No. 409PA15 THIRD DISTRICT

SUPREME COURT OF NORTH CAROLINA
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GREGORY P. NIES and DIANE S. NIES, Plaintiffs - Appellants,	)	
v.	)	From Carteret County No. 11-CVS-1569 No. COA15-169
TOWN OF EMERALD ISLE, a North Carolina Municipality, Defendant - Appellee.	)	

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AMICUS CURIAE BRIEF OF THE COUNTY OF DARE, THE COUNTY OF CURRITUCK, THE COUNTY OF HYDE, THE TOWN OF NAGS HEAD, THE TOWN OF KILL DEVIL HILLS, THE TOWN OF KITTY HAWK, THE TOWN OF SOUTHERN SHORES, THE TOWN OF DUCK AND THE NORTH CAROLINA BEACH BUGGY ASSOCIATION, INC.

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****

ISSUES PRESENTED

I. WHETHER UNDER NORTH CAROLINA LAW, THE COURT OF APPEALS CORRECTLY HELD THAT PUBLIC TRUST RIGHTS APPLY TO THE ENTIRE BREADTH OF THE STATE'S OCEAN BEACHES.

II. WHETHER UNDER NORTH CAROLINA LAW, THE COURT OF APPEALS CORRECTLY HELD THAT THE TOWN OF EMERALD ISLE HAS NOT TAKEN ANY PORTION OF THE PLAINTIFFS' PROPERTY.

INTRODUCTION

North Carolina's ocean beaches represent one of the State's most precious public resources. Our state's 320 miles of ocean beaches fuel a 2.9 billion dollar coastal tourism industry that employs 50,000 people.[1] Open, accessible public beaches are not only an attraction; they are a natural resource preserved for the people of our state by constitutional mandate. N.C. Const., Art. XIV, Sec. 5. North Carolina has a long history of public use of the ocean beaches along the State's ambulatory border with the Atlantic Ocean. In recent times, public beach usage has increased along with the development of private property along the oceanfront. The collision of these two competing interests has driven litigation over both the scope of the area of the ocean beaches subject to public trust rights and the scope of the public trust rights themselves. A careful consideration of the historical usage of the ocean beaches along with the various appellate cases that have considered these issues shows that much of the confusion regarding the scope of the area of the ocean beaches has been driven by the use of the two terms Mean High Water Mark ("MHW Mark") and Mean High Water Line ("MHW Line"). The MHW Mark at common law was associated with a physical mark or natural indicator that took into account wave action, while

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[1]Legislative Research Commission Report to the 2001 General Assembly, "Coastal Beach Movement, Beach Renourishment and Storm Mitigation", p. 11, 23-34. See also, 2000 N.C. Sess. Laws 67 § 13.9(a).

the MHW Line it has been equated with arose in much more recent jurisprudence and has been specifically measured and calculated so as to exclude wave runup along the beaches. Over time, the conflict associated with the two terms has arisen as a conflict between the historical usage of the State's ocean beaches and the law used to describe that usage. Consistent with long historical usage, the Court of Appeals applied public trust rights to the entirety of the ocean beaches, and clarified how the case law, statutes and history should be construed together. The Court of Appeals harmonized these legal principles and ended years of confusion. This Court should affirm the Court of Appeals and allow the public to continue to use the State's ocean beaches in the manner they have been used since time immemorial.

INTERESTS OF THE AMICI CURIAE

The northern Outer Banks of North Carolina compromise approximately 135 miles of the State's ocean beaches reaching from Ocracoke Inlet to the Virginia border. The 15 miles of coastline on Ocracoke Island are part of Hyde County. Dare County includes the approximately 87 miles of coastline from Hatteras Inlet to the border with Currituck County. Within Dare County's coastline is the entirety of Hatteras Island, and the municipalities of Nags Head (11 miles), Kill Devil Hills (5 miles), Kitty Hawk (4 miles), Southern Shores (4 miles) and Duck (6 miles). Much of Hatteras Island's coastline is comprised of the Pea Island National Wildlife Refuge

and the Cape Hatteras National Seashore. However, full time residents and vacationers live and own property within the villages of Rodanthe, Waves, Salvo, Frisco and Hatteras. All of the Dare County municipalities operate motor vehicles on the ocean beaches for the purpose of public works and public safety. All also regulate the use of private motor vehicles upon the ocean beaches, with Nags Head and Kill Devil Hills allowing such usage by permit from approximately October 1 through May 1. Citizens and visitors alike have driven upon the beaches of Dare County for a very long time, and at times it has been the only way to travel between certain areas. (Wayne Gray Affidavit, Appx. p. 5).

Nags Head performed a beach nourishment project upon all, but the northern most mile of its shoreline in 2011 at a cost of approximately $36 million. In order to do so, the Town obtained approximately 1,300 nourishment easements with well over 1,000 of them being obtained voluntarily for no value. The remainder were condemned and all, but about a dozen have resulted in a $50 per lot *de minimis* payment through default or consent judgments. The remaining dozen are being litigated with approximately ten being stayed while two are moving forward. Of those two cases, in the Town of Nags Head v. Richardson, in August of last year the Honorable Special Judge Gary E. Trawick decided that the application of public trust rights to the entire ocean beach consistent with the Court of Appeals opinion in this

case. (Order date August 25, 2015, Appx. p. 1). Dare County funded a significant portion of the cost of Nags Head's nourishment project through its occupancy and sales taxes which are driven primarily by tourism.

Kill Devil Hills, Kitty Hawk and Duck are embarking upon a beach nourishment project planned for 2017. While most of the easements for their joint project have been provided voluntarily at no charge, there remains the potential for some easements to result in a condemnation actions being filed. Similarly, Dare County is planning a beach nourishment project for a portion of the oceanfront in Buxton and recently performed a nourishment project in a portion of Rodanthe. All of these projects are being funded substantially with Dare County occupancy and sales taxes.

In 1999 it was estimated that the effective peak seasonal daytime population of Dare County surpassed 230,000 people which is nearly seven times its resident population. During the twelve week peak tourist season, the tourist population rotates approximately weekly basis totaling between approximately 1.6 million and 2.3 million visitors. In 2014, that resulted in $1.019 billion into the local economy, 12,300 jobs, and $207.24 million in payroll. Tourism spending in Dare County in 2014 ranked 4th out of 100 counties in the State. A 2015 survey of visitors found that 87.7% came to the Dare County Outer Banks for the "beach." That was the highest

point of interest by far with next being almost 20% points lower for "scenic drives." Duck's official population of 369 people swells to between 20,000 and 25,000 people during the peak of tourist season.

Currituck County begins its 23 miles of coastline just north of Duck, and the northern most 11 miles of the county, known as Carova, includes multiple developed vacation home subdivisions which are only accessible by motor vehicle via travel upon the ocean beach. The Currituck Outer Banks population was 542 permanent residents during the 2010 U.S. Census, but swells to approximately 65,000 people during the peak of tourist season. Of the 558 ocean front properties in Corolla and 396 in Carova, there are less than 45 houses with full-time residents according to Currituck Tax records. On the Currituck Outer Banks, there are 3,101 rental properties. The Tourism industry is vital to Currituck County for the amount of revenue generated by occupancy and sales tax from visitors, as well as the many jobs available with local businesses that are involved in Tourism.

The North Carolina Beach Buggy Association, Inc. ("NCBBA") is a non-profit organization established in 1964, dedicated to the preservation of and vehicular access to the natural beach resources of the Outer Banks through conservation, a code of ethics for beach behavior and support of local, state, federal officials and other organizations dedicated to these same goals. NCBBA currently has approximately

3,800 members from across the United States. The NCBBA is a conservation organization, hosting four Operation Beach Respect clean-ups each year(for 36 years), sponsoring five scholarships awarded each year to area students, supporting local charities and organizations as well as donations in times of emergencies, hosting an Annual Red Drum Fishing Tournament each October, sponsoring a Youth Fishing Tournament each July and publishing a quarterly newsletter for members. The ability to drive and walk upon the ocean beaches is essential to the NCBBA's mission.

The issue of public rights to use of the ocean beaches via foot and vehicle traffic is of central importance to this case and to all of the amici curiae herein. An opinion by this Court resulting in a change in the application of public trust rights to the ocean beach will very likely have far reaching negative effects upon tourism, jobs, public safety, public convenience, revenue, beach nourishment and litigation for each of the amici curiae.

ARGUMENT

I. THE COURT OF APPEALS CORRECTLY HELD THAT PUBLIC TRUST RIGHTS APPLY TO THE ENTIRE BREADTH OF THE STATE'S OCEAN BEACHES

A. North Carolina's Public Trust Doctrine Generally[2]

The courts look to the underlying state law of the jurisdiction to determine the scope and application of public trust rights. Stop the Beach Renourishment, Inc. v. Florida Dept. of Envtl. Prot., 130 S. Ct. 2592, 2597, 177 L. Ed. 2d 184 (2010) (citations omitted). In North Carolina, the State's ocean beaches include the State owned portion of the beach located seaward of the MHW Mark (the "wet sand beach") and the portion of the beach located between the MHW Mark and the landward extent of the ocean beach (the "dry sand beach") which may be privately owned. See N.C.G.S. § 77-20(a) and (e); see also, N.C.G.S. § 113-131(e) (2015) (recognizing that "land and water areas, both public and private" can be subject to public trust rights). The North Carolina General Assembly has established that "[n]atural indicators of the landward extent of the ocean beaches include, but are not limited to, the first line of stable, natural vegetation; the toe of the frontal dune; and

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[2]See generally, Kalo, Joseph J., The Changing Face of the Shoreline: Public and Private Rights to the Natural and Nourished Dry Sand Beaches of North Carolina, 78 N.C.L.Rev. 1869 (2000) ("Kalo Art."). Professor Kalo's insights into coastal law have been accepted by North Carolina courts on multiple occasions. See, e.g., Gwathmey v. State, 342 N.C. 287, 293, 464 S.E.2d 674, 677-8 (1995).

the storm trash line." N.C.G.S. § 77-20(e). Thus, the entire area of an ocean beach in North Carolina is subject to public trust rights. See N.C.G.S. § 77-20(d) and (e). Such rights "include, but are not limited to, the right to navigate, swim, hunt, fish, and enjoy all recreational activities in the watercourses of the State and the right to freely use and enjoy the State's ocean and estuarine beaches and public access to the beaches." N.C.G.S. § 1-45.1; Fabrikant v. Currituck Co., 174 N.C. App. 30, 42, 621 S.E.2d 19, 28 (2005); Friends of Hatteras Island v. Coastal Resources Comm., 117 N.C. App. 556, 452 S.E.2d 337 (1995). These rights may be exercised "by the public by foot, vehicle and boat... ." West v. Slick, 313 N.C. 33, 62, 326 S.E.2d 601, 618 (1985). Multiple other cases show that the public has used the entire beach strand for vehicular travel at least since the advent of the automobile. Wise v. Hollowell, 205 N.C. 286 (1933); Town of Emerald Isle v. State of N.C., 320 N.C. 640, 360 S.E. 2d 756 (1987); see also, Kalo Art. at n. 32.

B. The Court of Appeals Holding is Consistent with Cases, Statutes and Physical Facts that are the Foundation for North Carolina's Public Trust Doctrine

(1) The Earliest North Carolina Public Trust Rights Cases Used a Natural Physical Indicator to Determine the Mean High Water Mark

Early North Carolina case law recognized that the scope of public use of the ocean beach, like the bank of a stream, included leaving it open for use of the

traveling, fishing, whaling and netting public and the private landowner did not "acquire any special or particular interest . . . over any other member of the public." Shepard's Point Land Co. v. Atlantic Hotel, 132 N.C. 517, 44 S.E. 39 (1903). The land area underneath the navigable waters of the oceans and the sounds were treated as a public highway. Collins v. Benbury, 3 Ired. 277, 25 N.C. 277 (1842); Lewis v. Keeling, 1 Jones (NC) 299, 46 N.C. 299 (1854). The right to use this highway was "superior to any incident to the ownership of the shores." Broadnax v. Baker, 94 N. C. 675 (1886). The uses available to the public were "for all purposes of pleasure or profit of all water courses, whether tidal or inland, that are in their natural conditions capable of such use." State v. Twiford, 136 N.C. 603, 48 S.E. 586 (1904) (emphasis added).

In considering the geographic scope of the ocean beaches, the courts recognized that land "at any time covered by a navigable water in its natural state is deemed to be in the same state as if it were in the bed of the water. . ." and was subject to public trust rights. Ward v. Willis, 51 N.C. 183, 185 (1858) (emphasis added). While rivers, sounds and estuaries might have very little shoreline that "at any time is covered" by their waters, the existence of ocean waves and great scale of the Atlantic Ocean cause a significant portion of the shoreline to be covered at times by ocean waters. "That is not confined to such portion of the soil as is always covered

by the water, but comprehends also the shores or such land as is between the lines of the ordinary ebb and reflux of the tide." Id. (emphasis added); see also, McKenzie v. Hulet, 4 N.C. (Taylor) 613, 614 (1817) (referencing the "ordinary high water mark"). "When, therefore, the sea, or a bay, is named as a boundary, the line of ordinary high-water mark is always intended where the common law prevails." United States v. Pacheco, 69 U.S. 587, 590, 17 L. Ed. 865 (1864).

Like the natural indicators of the landward extent of the ocean beaches stated in G.S. 77-20(e), the ordinary high-water mark referenced at common law was a physical mark upon the ground:

> The ordinary high water mark is the usual boundary between the bed of navigable watercourse and the adjacent up-land. According to the weight of authority, the ordinary high water mark is the line that water impresses upon the soil by covering it for sufficient periods to deprive it of vegetation and to destroy its value for agriculture. Unlike the mean high water line ... the ordinary high water mark does not represent the intersection of a particular vertical datum with the shore. Instead it is a physical mark caused by the action of the water on the land, and refers to a point at which the character of the soil and vegetation, if any, differs from that of the upland.

Frank E. Maloney & Richard C. Ausness, The Use and Legal Significance of the Mean High Water Line in Coastal Boundary Mapping, 53 N.C. L. Rev. 184, 260-61 (1974) (explaining the meaning of the "ordinary high water mark" and providing history of NOAA mapping of coastline). Therefore, the earliest public trust cases in

North Carolina contemplated a physical mark on the oceanfront or the absence of vegetation consistent with the natural indicators referenced in N.C.G.S. § 77-20(e).

(2) North Carolina's Recognition of the Borax Tidal Epoch Mean High Water Analysis Creates Confusion in Locating the MHW Mark and the Area of Beach Subject to Public Trust Rights

In 1970, the North Carolina Supreme Court held "that the seaward boundary of plaintiff's lots is fixed at the high-water mark [and that t]he high-water mark is generally computed as a mean or average high-tide, and not as the extreme height of the water." Carolina Beach Fishing Pier, Inc. v. Town of Carolina Beach, 277 N.C. 297, 303, 177 S.E.2d 513, 516 (1970) (citing People v. William Kent Estate Co., 242 Cal.App.2d 156, 51 Cal.Rptr. 215 (1966); Borax Consol. v. City of Los Angeles, 296 U.S. 10, 27, 56 S. Ct. 23, 31, 80 L. Ed. 9 (1935)). In doing so, the Court implicitly seemed to adopt the Borax holding that "an average of 18.6 years should be determined as near as possible." Borax, 296 U.S. at 27. Both William Kent and Borax held that in California, at least, the mean high water mark was not a physical mark upon the beach, but instead a fixed elevation equal to the average tidal water heights (not including wave run up) calculated over an approximately 19 year period called a lunar epoch. Id. at 26. That fixed elevation could be used to precisely locate a line upon a parcel of property on a given date. William Kent, 242 Cal.App.2d at 160. The Borax Court based this decision on the "definition of mean high tide, as given by the

United States Coast and Geodetic Survey[3] … ." Borax, 296 U.S. at 26. Interestingly, in its analysis, the Borax court treated this new mean high water analysis as if there had been such calculations of tidal epochs throughout history. Borax, 296 U.S. at 24-26. However, the method of reduction of tides by harmonic analysis was not even devised until 1867, (See https://tidesandcurrents.noaa.gov/predhist.html; Appx. p. 10), and certainly the actual calculations of average tides over a lunar epoch were never available at common law or to North Carolinians during the later 19th and early 20th century. Borax nationally, and Carolina Beach Fishing Pier in North Carolina gave rise to a legal fiction that initiated substantial confusion between the historical use of the ocean beaches and the scope of the area of the ocean beaches.

(3) N.C.G.S. § 77-20 Codifies the Mean High Water Mark as the Boundary of Public and Private Oceanfront Lands Without Clarifying the Use of a Natural Physical Indicator or a Tidal Datum Driven Location of the Mean High Water Mark

Beginning in 1971, with the adoption of a new State Constitution, North Carolina began to further codify its coastal laws and expressly recognized the importance of the State's ocean beaches and the power of local governments[4] to adopt

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[3]At the time of the Borax decision, the U.S. Coast and Geodetic Survey maintained and calculated tidal datum information. N.O.A.A. currently maintains and calculates tidal datum information for the United States. (See https://tidesandcurrents.noaa.gov/predhist.html, Appx. p. 10).

[4]Texfi Indus., Inc. v. City of Fayetteville, 44 N.C. App. 268, 273, 261 S.E.2d 21, 25 (1979) aff'd, 301 N.C. 1, 269 S.E.2d 142 (1980) ("municipal corporations are political

regulations "to preserve as a part of the common heritage of this State its . . . beaches . . . and places of beauty." N.C. Const. Art. XIV, § 5; Parker v. New Hanover Co., 173 N.C. App. 644, 654, 619 S.E.2d 868, 875-76 (2005). Shortly thereafter, the General Assembly adopted the Coastal Area Management Act of 1974 ("CAMA") which created and provided authority to a State agency to regulate development upon the oceanfront. One of the goals of CAMA is "[t]o establish policies, guidelines and standards for… the [p]rotection of present common-law and statutory public rights in the lands and waters of the coastal area." N.C.G.S. § 113A-102(b)(4).[5] In 1979, the General Assembly adopted N.C.G.S. § 77-20 which codified the seaward boundary of private property as the "mean high water mark," but did not further define the term or disclose any direction for locating it on the ground. N.C.G.S. § 77-20(a).

(4) The Concerned Citizens and Cooper Cases Apply Public Trust Rights

In 1991, the North Carolina Supreme Court rejected a litigant's contention that

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subdivisions of the State.").

[5]Over time, various CAMA regulations have been adopted which further demonstrate that public trust rights apply to the entire ocean beach. See 15A NCAC 7H.0207(a); 15A NC ADC 7H.0106(1) (defining "normal high water" as "the ordinary extent of high tide based on site conditions such as presence and location of vegetation which has its distribution influenced by tidal action, and the location of the apparent high tide line"); 15A NCAC 7H.0305(a)(1) (defining "ocean beach" consistent with N.C.G.S. § 77-20(e)); 15A NC ADC 7M.0202(a) (recognizing public trust rights in the entire ocean beach); 15A NC ADC 7M.0301(a) (recognizing public trust rights in the ocean beach and public trust waters); 15A NC ADC 7M.0302(4) & (5) (equating "public trust waters" to "public trust area" and providing a broader definition for "beach" consistent with N.C.G.S. § 77-20(e)).

public trust rights cannot exist landward of the MHW Mark when it expressly disavowed the portion of a "Court of Appeals opinion to the effect that the public trust doctrine will not secure public access to a public beach across the land of a private property owner." Concerned Citizens of Brunswick Cnty. Taxpayers Ass'n v. State, 329 N.C. 37, 55, 404 S.E.2d 677, 688 (1991)[6] ("Concerned Citizens II"). In doing so, the Supreme Court expressly rejected the Court of Appeals' statement that the public trust doctrine could not be extended "to deprive individual property owners of some portion of their property rights without compensation." Concerned Citizens of Brunswick Cnty. Taxpayers Ass'n v. Holden Beach Enterprises, Inc., 95 N.C. App. 38, 46, 381 S.E.2d 810, 815 (1989) ("Concerned Citizens I") rev'd sub nom. Concerned Citizens II. Careful consideration of the specific language of Concerned Citizens I that was disavowed shows that public trust rights should be applied against privately owned property without compensation and that the public trust doctrine itself could be used to shield the unlawful use of property subject to public trust rights even against a private property owner. Id.

Also in 1991 following consideration of the Concerned Citizens II case, the

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[6]The Concerned Citizens cases involved perpendicular access across the private land owners' uplands to reach the shoreline. If such rights exist allowing the public to perpendicularly cross a private owners' uplands, they must surely exist along the dry sand beach which runs parallel to the ocean waters themselves. See also, Kalo Art. at n. 35; Gaither v. Hospital, 235 N.C. 431, 70 S.E.2d 680 (1952) (finding no perpendicular access right to river);

United States District Court for the Eastern District of North Carolina considered the scope of public trust rights in a case where a landowner espoused their existence on the dry sand beach in an attempt to avoid taxation. Cooper v. U.S., 779 F.Supp. 833 (E.D.N.C. 1991). In what is arguably *dicta*, the District Court noted that the scope of public trust rights to the dry sand beach was an "unsettled question" and "unclear." Cooper, 779 F.Supp. at 835 (citing Concerned Citizens of Brunswick County Taxpayers Ass'n v. State, 329 N.C. 37, 55, 404 S.E.2d 677, 688 (1991).

(5) The General Assembly Adopts N.C.G.S. § 77-20(d) & (e) and Recognizes the Common Law Right of the Public to the Customary Free Use and Enjoyment of the Ocean Beaches

In 1998, the General Assembly adopted "An Act … recognize the common law right of the public to the customary free use and enjoyment of the ocean beaches." 1998 N.C. Sess. Law 225. The act amended N.C.G.S. § 77-20 to add subsections (d) and (e). Given the presumption that the Legislature acts with full knowledge of existing law, the adoption of N.C.G.S. § 77-20(d) and (e) in 1998 must be read as an intentional clarification of the application of public trust rights to the entire ocean beach, at least in part, in response to Cooper v. U.S.; accord, Kalo Art., at pp. 1895-96. The Nies position that N.C.G.S. § 77-20(d) and (e) clarifies the contrary, App. Br. 29-30, cannot be maintained where the amendment clearly delineates the landward extent of the ocean beaches as including the dry sand beach and provides

that the public has customarily used the ocean beaches since time immemorial. If read the way the Nies suggest, the N.C.G.S. § 77-20(d) and (e) provide confusion rather than clarity.

C. The Use of a Nineteen Year Epoch Driven Mean High Water Line as the Delineation of the Landward Extent of the Beach Subject to Public Trust Rights Leaves No Beach Upon Which Those Rights May Be Exercised Without Applying Public Trust Rights to the Dry Sand Beach

As noted above, in North Carolina private property ownership ends and State ownership begins at the "mean high water mark" of the Atlantic Ocean. N.C.G.S. 77-20(a) (2015). However, existing case law suggests that the courts' use of the common law fiction created by adoption of the 18.6 year epoch standard have equated the MHW Mark and MHW Line in a manner that is contradictory. Prior to the Court of Appeals decision in this case, no North Carolina appellate court had clearly defined how to determine the location of the MHW Mark under G.S. 77-20(a). Carolina Beach Fishing Pier, Inc. v. Town of Carolina Beach, 277 N.C. 297, 303, 177 S.E.2d 513, 516 (1970) "generally computed as a mean or average high-tide, and not as the extreme height of the water"). However, like the early North Carolina case law, multiple recent decisions have upheld regulatory approximations of the MHW Mark based on natural indicators as being sufficient evidence. See Webb v. N.C. Dept. of Env't, Health & Natural Res., Coastal Res. Comm'n, 102 N.C. App. 767, 772, 404

S.E.2d 29, 32 (1991); Fisher v. Town of Nags Head, 220 N.C. App. 478, 484-85, 725 S.E.2d 99, 105 (2012) appeal dismissed and rev. denied, 366 N.C. 244, 731 S.E.2d 166 (2012); Hassinger v. Tideland Elec. Membership Corp., 627 F. Supp. 65, 70 (E.D.N.C. 1985) aff'd, 781 F.2d 1022 (4th Cir. 1986).

In the beach nourishment easement related case of Fisher v. Town of Nags Head, the Court of Appeals held that the "mean high water mark. . . can be located by natural indicators and observation." 220 N.C. App. 478, 485, 725 S.E.2d 99, 105 (2012). Such a determination is consistent with the general public practice of treating the entire ocean beach as being subject to public trust rights. In other cases, the State's appellate courts require application of an average of the high water mark over time, typically an approximately 19 year lunar epoch. See Carolina Beach Fishing Pier, Inc. v. Town of Carolina Beach, 277 N.C. 297, 303, 177 S.E.2d 513, 516 (1970) (citing Borax Consol. v. City of Los Angeles, 296 U.S. 10, 27, 56 S. Ct. 23, 31, 80 L. Ed. 9 (1935) (holding that "an average of 18.6 years should be determined as ne as near as possible")).

There is no organization or agency currently providing analysis of physical high water marks over a 19-year period, and the technology for doing so is still in its infancy. However, the National Oceanic and Atmospheric Administration ("NOAA") currently measures and maintains the MHW elevation information that is averaged

over a lunar epoch at various different coastal tide stations in the United States. As an example, on the northern Outer Banks, the NOAA tide station with the most relevant local epoch being measured is located at the U.S. Army Corps of Engineers, Duck Research Pier and covers the lunar epoch from 1983-2001. (http://tidesandcurrents.noaa.gov/datums.html?id=8651370; Appx. p. 12). The current mean high water tidal datum at the Duck Research Pier is 1.18ft. above NAVD88[7]. Id. To locate the MHW Line based on this tidal datum requires a surveyor to locate and plot a line at the MHW Line datum elevation. A MHW Line point is where the elevation of the land on a parcel of oceanfront property intersects with the MHW Line datum elevation determined to be associated with the property's geographic location. Using surveying techniques and equipment, a series of measured MHW Line points can be located on the ground to derive a contour line along the MHW elevation on a parcel of property. That contour line is the MHW Line. Once the MHW Line is located on a parcel of property, a plat can be prepared to illustrate the MHW Line at a specific location by plotting the MHW Line points found and "connecting the dots" to draw the MHW Line. The MHW Line datum elevation stays fixed until NOAA

[7]NAVD88 stands for the North American Vertical Datum of 1988, and is the current generally accepted vertical control datum for use in determining elevations in the United States. In essence, a particular vertical datum is a plus/minus value associated with a known reference point to determine a location in three dimensional space.

releases its analysis of a new epoch period, but the actual MHW Line associated with that elevation on a particular property fluctuates constantly depending on tides, currents and wave action just like the rest of the beach. Sometimes the location of the actual MHW Line on a parcel of property can change considerably over a very short period of time due to erosion and accretion, just like the natural indicators that are located upon the beach. While one can probably approximate the location of a MHW Line after seeing multiple of them located by surveyors, it is not nearly as easy to locate for a layperson as a physical natural indicator such as those listed in N.C.G.S. § 77-20(e) would be.

In consideration of the issue of locating the correct MHW reference, it is important to recognize that NOAA uses the following definitions:

> **High Water Mark**: A line or mark left upon tide flats, beach, or along shore objects indicating the elevation of the intrusion of high water. The mark may be a line of oil or scum on along shore objects, or a more or less continuous deposit of fine shell or debris on the foreshore or berm. This mark is physical evidence of the general height reached by wave run up at recent high waters. It should not be confused with the mean high water line....
>
> **Mean High Water (MHW)**: A tidal datum. The average of all the high water heights observed over the National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch.
>
> **Mean High Water Line (MHWL)**: The line on a chart or map which

> represents the intersection of the land with the water surface at the elevation of mean high water. See shoreline.
>
> **Shoreline (coastline)**: The intersection of the land with the water surface. The shoreline shown on charts represents the line of contact between the land and a selected water elevation. In areas affected by tidal fluctuations, this line of contact is the mean high water line…

(See http://tidesandcurrents.noaa.gov/glossary.html). As one can easily see, the problem with using a NOAA 19-year average MHW Line as the MHW Mark is that it is meant to be the shoreline where water and land intersect based upon lunar tides without regard to the run up of waves. On North Carolina beaches it is quite rare to have a day when there is no wave run up along the beach, particularly north of Cape Hatteras. Therefore, by definition there will be no actual ocean beach seaward of a NOAA derived mean high water line and the use of such a line as the landward extent of public trust rights would leave no beach upon which the public could actually exercise those rights.

The Nies contend that N.C.G.S. § 77-20 delineates the ocean beach subject to public trust rights as being solely that area of the beach seaward of the MHW Mark. Such a reading is untenable and would make the majority of N.C.G.S. § 77-20(d) and (e) meaningless if the MHW Mark under N.C.G.S. § 77-20 is determined by use of a NOAA data driven MHW Line. Brown v. N. C. Dept. of Env't & Natural Res., 212 N.C.App. 337, 714 S.E.2d 154 (2011) ("If possible, a statute must be interpreted so

as to give meaning to all its provisions."). Such a contention also presents a clear conflict with this Court's statement in West v. Slick that "passage by the public by foot, vehicle and boat must be free and substantially unobstructed over the entire width of the foreshore." West v. Slick, 313 N.C. 33, 62, 326 S.E.2d 601, 618 (1985) (defining the foreshore as being seaward of the mean high water mark). No sober knowledgeable adult driving upon the beach would take their motor vehicle into the water, and most people do not walk, fish or recreate along the portion of the ocean beach that is in the water. See Kalo Art., n. 27. The beach area that people typically use is located between the toe of the dune and a NOAA MHW Line rather than seaward of the MHW Line that is located in the water. (See e.g., Order Appx. pp. 3-4, Ex. A & B; Image of Beach Usage Appx. p. 20).

The confusion arising over time between the historical customary use of the ocean beaches and specific language in cases can clearly be seen in the case of Nags Head v. Toloczko. 728 F.3d 391 (4th Cir. 2013). In Toloczko, the 4th Circuit recognized that the Public Trust Doctrine protected the historical usage of the Town's beaches "by the public for transportation and recreational activities." Toloczko, 728 F.3d at 393. However, the 4th Circuit then went on to indicate that "various natural indicators can demarcate public trust lands from private property," while at the same time saying that the relevant area is "seaward of the mean high water mark" that "is

the average of all high tide elevations measured over a nineteen-year period." Id.; Id. n. 1.

The justices and judges who have previously considered this issue clearly operated under an expectation that public trust rights apply to the entirety of the ocean beach as defined under G.S. 77-20(e), but they also mistakenly expected a 19 year average MHW Line to lie near the natural indicators delineated in G.S. 77-20(e). That is just not the case, and it never will be because a NOAA elevation derived MHW Line does not take into account the constant wave run up of our shores. However, an actual high water mark, the ordinary high water mark discussed in North Carolina's earliest cases, will always be in the general vicinity of the natural indicators listed in G.S. 77-20(e). Given this classic misunderstanding, there are only two ways to reconcile the various statutes, cases and customary historical usage of the States ocean beaches:

> (i) Decide that the entire ocean beach from the natural indicators of its landward extent as provided in G.S. 77-20(e) is State owned; or
>
> (ii) Decide that the entire ocean beach from the natural indicators of its landward extent as provided in G.S. 77-20(e) is subject to public trust rights, but that the mean high water mark under G.S. 77-20(a) equates to a NOAA mean high water line and the area between the landward extent of the ocean beach and the mean high water mark/line is privately owned.

North Carolina's historical usage of the ocean beaches and North Carolina's case law

supports either reconciliation. However, the second option, which expands private ownership seaward and overlaps public trust rights on the privately owned portion of the ocean beach, provides the best balance between historical public rights and private rights.

D. The Court of Appeals Correctly Applied Public Trust Rights to the Entirety of the Ocean Beach

In late 2015, the North Carolina Court of Appeals issued its opinion in this case. Nies v. Emerald Isle, ___ N.C.App. ___, 780 S.E.2d 187 (Nov. 17, 2015). In affirming the trial court, the Court of Appeals addressed multiple issues that needed clarification under the law, including the delineation of the MHW Mark, the need to "establish" public trust beaches via some proceeding, and the scope of State ownership of dry sand beach following a beach nourishment project. Id. at 192-197. In addition to each of those issues, the Court confirmed that the scope of public trust rights includes all of the rights under N.C.G.S. 1-45.1 as well as rights for the public and the Town of Emerald Isle to drive upon the ocean beaches within the Town. Id. By finding that these rights were included in the public trust doctrine or otherwise applied to the Town's ocean beaches, the Court further held that the Town's ordinance was not a taking of private property. Id. at 197-202.

(1) The Court of Appeals Correctly Adopted the Mean High Water Line as the Seaward Boundary and Applies Public Trust Rights to the Landward Natural

Indicators of N.C.G.S. § 77-20(e)

The Court of Appeals opinion adopted the second recommendation stated above for reconciling the public's historical usage of the ocean beaches with the existing case and statutory law within the jurisdiction. The Court first recognized that the MHW Mark is not defined by statute, but that the North Carolina Supreme Court had cited Borax with approval as using the "average of all high tides over a period of 18.6 years. In doing so, the Court implicitly recognized that the MHW Mark should be located on the ground as a NOAA tidal datum derived MHW Line. Next, the Court of Appeals correctly applied public trust rights to the entire ocean beach, including the dry sand beach from the MHW Mark to the landward extent of the natural indicators stated in N.C.G.S. 77-20(e), and expressly acknowledged "both the long-standing customary right of access of the public to the dry sand beaches of North Carolina as well as current legislation mandating such." Id. at 196.

(2) The Court of Appeals Correctly Took Judicial Notice of the Historical Use of the State's Ocean Beaches and Correctly Confirmed that North Carolina Does Not Require Establishment of Areas Subject to Public Trust Rights via Litigation or Other Processes

The Court of Appeals also held that N.C.G.S. § 77-20(d) & (e) do not require that some action be brought by the State or a local government to "establish" an area as being subject to public trust rights through the use of various common law

doctrines. While some states have adopted such requirements, the North Carolina Legislature clearly chose not to do so. Compare N.C.G.S. § 77-20(d), (e), with Tex. Code Ann. § 61.013(a), (c) (2012) (defining beaches in Texas as being "public" only "if the public has acquired a right of use or easement to or over the area by prescription, dedication, or has retained a right by virtue of continuous right in the public."). See also Severance v. Patterson, 55 Tex. Sup. Ct. J. 501, 370 S.W.3d 705, 2012 WL 1059341 (2012) (holding that Texas law requires the state to establish an oceanfront easement though a civil action). The Court of Appeals recognized various means of reaching this conclusion and took judicial notice that:

> public right of access to dry sand beaches in North Carolina is so firmly rooted in the custom and history of North Carolina that it has become a part of the public consciousness. Native-born North Carolinians do not generally question whether the public has the right to move freely between the wet sand and dry sand portions of our ocean beaches. Though some states, such as Plaintiffs' home state of New Jersey, recognize different rights of access to their ocean beaches, no such restrictions have traditionally been practiced in North Carolina.

Id. at 196.

To have held otherwise would have disregarded the plain meaning of N.C.G.S. § 77-20(d) & (e), where the Legislature used the present tense to show that in North Carolina, when the statutory provisions where adopted in 1998, the location and extent of the State's ocean beaches was already established and that their landward

extent reached at least to the natural indicators stated in N.C.G.S. § 77-20(e) ("are established"). The Legislature has complete authority to establish the laws of the State including the authority to modify or abolish the common law. Rhyne v. K-Mart Corp., 358 N.C. 160, 169, 594 S.E.2d 1, 8 (2004); Wells v. Guardian Life Ins. Co. of New York, 213 N.C. 178, 195 S.E. 394, 397 (1938); Gwathmey, 342 N.C. at 295-297, 464 S.E.2d at 679-680 (holding that common law lunar tides test for navigable waters did not apply in North Carolina because it had never been applied). The adoption of the 19-year tidal epoch measurement which did not exist at common law is also an example of the North Carolina courts misapplying the common law with regard to public trust rights.

Even if the clear statutory language of N.C.G.S. § 77-20(d) and (e) did not precisely clarify that public trust rights apply to the entirety of the ocean beach as the Nies contend, by amending N.C.G.S. § 77-20, the Legislature also firmly established judicial notice and the legislative facts necessary to reach that conclusion under North Carolina case and common law.[8] The amended legislation established that the public

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[8]See N.C.G.S. 8C-1, Rule 201, commentary; Fed. R. Civ. P, Rule 201, commentary; Courts may take judicial notice of legislative facts to determine the meaning of law or legal doctrines without regard to the standards necessary to consider adjudicative facts. See, 21B Charles Alan Wright & Arthur R. Miller, Fed. Prac. and Pro., Evid. § 5103.2 (2d ed.); 12 Fed. Proc., L. Ed. § 33:52 (current June 2011) ("'Adjudicative facts' are facts that are relevant to a determination of the claims presented in a case; they must be controlling or operative. … "Legislative facts," . . . do not relate specifically to the activities or characteristics of the litigants, but are general facts which help the tribunal decide questions of law, policy, and discretion.").

has "made frequent, uninterrupted, and unobstructed use of the full width and breadth of the ocean beaches of this State from time immemorial" and that the public has rights "to the customary free use and enjoyment of the ocean beaches, which rights remain reserved to the people of this State under the common law and are a part of the common heritage of the State." N.C.G.S. § 77-20(d). These clear legislative statements support any necessary legal conclusion that public trust rights exist and have always existed on the entire ocean beach under some or all of the following legal doctrines:

1. *Easement By Prior Use/Quasi Easement*[9] - See Hodges v. Winchester, 86 N.C. App. 473, 358 S.E. 2d. 81 (1987); Cash v. Craver, 62 N.C. App. 257, 302 S.E.2d 819 (1983); see also, Hetrick, Patrick,

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Legislative facts "cannot be trumped by the fact finding apparatus of a single court." Anheuser-Busch, Inc. v. Schmoke, 63 F.3d 1305, 1312 (4th Cir. 1995) cert. granted, judg. vac. on other grnds., 517 U.S. 1206, 116 S. Ct. 1821 (1996) adopted in part, 101 F.3d 325 (4th Cir. 1996) (citations omitted).

[9]Public trust rights have always been considered paramount to private rights and would not have transferred from the State to private owners without express action by Legislature. See e.g., Gwathmey, 342 N.C. at 304, 464 S.E.2d at 684. Oceanfront properties in North Carolina were all either granted by the British Crown, the Lord's Proprietors or the State to private landowners. Due to the public's use of the ocean beach since time immemorial, an easement by prior use would have arisen in favor of the public over the State which could not have been transferred by grant unless expressly provided for in the grant. See State ex rel. Rohrer v. Credle, 322 N.C. 522, 369 S.E.2d 825 (1988); McKenzie's Ex'rs v. Hulet, 4 N.C. 613, Taylor 181, 1817 WL 1667 (1817); Tatum v. Sawyer, 9 N.C. 226 (1822); Wilson v. Forbes, 13 N.C. 30 (1828); Hatfield v. Grimstead, 7 Ired. 139, 29 N.C. 139 (1846); Ward v. Willis, 51 N.C. 183 (1858); Shepard's Point Land Co. v. Atlantic Hotel, 132 N.C. 517, 44 S.E. 39 (1903); State v. Young, 138 N.C. 571, 50 S.E. 213 (1905); Home Real Estate Loan & Ins. Co. v. Parmele, 214 N.C. 63, 197 S.E. 714 (1938); Resort Dev. Co. v. Parmele, 235 N.C. 689, 71 S.E.2d 474 (1952); Swan Island Club, Inc. v. White, 114 F.Supp. 95 (E.D.N.C. 1953); RJR Technical Co. v. Pratt, 339 N.C. 588, 453 S.E.2d 147 (1995); Gwathmey v. State, 342 N.C. 287, 464 S.E.2d 674 (1995).

Webster's Real Estate Law in North Carolina, §§ 15-14 (along with cases cited therein).

2. *Law of Custom* - State ex rel. Thorton v. Hay, 462 P.2d 671, 673 (Or. 1969); Kalo Art. at n. 106-108; Gwathmey, 342 N.C. at 295-297, 464 S.E.2d at 679-680 (holding that common law lunar tides test for navigable waters did not apply in North Carolina because it had never been applied); Bell v. Smith, 171 N.C. 116, 87 S.E. 987, 989 (1916) (recognizing that each member of the public may exercise the public trust right to fish in Bogue sound and that one may not unlawfully restrict another from doing so who was there first under the "general custom of fishing in the Sound.") But see, Winder v. Blake, 49 N.C. 332, 337 (1857) (declining to apply customary usage to avoid trespass for traversing over uplands to reach a stream for fishing).

3. *Prescriptive Easement*[10] - West v. Slick, 313 N.C. 33, 326 SE 2d 601 (1985); Concerned Citizens of Brunswick County Taxpayers Ass'n v. State, 329 N.C. 37, 55, 404 S.E.2d 677, 688 (1991).

4. *Expanded Public Trust Doctrine* - Matthews v. Bay Head Improvement Assoc., 95 N.J. 306, 471 A2d 355, cert. denied, 469 US 821, 105 S.Ct. 93, 83 L.Ed.2d 39 (1984).

5. *Implied Dedication by Public Use* – See e.g., 3232 Page Ave. Condo. Unit Owner's Ass'n v. City of Virginia Beach, 284 Va. 639, 735 S.E.2d 672 (2012) (holding that public use, city patrolling and city maintenance for 30 years without objection was a dedication of public trust easement upon the Chesapeake Bay); Spaugh v. City of Charlotte, 239 N.C. 149, 159, 79 S.E.2d 748, 756 (1954) (holding implied dedication possible and irrevocable once complete).

Without a doubt, the Legislature intended for public trust rights to apply to the

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[10]Consistent with the "substantial identity" requirement of West and Concerned Citizens I, the description of an easement as being bound by the natural indicators has recently been held sufficient to describe an easement area. Fisher v. Town of Nags Head, 220 N.C. App. 478, 484-85, 725 S.E.2d 99, 105 (2012) appeal dismissed and rev. denied, 366 N.C. 244, 731 S.E.2d 166 (2012).

entirety of the ocean beach and that N.C.G.S. § 77-20 "shall not be construed" otherwise. N.C.G.S. § 77-20(d) & (e) (emphasis added). The Court of Appeals correctly took heed of the language of N.C.G.S. § 77-20(d) & (e) and the clear historical usage of the State's ocean beaches and accordingly took judicial notice of the same. For all of the above reasons, the Court of Appeals correctly held that public trust rights applied to the entirety of the ocean beaches and those beaches are open to the public and the Town of Emerald Isle for use by foot and motor vehicles.

II. THE COURT OF APPEALS CORRECTLY HELD THAT THE TOWN OF EMERALD ISLE HAS NOT TAKEN ANY PORTION OF THE APPELLANTS' PROPERTY

A. The Application of Public Trust Rights to the Dry Sand Beach Includes the Right to Use Motor Vehicles and Is a Background Principle of North Carolina Law That Inhered in Appellants' Title

The United States Supreme Court in Lucas and its progeny have established that a government entity may defend a taking claim by showing that the actions are supported by restrictions that the "background principles of the State's law of property and nuisance already place upon land ownership." Lucas v. S. Carolina Coastal Council, 505 U.S. 1003, 1029, 112 S. Ct. 2886, 2900, 120 L. Ed. 2d 798 (U.S.S.C. 1992); see also, Virginia Elec. & Power Co. v. King, 259 N.C. 219, 221, 130 S.E.2d 318, 320 (1963) ("One cannot condemn that which he owns.").Thus, if a law or decree merely duplicates "the result that could have been achieved in the courts-by

adjacent landowners (or other uniquely affected persons) under the State's law of private nuisance, or by the State under its complementary power to abate nuisances that affect the public generally, or otherwise…," then these defenses would apply. Lucas v. S. Carolina Coastal Council, 505 U.S. 1003, 1029, 112 S. Ct. 2886, 2900, 120 L. Ed. 2d 798 (U.S.S.C. 1992)[11]. Such defenses apply to permanent physical takings as well as regulatory takings. Id.

In Sansotta, the Fourth Circuit expressly applied these Lucas defenses to the town's actions, citing Lucas in the process of considering the plaintiffs' procedural due process claim by holding that, "[a]bating public nuisances and protecting the public trust have long been part of governmental authority in North Carolina" and that doing so is not a deprivation of property because "they represent limitations on the use of the property that 'inhere in the title itself, in the restrictions that background principles of the State's law of property and nuisance already place upon land ownership." Sansotta v. Town of Nags Head, 724 F.3d 533, 541 (2013) (citing Lucas,

[11]Additionally, the purchase of property subject even to statutory or regulatory restrictions such as G.S. 77-20(d) & (e) and CAMA regulations provides a limitation (and potential bar) upon an owners' reasonable investment backed expectations. Tahoe-Sierra Pres. Council, Inc. v. Tahoe Reg'l Planning Agency, 535 U.S. 302, 336, 122 S. Ct. 1465, 1486, 152 L. Ed. 2d 517 (2002); see also, Shell Island Homeowners Ass'n, Inc. v. Tomlinson, 134 N.C. App. 217, 230, 517 S.E.2d 406, 416 (1999) ("in the very regulatory scheme under which the original permit was issued, and the land upon which the hotel was constructed was subject to the restrictions at the time the permit was issued.").

505 U.S. at 1029).[12] This Court has often held that restrictions upon public trust rights constitute an actual public nuisance. Hampton v. N. Carolina Pulp Co., 223 N.C. 535, 541-42, 27 S.E.2d 538, 542 (1943) (interference with public trust fishery through pollution); State v. Baum, 128 N.C. 600, 38 S.E. 900 (1901) (restriction of public trust right to navigation); State v. Twiford, 136 N.C. 603, 48 S.E. 586 (1904) (restriction of navigation); Pedrick v. Raleigh & P.S.R. Co., 143 N.C. 485, 55 S.E. 877 (1906)(restriction of navigation); State v. Narrows Island Club, 100 N.C. 477, 5 S.E. 411 (1888) (restriction of navigation); State v. Parrott, 71 N.C. 311 (1874); State v. Dibble, 49 N.C. 107 (1856) (restriction of navigation); Reyburn v. Sawyer, 135 N.C. 328, 47 S.E. 761, 764 (1904) (restriction of navigation); Farmers' Co-operative Mfg. Co. v. Albemarle & R.R., 117 N.C. 579, 23 S.E. 43, 43 (1895) (restriction of navigation). "[I]t is not necessary that obstructions in the way of navigation should have actually interfered with, or done it in order to render such obstructions nuisances; it is sufficient if navigation was thereby rendered less convenient, secure, and expeditious." Gaither v. Albemarle Hosp., 235 N.C. 431, 445, 70 S.E.2d 680, 692 (1952) (upholding injunction sought by private party barring defendant from building bulkhead which would have restricted plaintiffs riparian and public trust rights).

---

[12]In this context, it is important to recognize that Lucas was a regulatory takings case, not a case about procedural due process. Lucas v. S. Carolina Coastal Council, 505 U.S. 1003, 1028-29, 112 S. Ct. 2886, 2900, 120 L. Ed. 2d 798 (U.S.S.C. 1992).

Public trust rights apply to the entirety of the ocean beach and they may be exercised "by the public by foot, vehicle and boat... ." West v. Slick, 313 N.C. 33, 62, 326 S.E.2d 601, 618 (1985); see also, Wise v. Hollowell, 205 N.C. 286 (1933); Town of Emerald Isle v. State of N.C., 320 N.C. 640, 360 S.E. 2d 756 (1987); see also, Kalo Art. at n. 32. The Town's Beach Driving Ordinance regulates a right to drive on the beach available to the public including the Town, and the Town's Beach Equipment Ordinance seeks to limit the potential nuisance associated with the obstruction of the right of the Town's personnel to use the ocean beach for public works and public safety purposes. Therefore, the Nies claims for inverse condemnation and takings under the North Carolina and U.S. Constitutions are precluded by background principles of property and nuisance law.

B. The Town's Beach Driving Ordinance and Beach Equipment Ordinance are Reasonable Regulations Pursuant to the Town's Police Power and Do Not Amount to a Taking for Which Compensation is Due

This Court has very recently considered the difference between government actions in the nature of eminent domain and those in the nature of police power regulation:

> Determining if governmental action constitutes a taking depends upon whether a particular act is an exercise of the police power or of the power of eminent domain. Under the police power, the government regulates property to prevent injury to the public. Police power regulations must be enacted in good faith, and have appropriate and

> direct connection with that protection to life, health, and property which each State owes to her citizens.... Under the power of eminent domain, the government takes property for public use because such action is advantageous or beneficial to the public. The sovereign determines the nature and extent of the property required and may take for a limited period of time or in perpetuity an easement, a mere limited use, or an absolute, unqualified fee. As such, the state must compensate for property rights taken by eminent domain; however, damages resulting from the proper exercise of the police power are noncompensable.

Kirby v. N. C. Dep't of Transp., No. 56PA14-2, 2016 WL 3221090, at *4 (N.C. June 10, 2016). The Nies have not challenged the Town's authority to enact either the Beach Driving Ordinance or the Beach Equipment Ordinance. Nor could they because the Legislature has clearly given them police power authority to do so pursuant to N.C.G.S. 160A-308, N.C.G.S. 160A-174 and N.C.G.S. 160A-205(a). The regulation of driving whether on the beach or on the road is clearly a safety related regulation. The regulation of beach equipment which may obstruct life saving, police and public safety personnel as the Beach Equipment Ordinance does on its face is a reasonable restriction upon the public and the Nies for a clear safety purpose.

All of the facts show that the Town's actions were taken to ensure that the public may safely and without injurious obstruction use the beach to exercise the public trust rights which have been defined by existing law and have been clarified by statute apply to the entirety of the ocean beach. Therefore, the Court should affirm the Court of Appeals holding that no taking of the Nies' property has occurred

through the adoption of the Town's Beach Driving or Beach Equipment Ordinances.

CONCLUSION

The Amici Curiae respectfully request that this Court affirm the Court of Appeals and bring closure and consistency to the application of public trust rights upon the State's ocean beaches.

Respectfully submitted this the 27th day of July, 2016.

By: /s/Benjamin M.Gallop
Benjamin M. Gallop
N.C. State Bar No. 33932
HORNTHAL, RILEY, ELLIS & MALAND, L.L.P.
2502 S. Croatan Hwy.
Nags Head, NC 27959
E-Mail: bmgallop@hrem.com
Telephone: (252)441-0871
Fax: (252)441-0822
General Counsel for Town of Southern Shores and Special Counsel for All Named Amici Curiae

Pursuant to N.C. App. R., Rule 33(b), I certify that all of the attorneys listed below have authorized me to list their names on this document as if they had personally signed it.

By: /s/ John D. Leidy
John D. Leidy
N.C. State Bar No. 14218
HORNTHAL, RILEY, ELLIS & MALAND, L.L.P.
301 E. Main Street
Elizabeth City, NC 27909
E-Mail: jleidy@hrem.com
Telephone No.: (252) 335-0871
General Counsel for Town of Nags Head

By: /s/Robert B. Hobbs, Jr.
Robert B. Hobbs, Jr.
N.C. State Bar No. 13543
HORNTHAL, RILEY, ELLIS & MALAND, L.L.P.
2502 S. Croatan Hwy.
Nags Head, NC 27959
E-Mail: rhobbs@hrem.com
Telephone: (252)441-0871
Fax: (252)441-0822
General Counsel for Town of Duck

By: /s/Donald I. McRee, Jr.
Donald I. McRee, Jr.
N.C. State Bar No. 13922
153 Courthouse Road, Suite 201
Currituck, NC 27929
E-Mail: Ike.Mcree@CurrituckCountyNC.gov
Telephone: (252)232-0300
Fax: (252)232-3551
Currituck County Attorney

By: /s/Ronald G. Baker
Ronald G. Baker
N.C. State Bar No. 6490
By: /s/Casey C. Varnell
Casey C. Varnell
N.C. State Bar No. 40405
SHARP, GRAHAM & BAKER, L.L.P.
Kitty Hawk, NC 27949-1027
E-Mail: baker@ncobxlaw.com
E-Mail: varnell@ncobxlaw.com
Telephone: (252)261-2126
Fax: (252)261-1640
General Counsel for Town of Kill Devil Hills & Town of Kitty Hawk

CERTIFICATE OF SERVICE

The undersigned hereby certifies that he served a copy of the foregoing **AMICUS CURIAE BRIEF OF THE COUNTY OF DARE, THE COUNTY OF CURRITUCK, THE COUNTY OF HYDE, THE TOWN OF NAGS HEAD, THE TOWN OF KILL DEVIL HILLS, THE TOWN OF KITTY HAWK, THE TOWN OF SOUTHERN SHORES, THE TOWN OF DUCK AND THE NORTH CAROLINA BEACH BUGGY ASSOCIATION, INC.** on counsel for the Plaintiff-Petitioner and Defendant-Respondent and on counsel for below noted amici by depositing a copy, contained in a First Class, postage-paid wrapper, into a depository under the exclusive care and custody of the United States Postal Service, addressed as follows:

J. David Breemer
Pacific Legal Foundation
930 G. Street
Sacramento, CA 95814
Attorney for Plaintiff-Appellants

Keith P. Anthony
Morning Star Law Group
630 Davis Dr., Ste. 200
Morrisville, NC 27560
Attorney for Plaintiff-Appellants

Brian E. Edes
Norwood P. Blanchard, III
Crossley, McIntosh, Collier, Hanley & Edes, PLLC
5002 Randall Parkway
Wilmington, NC 28403
Attorneys for Defendant-Appellee

Elliot Engstrom
Center for Law and Freedom
Civitas Institute
100 S. Harrington Street
Raleigh, NC 27603
P: (919) 834-2099
E: elliot.engstrom@nccivitas.org
Attorney for Amicus Curiae Civitas Institute Center for Law and Freedom

Jason T. Campbell
Law Offices of James Scott Farrin
280 South Mangum Street, Ste. 400
Durham, NC 27701
P: (877)393-4990
E: jcampbell@farrin.com
Local Counsel for Amicus Curiae Owners' Counsel of America and Professor David L. Callies

Robert H. Thomas
DAMON KEY LEONG KUPCHAK HASTERT
1003 Bishop Street, 16th Floor
Honolulu, Hawaii 96813
P: (808)531-8031
E: rht@hawaiilawyer.com
Counsel for Amicus Curiae Owners' Counsel of America and Professor David L. Callies

This the 27th day of July, 2016

HORNTHAL, RILEY, ELLIS & MALAND, LLP

/s/ Benjamin M. Gallop
N.C. State Bar No. 33932
Of Counsel for Amici

INDEX TO APPENDIX

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FILED
DATE: 8-25-15
DARE COUNTY C.S.C.
BY

STATE OF NORTH CAROLINA
DARE COUNTY

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
11-CVS-304

TOWN OF NAGS HEAD, Plaintiff, v. WILLIAM W. RICHARDSON and wife, MARTHA W. RICHARDSON, Defendants.	)	ORDER (With Rule 54(b) Certification)

THIS CAUSE came on for hearing and was heard by the Honorable Gary E. Trawick, Rule 2.1 Judge presiding at the August 24, 2015 Special Civil Session of Dare County Superior Court held at the Dare County Courthouse in Manteo, N.C. The plaintiff, Town of Nags Head (the "Town"), was represented by M. H. Hood Ellis and Benjamin M. Gallop, and the Defendants were represented by Norman W. Shearin, Wyatt M. Booth and Ashley P. Holmes. Prior to beginning the trial, the Court held a hearing on the following: (i) the Town's Motions in Limine; and (ii) the Defendants' Motion in Limine – Evidentiary Matters. The Town and Defendants each raised the issue of the application of public trust rights to the area of property encompassed by the beach nourishment easement area condemned (the "Beach Nourishment Easement") by the Town. The Beach Nourishment Easement at issue in this action is identified and shown as "AREA BETWEEN PRE-NOURISHMENT MHW & 2011 TOE OF DUNE" on the plat attached as Exhibit A to the Order on G.S. 40A-47 hearing signed December 12, 2014. The same is also shown as "EASEMENT AREA ACQUIRED" on Exhibits A and B attached to this Order which were Plaintiff's exhibits considered by the Court during the hearing. The Town contends that public trust rights apply to the entire area of the Beach Nourishment Easement and the Defendants contend to the contrary.

Based on a review of the record and the arguments of counsel it is **ORDERED, ADJUDGED** and **DECREED** as follows:

1. The Beach Nourishment Easement is entirely located within the "ocean beaches" as defined in N.C.G.S. § 77-20(e) and is thus subject to and encumbered by traditional public trust rights as set out in N.C.G.S. § 1-45.1.

2. The foregoing determination affects a substantial right, to wit: the valuation of the Beach Nourishment Easement. This determination also affects another eleven (11) beach nourishment easement condemnation cases filed by the Town, still pending and awaiting disposition by the undersigned pursuant to a Rule 2.1 designation. Accordingly, this Order is certified pursuant to Rule 54(b) of the North Carolina Rules of Civil Procedure and there is no just reason for the delay of an appeal therefrom.

3. Defendants be and are hereby granted a continuance of the trial from August 24, 2015 to October 12, 2015 unless Defendants appeal this order.

4. The parties are permitted to reappraise the Beach Nourishment Easement condemnation in light of the determination made in Section 1 above. Any new appraisals shall be served upon the opposing party by September 11, 2015, and any review appraisals shall be served by September 18, 2015. The parties shall further have the right to depose any appraiser preparing a new appraisal report or review appraisal report prior to trial.

5. Defendants shall have the right to depose Dr. Timothy W. Kana prior to trial, and Defendants shall pay all related court costs and travel expenses, if any, of Dr. Kana.

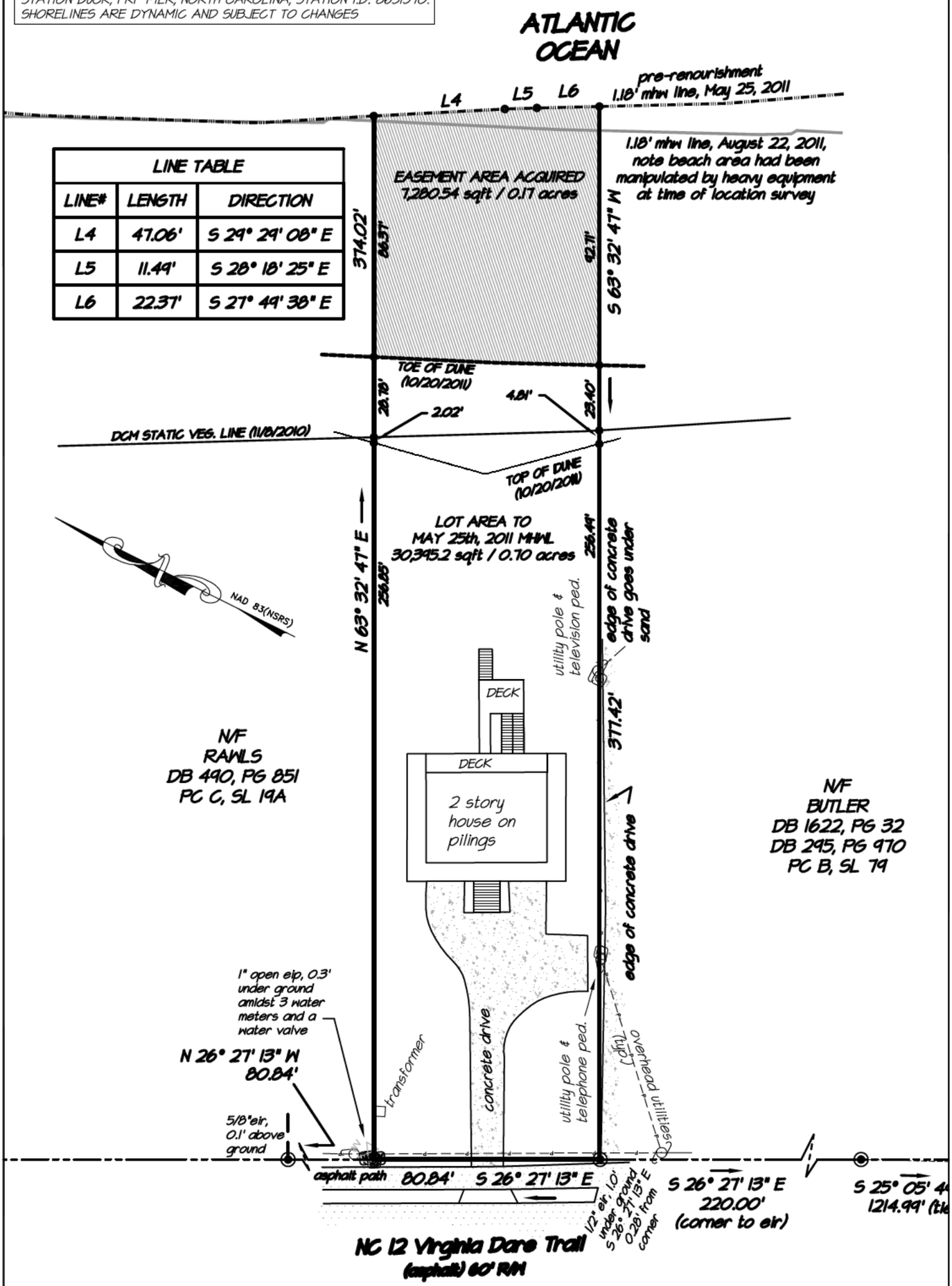
This the 25th day of August, 2015.

Gary E. Trawick
Rule 2.1 Superior Court Judge Presiding

EXHIBIT

A

*MHW VALUE OF 1.18' NAVD '88 DERIVED FROM NOAA'S NOS TIDAL STATION DUCK, FRF PIER, NORTH CAROLINA, STATION I.D. 8651370. SHORELINES ARE DYNAMIC AND SUBJECT TO CHANGES



LINE TABLE		
LINE#	LENGTH	DIRECTION
L4	47.06'	S 29° 29' 08" E
L5	11.49'	S 28° 18' 25" E
L6	22.37'	S 27° 49' 38" E

COMMISSION NO.	P11055
DESIGNED BY	KCM/DT
DRAWN BY	KCM/DT
CHECKED BY	BDR
ISSUE DATE	11/11/14

EXHIBIT FOR 3901 VA. DARE TR

MARTHA & WILLIAM RICHARDSON
TOWN OF NAGS HEAD

NAGS HEAD TOWNSHIP DARE COUNTY NORTH CAROLINA

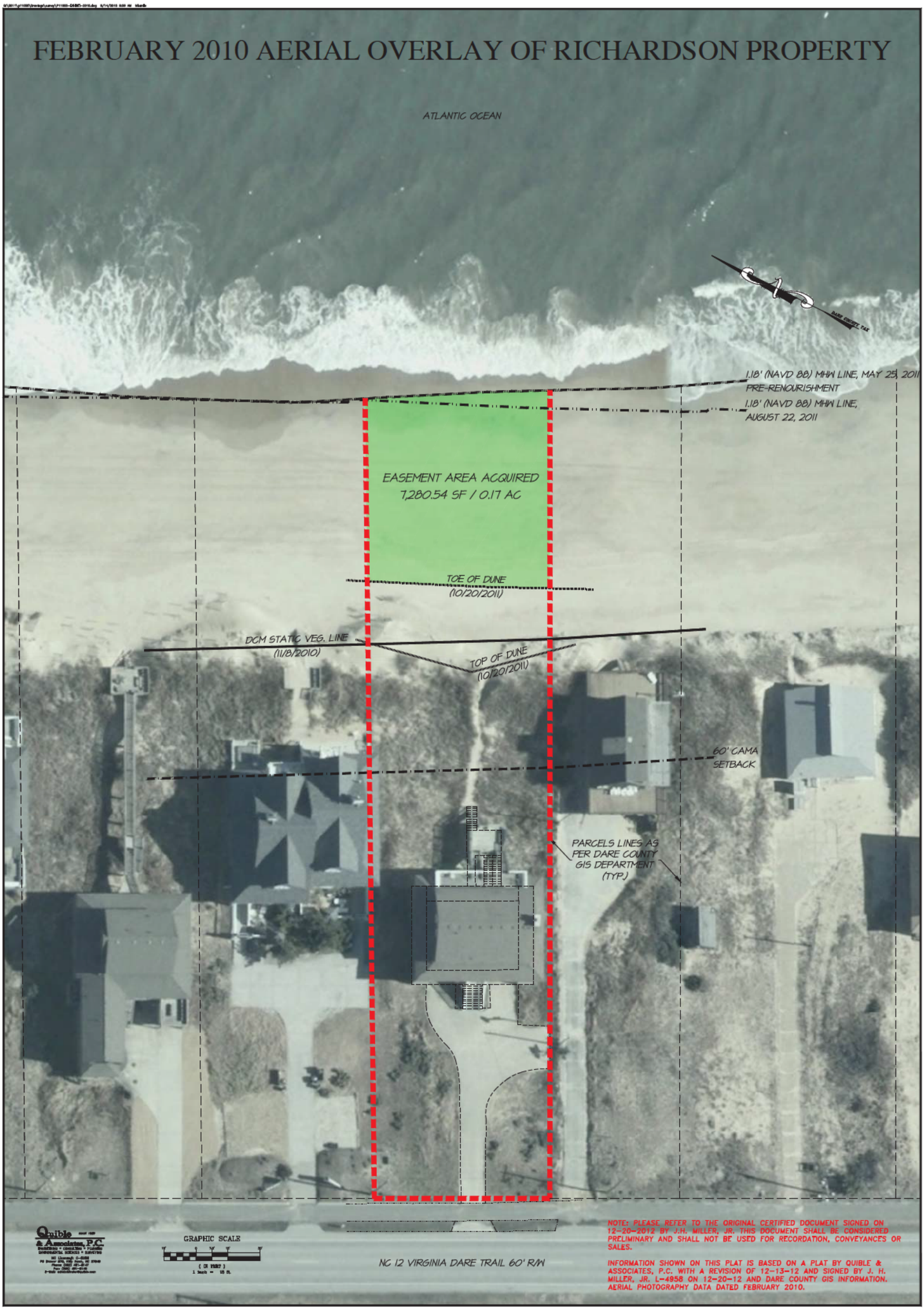
Quible & Associates, P.C. SINCE 1939
ENGINEERING * CONSULTING * PLANNING
ENVIRONMENTAL SCIENCES * SURVEYING
NC License# C-0205
PO Drawer 870, Kitty Hawk, NC 27949
Phone (252) 491-8147 Fax (252) 491-8149
E-Mail: admin@quible-quible.com

NOTE: PLEASE REFER TO THE ORIGINAL CERTIFIED DOCUMENT SIGNED ON 12-20-2012 BY J.H. MILLER, JR. THIS DOCUMENT SHALL BE CONSIDERED PRELIMINARY AND SHALL NOT BE USED FOR RECORDATION, CONVEYANCES OR SALES.

INFORMATION SHOWN ON THIS PLAT IS BASED ON A PLAT BY QUIBLE & ASSOCIATES, P.C. WITH A REVISION OF 12-13-12 AND SIGNED BY J. H. MILLER, JR. L-4958 ON 12-20-12.

EXHIBIT

B


FEBRUARY 2010 AERIAL OVERLAY OF RICHARDSON PROPERTY
ATLANTIC OCEAN
1.18' (NAVD 88) MHW LINE, MAY 25, 2011
PRE-RENOURISHMENT
1.18' (NAVD 88) MHW LINE,
AUGUST 22, 2011
EASEMENT AREA ACQUIRED
7,280.54 SF / 0.17 AC
TOE OF DUNE
(10/20/2011)
DCM STATIC VEG. LINE
(11/8/2010)
TOP OF DUNE
(10/20/2011)
60' CAMA
SETBACK
PARCELS LINES AS
PER DARE COUNTY
GIS DEPARTMENT
(TYP.)
GRAPHIC SCALE
NC 12 VIRGINIA DARE TRAIL 60' R/W
NOTE: PLEASE REFER TO THE ORIGINAL CERTIFIED DOCUMENT SIGNED ON 12-20-2012 BY J.H. MILLER, JR. THIS DOCUMENT SHALL BE CONSIDERED PRELIMINARY AND SHALL NOT BE USED FOR RECORDATION, CONVEYANCES OR SALES.
INFORMATION SHOWN ON THIS PLAT IS BASED ON A PLAT BY QUIBLE & ASSOCIATES, P.C. WITH A REVISION OF 12-13-12 AND SIGNED BY J. H. MILLER, JR. L-4958 ON 12-20-12 AND DARE COUNTY GIS INFORMATION. AERIAL PHOTOGRAPHY DATA DATED FEBRUARY 2010.

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF NORTH CAROLINA
NORTHERN DIVISION
CIVIL ACTION NO. 2:10-CV-00029 D

ROC F. SANSOTTA, INDIVIDUALLY; ROC F. SANSOTTA, Trustee and Executor of the ESTATE OF FATHER JOSEPH KLAUS; RALPH S. TOMITA; GLORIA H. TOMITA; CAROLE A. SCHECKELFORD; JAMES BERGMAN; LINDA ATSUS; and GEORGE D. RUSIN Plaintiffs,	:	**AFFIDAVIT OF WAYNE GRAY**
v.	:	
TOWN OF NAGS HEAD, Defendant.	:	

I, Wayne Gray, Mayor Pro Tem for the Town of Nags head (the "Town"), being first duly sworn, do hereby certify the following:

1. I am under no legal disability; I am not a minor; I am not incompetent; I am authorized by the Town of Nags Head to execute this affidavit and I have personal knowledge of the information contained herein developed through my own observations.

2. I am a citizen and resident of the Town of Nags Head, Dare County, North Carolina.

3. I was born in 1940. I am 71 years old. I was born and raised in the village of Avon on Hattaras Island in Dare County, North Carolina. I lived in Avon from 1940 until 1958 when I went into the United States Coast Guard. I was a member of the United States Coast Guard for 32 years. During that time I was stationed at Oregon Inlet for two years in the early 1960's. In 1984, I returned to Station Oregon Inlet as skipper of the Coast Guard cutter, Point Brown, and in 1985 became the officer in charge of Station Oregon Inlet. I retired from the United States Coast Guard in 1990. Since 1984, I have lived in Nags Head, North Carolina. During the time that I lived away from the Outer Banks, my parents lived on

the Outer Banks and I returned to visit at least once a year except during the years that I served in the Vietnam War.

4. I am familiar with and have personal knowledge of the general public's use of the ocean beaches on the Outer Banks including Currituck, Dare, and Hyde Counties as well as all of the municipalities and villages located therein. I have driven upon, ridden upon, and walked upon the ocean beaches of the Outer Banks and observed members of the general public doing the same on numerous occasions.

5. From the year 1995 to the year 2000, I was officer with the North Carolina Marine Patrol, the law enforcement section of the North Carolina Division of Marine Fisheries. One of my primary duties was to travel the ocean beaches of the Outer Banks to enforce fishing regulations.

6. The best driving conditions are upon portions of the ocean beach that are level, hard packed and not covered by water. Those conditions are most easily found at low tide or as close to the water as one can get at high tide. Packed sand is easier to drive upon than soft sand and decreases the likelihood that a vehicle will get stuck. Gravel areas of the beach are often bottomless and should be avoided.

7. When I lived in Avon in the 1940's and 1950's we had to travel to Manteo for to do business, to visit the dentist, to visit the doctor and for various other reasons. During that time, there was no paved roadway from approximately Whalebone Junction to Oregon Inlet where the ferry to Hatteras Island was located. Much like the northern Outer Banks, there were two ways to travel from Nags Head to Oregon Inlet and vice versa. The preferred method of travel was to follow the ocean beach, "the wash," at low tide. When the ocean waters were too high on "the wash" we would travel the "inside road" which usually followed along the Coast Guard's telephone line at the edge of the woodline located behind the ocean dune line approximately 300 yards. I often saw other members of the general public taking the same routes.

8. The exact location and extent of "the wash" changed over time due to accretion and erosion.

However, it was always simple to identify "the wash" based on the location of the dunes and the vegetation line located on the dunes. "The wash" was always located seaward of the dunes and the vegetation line. The portion of "the wash" that was used and traveled by the general public often extended all the way landward to the toe of the dunes, particularly at times of high tide.

9. I am familiar with and have personally seen the properties located at Seagull Drive in the Town of Nags Head which are owned by the Plaintiffs and at issue in this legal action (the "Properties"). Located on each Property is a structure or group of structures and associated personal property and attachments (collectively a "Cottages"). In addition to the Cottages the Properties have numerous sandbags placed upon them.

10. Traveling between Oregon Inlet and Nags Head along "the wash" would have taken me and the general public by the general location of the Properties and the Cottages on numerous occasions.

11. In addition to seeing the general public travel upon the ocean beaches of the Outer Banks on numerous occasions I usually, if not always, saw members of the general public performing numerous recreational activities such as swimming, sunbathing, fishing commercially and recreationally, as well as other types of activities.

12. Since at least 1984 when I returned to live on the Outer Banks, Town employees, officials, and agents have traveled the ocean beaches of the Town by vehicle and by foot for the purposes of providing police, fire, life saving and sanitation services. For many years I was a volunteer fireman, and I drove on the ocean beach at times to reach fires and other emergencies.

13. During my time living on the Outer Banks, I have witnessed numerous storm events of varying sizes and intensities. During and after such storm events, I have witnessed damage to structures located on the ocean front, particularly those located the farthest seaward on the ocean front. I have seen significant damage from storm events with both very intense storms and storms of limited intensity. Most major storms in the area are hurricanes, but typically the most damage occurs during Nor'easters. Often

storm damage occurs without warning or an opportunity to prepare in advance.

14. When damage occurs due to storm events other persons and property are often affected, injured or otherwise damaged by the resulting debris. The debris caused by storm events often causes damage to other properties. The resulting storm damage debris litters the beach, private properties and the ocean waters. The amount of debris from storm damage is often costly to cleanup. The resulting storm debris creates potential dangers for those using the beach and the ocean for days, weeks, months and even years depending on what sort of debris is deposited and where it is deposited.

15. Following the 2009 Nor'easter that occurred during the week of Veteran's Day, the location of the Cottages and the sandbags associated with the Cottages made the ocean beach in the vicinity of the Properties impassable by vehicle during high tide. This situation continued for many months and has occurred on and off since that time.

16. The location of the Cottages makes them more susceptible to storm damage than most other ocean front cottages within the Town because they are situated farther east out upon the beach and beyond most other ocean front houses.

17. The location of the Cottages makes the Cottages more dangerous to the public because of the high potential for storm damage and the restrictions they place upon emergency and life saving services traveling upon the ocean beach to perform their duties.

18. The location of the Cottages adversely affects the public convenience and public health by restricting public access along the beaches and restricting the Town's ability to provide public services such as sanitation services along the beach.

19. Based on my experience viewing other similar properties, the location of the Cottages also invites the general public, particularly children, to climb upon the sandbags located under the structures in an unsafe manner. Were the Cottages located landward of the ocean beach, this situation would be much less likely.

In witness whereof, I hereunto subscribe my name this 15th day of August, 2011.

Wayne Gray

Wayne Gray

Subscribed and sworn to before me
this the 15th day of August, 2011.

Carolyn F. Morris

Notary Public

My Commission expires: 3/29/16

CAROLYN F. MORRIS
(SEAL) NOTARY PUBLIC
DARE COUNTY, N.C.

History of Tidal Analysis and Prediction

People who live in coastal areas or who look to the sea for their livelihood have been observing the tides and tidal currents for many years. They have used their observations and practical knowledge in a variety of ways to their advantage. For example, it has aided them in timing the sailing of ships to and from port. It has also aided them in maintaining aquaculture and fishery activities in the inter-tidal zone near their shores.

A more theoretical study of tidal phenomena was undertake by notable people from the past. The work of the people highlighted here has formed the basis of present-day tidal analysis and prediction as practiced in the National Ocean Service.

Sir William Thomson (Lord Kelvin) devised the method of reduction of tides by harmonic analysis (/harmonic.html) about the year 1867. The principle upon which the system is based, which is that any periodic motion or oscillation can always be resolved into the sum of a series of simple harmonic motions, is said to have been discovered by Eudoxas as early as 356 B.C., when he explained the apparently irregular motions of the planets by combinations of uniform circular motions. In the early part of the nineteenth century Laplace recognized the existence of partial tides that might be expressed by the cosine of an angle increasing uniformly with the time, and also applied the essential principles of the harmonic analysis to the reduction of high and low waters. Dr. Thomas Young suggested the importance of observing and analyzing the entire tidal curve rather than the high and low waters only. Sir George B. Airy also had an important part in laying the foundation for the harmonic analysis of the tides. To Sir William Thomson, however, we may give the credit for having placed the analysis on a practical basis.

In 1867 the British Association for the Advancement of Science appointed a committee for the purpose of promoting the extension, improvement, and harmonic analysis of tidal observations. The report on the subject was prepared by Sir William Thomson and was published in the Report of the British Association for the Advancement of Science in 1868. Supplementary reports were made from time to time by the tidal committee and published in subsequent reports of the British association. A few years later a committee, consisting of Professors G. H. Darwin and J. C. Adams, drew up a very full report on the subject, which was published in the Report of the British Association for the Advancement of Science in 1883.

Ship Transit
Early example of a "real-time" tide gauge. Mechanical tide gauges were first used in the United States in the 1850s. This old wooden station, used in 1897 at Fort Hamilton, New York, is one of the earliest examples of a real-time, tide-measuring device. When entering or leaving the port, mariners would view this station through binoculars. The pointer indicates the present level of the water while the vertical arrow indicates whether the tide is rising or falling.

Among the American mathematicians who have had an important part in the development of this subject may be named Professor William Ferrel and Dr. Rollin A. Harris, both of whom were associated with the U.S. Coast and Geodetic Survey. The Tidal Researches, by Professor Ferrel, was published in 1874, and additional articles on the harmonic analysis by the same author appeared from time to time in the annual reports of the Superintendent of the Coast and Geodetic Survey. The best known work of Dr. Harris is his Manual of Tides, which was published in several parts as appendices to the annual reports of the Superintendent of the Coast and Geodetic Survey. The

subject of the harmonic analysis was treated principally in Part II of the Manual which appeared in 1897.

The methods for the prediction of the tides may be classified as harmonic and nonharmonic. By the harmonic method the elementary constituent tides (/constitu.html), represented by harmonic constants, are combined in to a composite tide. By the nonharmonic method the predictions are made by applying to the times of the moon's transits and to the mean height of the tide systems of differences to take account of average conditions and various inequalities due to changes in the phase of the moon and in the declination and parallax of the moon and sun.

Up to and including the year 1884, all tide predictions for the tide tables were computed by means of auxiliary tables and curves constructed from the results of tide observations at the different ports. From 1885 to 1911, inclusively, the predictions were generally made by means of the Ferrel Tide-Predicting machine. From 1912 to 1965, inclusively, they were made by means of the Coast and Geodetic Survey Tide-Predicting Machine No. 2. Without the use of a tide-predicting machine (/predmach.html) the harmonic method would involve too much labor to be of practical service, but with such a machine the harmonic method has many advantages over the nonharmonic systems.

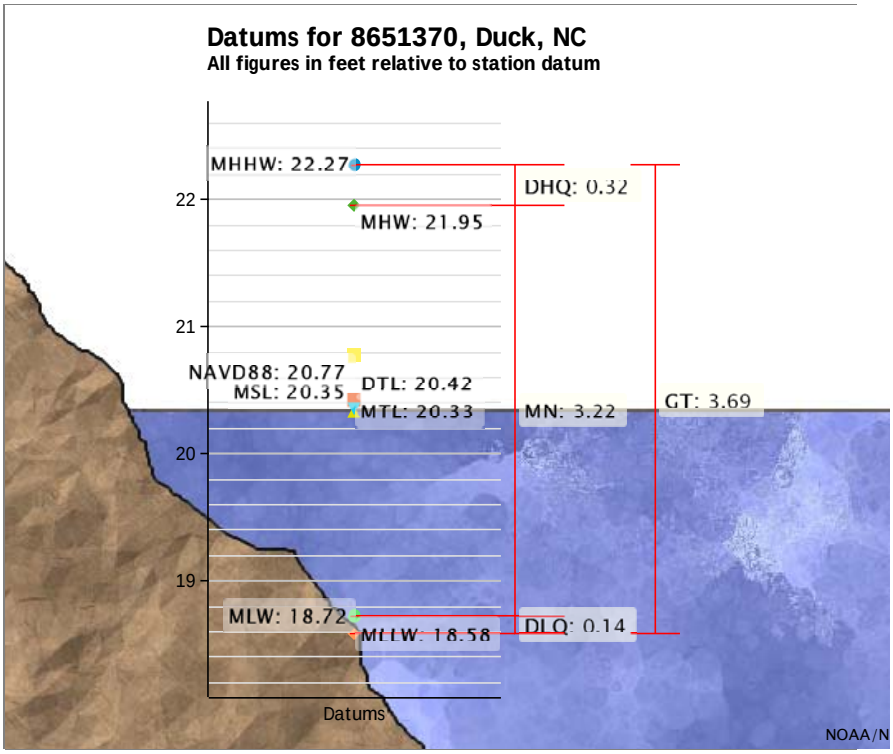
Predicting machines were superseded in 1966 by the advent of digital electronic computers. Initially these computers were of the large main-frame type. In the late 1980s main-frames were replaced by the growing sophistication of desktop computers. These are now used exclusively by the National Ocean Service in making predictions for the standard ports of this country and at other locations where sufficient observational data exists.

Datums for 8651370, Duck NC

Elevations on Station Datum

Station: 8651370, Duck, NC **T.M.:** 75
Status: Accepted (Sep 26 2011) **Epoch:** **(/datum_options.html#NTDE)** 1983-2001
Units: Feet **Datum:** STND

Datum	Value	Description
MHHW (/datum_options.html#MHHW)	22.27	Mean Higher-High Water
MHW (/datum_options.html#MHW)	21.95	Mean High Water
MTL (/datum_options.html#MTL)	20.33	Mean Tide Level
MSL (/datum_options.html#MSL)	20.35	Mean Sea Level
DTL (/datum_options.html#DTL)	20.42	Mean Diurnal Tide Level
MLW (/datum_options.html#MLW)	18.72	Mean Low Water
MLLW (/datum_options.html#MLLW)	18.58	Mean Lower-Low Water
NAVD88 (/datum_options.html)	20.77	North American Vertical Datum of 1988
STND (/datum_options.html#STND)	0.00	Station Datum
GT (/datum_options.html#GT)	3.69	Great Diurnal Range
MN (/datum_options.html#MN)	3.22	Mean Range of Tide
DHQ (/datum_options.html#DHQ)	0.32	Mean Diurnal High Water Inequality



Showing datums for

8651370 Duck, NC

Data Units ◉ Feet ○ Meters

Epoch ◉ Present (1983-2001) ○ Superseded (1960-1978)

Submit

Datum	Value	Description
DLQ (/datum_options.html#DLQ)	0.14	Mean Diurnal Low Water Inequality
HWI (/datum_options.html#HWI)	12.23	Greenwich High Water Interval (in hours)
LWI (/datum_options.html#LWI)	6.06	Greenwich Low Water Interval (in hours)
Maximum	26.40	Highest Observed Water Level
Max Date & Time	09/18/2003 16:06	Highest Observed Water Level Date and Time
Minimum	15.92	Lowest Observed Water Level
Min Date & Time	03/16/1980 17:54	Lowest Observed Water Level Date and Time
HAT (/datum_options.html#HAT)	23.52	Highest Astronomical Tide
HAT Date & Time	10/16/1993 12:24	HAT Date and Time
LAT (/datum_options.html#LAT)	17.60	Lowest Astronomical Tide
LAT Date & Time	02/08/1997 06:24	LAT Date and Time

Tidal Datum Analysis Periods
01/01/1983 - 12/31/2001

To refer water level heights to NAVD88 (North American Vertical Datum of 1988), apply the values located at National Geodetic Survey (http://www.ngs.noaa.gov/Tidal_Elevation/diagram.jsp?PID=FW0688&EPOCH=1983-2001).

Show nearby stations

Products available at 8651370 Duck, NC

TIDES/WATER LEVELS

Water Levels (/waterlevels.html?id=8651370)

NOAA Tide Predictions (/noaatidepredictions/NOAATidesFacade.jsp?Stationid=8651370)

Harmonic Constituents (/harcon.html?id=8651370)

Sea Level Trends (/sltrends/sltrends_station.shtml?stnid=8651370)

Datums (/datums.html?id=8651370)

Bench Mark Sheets (/benchmarks.html?id=8651370)

Extreme Water Levels

Reports (/reports.html?id=8651370)

METEOROLOGICAL/OTHER

Meteorological Observations (/met.html?id=8651370)

Water Temp/Conductivity

PORTS®

This station is not a member of PORTS®

OPERATIONAL FORECAST SYSTEMS

This station is not a member of OFS

INFORMATION

Station Home Page (/stationhome.html?id=8651370)

Data Inventory (/inventory.html?id=8651370)

Measurement Specifications (/measure.html)

Information

About CO-OPS (/about.html)
Disclaimers (/disclaimers.html)
Contact Us (/contact.html)
Privacy Policy (/privacy.html)

Products

PORTS (/ports.html)
OFS (/models.html)
Tide Predictions (/tide_predictions.html)
Currents (/cdata/StationList?type=Current+Data&filter=active)
More about products... (/products.html)

Programs

Mapping and Charting Support (/mapping.html)
Maritime Services (/maritime.html)
COASTAL (/coastal.html)
More about programs... (/programs.html)

Partners

Hydrographic Survey Support (/hydro.html)
Marsh Restoration (/marsh.html)
GoMOOS (/gomoos.html)
TCOON (/tcoon.html)

Revised: 10/15/2013
NOAA (http://www.noaa.gov) / National Ocean Service (http://oceanservice.noaa.gov)
Web site owner: Center for Operational Oceanographic Products and Services

Tides and Currents Glossary

A B C D E F G H I J K L M N O P Q R S T U V W Z

A

absolute mean sealevel change

An eustatic change in mean sea level relative to a conventional terrestrial coordinate system with the origin at the center of mass of the Earth.

accepted values

Tidal datums and Greenwich high and low water intervals obtained through primary de- termination or comparison of simultaneous observations with a control tide station in order to derive the equivalent value that would be obtained with a 19-year series.

acoustic Doppler current profiler (ADCP)

A current measuring instrument employing the transmission of high frequency acoustic signals in the water. The current is determined by a Doppler shift in the backscatter echo from plankton, suspended sediment, and bubbles, all assumed to be moving with the mean speed of the water. Time gating circuitry is employed which uses differences in acoustic travel time to divide the water column into range intervals, called bins. The bin determinations allow development of a profile of current speed and direction over most of the water column. The ADCP can be deployed from a moving vessel, tow, buoy, or bottom platform. In the latter configuration, it is nonobtrusive in the water column and thus can be deployed in shipping channels.

ADR gauge

anomaly

As applied to astronomy, the anomaly is the angle made at any time by the radius vector of a planet or moon with its line of apsides, the angle being reckoned from perihelion or perigee in the direction of the body's motion. It is called the true anomaly when referred to the actual position of the body, and mean anomaly when referred to a fictitious body moving with a uniform angular velocity equal to the average velocity of the real body and passing perihelion or perigee at the same time.

Antarctic Circumpolar Current

The largest permanent current in the world, setting eastward around the Antarctic Continent south of Cape Horn, Cape of Good Hope, Tasmania, and New Zealand. Through Drake Passage, it transports approximately 200 x 10^6 m^3/s. Same as West Wind Drift.

anticyclonic ring

A meander breaking off from the main oceanic current and spinning in a clockwise direction in the northern hemisphere (counter-clockwise in southern).

Antilles Current

A North Atlantic Ocean current setting northwestward along the northeast coasts of the Bahama Islands.

aphelion

H

h

Rate of change (as of January 1, 1900) in mean longitude of the Sun.

h = 0.041,068,64° per solar hour.

half-tide level

Same as mean tide level.

halocline

A layer in which the salinity changes significantly (relative to the layers above and below) with depth.

harmonic analysis

The mathematical process by which the observed tide or tidal current at any place is separated into basic harmonic constituents.

harmonic analyzer

A machine designed for the resolution of a periodic curve into its harmonic constituents. Now performed by electronic digital computer.

harmonic constants

The amplitudes and epochs of the harmonic constituents of the tide or tidal current at any place.

harmonic constituent

See constituent.

harmonic function

In its simplest form, a quantity that varies as the cosine of an angle that increases uniformly with time. It may be expressed by the formula:

y = A cos at TODO: investigate mathjax.

in which y is a function if time (t), A is a constant coefficient, and a is the rate of change in the angle at.

harmonic prediction

high tide

Same as high water.

high water (HW)

The maximum height reached by a rising tide. The high water is due to the periodic tidal forces and the effects of meteorological, hydrologic, and/or oceanographic conditions. For tidal datum computational purposes, the maximum height is not considered a high water unless it contains a tidal high water.

high water, full and change (HWF&C)

Same as establishment of the port.

high water inequality

See diurnal inequality.

high water interval (HWI)

See lunitidal interval.

high water line

The intersection of the land with the water surface at an elevation of high water.

high water mark

A line or mark left upon tide flats, beach, or along shore objects indicating the elevation of the intrusion of high water. The mark may be a line of oil or scum on along shore objects, or a more or less continuous deposit of fine shell or debris on the foreshore or berm. This mark is physical evidence of the general height reached by wave run up at recent high waters. It should not be confused with the mean high water line or mean higher high water line.

higher high water (HHW)

The highest of the high waters (or single high water) of any specified tidal day due to the declinational effects of the Moon and Sun.

represented on the abscissa and the height of the water level on the ordinate. See tide curve.

marine boundary

The mean lower low water line (MLLWL) when used as a boundary. Also, lines used as boundaries seaward of and measured from (or points thereon) the MLLWL. See coastal boundary.

mascaret

French for tidal bore.

mean current hour

Same as current hour.

mean diurnal tide level (MDTL)

A tidal datum. The arithmetic mean of mean higher high water and mean lower low water.

mean high water (MHW)

A tidal datum. The average of all the high water heights observed over the National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch.

mean high water line (MHWL)

The line on a chart or map which represents the intersection of the land with the water surface at the elevation of mean high water. See shoreline.

mean higher high water (MHHW)

A tidal datum. The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch.

mean higher high water line (MHHWL)

The line on a chart or map which represents the

meteorological constituents recognized in the tides are Sa, Ssa, and S_I. See storm surge.

Metonic cycle

A period of almost 19 years or 235 lunations. Devised by Meton, an Athenian astronomer who lived in the fifth century B.C., for the purpose of obtaining a period in which new and full Moon would recur on the same day of the year. Taking the Julian year of 365.25 days and the synodical month as 29.530,588 days, we have the l9-year period of 6,939.75 days as compared with the 235 lunations of 6,939.69 days, a difference of only 0.06 day.

Mf

Lunar fortnightly constituent. This constituent expresses the effect of departure from a sinusoidal declinational motion.

Speed = 2s = 1.098,033,1° per solar hour.

midextreme tide

An elevation midway between extreme high water and extreme low water occurring in any locality.

mixed (current)

Type of tidal current characterized by a conspicuous diurnal inequality in the greater and lesser flood strengths and/or greater and lesser ebb strengths. See flood current and ebb current.

mixed (tide)

Type of tide characterized by a conspicuous diurnal inequality in the higher high and lower high waters and/or higher low and lower low waters. See type of tide.

Mm

Lunar monthly constituent. This constituent expresses the effect of irregularities in the Moon's rate of change of distance and speed in orbit.

Speed = s – p = 0.544,374,7° per solar hour.

modified epoch

periods each day. A semidiurnal constituent has two maxima and two minima each constituent day, and its symbol is the subscript 2. See type of tide.

sequence of current

The order of occurrence of the four tidal current strengths of a day, with special reference as to whether the greater flood immediately precedes or follows the greater ebb.

sequence of tide

The order in which the four tides of a day occur, with special reference as to whether the higher high water immediately precedes or follows the lower low water.

set (of current)

The direction towards which the current flows.

shallow water constituent

A short-period harmonic term introduced into the formula of tidal (or tidal current) constituents to account for the change in the form of a tide wave resulting from shallow water conditions. Shallow water constituents include the overtides and compound tides.

shallow water wave

A wave is classified as a shallow water wave whenever the ratio of the depth (the vertical distance of the still water level from the bottom) to the wave length (the horizontal distance between crests) is less than 0.04. Such waves propagate according to the formula:

$C = \sqrt{gd}$

where C is the wave speed, g the acceleration of gravity, and d the depth. Tidal waves are shallow water waves.

shear

A quasi-horizontal layer moving at a different velocity relative to the layer directly below and/or above.

shoreline (coastline)

The intersection of the land with the water surface. The

MHW = MLW + MN

MLLW = MLW - DLQ

MHHW = MHW + DHQ

standardtime

A kind of time based upon the transit of the Sun over a certain specified meridian, called the time meridian, and adopted for use over a considerable area. With a few exceptions, standard time is based upon some meridian which differs by a multiple of 15° from the meridian of Greenwich. The United States first adopted standard time in 1883 on the initiative of the American Railway Association, and at noon on November 18 of that year the telegraphic time signals from the Naval Observatory at Washington were changed to this system.

standing (stationary) wave

A wave that oscillates without progressing. One-half of such a wave may be illustrated by the oscillation of the water in a pan that has been tilted. Near the axis, which is called the node or nodal line, there is no vertical rise and fall of the water. The ends of the wave are called loops and at these places the vertical rise and fall is at a maximum. The current is maximum near the node and minimum at the loops. The period of a stationary wave depends upon the length and depth of the body of water and, for a simple rectangular basin, may be expressed by the formula:

$T = 2L / \sqrt{gd}$

in which T is the period of wave, L the length of the basin, d the depth of water, and g the acceleration of gravity. A stationary wave may be resolve d into two progressive waves of equal amplitude and equal speeds moving in opposite directions.

stationary wave theory

An assumption that the basic tidal movement in the open ocean consists of a system of stationary wave oscillations, any progressive wave movement being of secondary importance except as the tide advances into tributary waters. The continental masses divide the sea into irregular basins, which, although not completely enclosed, are capable of sustaining oscillations which are more or less independent. The tide-producing force

shoreline shown on charts represents the line of contact between the land and a selected water elevation. In areas affected by tidal fluctuations, this line of contact is the mean high water line. In confined coastal waters of diminished tidal influence,the mean water level line may be used. See coastline.

sidereal day

The time of the rotation of the Earth with respect to the vernal equinox. It equals approximately 0.997,27 of a mean solar day. Because of the precession of the equinoxes, the sidereal day thus defined is slightly less than the period of rotation with respect to the fixed stars, but the difference is less than a hundredth part of a second.

sidereal month

Average period of the revolutionof the Moon around the Earth with respect to a fixed star, equal to 27.321,661 mean solar days.

sidereal time

This is usually defined by astronomers as the hour angle of the vernal equinox. The sidereal day is the interval between two successive upper transits of the vernal equinox. It is to be noted that when applied to the month and year the word sidereal has reference to motion with respect to the fixed stars, while the word tropical is used for motion with respect to the vernal equinox. Because of the precession of the equinox there is a slight difference.

sidereal year

Average period of the revolution of the Earth around the Sun with respect to a fixed star. Its length is approximately 365.256,4 mean solar days.

sigma-t (σ_t)

An expression of density as a function of temperature and salinity (at atmospheric pressure) in a convenient numerical form. See density.

$\sigma_t = (\rho_{s,t,p} - 1)1{,}000$

sigma-zero (σ_0)

consists principally of two parts, a semidiurnal force with a period of approximately half a day and a diurnal force with a period of approximately a whole day. Insofar as the free period of oscillation of any part of the ocean, as determined by its dimensions and depth, is in accord with the semidiurnal or diurnal tide-producing forces, there will be built up corresponding oscillations of considerable amplitude which will be manifested in the rise and fall of the tide. The diurnal oscillations, superimposed upon the semidiurnal oscillations, cause the inequalities in the heights of the two high and the two low waters of each day. Although the tidal movement as a whole is somewhat complicated by the overlapping of oscillating areas, the theory is consistent with observational data.

stencils

Perforated sheets formerly used with the tabulated hourly heights of the tide or speeds of the tidal current for the purpose of distributing and grouping them into constituent hours preliminary to summing for harmonic analysis. See Coast and Geodetic Survey Special Publication No. 98, Manual of Harmonic Analysis and Prediction of Tides. This analysis is now performed on electronic digital computers.

steric anomaly

Same as specific volume anomaly.

stilling well

A vertical pipe with a relatively small opening (intake) in the bottom. It is used in a gauge installation to dampen short period surface waves while freely admitting the tide, other long period waves, and sea level variations; which can then be measured by a water level gauge sensor inside. See float well and protective well.

storm surge

The local change in the elevation of the ocean along a shore due to a storm. The storm surge is measured by subtracting the astronomic tidal elevation from the total elevation. It typically has a duration of a few hours. Since wind generated waves ride on top of the storm surge (and are not included in the definition), the total instantaneous elevation may greatly exceed the