Summary – Guidelines for Low Impact Coastal Tourism Development

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This five year project aims to conserve critical coastal resources in Mexico by building capacity of NGOs, Universities, communities and other key public and private stakeholders to promote an integrated approach to participatory coastal management and enhanced decision-making. This publication was made possible through support provided by the U.S. Agency for International Development's Office of Environment and Natural Resources Bureau for Economic Growth, Agriculture and Trade under the terms of Cooperative Agreement No. PCE-A-00-95-0030-05.

GUIDELINES FOR LOW-IMPACT COASTAL TOURISM DEVELOPMENT

QUINTANA ROO, MEXICO

(DRAFT SUMMARY '99)

Amigos de Sian Ka'an A.C.
Coastal Resources Center/URI
US Agency for International Development

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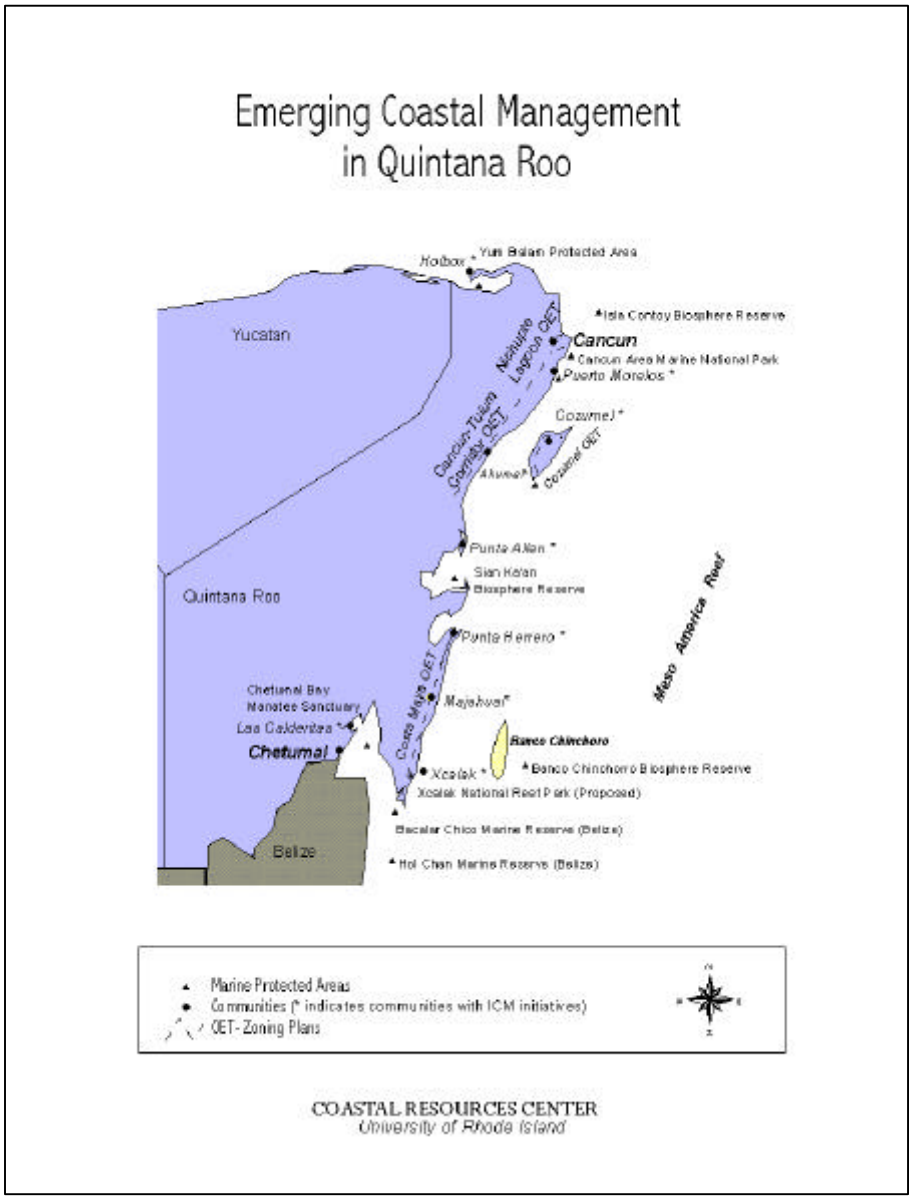
PROLOGUE

The Amigos de Sian Ka'an (ASK), the University of Quintana Roo (UQROO), and the Coastal Resources Center (CRC) at the University of Rhode Island are currently working on an Integrated Coastal Management Project along the coast of Quintana Roo, financed by the US Agency for International Development. These *Guidelines*, developed by the ASK and CRC are geared towards developers, investors, government, and communities interested in developing the coastal zone in a manner that will mitigate ecological damage, thereby increasing long-term economic gains.

This is a SUMMARY, developed for the purposes of the Summer Institute in Coastal Management, sponsored by the Coastal Resources Center and the USAID. The full document has been completed in spanish and is the process of being translated into english, which will be available in April 1999. This summary includes many of the guidelines that we have complied for application to the planning and design of coastal infrastructure. In general, these guidelines are currently being used on many of our shores, and are applicable to the coastal development issues being faced today in Quintana Roo and other parts of the world. The application of these guidelines is voluntary and they compliment the many other activities planning and regulatory activities ongoing in coastal management

Over the next year we will use the full draft document to work with practitioners and other users to test these guidelines in Quintana Roo, and to obtain experience in their application. We are currently developing partnerships with private developers who have been invited to voluntary participate in the Project and obtain technical assistance in the application of these guidelines. It is our goal to then incorporate these field experiences as well as other recommendations into a final document next year.

We hope that when you review this document useful for your tourist projects and coastal programs. By incorporating such guidelines into planning and design of new developments, we can promote low-impact tourism activities that support a more sustainable form of coastal development. Please feel free to send us your comments and suggestions.



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INTRODUCTION

Tourism represents one of the most important sources of revenue for Mexico. Tourism is particularly important in the Mexican Caribbean, where the prime attraction is the diverse ecosystems present in the coastal zone, including coral reefs, sandy beaches and coastal lagoons. This region marks the entrance of the "Mundo Maya", an area rich in Mayan archeological and cultural sites. Together, these attractions make the coastal shores of Quintana Roo one of Mexico's finest tourist paradises which draws a constant flow of new investment projects to the region.

Along the coast of Quintana Roo, tourism has developed on different scales. To the north, the development of the Cancun-Tulum corridor created destination with extensive infrastructure which receives over two million visitors a year. To the south, in what is referred to as the Costa Maya corridor, the tourism industry is just beginning and holds great potential for development.

The state government of Quintana Roo has a different vision for the new tourism development along the Southern coast of Costa Maya. According to this vision, tourism complements a regional plan for economic development by expanding and improving the existing infrastructure. Integrating environmental aspects throughout the plan will ensure that development proceeds with intelligent use and conservation of natural resources. This development strategy compliments the Federal government's Environmental Program 1995-2000. The objective of this program is to minimize environmentally destructive tendencies and establish a basis for a process of ecological recuperation. Accordingly, development should be economically, socially and ecologically sustainable.

The coastal zone is a unique interface of terrestrial and marine ecosystems, subject to the forces of natural processes (including hurricanes, storms and erosion), all of which can have a profound impact on coastal development in both the short and long term. In order to implement this development strategy along the coast, it is essential to consider the dynamic nature of the coastal zone, and the strong interrelationship between these two ecosystems. Where natural forces were not taken into account, development may suffer from expensive consequences. For example, in Cancun and Playacar, large amounts of money are being invested to restore eroded beaches. This destructive erosion has been enhanced by constructing coastal structures (including seawalls) which prevent the natural dynamics of the beach system from restoring itself.

The *Guidelines for Low-Impact Tourism Development in Quintana Roo* is intended to guide developers through the process of planning new developments in the coastal zone. This guide includes practical measures for the design and placement of coastal infrastructure. Recommendations are based on principles and techniques that respect the dynamics of coastal ecosystems as well as maintaining traditional uses of the shore. The goal of the *Guidelines* is to protect tourism investment and preserve the environment as a core element to this tourist attraction.

This summary version of the *Guidelines* is organized into thematic sections. Each section gives a brief background of a coastal issue, and proposes various mitigating measures for low-impact design and placement of coastal structures. Additionally, an introduction to the characteristics and dynamics of the coast are provided to establish a foundation for understanding the role of these guidelines.

ESTABLISHING A VISION FOR FUTURE DEVELOPMENT

Over the past few decades, the state of Quintana Roo has made significant advances in the protection of its natural resources and improving coastal management. One important achievement has been the designation of natural protected areas such as the Sian Ka'an Bioshpere Reserve and the National Coastal Parks of Isla Mujeres, Punta Cancun, Punta Nizuc and Cozumel. Another significant achievement is the establishment of environmental zoning plans for both the Cancun-Tulum and Costa Maya tourist corridors, and development of urban plans for various coastal communities.
Together, these advances establish a vision that combines the economic success of tourism with the health of natural and cultural resources present in the coastal region of Quintana Roo. Through these initiatives the government aims to promote a new model of sustainable development for Mexico, and to realize a vision of low-impact development for tourist destinations.

The principles of sustainable development explicitly recognize the strong interdependence between environmental and economic sectors. A comprehensive planning process is the key to success for future development in Quintana Roo. Therefore, planning should focus on integrating tourism and the environment, where one depends upon the other.

The Hague Declaration on Tourism pointed out the essential relationship of the environment and tourism (WTO, 1989)

An unspoilt natural, cultural and human environment is a fundamental condition for the development of tourism. Moreover, rational management of tourism may contribute significantly to the protection and development of the physical environment and the cultural heritage, as well as to improving the quality of life.

The community of Xcalak (above), at the southern border of Quintana Roo, has determined their vision to include low impact tourism, a marine park and active community participation in managing their resources. Cancun (below) has been a "successful" tourist destination that attracts up to 2 million visitors annually.

INTEGRATING THE GUIDELINES INTO THE PLANNING PROCESS

There are various stages in the planning process where the public sector, investors and local communities need to recognize the condition and vulnerability of the natural resources in question. By considering the physical characteristics of a proposed development site, it is possible to determine some practical alternatives for siting and design. This type of information is critical to making sound economic and environmental decisions, both of which should help achieve the desired success of the project.

These *Guidelines for Low-Impact Coastal Tourism Development in Quintana Roo* have an important role within the planning process as seen by the three principles on which they are based:

1) Protect investments by reducing the economic and environmental costs caused by natural processes and coastal hazards.
2) Maintain the healthy ecosystems which are a principal tourist attraction that provides long term economic benefits.
3) Compliment existing environmental regulation. Environmental impacts will be minimized by requiring projects to complete an Environmental Impact Statement and to adjust projects to comply with environmental regulations and best management guidelines.

A better understanding of coastal processes along with the application of the *Guidelines* are important elements consider when planning and designing infrastructure that supports regional and local sustainable development. An investor or developer has the opportunity of selecting techniques which in many cases will reduce long term costs. By choosing these alternatives, a developer can mitigate the potential risk of negative impacts to the surrounding areas. For example, locating coastal structures sufficiently away from the shore may save millions of dollars by avoiding storm and flood damage, while conserving the natural dynamic of beaches and dunes.

The low impact tourism market offers great opportunities for the development of the coastal zone in areas where there is minimal tourism development. The *Guidelines for Low-Impact Tourism Development* presents alternatives for a new genre of tourism development; one which respects natural and local conditions instead of going against these elements. In this model, environmental benefits can translate into savings of time and money.
Many hotels have already capitalized on the growing market for low-impact tourism alternatives by practicing effective environmental management. Some examples include the hotels that participate in "Green Globe" and the "Environmentally Sensitive" hotel certification programs. These businesses promote operating and management techniques that conserve and protect the environment.

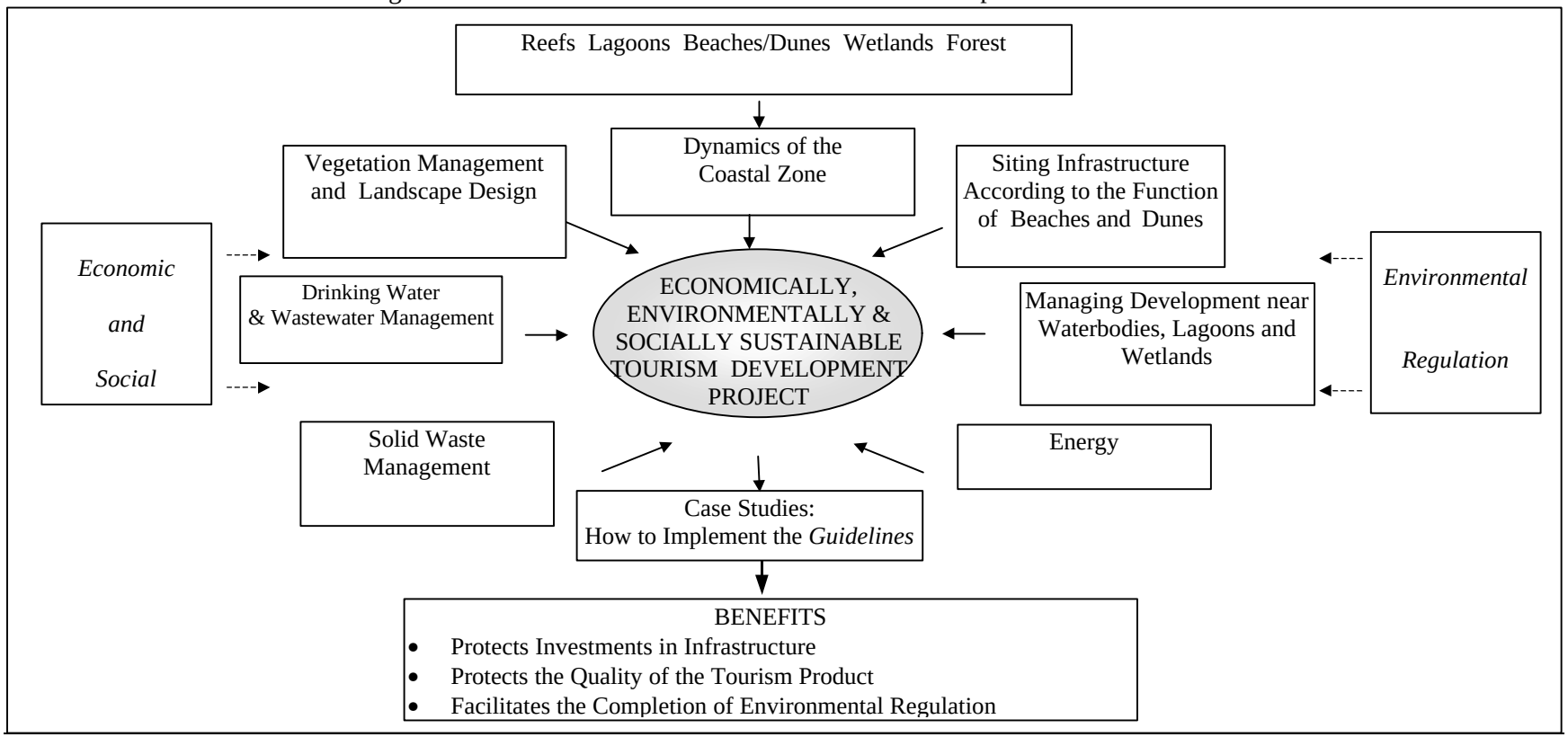
It is important to realize that the application of the *Guidelines* is voluntary, and the recommendations within this manual work as a function of the benefits that accrue to those who use them. These *Guidelines* are applicable to developers, property owners and the community in general. The *Guidelines* compliment existing environmental regulations, which provide the framework for sound investment planning within the preservation and sustainability framework. This process should help to avoid the damage which inadequate planning can do to the environment.

The Environmental Zoning Plan evaluates, regulates, and plans land uses and activities according to natural, social, and economic conditions. The goal of the Zoning Plans is to preserve and restore ecological equilibrium and protect the environment. Environmental Impact Assessments outline the impacts of a proposed project, and assist in reducing or avoiding the negative impacts to the environment. Likewise, the Impact Assess,emts are also applicable to urban development plans, which define zones of use within urban centers.

The "bigger picture" context within which tourism development is taking place should be examined during the planning process. It is important to consider the environmental, social and economic factors of which the proposed project could potentially influence. Through this type of examination, the short and long-term benefits will be clearly reflected in the economic success of the tourist development, the improvements in the quality of life of local communities and the health of the natural resources.

The objective of this manual is to protect investments and the quality of the tourist product while facilitating the completion of environmental reviews. The overall goal is to achieve sustainable development in the region. There is an emphasis on the applying guidelines to the design and siting of structures in the coastal zone considering the characteristics of ecosystems and the processes which take place there. The diagram on the following page demonstrates how key elements incorporated in this manual contribute to the success of a development.

While the *Guidelines for Low-Impact Coastal Tourism Development* draws on examples within Quintana Roo, They can be applied to other coastal regions that present similar conditions and challenges for tourism development.



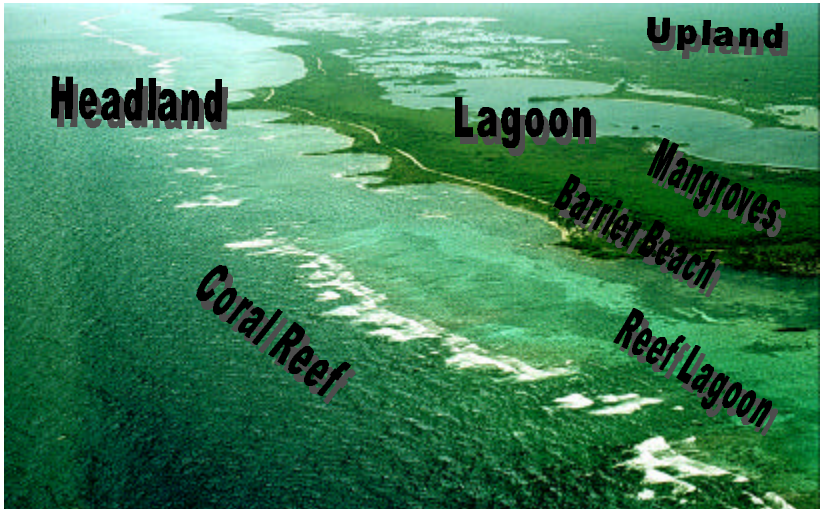
CHARACTERISTICS OF THE COASTAL ZONE IN QUINTANA ROO

Natural resources have always played an important role in the economy and quality of life of the people of Quintana Roo. These resources also constitute the principal attraction for tourism development. From the time of exploitation of trees for color dyes to the present, the natural resources have influenced the economic sector. Initially, the inhabitants focused on the exploitation of forestry resources. Later, agriculture dominated in the south, tourism in the north, and fishing became important along the mid-regions of the coastline.

Usually the coast is described in terms of its physical characteristics: lagoons, coral reefs, wetlands and sandy beaches. At other times we view the coast in terms of its common uses: fishing and tourism. Nevertheless, planning for sustainable development requires a global vision. It is essential to understand the interdependence of ecosystems and the potential of an environment to be affected by activities that are carried out in faraway places some distance away. Once we understand the relationship between ecosystems, we can identify the benefits as well as the effects caused by different activities, and make wise decisions while planning new tourism development.

The coast of Quintana Roo is characterized by its great variety of closely related ecosystems coral reefs, beaches, wetlands, floodplains and lagoons among others. These ecosystems can be severely impacted by uncontrolled development, which may limit the use value (value of potential uses) and diminish their natural functions. For example, lagoons, estuaries and enclosed waterways are important areas for the development of juvenile fish. When these areas are altered by coastal development, the sustainability of coastal fisheries is often jeopardized. Generally, ecosystems are transformed by: a) the loss of habitat to development of infrastructure such as piers, houses, hotels and agricultural farms; b) alteration of water flow; c) pollution; d) extraction of resources and raw materials such as fisheries and quarries; e) erosion and sedimentation.

Using appropriate practices in the planning process and intelligent design and siting of coastal structures it is possible to mitigate the harmful effects that development can have on ecosystems. This allows for the compatibility of coastal development and conservation, with the overall goal of preserving the potential uses of ecosystems, as much for recreational as productive purposes.



Characteristics of the Costa Maya shoreline

THE DYNAMICS OF THE COASTAL ZONE

In their desire to be as close to the water as possible, developers and landowners along the shoreline frequently overlook the fact that the geomorphology of the beach is continually changing to adjust to the natural processes and effectively dissipate wave energy. Sand present during one time of the year, can be removed by the sea at another time as a response to the natural dynamics of waves in both normal conditions or during a storm season.

Some of the most frequent coastal problems are associated with the processes of erosion and accretion. These forces can change the shoreline drastically and threaten poorly-sited structures. In both cases the results are similar: these forces generally result in serious financial losses to the coastal property owner. Expensive coastal developments are impacted by erosion, and large sums of money are invested in protective measures to slow these forces.

By understanding the dynamics of the coastal zone, it is possible to minimize the impacts of development and infrastructure on adjacent ecosystems. In considering these dynamics, it is possible to select appropriate siting and design criteria for new projects and implement techniques to help guarantee long term success.

SEDIMENT TRANSPORT

The beach is that area most directly affected by the forces of the sea and is considered to be the most dynamic areas within the coastal zone. The beach can be described as the place where sand or boulders are deposited, located from the point in the ocean where waves begin to move sand particles on the bottom, to the inter-tidal zone. In the Caribbean, sand is composed of grains of coral and shells which are transported by the action of wind, waves and current.

Movement of sand is both onshore-offshore (perpendicular from the sea to the land or vice versa) and parallel (along the coastline). Longshore transport is a natural process that moves sand laterally along the coast, continually changing the beach profile. Onshore-offshore movement is primarily determined by the height of the waves and the slope of the beach. For this reason we typically see many changes to the beaches resulting from transport directly associated with storm events. Changes in the characteristics of a beach occur over time with the changing seasons, where the storm season with larger wave energy and wave height tend to build a beach higher and the lower wave energy tends to promote a smoother and wider beach.

The pier has interrupted the natural flow of sand, thereby enhancing erosion on the down-drift side (left) and accretion on the up-drift side (right).

When man-made artificial structures, such as breakwaters or piers, are constructed along the shore, the longshore transport of sediments may be interrupted. The result is often increased erosion to certain areas (while other areas may in fact see an increased sedimentation. For example, in Playa del Carmen (pictured here), south of Cancun, the natural current in this area runs from north to south. When the ferry pier was constructed (the portion adjacent to the beach is solid

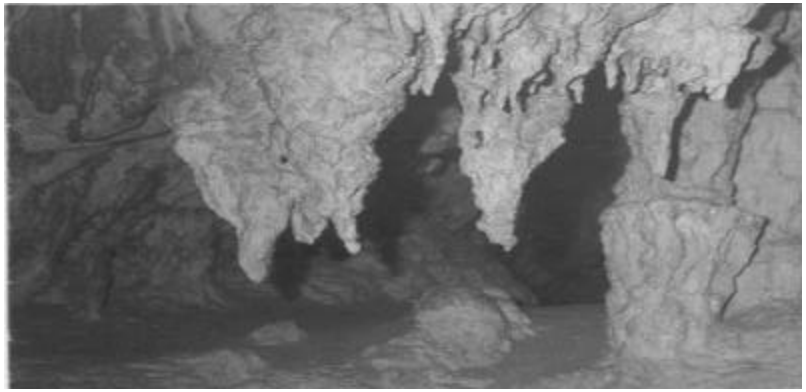
fill), the longshore transport pattern was interrupted which resulted in significant deposition of sediments to the north, and severe erosion to the south.

NATURAL HAZARDS

Quintana Roo is the state in the Yucatan Peninsula most exposed to meteorological phenomena such as tropical storms, hurricanes and strong winter storms from the North). The coast is particularly vulnerable along the northern coast where storms hit the highly populated coast between Cabo Catoche, Cancun and Carillo Puerto.

These natural phenomena play an important role in the state's economy due to the importance of tourism. If the forces of these natural hazards are not taken into consideration during the planning process, then significant economic impacts may result. While such natural hazards can not be avoided, proactive planning can reduce the negative impacts of these occurrences, preserve natural resources and promote a process to establish a balance in decision-making regarding the type and location of development.

Damage from Hurricane Gilbert, 1988



Groundwater caverns

GROUNDWATER

The Yucatan Peninsula is a large, limestone plain, running on a slight inclination from the inland region to the coast. Due to the flat topography, rainwater does not form rivers on the surface of the land. Instead, the porous rock results in an underground flow of water, referred to as groundwater. Rainwater passes quickly through the surface layer of limestone, and accumulates in the deep areas and cavities of rock or in areas of calcium, to form what is known as a groundwater lense or aquifer. Water from the aquifer moves towards the coast of the peninsula infiltrating the porous, underground limestone and passes through interconnected routes at various depths. The groundwater flow dissolves calcium rocks forming caverns and caves which eventually collapse. These features appear on the surface as sinkholes or "cenotes".

The characteristics of the subterranean groundwater flow play an important role in human health; often, these waters are the only supply of drinking water for local communities. This groundwater flow is also important with regard to conservation because the majority of this water empties directly into coastal ecosystems such as wetlands, coastal lagoons and coral reefs, and if it is polluted then there may be associated problems with these resources.

SITING INFRASTRUCTURE ACCORDING TO THE FUNCTION OF THE BEACHES & DUNES

Applying techniques that integrate methods to reduce the damage to development and respect the dynamic processes of the beach and dunes contribute to achieving the goal of sustainable tourism development.

Guidelines to Consider When Constructing Near Beaches and Dunes

- ✓ Minimize the Risk of Beach Erosion Caused by Wave Action
- ✓ Minimize the Damage Caused by Storms and Floods
- ✓ Preserve Natural Processes

Beaches and dunes are the prime resource for fishing and tourism development, and provide a habitat and function for many wildlife species. As such, beaches and dunes have both ecological and economic value.

The dynamic nature of should be taken into consideration during the design phase of a project to ensure the long term sustainability of new developments.

The coastline is vulnerable to changes on different time scales:

- Each day, with the changing of the tides;
- Seasonally, with the effects of meteorological phenomena such as storms and hurricanes;
- In the long term, in response to anthropogenic modifications and sea level rise.

The beaches along the coast of Quintana Roo are differentiated by both their width and slope of the beach and the height and shape of the dunes. Many of these beaches are barrier beaches, conforming to a thin strip of land (40-400m) at the interface between wetlands and the Caribbean Sea. These barrier beaches are subject to dynamic physical processes and vulnerable to the natural effects of erosion and the impacts caused by storms.

Considering these shoreline characteristics, the land available for new infrastructure development is very thin. As a result, developers are faced with the task of determining sites for coastal construction that will be attractive for tourism, yet protect their investments while adapting the natural processes.

To achieve long term sustainability of coastal developments, coastal design and construction should consider the natural changes of the

coastline, the forces of wind and waves during storms, and the influences of these forces on the beach. The following guidelines can help to achieve this goal.

Principles for planning and designing projects along the beach

- Prevent risks from storms, hurricanes and erosion, while reducing economic costs and environmental losses by constructing new development out of vulnerable areas.
- Consider the natural characteristics and the dynamic processes when designing new structures, with the goal of maintaining the ability of the barriers, beaches and dune and the associated habitats to remain dynamic, and to reduce the necessity to construct future erosion control structures to protect the coastal investments.
- Contribute to the success of a regional vision of low-impact tourism, by considering designs that are of small scale, and setback from the beach to maintain aesthetic value and natural function of the beaches

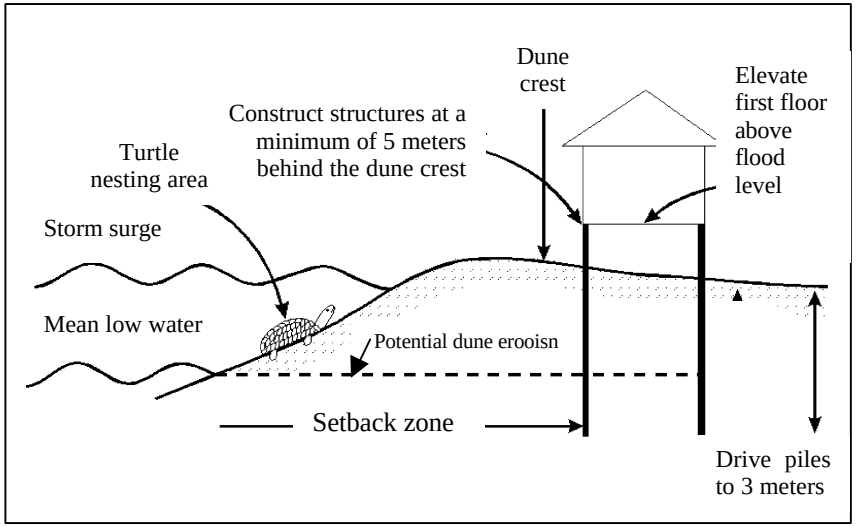
MINIMIZE THE RISK OF BEACH EROSION CAUSED BY WAVE ACTION

➢ ***Establish a construction setback:*** A construction setback (or "no construction" zone) acts as a buffer zone and helps protect infrastructure from the destructive action of storm waves. This setback zone will allow the beach and dune to maintain a natural equilibrium.

➢ ***Construction should be placed behind the first dune, not on top or in front of it.*** The dune can then maintain its natural function as well as help protect property.

➢ ***Avoid constructing rigid structures such as cement or concrete seawalls on the beach or in front of the dune***. As the diagram shows, these walls tend to increase the forces of erosion directly in front of the structure during storms. This happens because wave energy is not dissipated, causing the sand to be eroded at the base of the structure, reducing the width of the beach.

➢ ***Design and construct developments to adapt to the natural characteristics and functions of dunes***. The sand and vegetation act as a buffer, reducing the potential for the waves from over-washing onto the back dune during storms. For this same reason, dunes should not be leveled during construction.



MINIMIZE THE DAMAGE CAUSED BY STORMS AND FLOODS

➢ ***Elevate structures in areas susceptible to flooding***. In communities such as Xcalak and San Pedro (Belize), many older houses are constructed on pilings. This is an old technique, which was historically used to prevent the damage caused by flooding.

➢ ***Structures should be designed so that the first floor is situated above the maximum height of storm waves***. In Cancun, during Hurricane Gilbert (1988), waves reached up to 8 m above sea level.

Setting the house behind the dune protects the structure while allowing the dune to continue to function in a natural way.

➢ ***The best practice to avoid damage in flood-prone areas is to construct buildings on pilings (wood or cement)***. Another alternative is to construct a foundation with cement walls perpendicular (not parallel) to the coastline. This would allow water to be channeled under the living space. This reduces the refracted wave energy that can cause erosion when structures are placed parallel to the coast.

PRESERVE NATURAL PROCESSES

➢ ***Rigid structures placed adjacent to beach may prevent sea turtles from nesting on the beach.*** The most appropriate siting for development is behind the first dune, landward of nesting areas.

➢ ***Reduce impacts on nesting sea turtles.*** Restrict the use of tractors when cleaning beaches during sea turtle nesting season.

➢ Beach cleaning along the coast should be limited to hand tools such as rakes which penetrates less than two inches into the sand.

➢ ***When designing and building a new development, it is essential to use techniques which assure that erosion will not be increased as a result of this construction.*** Natural processes should be maintained as much as possible. It is recommended that "non-structural" alternatives are (often called "soft solutions") considered as a first option. These methods, when used and maintained, can be more cost effective in the long term than installing a wall or coastal structure because of the negative impact which the structure may have on natural processes and beach erosion.

➢ ***Re-create a wide sandy beach to reduce the impacts of waves.*** Increasing the width of a beach with beach nourishment can frequently improve its natural ability to protect against waves. The initial cost of mitigation measures, and the future costs of maintenance should be carefully studied to determine the feasibility of the project.

Seawalls and other rigid shore protection structures may increase the erosion of the beach, resulting in storm damage and loss of public access.

MANAGING DEVELOPMENT NEAR WATER BODIES, LAGOONS & WETLANDS

Using practices that promote the pollution control, maintenance or critical habitats and adequate accesses to lagoons and wetlands will contribute to a goal of sustainable tourism development.

Guidelines to Consider When Managing Development near Water Bodies, Lagoons and Wetlands:

- ✓ Reduce and Prevent Pollution to Water Bodies
- ✓ Mitigate Alterations that Reduce the Quality of Wetlands and Waterways
- ✓ Minimize Impacts While Enhancing Access With Docks and Piers

The Yucatan Peninsula is known worldwide for its clear blue waters, surrounding a peninsula of great cultural and environmental wealth. These waters, both coastal and inland, and their adjacent lands are essential components of valuable ecosystems, that provide habitat for fisheries, plants and animals. Today, many of these environments remain intact and are functioning well. As development increases along the landward portion of the coast of Quintana Roo, there will be increased pressure to build up the waterside—within the coastal tidal zone and along the lagoons—for tourism, recreation, and other commercial purposes. Clean water is the product that we rely on for shoreside hotels, marinas, and recreational parks. Thus, while there may be economic benefits associated with such water-dependent infrastructure (i.e. marinas or shoreline protection structures), it is important to identify those areas where this type of development is most appropriate, then design, operate, and maintain the facilities to avoid very costly impacts for the future.

With new development along the coast of Quintana Roo we have the opportunity to plan and design development to avoid pollution and habitat destruction and promote public access. Such foresight will be useful so that in 25 years in the future, we will not have to spend excessive money on restoring habitat and cleaning water quality, and buying waterfront property for public recreation.

Principles for planning and designing projects in and adjacent to lagoons, wetlands, and other waterbodies

- Reduce costs of future project maintenance or ecological restoration by maintaining functional hydrological processes and ecological characteristics necessary for healthy ecosystems.
- Maintain high water quality and avoid input of contaminants to insure enhanced fisheries and recreational opportunities.
- Promote appropriate economic opportunities in natural environments and provide enhanced opportunities for low-impact recreation.

REDUCE AND PREVENT POLLUTION TO WATER BODIES

➢ ***Incorporate a 10-meter vegetation strip between development and shoreline***. Incorporating a buffer zone of natural vegetation adjacent to lagoons and wetlands is a low-cost, natural method for leaching out pollutants (oils, fertilizers) from upland activities, reduces runoff velocity, and filters sediments from entering the waterbody. Additionally an undisturbed vegetation buffer provides an essential habitat for wildlife and erosion protection. (See vegetation section for more information).

➢ *Construct roads, walkways, and parking areas with pervious materials.* Designs that incorporate shell, gravel or open paving blocks will permit water to enter the ground and enhance natural drainage, minimize runoff, and improve safety. Subgrade materials should be porous to enhance percolation of water. Areas that receive high auto traffic may user interlocking pavement blocks that have open space that allow grass to grow in the openings, thereby combining good load-bearing capacity and large pervious openings.

➢ *Do not directly discharge untreated wastewater to lagoons, wetlands, or coastal waters.* Wastewater should be treated to insure that both the coliform and nutrients are removed before the groundwater enters the lagoons or coastal waters. (See wastewater).

➢ *Minimize use of fertilizers for landscaping*. Landscape with native plants that require little or no fertilizers or pesticides and are attractive for visitors. (See vegetation section).

MITIGATE ALTERATIONS THAT REDUCE THE QUALITY OF WETLANDS AND WATERWAYS

➢ ***Design development to maintain function of wetlands.*** Maintaining the ecological balance with water flow, vegetation, and animal habitat is critical to success of the wetlands. Cutting off water circulation, or filling the wetland without consideration for maintaining flow can cause drainage impacts to adjacent property with increased flooding, as well as often destroying the entire habitat through changes of soil, vegetation and water quality.

➢ *Generally, wetlands should not be filled or cut down.* Design buildings and facilities to *compliment* the existing landscape of the wetlands in a manner that they can co-exist. Wetlands should not be considered "waste lands" that could be filled to produce hard substrate for development since this may have a severe impact on flooding and habitat destruction.

Impacts to the wetlands occur by filling for hotels and roads. Concerns for water pollution exist where such facilities do not incorporate a setback.

➢ *Design roads in upland areas* that will avoid impact to wetlands and avoid flooding of road. If there are no routing alternatives to constructing a portion of the road within the wetland, identify methods such as bridges or culverts to insure that the flow of water is maintained within the wetland.

➢ *Establish a balance between the use of mangrove areas and beach and dune areas* for new development to insure that the development is sustainable and marketable for long term. In areas where the barrier is narrow, projects should be smaller in scale, since the land can not accommodate intensive, high impact, use.

➢ *Use pile foundations to reduce the filling necessary to construct a stable building.* In instances where it is appropriate to construct buildings or boardwalks within wetlands, they should be constructed on piles above the wetland to insure that flow is maintained.

➢ *Where necessary, fill with permeable materials.* Use of permeable materials, such as rock, gravel or sand will allow for water movement through the fill and will help maintain the circulation of water necessary for the wetland to function. Clay is not permeable and will cause unnecessary alterations. Roads constructed in wetlands should be avoided, however, if constructed should incorporate permeable materials as well as culverts to aid in drainage, water circulation and minimizing flooding.

MINIMIZE IMPACTS WHILE ENHANCING ACCESS WITH DOCKS AND PIERS

➢ *Piers should be designed in areas where water depths are adequate for boats* without the need to dredge and in areas where submerged vegetation will not be destroyed by boat activity. This will minimize future maintenance and potential impacts to fisheries/shellfish habitat, submerged and emergent vegetation. Where the water is very shallow, evaluate the feasibility of building a longer pier to get to a required depth, or relocate the pier to shoreline with deeper water. Although a longer pier may be initially more costly for construction, the long-term costs of maintenance dredging will be reduced.

➢ *Design the boating activity to the meet the physical constraints and the ecological opportunities of the area.* In shallow waters, it is more appropriate to use smaller boats that do not require as much water depth under the boat. If the area is a lagoon with many mangroves, canoes or kayaks may be more appropriate use of the area than larger tour boats.

➢ *Use materials that enhance the natural aesthetics*. Modest wooden piers are traditional to the coast of Quintana Roo. Identify woods that are naturally resistant to degradation. If treated wood is used, it is recommended that non-leaching treatment should be utilized so that chemicals to not leach into the water.

➢ *Pile structures are recommended* instead of solid fill structures to reduce the impact on water circulation or increased shoreline erosion in adjacent areas.

➢ *Consider the development of a community pier*. Where many piers are planned for a small area, a community pier owned and operated by several owners could be a cost saving. This also may reduce the cumulative effects of many small piers that typically result in impacting navigation, turtle grass habitat, and result in increased damage from hurricanes.

Piers in San Pedro: Decisions must be made on developing community piers vs. Constructing many piers adjacent to each other which may promote impacts to navigation, beach swimming, and pollution.

VEGETATION MANAGEMENT AND LANDSCAPE DESIGN

Conserving the natural landscape and enhancing the scenic beauty of tourism development contributes to the high quality coastal habitat, which is one of the principal attractions of the area.

Guidelines to Consider for Managing Vegetation and Landscapes:

- ✓ Preserve Coastal Habitats
- ✓ Mitigate Erosion

The coastal zone is a dynamic area in which the processes of sedimentation and erosion shape the landscape. Additionally, periodic storms render this zone an unstable environment for many plants. In this harsh environment vegetation plays an important role in contributing to coastal ecosystems and conserving the quality of lagoons, wetlands and aquifers, while providing an important nesting and feeding habitat for many species of animals and birds (including migratory species).

In the coastal zone of the Yucatan Peninsula, vegetation is distributed in bands of varying width running north to south, corresponding to both the elevation and soil substrate. The salinity and moisture content of the soil are important factors in determining the distribution of plants and influence the plant's characteristics and special adaptations to the environment. In general, coastal dune vegetation is found adjacent to most of the shoreline. Moving inland, depending on the soil substrate, the vegetation is dominated by either mangrove or jungle vegetation.

Commonly, coastal development projects remove the existing vegetation to "clean" the area. This is often done without realizing that a denuded landscape leads to sand loss, by exposing the development to erosion from strong storm winds and rain, and create other impacts by habitat destruction. Similarly, the water quality of lagoons and cenotes (sinkholes) can be adversely affected by removing the vegetated buffer zone, adjacent to the water body by increasing the threat to pollution from upland runoff thereby diminishing its fishing and recreation potential.

Nevertheless, by understanding the general functions and characteristics of the native vegetation in the region, one can take advantage of this valuable resource. Integrating native vegetation into tourist and residential development can yield exceptional benefits to the natural processes as well as aesthetic enhancement.

Principles for Planning and Designing Projects with the Vision towards the Landscape

- Conserve or restore critical vegetation and mitigate impacts to other vegetation in the areas of development to receive the benefits of the natural landscape.
- Maintain high water quality of lagoons and wetlands by managing adjacent vegetation.

- Mitigate the effects of erosion caused by wind and water.

PRESERVING COASTAL HABITATS

➢ ***Evaluate the type of soil at your site.*** Some important factors to consider: exposure to the natural elements such as wind; influence of salt water; influence of the rainy season; contour and elevation of the property; and the type of wildlife in the area. Appropriate analysis will contribute to a landscape design that minimizes maintenance, enhances the aesthetics and maintains the area suitable for animal habitat.

➢ ***Use native vegetation to reduce maintenance costs.*** Native vegetation is firmly adapted to the substrate, making it resistant to diseases and extreme conditions.

➢ *Conserve existing, native plants that fit within the parameters construction plans and identify.* Utilize those existing on-site plants that benefit a decorative landscape. If necessary, plants should be temporarily removed in a careful manner so that they can be reused in landscaping the finished project.

Beach vegetation assists in stabilizing the beach and provides habitat for birds and other species.

Australian pine has become a nuisance species here where it has killed off much of the native vegetation

➢ ***Avoid the use of exotic species***. Using exotic species can have a negative impact on native species. One example is the Australian pine who's roots spread and kill roots of other plants.

➢ ***Remove and avoid the propagation of Australian pines***. Native plants can accomplish the same function for providing shade without creating so many problems.

MITIGATE EROSION

➢ ***Replant areas that have been cleared of vegetation.*** One of the principle functions of plants is to serve as sediment traps. Establishing a new community of plants in the coastal zone promotes soil stability and mitigates erosion, while promoting groundwater recharge and cleaning (filtering) of water.

➢ ***Maintain buffer zones.*** Coastal dune vegetation acts as a protective barrier against the erosive forces of water and wind by trapping sand and building dunes. Erosion along the Costa Maya has been observed during the "sureste" storm season (from February-May, when the strength of the southeast winds increases along the coast of Quintana Roo) in areas where dune vegetation has been removed.

➢ ***Maintain vegetation along the shores of water bodies to minimize the erosive effects of water and wind.*** For example, mangroves act as a barrier (windbreaker) from winds and waves. Additionally the vegetation helps to retain and build sediments.

Elevating structures above the height of the vegetation helps maintain vegetation and stabilize the dune.(South Kingston, RI)

Integrating vegetation into the landscape enhances the aesthetics of a resort, as well as maintaining a natural habitat

WATER RESOURCES: THE USE OF DRINKING WATER AND THE MANAGEMENT OF WASTEWATER

By using techniques that optimize the use of drinking water and adequately manage wastewater it is possible to guarantee a long-term supply of this resource, and to maintain the health and productivity of coastal ecosystems.

Guidelines to Consider in Water Resource Management:

- ✓ Determine the Availability of Drinking Water
- ✓ Monitor Water Quality
- ✓ Optimize Water Use
- ✓ Manage Wastewater

In the Yucatan Peninsula the principle source of drinking water is groundwater, which is the result of the unique hydrological characteristics of the subsoil. The Peninsula is formed of a porous limestone platform, which does not permit the flow of surface water. The underground aquifer is recharged by rainwater, which filters and flows towards the ground water table. This flow dissolves the limestone and leads to the formation of caverns and caves.

This groundwater flow plays an important role in the conservation of coastal ecosystems, and determines the dynamics and biological and chemical characteristics of these ecosystems. Lagoons, mangroves, wetlands, swamps, and coral reefs can be significantly altered if the groundwater flow is altered or contaminated. Nutrient and coliform pollution may occur from inadequate treatment of wastewater. Saltwater intrusion may result from overuse or over-pumping of the aquifer. As a result, the potential use of these waters for human consumption, fishing activities and recreation becomes diminished.

The different processes by which the water is contaminated, treated and monitored illustrate one of the important differences between surface water and groundwater. These factors determine how and when water can be purified and contamination problems rectified.

In the case of groundwater, contamination may advance undetected, sometimes leading to a situation where the potable water supply has to be temporarily or permanently abandoned. Determining the source and type of contamination, as well as an appropriate method to restore and purify the water, can often be time consuming and very expensive. As a result, some local water sources have to be permanently abandoned.

Considering the hydrologic attributes of the coastal zone of Quintana Roo and the fact that groundwater supplies are the sole source of drinking water, this natural resource must be used and managed wisely. Key to this is that wastewater should be appropriately managed to assure long-term supplies of potable water, free of contamination. One innovative approach is to establish a "closed-cycle" system where the water supply is initially used for human consumption and recycled for use in landscaping. As a result the major benefit to establishing a water-recycling program is to contribute to reducing precious water supplies and minimizing the need to treat this water.

Principles for Use of Water and Management of Wastewater

It is necessary to insure that there is an adequate provision of drinking water and high quality water resources, since this will be a limiting factor to growth and development in the region.

- Maintain adequate quality of water for consumption, recreational activities and habitats on land and in water, some of which have commercial value.
- Insure long term supply of potable water by evaluating the hydrological characteristics during design of developments
- Optimize the use of water to reduce costs of obtaining and treating the water.

DETERMINE THE AVAILABILITY OF DRINKING WATER

➢ ***An adequate supply of water is a fundamental necessity for any tourism infrastructure.*** To best take advantage of water resources, proper siting of water wells is one of the most important design considerations**.**

➢ ***Carefully define the well site***. Drill an exploratory well hole to determine the potential of the aquifer, the permeability of the subsoil, and the quantity of underground water stored in the zone of exploitation. This information is necessary to determine the volume amount of water possible to extract.

MONITOR WATER QUALITY

➢ ***Perform a hydrologic study.*** Drilling a test well with the goal of evaluating the quality of water at different levels and its fluctuations over time.

➢ ***Monitor the quality of well water.*** Periodically, measure the conductivity of the water to evaluate the potential increases in the salinity of water. Monitoring will provide information necessary to establish a limit for exploitation.

Traditional wells are the most common method of obtaining drinking water.

OPTIMIZE WATER USE

➢ ***Use compost toilets in area where the water supply is limited.*** This technique will conserve water in residential uses, where 60% of

the total water use is used inside, and 40% of that goes towards sanitary purposes.

➢ *Reuse gray water.* Water used for showers and other household activities can be "recycled" and used for gardens and outside landscaping. This would require planning during the design phase.

MANAGE WASTEWATER

➢ ***Injection techniques into deep wells*** are a good approach to help recharge the groundwater. It is recommended that water quality is equal to or better than 19,000 parts per million (PPM) of total dissolved solids, so that groundwater is not contaminated.

➢ ***Do not discharge untreated wastewater directly into waterbodies***. Discharging untreated water into lagoons, reef lagoons or wetlands can increase nitrogen, bacteria and phosphorous levels, leading to an overpopulation of algae. This situation may contribute to the decline of the ecosystem, making it unusable for human activities.

➢ ***The location of existing wells should be considered when installing a septic system***. Mexican standards provide for a minimum distance of 30 m between wells and septic systems. A greater distance is recommended for tourist development since the demand for water and the quantity of wastewater is typically greater.

➢ ***Septic systems should be situated so that residual leachate liquid flows away from the well.*** Likewise, the walls and floor of the septic tank should be constructed to be impermeable to prevent leakage of untreated, high nutrient waters to the surrounding groundwater.

➢ ***Identify alternative systems for waste treatment.*** Technologies are being utilized which incorporate constructed wetlands, re-circulating sand filters, and other filtration systems that compliment the traditional septic system designs. These systems, appropriate for single family homes or groupings of houses/hotel rooms, are designed to reduce nitrogen and coliform, thereby providing a higher level of treatment than traditional septic system designs. There are several examples of the constructed wetland systems that have been in operation in Akumal.

Constructing wetlands to treat wastewater is an innovative technology that reduces pollution and enhances the landscape with a garden of plants that are using the nitrogen as a fertilizer.

MANAGING SOLID WASTE

Implementing solid waste management practices that considers concerns of human health and environmental enhancement contributes to the goal of sustainable tourism development.

Guidelines to Consider in Managing Solid Waste:

- ✓ Reduce the Amount of Trash Destined for Land Fills
- ✓ Identify the Most Appropriate Location for a Landfill

With the increase in residents and visitors to the coastal zone, millions of tons of trash are inevitably generated each year. The appropriate disposal of this waste is becoming an increasingly difficult and costly proposition for many tropical regions. Nevertheless, the proper handling and disposal of solid waste is essential to maintaining human and environmental health and promoting a tourist destination for thousands of visitors.

Solid waste concerns are not unique to large cities and local communities. This problem is also present in the uninhabited areas of Quintana Roo, where large quantities of trash litter the shoreline. These wastes often originate in places as far away as South America, and are carried by river and ocean currents. Trash and debris may alter animal habitat and disrupt the nesting activities of both marine turtles and birds as well as diminish the aesthetic quality of the beaches that are a prime tourist attraction and community resource.

Landfills are the most common solution for solid waste disposal. However, as these landfills eventually reach capacity, communities are constantly searching for new places to dispose and manage their wastes. Larger spaces become necessary to meet this burgeoning need, and the cost of disposal increases. Due to this situation, it is necessary to develop new methods when designing and operating new development, which save both economic and natural resources through proper management of solid waste.

Reducing, recycling and reusing has become a strategy adopted. This process diminishes the quantity of materials destined for landfills, thereby increasing the life expectancy of these areas, and the long-term costs of solid waste management. In order for this policy to be effective, firms, tourists and local communities must make a shift in their daily lives, and work together to change the patterns of waste generation and disposal.

The demand for new waste management strategies has sparked a new industry for collecting and re-using recycled materials worldwide. As the demand for these program increase the materials and disposal options will become more common along the coast. Developers can contribute to the promotion of such strategies while implementing appropriate solid waste management initiatives during the planning, construction and operation of their new establishments.

Principals for Managing Solid Waste

- Implement actions to prevent pollution and minimize risks to the environment.
- Reduce long-term economic costs and impacts to the natural resource by endorsing a strategy to reduce, reuse, and recycle for manmade and organic materials. This will result in reducing the demand and volume for landfills.

REDUCE AMOUNT OF TRASH DESTINED FOR LAND FILLS

➢ ***Reduce and reuse.*** The best way to prevent pollution is to limit the amount of solid waste to be discarded and avoid those materials, which are difficult to dispose. Existing hotel operations should not be stopped but optimized to reduce solid waste. For example, pollution caused by an excessive number of plastic containers can be minimized through purchasing different packaging or container that are recyclable.

➢ ***Implement a trash separation program.*** Trash separation schemes support the effort to reuse and recycle materials. Moreover, this process provides a way for people to realize the type of trash which is generated, which can assist in the long-term establishment of better programs and policies. Trash separation schemes should be designed according to the composition of waste and then deposited in properly labeled receptacles. There is an opportunity for both the general community and the tourist community to participate in this program.

➢ ***Develop a composting plan.*** Approximately 40-50% of trash is made up organic wastes, which can be easily decomposed, composted, and used for landscaping. Re-use of organic waste generated in hotels or at the community level for compost can be an economic and effective tool in reducing the amount of material destined for landfills.

➢ ***Tourist facilities should involve their guests in recycling programs.*** Today, waste reduction and recycling programs are found throughout the world, therefore it would not be difficult for visitors to understand and participate in such programs in your establishment. This is a good way to involve your clients while achieving the goals of a waste reduction program to reduce pollution, promote efficient resource use, and reduce costs of disposal.

Garbage along the beach becomes a human health risk as well as a risk to wildlife. Such issues impact tourism along the coast.

IDENTIFY THE MOST APPROPRIATE LOCATION FOR A LANDFILL

➢ ***Evaluate the characteristics of the land and the volume of trash to be generated prior to establishing a sanitary landfill.*** It is necessary to consider the soil characteristics in the area in which you intend to install a landfill. The groundwater table found in the Yucatan Peninsula is very susceptible to contamination from runoff and leaching from landfill wastes. Mexican Federal Law NOM-083-ECOL-1994 establishes the provisions for designing sanitary landfills. Some of the conditions for siting a landfill include:

- Locate at least 10 meters above the groundwater table and at least 1 km from recharge areas for the drinking water aquifer.
- Locate at a distance of at least 1-km from flood areas, standing bodies of water and natural currents.
- Located at least 500 m from urban areas; 70 m from roads and highways; 3 km from natural protected areas and airports; 20 m

to either side of electric power lines, pipelines and gasoline lines; and 150 m from gasoline storage areas.

WORLD WIDE WEB RESOURCES

TOURISM

European Community for Environmental Travel and Tourism
http://www.wttc.org
This site was designed to promote environmental awareness and good practice in the travel and tourism industry

Island Resources Foundation
http://irf.org/
This site provides information regarding the development and management of small tropical islands. Address:

Sources Environmental Website
http://www2.planeta.com/
http://www2.planeta.com/mader/ecotravel/etour.html
This is a solutions-based environmental site. Links to ecotourism materials and conferences can be found here.

Sustainable Tourism Research Interest Group
http://www.dkglobal.org/string/rohr
This site provides links to organizations specializing in sustainable tourism as well as links to articles, conferences and codes of ethics dealing with tourism.

Tourfor
http://www.buckscol.ac.uk/leisure/tourfor/tourfor.shtml
This is an environmental management system for forest based tourism. Links to topics on tourism and forestry are provided within this website. Address

ECOTEL
http://www.hvs-intl.com/ecotel/welcome.htm
Environmental hotel certification program.

World Tourism Orgnaization - What Tourism Managers Need to Know.
http://www.world-tourism.org
Practical guide to the development and use of indicators for sustainable tourism

WATER RESOURCES CONSERVATION

Waterfront: City of Winnipeg Water Conservation Network
http://www.mbnet.mb.ca/wpgwater/welcome.html
Contains some information on Municipal water conservation, including practical home tips.

EPA: Cleaner Water through Conservation
http://www.epa.gov/ow/you/intro.html
A large site which contains a good background on water conservation, and links lack of conservation to a broad range of water problems. Reads like a long papers or book but filled with important information.

Learning to be Water Wise & Energy Efficient – An Education Program
http://www.getwise.org/splash.html
Targets a younger audience but contains some interesting facts and tips for people of all ages, including a section describing the Water Cycle.

American Water and Energy Savers Inc.
http://www.americanwater.com/49ways.htm
A commercial site which sells water saving products. Contains the big "49 ways to save water."

Greywater: A Recyclable Solution
http://www.waterstore.com
Advocates greywater use, including a general description and diagram of a greywater system.

Waterwiser: The Energy Efficiency Clearinghouse
Http://www.waterwiser.org
Contains a good list of links.

DRINKING WATER

Drinking Water Help Homepage
http://ourworld.compuserve.com/homepages/outtaway/welcome1.htm
Excellent site which gives a good background on chemical and organism problems, and includes a good troubleshooting section which recommends various treatments.

American Ground Water Trust Public Information Pamphlet #10
http://www.agwt.org/Bacteria.htm
An easy to read, comprehensive document on bacteria and water wells. Includes well protection strategies and treatment techniques.

Waterhealth International
http://www.waterhealth.com
Makers of UV treatment systems.

The Chlorine Dioxide Water Treatment Resource Center
http://clo2.com
Provides information on Clo2 water treatment.

The Water Quality Association
http://www.wqa.org/
Site contains a broad reference for many water quality issues, including technical papers and easily accessible public information.

WaterPartners International
http://www.water.org/12projco.htm
An organization which works with Central American communities to meet drinking water needs.

GENERAL WATER RESOURCES

CEPIS: The Pan American Sanitary Bureau
www.cepis.org.pe/eswww/proyecto/repidisc/publica/hdt/hojadivu.html
A very large site with full text documents on water, water supply, water resources, and wastewater (in Spanish).

Texas Environmental Center
http://www.tec.org/tec/terms2.html
An immense dictionary of water terms.

USGS: Water Use
http://water.usgs.gov/public/watuse
Site provides a large amount of information and good links on water use issues.

VEGETATION/LANDSCAPING

Best Management Practices – Nutrients
http://www.cjnetworks.com/~sccdistrict/bestfert.htm
Nine Best Management Practices for nutrient management.

Florida Agricultural Information Retrieval System: Weed Management

http://hammock.ifas.ufl.edu/text/wg/31591.html
Good background on weed management in many vegetative settings.

Bureau of Land Management: Prevent the Spread of Noxious Weeds
http://www.blm.gov/education/weed/weed.html
Good overview of exotic and invasive plant species.

MANGROVES, CORAL & COASTAL PROCESSES

Fundacion Humedales/ Wetlands Foundation
http://www.humedales.org
Site provides information on a mangrove project in Costa Rica. The description of threats to mangroves is relevant to most mangrove areas.

Ramsar Convention
http://iucn.org/themes/ramsar/
This page contains a list of Ramsar sites.

Cairns On-line Environment Guide-Mangroves
http://www.cairns.aust.com/Environ/mangroves.html.
Detailed description of mangroves, with access to scientific studies.

The Florida Mangrove Forest
http://www.sptimes.com/aquarium/FA.2.1.html.
Describes mangroves and some of their inhabitants for a lay audience.

Inside the Mangrove Jungle (Florida)
http://www.flsun.com/wild_eco/mangrove.htm
Describes mangroves for a lay audience.

EarthIsland Institute's Mangrove Action Project
http://www.earthisland.org/ei/map/map.html.
Not much general information, but good updates for the project areas.

Mangrove Replenishment Initiative
http://mangrove.org
Good view of specific threats to mangroves. Includes good links.

NOAA Coral Health and Monitoring Homepage
http://coral.aoml.noaa.gov
Site includes an immense list of coral related abstracts and the US regulations for Marine Sanctuaries, and links to other sources.

Coral Reefs and Mangroves: Modeling and Management -
http://ibm590.aims.gov.au/
This site describes a three-year study sponsored by the Australian Institute of Marine Science and the IBM International Foundation.

St. Petersburg Times – Florida Aquarium Habitats
http://www.sptimes.com/aquarium/FA.2.1.4a.html
A good (simple) description of coral/mangrove interaction: site traces a drop of water through the wetlands and out to the reef.

The Stuttgart Reef Group – University of Stuttgart
http://www.uni-stuttgart.de/uniuser/igps/researchfiles/reefgroup.html
Gives a good geological background of coral reefs, with a good list of www reef links.

The Surfrider Foundation – Growing the Beaches
http://www.rain.org/~pjenkin/point/growing/grow2.htm
Gives a general description of coastal processes and structures.

Australian Institute of Marine Science
http://ibm590.aims.gov.au/reports/gbra/gbra96.html
Online Paper on Sediment Flows.

http://ibm590.aims.gov.au/reports/mangfloc/mangfloc.html
Online paper on mangrove, seagrass and sediment anchoring.

Seagrasses
http://www.botany.hawaii.edu/seagrass
This web site provides researchers, managers and the public with information that will help foster understanding of seagrasses. The best starting place for information on seagrass and its function in coastal processes.

ALTERNATIVE ENERGY, WASTES & BUILDING TECHNIQUES

National Small Flows Clearinghouse
http://www.estd.wvu.edu/nsfc/
Information, technical asisstance and links for small community wastewater systems.

NRDC – Composting Overview
http://www.igc.apc.org/nrdc/bkgrd/gacompov.html
Short article which gives an overview of the benefits of composting.

NRDC – Recycling Overview
http://www.igc.apc.org/nrdc/bkgrd/garecyc.html
Short article which gives an overview of the benefits of recycling.

Energy Efficient Building Association
http://www.eeba.org/manuals.htm
Sells references and manuals on energy efficient construction and design, including the "Hot Climate Builder Field Guide."

James & James – Renewable Energy Suppliers and Services
http://www.jxj.com/dir/wdress
Site maintains a searchable database of renewable energy suppliers and services in many different countries worldwide.

Clivus Multrum – Waterless Composting Toilets
http://www.earthlink.com.au/clivus/index.html
A company selling composting toilets.

Alternative Energy Engineering
http://www.asis.com/aee
A company offering energy efficient design information and equipment,including composting toilets.

Sustainable Building Sources
http://www.greenbuilder.com/general/BuildingSources.html
Good links to many environmentally sound building references.

Envirolink Library
http://www.envirolink.org/envlib/alpha.html
Provides a large list of reference sites and literature on a broad range of environmental issues.

MARINAS

Sea Grant Coastal Recreation and Tourism - Marina Net
http://seagrant.orst.edu/crt/index.html
Information on marinas and coastal tourism programs dedicated for the industry and decision makers.

Best management Practices: Environmental Guide for Marinas
http://seagrant.gso.uri.edu/riseagrant/BMP.html
Guidelines to prevent and minimize non-point source pollution from marinas.


amigos de
sian ka'an
Coastal Resources Center
University of Rhode Island
USAID