipe.
- Optimum use of available surface slope is attempted in pipe and open canal grade design within the design velocity ranging from 0.60 to 3.00 [m/s].
- A minimum diameter of 150 mm for storm water pipe around the facilities is adopted. However 200 mm diameter pipes will also be used for maximum design capacity.
- Catch basins or manholes are to be incorporated for drops in pipe orifice of two abutting pipes. These were sized to accommodate the pipes.
- An open canal was provided to collect the accumulated water from the facilities and transport it to a common pond before it discharges to its outfall.

(2) Design Criteria and Calculation

The design storm frequencies were considered based on the 10 years return period for pipe culverts and the rectangular canal. The Rainfall Intensity Duration Frequency (RIDF) data in Kalibo, Aklan has been adopted. These data were obtained from the publication of the Flood Forecasting Branch of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA).

Design Storm Frequency

The design storm frequencies considered were based on the following:

For Pipe Culvert	-	10 years
For Rectangular Canal	-	10 years

Rainfall Intensity

The Rainfall Intensity Duration Frequency (RIDF) data for the R.M.S.A.T. located in Kalibo, Aklan had been adopted. These data were obtained from the publication of the Flood Forecasting Branch of the Philippine Atmospherical Geophysical and Astronomical Services Administration (PAGASA). The RIDF records for the R.M.S.A.T. rainfall station are shown as Table E.5.2-7.

Table E.5.2-7 Rainfall Intensity Duration Frequency Data

[mm]

Return Period	Consecutive duration														
	5 min	10 min	15 min	20 min	30 min	45 min	60 min	80 min	100 min	120 min	150 min	3 hr	6 hr	12 hr	24 hr
2year	8.7	13.4	17.2	20.3	25.3	30.2	33.5	39.2	44.3	48.3	53.5	58.1	75.5	92.3	104.5
5year	12.3	18.9	24.4	28.9	36.2	43.3	48.2	56.5	64.0	70.0	77.6	84.4	110.7	135.4	154.0
10year	14.8	22.6	29.2	34.6	43.4	52.1	58.0	68.0	77.1	84.3	93.6	101.8	134.0	163.9	186.7
15year	16.1	24.7	31.9	37.9	47.4	57.0	63.5	74.4	84.4	92.4	102.6	111.6	147.1	180.0	205.2
20year	17.1	26.2	33.8	40.1	50.3	60.4	67.3	79.0	89.6	98.1	108.9	118.5	156.3	191.3	218.1
25year	17.8	27.3	35.3	41.9	52.5	63.1	70.3	82.5	93.6	102.4	113.7	123.8	163.4	200.0	228.1
50year	20.1	30.8	39.7	47.2	59.2	71.2	79.4	93.2	105.8	115.9	128.7	140.1	185.2	226.7	258.8
100year	22.3	34.2	44.2	52.5	65.9	79.3	88.5	103.9	118.0	129.2	143.5	156.3	206.8	253.3	289.3

Note: Each data indicates the maximum rainfall amount during consecutive duration of each return period. For example, the consecutive 30 minutes rainfall which occurs in the possibility once a 100 year will cause maximum rainfall amount of 65.9mm.

Source: Atmospheric, Geophysical and Astronomical Services Administration（PAGASA）, (1980 to 2000)

The rainfall intensity duration frequency data is converted into the intensity per hour for utilization of rational equation.

I_{10}= 22.6*(60/10) = 135.6 mm/hr

I_{10}= 135.60 mm/hr of 10 years return period and minimum time of concentration was set at 10 minutes, which are utilized for the calculation.

The run-off volume calculation was done using the Rational Formula for the catchment area as follows:

Q = C * I * A / 3.6

Where,

Q = Run-off Volume or Peak Discharge [m^3/s]
C = Run-off Coefficient [0.95 was used for facility areas]
I = Rainfall Intensity in mm/hr based on time of concentration, [I_{10}= 135.60 mm/hr]
A = Drainage Area [km^2]

The mean velocity of water in drainage facilities both in open canals and pipes were determined using Manning's Formula as described below.

S = Q/V

Where,

S = Cross-sectional area of flow [m^2]
V = Average flow velocity [m/s]

The average flow velocity has been calculated by using Manning's equation as:-

$V = 1/n * R^{2/3} * T^{1/2}$

Where,

V = Average flow velocity [m/s]
n = Manning's coefficient of roughness

T = Gradient of channel
R = Hydraulic Radius [m] = S/P
P = Wetted perimeter [m]

Computed design flow capacities of reinforced concrete pipes and rectangular canal used are as shown in Table E.5.2-8.

Table E.5.2-8 Designed Drainage Size and Design Flow Capacity

Type of Drainage	Size of Drainage Structures at minimum slope = .5%	Capacity [m^3/s]
Pipe around facilities	150mm diameter concrete pipe	0.0107
Pipe around facilities	200mm diameter concrete pipe	0.0231
Rectangular canal	400mm x 600 mm	0.32 to 0.714 (at max T [gradient of the drainage in Manning Formula] =0.03)

Source: JICA Study Team

5.2.3 Other Facilities

(1) Composting System

1) Shredder

To implement fermentation of biodegradable waste effectively, shredding the target biodegradable waste for composting is important. The composting process is chemical and biological reaction, and the larger reaction area is needed for the faster reaction. Therefore, as the size of waste materials become smaller and smaller, better and earlier the decomposition of waste materials. Then, biodegradable waste is cut into small sizes by shredder before putting them into the bioreactor. Before shredding, it is important to sort out some impurity to prevent the damage of shredder as well as to promote effective fermentation process in bioreactor.

2) Bioreactor

Bioreactor promotes the fermentation of biodegradable waste by blowing air automatically. Though there is no temperature control system, the thermometer indicates temperature to control the temperature and observe the fermentation condition for effective operation of composting.

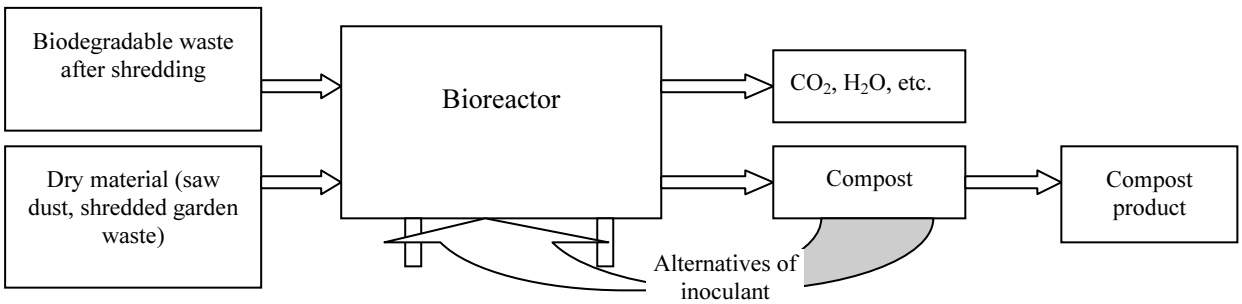


Figure E.5.2-9 Composting Process by Bioreactor

Source : JICA Study Team by referring the information of DOST

3) Sieving equipment

Sieving equipment is also important to secure the quality of compost product. After the fermentation and curing process, sieving is conducted by sieving machine.

(2) Charcoal System

1) Drum Type Kiln for Charcoal Production

Drum type kiln is equipment for carbonization in the process of charcoal briquettes production. The heating condition is controlled by the flow control for air flowing within a certain degree. The process condition is monitored in the gas condition of chimney.

2) Manual Hydraulic Briquetter

After the carbonization of biodegradable, the adherence material such as corn starch is mixed. The equipment is to press the carbonized biodegradable to prepare charcoal briquette as final product after the mixing adherence material.

(3) Sorting System

1) Belt Conveyor

The capacity was determined for the recyclable waste to be received at MRF in 2017.

Calculate parameter was as follows.

- Operation hour : 5h
- Received waste : 8.0 ton/day
- Bulk density : 0.15 ton/m^3

According to the parameter, the sorting line of paper, plastic, glass bottle is designated as 1.6 ton/h. With the assumption of 0.15t/m^3 of the bulk density, the handling capacity of recyclable waste will be approximately 10.6m^3/h. Section Area is calculated by the thickness of the waste on conveyors. As the thickness is 0.05m and effective belt width is 0.8m, the section area is 0.04m^2.

Appendix

Appendix III-E Photos

Permanent Benchmark No.1

Permanent Benchmark No.2

Permanent Benchmark No.3

Permanent Benchmark No.4


Instrument of Global Positioning System