SOUTHEAST FLORIDA CORAL REEF INITIATIVE
MARITIME INDUSTRY AND COASTAL CONSTRUCTION IMPACTS WORKSHOP
DANIA BEACH, FLORIDA
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IDENTIFY AND EVALUATE EXISTING AND EMERGING INNOVATIVE TECHNOLOGIES FOR COASTAL CONSTRUCTION

A study to identify and evaluate existing and emerging innovative technologies in coastal construction practices and procedures that minimize or eliminate impacts to coral reefs, hard/live bottoms, and associated coral reef resources in southeast Florida.

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1. INTRODUCTION

1.1 Background

The general health and conditions of the nearshore coastal habitats in southeast Florida have been, and continue to be, impacted by multiple anthropogenic and natural stressors. Coral cover on many Caribbean reefs has declined up to 80% over the past three decades (Johns, et al., 2003). Although, southeast Florida reefs, which are a part of the greater Caribbean reef system, are being monitored for diseases, bleaching, and other adverse effects associated with human activities in the coastal regions of the State, the majority of reef areas in this geographic location are not protected under a comprehensive management plan and are not part of an active long-term monitoring effort. Activities affecting coral reefs and associated reef resources include: coastal development; increased nutrient and sediment loads from storm water runoff; physical destruction from boat groundings, dredging activities, placement of municipal and utility infrastructure; and increased turbidity and sedimentation from beach nourishment projects. Corals and coral reef resources have been damaged from these activities in many areas. Because corals are very slow growing, this loss represents a serious and significant threat to local coral ecosystems.

In 1998, Presidential Executive Order No.13089 established the United States Coral Reef Task Force (USCRTF) to lead efforts to preserve and protect coral reef ecosystems. The USCRTF is comprised of representatives from federal, state, territorial and commonwealth agencies responsible for various aspects of coral reef conservation. During the eighth meeting of the USCRTF, held in Puerto Rico in 2002, the *Puerto Rico Resolution* was adopted, calling for the development of Local Action Strategies (LAS) by its member agencies. These LAS are locally driven roadmaps resulting from collaboration and cooperation among agencies and non-governmental partners, which identify priority actions needed to reduce key threats to coral reef resources.

The State of Florida contains a substantial portion of the United States' coral reef ecosystems and is committed to the preservation and protection of the biodiversity, health, heritage, and social and economic value of coral reef ecosystems and the marine environment. With guidance from the USCRTF, the Florida Department of Environmental Protection and the Florida Fish and Wildlife Conservation Commission coordinated the formation of a team of interagency marine resource professionals, scientists, non-governmental organizations and other interested stakeholders. The Southeast Florida Coral Reef Initiative (SEFCRI) Team first gathered to develop a LAS in May 2003, targeting coral reefs from Miami-Dade County, through Broward and Palm Beach, to Martin County. This region was chosen because its reefs are close to an intensely developed coastal region, with a large and dense human population, and therefore at greater risk of anthropogenic impacts. Even though local reefs are exhibiting the same signs of degradation that have been documented in other parts of the world, prior to development of the SEFCRI, there was no coordinated public education or management plan proposed for reefs located north of the Florida Keys. The SEFCRI Team is divided into four sub-teams, each focusing on one of four recognized threats to local reefs: a lack of public awareness and appreciation; impacts associated with fishing, diving and other uses; land-based sources of pollution; and, maritime industry and coastal construction impacts.

1.2 Purpose

The Maritime Industry and Coastal Construction Impacts Team (MICCI) (one of four focus teams of the SEFCRI Team) worked to develop the LAS to address threats to coral reefs and coral reef resources that are associated with coastal activities and projects in southeast Florida. Large coastal infrastructure projects, such as commercial and residential shoreline development waterward of the Coastal Construction Control Line and natural dune system, manmade inlets, and installation of pipes, cables and outfalls for public utilities contributes to shoreline erosion and can damage coral habitat by increasing turbidity. Decades of dredging to build and maintain inlets, harbors, and canals have disrupted the natural littoral flow of sediments and as a result shoreline erosion in many areas is more pronounced. Communities have undertaken continuing beach nourishment projects, in which great quantities of sand are dredged from offshore locations and transported to beaches and nearshore waters to stabilize shorelines. Increased turbidity as a result of dredging and beach renourishment can damage coral habitat. Sediments can smother corals and reduced water clarity deprives corals of the light they require for photosynthesis. Dredge and fill projects, and construction of seawalls and docks, can also negatively affect seagrasses, mangroves and other benthic communities that are important to the entire coral reef ecosystem. These projects can have either direct or indirect impacts to coral reefs and coral reef resources.

The cumulative impacts from these activities impair the resiliency of the coastal reef habitats, making them more susceptible to anthropogenic and natural perturbations. To address these threats and minimize or eliminate impacts to coastal habitats and coral reef systems, the MICCI Team identified and developed a priority project in the LAS (number 3 of 30 projects that had been proposed) to conduct an investigation and evaluation of existing and emerging technologies for coastal construction activities in southeast Florida. As population densities in southeast Florida continue to increase, it is logical to assume that coastal construction activities will also proportionally rise. The increasing demand of residents and seasonal residents to live on or in close proximity to the water continues to increase. This demand has placed continued stress from coastal construction activities on the coastline. This study to evaluate existing and emerging innovative technologies for coastal construction is an effort to find alternative ways of working in and around coral reef and hardbottom communities with fewer environmental impacts to reef resources. This document presents the results of the study, including the proceedings from a workshop to obtain additional insights from local and distant stakeholders involved in coastal construction. The focus of this study was to investigate emerging technologies in coastal construction practices that will serve to minimize or eliminate impacts to coastal habitats and resources. The MICCI Project 3 Team proposed an open forum to provide environmental managers, regulators, stakeholders, and the coastal engineering and coastal construction-related industries the opportunity to review, discuss, and recommend advances and modifications of existing or emerging technologies.

1.3 Participants

This effort was accomplished through a 2-day workshop that included representatives from the coastal construction industry, coastal engineers, regulatory agencies, environmental agencies, non-governmental and not-for-profit organizations, and academic institutions. The goal of the workshop was for the participants to assess existing technologies and strategies for activities in the nearshore coastal areas by reviewing present concerns and impacts associated with existing methods and learning about new or emerging technological advances that could minimize or reduce the environmental concerns of these activities.

The MICCI Project 3 Team identified key topics to be addressed at the workshop and incorporated into the workshop proceedings. which include: 1) Identification of activities or actions, which have the potential to have minimal/maximal effectiveness toward the protection of coral reefs, hard/live bottoms and associated coral reef resources; 2) Identification of innovative technologies that minimize or eliminate impacts to reef communities; 3) Identification/recommendations for cost incorporation of advanced and/or emerging technologies into regional beach nourishment, erosion control, inlet management and infrastructure placement programs; 4) Identify/recommend study designs to monitor projects and mitigation associated with associated with coastal construction activities, infrastructure installation, beach renourishment, dredging and groundings; and 5) Recommendations permit conditions that could advance utilization of emerging technologies for coastal and marine construction activities while maintaining protection of coral reefs, hard/live bottoms and associated coral reef resources. Experts from the coastal engineering industry, the dredging industry, academia, and agencies were identified by the MICCI Project 3 Team to address the key topics and present information to the workshop participants.

The expert speakers and their perspective topics included: Dr. Kerry Black (ASR Limited, New Zealand), Methods of a developed mixed use artificial reef structure; Bill Hanson (Great Lakes Dredge and Dock Company, LLC), Different types of dredge equipment and uses in Florida; Dr. Bill Dally (Surfbreak Engineering Sciences, Inc), Mitigation Reef Gardens – Pilot Study; Dr. Don McNiell on behalf of Dr. Hal Wanless (University of Miami), Geological importance of sand compatibility for sustaining beaches; Billy Causey (Florida Keys National Marine Sanctuary), Importance of Florida's resources; Paden Woodruff (FDEP, Beaches and Coastal), Proceedings from February 2006 Innovative Shore Protection; Georgia Vince (FDEP, Environmental Resources Program), Means of Avoidance and Minimization of Coral Reef Impacts During Offshore Coastal Construction Projects; Dr. Pete Peterson (University of North Carolina at Chapel Hill, Institute of Marine Sciences), Appropriate Monitoring Methods and Monitoring Design; and Phil Bates (US Army Corps of Engineers), Silent Inspector Monitoring of Dredging Equipment. Participants at this workshop identified priority issues and criteria that are components of coastal construction activities. The workshop was widely advertised to bring together people from diverse backgrounds and differing points of view. The workshop agenda is provided in Appendix 1 and the registered participants are listed in Appendix 2. Copies of the PowerPoint presentations made by the invited speakers are included in Appendix 3.

1.4 Process

Following the experts' presentations on the first day, participants selected one of five working groups covering four topics of concern to join in discussions of the issues and formulate recommendations by answering specific questions pertaining to the group's topic. Each group included representatives from local, state and federal agencies, academia, coastal construction and related industries, and non-profit organizations. A facilitator led each group and was assisted by a volunteer from the group; they recorded the discussions and responses manually on flip charts and electronically. A participant from each session was also tasked with reporting their group's findings at the end of the day.

This format was repeated on the second day. After more presentations, participants were asked to report to the same working group session as on the day before (new participants could select a working group session for the day based on their interests). Information from the presentations was used during the working group sessions to identify activities and innovative technologies, which might produce the most significant impacts or provide the maximum amount of protection to coral reefs and associated coral reef resources. The groups were also asked to identify study designs to monitor projects associated with coastal construction activities, infrastructure installation, beach renourishment, dredging, and groundings to determine the efficacy of implementing particular technologies to protect southeast Florida coral reef resources. In addition, copies of Florida regulations related to coastal construction were provided in the participant's workshop materials (see Appendix 4). At the end of the second day's sessions, the group representatives presented prioritized issues and recommendations to all remaining participants and consensus items were identified.

1.5 Working Group Sessions

Attendees of the workshop were asked to choose a session (breakout group) of their interest to participate in. Each working group was assigned questions to discuss that address the key topics identified by the MICCI Project 3 Team (listed in Section 1.1.3). The groups collected and recorded answers from their discussions, and were asked to pick the top five priority items (e.g. issues, technologies, practices) from their recorded discussions. At the end of Day 2 of the workshop each group gave a short presentation summarizing their discussion and the priority items (i.e. impacts, technologies, practices) that were agreed upon by the group. The priority items were numbered one through five and do not signify ranking. The questions each of the groups addressed with the associated priority items are summarized below.

Section 2 of the workshop proceedings presents each working group's objective, the questions the participants discussed, and highlights from each session. The highlights are taken directly from the notes recorded on the flip charts and each group's reporting PowerPoint slides presented to the participants at the end of the workshop. Section 3 presents the consensus recommendations developed during the workshop. Drafts of this document were submitted to the MICCI Project 3 Team, the speakers, the participants, and the public for review and comment. Their suggested revisions have been incorporated to improve the clarity and consistency of this report; however, the consensus recommendations from the workshop have not been altered.

Group/Session 1 addressed the following questions pertaining to coastal construction in southeast Florida, including physical activities and secondary responses, known to impact coral reef systems: 1) What coastal construction practices have caused adverse effects on coral reefs or hard/live bottoms? Name the specific construction practice, identify the stressor that is caused by the construction practice, and identify the impact that is caused.; 2) What dredging practices have been known to cause the most impacts within the Florida region and why.; 3) What practices associated with beach erosion control programs adversely affect coral reefs or hard/live bottoms?; and 4) Have any practices associated with dredging, beach nourishment/re-nourishment, or other coastal construction activities protected near shore coral reefs or hard/live bottoms?

The top five priority issues Group 1 identified are: Water quality**;** Physical damage**;** Sedimentation and direct burial**;** Turbidity; and Near-shore habitat loss.

Group/Session 2 focused on the review of advanced technologies and/or methodologies that minimize or eliminate coral reef resource impacts, including shoreline stabilization and erosion/beach stabilization. The questions addressed by Group 2 are as follows: 1) What technological advances have been used or implemented to minimize or eliminate impacts to coral reefs and hard/live bottoms? (Name the technology, when it is used or what aspect of construction it is used during, identify the stressor or impacts that it will minimize or eliminate); 2) Discuss the following technologies that have been implemented in projects constructed within the Florida region: a)Acoustic Doppler Current Profilers (ACDP), used in the Key West Harbor dredging project; b)Fluorometry, used throughout the Florida Keys; c)Pipe collars for beach nourishment, used in the Midtown, Phipps, and Broward County beach nourishment projects; d)Reduced turbidity levels from 29 NTUs (nephelometric turbidity units) to 15 NTUs, used in the Key West Harbor; e)Dredging project, Broward County Beach Nourishment Project and the AES and Tractebel Calypso geotechnical borings and pipeline installation permits; f)Horizontal Directional Drilling (HDD), AT&T & Tycom fiber optic cables (FOC), other known multiple FOC projects; g)The use of pre-determined reef gaps for linear project installation. Discuss their positive or negative effects, identify their mode of avoidance and minimization; 3) What technologies have been proposed to improve and mitigate impacts from shoreline/beach stabilization, nourishment activities, unpredicted equilibration of new beach nourishment equilibrium toe of fill?; and 4) Have the proposed technologies mentioned above been tested on a small scale or in special projects? What successes were achieved?

The top five priority practices identified in Group 2 are: Alternatives to conventional mitigation; Tunneling/HDD/corridors; integrating habitat characterization with management strategies; Hybrid solutions-multiple technologies within 1 project; and Turbidity monitoring technologies.

Session 3 was divided into two groups, Group 3A and Group 3B, focusing on coastal construction technologies proposed to improve and mitigate impacts from shoreline/beach stabilization projects. This session was divided into two groups to accommodate the large number of participants interested in this topic. The questions addressed in group 3A are as follows: 1) What technologies are emerging that will be used to stabilize shorelines and beaches, reduce erosion, or renourish beaches? 2) What opportunities are available to incorporate or implement these emerging technologies to solve coastal and marine construction challenges? Identify sites, problems to be addressed; 3) What factors might get in the way of implementing such technologies (i.e. cost, expertise, human resources)?; 4) Which components of these technologies could be used to minimize impacts to coral reef resources?; 5) What criteria must be established during the planning phase that will minimize impacts during construction?; and 6) What kind of oversight/enforcement would be needed to verify that the established criteria were being met? What are reasonable solutions to oversight/enforcement?

The top five priority technologies and solutions identified that would minimize impacts to coral reefs and associated reef resources are: Involvement of dredging industry early in permitting process/conditions and BMPs (involve Dredging Contractors of America (DCA) and the Western Dredging Association (WEDA) for representative review/resource group); Use of submerged structures to stabilize shoreline and reduce need for nourishment (wave breaks/modifiers, multi-purpose/reef ball/bio-reefs/eco-reefs); Sand bypassing/back-passing (fixed systems/dredging/trucking); Alternate sand sources (upland/deep water/beneficial use/manufactured sand, Aragonite (foreign)); Operational/technology improvements (e.g. minimization of dredging time, pump/slurring mods to allow pumping up slurry density, borrow area design/shape (dredge efficiency), recycle "skim" water (use for drag arm jets), utilization of "operational box", designated pipeline corridors, reef gaps, refined work areas, pushing rather than sucking sand).

Group 3B questions addressing coastal technologies are as follows: 1) What technologies are emerging that will be used to stabilize shorelines and beaches, reduce erosion, or renourish beaches? Name technology, identify which field has developed it (coastal engineering, dredging, or industry), state which problem it addresses; 2) What opportunities are available to incorporate or implement these emerging technologies to solve coastal and marine construction challenges? Identify sites, problems to be addressed; 3) What factors might get in the way of implementing such technologies (i.e. cost, expertise, human resources)?; 4) Which components of these technologies could be used to minimize impacts to coral reef resources?; 5) What criteria must be established during the planning phase that will minimize impacts during construction?; 6) What kind of oversight/enforcement would be needed to verify that the established criteria were being met? What are reasonable solutions to oversight/enforcement?; and 7) Regional bypass strategy?

The priorities associated with coastal construction technologies identified by the group are: BMPs to be investigated/implemented where possible; sand bypassing-strategic regional initiative; multi-purpose reefs; beach vegetation/dunes (where appropriate); and the highest possible sand quality.

The final breakout group, Group 4, focused on mitigation, monitoring and permitting issues. The following questions were addressed by this group: 1) What modifications to permit conditions, if any, are necessary to advance the use of emerging technologies that would protect reefs during coastal and marine construction?; 2) What rule changes might be required to ensure that coral reefs, hard/live bottoms and associated coral reef resources are protected during these activities?; 3) What criteria should be established for mitigation of coral reefs affected by coastal construction, infrastructure installation, beach renourishment, dredging, or groundings? Identify the activity, its impacts on reef resources, and how the criteria will protect the reef; 4) Can monitoring programs track the success or identify failures of new technologies in relation to protection of reef resources?; 5) Which factors must be considered in the design of a monitoring program for a particular site?; 6) Which monitoring methods or techniques provide data to answer the question of what reef impacts are occurring before impacts are visible?; and 7) What should be done with the data that are collected and who is responsible for reporting problems to the parties involved in the project (regulated vs. regulator)?

The priority item identified by Group 4 addressing mitigation, monitoring and permitting issues are: Hypothesis-driven monitoring that is time sensitive, adaptive, plus has good statistical and experimental design (empirically- derived project specific thresholds); Real-time monitoring and ops alarm systems (required in permit conditions to avoid damage) (spec-alarms on all moving parts with potential to impact corals (spuds, drag arms); Mitigation reform: result in rule changes (allow out-of-kind, out-of-box in rule (research, WQ, etc.), UMAM review, define reasonable assurance in rule, define cumulative impacts in rule; MICCI 11 (one stop housing for data and information on proposed and permitted projects for agencies and public); Pre-during-post construction meetings to discuss staff and lessons learned and train/educate contractors on environmental resources- these lessons learned from each project evolve into written BMPs; and Require coral stress monitoring with thresholds and shutdown provisions adequate to protect resource before physical and macro-level manifestations of impacts occur such as histopathological sampling, development of biochemistry, and field procedures.

The summary of each on the groups are included in Section 2 of these Proceedings, following each group's session notes.

2. WORKSHOP PARTICIPANT WORKING GROUP RESULTS AND CONCLUSIONS

The following section details the discussion notes taken directly from each group's flip charts. As stated, Groups focused on questions which addressed the key topics identified in Section 1.3. However, definitions and explanations of practices have been expanded beyond the each Group's notes. A consensus report has been included at the end of each Session/Group to identify the Group's findings. The consensus report is based on the priority items presented by each Group's representative at the end of Day 2. It should be clarified that not all Groups conducted a powerpoint presentation, nor prepared or presented a copy of a complete presentation of their perspective Group's findings. Therefore, the Session/Group formal presentations are not included in these workshop proceedings. The consensus report following each Session/Group utilized information collected from notes taken on flip charts during Group presentations.

The Sessions are categorized into five groups. Each session has an objective, also called key topic, which was the focus for that breakout group. The objective for each session is listed below. The questions and breakout group answers associated with the session follow the objective/key topic. The original language of the group notes has not been changed; however the order of the group's responses may have been altered for flow and consistency to correspond with the appropriate question.

2.1 Session 1

Objective:

Identify and prioritize existing practices and their known impacts on coral reef systems, including coral reefs, hard and/or live bottoms, and associated coral reef resources.

- Physical activities (i.e. dredging, blasting, beach renourishment)
- Process-based activities and secondary responses (i.e. turbidity, shoreline erosion)
- Regional beach erosion control programs and infrastructure placement
- Lessons learned from past beach nourishment and renourishment projects in Southeast Florida

Question 1: What coastal construction practices have caused adverse effects on coral reefs or hard/live bottoms? Name the specific construction practice, identify the stressor that is caused by the construction practice, and identify the impact that is caused.

- **Installation of Large Ship Mooring Areas**
  Secondary impacts caused by installed mooring areas due to placement of anchorage and vessels:

a. Increased vessel traffic and untrained vessel operators increases the possibility of resource destruction form prop wash, anchor drags and groundings on reef and hardbottom.
b. Applications are being evaluated to widen and deepen portions of the Atlantic Intracoastal Waterway to accommodate megayachts.
c. Fish nurseries (e.g., mangroves, seagrass, nearshore hardbottm habitats) lost due to degraded habitat by large ship anchor damage and port traffic
d. Sediment trapping
e. Lack of compliance and law enforcement
f. Sea turtle and manatee strikes
g. Vessel position (e.g. anchoring on coral reef and hardbottom)
h. Vessel groundings on coral reef and hardbottom
i. Anchor drags and large vessel anchor damage
j. Tow lines – using non-floating lines or chain

- **Beach Nourishment/Renourishment:**
  a. Burial of living marine resources (coral reef, seagrass, hardbottom, worm reef, invertebrates)
  b. Sea turtle takes and nesting disruption
  c. Inadequate or non-compatible sand size, color and overall and quality resulting in difficulties predicting sediment movement
  d. Pre, during, and post nourishment monitoring lacks statistical rigor
  e. Turbidity
  f. Sedimentation (smothers corals and other live marine organisms)
  g. Modeling issues
  h. Equilibrium Tow of Fill
  i. State of Florida water quality standards (WQS)
  j. State of Florida nephelometric turbidity units (NTU) standard (may not be adequate for corals)
  k. Meaningful mitigation (Mitigation may not replace lost functions or values)

- **Coastline Lighting:**
  a. Affects sea turtle nesting and hatchlings (increased mortality)
  b. Illumination is wider/higher on the beach negatively impacting coastal and nearshore organisms (fish, coral and other fauna)
  c. Birds' eyesight can be disturbed causing disorientation
  d. Sky glow from cities, condos block night light (stars, moon) (cumulative glow)

- **Installation/Repair of Docks and Piers**
  a. Pile driving, tug prop wash
  b. Sedimentation
  c. Turbidity
  d. Barge sitting over or on bottom (due to tide)
  e. Shading/physical injury
  f. Construction debris
  g. Mechanical damage (acute and chronic)

- **Blasting**
    a. Turbidity
    b. Sedimentation
    c. Impacts on fisheries (e.g. swim bladder destruction, vibrations)
    d. Removal of habitat
    e. Acoustic damage to marine mammals

- **Placement of Stormwater Outfalls, Air-conditioning Drains, Deep Well Injection and Waste Water Treatment Plants**
    a. Stormwater outfalls: fuel, cleaning agents, pesticides, fertilizers dispersed into water. Basins and wells designed for city flood control measures where street water is caught in a basin and drained into canals, the intracoastal and beaches

    b. Air conditioning drain water (not treated with algaecides or fungicides) needs diversion to wastewater treatment plants
    c. Groundwater flows, deep well injection for water/sewage: decreases salinity, overloads nutrients into the system, fluctuates water temperature, percolation changes hydrodynamics
    d. Wastewater Outfalls – Pipes which extend from facilities designed to treat waste (sewage) to the ocean. Wastewater is pumped into the ocean through the utility pipes
       Causes:
       Chronic turbidity
       Nutrient overloads from treated sewage
       Pollutants from automobile oil, gas, air conditioning, etc. discharged into water
       Solutions: Fines, increased flow rate, or drainage behind dunes

- **Shoreline Building Construction**
    a. Turbidity
    b. Sedimentation
    c. Invertebrates impacted by chemical, nutrient loads and habitat loss
    d. Mangrove loss – loss of habitat and shoreline protection
    e. Sedimentation – storm waves and construction methods disturb deep lime muds
    f. Beach shading by high-rises – shading of near shore hardbottom disrupts flora and degrades seagrasses and coral by inhibiting sunlight. Decreases water temperature in winter by blocking sunlight which effects turtle sex ratios
       Solutions: Eliminate beach condo high rises

Question 2: What dredging practices have been known to cause the most impacts within the Florida region and why?

- **Dredging Practices**

a. Blasting: Destroys habitat and increases turbidity (minimize pressure waves directional)
b. Filling: Increases turbidity and direct burial of habitat through sedimentation.
c. Continuous Dredging - 24 hour dredging activities cause continuous impacts. Natural repair of resources is not able to occur because recovery time does not exist.
d. Equipment Selection:
    i. Clamshell disperses fine sedimentation though opening unless sealed
    ii. Hopper Dredge spills over sediment creating turbidity plume; the required buffer zone could be inadequate
e. Open Trenching
f. Borrow Area Sites for Beach Renourishment
   Proximity of dredging close to coral reefs causes: turbidity, blocking essential sunlight from coral reefs; sediment displacement settles on coral smothering polyps; Sand Source Complexity: issues with sand grain size and compatibility to beach sand; sand has not been stable due to size and consistency with nearshore/beach sand

Question 3: What practices associated with beach erosion control programs adversely affect coral reefs or hard/live bottoms?

- **Beach Erosion Control Practices**
  a. Armoring: Stabilization structures to control movement of sand. Stuctures interfere with nearshore waves and current and sand movement
     i. Breakwaters – Built offshore to lower wave energy; sand accumulates behind the breakwater
     ii. Groins – Built either straight and perpendicular to the shoreline, Y-shaped, or T-shaped and can be built at an angle; Groins trap sand withing the littoral system. Sand accumulates at one side of the groin while the downdrift shoreline is eroded.
     iii. Jetties – Built to reduce shoaling in channels – disrupt the longshore movement of sand in the littoral zone and deplete adjacent beaches of sand.
  b. Beach Nourishment –
     i. Pipes used to transfer sand from offshore to beach crush corals and coral reef resources
     ii. Burial of corals and reef resources by deposit of sand
     iii. Increased turbidity blocks essential sunlight
     iv. Borrow area – loss of sand and disruption of waves and current.

Question 4: Have any practices associated with dredging, beach nourishment/re-nourishment, or other coastal construction activities protected nearshore coral reefs or hard/live bottoms?

- **Protective Practices and Technologies**
  a. Tunneling (not yet tested in southeast Florida)
     See session 2

b. Horizontal directional drilling (HDD) (not yet tested in southeast Florida) – Trenchless construction technique which uses guided drilling. Involves 3 main stages: drilling of a pilot hole; enlarging the pilot hole in stages; and installing the carrier pipe. HDD can be utilized on hard rock to sand and silt formation. Bentonite is used to support the bore hole.
c. Elevated docks/piers (prevent shading)
d. Dock construction guidelines (excluding fishing piers) NOAA National Marine Fisheries Service Habitat Conservation Division and US Army Corps of Engineers Dock and Pier Guidelines for Florida (http://sero.nmfs.noaa.gov/dhc/habitat/pnc/dockhome.htm)
e. Dynamic Global Positioning System (DGPS) on vessels – no anchoring
f. Storm water/sewer controls – wastewater treatment plants, cap AC drains, outfall improvements
g. Coral sensitivity training
h. Permitting - Require operator training for boats and equipment used in projects in permit conditions.
i. Bypassing plants - Sand bypassing is the hydraulic or mechanical movement of sand from an accreting area updrift of a barrier to a downdrift eroding area. Dredged or mechanically moved material is placed on a beach immediately downdrift from the obstruction that then serves as a feeder beach to nourish beaches further downdrift (NOAA Coastal Services Center website, September 6, 2006).
j. Long-term monitoring – baseline/before-after control impact (BACI, Peterson Presentation, Appendix 3)
k. Dune plants for shoreline stabilization

Session 1 Consensus Report:

The group was asked to identify the top priorities that address the session's objectives. The top four most destructive practices, not in ranking order, identified in coastal construction practices that negatively impact coral reefs and coral reef ecosystems are:

1. Dredging and blasting;
2. Shoreline development;
3. Beach nourishment and renourishment; and
4. Placement of pipes and cables.

The five most important impacts, not in ranking order, identified as resulting from coastal construction practices are:

1. Water quality changes;
2. Physical damage;
3. Sedimentation/direct fill or burial;
4. Turbidity; and
5. Nearshore habitat loss.

Resource impacts can occur from secondary effects of a specific construction practice such as sedimentation and turbidity from tug prop wash, mechanical injuries, cable drags, shading from pipeline and cable installation, acute and chronic impacts from construction debris, disturbance of deep lime mud, and injuries due to vessel groundings. Sedimentation occurring from these types of practices settles on coral polyps, which results in high levels of stress as the polyps expend energy to remove the particles. Partial or complete coral colony mortality may result from smothering.

Another issue associated with construction practices is shading of beach and nearshore habitats from building design and height or from seawalls, docks and piers with short-term and long-term effects; Shading produces negative impacts affecting natural resources (including coral reefs and coral reef ecosystems, other invertebrates, mangroves, essential habitat and nurseries, and shore birds) acclimated to particular light regimes for photosynthesis or fluctuating daily or seasonal light changes that drive reproduction or other life cycles. Building high rise condominiums and hotels not only introduces new patterns in shading of coastal resources, but also introduces nightly lighting that can significantly disrupt the navigational and seasonal cues important in reproduction for coastal species. These tall buildings also contribute to increases in stormwater and AC outfalls on the beach. Older pipes lying on the beaches in southeast Florida are sending runoff directly into the ocean. This runoff carries chemicals and other land-based pollutants, which are distributed onto the reef system. The group suggested that stormwater runoff be diverted to wastewater treatment plants before being dispersed into the ocean.

Dredging in southeast Florida waters is a continuing practice due to dynamic shoreline fluctuations that threaten beachfront properties, widen and deepen channels to allow access for larger vessels, and create openings where access may be limited or unavailable. Equipment used in dredging (e.g., clamshell dredges) can have detrimental impacts to reef resources. Workshop participants identified the need for increased control measures during dredging to address controlling turbidity: in high energy water movements (e.g., turbidity curtains ripped away), preventing and minimizing habitat loss by addressing the complex patterns needed by species and implementing micro monitoring pre, during and post projects, implementing sedimentation control by proper maintenance of dredge site and equipment, appropriate release of material and strict controls on equipment leaks and dump site discharges, year-round issues such as dredge during cycles that will not affect spawning and nesting cycles for turtles, fish, birds or contribute to cumulative summer impacts from seasonal events (e.g. temperature changes, storm events, and changing flow dynamics to prevent slopes from developing after dredging due to erosion and slumping.

Anchorage areas for large vessels were identified by this group as a severe problem, specifically at the Port Everglades anchorage in Broward County. The current anchorage area lies between the second and third reef tracts and numerous grounding by larger vessels as well as anchor damage to reef resources surrounding the area have been reported. Establishing perimeter buoys to indicate anchorage areas was suggested to relieve these types of impacts. Training for all vessel operators was also recommended to diminish incidents that cause damage to reef resources, including seagrass communities, sea turtles, and manatees.

2.2 Session 2

Objective:

Review recent applications of advanced technologies and/or methodologies associated with coastal and marine construction activities that minimize or eliminate resource impacts.

- Shoreline stabilization
- Erosion/beach stabilization
- Beach renourishment
- Infrastructure placement

Question 1: What technological advances have been used or implemented to minimize or eliminate impact to coral reefs and hard/live bottoms?

Name the technology
Note when it is used or during what aspect of construction it is used
Identify the stressor or impacts that it will minimize or eliminate

- **Coral Stress Index Protocol**
  Used in the Broward Beach Renourishment Project. Corals are tested when borrow dredging is occurring to test stress to coral from sedimentation and turbidity Lab based-controlled technique to determine a pre set stress level where dredging would be ceased to allow recovery time.
  a. Limited species
  b. Very costly
  c. Could be deemed research

- **Tunnel Boring** (Tunnel Boring Machine (TBM) or Earth Pressure Balance Machine (EPBM)- Excavates under or through geologies with a circular cross section that cuts through hard rock and are used as an alternative to drilling and blasting.
  Proposed uses in southeast Florida:
  a. AES Ocean Express, LLC (AES) and Calypso Tractebel, LLC (Calypso) have proposed to transport natural gas from the Bahamas to southeast Florida. It is proposed a tunnel boring machine will be utilized to tunnel underneath the reef system.
  b. Port of Miami Vehicle access from Port to the adjacent Interstate via tunnel under the channel.
  Eliminates Impacts:
  a. Person on TBM can monitor drilling needs, which can result in fewer released of drilling lubricants (Frac-outs)
  b. Laying fiber optic cables using tunnels results in less reef impacts from cables
  c. No pull corridors for pipelines

- **Biorock reef –** "Biorock reef, an electrically conductive frame, usually made from readily available construction grade rebar or wire mesh, is welded together, submerged and anchored to the sea bottom. A low voltage direct current is then applied. (Power sources can include chargers, windmills, solar panels or tidal current generators.) This initiates an electrolytic reaction causing mineral crystals naturally found in seawater, mainly calcium carbonate and magnesium hydroxide, to grow on the structure. Coral fragments are wedged into crevices and holes within the structure or attached using plastic cable ties or steel binding wire. Within days to weeks, as the mineral accretion grows around the attached coral fragments, corals begin to grow at accelerated rates. Their rapid growth is directly attributable to the electrical current in the underlying steel framework" (Global Coral Reef Alliance, 2006).

- Stimulate coral growth rates for mitigations

- **Armor Structures for Beach Stabilization (e.g.Breakwaters)**
  Offshore structures used to lower wave energy and prevent beach erosion
  Eliminate impacts to coral habitat by not directly smothering or laying on coral or hardbottom. Designed to lower wave action, not changer the littoral drift of sand
  Structures also provides hard habitat for resources

Question 2: Discuss the following technologies that have been implemented in projects constructed within the Florida region, discuss their positive or negative effects and identify their mode of avoidance and minimization?

Acoustic Doppler Current Profilers (ACDP), used for the Key West and Miami Harbor dredging projects to track currents

Fluorometry, used throughout the Florida Keys

Pipe collars for beach nourishment, used in the Midtown, Phipps, and Broward County beach nourishment projects

A multi-tiered turbidity standard for Key West

Dredging project, Broward County Beach Nourishment Project and the AES and Tractebel Calypso geotechnical borings and pipeline installation permits

Horizontal Directional Drilling (HDD), AT&T & Tycom Fiber Optic Cables (FOC), other known multiple FOC projects

The use of pre-determined reef gaps for linear project installation

- **Acoustic Doppler Current Profiler (ADCP)** Acoustic Doppler Current Profiler (ADCP) An Acoustic Doppler Current Profiler (ADCP) is a type of sonar that attempts to produce a record of water current velocities over a range of depths (Wikepedia, 2006). Used to determine direction and collect real time data of the turbidity plume during dredge operations in Key West and Miami Harbor dredge projects.
  a. Miami Ocean Dredged Material Disposal Sites: Management objectives: 1).Protection of the marine environment; 2) Beneficial use of dredged

material whenever practical; and 3)Documentation of disposal activities at the ODMDS (Guidelines for Dredged Material Disposal, 2006)

b. Turbidity baseline study in Biscayne Bay - Development of Guidelines For Dredged Material Disposal Based On Abiotic Determinants of Coral Reef Community Structure Three factors were determined to be important aspects of coral and coral community effects of exposure to suspended sediments; 1) intensity, 2) duration, and 3) frequency ADCP used to collect current and acoustic backscatter data (McArthur, et.al. 2002).

c. AES and Caplypso proposing to used in southeast Florida pipeline project

- **Fluorometry (dye)** (Used to track plumes and frac outs used in pipeline projects (Broward County, US Army Corp of Engineers (USCOE)
  - Not 100%
  - Delay (time) pump to fracture
  - Cleanup can be extensive; requires remote sensing
  - Material Safety Data Sheets (MSDS) for Wavelength Dispersal Spectrometry (WDS) are needed
  - Tracs bentonite frac out during drilling process
  - Able to monitor in real time; Chemical sensor monitor on boat senses dyes during process.

- **Pipe Collars**
  - Original use because pipe junction (had a "foot") small footprint
  - Track tires – larger footprint (tires deflate)
  - Rigid styrofoam – lots of unknowns (how long would it hold up?)
  - Pipeline stability – still question regarding how pipes hold up to storms and if anchoring is needed to prevent movement over hardbottom and reef. Storm contingency plan/Emergency plan must be put in place
  - Best management practices (BMP) must be implemented for pulling pipe

- **Baseline Turbidity Study**
  - Revised NTU concentration criteria for habitat analysis in Key West Harbor project. A 15 NTU standard was applied when the dredge was close to reef resources. If 15 NTU met – a retest protocol was initiated. Trend results from the re-testing used to determine if dredging operations could continue.
  - Based species/habitat specifically to coral reefs and included a qualifier for normal variations
  - Turbidity controlled at a localized level
  - Berm at disposal site used to guide material disposal
  - Quantity dredge material per amount of water

- Quality of material (fines)

- **Horizontal directional drilling**
  - Positioning can be very accurate
  - Well-educated regulators are imperative!
  - Training of staff both ways, agency ⇔contractors
  - Pulse amplitude modulation (PAM) fluorometry – Fluorescence analysis during operations to test photosynthesis in coral habitat
  - Mud releases possible within 100 feet of punch out
  - Best management practices for spoil containment

- **Floating Lines/Cables**
  - Prevent line and cable from dragging across corals, reef habitat and hardbottom.

- **Use of Cutter Head (**Oversize material is prevented from entering the pipeline of a suction dredge by grid placed across the draghead cutterhead)
  - Anchor in channel only
  - Shearing (functions relate fluid properties (shear stress) to sediment properties (shear resistance) shear resistance is approximated by; grain size, grain density, angle of repose (University of Rhode Island, 2006.)

- **Laser Airborne Depth Sounder (LADS)**
  - Identification of resources (3 counties, missing Martin)

- **Vessel Tracking**
  - Global positioning system (GPS) Devices
  - Real-Time telemetry- line of sight/dredge itself

- **Hawkeye/Global Positioning Systems (GPS) – United States Coast Guard (USCG)**
  - Track location of vessel movement at anchoring location

- **Pulse Amplitude Modulation (PAM) Fluorometry**
  - Light pulse shines on surface of coral polyps or sea grass leaf and measures fluorescence of chlorophyll as an estimate of photosynthesis
    - Interpretation requires data-intensive analysis
    - Expensive ($50,000) tool

- **Site-Specific Testing**
  - Education of project team (regulators, engineers, industry)
  - Cost sharing can be an issue

Question 3: What technologies have been proposed to improve and mitigate impacts from shoreline/beach stabilization, nourishment activities, and unpredicted equilibration of new beach nourishment equilibrium toe of fill?

- More precise mapping using LADS or LIDAR (Light Detection And Ranging) sytems
- By-passing – Mechanical method to captures sand on updrift side of inlet and moves material to downdrift beaches.
  a. Intercept – device or series of devices continuously or episodically moves material as it arrives.
  b. Storage – A deposition area is constructed to capture arriving sand and is periodically excavated. The sand is piped or transported to beaches. (Higgens Presentation, Appendix 3)
- Backpassing – Mechanical transport of sand from an accreted stable beach to an eroded beach. The sand is recycled back to eroded beach.
- Backpassing and Bypassing
  - Con: anti-property (owners who are against because they do not want “their” sand taken
  - Pro: wave impacts can be custom tailored (for back passing) so that material is not being lost
  - Pro: Can be cost effective is location of movement is in close proximity of each other.

Question 4: Have the proposed technologies mentioned above been tested on a small-scale or in special projects? What successes were achieved?

- **Glass Beaches**
  - Grain size can be customized
  - Need glass source and can be <u>very</u> expensive
  - Not fully tested (Broward County is currently testing a small glass beach)

- **Hybrid Solutions- perpendicular shore wave breaks**
  - Multi Purpose Reefs/Submerged breakwaters: Acts to reduce wave energy at the shoreline by breaking waves offshore. Re-aligns wave crests and/or spreads wave energy to reduce wave driven-currents. Promote multi use for diving, fishing, surfing and beach activities (Black Presentation, Appendix 3).
  - Accumulates sand beachward
  - Cost currently unknown
  - Need to be strategically placed according to natural functions; concerns are biological functions of the system
  - Longevity and hardiness of material unknown (e.g., limestone)
  - Possible collaboration: e.g., reef ball systems and bio-rock
  - Could be difficult in southeast Florida due to coral reef track.

- **Mitigation**
  - Alternatives to conventional mitigation processes (most recognized

multiple stressors)

- Water quality study done as a mitigation project, e.g., ways to prevent future events/impacts (radon beacons, alternative anchorages); tire removal/removal of previous technologies
- Creating nursery grounds for corals
- Reef Mitigation Gardens: Identify areas where natural rock is covered by a thin veneer of sand; hydraulically dredge area using a gentle suction-head; either a) construct a low-sill wall, or b) dredge a sacrificial buffer around the garden. Construct the reef garden and perform biological monitoring and maintenance (Dally Presentation, Appendix 3).
- Beach de-watering – Lowers the water table beneath the beach and reduces the fluid in the material. Sediment suspension is reduced in the squash zone (Woodruff Presentation Appendix 3)

Session 2 Consensus Report:

The group identified the following existing technological advances as the top five that offer alternatives to conventional mitigation to minimize or eliminate resource impacts during coastal construction activities. Conventional mitigation for marine resource impacts includes constructing artificial reefs with limerock and/or reefballs, seagrass transplantation and the filling of dredge holes to grade.

1. Non-conventional mitigation options, include:

Water quality improvements by retrofitting stormwater and discharge structures;

Removal or modification of existing structures or uses that cause direct impacts to the reef ecosystem, such as tire removal in Broward County;

Beacons for ships, and removal or modification of anchorages to prevent groundings and anchor damages;

Establish coral nurseries for lab-raised or "rescued corals; and

Not replacing avoidance with minimization.

The pros identified with non-conventional mitigation are: the cumulative benefits to the entire reef ecosystem; and defining the responsibilities (effectiveness and success) regarding the mitigation. The cons are quantifying the amount of mitigation that is necessary, lack of agency coordination (federal, state, and local), and regulatory limitations (laws, regulations and policy).

2. Tunneling/HDD/corridors

This technique facilitates the avoidance and minimization of direct impacts to reef resources by directing efforts under the resource and directly over and consolidation impact and/or infrastructure in one area. The cons are construction challenges (e.g., frac-outs-release of drilling lubricants and subsidence-sinking of land) and higher operating costs.

3. Integrating habitat characterization with management strategies

LADS/LIDAR – High-resolution bathymetric topographic survey tools exist for three of the four SEFCRI geographic area counties, Miami-Dade, Broward and Palm Beach (maps are needed for Martin County and protected species mapping and tracking. A scientific method is applied to mapping efforts and assists resource managers in identifying the locations of resources to improve avoidance, quantification of impacts and resource management. The challenges with these methods may include data completeness and accuracy/validation. Using existing technologies (e.g. USCG Hawkeye/Multifunctional Information Distribution System-Low Volume Terminal MIDS-LVTS/Global Positioning System-GPS) and the U.S Army Corp of Engineers Silent Inspector (an automated dredge monitoring system for impartial automated dredge monitoring – Bates Presentation, Appendix 3), also provide managers and enforcement with tools to protect and manage the resource.

4. Hybrid solutions-multiple technologies within 1 project:

By applying multiple technologies within a single project, project performance and resource protection may be maximized. For example, beach renourishment projects have known impacts to reef resources. By combining and utilizing techniques including sand compatibility, dune restoration, bypassing or backpassing, and perpendicular shore wave breaks (presented by invited speaker Dr. Kerry Black, ASR Limited) the need for future renourishment events due to sand loss would be greatly reduced. There are higher costs initially, but future maintenance costs would be lowered. Dr. Black discussed the importance of reducing wave energy at the shoreline by breaking waves offshore using submerged breakwaters. These submerged breakwaters not only protect the shoreline from erosion, but also "enhance coastal constructions by incorporation of the multiple use options of surfing, diving, recreational and commercial fishing, navigation and swimming safety." Offshore reefs serve as natural protective barriers by dissipating waves, which can destroy upland communities during storm events. Submerged breakwaters act as natural reefs by re-aligning wave crests and spread wave energy to reduce wave driven-currents.

5. Turbidity monitoring technologies.

Using technologies such as ADCP/acoustic backscatter, and fluorometry to monitor turbidity would assist in catching increased turbidity levels before a crisis occurs. Lowering regulatory limits of the turbidity measured as NTUs adjacent to reef resources would prevent resource damages during sediment displacement.

2.3 Session 3

Objectives:

Review emerging technologies for shoreline stabilization, erosion/beach stabilization and beach renourishment.

- Coastal engineering solutions

- Dredging and industry solutions

Identify opportunities for incorporation/implementation of advanced/innovative technologies in coastal and marine construction activities and infrastructure placement programs.

- Recommend criteria and components for appropriate/acceptable "pilot" renourishment projects designed to minimize impacts to coral reef resources (corals, hard/live bottom, reef resources).

<u>**Session 3A**</u>

Question 1: What technologies are emerging that will be used to stabilize shorelines and beaches, reduce erosion, or renourish beaches?

- Pressure Equalizing Modules (PEM) system (permeable drain tubes installed vertically into the beach to promote sand build up on beach) – EcoShore International is have success with test PEMs in Denmark (http://www.ecoshore.com)
- Multi-purpose reefs (see Session 2)
  -artificial underwater reefs for wave alteration and rotation
- Utilization of sand recycling back-passing by pipe (see Session 2)
  -works at the end of a sand cycle
- Finding alternative sand sources
  -national dredging committee
- Recycled glass beaches – Broward county testing crushed recycled glass for placement on eroding beaches.
- Utilize Concrete Mat plus Reef Ball combination
- Use of submerged structures to stabilize beach/shoreline
  - multi-purpose reef; growing reefs; wave break/modifiers
- Use of upland sand sources
  -more expensive, but could have better cost/benefit analysis
- Long term cost/benefit analysis
  -Construction considerations to increase stability
- Long Boat Key (sugar sand) mix/layering technique (Higher impact to sea turtles as a result of the required dredging methods).
- Directional jets on dredge head to blow sand on shore - Potential mediation activity
- Accelerated "Growing" of reefs to protect shoreline (Biorock)
- Utilization of innovative reef structures as shore protection (eco-reefs) and placement
- Utilization of modified construction (terraced beach)
  -profile-increased stability and turtle friendly

- Greater utilization of vegetation in beach/dune stability
- HDD/Tunneling under resources (See Section 2)
- Dredging time reduction minimizes environmental impacts
  -equipment improvement increase pumping capabilities
- Creation of defined pipeline corridors

Question 2: What opportunities are available to incorporate or implement these emerging technologies to solve coastal and marine construction challenges? Identify sites, problems to be addressed.

- Approach national dredging committee
- Shore protection as mitigation
- Greater implementation of sand bypass
- Dried clay (dredged spoil) placed in growth of organisms
- "Beneficial Use" (alternate sand source?) National Dredging Team
  -strategic hardening of shoreline- very limited applications
- Rock and geo-textile sandwich in land
  -reclamation area in Belize –stabilization
- Use/modification of jetties for sand bypassing
  -minimize accretion on one side of an inlet
- T-Head (attached headlands) groins to get wave rotation/circulation to minimize erosional impacts
- Involvement of dredging contractors- prior to permit..?
  -consult prior to work to determine better dredging practice (most site appropriate)
- Dredging Contractors of America (DCA) and Western Dredging Association's (WEDA) review/reference committee
  -i.e., BMPs for dredging industry –increased research and development
- Improved technologies for deep water borrow sites (sand removal)
- "key points" from regional sand budget as locations for potential pilot projects- site ID
- Port Everglades as potential location for alternative technologies
- Erosional "hot spots"
- Regulatory agencies; better understanding of dredge
  -equipment and borrow area design
  -criteria for borrow area identification
- Sand transfer at Port Everglades
- Lobby agencies to use alternative technologies and support pilot projects

Question 3: What factors might get in the way of implementing such technologies (e.g., cost, expertise, human resources)?

- More mechanisms (available programs) to promote pilot projects
- Better understanding of requirements to permit a pilot program;
  -federal experimental project program
  -state experimental project program
- Lack of access to reports/knowledge of what has already been tried
- Availability of resources for monitoring (money and people)

- Timing of funding, permitting, and monitoring
- Level of potential conflict of interest
- Public opinion-local concern various stakeholders
- Cost and cost sharing
- Promote modification/present method of cost benefit analysis
- Endangered species issues
- Ensuring appropriate regional sand
  -finding "key points" for bypassing or nourishment

Question 4: Which components of these technologies could be used to minimize impacts to coral reef resources?

- Balancing productivity of equipment with permitted design (borrow area)
- Can we use this technology with recent projects or pending projects?
  -seek opportunities to use these technologies
- Promote an expedited process for permitting pilot projects

Question 5: What criteria must be established during the planning phase that will minimize impacts during construction?

- Use of independent peer-reviewed monitoring design and construction
- Ensuring appropriate regional sand
  -finding "key points" for bypassing or nourishment
- Incorporate and emphasize detailed modeling of effects on shoreline, etc.
- Improved/Independent modeling
- Create BMPs for marine/coastal construction
- Realistic performance indicators for projects
- Monitoring plan that addresses performance
- Measures and indicators
- Inclusion of stakeholders in project development
- Proper project planning and management

Question 6: What kind of oversight/enforcement would be needed to verify that the established criteria were being met? What are reasonable solutions to oversight/enforcement?

- Use of independent peer-reviewed monitoring design and construction
- Level of potential conflict of interest
- Use of silent inspector technology
- Realistic performance indicators for projects
- Predetermined performance measures
- Independent oversight of QA/QC and independent modeling

Session 3A Consensus Report:

When asked to identify the top five actions and technologies that could reduce impacts to southeast Florida's coral reef resources during shoreline stabilization, beach renourishment, or other coastal construction activities, the group identified the following:

- Involvement of dredging industry early in permitting process/conditions and BMPs
  -involve DCAA and WEDA for representative review/resource group
- Use of submerged structures to stabilize shoreline and reduce need for nourishment
  -wave breaks/modifiers
  -multi-purpose/reef ball/bio-reefs/eco-reefs
- Sand bypassing/back-passing
  -fixed systems/dredging/trucking
- Alternate sand sources
  -upland/deep water/beneficial use/manufactured sand
  -Aragonite (foreign)
- Operational/technology improvements
  -minimization of dredging time
  -pump/slurring mods to allow pumping up slurry density
  -borrow area design/shape (dredge efficiency)
  -recycle "skim" water (use for drag arm jets)
  -utilization of "operational box", designated pipeline corridors, reef gaps, refined work areas
  -pushing rather than sucking sand

In particular the group noted that Dr. Harold Wanless, University of Miami, speaking on "Economically Wasteful and Environmentally Damaging Beach 'Renourishment'," presented research results showing the importance of selecting the proper grain size, durability, and hydrodynamic behavior of sediment for beaches in southeast Florida to reduce turbidity, siltation, and smothering of the nearshore coral and hardbottom communities. As stated in his abstract, "Historic and proposed renourishment sands derived from dredging on the adjacent shelf contain excessive amounts of fine sand and silt too small to remain on the beach, resulting in persistent long-term suspension-transport release to nearshore waters. Most shelf-derived renourishment sands contain much less durable carbonate skeletal material than the natural beach sands, when tested in a tumbling barrel designed to reproduce natural beach abrasion. In addition, carbonate skeletal grains display hydrodynamic behavior of grain sizes smaller than their sieve sizes when settled in a vertical accumulation tube. When used for renourishment, a higher percentage of these sands will not remain on the beach. Durability and wet settling analyses must be utilized in evaluating sediment for possible placement on a beach. Failure to use sand of proper size, behavior, and durability in beach-fill projects results in decreased project life and long-term degradation of the adjacent sandy and hardbottom communities and coral reefs."

Session 3B

Question 1: What technologies are emerging that will be used to stabilize shorelines and beaches, reduce erosion, or renourish beaches? Name technology, state which problem it addresses.

- The following listed items are primary concerns and issues that are contributing to continuous erosion along the Southeast Florida coast.

a. Stabilized inlets with no sand bypassing
b. Storm events-wind, water, and wave activity
c. Sea level rise
d. Gulf Stream currents (near-shore currents)
e. Coastal construction/development near or on the shoreline
f. Small/none/loss of dune system-sand, vegetation
g. Land-based runoff (storm water, outfall pipes)
h. Erosion control structures and shoreline armoring-poorly planned

- Technologies
  - Review Coastal Construction Line (CCL) locations – evaluate the feasibility of relocating the CCL to stop future development immediately on the coast/beach
  - Retreat from shoreline
    -land use policy
    -require larger local setbacks so that development is moved further away from the coast/beach
  - Dune management- vegetative berms for stabilization
  - Breakwater structures- in water or emergent. Breakwater structures will eliminate wave velocity and also create softer wave activity on the beach sand
  - Groin fields - allow sand to be collected or trapped in between the groins, thereby building the beach. Although longshore transport is interrupted by groins, the field aides in building the beach when longshore transport occurs in one direction.
  - Sand bypassing/back-passing (permanent vs. temporary)
    -sand trap (constant storage of sand is created on the updrift side. By transporting this sand to the downdrift side will help to maintain the flow of littoral drift.)
    -intercept
  - Dredging and fill - addresses an immediate problem of beach erosion by replenishing sand on the beach.
  - Retrofit drainage structures (storm water draining from street ends)- may slow beach erosion down in certain areas by minimizing runoff that washes sand off of the beach.
  - Use more compatible sand to create a more stabile beach and increased compaction of sand grains. Mo compatible sand will increase the life of a newly nourished beach.
  - Low turbidity dredging practices will reduce smothering of nearshore reef habitats.
  - Tagging sediments; muds/sands (tracers-like fluorescent dyes)

Question 2: What opportunities are available to incorporate or implement these emerging technologies to solve coastal and marine construction challenges?

- Implement dune management, sand bypassing, and using more compatible sand first with nourishment as an option
- Create habitat effective habitat

-developing new/efficient technology
-driven by cost and availability

- Public sensitivity to coastal construction issues is getting stronger- more new technologies (improved) are being explored
- Project design/modeling to include dunes
- Testing for compaction improved measurement device
- Examine recycled glass as an alternative sand source
- Change wave alignment by changing reef alignment (deal with the cause not the effect, i.e., South Hollywood submerged reefs hot spot)
- Retrofit storm water drains/outfalls to fix problem of washing sand off beaches
- More frequent beach sampling to better understand natural recovery processes
- Utilize best available science and technology to better understand physical and biological processes, to help supplement natural processes
- Use wave gauges to measure near-shore waves for improved modeling
- More frequent LIDAR surveys (3-meter resolution)
- Improve remote sensing/satellite technology

Question 3: What factors might get in the way of implementing such technologies (e.g., cost, expertise, human resources)?

- Limited financial resources
- Lack of regional standardization in data collection
- Lack of independent peer review of studies
- Competing interest/user groups/stakeholders
- Private property rights/tax payer equity
- Lack of public education and awareness of environmental values and impacts
- Reluctance to experiment on new technologies that may not perform well (budget issues)
- Bureaucratic issues/setbacks
  -lack of government coordination at all levels on engineering and biological impacts
- Lag in scientific information being available for use and actually being applied
- Translation of scientific information to non-scientific audiences
- Lack of technical and scientific expertise at local government and other levels of government
- Lack of scientific community involvement and input
- Inaccurate information
- Lack of cooperation by all parties

Question 4: Which components of these technologies could be used to minimize impacts to coral reef resources?

- Sand bypass
- Examine changing wave refraction

- Dune vegetation
- Retrofit or eliminate Outfalls from land

Question 5: What criteria must be established during the planning phase that will minimize impacts during construction?

- Sediment compatibility
- Comprehensive monitoring plan and appropriate monitoring design
- Sequencing: avoidance, minimize, mitigate
- Implement BMPs as part of early planning (dune management, sand bypassing, and using more compatible sand)
- Examine secondary and cumulative impacts, social and environmental
- Project need/economics of project: cost/benefit analysis
- Look at alternatives
- Thresholds for halting/modifying projects, e.g., sedimentation coral response
- Consideration of all user groups:
- Maximize durability through project design

Question 6: What kind of oversight/enforcement would be needed to verify that the established criteria were being met? What are reasonable solutions to oversight/enforcement?

- More strict monitoring of BMPs for borrow sites and fill areas (monitoring)
- Independent peer review of monitoring and conclusions methodology
- Pre, during, post construction (relative) analysis
- Using third-party inspectors to enforce BMP criteria
- Compulsory stakeholder consultations
  -possibly every three months
  - (NGOs, citizen activists, etc.)
- Open access to all reporting and data (electronic)
- More effective regulatory enforcement

Question 7: Regional bypass strategies?

- Reevaluate engineering at existing bypass plants to maximize quantities. The following is a table that lists the Florida Inlets located on the east coast, their jurisdiction, and if bypassing is present:

Inlets	Jurisdiction	Bypassing?
St. Mary's year	Federal	yes-$500K/2
Nassau Sound passing	Federal	yes-back-
Ft George (St.John's)	Federal	rare

St. Augustine (Mayport)	Federal	use ebb-shoal
Matanzas years	Federal	yes-every 3
Ponce	Federal	no
Cape Canaveral	Federal	yes
Sebastian	Tax District	yes
Ft. Pierce	Federal	no
St. Lucie	Federal	yes
Jupiter	Tax District	yes
Lake Worth	Federal	yes
Boynton	County	yes
Boca	City	yes
Hillsborough	Tax District	yes
Port Everglades the USACE there is not a hard plant, but sand has been moved from the port everglades channel and placed on Broward county beaches in Nov 2005 by dredge. USACE has an Environmental Assessment (EA) for placement of sand from the Navigation Channel onto Broward Beaches)	Federal	no (According
Haulover	Federal	yes

- <u>Types of bypassing/sand movement</u>   <u>Improvement Potential</u>
  Hopper Channel   Fixed plant
  Dredge Creek   Fixed plant
  Channel maintenance
  Dredge Shoal
  Channel maintenance same on beach
  Mine North Beach
  Interior trap
  Channel trap
  Channel/trap
  Fixed plant/channel maintenance/basin
  Basin/channel
  Basin
  Ebb/flood shoals

- Corp needs the authorization to bypass for shore protection (Authorization exists in some cases, but funding is needed)
- Update State strategic beach management plan- implement
- Consider all bypassing options (technology)
- Non-traditional partnerships for funding

Session 3B Consensus Report:

The five most important technologies for shoreline stabilization that were identified by this group as being potentially the most beneficial to nearshore coral and hardbottom habitats were:

a. BMPs to be investigated/implemented where possible
b. Sand bypassing-strategic regional initiative
c. Multi-purpose reefs
d. Beach vegetation/dunes (where appropriate)
e. Highest possible sand quality

One of the workshop speakers, Steve Higgins, Broward County Environmental Protection Department, presented the benefits of sand backpassing at Port Everglades, Broward County, on navigation, beach management and the environment. By using the backpassing method the demand for remote sand sources would be reduced and the potential for reef impacts from dredging would be eliminated or reduced by introducing the flow of natural sand back into the system,

In October of 1988, Coastal Technology Corporation conducted a Port Everglades Sand Bypassing Study for the Broward County Erosion Prevention District as part of a settlement agreement between the American Littoral Society and the Broward County Environmental Quality Control Board to explore the justification for constructing a sand bypassing system at the Port Everglades Inlet. Six alternatives were researched including beach renourishment. The most cost-effective method established was the construction of an efficient jet pump bypassing system in combination with dune restoration. In the study it is stated that, "These alternatives will preclude the need for future renourishment projects of the magnitude proposed for the 1988-1989 project. The John U. Lloyd beach may be maintained with beach renourishment on a 15-year cycle using only 25 percent of the fill proposed for the1988-1989 project. Alternatively, dune restoration would preclude the need for beach renourishment" (Coastal Tech, 1988). The group identified a bypassing unit at Port Everglades that is under Federal jurisdiction (see chart above), but is not currently operating. In November 2005 the USACE removed sand by dredge from the entrance channel at Port Everglades and placed it on beaches downdrift of the port. There Corp has an Environmental Assessment to continue this practice for the next ten years.

2.4 Session 4

Objective:

For the purpose of protection of coral reefs, hard/live bottoms and associated reef resources review permit conditions, study designs, and criteria for mitigation in innovative or advanced coastal construction activities.

- Discuss and propose reasonable or 'standard' permit condition modifications that could advance utilization of emerging technologies for coastal and marine construction activities

- Review criteria for mitigation associated with coastal construction activities, infrastructure installation, beach renourishment, dredging and groundings

- Identify and recommend study designs to monitor projects and mitigation associated with innovative/advanced coastal activities

Question 1: What modifications to permit conditions, if any, are necessary to advance the use of emerging technologies that would protect reefs during coastal and marine construction?

- Real-time monitoring
  -Acoustic Current Doppler Current Profiling, needs calibration but provides information on sedimentation and turbidity issues (NOAA- Dr. Proni's research)
- Ops-alarm systems placed on hopper dredges
  -if drag arms move outside boundaries- alarm sounds based on computer thresholds. Alarms for placement of drag-arms, etc.
- Implement soft and hard coral health triggers
  -require dredge to shut down and move to another location
  -polyp extension
  -Bleaching percentage, mucus production, plus 15 additional parameters
  -i.e., coral stress index
  -periodic histological exams of coral tissue from similar area used to verify field observations (costs $36,000/month)
- Alternative mitigation options – such as retrofit of beach discharge as mitigation (i.e., pool pumps, storm water, air conditioning)
- Turbidity and sedimentation monitoring difficulties in finding plume, etc., cost
- Experimentally develop turbidity monitoring that is appropriate
  -Goldberg used for Navy dredging, e.g. 15 NTU (soft trigger)
- Implement resource turbidity thresholds
- Project specific monitoring conditions
  -pre-project baselines and data (historic and existing), background and appropriate place/time
  -applicant awareness of these requirements
- Permit Special Condition stating that construction can't begin until monitoring data has been examined in pre-project phase, then construction methodology can be determined with contractor
  -water quality plus key resources (i.e. hard bottom, essential fish habitat)
  - Impose importance of analysis and issues of historic data?
- Require BACI design on all coastal projects
- Tracking of all vessels operating in project
- All cables/lines be floating, use of buoys
- Use of ROVs/AUVs with onboard instruments and meters
  -fluorometers- track submerged aquatic vegetation (SAV), algae, chlorophyll. Track bleaching.
- Ocean observing systems

- Pre-during-post construction meetings to discuss staff and lessons learned and train/educate contractors on environmental resources- these lessons learned from each project evolve into written BMPs
- Ability to reject insufficient application requests at the regulatory level
- Develop a system to gather all the baseline and monitoring data into one system to develop a long term data set for monitoring and use.

Question 2: What rule changes might be required to ensure that coral reefs, hard/live bottoms and associated coral reef resources are protected during these activities?

- Rule changes for new language that's more specific beyond "reasonable" assurances
  -Non-traditional partnership for implementation between state agencies; need rule revision for particular taxation
- Need statewide standards, need more stringent and specific protections
- Rule changes to incorporate more stringent protections for water quality
- Enforce state regulations on discharge prohibitions across the beach and develop county level prohibitions
- Ability to regulate research as part of permit/mitigation
  -required to use MICCI database if implemented
  -standards of literature review
- Restore and recognize environmental conditions necessary for coral recruitment and health
- Allow out-of-kind mitigation to improve water quality
- Beach re-nourishment should require National Pollutant Discharge Elimination System (NPDES) permit
- Cumulative impacts from sand placement over time
- More stringent regulations on grain size requirements during construction
  -publications coming soon
- More stringent criteria for evaluating borrow areas
- Research impacts associated with chronic turbidity (data needed)
- Establish monitoring standards and protocols
- Environmental impact statements (EIS) and environmental assessments (EA) need more comprehensive cumulative impact analysis
- Redesign fill templates for better equilibration
- Mitigation needs to replace ecological functions
- Need mechanism for addressing over and under mitigation
- Need to confirm that actual mitigation satisfies requirements by functional assessment
- Need to mitigate for chronic turbidity (How?)
- Need consistent success criteria- would be hard to incorporate into rule
- Unified Mitigation Assessment Method (UMAM), State Rule 62-345, re-evaluate for appropriateness as applied to near-shore habitat and submerged aquatic vegetation
- Do not violate statistical "rules" or principles

Question 3: What criteria should be established for mitigation of coral reefs affected by coastal construction, infrastructure installation, beach renourishment, dredging, or groundings? Identify the activity, its impact on reef resources, and how the criteria will protect the reef.

- Avoid- regional sand bypass suggestion
- Good information and data assessment prior to project approval
  -SEFCRI has ongoing LIDAR, inventory, etc.
- Clear demarcation of resources with physical barriers used during construction (buoys, etc.). This method will better delineate the reef edge within a working area and keep the contractor informed at all times.
- Oversight by local sponsor
- U.S. Coast Guard (USCG) Anchoring Restrictions (and minimum)
- Beach 'footprint' tapered to avoid resources appropriate and least impacting design and equipment
- Early coordination with agencies in planning and design phases (permittee cost sharing for meetings, etc.)
- Compiling data for availability to reduce duplication of efforts
  -Synthesize data (SEFCRI Maritime Industry and Coastal Construction Impacts (MICCI) Project 11 would potentially address this)
  -funding needs to be available for updating and continuation

Mitigation

- Storm water retrofits
  - -offsets water quality impacts and provides overall benefits to system
- Rebuilding impacted reefs with limestone/structure for reef restoration
  - -groundings (at impact site) use modules for relief and restoring framework
- Feasibility studies (funding), relocation of anchorages, etc.
  - -find solutions to current problems
- Studying coral nurseries (implementing)
- Research as part of mitigation. Add to common database! Can permittee fund other restoration projects?
  - -minimum use of existing literature
- Outreach to academia regarding need for research coordination
  - -meet resource manager's need
- Gray water and storm water outfalls need state lead due to water quality
- Concurrent ecological improvements along with physical restoration to allow for recovery- Ecosystem Approach

Question 4: Can monitoring programs track the success or identify failures of new technologies in relation to protection of reef resources?

YES – If some of the following occur:

- Regulatory agencies require more stringent monitoring programs (see Question 2)

- Pre and post construction controlled investigations (BACI, Peterson Presentation, Appendix 3)
- Peer review (independent)
- Scientific/statistically sound studies
- Replication, spatial/temporal study component
- Minimum sample size, pre-post impact controls
- Contingency plans for acceptability
- Develop acceptable standards for monitoring programs
  -publication of success stories
- Set data collection standards and have data publicly available for independent analysis review
- Independent scientific advisory panel for complex projects used by regulatory agencies for advice oversight committee

Examples for successful monitoring:

- Mangroves (elevation sensitivity)
- Submerge aquatic vegetation (SAV)
- Monitoring for impact-salvaged corals that go from nursery => ocean/reef showing preliminary success

Question 5: Which factors must be considered in the design of a monitoring program for a particular site?

- Identification of project type
- Identification of dominant resources at project site. (e.g., SAV, fish, coral, etc.)
- Determine threshold for acceptable level of impact
- Tolerance for error in predicted impacts
- Consider available research/literature for similar projects
- For coral and SAV; turbidity, sedimentation, live-bottoms
- Reduce number of dredge projects (alternative = sand bypass)
- Need long-term data on cumulative ecosystem impacts from beach nourishment (should be cost effective) e.g., chronic turbidity
- For SAV measure incident light (e.g., Panama City USACE project)
- Who is accountable for data collection and analysis
  -credentials
- Identification of monitoring techniques and appropriate methodology based on habitat types (e.g., transects)
- Establish time frames and reporting requirements
- Monitor winds, waves, and currents in beach nourishment projects
  -use available data – if not available gather baseline data
- Duration and frequency of sampling
- For coral reefs, data on abundance and diversity pre- and post-construction
  -water temperature and photos

Question 6: Which monitoring methods or techniques provide data to answer the question of what reef impacts are occurring before impacts are visible?

- Evaluate impacts associated with previous beach nourishment projects in Florida (i.e., cumulative impacts) to design the project's monitoring plan
- Biomarkers and histopathology of corals (e.g., SEFCRI Land Based Sources of Pollution (LBSP) project in Broward County)
- Epidemiology to identify coral stressors
- Measure turbidity and sedimentation
- Take tissue samples (analyze)

Question 7: What should be done with the data that are collected and who is responsible for reporting problems to the parties involved in the project (regulated vs. regulator)?

Data should be delivered by risk of activity, (i.e., high risk activities need almost immediate data transmitted to agency/other via FTP, email, etc.) when established directly to one place

- Electronically compiled in one place (MICCI Project 11) -compendium/clearing house
- Review of all past data prior to new monitoring data
- Both analysis and practical application to "Lessons Learned"- post-project team (summary documentation, e.g. Key West Dredge Project)
- Adaptive management of monitoring efforts
- Create a long-term record of lessons learned (living document) for continuity of institutional knowledge
- QA/QC of data conducted by the regulators with help from peer-review team. Regulators need to reporting problems and track the permittees response
- regular communication between all groups is essential

Session 4 Consensus Report:

The group was asked to identify the top issues the members had discussed for protecting nearshore coral reef resources during coastal construction activities through changes in permitting, operating rules, monitoring programs, and data collection efforts. The most important issues identified were:

a. Hypothesis-driven monitoring that is time sensitive, adaptive, plus has good statistical and experimental design
    i. Empirically derived project-specific thresholds
b. Real-time monitoring and ops alarm systems (required in permit conditions to avoid damage)
    i. Special alarms on all moving parts with potential to impact corals (spuds, drag arms)
c. Mitigation reform: result in rule changes
    i. Allow out-of-kind, out-of-box in rule (research, water quality, etc.)
    ii. Re-evaluate UMAM
    iii. Define reasonable assurance in rule
    iv. Define cumulative impacts in rule

d. MICCI Team Project 11 (one- stop place for data, permitting review) Data => Info
e. Pre-during-post construction meetings to discuss staff and lessons learned and train/educate contractors on environmental resources- these lessons learned from each project evolve into written BMPs
f. Require coral-stress monitoring with thresholds and shutdown provisions adequate to protect resource before physical and macro-level manifestations of impacts occur that are based on histopathological and biochemical studies of field sampled corals or other (surrogate) organisms.

Paden Woodruff, Florida Department of Environmental Protection, Office of Beaches and Coastal, presented the Department responsibilities as follows: The Department has a responsibility to evaluate new and innovative technologies developed to protect and restore the sandy beach resources of the state. The Department also has the authorization to sponsor or cosponsor demonstration projects of technologies, which have the potential to reduce project costs, conserve beach quality sand, extend the life of beach nourishment projects, and improve inlet sand bypassing pursuant to section 161.091, Florida Statutes. It is the Department's philosophy to encourage the application of technologies that are based on sound engineering and scientific principles and have been favorably peer reviewed or scientifically documented (Paden Woodruff, Abstract, May 2006 SEFCRI Workshop Presentation).

3. WORKSHOP RECOMMENDATIONS

Participants found consensus on many of the issues associated with coastal construction activities as each group identified similar concerns and ways to reduce damage to coral reef resources. Participants agreed that current practices can result in adverse water quality changes, physical damage to stationary benthic organisms like corals, gorgonians, and seagrasses; increased release of suspended sediments that fill or bury reef topography and contribute to turbidity; and direct or indirect nearshore habitat loss, from the dunes to the subtidal shelf waters. The practices that were of most concern were dredging and blasting, used in construction of harbors, canals, and beaches; development on shorelines, including roads and high-rise buildings with inadequate consideration of storm water and air conditioning discharges and shading effects; the continuing beach nourishment and renourishment requirements for southeast Florida; and placement of pipes and cables directly on and through reef resources.

Participants overall felt that the alternative of avoiding construction along southeast Florida shorelines should be considered whenever possible. If construction were required that would alter shorelines and could potentially affect the integrity of nearshore benthic communities, they made the following recommendations, which are not presented in a particular order. Rather, to the extent possible, most or all should be considered and implemented as appropriate to achieve maximum benefit to the southeast Florida reefs and other coastal habitats.

Activities or actions that can effectively protect coral reefs, hard/live bottoms, and associated coral reef resources:

Water quality improvements by retrofitting stormwater and discharge structures along developed shorelines

Removal or modification of existing structures or uses that cause direct impacts to the reef ecosystem, such as tire removal in Broward County

Beacons for ships, and removal or modification of anchorages to prevent and minimize goundings and anchor damages

Establishing coral nurseries for lab-raised or "rescued corals

Integrating habitat characterization with management strategies

Innovative technologies that minimize or eliminate impacts to reef communities:

Tunneling/HDD/corridors

LADS/LIDAR to identify locations of resources to improve avoidance, quantify impacts and manage resources.

ADCP/acoustic backscatter, and fluorometry to monitor turbidity or sedimentation would assist in catching increased turbidity or sedimentation levels before a problem develops during project implementation

USGS Hawkeye/LVTS/GPS) and the U.S Army Corp of Engineers Silent Inspector also provide managers and enforcement with tools to protect and manage the resource

Real-time monitoring and operations alarm systems (required in permit conditions to avoid damage)

Advanced and/or emerging technologies for regional beach nourishment, erosion control, inlet management and infrastructure placement programs:

Submerged structures such as wave breaks, multipurpose reefs to stabilize shoreline and reduce need for nourishment

Sand bypassing/back-passing

Alternate sand sources

Minimization of dredging time and implementation of other technological advances (e.g., modifications to allow pumping up slurry density or pushing sand, changes in borrow area design to improve dredge efficiency, recycling "skim" water, designated pipeline corridors in reef gaps and refined work areas)

Applying hybrid solutions-multiple advanced technologies in a single project

Study designs to monitor projects and mitigation associated with coastal construction activities, infrastructure installation, beach renourishment, dredging, and groundings should:

Be hypothesis-driven

Be based on review of past data collection efforts

Be time sensitive (especially real-time, during the activity)

Incorporate adaptive management strategies
Have good statistical and experimental design, BACI

Include measurements of multiple parameters to address spatial, temporal, water quality, and organismal changes

Provide data to develop sensitive organism sublethal stress thresholds and parameter levels above which the activity will be shutdown to reduce impacts

Set data collection standards to be met for acceptability (e.g., precision, accuracy, completeness)

Monitoring program and design should be peer-reviewed before monitoring begins

Have data validated during the project by regulators and peer-review team

Include a plan to submit data based on risk associated with the activity to appropriate archives, such as to the overseeing regulatory agency (for high risk, immediate data review to determine whether parameter levels are exceeded and action must be taken to reduce risk to marine organisms) or the proposed electronic compendium of coastal construction data (MICCI Team Project 11) for long-term use

Ensure regular communication between all groups

Potential rule changes and or 'standard' permit conditions that could advance utilization of emerging technologies for coastal and marine construction activities while maintaining protection of coral reefs, hard/live bottoms and associated coral reef resources:

Require involvement of dredging or construction industry early in the permitting process and review pre-project monitoring data to determine, with a dredging contractor or their industry representative (DCA/WEDA), the most appropriate methods and equipment to use for each project and site

Require pre-during-post construction meetings to educate contractors on environmental resources and discuss lessons learned throughout the project

Specify BMPs for the different types of operations

Require alarm systems for operations

Implement statewide or, if more appropriate, site-specific turbidity, sedimentation, and other thresholds to protect coral reef or hardbottom resources (based on experimental research on health and recruitment)

Require real-time tracking, at frequent intervals, of all vessels operating within the project area

Require floating lines and cables

Enforce state regulations on discharge prohibitions across the beach and develop county level prohibitions

Implement more stringent criteria for evaluating borrow areas

Environmental impact statements (EIS) and environmental assessments (EAs) need more comprehensive cumulative impact analysis

Mitigation must be appropriate and ecological functions assessed to ensure requirements met

References

Army Corps of Engineers. Website accessed September 2006. http://chl.erdc.usace.army.mil

Coastal Technology Corporation. October 1988. Sand Bypassing Study for Broward County Erosion Prevention District.

EcoShore International. Website accessed September 2006. http://www.ecoshore.com

Global Coral Reef Alliance. Website accessed September 2006. http://www.globalcoral.org

Johns, Grace, M., Vernon R. Leeworthy, Frederick W. Bell, and Mark A. Bonn. 2003. Socioeconomic study of reefs in southeast Florida: Final Report. Hazen and Sawyer, Florida State University and National Oceanographic and Atmospheric Administration.

McArthur, Christopher, R.Ferry, J. Proni. 2002. Development of Guidelines for Dredged Material Disposal Based on Abiotic Determinants of Coral Reef Community Structure. Dredging '02 Proceedings of the Third Specialty Conference on Dredging and Dredged Material Disposal Coasts, Oceans, Ports, and Rivers Institute (COPRI) of ASCE May 5, 2002, Orlando, FL USA. Website: http://www.epa.gov/region4/water/oceans/documents/Miami

NOAA Coastal Services Center. Website accessed September 2006. http://www3.csc.noaa.gov/beachnourishment/html/geo/shorelin.htm

NOAA National Marine Fisheries Service – Habitat Conservation Division website. September 2006. Florida Dock and Pier Guidelines. http://sero.nmfs.noaa.gov/dhc/habitat/pnc/dockhome.htm

State of Florida Department of Natural Resources. March 1986. A Proposed Comprehensive Beach Management Program for the State of Florida.

U.S. Environmental Protection Agency. Website accessed August 2006. http://www.epa.gov/region4/water/oceans/sites.htm

Wikipedia. Website accessed August 2006. http://en.wikipedia.org/

University of Rhode Island. Website accessed. September 2006. Powerpoint Presentation. http://www.oce.uri.edu/oce582/oce582_coastal.pdf#search=%22what%20is%20a%20cutterhead%20dredge%20shear%22