

General Comments on Coastal Armoring Using Geotextile Tube Technology and its Impact on Sea Turtles and their Habitat

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In 2004 and 2005 seven hurricanes slammed into the Florida coast, causing massive erosion along the state's beaches. This erosion significantly affected the Archie Carr National Wildlife Refuge, an area that attracts more nesting loggerhead turtles, a threatened species, than virtually anyplace else on Earth and more nesting green turtles, an endangered species, than any other place in the continental United States. The federal and state systems responded swiftly to beach erosion, authorizing funding for the largest beach and dune restoration project in the state's history. At the same time private landowners, their property threatened by the forces of nature, sought emergency "temporary" coastal armoring authorization from local governments.¹ In addition to traditional seawalls and revetments, private individuals sought permits to introduce geotextile tube technology into the mix of armoring options. Geotextile tubes are plastic sand filled structures that are buried beneath the active beach, substantially closer to the mean high

¹ Under Florida law, local governments have independent authority to issue temporary armoring permits. FLA. STAT. § 161.085(3) (2004); FLA. ADMIN. CODE r. 62B-33.0051(5). Temporary permits are valid for sixty days, during which time the temporary permit holder must submit a complete application for a permanent permit. FLA. ADMIN. CODE r. 62B-33.0051(5)(g). Research undertaken for this report failed to uncover a single instance in which a "temporary structure" had been denied a permanent permit and had been removed. This tends to indicate that the "emergency" permits have in some instances become virtually an alternate means of securing a permit to construct armoring. In addition, so-called temporary structures are often the same structures that are installed for permanent use. For example, steel sheet piling may be driven in as "temporary" armoring and not capped with concrete to make it permanent until issuance of a permanent permit. Geotextile tubes also do not seem very "temporary" when one views photos of the amount of work required for their installation., there is little to distinguish a temporary structure from a permanent structure.

water line than other traditional coastal armoring structures.² However, until recently, the Florida Department of Environmental Protection (DEP) discouraged technologies other than traditional seawalls, based in part on the premise that vertical seawalls directly affect less of the active sand beach than sloped structures.³ In the spring of 2005 this policy changed. Under the threat of legislation,⁴ DEP initiated rulemaking to modify the policy to remove guidelines that favored vertical walls over geotextile tubes built further out onto the active beach.⁵ Nothing in DEP's rule development indicated that it had developed data to suggest a change in the prior policy favoring vertical seawalls. In response to the pending permits, and proposed rulemaking, the University of Florida Conservation Clinic began working with the Caribbean Conservation Corporation (CCC), a sea turtle advocacy organization, to examine the legal and scientific issues surrounding geotextile tube technology, and provide comments to DEP and other regulatory agencies. Formal comments were submitted at a DEP rulemaking workshop on May 6, 2005.⁶ These comments were restricted to the operational aspects of the rule, including the need for enhanced monitoring, financial assurances and provisions binding subsequent owners of property with buried tubes. On June 6, 2005, DEP adopted its proposed rule, disregarding CCC and Clinic comments.⁷

The comments below include the substance of those submitted to DEP, as well as more far-reaching comments on the impact of geotextile and other coastal armoring on the beach-dune

² SURFRIDER FOUNDATION: TEXAS CHAPTER, GEOTEXTILE TUBES: A POSITION PAPER FROM THE TEXAS CHAPTER OF THE SURFRIDER FOUNDATION, (October 19, 2005) *available at* <http://www.surfrider.org/texas/issues/geotextile-tubes/>.

³ FLA. ADMIN CODE r. 62B-33.0051(2)(b)(1) (2004).

⁴ S.RES. 796 2005 LEG. (Fla. 2005).

⁵ NOTICE OF PROPOSED RULE DEVELOPMENT, (April 22, 2005) *available at* <http://tlhora6.dep.state.fl.us/onw/publications/5-PRD62B33-4-22-05-INT.pdf>.

⁶ These comments appear on the public record for the meeting held pursuant to the NOTICE OF PROPOSED RULE DEVELOPMENT (April 22, 2005) *available at* <http://tlhora6.dep.state.fl.us/onw/publications/5-PRD62B33-4-22-05-INT.pdf>.

⁷ *Compare* FLA. ADMIN. CODE r. 62B-33.0051(2)(b)(7) (2005) *with* NOTICE OF PROPOSED RULE DEVELOPMENT (April 22, 2005) *available at* <http://tlhora6.dep.state.fl.us/onw/publications/5-PRD62B33-4-22-05-INT.pdf>.

system and sea turtle habitat. They remain relevant to current and future efforts to install geotextile tubes on Florida beaches.

I. Sea Turtle Take

Several species of sea turtles nest in large numbers on eroding beaches where geotextile tubes might be installed for coastal armoring.⁸ Geotextile tubes may cause a take of sea turtles if its placement on the beach significantly impairs nesting behavior or nesting success.

The federal government and the State of Florida prohibit the take of any sea turtle.⁹ Under the Endangered Species Act and Florida law, a “take” occurs when turtles are killed or injured as a result of a “significant habitat modification or degradation” that impairs their “essential behavior patterns such as breeding, feeding, or sheltering.”¹⁰ The ESA prohibits the unauthorized take of federally listed species. If proposed armoring will likely cause a take of an endangered sea turtle, an applicant must obtain authorization for take from the United States Fish and Wildlife Service (FWS).¹¹ The Secretary of FWS may issue an Incidental Take Permit (ITP) if the take is found to be incidental to an otherwise lawful activity.¹² The ITP applicant must submit a Habitat Conservation Plan (HCP) that ensures that the applicant will minimize and mitigate any anticipated effects of the authorized take, that adequate funding exists for the proposed minimization or mitigation plan, and that the take will not appreciably reduce the likelihood of survival and recovery of the species in the wild.¹³ Under Florida’s Marine Turtle Protection Act (MTPA), DEP may only issue permits for any activity that affects sea turtles or

⁸ U.S. FISH AND WILDLIFE SERVICE, SEA TURTLE INFORMATION, (Feb. 16, 2005), *available at* <http://northflorida.fws.gov/SeaTurtles/seaturtle-info.htm>.

⁹ 16 U.S.C. § 1538 (a)(1)(B) (2004); FLA. STAT. § 370.12 (1)(d)(2) (2004).

¹⁰ FLA. STAT. § 370.12 (1)(c)(2) (2004); *See also* 16 USC § 1532 (19); *See generally* Babbitt v. Sweet Home Chapter of Communities for a Great Oregon, 515 U.S. 687 (1995).

¹¹ FLA. STAT. § 370.12 (1)(d)(3) (2004).

¹² 16 U.S.C. § 1539(a)(1)(B), FLA. STAT. § 370.12(1)(f) (2004).

¹³ 16 U.S.C. § 1539 (a)(2)(B) (2004).

their nests or habitat subject to the conditions and requirements for sea turtle protection.¹⁴ DEP must recommend denial of a permit if a proposed activity would result in a take, unless the take is determined to be incidental under the Federal Endangered Species Act.¹⁵ Thus, the permitting of subsurface sand-filled geotextile containers should only occur when it is demonstrated that no unauthorized take of marine turtles or marine turtle habitat will occur.¹⁶

The DEP and the Army Corps of Engineers (ACOE) have proposed terms and conditions for the permitting of geotextile armoring. The FWS has proposed similar terms and conditions for any geotextile sloped armoring that may be included by amendment to an existing regional HCP developed by Indian River County for anticipated take resulting from the emergency authorization of coastal armoring by the county.¹⁷ However, neither the conditions set forth in the armoring permit by DEP, the ACOE, nor Indian River County's existing HCP amendment consider the full range of impacts of geotextile armoring.

The effects of geotextile tubes on sea turtle nesting and sea turtle nest viability have not been fully studied. Concerns have been raised that the installation of sloped geotextile coastal armoring may inhibit nesting due to an increase in the slope of the back beach area. Changes in dune profile are known to affect sea turtle nesting behavior. Other possible problems include the possibility that the plastics associated with the geotextile tubes could diminish the viability of sea turtle eggs and hatchlings due to the effects of plasticizers from the geotextile fabric, and impacts

¹⁴ FLA. STAT. § 370.12(1)(f) (2004).

¹⁵ FLA. STAT. § 370.12(1)(g) (2004).

¹⁶ FLA. ADMIN CODE r. 62B-33.0051(2)(b)(7).

¹⁷ Ten days following a storm event, a beach front owner may petition Indian River County to install temporary coastal armoring in critically eroding areas of Indian River County. The armoring must meet certain siting and design requirements and be readily removed at the end of 60 days after the emergency permit has been issued. The beach front property owner may then apply for permanent coastal armoring protection through the DEP. If the proposed emergency armoring is not in one of the designated critically eroding areas, then the property owner must petition to amend the HCP. INDIAN RIVER COUNTY PUBLIC WORKS DEPARTMENT, HABITAT CONSERVATION PLAN, A PLAN FOR PROTECTION OF SEA TURTLES ON ERODING BEACHES IN INDIAN RIVER COUNTY, FLORIDA. available at http://www.ircgov.com/Departments/Public_Works/Coastal_Engineering_Section/HCP.pdf.

resulting from changes in the moisture level of the sea turtle nest, and other detrimental impacts to nesting habitat.

A. Uncertainties Related to Geotextile Tubes

There are currently no independent, long-term studies of geotextile tubes and their stability in a marine environment. Moreover, a search in peer-reviewed literature found nothing that addresses geotextile tubes and their effect on coastal habitat. Such uncertainties indicate that geotextile tubes remain an experimental technology for coastal armoring. It is unwise policy to allow installations of uncertain technologies, particularly on beaches serving endangered species such as sea turtles.

This does not mean the law does not allow for experimental technologies. The Florida Administrative Code recognizes the sensitive nature of experimental coastal construction by outlining special criteria to consider in applications for experimental armoring.¹⁸ These criteria specifically note that any proposed project should not be in an environmentally sensitive area and should not be any larger than necessary to accomplish the objectives of the field test.¹⁹

B. Poor Nesting Habitat

The construction of a geotextile tube coastal armoring system may degrade nesting habitat for sea turtles and may discourage sea turtles from nesting. Scientists have identified a number of factors that help determine whether—and how successfully—sea turtles nest at a site. These factors include sand hardness, beach profile, and sand moisture.

Under current DEP rules, geotextile tubes must be covered with three feet of “beach-quality” sand following their installation, resulting in changes in sand composition similar to what is found after a beach is renourished. Renourished beaches often differ from natural

¹⁸ FLA. ADMIN. CODE r. 62B-41.0075 (2004).

¹⁹ *Id.* at (1)(c) and (d).

beaches in the sand grain size, density, shear resistance, color, gas diffusion rates, and moisture content.²⁰ Beach nourishment often results in more compact sand, which has resulted in a lower number of successful sea turtle clutches laid.²¹ The compaction of the sand also affects the nesting cavity, potentially causing unnatural variability in the nest depth, air space, and nest shape.²² The sand used for beach nourishment may also differ in color from the original sand, causing a difference in temperature.²³ Since the sex of the turtle is based on the incubation temperature, this factor can affect the sex ratios of the species. The water content of the sand may also differ, possibly “increasing water availability and decreasing temperature fluctuations and gas exchange.”²⁴

Another potential moisture issue presents itself as geotextile tubes could modify nest moisture by causing pooling or reducing drainage since the interior layer of the tube is impermeable, or at least less permeable than natural sand. Since beach moisture is a factor that helps determine where Loggerhead turtles choose to nest,²⁵ changing the moisture of the beach sand may cause the turtles to abandon that area as a nesting site. Increased moisture could also cause increased nest failure due to molds or fungus that lead to egg decomposition.

Furthermore, construction of geotextile tube armoring systems in the dune and beach zone could cause light visibility issues. The effects of lights on nesting and hatchling turtles are

²⁰ Karen Greene, Beach nourishment: A review of the biological and physical impacts, ATLANTIC STATES MARINE FISHERIES COMMISSION HABITAT MANAGEMENT SERIES #7 (2002) available at <http://www.asmfc.org/publications/habitat/beachNourishment.pdf>.

²¹ Jeffrey D. Miller, Colin J. Limpus, and Matthew H. Godfrey, Nest site selection, oviposition, eggs, development, hatching, and emergence of loggerhead turtles in LOGGERHEAD SEA TURTLES (Alan B. Bolten & Blair E. Witherington, eds. 2003).

²² Raymond R. Carthy, Allen M. Foley, and Yoshimasa Matsuzawa, Incubation environment of loggerhead turtle nests: Hatchling characteristics, in LOGGERHEAD SEA TURTLES (Alan B. Bolten & Blair E. Witherington, eds. 2003).

²³ *Id.*

²⁴ *Id.*

²⁵ See Daniel W. Wood and Karen A. Bjorndal, Relation of Temperature, Moisture, Salinity, and Slope to Nest Site Selection in LOGGERHEAD TURTLES, 2000 COPEIA 1, 119-128 (2000).

well documented.²⁶ Too much light visible from the beach often causes a turtle coming out of the water to nest to instead return to the ocean; excessive light also disorients hatchling turtles and causes them to crawl towards the dunes instead of the ocean. The planning of these tubes must take pre- and post-construction elevation of the dunes into consideration. If an applicant raises the elevation of the beach by burying the geotextile tubes and then covering them with sufficient sand, this could lead to more visible light from upland sources affecting nesting turtles or hatchlings. This may violate beach lighting codes of coastal counties and could discourage nesting and increase hatchling disorientations.

C. Effect of Plastics on Sea Turtles

DEP regulations require only three feet of sand on top of geotextile tubes. Loggerhead sea turtles dig nests three feet deep while Leatherback sea turtles dig nests as much as five feet deep. Thus, even assuming proper sand placement on top of geotextile tubes and no erosion, turtles could easily place eggs directly on or within fractions of an inch of geotextile tubes. Geotextile tubes are constructed from materials that contain plasticizers (phthalates) that may seep into permeable sea turtle eggs that are laid on top of geotextile material. Phthalates have been shown to be endocrine disruptors in reptiles and mammals and cause reproductive alterations.²⁷ Phthalates are anti-androgens, which affect a developing male reproductive system

²⁶ B.E. WITHERINGTON AND R.E. MARTIN, UNDERSTANDING, ASSESSING, AND RESOLVING LIGHT-POLLUTION PROBLEMS ON SEA TURTLE NESTING BEACHES, 2nd ed. rev., Florida Fish and Wildlife Conservation Commission, F.M.R.I. Technical Report TR-2. 73 (2000).

²⁷ See Jennifer J. Adibi, et al., Prenatal Exposures to Phthalates Among Women in New York City and Krakaw, Poland, 111 ENVIRONMENTAL HEALTH PERSPECTIVES 1719-1722 (2003); L. Earl Gray Jr., et al., Perinatal Exposure to the Phthalates DEHP, BBP, and DINP, but not DEP, DMP, or DOTP Alters Sexual Differentiation of the Male Rat, 58 TOXICOLOGICAL SCIENCES 350-365 (2000); Louis J. Guillette Jr. & Taisen Iguchi, Contaminant-induced Endocrine and Reproductive Alterations in Reptiles, 75 PURE AND APPLIED CHEMISTRY 2275-2286 (2003); Louis J. Guillette Jr., et al., Alligators and Endocrine Disrupting Contaminants: A Current Perspective, 40 AMER. ZOOL., 438-452 (2000).

as well as other organs.²⁸ This is a recent topic of concern among scientists including the U.S. Center for Disease Control (CDC), not just for wildlife populations, but also humans.²⁹

The potential for adverse effects on sea turtle nests due to chemical constituents of geotextile tubes has not been adequately addressed. Further research should be undertaken to discern whether these chemicals infiltrate the nest cavity and affect turtle eggs.

II. DEP Rules and Permit Conditions Should Incorporate More Rigorous Conditions for the Installation of Geotextile Tubes.

Geotextile tubes differ greatly from typical vertical seawall in that the tubes extend far onto the active beach. As a result, geotextile tubes require maintenance to ensure protection of sea turtle habitat, public use of the beaches, and their own structural integrity.

A. Sea Turtle Monitoring

The preamble to the proposed amendment to the Indian River Sea Turtle Habitat Conservation Plan (HCP) states that more stringent sea turtle nest monitoring will occur for only two seasons after the addition of proposed geotextile tubes on beaches subject to the HCP. Given the paucity of research on the effect of these tubes, the cyclical nature of nesting, and the long-lived nature of sea turtles and their complex, enigmatic life history, effective management requires more extensive data gathering. Monitoring should be extended to a minimum of five years to fully understand the effect these tubes have on sea turtle nesting behavior and success.³⁰

²⁸ Shanna H. Swan, *et al.*, Decrease in Anogenital Distance Among Male Infants with Prenatal Phthalate Exposure, ENVIRONMENTAL HEALTH PERSPECTIVES (June 1, 2005) available at <http://ehp.niehs.nih.gov/docs/2005/8100/abstract.html>.

²⁹ See Center for Disease Control and Prevention, Phthalates: General Information, available at http://www.cdc.gov/exposurereport/3rd/pdf/results_06.pdf.

³⁰ See 1993 Fla. Dept. of Env't'l. Protection, permit ST-884, (Amend) M1, p.3, condition 1.3 (permit for coastal armoring requiring marine turtle monitoring).

B. Sand Depth Monitoring

DEP currently requires that three feet of sand be maintained over the geotextile tubes at all times. This is normal depth to which loggerhead turtles dig their nests, leaving little or no margin of error between egg and plastic. Nevertheless, under the terms and conditions section of many geotextile permits, applicants are only required to check the depth of sand once, at least one month before sea turtle nesting season. Checking the level of sand on top of the geotextile tubes only once a year is insufficient. Due to wind, storms, and normal erosion processes, and considering that the sea turtle nesting season extends over seven months from April to October, it is very likely that the depth of sand will change and, if insufficient, sea turtle nesting will be compromised. Sand depth should be checked every two weeks throughout the sea turtle nesting season to ensure sufficient sand coverage.

Furthermore, the time period for measuring and adding sand is unrealistically short. The permit requires measuring sand depth “no sooner than one month before marine turtle nesting season.” This means that the measurement could be done the day before the nesting season begins. If a measurement demonstrates that less than three feet of sand covers the tube, then “the permittee shall contact DEP, which shall advise in writing, after consultation with the FWC and USFWS, if additional sand placement is required.” Actual sand placement would likely not take place within twenty-nine days were measuring to take place thirty days before the beginning of the turtle nesting season. It becomes virtually impossible for all necessary steps to occur if measuring is done less than three weeks prior to nesting season.

A more rational permit condition would require the permit holder to automatically replace sufficient sand cover if the measurement, taken at least twenty, but no more than forty days prior to the sea turtle nesting season, demonstrates that less than three feet of sand covers the tubes.

C. Binding Subsequent Purchases

To ensure proper performance over the life of the structure, permit conditions for geotextile tubes should bind subsequent purchasers that wish to maintain existing geotextile tubes to the same conditions as the applicant(s) that originally installed the tubes. The conditions set forth in current permits do require some measures to ensure current owner compliance with the permit. However, these conditions will no longer be binding when the current owners decide to sell their property. Nothing in the current permits require subsequent purchasers to comply with the conditions once they take control of property equipped with geotextile armoring. Failure to bind subsequent property owners increases the risk of damage to installed tubes and detrimental impacts to sea turtle habitat. Unless required to do so by law, subsequent owners may not be willing to incur the expenses associated with proper renourishment and monitoring. The permit and conditions should be altered to expressly bind subsequent purchasers to the permit conditions.

D. Notice to Subsequent Purchasers

Related to the importance of binding subsequent property owners, permit conditions should require giving possible purchasers notice of the presence of geotextile tubes and delivery of a copy of the permit and its conditions. Subsequent purchasers must know about the obligations imposed on them if they decide to own property armored by the geotextile tubes. If subsequent purchasers are not informed of these obligations and later determine that they cannot financially comply with them, then the conditions are likely to go unfulfilled. The state, through DEP, would then likely have to ensure compliance with the permit.

E. Financial Assurances

Current permits do not require permit holders to financially guarantee maintenance of geotextile structures. Geotextile permits should require financial assurance that the structures

will be maintained in the event the owners go into default. Both DEP's rule and permit conditions require that the geotextile tubes be covered with a minimum of three feet of sand.³¹ In order to guard these geotextile tubes from damage and ensure sea turtle nesting success, a layer of beach-quality sand must remain on top of the tubes. The person or entity that constructs or installs coastal armoring is charged with the duty of maintaining such structures.³² Yet nothing in the permit sets forth who should be held responsible for sand renourishment, maintenance or tube removal in the event the owner neglects these duties. DEP and water management districts often require performance bonds or some other form of financial assurance in Environmental Resource Permits that require long-term maintenance.³³ Since geotextile tubes also have long term-maintenance needs in the form of sand coverage, equivalent forms of financial assurances are appropriate.

F. Monitoring Impact to Neighboring Property

Coastal Armoring projects often have an adverse impact to adjacent areas of the beach because coastal armoring may impede the distribution of sand down the beach.³⁴ Therefore, the permit should include monitoring of the impacts of coastal armoring on adjacent property. This monitoring should take place immediately north of the armoring (within 50 feet), immediately south of the armoring (within 50 feet), and 1000 feet south of the armoring.³⁵ Such requirements would expand the knowledge base about the effects of geotextile armoring.

³¹ 2005 Fla. Dept. of Env't'l. Prot., permit number IR-710, p.3, condition 4.

³² FLA. STAT. § 161.051.

³³ See 1993 Fla. Dept. of Env't'l. Protection, permit ST-884, (Amend) M1, p.3, condition 1.4 (permit for coastal armoring requiring marine turtle monitoring).

³⁴ S.P. Leatherman, Shoreline stabilization approaches in response to sea level rise: U.S. experience and implications for Pacific island and Asian nations, 92 WATER, AIR, AND SOIL POLLUTION 149, 151 (1996).

³⁵ See 1993 Fla. Dept. of Env't'l. Protection, permit ST-884 (Amend) M1, p.3, condition 1.2 (permit for coastal armoring requiring monitoring of adverse impact to adjacent property owners).

G. Access Assurance for Maintenance

Geotextile permits stipulate maintenance of sand on top of the tubes.³⁶ Placing sand on the beach requires a reasonably close point of access to the tube structures to minimize the impact of heavy machinery and large dump trucks full of sand on the beach. In the event the applicant does not maintain the proper level of sand, state and local entities may be required to place sand on the geotextile tubes in order to maintain the beach in the public's interest.³⁷ The decreasing number of access points to Florida's beaches may make access for such work difficult. To maintain the sand level on the geotextile tubes with heavy machinery, the state and local entities may have to access the beach at a distant location, disturbing the beach dune system. Any long commute with heavy machinery may cause significant adverse impact to the beaches. Thus, the permit applicants should be required to assure an access point for the state by use of a license, easement or other suitable arrangement.

H. Identifying Sand Source

Sea turtles are very selective in their nesting habitat.³⁸ In order for them to nest on a certain beach, they require the beach sand to meet certain qualifications. The sand placed on top of the geotextile tubes must meet certain sand criteria to assure continued sea turtle nesting.³⁹ However, the permits do not require the applicant to identify the location from which the sand was taken and quality of the sand to be placed on the structure. This identification would assure that sand placed on geotextile tubes would be adequate for sea turtle nesting and would allow DEP and others to evaluate the impacts to the sand source area, which may be relic coastal scrub.

³⁶ See e.g. 2005 Fla. Dept. of Env'tl. Prot., permit number IR-710, p.3, condition 4.

³⁷ Cf. FLA. STAT. § 161.061 (2004) (giving the state the power to enter the property to adjust, alter, or remove coastal armoring in the event it becomes a nuisance).

³⁸ See Daniel W. Wood and Karen A. Bjorndal, Relation of Temperature, Moisture, Salinity, and Slope to Nest Site Selection in LOGGERHEAD TURTLES, 2000 COPEIA 1, 119-128 (2000).

³⁹ FLA. ADMIN. CODE r. 62B-33.00155(1)(h) (2004).

III. Fulfilling Permit Requirements

Those wishing to erect coastal armoring must obtain a coastal construction permit prior to any coastal construction.⁴⁰ The Florida Coastal Construction Statutes and DEP regulations⁴¹ require that structures to be protected by armoring are “eligible” and “vulnerable,” that no beach nourishment project is scheduled after armoring construction,⁴² and that the project not cause significant adverse impact over a short-term or long-term period.

A. Eligible and Vulnerable Structures

Coastal construction permits may be denied if the structures to be protected are not “eligible” and “vulnerable” as defined by relevant laws and regulations. Private eligible structures include: 1) non-conforming habitable structures, 2) major non-habitable structures which are not expendable, 3) expendable structures necessary for occupation of the major structure, and 4) expendable structures whose failure would cause the loss of adjoining non-conforming habitable structures and major non-habitable structures which are necessary for occupation of the major structure.⁴³ Beach homes clearly do not fit into the second, third or fourth definitions of private eligible structures because they are habitable residences. Further they do not fit into the first definition if the structures were built pursuant to a permit issued by DEP under Florida Statute Section 161.052 or 161.053 and thus are conforming.⁴⁴

B. Adequate Structure Protection

Vulnerable structures are eligible structures that are “subject to either direct wave attack or to erosion from a 15-year return interval storm which exposes any portion of the

⁴⁰ FLA. STAT. § 161.041 (2004).

⁴¹ FLA. STAT. § 161; FLA. ADMIN. CODE r. 62B-41.005 (2004).

⁴² FLA. ADMIN. CODE r. 62B-33.0051(1)(b).

⁴³ *Id.* at 62B-33.002(18)(b).

⁴⁴ *Id.* at 62B-33.002(41)

foundation.”⁴⁵ Vulnerability is determined by using a dune erosion model published by the University of Florida in 1995.⁴⁶ If the structure is not found vulnerable through the erosion model, the applicant may show vulnerability by demonstrating the structure will become vulnerable at a future point in time within the authorized time limit of the permit, the neighboring structures are vulnerable and their proposed armoring would cause the applicant’s structure to become vulnerable, or the structure is on a dune or escarpment and is subject to collapse within a fifteen year storm interval according to a dune erosion model.⁴⁷

Coastal construction permits may not be issued if the state plans to renourish the beach within the next nine months.⁴⁸ Applicants are not allowed to install coastal armoring structures when beach nourishment, beach restoration, sand transfer, or other activity that would provide protection for a vulnerable structure is scheduled to take place within nine months of the proposed construction of the coastal armoring.⁴⁹ This is true even when the applicant meets all the other requirements for coastal armoring.⁵⁰

C. Siting and Design Requirements

DEP coastal armoring rules require certain siting and design requirements to minimize adverse impacts to the beach dune system, sea turtles, native salt-tolerant vegetation, existing upland and adjacent structures, and interference with public beach access.⁵¹ An armoring structure must not cause destabilization of the beach dune system or block access to the beach

⁴⁵ *Id.* at 62B-33.002(60).

⁴⁶ *Id.* at 62B-33.0051(1)(a)2.

⁴⁷ *Id.*

⁴⁸ Whether or not this is applicable at any given permit application site may be reviewed at <http://www.dep.state.fl.us/beaches/programs/coasteng.htm>.

⁴⁹ *Id.* at 62B-33.0051(1)(b).

⁵⁰ *Id.*

⁵¹ *Id.* at 62B-33.0051(2).

without providing alternative access.⁵² All armoring destabilizes the beach dune system by fixing a dynamic shoreline and preventing actual beach replenishment from the dunes.

DEP also requires that armoring structures minimize encroachment on sea turtle nesting habitat.⁵³ Yet, geotextile structures generally extend well into established sea turtle nesting areas by placing a plastic layer directly beneath nesting sea turtles. This represents a substantial departure from traditional armoring.

D. Cumulative Impacts

DEP has failed to fully assess the long-term impacts of continued coastal armoring on the Florida coast. Applications for coastal construction permits must be denied when the activity will cumulatively result in significant adverse impact.⁵⁴ Significant adverse impacts are adverse impacts of such magnitude that they may alter the coastal system by affecting the existing shoreline change rate, significantly interfering with the dune's ability to recover after a coastal storm, disturbing topography or vegetation such that the dune system becomes unstable or suffers catastrophic failure or the protective value of the dune system is significantly lowered; or cause a take, as defined in Florida Statute section 370.12(1), unless the take is incidental pursuant to Florida Statute section 370.12(1)(f).⁵⁵

DEP must consider the short and long-term impacts, as well as direct and indirect impacts the armoring would cause in combination with existing armoring or pending coastal armoring permits.⁵⁶ Beach residents across Florida will be seeking coastal armoring permits to make their recent emergency armoring permanent.⁵⁷ Unlike the future permits speculated in *Caloosa*

⁵² *Id.* at 62B-33.0051(2)(a).

⁵³ *Id.* at 62B-33.0051(2)(b)(2).

⁵⁴ *Id.* at 62B-33.005(3)(a)

⁵⁵ *Id.* at 62B-33.002(31)(b)

⁵⁶ *Id.*

⁵⁷ COUNTY COASTAL ENGINEERS CAN SUPPLY A LIST OF PROPOSED COASTAL ARMORING PERMITS.

Property Owners' Association, Inc. v. Department of Environmental Regulation,⁵⁸ it is reasonably foreseeable that homeowners will seek to make their emergency coastal armoring permanent. These armoring activities will cumulatively affect the existing shoreline rate of change by permanently locking the dune sites in place, interfering with the dunes' ability to recover by artificially supplementing the replenishment cycle of sand dunes, and causing a take of sea turtles by altering their habitat in a way that significantly impairs essential behavioral patterns associated with nesting.

Beaches in Florida are constantly shifting and buildings built adjacent to eroding shorelines are in danger of falling into the sea. The 2005 draft copy of the Critically Eroded Beaches Report designates 365.1 miles of Florida's beaches as critically eroded, 8.4 miles of inlet shoreline as critically eroded, 110.2 miles of beaches as non-critically eroded, and 3.2 miles of inlet as non-critically eroded statewide.⁵⁹ These eroded beaches make up 59 percent of Florida's 825 miles of sandy shoreline.⁶⁰ Rather than continued armoring and renourishment, Florida should develop a rigorous retreat strategy to prevent buildings from being located in this compromising situation.⁶¹ Until these strategies are implemented, shoreline stabilization methods should be eschewed.

Furthermore, sea levels are predicted to rise from 0.2 m to 1.0 m by 2100.⁶² As sea levels rise, the mean high water (MHW) line will move further landward and cause an increasing loss

⁵⁸ 462 So.2d 523 (Fla. 1st DCA 1985).

⁵⁹ BUREAU OF BEACHES AND COASTAL SYSTEMS, FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, CRITICALLY ERODED BEACHES IN FLORIDA (2005) available at <http://bcs.dep.state.fl.us/reports/cebr04-2005.pdf>. (This report is updated regularly by the Bureau of Beaches and Coastal Systems.)

⁶⁰ SURFRIDER FOUNDATION, STATE OF THE BEACH 2004: FLORIDA BEACH EROSION, available at <http://www.surfrider.org/stateofthebeach/05-sr/state.asp?zone=SE&state=FL&cat=be>.

⁶¹ See Duke University's Program for the Study of Developed Shorelines, Report from the Second Skidaway Institute of Oceanography's Conference on America's Eroding Shoreline, (June 1985) available at http://www.env.duke.edu/psds/psds_skidaway.htm.

⁶² S.P. Leatherman, Shoreline stabilization approaches in response to sea level rise: U.S. experience and implications for Pacific island and Asian nations, 92 WATER, AIR, AND SOIL POLLUTION 149-157 (1996).

of beach and dune in front of coastal buildings. As continued coastal development moves closer to the dune line, there will be an increasing need for shoreline hardening to protect upland development, resulting in an increase on loss of sea turtle nesting habitat.⁶³ The inexorable landward movement of beaches due to sea level rise indicates that a strategy focused on armoring will lead to the degradation of much of Florida's coastal resource and the eventual extirpation of sea turtle nesting habitat on developed beaches.

IV. Conclusion

The harms that armoring inflicts on beaches have been well documented. This indicates that further restrictions on coastal armoring are needed and that new, unproven technologies such as geotextile tubes should not receive permits absent careful and copious research.

A plethora of uncertainties regarding the long-term performance of the geotextile tubes and their effects on sea turtles exist. Responsible, conservative management principles counsel against further or increased permitting of geotextile tube armoring without first conducting additional research to determine the effects of altered beach sand composition, gas exchange rates, density, slope, moisture content, increased visible lighting, and other factors on nesting sea turtles. Finally, even if geotextile technology is permitted on a case-by-case basis, the permit conditions indicated do not sufficiently ensure minimization of the impact to the beach and dune system or to nesting sea turtles. Permit conditions should expressly bind future land owners, require a performance bond or equally powerful financial assurance to ensure compliance, require notification of potential future owners of the land of the permit conditions and burdens to

⁶³ In a study conducted in the Netherlands Antilles, Fish et al. found that up to 32 percent of the total beach area could be lost with a 0.5 meter rise in sea level. The vulnerability of a particular beach varied based on the land use adjacent to that beach. Fish et al., Predicting the impact of sea-level rise on Caribbean sea turtle nesting habitat, 19 CONSERVATION BIOLOGY :482-491 (2005).; Studies suggest that sea levels will rise between 0.2 meters and 1.0 meters by the year 2100. S.P. Leatherman, Shoreline stabilization approaches in response to sea level rise: U.S. experience and implications for Pacific island and Asian nations, 92 WATER, AIR, AND SOIL POLLUTION 149-157 (1996).

which they would be subject as owners of the land, and require increased monitoring and information reporting by the applicant.