Proposal for Reef Ball Artificial Reef Submerged Breakwater to Assist with Shoreline Stabilization for the Maho Beach Resort with Optional Snorkeling/Diving Trails and Coral Propagation

For

Maho Beach Resort and Casino, St. Maarten, Netherlands Antilles

July 21, 2004

Submitted to

The Maho Beach Resort and Casino

By The

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With Contributions From

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Subject: Proposal for Reef Ball Artificial Reef Submerged Breakwater Proje ct

Introduction

Locals have noted beach erosion for several years at Maho Beach. The Nature Foundation, a St. Maarten based Non-profit organization, had been searching for environmentally friendly ways of addressing this problem when it began working with Reef Ball artificial reefs for restoration of corals. Since Reef Balls had been used successfully on several Caribbean Islands and in other parts of the world to control beach erosion, the Nature Foundation asked Coastal/Ocean Engineer Dr. Lee E. Harris, Ph.D., P.E. from the Florida Institute of Technology to visit Maho Beach to see if Reef Balls would be an appropriate technology to apply to the existing erosion problem. Site visits by Dr. Harris, including review of past and present aerial photography, indicate that Maho Beach is faced with periodic beach erosion that has been detrimental to guest satisfaction and occupancy rates at the Maho Beach Resort. Therefore, the Nature Foundation asked for a grant from the Dutch Fund to demonstrate this environmentally friendly way of controlling beach erosion. After a simple demonstration of the technology and additional site visits by Dr. Harris, Maho Beach Resort and Casino has requested a proposal for the construction of a Reef Ball artificial reef submerged breakwater system to be located along the beach in front of the resort. For purposes of clarity, this proposal is divided into 6 sections:

1) Background
2) Project Scope
3) Optional Features
4) Previous Projects
5) Costs
6) Next Steps

Background

Previously in February 2003 Dr. Harris performed an initial site survey with the purpose of investigating the erosion problem at Maho Beach and alternatives for stabilizing the beach. Figure 1 is a pair of photos from that report taken at different times that clearly show the erosion problem at Maho Beach.

Figure 1 Previous wide beach (on left) and subsequent narrower beach (on right)

Subsequently in March 2003 Dr. Harris submitted a report detailing his earlier findings as well as a conceptual design for a submerged breakwater and the additional information he would need to collect to ensure that it would be designed correctly. This information included additional water depth and jet probe measurements. Water depth measurements are used to locate the breakwater in the correct depth to ensure the breakwater will function properly. Jet probe measurements are made to determine the thickness of the sand layer where the breakwater will be placed in order to determine the type of anchoring system necessary to prevent movement of the Reef Balls due to large wave or surge conditions. The Nature Foundation had since acquired funding to fabricate and deploy at least 4-10 Reef Balls as a demonstration of the breakwater concept. During the week of June 29 – July 4, 2004 Dr. Harris and Robbie Duke of Reef Innovations Inc. arrived in Maho Beach to supervise the fabrication of the Reef Balls and to perform the water depth and jet probe measurements. The measurements were successfully completed and the necessary anchoring system was determined. At this point the Maho Beach Resort and Casino requested a proposal for the construction of a complete Reef Ball submerged breakwater.

Project Scope

The primary goal of the Maho Beach Resort and Casino Reef Ball artificial reef submerged breakwater project is to stabilize the beach fronting the resort. The Reef Beach Company is proposing a submerged breakwater system of sufficient length to provide maximum protection to Maho Beach, but ultimately budgetary constraints will determine the overall length of the submerged breakwater system and thus the amount of protection the project will afford Maho Beach. Figures 2 and 3 show conceptually where the submerged breakwater system will be located.

Figure 2 Existing Conditions at Maho Beach with Conceptual Location for Submerged for Breakwater System.

Figure 3 Previous Conditions at Maho Beach with Conceptual Location for Submerged Breakwater System.

While not the primary goal of the Maho Beach Resort and Casino submerged breakwater project, optional features such as coral transplants and snorkeling/diving trails should be considered as secondary goals because of the added value and benefits they represent.

Optional Features

Coral transplants

Coral transplants onto the Reef Balls of the breakwater provide numerous benefits. Reef Balls naturally provide habitat and they also provide a substrate for coral growth. The only problem is that coral growth naturally can be very slow. The use of coral transplants can accelerate the growth process and provide resort guests with a visually stimulating snorkeling adventure as they enjoy the beach and beautiful Caribbean waters.

~~Unfortunately, a~~A visit by Todd Barber, Chairman of the Reef Ball Foundation found that conditions in front of the resort are ~~not ideal~~marginal for coral reef growth. A snorkeling area with fish, soft corals and some hard coral is possible, but expectations of a world-class snorkeling ~~area~~ should not be anticipated. However, limitations to coral reef growth where primarily high wave action and sedimentation in the water column as a result of waves….therefore if the breakwater is large enough to reduce the general sedimentaion and wave climate in the area, conditions may improve creating better biological conditions for coral reefs. Even so, ~~T~~herefore, Initially we recommend that if the resort wishes to undertake a coral transplanting program that it be modest in scope and of minimal cost until it is determined that the breakwater has improved the conditions sufficiently to allow for more investment in the coral reef assets of the property.

While the Reef Beach Company will handle the breakwater portion of the project, should coral transplants be desired, the Reef Ball Foundation has a separate division for coral transplanting, the Volunteer Services Division, which hosts the Reef Ball Foundation Coral Team. The Coral Team specializes in assisting clients in propagating and transplanting both hard and soft corals onto the Reef Balls. They also assist clients in aquascaping their Reef Balls to make attractive snorkeling and diving sites from a human visual perspective. Since this site is suitable for coral transplants, but not ideal, we recommend only reviewing low cost options such as volunteers rather than paying for expensive professional plantings.

REEF BALL
Volunteer Services Division

The Volunteer Services Division is just that, a division that enlists volunteers lead by trained personnel to assist clients in achieving project goals. This division funds itself by asking the clients ~~(almost exclusively resorts)~~ to provide airport transfers, lodging, food, scuba tanks/weights, and a dive boat, items that are normally considered “soft costs” for the resort. The divis ion “sells” eco-vacations to diving and coral enthusiasts who pay for their own airfare and a program fee that covers the cost of coral transplanting supplies, trainer fees, and other expenses for the project. This way ~~you~~ resorts can have their ~~your~~ Reef Balls planted with corals to create an exciting snorkeling trail without any “hard “ costs. Figure 4 is a photo of what Reef Balls

transplanted ~~wil~~l look like days after planting. In an effort to keep this section brief detailed information concerning coral transplanting will be furnished upon request. However, ~~detailed~~ more information may be found at the following website http://www.reefball.com/reefballcoalition/index.html.

Figure 4 Reef Ball after coral transplanting.

Snorkeling/Diving Trails

Snorkeling / diving trails also represent ~~added value and multiple benefits~~ additional guest enhancements and add re-sale value to hotel properties. Snorkeling / diving trails are designed using various sizes of smaller Reef Balls to create a diverse habitat for fish and corals. These trails are ~~placed~~ primarily placed on the leeward side of the submerged breakwater running from the beach to the breakwater and can also be "snaked through" the breakwater and end ~~placed~~ on the seaward side for deeper attractions. This creates a "reef system" and enhances the snorkeling/diving adventure by providing additional habitat resulting in more diverse, longer and enjoyable snorkeling/diving outings. The key difference in Reef Balls used for the snorkeling /diving trails is that each unit is made visually different verses standard breakwater Reef Balls which are very similar in appearance.

[TONY: PUT A PICTURE OF A LARGE LAYER CAKE FROM ANTIGUA HERE]

Further detailed information will be provided upon request. More detailed information can be found on the following website, http://www.reefball.com/reefballcoalition/index.html.

Previous Projects

To date the Reef Beach Company has successfully completed nine submerged breakwater projects in various countries in the Caribbean, Mexico and the USA. Table 1 lists the completed projects by year of completion.

Table 1 Completed Submerged Breakwater Projects

Project	Country	Date Built
Gran Dominicus	Dominican Republic	1998
Iberostar	Dominican Republic	2000
Marriott Resort	Grand Cayman, C.I.	2002
Progresso	Progresso, Mexico	date?
Mayan Palace	Playa Carmen, Mexico	2003-2004
Maiden Island	Antigua	2003
Hilton Coral Canoa	Dominican Republic	2004
Gran Dominicus II	Dominican Republic	2004
MacDill AFB	Tampa, FL, USA	2004

Figure 5 shows the submerged breakwater systems constructed in front of the Gran Dominicus and Iberostar resorts in the Dominican Republic. The blue line in to photo represents where the original beach was located prior to installing the submerged breakwater systems. Figure 6 shows striking before and after photos of the effectiveness of the submerged breakwater project in the Dominican Republic. As a result of these projects and the beach stabilization, these resorts have been awarded the European "Blue Flag Beach" designation.

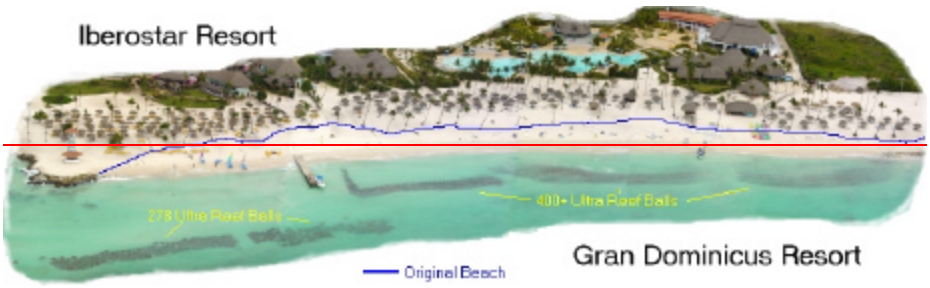

Figure 5 Aerial view of Gran Dominicus and Iberostar submerged breakwaters showing pre and post project shorelines.

Figure 6 Before and after photos of the Dominican Republic project from 1998 – 2001.

Another very successful and important project is the one constructed off Maiden Island, Antigua. This project demonstrates all the different options including submerged breakwater, special anchoring techniques, coral transplanting, and snorkeling/diving trails using all the various sizes and specialized styles of Reef Balls. It is certainly our most ambitious project completed to date requiring 1200 Reef Balls with over 5000 live coral transplants and all completed in a record 2 months. Figure 7 shows an aerial photo of the Maiden Island project.

~~**Figure 7 Aerial photo of the Maiden Island, Antigua project.**~~

~~In addition thousands of Red Mangroves have been and are still being planted on Maiden Island as an on-going project to further enhance the environment. The Maiden Island, Antigua project also won the Reef Ball Foundation's 2003 Project of the Year Award. Additional information can be found at the following website http://www.reefball.com/map/antiguascience/antiguapressrelease.htm.~~

Costs

The Nature Foundation was granted a license only to demonstrate the possible use of Reef Balls as a submerged breakwater and under this license Maho Beach Resort and Casino may use its two molds to build up to 20 Reef Balls. The Reef Beach Company is authorized to offer a full breakwater if the Maho Beach Resort and Casino desires it. Fortunately, some of the engineering costs have already been borne by the Nature Foundation and your existing local contractor can be trained and supplied with additional molds to be able to provide a full breakwater.

Reef Innovations, an authorized Reef Beach contractor would supervise quality control of the construction portions of the project and Reef Beach; working with Dr. Lee Harris would provide the required engineering. Because Reef Beach also has proposals in for Nevis and St. Eustatius projects, mobilization costs may be less if multiple projects can be constructed at similar timeframes.

Below is a summary of the costs estimated to complete this project.

Mobilization = $88,000 ($54,000 if one of the other projects occurs about the same time)
Cost per Golieth sized Reef Ball = $700
Cost to deploy each Reef Ball = $230
Cost t o anchor each Reef Ball
    8 foot concrete pilings = $300
    Fiberglass rebar drilled = $150
Engineering fees estimated to be 15% of total project costs.

Prices do not include travel expenses for engineers, trainers, etc. which are estimated to be between 10-15% of total project costs.

Next Steps

Based on the cost estimates provided by the Reef Beach Company, the Maho Beach Resort and Casino would now need to decide if they wish to pursue the Reef Ball artificial reef submerged breakwater project. If they choose to move forward with the project, the next decision would be the scope of the project. That is, how large of a breakwater to construct and whether to add any of the optional features previously discussed.

Please don't hesitate to ask questions regarding any portion of this proposal, as we will gladly answer them promptly. The Reef Beach Company thanks you for your interest and we look forward to working with you.

Sincerely,

Todd R. Barber
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