

An underwater photograph showing a reef structure made of stacked tires. The water is clear and blue, and the tires are arranged in a grid-like pattern on the seabed.

# **A Plan for the Recovery of the Artificial Tire Reef in Ft. Lauderdale, Florida**

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Produced for the NOAA National Marine Fisheries Service  
SE Region and the NOAA Marine Debris Program by  
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## **Table of Contents**

List of Tables and Figures	3
Executive Summary	4
Background	6
Environmental Challenges and Opportunities for the Project	6
The Scope of the Problem	7
Tire Quantity Estimate	8
The Recovery of the Tires from the Seafloor	10
Permits for the Tire Salvage	11
Anticipated Resources Required for the Marine Salvage Phase	12
The Tire Processing Phase	13
Anticipated Resources Required for the Tire Disposal and Recycling Phase	14
Non-Competition with the Private Sector	20
The Value of Partnerships – Making the Project Possible	20
Appendix. A Tire Processor Questionnaire	21

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### **On the Cover:**

Waste tires extend for more than 34 acres on the seafloor just over a mile off of the beaches of Ft. Lauderdale, Florida. Photographer: William Nuckols. August 22, 2006 at 65'.

## **Tables**

Table 1. Estimated Stockpile Quantity (as of 9/1/2006)	10
Table 2. Location of Sample Tires Collected	
Table 3. Values of in-kind and funding sought from the State of Florida and Broward County	18
Table 4 Summary of Estimated Costs Associated with Retrieval of Waste Tires from the Osborne Reef area, Including Assumptions and Bases for Estimates.	19

## **Figures**

Figure 1. Most of the tires dumped in the 1970's were placed as bundles	6
Figure 2. A few individual tires do have living corals on them which will be collected and transplanted onto nearby reefs	7
Figure 3. The tire field lies approximately 1.3 miles off of the beach in Ft. Lauderdale, Florida, and is approximately four miles from Port Everglades	7
Figure 4 Priority Areas for Tire Recovery	9
Figure 5 Tires exist in differing densities throughout the tire field. DEP tire experts were called upon to make estimates of the number of tires based on video, photographs and diver input	9
Figure 6. Locations of Tire Samples	15
Figure 7. Relatively clean sample tires from the west side of the second reef line	15
Figure 8. Underwater Photo of Relatively clean tires after 20 hours of drying	15
Figure 9. Underwater Photo of tires Partially Submerged in Sand (high sediment contamination)	16
Figure 10. Higher organic contamination sample tires after 20 hours of drying	16

## **Executive Summary**

Beginning in the early 1970's, as many as two million tires were dumped into the ocean onto sand bottom in between the outer and middle coral reef tracts offshore Ft. Lauderdale, Florida. The tires were originally placed as both bundles and loose, but due to the failure of the strapping almost all the tires are presently loose. The individual tires are unstable due to their light weight in water, so they are easily mobilized during coastal high energy storms. As the pile migrates shoreward, the tires pile up on the seaward face of the middle reef tract, physically destroying the corals on the natural reef and those that have settled onto individual tires. Recent video surveys of an area comprising the highest concentrations of the remaining tires indicates approximately 700,000 tires remain in a 34 acre area. The location of the remaining one million tires remains unknown, but possible explanations include movement of some tires north and south of the main tire pile area and some times being west of the main pile with some of those having made it all the way to the beach over the last 30 years.

To stop this destructive process, the tires must be removed from the ocean. While no single level of government possesses the available resources and expertise to accomplish the task, a partnership of agencies is coming together to craft a solution to this ongoing environmental threat. Working under the umbrella of Coastal America, a partnership process which brings together networks of agencies, the federal government, State of Florida and Broward County have developed a plan to remove the tires from the ocean and recycle the tires into products that will have a constructive use.

To accomplish the collection of the tires from the seafloor, the military is being tapped as a partner. The Department of Defense's Innovative Readiness Training Program matches real world training opportunities for our sailors and soldiers through projects that can have incidental benefit to communities. In this particular project, Broward County is presenting the military with a marine salvage job of significant scale. A salvage mission, which is proposed to comprise the Navy's Mobile Diving Salvage Unit TWO (MDSU TWO) and Army diving and watercraft assets from the 7<sup>th</sup> Transportation Group, is being requested to begin full-scale salvage operations in federal fiscal year 2008. The marine salvage mission is anticipated to last approximately three years. FY2008 requests for assistance are being submitted to the Navy, the lead service in this project, in the fall of 2006 to meet the February 2007 application deadline for FY2008. An out-of-cycle funding request is also being submitted in the fall of 2006 for a one or two month trial project in FY2007.

Salvaged tires would be placed in an Army landing craft and transported to Port Everglades, another partner in the project. Tires will then be transported by commercial trucks from the port to a tire processing facility.

The Florida Department of Environmental Protection (DEP) has years of experience managing tire abatement projects that dispose of legacy tire piles. Their staff expertise is being sought to guide the tire recycling portion of the project. A state budget initiative is being put forward by the DEP to secure the funding to ensure the recycling and proper

management of the tire processing. Broward County has appreciable expertise in marine resource protection, as well as solid waste management, and accordingly will be involved in all aspects of the project. Although the production rate of the tire salvage operations is not yet known, the multi-agency team is hoping to complete the project by approximately 2011.

The ability to recycle tires that have been in the ocean for over 30 years was in question, therefore, a project to determine the anticipated costs of recycling the tires has been conducted, funded by the NOAA Marine Debris Program and executed by NOAA Fisheries Southeast Region. Working with several tire recycling companies, NOAA is estimating that the recovered tires could be processed for approximately \$3.00 per passenger tire equivalent (PTE).

DEP will seek state funding for the tire recycling and disposal component of this project; contract with Broward County for on-site management of the project; provide assistance through their technical consultant on tire recycling and disposal issues; and manage state contracts. State funding requirements for the tire recycling and disposal are \$2,830,600. Including Port Everglades costs, if born by the state, DEP resources required could run as high as \$3,218,500.

Broward County has agreed to accept responsibility for project management including, but not limited to, County contract administration; permitting; on-site management, to include training, work oversight and troubleshooting problems; and to provide necessary equipment, supplies, and other consumables for operations. State funding will be sought, under contract to DEP, for a portion of these costs. The County's in-kind contribution by their Environmental Protection Division staff is estimated at \$96,800. Port Everglades, owned by Broward County, anticipates up to an additional \$445,500, proposed in this report to be born by the DEP.

The military's potential contribution is significantly harder to quantify. To capture a relative value of the military's participation, a look to comparable private sector costs for the marine salvage is one way to determine value. A survey of private sector marine salvage vessels and dive companies indicated that for the same number of working days over the three year period, over \$3,400,000 would be expended, resulting in less than 22% of the targeted tires being recovered. Preliminary military internal budget estimates indicate a potential internal budget allocation of approximately \$230,000 per month of salvage operations, however final cost calculations have yet to be determined.

When combined, the marine salvage capabilities of the military, matched with the tire processing skills and resources of the State, along with the multi-talented staff of professionals at Broward County, are poised to finally put an end to this ongoing environmental threat.

## **Background**

In the early 1970's, a large number (estimates range between 1 and 2 million) of waste tires were dumped offshore between the outer two coral reefs in Broward County, Florida, for fishery enhancement purposes. This was done, under the auspices of permits issued by the State of Florida and the US Army Corps of Engineers, to enhance fish habitat. Most of the tires were bundled with metal or nylon strapping secured with metal clips to provide some structure to the reef. Many, however, were dumped as single tires on the bottom. Over time the strapping has failed, so most of the tires are presently loose on the bottom. It was quickly realized, by creators of this reef site, that tires were not suitable as an artificial reef and the project was suspended. However, the legacy of the decision to place tires there in the 1970s remains with us today. High wave and current conditions over the past 30 years have resulted in dispersal of many of these tires on to valuable reef areas, significantly impacting these resources. Most of the reef epibiota on the middle reef face have been killed and the original intent of the tire reef as substrate has not been realized because of poor colonization onto the tires by reef organisms. It has, thus, become obvious that these tires need to be removed.

**Figure 1. Most of the tires dumped in the 1970's were placed as bundles**



## **Environmental Challenges and Opportunities for the Project**

The goal of the project is to remove these tires from the ocean, thus removing the threat to the living coral reef habitat.

Not all coral resources in and adjacent to the tire field have been destroyed. On a few of the more stable tires, corals have been able to settle and establish themselves. These living corals are a resource that will be protected as the salvage operation continues.

**Figure 2. A few individual tires do have living corals on them which will be collected and transplanted onto nearby reefs**



### **The Scope of the Problem**

The main tire pile comprises approximately 34 acres on the seafloor. While there are scattered piles of tires to be found up to several miles north and south of the main tire pile area, those tire densities are believed to be comparatively low. Accordingly, this report confines itself to the 34 acre site.

**Figure 3. The tire field lies approximately 1.3 miles off of the beach in Ft. Lauderdale, Florida, and is approximately four miles from Port Everglades**

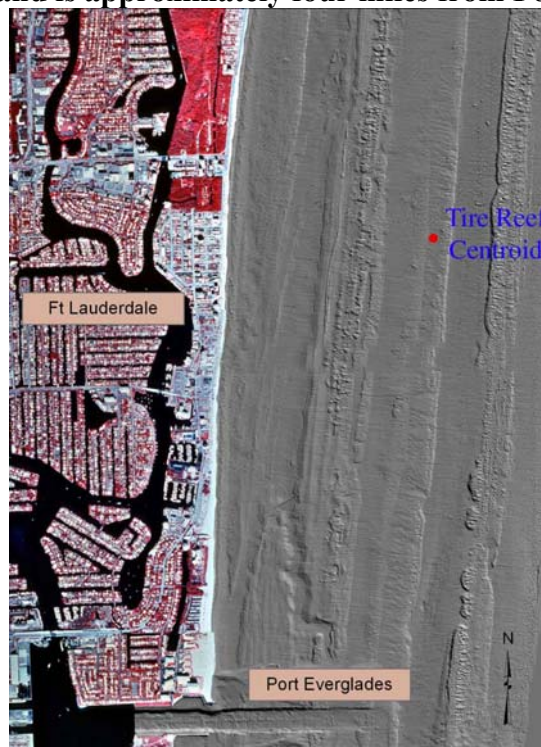


Figure Provided by Broward County

## Tire Quantity Estimate

At the inception of Florida's waste tire management program in 1989, the Legislature directed the Department of Environmental Protection (DEP) to develop and implement a comprehensive program to abate all waste tire stockpiles in the state. Since then, DEP's stockpile management program has been responsible for abatement of over 46 sites, containing over 15 million waste tires. The remaining piles contain a total of less than 100,000 tires and are currently under enforcement action or are being abated by landowners.

As a result of its comprehensive program, Florida has developed extensive experience in critical program components, including assessing stockpile conditions, estimating stockpile quantities and working with experienced abatement contractors to remove, process and constructively utilize stockpiled tires whenever possible. The expertise of DEP's technical consultant was tapped to calculate the quantity estimates for the underwater tire field. The methodology utilized is the basis for the procedures cited in "The Scrap Tire Cleanup Guidebook" recently published by the United States Environmental Protection Agency<sup>1</sup>.

Although the Broward tire stockpile is located several miles offshore in 60 – 70 feet of water, the methodology developed for stockpiles on land is still applicable with some modifications. For instance, the method for estimating the quantity of waste tires in a stockpile is still applicable, but pile measurement methods require modification to reflect limited accessibility and underwater stockpile conditions.

The first step in stockpile estimation is a detailed measurement of the physical volume containing tires. A large stockpile site is generally broken into segments with standard shapes to simplify volume calculations. Each segment is carefully examined and measured to determine dimensions and characteristics. On land, this is accomplished by walking around, through, and over all pile segments to conduct measurements. Practical limitations on dive time prevent comparably detailed examination of a large site in 60 – 70 feet of water, but Broward County conducted an underwater video survey of the site in mid-2003. Additional dives by County and Navy divers during August, 2006, allowed modification of the earlier survey to reflect interim tire movement. GPS coordinates were used to define horizontal segment dimensions and diver examination provided a basis for estimating average depth within each segment.

The Broward offshore waste tire site is depicted schematically in Figure 4, with the three major segments delineated. The three areas' numbers correspond to the cleanup priorities. As baled tires have broken apart, many loose tires have been moved by storms to an area bordering the second living coral reef (Segment 1). It is a trapezoidal area approximately 50 yards wide and 500 yards long, representing 25,000 square yards. The

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<sup>1</sup> The Scrap Tire Cleanup Guidebook, EPA publication EPA-905-B-06-001, January 2006  
[http://www.epa.gov/reg5rcra/wptdiv/solidwaste/tires/508%20guidebook/ScrapTireCleanupGuidebook\\_Jan-2006-508.pdf](http://www.epa.gov/reg5rcra/wptdiv/solidwaste/tires/508%20guidebook/ScrapTireCleanupGuidebook_Jan-2006-508.pdf)

average depth has been estimated to be 5 tires or about 1 yard deep, so total volume of this segment is estimated to be 25,000 cubic yards.

**Figure 4 Priority Areas for Tire Recovery**

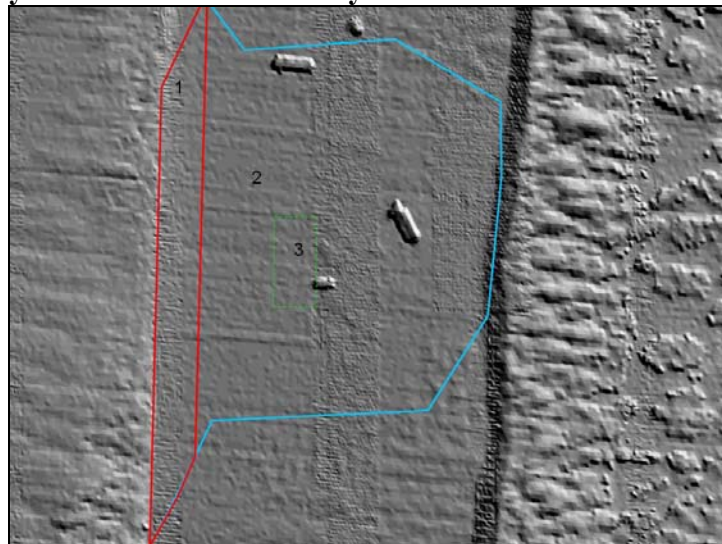


Figure Provided by Broward County

Segment 2 can be approximated by a rectangle 420 yards long and 310 yards wide, representing 130,000 square yards containing predominantly scattered tires. There are some bare sand areas and some multi-tire depths. The estimated average depth is 6 inches, so the total volume of tires is about 21,750 cubic yards.

Segment 3 represents baled tires that are still intact. It is estimated that up to 1,000 bales remain, containing approximately 25 tires each, or an additional 25,000 waste tires. This quantity estimate has been used in place of a volumetric calculation.

**Figure 5 Tires exist in differing densities throughout the tire field. DEP tire experts were called upon to make estimates of the number of tires based on video, photographs and diver input**



Once volume has been determined, tire quantity is calculated by multiplying volume times estimated density for each segment. Densities are based on comparison of

observed pile characteristics to defined densities associated with similar piles at other sites, adjusted to reflect underwater conditions.

A normal density for shallow, uncontaminated piles on ground is 10 passenger tire equivalents (PTE) per cubic yard. By definition, a PTE is 20 pounds, allowing tire quantity to be converted to weight since removed tires are weighed in trucks rather than counted. However, many of the observed tires at the Broward County stockpile are deformed (compressed) from initial baling, increasing effective density to an estimated 12 PTE/ cubic yard. In addition, sand and water will remain trapped within tire contours, further increasing effective unit weight. Tires within Segment 1 appear to have little sand contamination in upper layers, but water contamination is projected to increase effective density to 14 PTE/cubic yard for this segment. Tires in Segment 2 are more heavily contaminated with sand, increasing the estimated density marginally to 15 PTE/cubic yard.

Volume and quantity calculations are summarized in Table 1. The total estimated quantity of waste tires at the Broward County stockpile site is estimated to be 701,151 PTE or 7,012 tons, rounded to 700,000 PTE and 7,000 tons. Tires are divided almost equally between Segments 1 and 2.

**Table 1. Estimated Stockpile Quantity (as of 9/1/2006)**

Pile Seg-ments	Characteristics		Dimensions (yards)			Volume	Density	Quantity in Passenger Tire Equivalent and Tons	
						(cubic yards)	(PTE/cu.yd.)	PTE	Tons
	Contamination	Form	Length	Width	Depth				
1	Limited	Loose	50	500	1	25,000	14.0	350,000	3,500
2	Sand/Growth	Loose	420	310	0.167	21,743	15.0	326,151	3,262
3	Growth	Baled						25,000	250
TOTAL								701,151	7,012

**The Recovery of the Tires from the Seafloor**

The recovery process will begin by removing those tires deemed to be the highest threat to the adjacent natural reef systems. Tire recovery will begin in priority area one, the area with the largest number of mobile tires (Figure 4). Progression to priority area 2 will follow, given sufficient military diver availability and project funding. Priority area 3 will be excluded from salvage operations and not disturbed because of its heavy colonization of live coral. The details of whether to tackle the multi-tire pile solely before addressing the lower density tires which have living corals on them is yet to be determined. The boundaries of the priority areas, as well as the day-to-day prioritization of the salvage

operation, are determined by the Broward County Environmental Protection Department staff, relying on their extensive coral protection and habitat restoration expertise.

Areas with tires deemed to be stable in the long-run, and which have significant coral colonies encrusting on them would be targeted last, or potentially not be removed at all. An informal risk assessment will be conducted by marine biologists, directing which corals to be targeted for transplanting and which would be left in place. The driving factor in that decision process will be ensuring the long-term viability of the living corals. Biologists will determine the timing of the removal of the few living corals from the tire field. The threshold size of the corals to be saved for transplant has yet to be determined, however, these issues will have been addressed in the environmental permit application process. All reasonable efforts will be made to save the few living hard corals and transplant them to other reefs. Federal, state and county agencies will all be involved in the process that determines the best methodology for addressing the living corals.

Due to potential sensitivity of adjacent living natural resources, all tires recovered will be collected by divers on the seafloor. The exact method for recovery is still a matter of discussion, and will likely be modified through practical experience. A month-long trial run is being pursued for 2007 to optimize salvage techniques. At the time of this report, having divers move groups of tires into cargo nets on the seafloor or have divers bundle groups of tires together with line are seen as the most likely options. The full cargo nets or bundled tires would then be lifted to the surface onto the deck of an Army Landing Craft Utility (LCU) with a crane. Onboard the LCU, the tires will be dumped loose into open-top trailers. We currently anticipate three open top trailers to be the maximum capacity for a single LCU. When the trailers reach capacity, the LCU will transport them to Port Everglades, a Broward County owned and operated port. The trailers will be offloaded at Port Everglades Roll-On-Roll-Off (RoRo) terminal. Empty trailers will be loaded into the LCU to replace the full ones. The ownership and movement of the trailers on and off of the LCU will be the responsibility of the private sector firm that is contracted to do this work by the State of Florida or its contracted partner, Broward County.

#### Permits for the Tire Salvage

Permits must be obtained for the salvage operation and all associated activities that relate to living marine resources at the project site. Broward County is poised to take the lead for obtaining the permits (or notifications of de minimus impact, which might waive the need for permits). The planning for the permits is best accomplished in consultation with all relevant permitting and commenting agencies, therefore, a joint workgroup comprising Broward County, the State of Florida Department of Environmental Protection and the Florida Fish and Wildlife Conservation Commission, NOAA Fisheries and the U.S. Army Corps of Engineers is recommended to facilitate and expedite the permit process. Note that although U.S. Military assets are proposed to be used in the project implementation, no Department of Defense components are involved in any way in the obtaining of permits. The Department of Defense (DOD) Innovative Readiness Training (IRT) program guidelines indicate that obtaining all permits is the responsibility

of the entity seeking assistance from the military. As Broward County will be the applicant seeking IRT support, obtaining permits will be their responsibility. Timing for all phases of the project, including permits, must be carefully synchronized. Significant cooperation and coordination will be a key to permitting success.

#### Anticipated Resources Required for the Marine Salvage Phase

In order to salvage the roughly 675,000 tires that are currently targeted for removal, a variety of resources from a variety of agencies must be brought to bear.

A request to utilize military assets is being presented to Department of Defense. This portion of the project will be funded by reallocating existing equipment and personnel who have ongoing training needs to this salvage mission. The salvage of the tires will be proposed as a joint Navy/Army mission. The mission will be led by the Navy's salvage experts, Mobile Diving Salvage Unit TWO, from Norfolk, VA. The Navy divers will be supported by Army watercraft from the 7<sup>th</sup> Transportation Group from Ft. Eustis, VA. One or two 174' Army Landing Craft Utility (LCU) will support the divers and be used to lift the groups of tires from the seafloor, once placed in a cargo net or bundled. Divers from the Army Dive Company, another component of the 7<sup>th</sup> Transportation Group, will also support the salvage mission. When performing training missions, the costs incurred by the units are covered by existing budgeted Annual Training (AT) funds. Training costs that exceed a unit's available AT funds may be sought from Department of Defense's Innovative Readiness Training program. These funds are competitive in nature, with DOD selecting projects to support which have high training value. Joint service missions are preferred as they enhance cross-service communication and interoperability capabilities. The close mission match to the diving and watercraft operations that are the day-to-day jobs for MDSU and the 7<sup>th</sup> Transportation Group, in addition to the joint service nature of the project, should make it highly competitive when DOD selects projects for support. While the environmental benefits of the tire cleanup are laudable, that factor is not allowed as a consideration when selecting what projects to support. The match to the training and the military mission is the only factor that can be considered by the military.

Active duty salaries and the basic cost of the equipment involved in IRT projects do not appear on project cost proposals. Those costs are not seen in IRT budget proposals and can not be realistically determined; therefore the complete value of military participation in a project is not calculated. To capture a relative value of the military's participation, a look to comparable private sector costs for the marine salvage is one way to determine value. A survey of marine salvage vessels and dive companies indicated an approximate cost of \$6000/day for the primary salvage vessel and \$4500/day for a team that could salvage 150 tires per day. These figures are equivalent to over \$3,400,000 for the 3-year period, would have removed only 139,000 of the targeted 675,000 tires slated for salvage. In contrast, the anticipated military production rate for a team of 20 divers is 700 tires per day for the three year period, a rate which anticipates cleanup completion in three years.

Preliminary internal budget requests indicate an internal budget allocation of approximately \$230,000/month for salvage operations, however final cost calculations, as well as, the portion of project costs covered under existing AT funds has yet to be determined. A detailed cost proposal will be prepared by the Navy and Army during the fall of 2006 for presentation to the Office of the Secretary of Defense by February 2007 for the FY2008 funding cycle. The funding request is not likely to be an extrapolation of the monthly cost times the number of months of operations. Cost savings will be sought at all levels of the military's participation to maximize the training opportunity accomplished for funds expended.

DOD is prohibited by statute for paying for what are considered as "consumables" out of the scope of normal training operations. This means items that would be used during the mission that would not be consumed during typical military training. For example, when assisting with the construction of a building, the military could supply a construction engineer who would come with his own hammer, but the project requestor would have to pay for and supply the nails and plywood. In the tire salvage scenario, the military proposal will include divers and their support vessels as well as associated support teams (dive medics, cooks, engineers, boat helmsmen and the like) but can not pay for certain items relating to the tire salvage. These items will include, but may not be limited to, cargo nets, line, floats to mark the collected tires, and other associated supplies. These materials will need to be provided by the IRT project applicant, Broward County.

### **The Tire Processing Phase**

Almost 80% of the 20.5 million waste tires generated annually in Florida are constructively utilized in a broad range of applications. Examples include use of whole tires as a supplemental energy resource in cement kilns and municipal solid waste (MSW) facilities. Shredded tires are used in many civil engineering applications including drain field aggregate, landfill drainage layers and gas collection channels, and as a light weight fill in highway construction. Smaller tire shreds called tire-derived fuel or TDF provide energy for power plants and paper mills, displacing fossil fuels like natural gas, oil and coal. Smaller waste tire particles become playground safety surfaces and colored mulch. Fine particles called crumb rubber are used in molded rubber products, rubber-modified asphalt and crack sealants. Florida has a well-developed waste tire management infrastructure with diverse product markets.

Tires removed from stockpiles by contractors in Florida are generally constructively utilized, but contamination with dirt, water or other objects can limit usage options. Water can preclude whole tires from cement kilns by decreasing thermal efficiency and production capacity. Contamination with dirt, sand or rocks increases equipment wear and damage, thereby increasing maintenance and processing costs. Processing equipment components and expense increase with decreasing product particle size, so the impact of contamination generally precludes stockpile tires from being used for crumb rubber products. Stockpile tires are generally used for energy or civil engineering applications.

Submerged tires from the Broward County stockpile are potentially different from normal stockpile tires, and these differences may impact the feasibility and economics of constructively utilizing them. Video of the stockpile area shows many tires with organic growth that can reportedly develop strong decomposition odors upon removal from the ocean. Many tires are partially submerged in sand, indicating probable contamination with associated equipment maintenance impact. Salt water trapped in tire contours can rust transportation and processing equipment, as well as, increase salt content in processing runoff and chlorides in energy applications. All of these factors can impact tire disposal options, products and costs.

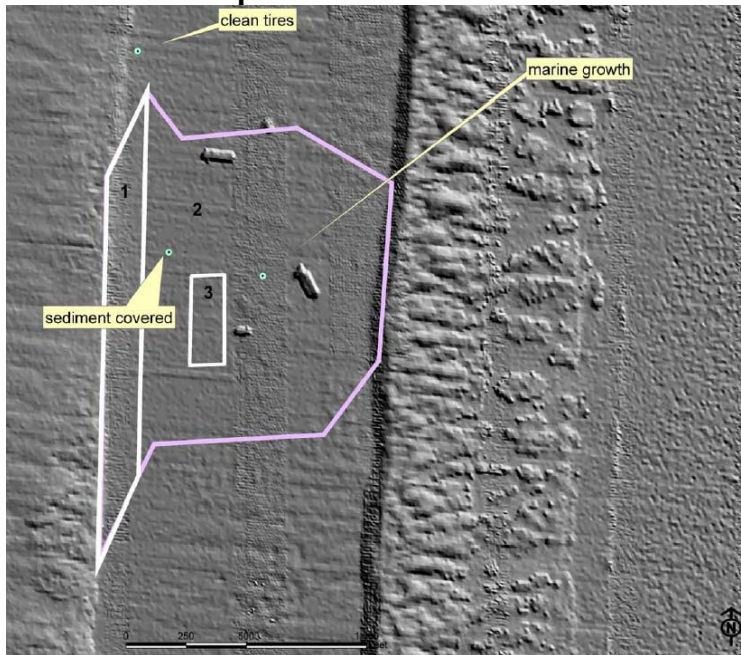
#### Anticipated Resources Required for the Tire Disposal and Recycling Phase

While processing costs of land-based tire piles is well understood from Florida and other states' experience with their tire abatement programs, the cost of disposing tires that have been in the sea have not been as easily researched through a review of past projects.

To enhance understanding of these issues, NOAA worked in partnership with a military reconnaissance dive team from MDSU TWO, the DEP and Broward County to collect sample tires and present them to the tire processing community to get the private sector's assessment on tire recycling options and costs. NOAA Marine Debris Program funds executed by the NOAA Fisheries SE Regional Office supported that week's efforts and the authoring of this report. The questions and assumptions and the suggested cost calculation spreadsheet presented to the tire processing companies is included in Appendix A.

Navy and Broward County divers bundled tires representative of three major classifications for retrieval and examination. Classifications included: a) relatively clean tires from the main accumulation along the reef (Segment 1), b) tires with significant organic growth and c) tires partially submerged in sand (both found within Segment 2). Ten tires of each classification were bound, hauled to the surface, and transported to shore on a boat.

**Figure 6. Locations of Tire Samples**



While sample 1 was obtained from outside the project boundary area, the tires are representative of the higher density tire area one in the figure.

Figure Provided by Broward County

**Table 2. Location of Sample Tires Collected**

Sample Tire	Longitude	Latitude
Clean Tires	26 08.5892'N	80 04.9502'W
High Sediment Tires	26 08.4513'N	80 04.9276'W
High Organics Tires	26 08.4344'N	80 04.8562'W

**Figure 7.**  
Underwater Photo of Relatively clean tires  
from the west side of the second reef line



**Figure 8.**  
Relatively clean sample tires  
after 20 hours of drying



**Figure 9.**  
**Underwater Photo of tires Partially Submerged**  
**in Sand (high sediment contamination)**



**Figure 10.**  
**Higher organic contamination**  
**sample tires after 20 hours of drying**



In general, the tires collected did not have the level of contamination and odor that some might have expected. In addition, much of the sand and water appear to be removed during retrieval and handling, and the organic material and encrusting organisms were not as prevalent as anticipated. After one day of drying, most organic components of the marine growth had dried and fell off easily when touched

It is currently anticipated that Florida DEP or Broward County (with support from DEP) will have responsibility for the tires once landed at Port Everglades. When DEP assumes responsibility for abating a stockpile, it generally selects an experienced contractor through a competitive RFP process to implement DEP's abatement plan. The contractor's cost becomes a major component in total site abatement economics.

The Broward County offshore site is significantly different from traditional stockpiles, and contractor economics could also be significantly different. Therefore, all waste tire processors in Florida and several from out-of-state were invited to a preliminary project discussion near the site on August 29, 2006. The potential contractors participated in a project description, observed the retrieved tires, and were invited to provide information about applicable methods, products, markets and economics. The objective was to enhance the understanding of issues, product markets and economics, thereby improving the basis for economic projections in budget requests for project implementation funding.

Four tire processing companies provided information representing a broad range of processing and products. Most focused on energy and civil engineering applications, indicating that these experienced processors felt that the type and level of contamination on the retrieved tires was acceptable. Some processors included provisions for additional pre-processing or cleaning of contaminated tires, if necessary. In general, they estimated the impact on operating and maintenance costs and reflected these costs.

Cost estimates ranged from \$2.00 to \$3.50 per passenger tire equivalent. Some had high mobilization and demobilization costs that may be charged multiple times if retrieval operations have to be campaigned 3-4 months per year during a 2.5 year implementation

period. Evaluation of the information provided suggests that \$3.00 per PTE is a reasonable budget estimate for contractor costs, based on current project parameters and understanding.

The Broward County stockpile site is estimated to contain 700,000 PTE. Colonized baled tires are likely to be left uncollected during this project, so an estimated maximum of 675,000 waste tires will be removed. The quantity ultimately removed will be controlled solely by available diving resources and their operating efficiency. If divers are able to retrieve all tires, the total contractor cost is estimated to be \$2.025 million at \$3.00/PTE. The \$3.00/PTE assumes as many as three mobilizations/demobilizations for the life of the project, reflecting annual diving campaigns lasting about 4 months during optimum weather conditions.

A breakdown of anticipated costs and in-kind contributions are listed in Table 3. DEP will seek funding for the tire recycling and disposal component of this project; contract with Broward County for on-site management of the project; provide assistance through their technical consultant on tire recycling and disposal issues; and manage state contracts. Expected State funding requirements for the tire recycling and disposal are \$2,830,600. Including Port Everglades costs, if born by the state, DEP resources required could run as high as \$3,218,500.

Broward County has agreed to accept responsibility for project management, including, but not limited to County contract administration; permitting; on-site management, to include training, work oversight and troubleshooting problems; and to provide necessary equipment and supplies for operations. The County's in-kind contribution by their Environmental Protection Division staff is estimated at a total of \$96,800 for three years. Port Everglades, a division of Broward County government, is looking into allowing the Army to dock at their Roll-on-Roll off berth at reduced cost for the project, pending formal approval by their Board of Directors. The full anticipated Port costs are detailed in Table 4 and the discussion that follows.

**Table 3. Values of in-kind and funding sought from the State of Florida and Broward County**

<b>LEAD AGENCY FOR TASK</b>	<b>TASK DESCRIPTION</b>	<b>ESTIMATE OF IN-KIND CONTRIBUTION</b>	<b>ESTIMATE OF STATE FUNDING NEEDED</b>	<b>TOTAL ESTIMATED VALUE OF TASK</b>
Broward County	Contract administration, permitting, training, work oversight and troubleshooting	\$96,800	\$100,000	\$196,800
Broward County	Dock fees at Port Everglades ( <i>see Table 4 for detail</i> )		\$445,500	\$445,500
Broward County	Equipment and supplies		\$39,000	\$39,000
Broward County	Consumables- fuel cost for Army ship (portion of actual operating fuel consumption)		\$600,000	\$600,000
DEP-Solid Waste	Contract management	\$27,000	\$9,000	\$36,000
DEP-Solid Waste	Technical assistance	\$20,000		\$20,000
DEP-Solid Waste	Tire recycling or disposal		\$2,025,000	\$2,025,000
<b>TOTAL</b>		<b>\$143,800</b>	<b>\$3,218,500</b>	<b>3,362,300</b>

**Table 4 Summary of Estimated Costs Associated with Retrieval of Waste Tires from the Osborne Reef area, Including Assumptions and Bases for Estimates.**

<b>Assumptions and Calculations:</b>	
<u>Tire Transport</u> 2-48' trailers per LCU 800 tires/trailer with no compaction 25 pounds/tire (including water/sand contamination), so 25 X 800 = 20,000 pounds/trailer, 2 X 20,000 = 40,000 pounds tires/LCU load Identified Port Costs (per Army LCU port call, based on quoted Port Everglades costs)	
Daily dockage charge (\$.191/GRT X 786GRT)	\$210.00
Harbormaster fee	\$237.10
Line handling (in & out, 2 X \$273.50)	\$547.00
Cargo warfage (20 tons tires X \$1.80/ton plus \$3.59/container X 2 containers or total load/off load)	\$ 43.18
Security fees (786 GRT X \$.0092/GRT plus \$2/container X 4 trailers (2 on, 2 off))	\$15.23
<b>Port cost per LCU</b>	<b>\$1,052.51</b>
<b>Port cost/tire</b>	<b>\$0.66</b>
<b>Port cost summary</b>	<b>\$445,500</b>
Max project total (675,000 tires X \$0.66/tire)	
Annual budget estimate (even 3 year operation)	<b>\$133,650</b>

*Table 4 Note: Annual and total Port costs may be proportionally reduced if retrieval rates limit removal. This port cost summary does not include stevedoring cost associated with transport of trailers from the Port or water provisioning at \$1.66/ton of water (240 gallons)*

For the purposes of this report the author assumes that all Port Everglades costs will be born by the FLDEP. However the appropriate split of Port costs between DEP and the County could be viewed as a function of the viewer's perspective, but the following fundamental approach might serve as a starting point for discussion of future allocation of Port Costs between Port Everglades and the FLDEP. One could view the reef tire abatement project as an incremental Port activity, with DEP reimbursing the County for actual incremental, out-of pocket expenditures and the County absorbing fixed cost/overhead components of their fee structure. For instance, costs associated with line handling, if actually required, involve real labor expense and would be borne by DEP, but the harbormaster charge is an overhead charge toward a cost that does not incur a directly related increased expense by the Port so it would be borne by the County. This approach could be applied to each fee component to allow the Port to cover actual incremental costs incurred so the County would not have out-of-pocket expense, but would absorb the overhead components as its contribution. The County would avoid actual incremental expense, but would exhibit a clear willingness to avoid the perception of profiting from other governmental agencies that are helping the County alleviate a serious local environmental problem. As the project moves forward the Port could look at each of its fees and suggest a split based on this approach since it understands its fee structure better

than anyone else. Any waiver of cost by the Port beyond \$10,000 will have to be approved by the Board of County Commissioners.

### **Non-Competition with the Private Sector**

While the military's participation does allow for cost avoidance by the county requesting assistance with the salvage side of the project, military forces are strictly prohibited by the Innovative Readiness Training Program from competing for a task with the private sector. The military's participation in the project is only possible because no program or funding stream is in place with the fiscal resources to accomplish the task. Rather than competing with Florida businesses, the marine salvage side of the project should make possible the tire processing components of the project, a task that will be contracted by the State to private sector firms.

### **The Value of Partnerships – Making the Project Possible**

Why, if the problem has existed for over 35 years, hasn't anyone developed a solution to the tire reef recovery and disposal? While there are many nuanced answers to this question, in its simplest terms, the answer lies in three categories: 1) legal authority 2) technical expertise and 3) financial resources.

The complete set of resources available to accomplish the safe recovery and processing of the tires from the seafloor in Broward County is beyond that available to any of the partners. However, combining these resources and authorities, the project, for the first time, appears possible. Working under the umbrella of Coastal America, a partnership process which brings together networks of agencies, the federal government, State of Florida and Broward County are moving forward a plan to remove the tires from the ocean and recycle the tires into products that will have a constructive use.

The marine salvage capabilities of the military, matched with the tire processing skills and resources of the State, along with the multi-talented staff of professionals at Broward County, are poised to finally put an end to this ongoing environmental threat.

## **Appendix. A Tire Processor Questionnaire**

### **OSBORNE REEF TIRE ABATEMENT PROJECT PRELIMINARY PROJECT SUMMARY AND REQUESTED RESPONSE**

(CONTRACTOR DISCUSSION - AUGUST 29, 2007 - REVISED)

#### Current Project Parameters

Tire Quantity – Over 2 million tires were reportedly placed along the Florida Coast as artificial reefs in the 1970s. Based on preliminary review of recent underwater video and diver observations, the estimated quantity currently in the Osborne Reef area is estimated to be between 500,000 and 1,000,000 tires in 60-70 feet of water.

#### Tire Characteristics

Size – Predominantly passenger/light truck tires, occasional medium truck and a few OTR tires

Contamination – About 80% of the tires are located along the reef in a long narrow accumulation 3-6 tires deep and appear to have limited sea growth, but will contain sea water and sand. Initial removal efforts will focus on these tires because they pose the greatest danger to the reef. Tires located in the outer areas will have more organic matter, sand and barnacles (significant coral growth will have been removed before retrieval), but retrieval of these tires will depend on availability of diving manpower.

#### Current Retrieval Plan

Methodology – (1) Divers will lift and place tires in cargo nets under water; (2) Nets will be raised onto an Army Landing Craft (LCU) by a crane and dumped directly into 2-3 open topped trailers on the LCU deck; (3) Trailers will be transported to Port Everglades, driven off the LCU and then transported off the Port Everglades site by the contractor expediently.

Retrieval Rate – Initial estimates range from 400 to 1,500 per day depending on diving resources, efficiency and weather conditions. Weekly retrieval is expected to be 2,000 to 7,500 tires, weather permitting. A pilot operation may be conducted in mid-2007 to better define this rate.

Preliminary Schedule – Military, DEP and county agencies plan to initiate budget requests within their respective planning cycles. If successful and assuming that military resources are available, tire removal is currently projected to begin in the 1<sup>st</sup> quarter of calendar year 2008. Operations may continue for up to 3 years, but will not be continuous due to weather and military manpower availability.

## Requested Contractor Response

Objective – Florida DEP must prepare a project description and budget by early October to support its request for capital project funding for FY 2007-2008 that begins July 1, 2007. Contractor responses defining methodology and cost are critical to the development and support of the project budget.

Response Date – Responses must be received by mail or email before 3pm EDT, Friday, September 15, 2006 by Mr. William H. Nuckols, W. H. Nuckols Consulting, PO Box 3060, Annapolis, Maryland 21403, telephone number (443) 994-1493, email address: <will@wknuckolsconsulting.com>

Confidentiality – Individual contractor responses will be kept confidential by W. H. Nuckols Consulting. Mr. Nuckols is prepared to execute a standard confidentiality agreement at the request of any contractor. Individual contractor responses will not be discussed in documents that enter the public domain, but common use or disposal methods may be discussed generically in budget or report documents, as well as economic ranges and budget recommendations.

## Requested Response Content

Methodology - Describe general methodology of planned trailer provision, retrieval, whole tire transport destinations, processing capabilities (capacity and products) and planned product markets or disposal locations. Describe any impact that contamination with sand or organic matter would have on the planned methods, contamination limits and any variations in methodology to be followed on contaminated tires. Costs associated with “normal” processing/ disposal method and any planned alternatives for contaminated tires should be stated in the “Normal Tires” and “Alternatives 1 and 2” columns on the attached estimated cost summary.

Transportation – Describe ability to provide, stage and transport up to 7 trailers/week from the LCU to the processing/disposal site, assuming that the LCU lands 2-3 times per week with 2-3 loaded trailers each time that can be driven off the LCU at an accessible dock at Port Everglades, Florida. Trailers must be off-loaded and empty trailers loaded immediately to minimize LCU dock time. Loaded trailers must be removed from Port Everglades within 6-8 hours to minimize any odor impact near the dock areas that also serve passenger ships. Describe the basis for transportation costs provided in the cost summary.

Processing – Provide any additional description of the location, capability, and planned products, including variations for contaminated tires, not covered in the preceding methodology section, and the basis for identified processing costs.

Products - Support planned product markets and/or disposal alternatives by describing current and planned market participation or disposal agreements.

Additional Information – Discuss the impact, if any, that variations from projected volumes would have on planned methodology and costs. Also, provide any additional information or alternatives that you feel are relevant to project execution. Please raise any issues that you feel are important but unresolved at this point.

The response can be brief and focused on specific plans. There is no need for lengthy general marketing-oriented discussions.

Excel Spreadsheet provided to tire processing companies

OSBORNE REEF TIRE ABATEMENT PROJECT  
ESTIMATED COST SUMMARY

ESTIMATED COST (\$/TON) BASED ON 500,000 TIRES IN 2.5 YEARS			
ACTIVITY	NORMAL TIRES	ALTERNATIVE 1 - CONTAMINATED TIRES	ALTERNATIVE 2 - CONTAMINATED TIRES
Transportation			
Port Trailer Staging			
Trailer Transport			
Processing			
Disposal			
Other (describe in text)			
TOTAL	\$0	\$0	\$0
Mobilization/demobilization (as total \$)			

ESTIMATED COST (\$/TON) BASED ON 750,000 TIRES IN 2.5 YEARS			
Transportation			
Port Trailer Staging			
Trailer Transport			
Processing			
Disposal			
Other (describe in text)			
TOTAL	\$0	\$0	\$0
Mobilization/demobilization (as total \$)			

ESTIMATED COST (\$/TON) BASED ON 250,000 TIRES IN 2.5 YEARS			
Transportation			
Port Trailer Staging			
Trailer Transport			
Processing			
Disposal			
Other (describe in text)			
TOTAL	\$0	\$0	\$0
Mobilization/demobilization (as total \$)			