

APPENDIX L

Tire Island

Tire Island

TIRE ISLAND SURVEY & REPAIR RECOMMENDATIONS

The Coronado Cays “Tire Island” wave attenuator is located approximately 900 feet southeast of The Point cul-de-sac on Green Turtle Cay. The wave attenuator consists of seven 12-inch square concrete piles spaced generally 25 to 30 feet apart. Since its construction in the 1980s, the rubber tires surrounding the piles have largely deteriorated. During a site visit on June 4, 2021, we observed only two of the piles with tires floating at water level. Bottom elevation of bay muds/sand was generally -3.8 feet MLLW. There is some spalling of the concrete piles, with rebar exposed in the upper portions of the piles. The base of the piles are thickly encrusted with marine life. A debris field ranging a distance of 10 to 20 feet from the piles in either direction and between each pile consisted of scattered minor concrete debris, a concrete block approximately 2 feet in height, several 12-inch square piles, what appeared to be two boat masts, and encrusted rubber tires scattered around the bottom near the base of the piles. Additional detail and photographs are provided in Appendix L.

Given the existing orientation of the piles, Tire Island is able to attenuate waves arriving from the east to southeast, providing a benefit to twelve to fifteen residences from easterly to southeasterly Santa Ana winds. Winds from the east to southeast occur about 23 days per year (6.4%) on average measured at the North Island Naval Station (Figure L-1).

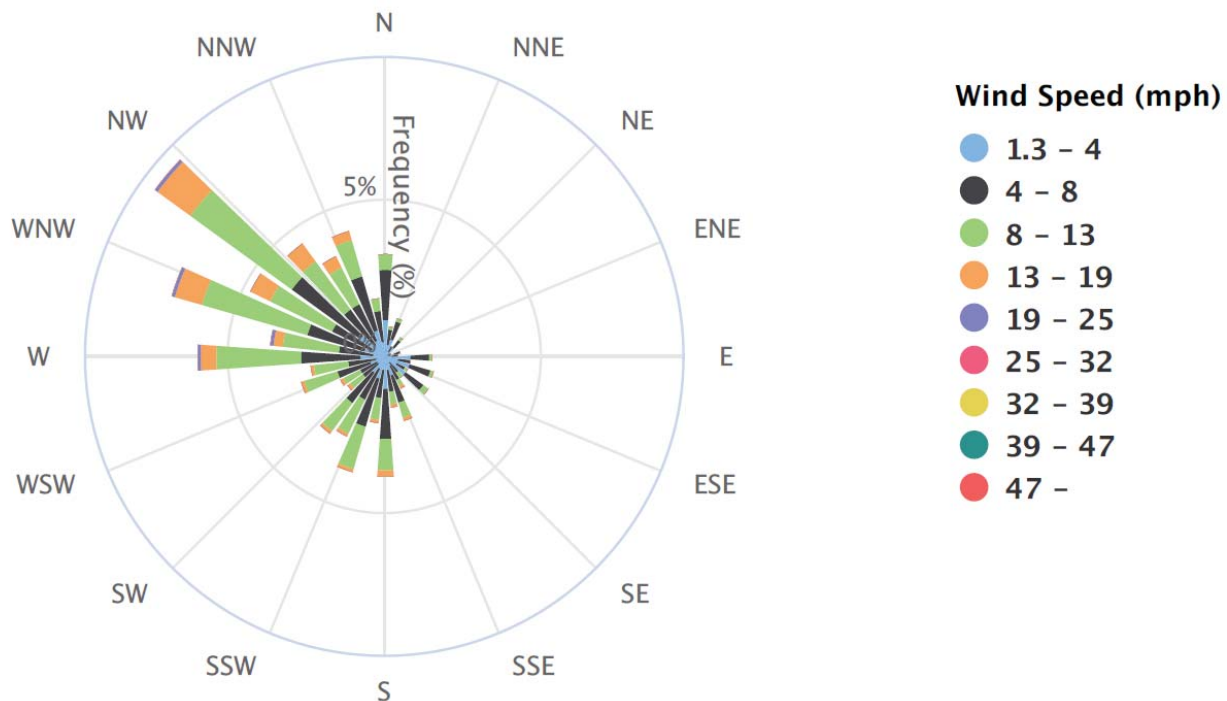


Figure L-1 – Wind Rose from Coronado North Island Naval Station (NOAA, 1945-2021)

More importantly, and as indicated on the wind rose, of the 23 days per year when winds come from the east through southeast, the majority of wind speeds these days are on the order of 4 to 8 miles per hour (mph). Strong Santa Anas, with winds over 30 mph, may occur only once or twice per year, with most of these winds from the south through southwest. Strong Santa



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Anas from the east through southeast may occur only once or twice per decade, with a 100-year design wind speed of 60 mph. For the 60 mph design wind speed, wave heights may approach approximately 2.5 feet with a wave period of 3 seconds, limited by the relatively short fetch length of 1.5 miles, along with a shallow water depth of less than 10 feet. Twenty to 30 mph winds from the east through southeast generate wave heights on the order of 1 to 1½ feet with wave periods of 2 seconds. Following guidance provided by the United States Army Corps of Engineers and Pile Buck, Inc. for floating scrap-tire breakwaters, we developed a graph showing the required Tire Island width for a given attenuated wave height and reduction in wave energy (Figure L-2).

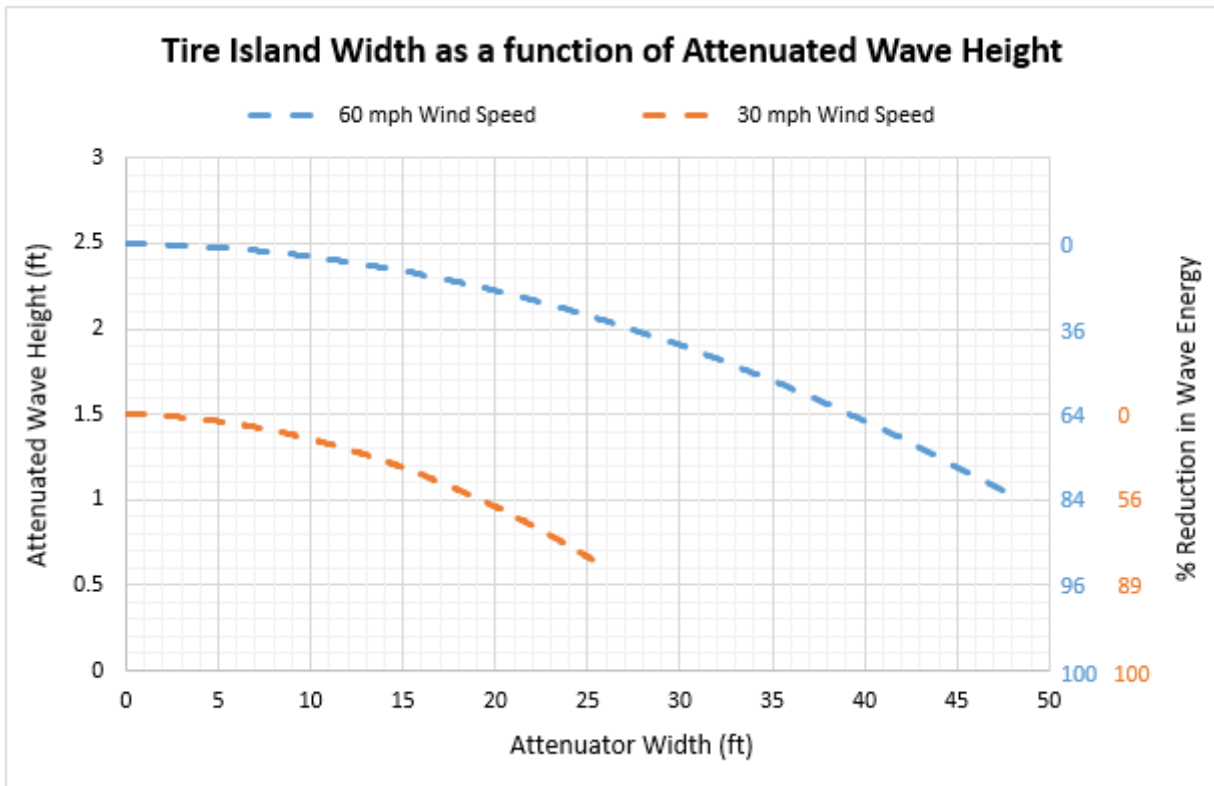


Figure L-2 – Tire Island Width as a function of Attenuated Wave Height

If it is desired to restore the wave attenuator at Tire Island, we recommend constructing a Goodyear Tire and Rubber Company scrap-tire floating breakwater, which uses a modular building block design. Each building block consists of 18 individual tires secured together to form a 7-foot-wide, 6.5-foot-long, and 2.5-foot deep module. The tires are stacked vertically and tied together as shown on Figure L-3.

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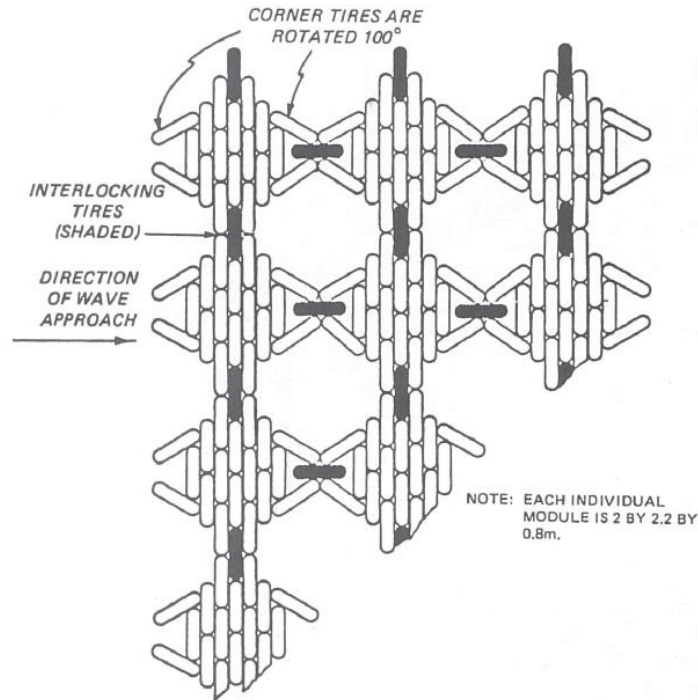


Figure L-3 – Assembly of Goodyear Tire and Rubber Company Floating Breakwater

The distance between the two Tire Island end piles is approximately 167 feet. Since each tire module is 6.5 feet long, 26 tire modules will be needed to span the total length. Using one row of tire modules would provide a 7-foot-wide attenuator, two rows a 14-foot-wide-attenuator, and so on. Table L-1 summarizes the number of tire modules, number of tires, attenuated wave height, and percent reduction in wave energy for a given attenuator width for both the 60 mph design wind speed and a more typical annual Santa Ana wind-generated wave from 30 mph. The depth of the tire attenuator should extend at least 1.25 feet (one half the incident wave height) below the water surface. Since each tire module is 2.5-feet deep, only one layer of tire modules is needed.

Table L-1 – Tire Island Design Considerations

ATTENUATOR WIDTH (FT)	NUMBER OF TIRE MODULES	NUMBER OF TIRES	60 MPH		30 MPH	
			ATTENUATED WAVE HEIGHT (FT)	% REDUCTION IN WAVE ENERGY	ATTENUATED WAVE HEIGHT (FT)	% REDUCTION IN WAVE ENERGY
0	0	0	2.5	0	1.5	0
7	26	468	2.46	3	1.42	10
14	52	936	2.36	11	1.22	34
21	78	1404	2.20	22	0.89	65
28	104	1872	1.98	37	0.43	92
35	130	2340	1.71	53	-	-

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The tire modules can easily be constructed on Grand Caribe Island, and then transported to Tire Island and interlocked. Goodyear Tire and Rubber Company found that 1/2-inch-diameter open-link chain proved to be the best material for interlocking the tire modules. Air trapped in the tire crowns provides sufficient buoyancy to keep floating tire breakwaters afloat for a short period time. However, to ensure that the structure remains in a position to provide protection for up to an estimated 10 years, and to compensate for the added weight of marine growth, supplemental flotation should be added in every tire. Urethane foam can be poured into the tires, or molded polyethylene floats can be inserted into the tires.

We would also recommend that all seven of the 12-inch square concrete piles be replaced with new 28-foot-long, 12"x12" concrete piles set with a top-of-pile elevation of +13 feet MLLW.



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Photo 1: Dive skiff attached to a boat mast looking southwest at the southerly 4 piles that made up Tire Island. By zooming in, one can see the badly deteriorated condition of the concrete piles.



Photo 2: Submerged tire on Pile No. 4.

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Photo 3: Northerly Tire Island Piles.



Photo 4: Close-up of badly deteriorated condition of Tire Island piles.