

ACCOMPLISHMENT REPORT

SLOPE STABILIZATION WORK
AT CORAL BAY NICKEL CORPORATION
RIO TUBA, BATARAZA
PALAWAN
MAY 2007



FOR:

**SUMITOMO MITSUI CONSTRUCTION CO. LTD
(SMCC PHILIPPINES, INC.)**

BY :



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1. PROJECT DESCRIPTION

PROJECT INFORMATION

Name of project: CORAL BAY 5, SLOPE STABILIZATION PROJECT
RIO TUBA, BATARAZA, PALAWAN

Client: CORAL BAY NICKEL CORPORATION



Contractor: SMCC PHILIPPINES, INC

ENGR. SHIGEO HANAOKI
Senior Project Manager
Sumitomo Mitsui Construction Co. LTD

ENGR. VIC HAMLIG
Site Project Manager

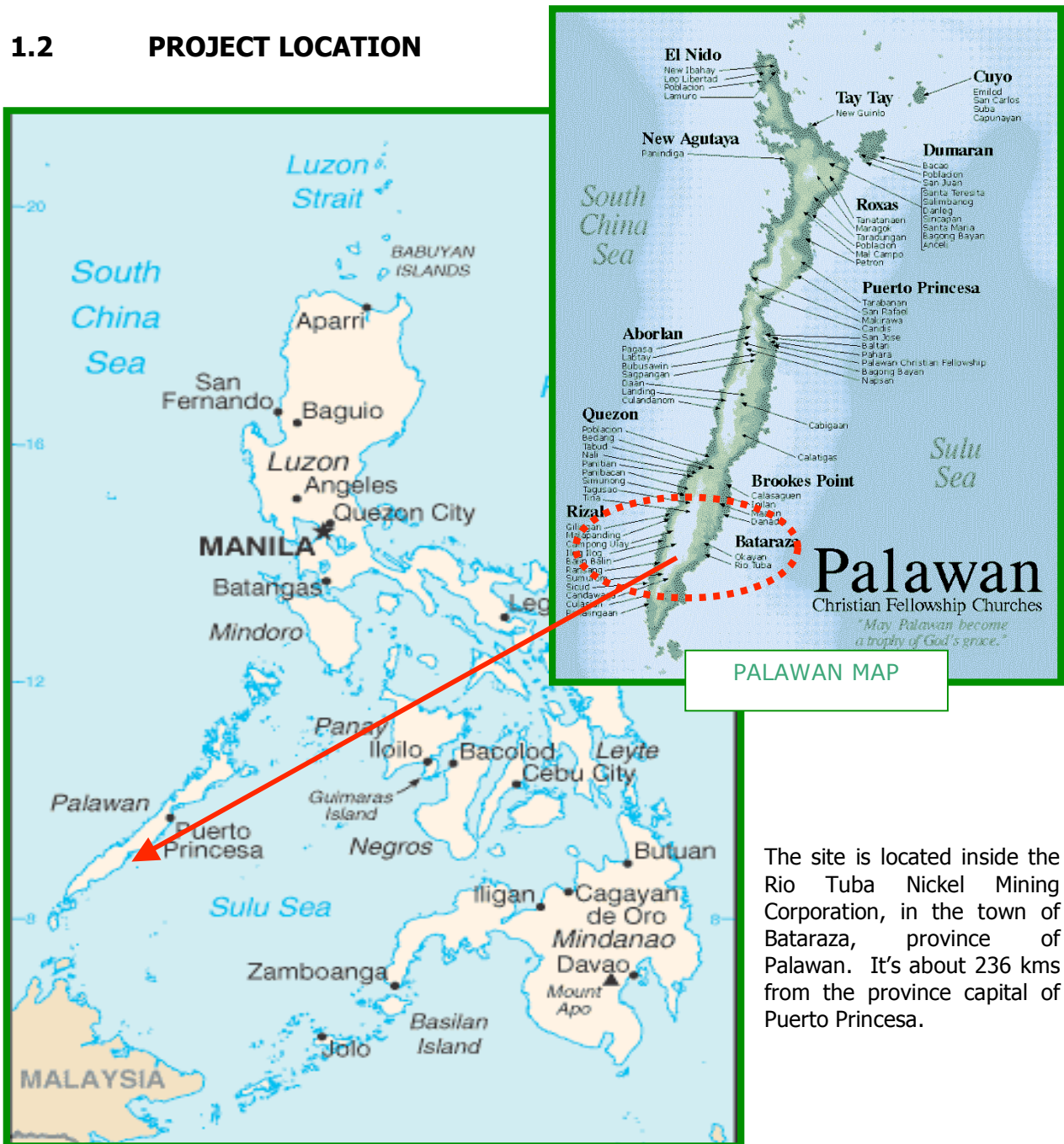
Sub-contractor: BIOSOLUTIONS INCORPORATED

MARY NOAH MANARANG
President/ Vetiver Consultant

NANCY RHOENA AGUDA
JENNY ANNE BARETTO
Project Geologists

The project is the slope stabilization at the expansion area of the CBNC. The project area covers approximately 2 hectares with a 1:2 degree of slope. The slope was stabilized using Vetiver Grass Technology (VGT) planted along the slope covered with cocofiber nets and Biomac. The description on these materials used will be discussed in the next sections of this report.

1.2 PROJECT LOCATION



2. DESCRIPTION OF PROJECT PHASES

2.1 PLANNING AND PREPARATION PHASE

An ocular inspection by Biosolution’s Noah Manarang was done with Engineers Hanaki and Hamlig at the site. The design for the slope protection works was thereafter submitted for consideration. After revisions by the client, the final design was approved and the contract was signed on February 13, 2007.



BIOSOLUTIONS CONSULTANTS INSPECTING THE SITE WITH ENGR HAMLIG

2.1.a MATERIALS AND LOGISTICS

- VETIVER GRASS**

Vetiver grass is a tropical plant which grows perennially. It can be found growing in a wide range of area from highlands to lowlands in various soil conditions. The species is referred to in scientific term as *Vetiveria zizanioides*. This species appears in a dense clump and grows fast through tillering. The special characteristic of the grass is in its roots which can grow up to 3 meters in months. The roots of the grass have an average tensile strength of Mpa 75 and improve the sheer



VETIVER GRASS 30 DAYS AFTER PLANTING

strength of soil by between 30 and 40%. *Vetiveria zizanioides*, was first developed by the World Bank for soil and water conservation in India in the 1980s. In addition to its very important application in agricultural lands, scientific research conducted in the last 10 years has clearly demonstrated that Vetiver Grass Technology is also one of the most effective and low-cost natural methods of environmental protection. As a result, Vetiver Grass Technology is now increasingly being used worldwide for this purpose.¹

For the Vetiver grass-planting slips required by the project, 80% was shipped from our Vetiver Farms Inc.² nurseries in Bulacan and Pampanga. The remaining 20% was sourced from the Iwahig Prison and Penal Farm where Vetiver was propagated in the prison's rice farms in a subcontracting arrangement with Vetiver Farms Inc. This is in line with BSI's commitment to provide livelihood opportunities to local communities near its project sites.



- **COCONET**

COCONET or COCOMAT is a high-strength woven coconut fiber. It is 100 % organic, yet provides heavy-duty performance for 3-5 years. It performs well on steep slopes, in high velocity flow channels and in shoreline and stream bank stabilization. It is an excellent tool for bioengineering designs and



¹ For more information on *Vetiveria zizanioides*, you may look up the world bank sponsored website www.vetiver.org

² Vetiver Farms Incorporated is a subsidiary of Biosolutions, Inc. who is in charge of Vetiver plants propagation, research and development.

constructions. It is a highly versatile, biodegradable, economical and durable organic erosion control material. It provides excellent ground cover and lasts until vegetation takes control. It successfully controls erosion on slopes, stream banks and in channels.

For this project, a combination of machine twisted cocofiber nets and Biomac were used to blanket the slopes. The nets were made with 400mm diameter of coconut twine and measured approximately 1meter x 20.6 meters per unit.



COCONETS DELIVERED ON SITE

- **MADRE DE CACAO**

Locally known as kakawate, it is a smooth deciduous tree. It is about 3 to 10 meters high. Leaves are opposite, oblong-ovate, 4-6 cm long with a pointed tip and rounded base. Flowers are pink, 2 cm long, with a truncate calyx. The tree is common in the southern Tagalog areas, shedding leaves around December and flowering in February. Wood is hard and durable used for small housing needs, posts,



A 30 DAY OLD KAKAWATE STAKE



KAKAWATE STAKES

- **MANPOWER**

For its manpower supply, BSI commissioned the services of HBL contractors as recommended by SMCC. It is BSI's policy to prioritize the hiring of laborers within the vicinity of the project to provide livelihood to the locals. Majority of HBL's manpower are residents of Rio Tuba and neighboring towns, some are natives of the local minority group. Within the project implementation BSI required between 15-45 workers at a time from HBL. Only five (5) staff of BSI specializing in Vetiver grass came from Manila. The project supervisor, King Salvador was also locally hired from Puerto Princesa



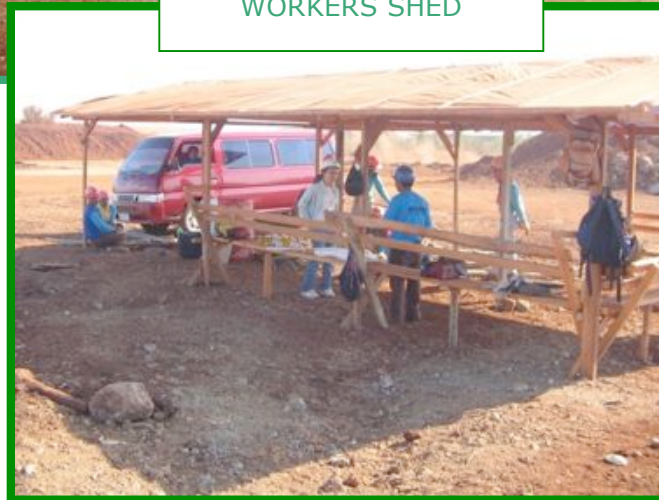
PROJECT GEOLOGIST JENNY ANNE BARETTO
MEETING THE HBL LABORERS

2.1.b CONSTRUCTION OF WORKERS SHED AND TEMPORARY NURSERY

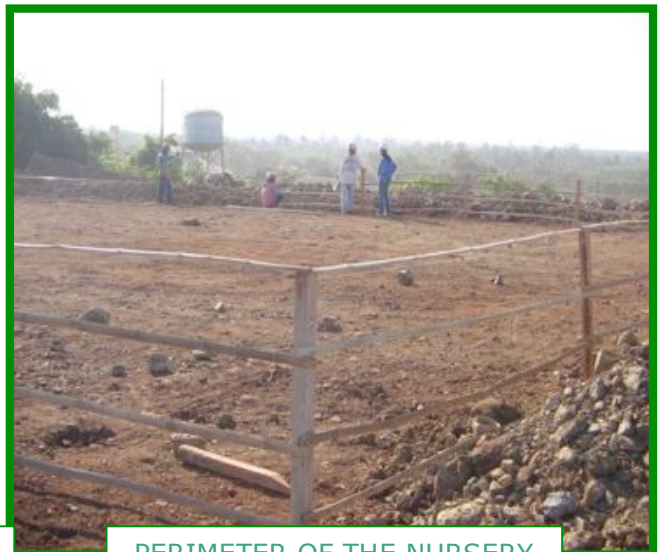
A workers shed and temporary nursery for the Vetiver grass was constructed on the northern side of the project area. The workers shed was made of coconut lumber and roofed with blue sheet. The nursery is a 1000sq.m. open space fenced with cut bamboo poles. Aside from vetiver plants, the coconets, biomac and other project materials were also kept in this fenced area.



WORKERS SHED



NURSERY WORKERS PREPARING VETIVER SLIPS AT THE NURSERY



PERIMETER OF THE NURSERY

2.1.c GROUND MEASUREMENT AND STAKING

The project area was divided into 3 sections for reference purposes: Area A, Area B and Area C (see attached plan view). The three sections were then measured and staked with kakawate sticks and nylon line. These lines guided the workers in laying out the nets and planting the Vetiver grass according to the design.



NYLON LINES ARE STRETCHED AND STAKED ON THE GROUND WITH KAKAWATE CUTTINGS



LEAD MAN MEASURING THE SURFACE RUN OF THE SLOPE

2.2 VETIVER OUTPLANTING AND NET APPLICATION

After the measurement and staking, the laborers proceeded with planting the vetiver grass hedgerows alternately with laying out the nets.

Vetiver planting procedure as follows:

1. A furrow or small ditch is dug up along the nylon line.
2. Compost and fertilizer mix is then applied along the ditch.
3. Vetiver grass is lined up, 10 plants per meter or approximately 10cm apart.
4. The ditch is backfilled with the dug up soil pressing firmly around the newly planted grass.
5. Newly planted vetiver hedgerow is then watered.
6. Planting of vetiver rows and laying out of nets on the slope alternately while, the landings or flat areas are covered with biomac.

After each row of vetiver, the coconut fiber nets are laid out and staked with the kakawate cuttings. The cocofiber nets measures 1x20 meters approximately per piece. All the ends are pulled and stretched out to its maximum size and staked firmly at the ends.



PROJECT METHODOLOGY FLOW CHART



BACKFILLED VETIVER ROWS



ALTERNATE ROWS OF VETIVER GRASS AND COCONET FIBER

2.3 MAINTENANCE

Right after completion of planting and laying out of nets, maintenance is undertaken by assigned laborers. The vetiver grass is watered everyday, dead or uprooted plants are re-planted and damaged nets are repaired. Biosolutions will be maintaining the site with 10 to 15 manpower for the next 2 month after completion of planting and net application as included in the contract. Another 10 months of maintenance after that is being proposed under a new contract.



WATER IS COLLECTED IN
CONTAINERS FOR USE ON THE
VETIVER GRASS



REPLACEMENT OF DEAD
PLANTS

3. SUMMARY OF ACCOMPLISHMENT AND REMARKS

SUMMARY OF ACCOMPLISHMENT

The project was scheduled to be finished in 45 days, but due heavy rains in the latter part of the project, the project was completed in 51 days. After inspection, SMCC officials instructed BSI to replant vetiver rows with dead plants, which is part of BSI's maintenance program. The rocky portions of the slope were required by SMCC to be replanted and some exposed areas of the slope covered with nets. As detailed in the attached plan view, BSI planted a total of **22,458.27 linear meters of Vetiver grass and 20,743.35 square meters of cocofiber nets/biomac. The difference of -1,958.73 of vetiver and +158.35 on nets is due to changes made on the design where SMCC built a fence on the lowest part of the slope where vetiver is supposed to be planted.**

Maintenance commenced per area as soon as it has been planted and covered with nets. A two-month maintenance with a work force of 10–15 laborers will officially start on June 1, 2007.

As requested by Engr. Hanaki, another 10-month maintenance program shall be undertaken subject to the approval of the new proposal/contract. Maintenance shall include the following:

1. replanting of dead/uprooted plants.
2. regular watering/irrigation
3. fertilizer application every 3 months
4. re-staking of detached nets
5. pruning/trimming of the grass every 3 months

REMARKS

While vetiver grass is known to grow in most types of soil and extreme weather conditions, its growth rate is still subject to these factors. For this particular project, the Vetiver grass grew faster than expected especially in the areas where the natural spring flows and spreads out. In the first 3 months after planting, the growth rate between vetiver rows in clayish portion of the slope will be significantly faster than those vetiver rows planted on the rocky surface. But on the 4th month onwards, the slow growing ones will eventually catch up and a uniform growth will be visible. Although the Vetiver grass will grow vigorously, with each plant becoming a dense clump, it will stay on the rows where it was planted and will not grow wild, as the seeds are sterile.

The nets are designed to hold the surface soil, while absorbing water from the heavy rains. It also provides moisture to the ground and thus encourages the growth of natural vegetation. Slowly, the nets will be overtaken by wild ground covers and local grass providing more protection for surface erosion. The nets are biodegradable being made of natural fibers, they are expected to last from 3-5 years. By then, the slope is safely protected with the Vetiver hedgerows and the natural vegetation in between.

The areas in between the vetiver rows will be highly fertile and productive for ornamentals, trees and even vegetables. This is due to the effects of the coconets as mentioned earlier and because the vetiver is a nitrogen fixing grass. It is thus recommended that planting in between the vetiver rows be considered on the 2nd year.

THE PROJECT IN PICTURES



VEG

RANDOM MEASUREMENT
SHOWING MAXIMUM LEAF
GROWTH BETWEEN 3 - 5 FEET

BEFORE AND AFTER



