JOSH STEIN
Governor
D. REID WILSON
Secretary
DANIEL S. HIRSCHMAN
General Counsel

NORTH CAROLINA
Environmental Quality

TO: The Coastal Resources Commission

FROM: Christine A. Goebel, DEQ Assistant General Counsel

DATE: November 12, 2025 (for the November19-20, 2025 CRC Meeting)

RE: **Variance Request by Andrew Krichman/Deep Water Management, Inc. (CRC-VR-24-11)**

Petitioners are Deep Water Management, Inc. and its Incorporator Andrew Krichman. Petitioners own property located at 813 Canal Drive in Carolina Beach, New Hanover County. Petitioners seek to retain artificial turf within the Commission's 30-foot buffer at the Site after installing it without understanding it was not allowed by the Commission's rules, specifically 15A NCAC 7H .0209. As part of the Notice of Violation and Restoration Plan, Petitioners sought a CAMA Minor Permit which was denied by the Carolina Beach CAMA LPO on January 20, 2024. Petitioners and Staff agreed to postpone this variance hearing until after the CRAC finished their consideration of artificial turf at the November 2024, February 2025 and April 2025 meetings. Petitioners now seek a variance to retain the artificial turf within the 30-foot buffer as proposed in their permit application.

The following additional information is attached to this memorandum:

Attachment A: Relevant Rules
Attachment B: Stipulated Facts
Attachment C: Petitioner's Positions and Staff's Responses to Variance Criteria
Attachment D: Petitioner's Variance Request Materials
Attachment E: Stipulated Exhibits including powerpoint

cc(w/enc.): Mr. Andrew Krichman, Petitioner, electronically
Haley Moccia, Town of CB CAMA LPO, electronically
Sarah Zambon, Assistant AG and CRC Counsel, electronically

Relevant Rules

15A NCAC 07H .0209 COASTAL SHORELINES

(a) Description. The Coastal Shorelines category includes estuarine shorelines and public trust shorelines.

(1) Estuarine shorelines AEC are those non-ocean shorelines extending from the normal high water level or normal water level along the estuarine waters, estuaries, sounds, bays, fresh and brackish waters, and public trust areas as set forth in an agreement adopted by the Wildlife Resources Commission and the Department of Environmental Quality [described in Rule .0206(a) of this Section] **for a distance of 75 feet landward**. For those estuarine shorelines immediately contiguous to waters classified as Outstanding Resource Waters (ORW) by the Environmental Management Commission (EMC), the estuarine shoreline AEC shall extend to 575 feet landward from the normal high water level or normal water level, unless the Coastal Resources Commission establishes the boundary at a greater or lesser extent following required public hearing(s) within the affected county or counties.

(2) Public trust shorelines AEC are those non-ocean shorelines immediately contiguous to public trust areas, as defined in Rule 07H .0207(a) of this Section, located inland of the dividing line between coastal fishing waters and inland fishing waters as set forth in that agreement and extending 30 feet landward of the normal high water level or normal water level.

(b) Significance. Development within coastal shorelines influences the quality of estuarine and ocean life and is subject to the damaging processes of shore front erosion and flooding. The coastal shorelines and wetlands contained within them serve as barriers against flood damage and control erosion between the estuary and the uplands. Coastal shorelines are the intersection of the upland and aquatic elements of the estuarine and ocean system, often integrating influences from both the land and the sea in wetland areas. Some of these wetlands are among the most productive natural environments of North Carolina and they support the functions of and habitat for many valuable commercial and sport fisheries of the coastal area. Many land-based activities influence the quality and productivity of estuarine waters. Some important features of the coastal shoreline include wetlands, flood plains, bluff shorelines, mud and sand flats, forested shorelines and other important habitat areas for fish and wildlife.

(c) Management Objective. All shoreline development shall be compatible with the dynamic nature of coastal shorelines as well as the values and the management objectives of the estuarine and ocean system. Other objectives are to conserve and manage the important natural features of the estuarine and ocean system so as to safeguard and perpetuate their biological, social, aesthetic, and economic values; to coordinate and establish a management system capable of conserving and utilizing these shorelines so as to maximize their benefits to the estuarine and ocean system and the people of North Carolina.

(d) Use Standards. Acceptable uses shall be those consistent with the management objectives in Paragraph (c) of this Rule. These uses shall be limited to those types of development activities that will not be detrimental to the public trust rights and the biological and physical functions of the estuarine and ocean system. Every effort shall be made by the permit applicant to avoid or

minimize adverse impacts of development to estuarine and coastal systems through the planning and design of the development project. Development shall comply with the following standards:

(1) All development projects, proposals, and designs shall preserve natural barriers to erosion, including peat marshland, resistant clay shorelines, and cypress-gum protective fringe areas adjacent to vulnerable shorelines.

(2) All development projects, proposals, and designs shall limit the construction of impervious surfaces and areas not allowing natural drainage to only so much as is necessary to service the primary purpose or use for which the lot is to be developed. Impervious surfaces shall not exceed 30 percent of the AEC area of the lot, unless the applicant can demonstrate, through innovative design, that the protection provided by the design would be equal to or exceed the protection by the 30 percent limitation. Redevelopment of areas exceeding the 30 percent impervious surface limitation shall be permitted if impervious areas are not increased and the applicant designs the project to comply with the rule to the maximum extent feasible.

(3) All development projects, proposals, and designs shall comply with the following mandatory standards of the North Carolina Sedimentation Pollution Control Act of 1973:

(A) All development projects, proposals, and designs shall provide for a buffer zone along the margin of the estuarine water that is sufficient to confine visible siltation within 25 percent of the buffer zone nearest the land disturbing development.

(B) No development project proposal or design shall propose an angle for graded slopes or fill that is greater than an angle that can be retained by vegetative cover or other erosion-control devices or structures.

(C) All development projects, proposals, and designs that involve uncovering more than one acre of land shall plant a ground cover sufficient to restrain erosion within 30 working days of completion of the grading; unless the project involves clearing land for the purpose of forming a reservoir later to be inundated.

(4) Development shall not have a significant adverse impact on estuarine and ocean resources. Significant adverse impacts include development that would directly or indirectly impair water quality increase shoreline erosion, alter coastal wetlands or Submerged Aquatic Vegetation (SAV), deposit spoils waterward of normal water level or normal high water, or cause degradation of shellfish beds.

(5) Development shall not interfere with existing public rights of access to, or use of, navigable waters or public resources.

(6) No public facility shall be permitted if such a facility is likely to require public expenditures for maintenance and continued use, unless it can be shown that the public purpose served by the facility outweighs the required public expenditures for construction, maintenance, and continued use.

(7) Development shall not cause irreversible damage to valuable, historic architectural or archaeological resources as documented by the local historic commission or the North Carolina Department of Natural and Cultural Resources.

(8) Established common-law and statutory public rights of access to the public trust lands and waters in estuarine areas shall not be eliminated or restricted. Development shall not encroach upon public accessways nor shall it limit the use of the accessways.

(9) Within the AECs for shorelines contiguous to waters classified as ORW by the EMC, no CAMA permit shall be approved for any project that would be inconsistent with rules adopted by the CRC, EMC or MFC for estuarine waters, public trust areas, or coastal wetlands. For development activities not covered by specific use standards, no permit shall be issued if the activity would, based on site-specific information, degrade the water quality or outstanding resource values.

(10) Within the Coastal Shorelines category (estuarine and public trust shoreline AECs), new development shall be located a distance of 30 feet landward of the normal water level or normal high water level, with the exception of the following:

(A) Water-dependent uses as described in Rule 07H .0208(a)(1) of this Section;

(B) Pile-supported signs (in accordance with local regulations);

(C) Post- or pile-supported fences;

(D) Elevated, slatted, wooden boardwalks exclusively for pedestrian use and six feet in width or less. The boardwalk may be greater than six feet in width if it is to serve a public use or need;

(E) Crab Shedders, if uncovered with elevated trays and no associated impervious surfaces except those necessary to protect the pump;

(F) Decks/Observation Decks limited to slatted, wooden, elevated and unroofed decks that shall not singularly or collectively exceed 200 square feet;

(G) Grading, excavation and landscaping with no wetland fill except when required by a permitted shoreline stabilization project. Projects shall not increase stormwater runoff to adjacent estuarine and public trust waters;

(H) Development over existing impervious surfaces, provided that the existing impervious surface is not increased;

(I) Where application of the buffer requirement would preclude placement of a residential structure with a footprint of 1,200 square feet or less on lots, parcels and tracts platted prior to June 1, 1999, development shall be permitted within the buffer as required in Subparagraph (d)(10) of this Rule, providing the following criteria are met:

(i) Development shall minimize the impacts to the buffer and reduce runoff by limiting land disturbance to only so much as is necessary to construct and provide access to the residence and to allow installation or connection of utilities, such as water and sewer; and

(ii) The residential structure development shall be located a distance landward of the normal high water or normal water level equal to 20 percent of the greatest depth of the lot. Existing structures that encroach into the applicable buffer area may be replaced or repaired consistent with the criteria set out in 15A NCAC 07J .0201 and .0211; and

(J) Where application of the buffer requirement set out in Subparagraph (d)(10) of this Rule would preclude placement of a residential structure on an undeveloped lot platted prior to June 1, 1999 that are 5,000 square feet or less that does not require an on-site septic system, or on an undeveloped lot that is 7,500 square feet or less that requires an on-site septic system, development shall be permitted within the buffer if all the following criteria are met:

(i) The lot on which the proposed residential structure is to be located, is located between:

(I) Two existing waterfront residential structures, both of which are within 100 feet of the center of the lot and at least one of which encroaches into the buffer; or

(II) An existing waterfront residential structure that encroaches into the buffer and a road, canal, or other open body of water, both of which are within 100 feet of the center of the lot;

(ii) Development of the lot shall minimize the impacts to the buffer and reduce runoff by limiting land disturbance to only so much as is necessary to construct and provide access to the residence and to allow installation or connection of utilities;

(iii) Placement of the residential structure and pervious decking shall be aligned no further into the buffer than the existing residential structures and existing pervious decking on adjoining lots;

(iv) The first one and one-half inches of rainfall from all impervious surfaces on the lot shall be collected and contained on-site in accordance with the design standards for stormwater management for coastal counties as specified in 15A NCAC 02H .1005. The stormwater management system shall be designed by an individual who meets applicable State occupational licensing requirements for the type of system proposed and approved during the permit application process. If the residential structure encroaches into the buffer, then no other impervious surfaces shall be allowed within the buffer; and

(v) The lots shall not be adjacent to waters designated as approved or conditionally approved shellfish waters by the Shellfish Sanitation Section of the Division of Marine Fisheries of the Department of Environmental Quality.

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Carolina Beach
Local Government

CB19-02
Permit Number

CAMA
MINOR DEVELOPMENT
PERMIT

as authorized by the State of North Carolina, Department of Environment, and Natural Resources and the Coastal Resources Commission for development in an area of environment concern pursuant to Section 113A-118 of the General Statutes, "Coastal Area Management"

Issued to David & Lisa Porter, authorizing development in the Estuarine Shoreline (AEC) at 813 Canal Drive, in Carolina Beach, as requested in the permittee's application, dated 01/16/2019. This permit, issued on 2/28/2019, is subject to compliance with the application and site drawing (where consistent with the permit), all applicable regulations and special conditions and notes set forth below. Any violation of these terms may subject permittee to a fine, imprisonment or civil action, or may cause the permit to be null and void.

This permit authorizes: FEMA House Elevation

(1) All proposed development and associated construction must be done in accordance with the permitted work plat drawings(s) dated received on 02/19/2019.

(2) All construction must conform to the N.C. Building Code requirements and all other local, State and Federal regulations, applicable local ordinances and FEMA Flood Regulations.

(3) Any change or changes in the plans for development, construction, or land use activities will require a re-evaluation and modification of this permit.

(4) A copy of this permit shall be posted or available on site. Contact this office at 910-458-2978 for a final inspection at completion of work.

(Additional Permit Conditions on Page 2)

RECEIVED
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This permit action may be appealed by the permittee or other qualified persons within twenty (20) days of the issuing date. From the date of an appeal, any work conducted under this permit must cease until the appeal is resolved. This permit must be on the project site and accessible to the permit officer when the project is inspected for compliance. Any maintenance work or project modification not covered under this permit, require further written permit approval. All work must cease when this permit expires on:

DECEMBER 31, 2021

In issuing this permit it is agreed that this project is consistent with the local Land Use Plan and all applicable ordinances. This permit may not be transferred to another party without the written approval of the Division of Coastal Management.

Miles Murphy

Miles Murphy
CAMA LOCAL PERMIT OFFICIAL
1121 N. Lake Park Blvd
Carolina Beach, NC 28428

PERMITTEE
(Signature required if conditions above apply to permit)

Name: David & Lisa Porter
Minor Permit # CB19-02
Date: 02/28/2019
Page 2

(5) In reference to 15A NCACA 07H .0209 (10)(H) – development over existing impervious surfaces, provided that the existing impervious surface is not increased and the applicant designs the project to comply with the intent of the rules to the maximum extent feasible.

(6) All unconsolidated material resulting from associated grading and landscaping shall be retained on site by effective sedimentation and erosion control measures. Prior to any land-disturbing activities, a barrier line of filter cloth must be installed between the land disturbing activity and the adjacent marsh or water areas, until such time as the area has been properly stabilized with a vegetative cover.

(7) Any proposed for grading within the 30' buffer from the Normal High Water Level must be contoured to prevent additional stormwater runoff to the adjacent marsh. This area shall be immediately vegetatively stabilized, and must remain in a vegetated state.

(8) All other disturbed areas shall be vegetatively stabilized (planted and mulched) within 14 days of construction completion.

SIGNATURE: _____ DATE: _____

PERMITTEE

NC COASTAL RESOURCES COMMISSION (CRC)
September 15, 2021
Video Conference

Present CRC Members
Renee Cahoon, Chair
Larry Baldwin, Vice-Chair
Robin Smith, Second Vice-Chair
Neal Andrew
Craig Bromby
Trace Cooper
Bob Emory
Robert High
Doug Medlin
Lauren Salter
Angie Wills

Present from the Office of the Attorney General
Mary L. Lucasse

Present from the Department of Environmental Quality, Office of the General Counsel
Christine A. Goebel

CALL TO ORDER/ROLL CALL
Renee Cahoon called the meeting to order at 9:00 a.m. on September 15, 2021, reminding the Commissioners of the need to state any conflicts due to Executive Order Number 34 and the State Government Ethics Act. The State Government Ethics Act mandates that at the beginning of each meeting the Chair remind all members of their duty to avoid conflicts of interest and inquire as to whether any member knows of a conflict of interest or potential conflict with respect to matters to come before the Commission. The Chair requested that if any member knows of a conflict of interest or a potential conflict of interest, they so state when the roll is called. Commissioners Norris and Tunnell were absent. No conflicts were reported. Based upon this roll call Chair Cahoon declared a quorum.

CHAIR'S COMMENTS
Chair Cahoon stated Commissioner Tunnell is not able to attend today as broadband connectivity is spotty in Hyde County. A special thanks to Commissioners Emory and Baldwin for representing the Commission on the Coastal Habitat Protection Plan (CHPP). Lastly, we would like to recognize and welcome Elizabeth Biser, the new DEQ Secretary.

MINUTES
Larry Baldwin made a motion to approve the minutes of the June 16, 2021, Coastal Resources Commission meeting. Trace Cooper seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Cooper, Emory, High, Medlin, Slater, Smith, Wills).

EXECUTIVE SECRETARY'S REPORT
DCM Director Braxton Davis gave the following report:

We appreciate your continued patience with the virtual meeting format – and please feel free to interrupt me anytime and use the "raise hand" feature to let us know you want to weigh in. We want to make sure we have your input on the rules, and we don't want to rush through anything given the challenges associated with virtual/online meetings. I'll start with a quick legislative update. I understand that Senate Bill 389, which is based on recommended legislative changes submitted by the NC Department of Environmental Quality and NC Dept of Natural and Cultural Resources, has been passed out of the General Assembly and is on the Governor's desk. In it are three provisions we submitted. First, changes to the Public Access program to align CAMA and the Commission's rules regarding the disposition of properties purchased with state access funds. Second, a removal of an outdated provision for notification of DCM permit actions by mail to an interested parties list. Last is an extension of the deadline for the Chair to make a decision on a third party appeal from 15 days to 30 days from the date filed.

On the regulatory side of DCM, we recently permitted beach nourishment projects for the Towns of Kill Devil Hills and Duck, with Southern Shores and Kitty Hawk anticipated to soon follow. Proposed nourishment projects for Buxton and Avon are also in process and have been distributed for interagency reviews. We have recently begun review of a nourishment project for Nags Head. The Dare County nourishment projects are planned for summer 2022. We also have an application from the Town of North Topsail Beach to conduct a truck haul nourishment project, which is planned to start this upcoming winter. As an example of a non-beachfront CAMA Major Permit issued since the last meeting, I'll highlight the Beacon Street/Moss East project in the City of Washington. A CAMA Major permit was issued on September 2 for a 50-lot subdivision, with 1,100 feet of bulkhead and a 51-slip residential marina consisting of 4 piers. This project received some comments and concerns from the Wildlife Resources Commission related to habitat for anadromous fish, and our major permit staff worked with the applicant and the WRC to come up with a plan that allowed the project to move forward while still protecting important habitat. DCM staff are participating in the NC12 Task Force that is being led by Dare County, NCDOT and the National Park Service to develop long-term plans and evaluate alternatives to address a series of hot spots along Highway 12 that are continually subjected to erosion and ocean overwash. Jonathan Howell and I were able to attend a meeting and field trip to visit each of the hotspots back in July, and DCM stands ready to assist in any way that we can.

Federal Consistency
On July 21, DCM received a Federal Consistency Determination from the Wilmington District of the Army Corps of Engineers to reauthorize 12 Regional General Permits. Corps Regional General Permits are issued for specific geographic areas, and each Regional General Permit has specific terms and conditions. In North Carolina, Regional General Permits are drafted to be consistent to the maximum extent practicable with DCM's general permits and Major Permit process to create a streamlined permitting process. This process allows DCM to serve as the lead permitting agency with streamlined coordination with the Corps on many major coastal projects. DCM is currently reviewing the proposed changes and updates to ensure consistency with DCM's general permits and Major Permit process. On August 5, DCM received a Federal Consistency Certification from Avangrid Renewables regarding their Construction and Operation Plan (COP) for an offshore wind facility within the Kitty Hawk Wind Energy Area.

The COP has been submitted to BOEM for approval, and after discussions with NOAA's Office for Coastal Management, we learned that DCM can ask for a "stay agreement" with the applicant to initiate the federal consistency review after the conclusion of BOEM's Draft Environmental Impact Statement so that the State will have the relevant information from that analysis. DCM is currently in contact with Avangrid to negotiate a Stay Agreement for that purpose. Finally, the Southern Environmental Law Center filed a lawsuit on August 4, claiming the Corps violated the National Environmental Policy Act and the Administrative Procedure Act by arbitrarily reversing agency policy and failing to prepare an Environmental Impact Statement for the proposed elimination of environmental windows for the federal shipping channels for the two NC State Ports. SELC is seeking a court order to prevent the Corps from proceeding with year-round hopper dredging unless and until the Corps conducts a review under the National Environmental Policy Act. The Corps has a deadline of October 8 for an initial response.

POLICY & PLANNING

The Division received one land use plan amendment request since your last meeting. The Town of Morehead City submitted a LUP amendment for certification and the Division found that the amendment met the substantive requirements outlined within your 7B Land Use Planning Requirements, that there are no conflicts evident with either state or federal law or the State's Coastal Management Program; and that the elected body of the local government provided opportunity for the public to provide written comment following local adoption of the plan. For these reasons, the request for certification of the land use plan action was granted. Local government work under the Resilient Coastal Communities Program is officially underway. Effective August 11, DCM entered into contracts with nine firms and the Mid-East Commission to work with the 26 communities receiving assistance this year. The contracts total $705,000, with most communities receiving technical assistance valued at $30,000. Work has begun in assembling citizen stakeholder groups, compiling data for vulnerability assessments, and conducting public outreach. Staff has been very encouraged by the high levels of interest and participation seen among the communities and the contractors, and all feedback to date has been constructive and supportive. We would like to acknowledge the strong support from NC Emergency Management's Floodplain Mapping Program and NCDOT in providing data and technical assistance for the vulnerability assessments, and we remain grateful for our ongoing partnerships with NCORR, NC Sea Grant and The Nature Conservancy. As I mentioned at our last meeting, DCM submitted a proposal to the NFWF National Coastal Resilience Fund for an additional $550,000 to fund more communities through the RCCP. We are awaiting a decision on that application. We are also tracking the state budget process, which may include additional funding and a permanent staff position for the RCCP.

Coastal Reserve

The public comment period for proposed changes to rules related to the NC Coastal Reserve, 15A NCAC 07O closed earlier this week. We received one written public comment with several suggestions, and I'd be happy to share that with anyone interested as we work through the suggested changes, which are generally minor. The public hearing was held virtually on August 26, and we received no comments at the hearing. I think the lack of comments reflects the extensive coordination we had with Local Advisory Committees and partners throughout the rule development process. These amendments satisfy the Legislative Periodic Review process requirements, and address priority updates to existing rules and address issues and gaps. The next steps include the Department's adoption of the rules and approval by the Rules Review

Commission. The proposed effective date is November 1, 2021. To continue to promote the use of living shorelines, the Coastal Training Program hosted a virtual training for real estate professionals on September 2. Participants learned about the benefits and limitations of using living shorelines for erosion control, different shoreline stabilization techniques, the living shoreline permitting process, use of marsh plants and oyster shell to prevent erosion, and existing living shoreline projects in NC. The virtual training was recently certified by the NC Real Estate Commission and participating real estate professionals received 4 elective continuing education credits. The virtual training compliments in-person trainings offered prior to the pandemic and demand is high – a second offering has been added to the schedule for September 30. The Reserve recently received funding from NOAA's National Estuarine Research Reserve System to update and improve its on-site research and public access infrastructure. Federal funds in the amount of $277,100 are being matched through Public Access Grant funds for the Currituck Banks Reserve boardwalk refurbishment and will also be used to design and construct storm-resilient research platforms to support the Reserve's implementation of the System-wide Monitoring Program. The funding will also be used to develop and install interpretive signage at the Currituck Banks and Masonboro Island Reserves.

Staffing News

In staffing news, our Resilience Coordinator Samantha Burdick has accepted a permanent position as the Town Planner for the Town of Beaufort. Sam was instrumental in getting the RCCP off the ground and we wish her the best in her new role. We are currently working to fill her position. We are happy to introduce Cameron Luck, our new Assistant Major Permit Coordinator in the Morehead City office. Cameron will be working the southern half of the CAMA counties. Cameron comes to us from the Division of Marine Fisheries where he served as the Artificial Reef coordinator in Morehead City. Cameron has been with the state for 3 years and we look forward to him joining our regulatory program in the Morehead office. Finally, I am proud to share that our own Dr. Brandon Puckett received the North Carolina Coastal Federation's Pelican Award. Brandon was recognized for leadership and expert scientific research advancing coastal restoration. Brandon's research has helped build a foundation for hundreds of acres of new oyster sanctuary in Pamlico Sound, a better understanding of marsh resiliency, and has helped advance water quality protection efforts in the state. Congratulations to Brandon for this well-deserved recognition.

CRAC REPORT

Spencer Rogers stated Greg Rudolph sends his regrets that he could not attend. The Council met virtually and discussed building code issues that had been delayed since the last CRAC meeting. This discussion was centered around our internal committee's work on conflicts between CAMA regulations, building codes, and flood plain ordinances. Mike Lopazanski gave a presentation reviewing CRC actions that had taken place since the last CRAC meeting. Lastly, we had a presentation on the CHPP, and the Commission will see a similar presentation on today's agenda.

VARIANCES

Sanders (CRC-VR 21-03), Topsail Beach, Oceanfront Setback
Christine Goebel, Esq., Tara MacPherson/Karen Sanders, Pro se

DCM District Manager Tara MacPherson gave an overview of the site. Christine Goebel stated Karen Sanders is present and will represent herself. Petitioner owns a residence at 705 N.

Anderson Blvd. in the Town of Topsail Beach. The property is located within the Commission's Ocean Hazard Area of Environmental Concern ("AEC"). In June of 2021, Petitioner filed a CAMA Minor Permit application seeking to convert her streetside roofed porch and unconditioned utility closet/laundry into conditioned Total Floor Area on her one-story home. On July 22, 2021, DCM denied Petitioner's CAMA Minor Permit application as the proposed addition does not meet the applicable setback rules from the vegetation line. While the porch proposed to be enclosed is landward of the 60' setback, the Commission's rules prohibit enlargements to non-conforming structures. On July 27, 2021, Petitioner filed this variance petition to request the Commission vary the oceanfront setback rules so she can develop the 92.5 square foot addition as proposed. Ms. Goebel reviewed the stipulated facts in this variance request and stated Staff and Petitioner agree on two of the four statutory criteria which must be met in order to grant the variance.

Larry Baldwin made a motion that strict application of the applicable development rules, standards, or orders issued by the Commission cause the petitioner unnecessary hardships. Neal Andrew seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Cooper, Emory, High, Medlin, Salter, Smith, Wills).

Larry Baldwin made a motion that hardships result from conditions peculiar to the petitioner's property such as location, size, or topography of the property. Neal Andrew seconded the motion. The motion passed with eight votes in favor (Cahoon, Andrew, Baldwin, Emory High, Medlin, Smith, Wills) and three opposed (Bromby, Cooper, Salter).

Larry Baldwin made a motion that hardships do not result from the actions taken by the Petitioner. Robert High seconded the motion. The motion passed with ten votes in favor (Cahoon, Andrew, Baldwin, Cooper, Emory, High, Medlin, Salter, Smith, Wills) and one opposed (Bromby).

Larry Baldwin made a motion that the variance requested by the petitioner is consistent with the spirit, purpose, and intent of the rules, standards, or orders issued by the Commission; will secure public safety and welfare; and will preserve substantial justice. Doug Medlin seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Cooper, Emory, High, Medlin, Salter, Smith, Wills).

This variance request was granted.

RULE INTERPRETATIONS

Use of Artificial Turf Grass in the Buffer (CRC 21-24)
Robb Mairs, DCM LPO Coordinator

Robb Mairs stated the topic of artificial turf grass installation has suddenly emerged for our program, and with no standards that specifically apply to this material, we are presently working through the appropriate next steps in several cases within the Coastal Shoreline Area of Environmental Concern and within the associated 30' shoreline buffer. Once staff gets guidance from the commission, we intend to reach out to the LPOs, coastal landscape architects and engineering firms to help communicate with coastal property owners about permitting requirements and best practices for these types of installations. A slide was shown depicting a

typical cross section of the underlayment associated with the installation of turf grass such as infill, filter fabric, stone, and soil. The turfgrass is secured with landscape nails. Plastic fiber soils made of polymer may be used to reinforce the soil to increase load bearing capabilities for heavy machinery such as emergency vehicles. DCM staff have been working directly with the State Stormwater Section in the Wilmington Regional Office for their assistance in determining whether this material, as installed, would be deemed as pervious or impervious if located within our Coastal Shoreline Area of Environmental Concern and the associated 30' buffer under our current rules 07H .0209. The DCM has also reached out to other interested resource agencies including the DWR, DMF, WRC, and the USACE to identify any concerns they may have with turf grass and additionally, the underlayment such as the microplastics that were placed within the soils prior to the installation of the turf grass, and turf infill that could potentially enter the adjacent surface waters. The CRC's rules currently restrict development within the 30-foot buffer to water-dependent uses which are typically docks, piers, boat ramps, bulkheads and accessways. There are also exceptions for limited non-water dependent uses which include pile supported signs; elevated, slatted wooden boardwalks; crab shedders; decks/observation decks; grading, excavation, and landscaping with no wetland fill except when required by a permitted shoreline stabilization project. With the implementation of the buffer rules, the CRC considered a wide range of uses and was consistent in not allowing non-water dependent uses. The buffer was identified as crucial to water quality in filtering contaminants from runoff, infiltration, stabilizing soil, slowing flood waters, and preserving natural character at the shoreline. Since the rules were implemented, there have been advances in technology that address stormwater runoff associated with traditional impervious surfaces. The use of pervious pavement, pavers and associated installation requirements have been promoted by various institutions and the Division of Energy, Minerals and Land Resources' Stormwater Design Manual includes specifications for construction of "hard" surfaces that capture stormwater through voids in the materials surfaces. Staff from DWR responded that the Tar-Pamlico and Neuse River buffer rules do not include turf grass in their respective Table of Uses and that the material would appear to contradict the intent of the rule to preserve buffer function for nutrient removal. DWR staff expressed concerns with the potential for these small plastic fibers, and rubber or silica beads, to enter nearby receiving waters and potentially lead to water quality standards violations. Under these rules as well as Session Law 2008-211, there would be options for artificial turf to be allowed within a vegetated setback if stormwater from the entire project is collected and treated prior to discharge. Artificial turf could be designed to meet the minimum design criteria provided in 15A NCAC 02H .1050 and .1055. State Stormwater staff responded that this approach is not recommended because there is a high likelihood of maintenance problems. There are some local level buffer developments codes. One example of a local level ordinance is within New Hanover County's Conservation Overlay District (COD) that comes into play. These vegetated setbacks are pulled from the upper limits of the resource, which for projects within our coastal shoreline AEC would be coastal wetlands. If applicable the COD vegetative buffer would be 75' landward from the upper limits of coastal wetlands for residential use, and up to 100' for commercial use. To retain the effectiveness of the 30' buffer in filtering runoff, Staff request that the Commission confirm DCM's interpretation that the application of artificial turf within an Area of Environmental Concern requires a CAMA permit, and that it is not allowable under the landscaping exception to the 30' buffer at 15A NCAC 07H.0209(d)(10)(G). While DCM can permit this material within the 75' or 575' AEC, it may be deemed as impervious surface based on a case-by-case review

and therefore count toward the maximum allowable impervious surface coverage depending on installation methods and materials, and any existing impervious surfaces.

Bob Emory made a motion to agree with Staff's interpretation that artificial turf grass requires a CAMA permit and that it is not considered landscaping and not allowed within the buffer. Lauren Salter seconded the motion. The motion passed with ten votes in favor (Cahoon, Andrew, Bromby, Cooper, Emory, High, Medlin, Salter, Smith, Wills) and one opposed (Baldwin).

Static Line Exceptions (CRC 21-25)
Tancred Miller

Tancred Miller stated in 2009 the rule was established allowing this measurement line to be used in conjunction with a large-scale beach fill project as a setback line for development. For communities with beach and inlet management plans, the Commission wanted to offer an incentive to continue with long-term plans. The static line exception offers communities the opportunity to use the actual vegetation line. Recently there have been implementation issues that staff would like to get the Commission's input on. Staff proposes to add any amendments into the beach management plan rules that will be presented to the Commission in November. The first issue is with 7H .0306(a)(12) where it states: "In order to allow for development landward of the large-scale beach fill project that cannot meet the setback requirements from the static vegetation line, but can or has the potential to meet the setback requirements from the vegetation line set forth in Subparagraphs (a)(1) and (a)(5) of this Rule, a local government, group of local governments involved in a regional beach fill project, or qualified "owners' association".... may petition the Coastal Resources Commission for a "static line exception" in accordance with 15A NCAC 07J .1200." This has been interpreted by at least one local government to mean that if a proposed development can meet the oceanfront setback from a community's static vegetation line, that it must do so, even if the community has a static line exception. Staff would like the Commission to clarify whether this is the Commission's interpretation. If not, amending the preamble by striking the first sentence can remove the ambiguity. The second issue is 7H. 0306(a)(12)(C) which prohibits any portion of a structure from extending farther oceanward than the landward-most adjacent building or structure. This provision presents four implementation issues. DCM has defined "adjacent" in the Adjacent Riparian Property Owner Notification for Minor Permits (updated July 2021) as "a property that shares a boundary line with the site of proposed development." If no adjacent structures exist, the proposed development would be sited in accordance with the "average line of construction" identified by the DCM director. Unless the Commission directs otherwise, staff will use this definition in the determination of landward-most adjacent. The current rule specifically provides for the Division of Coastal Management to determine an "average line of construction" on a case-by-case basis. Should LPO's have this authority also? Staff prefers that the DCM Director be the only individual authorized to make this call. In addition, Staff proposes that the average line of construction be based on an approximation of the average seaward-most positions of the rooflines of adjacent structures along the same shoreline and extending 500 feet in either direction. To prevent gazebos, boardwalks, sheds, pools, and other types of accessory structures from being treated as an adjacent building or structure, staff proposes that only habitable structures of any size be used for measurement. If no structures exist within 500 feet in either direction, the proposed structure will need to meet the applicable setback from the Vegetation

Line but would not be held to the landward-most adjacent structure or an average line of structures. Another question is from what part of an adjacent building or structure should the "landward-most" standard apply? Staff proposes that this be the most oceanward point of the building or structure's roof line, including roofed decks, but not the 500 square feet of uncovered decked, allowed as an exception in 7H .0309. Another issue arises under 7H. 0306(a)(12)(D) which authorizes, with the exception of swimming pools, that the development exceptions in 7H .0309(a) be located oceanward of the static vegetation line. This rule is silent on whether those types of development can be placed oceanward of the landward-most adjacent building or structure. Staff recommends that all .0309(a) exceptions, except swimming pools, be allowed seaward of the landward-most adjacent structure under the static line exception. Staff is seeking feedback from the Commission but is not recommending action today. All proposed amendments will be included in the proposed Beach Management Plan rules to be presented in November.

By consensus, the Commission approved staff's interpretations and recommendations. Staff will provide rule amendments to the beach plan rules at the November CRC meeting.

Public Beach and Coastal Waterfront Access Grant Program & Parking Fees (CRC 21-26) Mike Lopazanski

Mike Lopazanski stated CRC rules have allowed local governments to collect parking fees at sites funded by the Access Program for the past 20 years, provided that the fees are used exclusively for the operation and maintenance of access facilities. The allowable uses of fee revenues were expanded in 2007 to include the acquisition or development of new access facilities. Also in 2007, a provision was added to require biannual reporting on the use of fees to the Division. There was no consequence for not reporting and some reporting was inconsistent. Amendments are being proposed to allow local government to post their collection of fees and use of fees. The decision to charge a fee is a local issue. Not all access sites are state funded. For example, New Hanover County has approximately 94 access sites, but only 26 of them are DCM supported. During discussion at a previous meeting, the question came up about whether local governments could use parking fees to supplement funding for beach nourishment. In amendments to 7M .0310 the Commission added the word "enhancements". Staff interprets enhancements to mean any of the usual amenities that would accompany an access site such as restrooms, picnic tables, gazebos, etc. New Hanover County sited NCGS 160A-301 which address on and off-street parking locally. This Statute allow the County to use on street parking fees to defray the costs of traffic and parking ordinances and allows the use of off-street parking fees to be used for any public purpose. Wrightsville Beach also sited Session Law 98-96 which allows the use of all fees to be used for any public purpose. During the last meeting, Commissioner Robin Smith offered to review the General Statutes and Session Laws relating to the use of fees within the context of public access facilities. Her analysis of CAMA and current CRC rules was attached to CRC 21-26 and provided to the Commission.

Commissioner Smith stated the current rules as written only apply to public access facilities that have been acquired or improved with State Access Grant Funds. When a local government receives a grant, the agreement includes a condition that fees are only to be used exclusively for acquiring, improving, or enhancing access sites. The CAMA provisions clearly state the funds are for public access to the beach and public trust waters but does not allow for enhancement of the beach or beach nourishment. New Hanover County raises the questions of whether NCGS

160A-301 conflicts with the general authority in CAMA which restricts use of parking fees for state funded access facilities. The Legislature has given local governments broad authority to use parking fees from municipal-owned or leased facilities for off street parking for any public purpose. As explained in the memo, the interpretation of public access provisions in CAMA and public access the CRC rules means access across upland property to reach the beach or public trust waters. The current rule limits the use of user fees at state-funded public access facilities to operation and maintenance of public access facilities and does not cover other general operation maintenance needs of the local government. The current rule falls within the CRC's authority to ensure that state-funded public access facilities are operated and maintained for public access and does not conflict with the more general authority of local governments to use fees from other municipally owned or leased parking sites.

Neal Andrew commented that he has a different interpretation. When people go to the beach to walk, swim and surf and there isn't any sand at the public accesses, then why go to access sites? Sand is an amenity just like lifeguards and trash cans. All funds and sources should go toward waterway management and beach nourishment.

Trace Cooper commented that this can be interpreted in different ways, but the CRC should revisit this during rulemaking. Operations, maintenance, and enhancements could be interpreted to use parking fees for fire and EMS services. The burden on Towns to have access sites is significant and fee use should not be limited.

Commissioner Smith stated the CRC should discuss the use of fees and consider rulemaking but agrees with the staff's interpretation of limited use of fees for maintenance and enhancements. Staff should bring back clear wording on the use of fees in rule amendments in November.

Robin Smith made a motion to approve the interpretation of 15A NCAC 07M .0310 as it's currently being applied. Bob Emory seconded the motion. The motion passed with seven votes in favor (Cahoon, Baldwin, Bromby, Emory, Salter, Smith, Wills) and two opposed (Andrew, Cooper).

CAMA LAND USE PLANS

Amendments to 15A NCAC 7B CAMA Land Use Plans – Enforceable Policies (CRC 21-27) Tancred Miller

Tancred Miller stated in June the CRC heard a presentation on the lack of clearly defined enforceable policies within Land Use Plans. Staff is looking for guidance on clarifying language. Definitions have been added to 7B .0702. Clear enforceable policies will ensure that DCM staff use a Land Use Plan in the way that the local government wants its plan to be used during permit review. Staff does not believe local governments should be required to update their Land Use Plan once these policies have been identified. If the plan is not update, DCM will only be able to enforce unambiguous policies. During the certification process, there are three options for the local government to choose from regarding implementation: they can select local administration of the plan and review their own CAMA permit applications; there is a joint administration option where the local government and DCM both review the permit applications, but with the local government identifying the enforceable policies; the third option for DCM administration is being removed as it is redundant.

The NC Homebuilders Association submitted comments on these proposed amendments. DCM would like counsel to review the comments prior to making any additional amendments and will bring recommendations back to the CRC for review in November.

PUBLIC INPUT AND COMMENT

Chris Matteo provided industry input from the NC Shellfish Growers Association regarding shellfish farming barge recommendations and provided responses to DCM staff recommendations. (written comments provided)

Chris Millis, NC Homebuilders Association, provided comments on CRC Memo 21-27 Amendments to 7B CAMA Land Use Plan Enforceable Policies. (written comments provided)

Leda Cunningham, Pew Charitable Trust, spoke in favor of the CRC approving the CHPP for public comment. (written comment provided)

Layton Bedsole, New Hanover County staff, provided comments regarding the interpretation of amenities at public accesses. (written comments provided)

Ryan Bethea, oyster farmer in NC with an oyster lease in Back Sound, provided comments in support of the CRC approving the CHPP for public comment. (written comments provided)

INLET HAZARD AREAS

General Permit for Beach Bulldozing & Inlet Hazard Areas (CRC 21-28)

Ken Richardson, Shoreline Management Specialist

Ken Richardson stated, given the expansion of the proposed Inlet Hazard Area boundaries at specific inlets, concerns and comments were raised during IHA public hearings and workshops, with regards to dune restoration inside an IHA and how the new boundaries would affect the ability to utilize General Permit for beach bulldozing. He briefly reviewed the rules to understand why these questions were asked, and also provide rule amendments for the Commission to consider that may help in clarifying and alleviating concerns on this issue. Beach bulldozing is a method of oceanfront erosion management within the Ocean Hazard Area of Environmental Concern that moves beach sand from areas seaward of the first line of stable and natural vegetation to repair or stabilize an existing dune damaged by erosion, or to create a protective berm for an imminently threatened structure and can be authorized through the CAMA permit process. A CAMA General Permit 15A NCAC 07H.1800 is available to individual property owners and authorizes the bulldozing of sand from the beach area between Mean Low Water Line and the FLSNV within the Ocean Hazard Area of Environmental Concern but does not apply within the boundaries of a designated Inlet Hazard AEC. As you are aware, General Permits have standards associated with them. 15A NCAC 07H. 2500 authorizes emergency general permits, however, all projects authorized under the 07H .2500 must also conform to the specific standards in other General Permits to include 07H.1800, thus not allowing this activity inside an IHA. 15A NCAC 07H.0308 Specific Use Standards in Ocean Hazard Areas sub-section (b) addresses dune establishment and stabilization and goes on state that "no new dunes shall be created in inlet hazard areas." "New" is different from restore or repair. For rule purposes "new" means creation of a dune that was not there before, while restore and repair addresses stabilization or restoration of an existing dune. Currently, restore and repair is allowed inside an IHA; however, it is not always clear to the rule interpreter. Historically, some local governments have pursued CAMA Major Permits for beach bulldozing activities in the aftermath of major storms or other significant weather events. A Major Permit for the purpose of beach bulldozing

for dune rehabilitation, or new dune construction, can be authorized for the local government's entire Ocean Erodible Area, including the IHA where a previous dune existed, not to be confused with creating a new dune where it did not exist before. Currently there are 7 local governments or communities that have active CAMA Major Permits for beach bulldozing: North Topsail Beach, Surf City, Figure Eight Island, Wrightsville Beach, Oak Island, Ocean Isle Beach, Sunset Beach. If a local government has an active beach bulldozing CAMA Major Permit, property owners can coordinate with the town to request use of the local government's permit from the Division of Coastal Management, provided that the property is within the town's legal jurisdiction, and the property owner has received authorization from the local government. If approved by the Division, the property owner could then theoretically bulldoze under the same conditions specified in the local government's Major permit. CAMA exempts beach bulldozing from the permit process when it is done to protect imminently threatened structures, including septic systems, for the purpose of creating protective sand dunes. A structure is considered imminently threatened if its foundation, septic system, or right-of-way in the case of roads, is less than 20 feet away from the erosion scarp. Property owners who believe their structure is imminently threatened must contact a CAMA representative for consultation and a site visit prior to beginning work. Although a CAMA permit is not required, any work performed below the Mean High Water Line still may need federal authorization, so the Division recommends that property owners also consult with the U.S. Army Corps of Engineers. This also applies to IHA. To re-emphasize, this work in intended to protect imminently threatened structures with the following stipulations: The area on which this activity is being performed must maintain a slope that follows the pre-emergency slope as closely as possible so as not to endanger the public or hinder the public's use of the beach. All mechanically disturbed areas shall be graded smooth of ruts and spoil berms that are perpendicular to the shoreline. The movement of material utilizing a bulldozer, front-end loader, backhoe, scraper or any type of earth moving, or construction equipment shall not exceed one foot in depth measured from the surface elevation; the activity shall not exceed the lateral bounds of the applicant's property without written permission of adjoining landowners; movement of material from seaward of the mean low water line shall not be permitted under this exemption; and the activity shall not significantly increase erosion on neighboring properties and shall not have a significant adverse effect on natural or cultural resources. To address concerns and comments raised, I'll start with amendments to 07H.0308(b)(5) for the Commission to consider, which are specifically for clarification purposes. Currently the rule states that "no new dunes shall be created in inlet hazard areas." Currently reconstruction or repair of an existing dune system within an IHA is permittable. This amendment is to make a distinction between "new dune creation" and "restoration & repair." Use of a General Permit, 07H.1800 or the Emergency GP 07H.2500, for the purpose of beach bulldozing, currently does not apply to areas inside Inlet Hazard Areas. With the expansion of the proposed updated boundaries, would also come added restrictions for those who are not in an IHA now. Staff is proposing amendments to 07H.1801 for the Commission to consider that would eliminate the restriction in Inlet Hazard Areas, and not allow the GP to apply where a town or community has a Major Permit for ongoing beach bulldozing project or has completed a project within 30 days of a request for a general permit. Where a project is completed, a property owner can request a GP once the 30-day period has closed. Lastly, Staff is also recommending amendments to 07H.1805(f) for the Commission to consider. Currently, this rule requires approval from DCM in coordination with NC Wildlife Resources Commission, US Fish & Wildlife, and the US Army Corps to minimize impacts to nesting sea turtles within the period of

April 1 – November 15. If utilization of GP for beach bulldozing is extended to Inlet Hazard Areas for the purpose of dune restoration or stabilization, not creation of new dunes, Staff is recommending that the Commission consider amending the rule to specify "threatened and endangered species" rather than "nesting sea turtles" since inlet areas can and do serve as habitat for other species. Additionally, when inside an IHA, the rule would require coordination with State and Federal agencies anytime, not just the period of April 1 to November 15. DCM Staff are asking the Commission's to consider approval of amendments to rules in 15A NCAC 07H. 0308(b)(5) and 15A NCAC 07H.1800 to clarify distinction between new dune creation and reconstruction or repair inside IHAs, and to allow the use of a CAMA General Permit for bulldozing in Inlet Hazard Areas unless the Town or community has an ongoing project under a Major Permit, or has just completed a project within 30 days of a property owner requesting a GP.

Bob Emory made a motion to approve amendments to 15A NCAC 07H .0308 and 07H .1800 for public hearing. Neal Andrew seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Cooper, Emory, Medlin, Salter, Smith).

FLOATING STRUCTURES

Proposed Concepts for Floating Structures Associated with Shellfish Leases (CRC 21-29) Mike Lopazanski

Mike Lopazanski stated the Coastal Federation gave a presentation and staff presented a review of the floating structures policy at the June CRC meeting. The division has investigated other states' policies on these structures. The Coastal Federation has discussed this need with local growers. They learned that growers are not always riparian property owners, shading and workspace needs, and sanitation requirements are a few of the reasons that these structures need to be moored on shellfish leases. Of the ten states that DCM contacted, six states allow but have not permitted these structures. In some states they require a permit. Other states also had similar concerns about these floating structures including public trust and navigation impacts, FDA issues, and bird roosting issues. DCM found that even where these structures were allowed, there were relatively few specific standards that apply to them. DCM learned from the other states' experience with these structures that there are still concerns about having floating structures in open waters. The CRC recently addressed floating upweller systems through rulemaking which requires them to be within a permitted marina or within a residential dock with platform criteria. If the Commission is interested in moving ahead with regulating these structures, staff has created some concepts that could be worked into formal rulemaking. Staff would propose a time limited permit. To address some of the sanitation issues, staff recommends that the applicant provide a proposal for how to deal with sewage associated with these structures. Staff also suggest that these floating structures not be habitable. In accordance with existing rules on freestanding moorings, moorings are for the exclusive use of riparian property owners. Several local governments are dealing with illegal moorings currently. Staff would recommend that no permanent moorings be allowed, and riparian property owner notification be provided for all of these structures. Staff would also recommend putting a size limit on any proposal and limit to single-story use. An identification system would need to be incorporated to link the owner to the structure.

Craig Bromby asked about including a bond requirement. Mike responded the CRC does not have the authority to require bonds. This would need a legislative change.

Neal Andrew asked about the size limitation. Mike responded that the Commission should limit the size 400 square feet. Growers have requested a minimum size of 30'x15'.

Lauren Salter commented that if shellfish growers are asking for these floating structures, it is because they need them. The CRC should look at this as part of the shellfish business so there is less likelihood of these structures being abandoned and the burden of removal being put on the State to clean up. To address some of the issues, there could be more focus on notification of riparian property owners and potentially a full public hearing. I would support finding a way to allow these.

Jacob Boyd, DMF, stated the Division requires a bird mitigation plan and can look at the suggestion for a time limited permit. A hurricane plan will also be required to allow these structures on water column leases. This option will be good for certain areas that are away from populated areas to provide the surface area that is needed for their operation. Most growers are only going to build the minimum of what they need to get the job done.

Robert High stated a bond or letter of credit should be required in case it's needed for cleanup.

Braxton Davis stated spatial planning and reducing user conflicts will be important. DMF has statutory authority to look at existing uses in a proposed lease location and can request use of another space. DMF evaluates the location and could provide comments on whether a floating structure could create user conflicts in certain locations.

Larry Baldwin asked how the Corps and Coast Guard feel about these structures in navigable waters. Mike Lopazanski responded that there is limited experience with these structures and advice on regulatory requirements was sparce. Staff would need to follow up to get an answer. Larry also asked about the density of these structures in an open water body. Braxton Davis commented that DMF would look at the water column leases, but there may be a need to expand the limitations to the amount of the structures allowed for cumulative impacts to the waterbody.

Neal Andrew stated he is a proponent of growing the mariculture industry. We should support the growers, but within reason. The maximum size of the structure should be considered, but make sure it is helpful to the growers. Jacob Boyd commented that it could be a similar regulation to the maximum number of corner markers allowed and the size of the markers. DMF can work with the growers to get input on the size that would be needed.

Robin Smith commented that Department of Administration should be consulted to see if any easements would be required for these structures.

Bob Emory asked how long these floating structures are in place. Mike Lopazanski stated the growers have asked for permanent mooring of the structures.

Chair Cahoon asked the Commission whether to continue to not allow floating structures, or whether staff should provide draft rule language based on the concepts staff provided. By consensus, the Commission requested staff to provide a first draft of rule language for the Commission's discussion in November.

STRUCTURAL BOAT COVERS

Amendments to 7H .0208(b)(6) & 7H .1200-Structural Boat Covers (CRC 21-30)
Kelly Spivey, District Manager

Kelly Spivey stated at your last meeting you were presented with current rules as they relate to boathouses. During the presentation we looked at examples of traditional boathouses as well as structural boat covers with retractable sides. Present at the meeting was a representative of Touchless Covers (a specific brand of retractable cover). In summary, two specific rules address construction of boathouses within your Estuarine Water and Public Trust water Areas of Environmental concern. They are 15A NCAC 07H .1205(l), General Permit & 15A NCAC 07H .0208(b)(6)(D), Use Standards. The question was asked by the commission why boathouses were not allowed on lots less than 75'. One of the reasons was view shed. The other reason was navigation concerns. I don't think I adequately answered the question as it relates to the navigation issue. I spoke with David Moye, a previous employee of the Division who was involved in pier/dock rulemaking while with the Division. The 75' was the minimum amount of shoreline the Division and the Commission felt would allow sufficient navigation between two structures given the required 15' setback from the riparian lines. On a 75' lot with a setback of 15' on each side would allow a 45' wide corridor to construct a pier, platform and boathouse to comply with your standard of 8 square foot of platform per foot of shoreline limitation. On a 75' wide lot, a maximum of 600 square feet of shaded impact is allowed. These are different configurations with a 400 square foot boathouse and 200 square foot deck on 75' lots. Based on the motion from your last meeting, staff propose the following rule changes if you choose to move forward. The proposed amendments in both 07H .0208 and 07H .1205 will clarify that structural boat covers will be reviewed under rules governing boathouses but will be allowed on smaller lots when using screened material for side walls. Additionally, boathouses and structural boat covers will continue to be subject to existing square footage limitations based on shoreline length found in 15A NCAC 07H .0208 (b)(6)(B) and 15A NCAC 07H .1205(e). Staff also incorporated a clarification that wall heights are measured down to the Normal Water Level or Normal High Water level.

Robin Smith asked how this language addresses the navigation issue between structures on small lots. Kelly Spivey responded that boatlifts are currently allowed on lots with less than 75'.

Neal Andrew made a motion to approve amendments to 15A NCAC 07H .0208 and 7H .1205. Larry Baldwin seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Cooper, Emory, High, Salter, Smith).

INNOVATIVE STORMWATER APPROACHES

ORWs and innovative Stormwater Systems (CRC 21-33)
Robb Mairs, LPO Minor Permit Coordinator

Robb Mairs stated, I am here to discuss our current rules for development adjacent to Outstanding Resource Waters (ORW). In 2019, the CRC amended 7H .0209 to remove the

prohibition against the use of stormwater collection systems on shorelines adjacent to ORWs, as designated by the Environmental Management Commission (EMC); however, some ambiguity exists over whether the ability to utilize innovative stormwater design to exceed the maximum built upon area applies to both ORW and non-ORW shorelines. The CRC's rule 7H .0209(d)(2) allows for the use of innovative stormwater design to exceed the 30 percent built upon area allowance on non-ORW shorelines, but the rule is silent on the use of innovative design along ORW shorelines. Coastal Shoreline rules basic standards allow for less than 30% impervious coverage along Coastal Shoreline AECs, innovative stormwater systems acceptable within the 75' AEC, and less than 25% impervious coverage along ORW coastal shoreline AECs (575' AEC). Staff is recommending that engineered stormwater design also be allowed as a way to increase built upon area along ORW shorelines if the proposed engineered stormwater design provides equal or greater protection than 25 percent built upon area; and the total built upon area does not exceed 30 percent of the AEC portion of the lot.

Neal Andrew made a motion to approve amendments to 15A NCAC 07H .0209 for public hearing. Bob Emory seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Emory, High, Medlin, Salter, Smith).

ACTION ITEMS

Consideration of Adoption 15A NCAC 7H .0308(c) Specific Use Standards for Ocean Hazard Areas & 15A NCAC 7K .0207 Structural Accessways Over Frontal Dunes Exempted

Mike Lopazanski stated these amendments allow for the use of matting for public access sites which was inconsistent with the specific use standards. These synthetic mats are used for handicap access. The installation of these mats is limited to state, federal, and local governments. No public comments were received during the public hearing, but there was support of these amendments through emails to the Division. Staff recommends adoption of these amendments.

Larry Baldwin made a motion to adopt amendments to 15A NCAC 7H .0308. Doug Medlin seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Emory, High, Medlin, Salter, Smith).

Larry Baldwin made a motion to adopt amendments to 15A NCAC 07K .0207. Neal Andrew seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Emory, High, Medlin, Salter, Smith).

Consideration of Adoption 15A NCAC 7H .0306 General Use Standards for Ocean Hazard Areas & 7J .1300 Development Line Procedures

Ken Richardson stated these amendments were approved by the Commission in September 2020 to resolve two rule implementation issues. These amendments address communities where there are approved development lines and static line exceptions. These amendments direct communities to notify the Division of which management approach will be utilized, not allowing for both. Additional amendments allow for development seaward of the development line as currently allowed under the current exceptions in 7H .0309. Public hearing was held in May 2021 and no comments were received. Staff is recommending adoption of these amendments.

Bob Emory made a motion to adopt amendments to 15A NCAC 07H .0306. Doug Medlin seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Emory, High, Medlin, Salter, Smith).

Doug Medlin made a motion to adopt amendments to 15A NCAC 07J .1300. Neal Andrew seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Emory, High, Medlin, Salter, Smith).

Consideration of Adoption 15A NCAC 7J .0403 & .0404 Renewals
Daniel Govoni stated amendments to 7J .0403 change the expiration date for new Major Permits from three years to five years from date of issuance and change the expiration date for multi-phased beach nourishment projects from three years to ten years from the date of issuance. Amendments to 7J .0404 allow for multi-phased beach nourishment projects to be granted ten-year extensions to allow for continuing project completion as opposed to the current two-year allowance. Renewals for maintenance of previously approved dredging projects may be granted for periods not to exceed five years. No comments were received during public hearing and staff recommends adoption of the amendments.

Larry Baldwin made a motion to adopt amendments to 15A NCAC 07J .0403. Doug Medlin seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Emory, High, Medlin, Salter, Smith).

Bob Emory made a motion to adopt amendments to 15A NCAC 07J .0404. Neal Andrew seconded the motion. The motion passed unanimously (Cahoon, Andrew, Baldwin, Bromby, Emory, High, Medlin, Salter, Smith).

Coastal Habitat Protection Plan
Consideration of 2021 Recommendations for Public Comment (CRC 21-31)
Jimmy Johnson/Anne Deaton
Larry Baldwin stated the CHPP stakeholder committee has met extensively to provide the recommendations. Bob Emory stated the CHPP started 15-20 years ago, and these updates give us the opportunity to develop specific objectives.

Jimmy Johnson stated over the past two years we have developed these recommended actions in the draft CHPP amendment, and we are here today to ask the CRC for their approval to take the document out for public comment. The 2016 source document has not been amended in any way and will continue to serve as the science document for this amendment. The focus of the 2021 amendment is on five priority issues. While oyster restoration remains a high priority, the Coastal Federation's Oyster Blueprint and oyster steering committee will take on most of the work of this priority. The CHPP originated out of the Fisheries Reform Act of 1997. It was intended to address concerns over decreasing fish stocks and the need to address habitat and water quality to improve those stocks. In addition to healthy fisheries, there are other benefits to healthy habitats and good water quality. They provide ecosystem services, water filtration, and erosion and flood control. These services sustain the coastal tourism economy and coastal community resilience.

Anne Deaton stated the five issue papers in this amendment have elements that will benefit all North Carolina habitats: wetlands, submerged aquatic vegetation, oyster reefs, ocean hard bottom, soft bottom, and water column. This amendment has an emphasis on estuarine water quality improvement– this was intentional due to the strong influence water quality has on fish and habitat condition, and some concerning trends. Because of this, the CRC and DCM are not listed as the lead for most of the recommended actions, but DCM would be a collaborative partner. Successful implementation would benefit coastal resources conserved and managed by CRC and increase coastal community resilience, benefiting local governments along the coast. The 1st issue paper is SAV Protection and Restoration through Water Quality Improvement. This was selected as a priority issue for the plan because of its critical importance for fisheries production, the ecosystem services provided, and concern due to evidence of decline. It is well documented that water quality is the greatest current threat. NC agencies have done a good job at protecting SAV from physical threats like dredging. Multiple land use sources contribute to the water quality decline, stormwater runoff being the most significant. Climate change is a major concern too (temperature increase and increased runoff). In NC, we have SAV in both low and high salinity estuaries. In the SAV issue paper there are nine recommended actions and some additional research needs. I won't be going over the research needs, but they are included in your briefing material. There are three actions that are about developing or modifying water quality standards that will protect SAV, working through an existing process. DWR and Nutrient Criteria Development Plan (NCDP) Scientific Advisory Council (SAC) are working on developing nutrient criteria for Albemarle Sound and Chowan River. This scientifically based process is already started and needs to be followed through. This has successfully been done in Chesapeake and Tampa Bays and we have collaborated with those involved to get successful approaches. Like SAV, wetlands are critical for fish production, but are probably the most important fish habitat for improving water quality from runoff, protecting property from erosion, and increasing coastal community resilience. This issue paper goes over the extent of documented losses and gains, sources of that change, and reviews new strategies to protect and restore wetlands using nature-based methods. This includes strategies such as living shorelines, nature-based stormwater BMPs and low impact development, hydrologic restoration by undoing ditching and draining, thin layer sediment dispersal, and preserving wetlands as greenways and parks. There is a need for updated wetland maps. This would have many benefits, particularly assessing where to prioritize nature-based projects, such as where living shorelines are suitable for shoreline stabilization; where to focus restoration and identify strategic marsh migration routes to protect for the future. These mapping actions would require multi-agency approach. While not the lead, we would hopefully have DCM participation. We are working with the Department of Defense's Southeast Partnership for Planning and Sustainability (SERPPAS) to develop a Southeast Regional Marsh Conservation Plan, which provides the framework for reaching the 1-million-acre salt marsh conservation initiative. There are a few actions about wetland restoration and living shorelines. DCM and CRC have already done a lot in this area to remove barriers and provide education on this topic. DMF and DCM are already working to determine how to prevent oyster harvesting from living shorelines that require oysters for integrity of the structure. Division of Mitigation Services, DCM, and others can research to see if constructing living shorelines could qualify for mitigation credits. This is currently being done in Virginia. DEMLR and other divisions can work to increase outreach and training for nature-based stormwater strategies. This is a voluntary approach to encourage more nature-based solutions for managing stormwater that also restore or create wetlands. The next issue paper is environmental rule

compliance to protect our coastal habitats. There is an insufficient number of staff in DWR and DEMLR in coastal regions to conduct follow-up compliance inspections. Non-compliance leads to increased wetland loss and water quality degradation. With increasing development and water quality degradation, there is a need to protect wetlands from unpermitted impacts. Compliance I shown to improve when staff conduct random inspections. The focus of this issue paper is on permits related to wetlands, particularly 404 wetlands, and stormwater BMP compliance. The paper reviews known compliance rates across divisions, and how having additional staff to conduct periodic site visits could go a long way to reducing unauthorized wetland and water quality impacts. The recommended actions include seeking funding to increase staffing in DWR and DEMLR to allow compliance monitoring which mostly involves 404 wetland impacts, buffers, stormwater structures, sediment and erosion control. This would increase compliance, benefiting wetlands and estuarine waters. Another recommended action involves approaches to increase outreach so public is more aware of and able to comply with the rules. The next issue paper is wastewater infrastructure solutions for water quality improvement. Inflow and Infiltration is prevalent in the coastal plain and the leading cause of sewer system breaks and spills. Raw sewage causes acute water quality problems. Climate change will compound the issue. Water quality can be enhanced by repairing and maintaining failing wastewater infrastructure. For this topic, there are five recommended actions. We will ask the Department to have the Division of Water Infrastructure and State Water Infrastructure Authority to prioritize funding for coastal projects that will protect sensitive estuarine resources, such as open shellfish waters, nursery areas, and seagrass. The State Water Infrastructure Authority has the responsibility of awarding grants and loans to local communities for wastewater infrastructure improvements. We also need to develop incentives and strategies to maintain wastewater infrastructure. DCM and others can work with NC Office of Recovery and Resiliency (NCORR) and local governments in coastal counties to develop flood proofing strategies and upgrades sewer infrastructure. DWR will evaluate modifying requirements for all or a subset of the deemed permitted collection systems. These are smaller systems with an average daily flow of less than 200,000 gallons per day. These systems are smaller but abundant.
They plan to look at the possibility of requiring annual pipe cleaning and having an assigned operator in responsible charge. These requirements are similar to those that are required at larger facilities, and they are good techniques to prevent or catch sewer line breaks early. The final issue paper is coastal habitat mapping and monitoring to assess status and trends. Fish habitats are cornerstone to healthy estuarine fish, waters, and coastal economy. There is very limited long-term funded habitat monitoring programs and regular monitoring is needed to know status of habitats and where to target actions. There are six recommended actions in this issue paper. To establish interagency workgroups by habitat type to determine parameters to monitor so that status and trends can be determined. Since DCM is not involved with monitoring, they wouldn't need to be involved with these, except possibly wetlands. Once we develop and implement sampling protocol, we can produce a NC Ecosystem Status Report. The five issue papers are related. Implementing actions in the compliance, wetlands, and wastewater infrastructure issue papers will improve water quality and benefit SAV and oyster reefs. The mapping and monitoring issue paper will help us understand habitat trends, help target future actions, and determine the health of our coastal ecosystem. The overall goal for these collective actions is improved habitat condition, more fish, and increased coastal resilience. Protecting and restoring our coastal habitats is a nature-based solution that can reduce climate change impacts and increase community resilience. We also want to point out that the appendix includes early public

comment received from a stakeholder workgroup. The group was organized by NCCF and Pew Charitable Trust, with the approval of the CHPP Steering Committee. The purpose was to develop some cross-cutting voluntary water quality recommendations that would be beneficial for coastal habitats and relevant to issue papers in this amendment. Their summary report was presented to the Steering Committee at their last meeting. The Committee directed the team to include the report in the Appendix to allow public comment on these recommendations as well as those included in 9 of the CHPP amendment. The public comment period will tentatively begin September 20th, for a 30-day period. There will be a news release with information on meetings and how to submit written comments.

Larry Baldwin made a motion to approve the draft CHPP 2021 amendment and appendix for public comment. Doug Medlin seconded the motion. The motion passed unanimously (Cahoon, Baldwin, Bromby, Emory, High, Medlin, Salter, Smith).

LEGAL UPDATES

Update on Litigation of Interest to the Commission (CRC 21-32)

Mary Lucasse, CRC Counsel, reviewed all active and pending litigation of interest to the CRC. She advised the Commission that since finalizing their summary memo, an additional third party hearing request was received. That brings the total to ten for the year. There is legislation on the Governor's desk that if signed will extend the time for the Chair to reach a decision on third party hearing requests to 30 days. Currently the Chair has 15 days to review the request, receive a written recommendation from Staff, and make a decision whether to grant or deny the request.

OLD/NEW BUSINESS

Chair Cahoon stated the CRC Executive Committee will meet to discuss recommending a new Science Panel Chair.

Tancred Miller stated under the current Charge to the Science Panel from the CRC, an update on the Sea Level Rise Report is due. In the interim, Executive Order 80 directed the State to produce a climate science report and resiliency plan. DEQ will be providing these reports. The IPCC Report was also recently released. Sea Grant's along with NOAA new website is looking at tide gauges across the county and on this site, you can view historic and projected reports on changes. Based on this information, the Science Panel could provide an annual summary on existing reporting to the CRC instead of a Sea Level Rise update. Robin Smith stated the Charge to the Science Panel could be updated at the November meeting. Braxton Davis commented that the Science Panel could provide the Commission with regular updates on the most current reports and information available to identify North Carolina's needs and trends. Bob Emory stated the modification to the Charge makes sense. North Carolina put Sea Level Rise on the map in 2010 and then provided an update in 2016. The Science Panel could be better used to provide what all of the available information means to North Carolina.

With no further business, the CRC adjourned.

Respectfully submitted,

Braxton Davis, Executive Secretary

Angela Willis, Recording Secretary

ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
BRAXTON DAVIS
Director

NORTH CAROLINA
Environmental Quality

CRC-21-24

August 31, 2021

MEMORANDUM

TO: Coastal Resources Commission
FROM: Robb Mairs
SUBJECT: Artificial Turfgrass within the Coastal Shoreline Buffer

The increasing use of artificial turf grass installation within the Coastal Shorelines Area of Environmental Concern, particularly within the 30' buffer, has recently presented implementation issues for DCM as there are no standards that specifically apply to this material. Your rules restrict development within the 30-foot buffer to water-dependent uses, which are typically docks, piers, boat ramps, bulkheads and accessways. There are also exceptions for limited non-water dependent uses, which include pile-supported signs; elevated, slatted wooden boardwalks; crab shedders; decks/observation decks; grading, excavation, and landscaping with no wetland fill except when required by a permitted shoreline stabilization project. Questions have been raised about the use of artificial turf in the buffer under the landscaping exception.

DCM staff have consulted with the DEQ Division of Energy, Mineral, and Land Resources (DEMLR) State Stormwater Section and with the DEQ Division of Water Resources (DWR) 401 & Buffer Programs for assistance in determining whether this material, as installed, would be considered pervious (if it were being reviewed through a state stormwater permit), and if it would be consistent with vegetative setback and buffer requirements. Staff from DEMLR replied that the material could be considered pervious on a case-by-case basis, but that they have regulations on what can be placed in a required vegetated setback from surface waters in coastal stormwater permits. Their rules require this area to remain vegetated unless one of the exceptions listed in the rules has been met, and artificial turf is not one of these exceptions. Staff from DWR responded that the Tar-Pamlico and Neuse River buffer rules do not include artificial turf grass in their respective Table of Uses and that the material would appear to contradict the intent of the rule to preserve buffer function for nutrient removal. Furthermore, in some cases small plastic fibers are mixed into the soil under the turf during installation to enhance soil compaction, and turf "infill" (small silica, rubber or plastic beads) is also sometimes applied to the surface of the artificial turf to stand up the blades following installation. DWR staff expressed concerns with the potential for these small plastic fibers, and rubber or silica beads, to enter nearby receiving waters and potentially lead to water quality standards violations.

Since adoption of the 30-foot buffer rule in 2000, the Commission has had a clear intent and has been consistent in not allowing non-water-dependent amenities within the buffer that could undermine the purposes and effectiveness of the buffer. The buffer area has been identified as crucial in protecting water quality by filtering contaminants from runoff, allowing infiltration, stabilizing soil, slowing floodwaters and preserving the natural character of the shoreline. When the Commission has granted variances, it has usually involved a habitable structure, and these variances have typically been conditioned on the use of an engineered stormwater system.

In order to retain the effectiveness of the 30' buffer in filtering runoff, Staff request that the Commission confirm DCM's interpretation that the application of artificial turf within an Area of Environmental

Concern requires a CAMA permit, and that it is not allowable under the “landscaping” exception to the 30’ buffer at 15A NCAC 07H.0209(d)(10)(G). While DCM can permit this material within the 75’ AEC, it may be deemed as impervious surface based on a case-by-case review and therefore count toward the maximum allowable impervious surface coverage (depending on installation methods and materials, and any existing impervious surfaces).

I look forward to answering any questions about this determination at our upcoming meeting.

Stipulated Facts and Exhibits

1. Petitioner is Deep Water Management, Inc., a North Carolina Corporation. According to filings with the Secretary of State, Deep Water was formed on March 3, 2022 and Andrew Krichman is listed as the Incorporator and President. The Registered Agent is Kelly J Mackay at 125 S. Estes Drive #9400 in Chapel Hill. Andrew Krichman is the Incorporator and President of Petitioner and is representing Petitioner in this Variance. Copies of the creation filing and 2024 annual report are attached as stipulated exhibits.

2. Petitioner owns property at 813 Canal Drive in Carolina Beach, New Hanover County ("Site"). Petitioner took title to the Site on March 8, 2022 through a deed recorded at Book 6545, Page 1527 of the New Hanover County Registry, a copy of which is attached. The Site is Lot 17A, Block 14A of Carolina Beach as show in Plat Book 3, Page 67 of the New Hanover County Registry, a copy of which is attached. The Site is riparian in that one of the deed calls follows high water of Myrtle Grove Sound. The tax card, attached as a stipulated exhibit indicates the area of the Site is 3,580 square feet (0.08 acres).

3. A copy of the New Hanover County Tax Card is attached and indicates that the property is developed with a 2,219 square foot home elevated and remodeled in 2020, along with a bulkhead, a pier, a gazebo, and boat lifts for two slips.

4. A search for past CAMA permits on the Site found the following:

    - A 2012 CAMA General Permit #60726D issued to Petitioner's predecessors the Porters authorizing the reconfiguration of an existing docking facility to include a pier, a covered platform, and two boat slips with lifts, a copy of which is attached.
    - A permit issued on January 16, 2019 to Petitioner's predecessors the Porters through CAMA Minor Permit CB19-02 for the elevation of the house through a FEMA program, a copy of which is attached.
    - A Permit Exemption 12-23-Ex-CB issued April 6, 2023 to Petitioner acknowledging that proposed maintenance and repair of a new driveway on top of an existing driveway did not require a CAMA permit, a copy of which is attached.
    - CAMA General Permit #90517D issued June 17, 2023 to Petitioner for the installation of a bulkhead, a copy of which is attached.

5. The property is bounded by Myrtle Grove Sound to the west, Canal Drive, a 40' Right-of-way to the east, 815 Canal Drive (owned by Amy and Paul Groff) to the north and 811 Canal Drive (owned by Amy and Justin Cox) to the south. That area of the Site within 75' landward of the high water line of Myrtle Grove Sound is within the Coastal Shorelines AEC, including the area within 30' of high water which is the Commission's 30' buffer area. Pursuant to G.S. § 113A-118, any "development" within the AEC required approval through the issuance of a CAMA permit.

6. The waters of Myrtle Grove Sound are classified as SB Waters by the Environmental Management Commission and are closed to the harvest of shellfish.

7. Ground-level and aerial photographs of the site are part of a Powerpoint attached as a stipulated exhibit.

8. This Site and the area around it are subject to flooding- both from weather events and sunny-day flooding. The Site is near and inside of the area where the Town has traffic barrier arms which are lowered to re-route traffic when Canal Drive is flooded. In April of 2024, the Commission saw a presentation about research by NCSU Assistant Professor Katherine Anarde related to Sunny Day Flooding in Carolina Beach. A copy of the report is attached as a stipulated exhibit.

9. According to Professor Anarde's study, Canal Drive experiences sunny day flooding over 50 days per year on average. During sunny-day flooding events, water from the Yacht Basin can move onto Canal Drive through stormwater pipes and properties which are not bulkheaded, and onto lots located between Canal Drive and the Yacht Basin including the Site.

10. On June 17, 2023, DCM issued Petitioner CAMA General Permit #90517D authorizing the installation of a bulkhead at the Site, a copy of which is attached as a stipulated exhibit. Photographs of the bulkhead are attached and show the elevation of the top of the bulkhead compared to the elevation of the Site.

11. After installation of the permitted bulkhead, Petitioner had installed artificial turf on the Site, including within the 30' CAMA Buffer. Petitioner claims in his attached affidavit that he was unaware that the installation of artificial turf required CAMA permit approval.

12. The ground on the Site waterward of the bulkhead is largely comprised of sand.

13. On July 28, 2023, DCM, through Field Representative Bryan Hall issued a Notice of Violation to Petitioner, a copy of which is attached. This was issued after a June 29, 2023 site visit by Mr. Hall, Ms. MacPherson and Petitioner--Mr. Krichman. The Restoration Plan was either to remove the artificial turf or to seek a CAMA Minor Permit/Denial and then seek a variance from the Commission to allow the turf within the 30' Buffer. Also attached is communication between DCM and Mr. Krichman.

14. On or about September 18, 2023, Petitioner applied for a CAMA Minor Permit to the Town of Carolina Beach LPO to "install drainage pipes with pervious artificial turf designed for proximity to wetlands application and fastened beyond manufacturers recommendations." A copy of the application materials is attached as a stipulated exhibit. Later that day the Carolina Beach CAMA Local Permit Officer ("LPO") Haley Moccia emailed the Petitioner informing him of missing items in his application.

15. On October 26, 2023 the LPO emailed Petitioner with a list of remaining items needed for the application. On December 6, 2023 the LPO checked in again on the status of the application materials.

16. The permit drawing, received on November 8, 2023 indicates that approximately 795 SF of artificial turf would be within the Commission's 30' Buffer area. Also, there would be a 4" perforated drain line within the buffer which drains to an area outside of the 75' Coastal Shorelines AEC near the street.

17. Another drawing received on January 30, 2024 indicates that the turf is "1000 inter/hour pervious Cali 73 Pinnacle Turf with Pinnacle Back Weed Blocker on top of 2" heavily compacted sand over filter fabric and 6" heavily compacted sand.

18. The applicant submitted a laboratory testing report on January 23, 2024 to the LPO indicating that drainage rates were tested and rainfall capacity was tested. A copy of this report is attached as part of the application materials.

19. Also attached as a stipulated exhibit is a copy of the 15-year warranty for Tailor Made Grass, which is the type installed at the Site.

20. As part of the minor permitting process, notice to the adjacent riparian property owners, which Petitioner listed as Paul Groff and Eric Smith, is required. As shown in the attached copies of the stipulated notice letters and associated USPS tracking, it appears Mr. Groff signed the notice form on October 20, 2023 indicating he had no objection to the project. It appears Mr. Smith signed the notice form on October 6, 2023 and indicated he had no objection to the project. DCM and the LPO did not receive any other comments on this application.

21. On January 30, 2024, the Town of Carolina Beach LPO denied Petitioner's permit application through a letter, a copy of which is attached. The denial letter indicated that the artificial turf grass and associated 4" drainage pipe within the 30' CAMA Buffer was inconsistent with 15A NCAC 7H.0209(10).

22. On September 25, 2024, Petitioner submitted variance petition materials to DCM. A copy of that email is attached as a stipulated exhibit. Through an email later that day, DCM Counsel Ms. Goebel emailed petitioner to explain the process and forecast when the variance could be heard. A copy of this email is attached.

23. On October 1, 2024, Ms. Willis, after reviewing the petition materials, emailed Petitioner to inform him which materials were still needed. Petitioner submitted the needed materials on October 21, 2024.

24. Petitioner Stipulates that the Permit was properly denied as the artificial turf and associated pipe are not allowed within the 30' Buffer per 15A NCAC 7H .0209(d)(10).

25. Petitioner did not seek a local variance ahead of requesting this variance as generally required by 15A NCAC 7J.0701 where the relaxation of local regulations would not eliminate/reduce the need for a variance from this Commission.

26. Petitioner seeks a variance from the Commission's 30' Buffer Rule at 7H.0209(d)(10) in order to keep the artificial turf and associated 4" pipe within the 30' Buffer.

27. Petitioner has included a video of the site and surrounding area that was included in a Washington Post article/video on June 13, 2024 and reported by Brady Davis and Niko Kommenda, which highlighted Professor Anarde's study. A copy of the Washington Post article and video is attached.

28. The Washington Post article illustrates the significant effects off Sunny Day Flooding and the damage it is causing. The article The article reports that "Carolina Beach, N.C. routinely floods with sea water without rain or storms. This phenomenon is called sunny-day flooding and sea level rise is making it worse." It also indicates that "As much as an additional foot of sea level rise is expected along this stretch of the coast by 2050" and "That, Scientists say, means that sunny day flooding will become only more chronic in Carolina Beach." It concludes that the sunny-day flooding "forces difficult questions about how to adapt to this changing reality."

29. Assistant Professor Katherine Anarde's research on chronic shallow flooding in coastal North Carolina was featured in this article. "The newspaper set up cameras along Canal Drive in Carolina Beach, North Carolina, to look at how high tides are causing flooding, even on days without major storms. Anarde and her team have documented 60 days over the past year when Canal Drive flooded." And "As the sea level gets higher and higher," Anarde said, "the groundwater table also increases. So even just a minor rainfall event can lead to ponding in low-lying areas and just can exacerbate the flooding in the roadway or in yards."

30. Petitioner has compiled a list of quotes from three newspaper articles about sunny-day flooding in Carolina Beach which he feels are important because they show the severity of the situation and the worsening of the problem. A copy of this compilation is attached as a stipulated exhibit.

31. Petitioner prepared sworn testimony through an affidavit, a copy of which is attached. While Staff do not stipulate to the truth of the statements in the affidavit, they acknowledge that these are Mr. Krichman's sworn statements.

32. At the Commission's September 15, 2021 meeting, after hearing from DCM Staff about new instances of owners placing artificial turf in the 30' CAMA Buffer, the Commission voted 10-1 in an interpretive ruling that the use of artificial turf in the 30' CAMA Buffer on Coastal Shorelines in not be interpreted to be part of the Commission's landscaping exception in 15A NCAC 7H .0209(d)(10)(G). A copy of the Commission's Interpretive Ruling is attached as a Stipulated Exhibit.

33. Session Law 2024-49 which became law on September 11, 2024 provides (Section 4.48) that artificial turf is not counted as built-upon area for state and local government stormwater programs where it is "(6) artificial turf, manufactured to allow water to drain through the backing of the turf, and installed according to the manufacturer's specifications over a pervious surface." Staff note this law applies to built upon area calculations which DEQ-DEMLR manages and did not amend this Commission's 30' Vegetated Buffer Requirement.

34. At the November 13, 2024 meeting of the CRAC, the Council heard an overview presentation about artificial turf by DCM Policy Analyst Jonathan Lucas. Following the presentation, the Council asked Staff to bring back pros and cons of allowing this artificial turf material in AECs. A copy of the powerpoint slides from this presentation are attached.

35. At the February 26, 2025 meeting of the CRAC, the Council heard Mr. Lucas' presentation about the pros and cons of allowing artificial turf in the Commission's 30-foot buffer. The Council asked Staff to bring back proposed rule language that would allow artificial turf in the buffer to consider and determine whether to bring it to the CRC or recommend that the rules would remain the same. A copy of the powerpoint slides from this presentation are attached. One of the slides describes a study from King's College, London which found that artificial turf had greater volumes and proportions of runoff than living grass.

36. At the April 30, 2025 meeting of the CRAC, the Council reviewed draft rule language for three possible options: 1) not regulating artificial turf in the 30-foot buffer (allowing it), 2) continuing to regulate (not allow) artificial turf in the 30-foot buffer as status quo, or 3) propose amending rules to regulate artificial turf in the buffer. After discussion, the Council voted unanimously to recommend keeping the status quo not allowing artificial turf in the 30-foot buffer and not amending propose amending the Commission's 30-foot buffer. A copy of the powerpoint slides from this presentation are attached. The purpose of vegetated buffers is primarily pollution reduction.

37. In a 1998 memo attached, the Commission considered whether to require vegetated buffers, with the ultimate result being the regulations of the Commission's 30' Buffer in the Coastal Shorelines AEC.

38. Staff and Petitioner delayed hearing of this variance until after the CRAC concluded its review of artificial turf in 2024-25.

39. Since filing its variance petition, Petitioner received statements from both adjacent property owners Amy Groff and Justin Cox, copies of which are attached as a Stipulated Exhibit. Both owners describe comments in support of the artificial turf remaining.

40. In addition to the Site, Petitioner owns the waterfront property at 1005 Canal Dr (two blocks to the north). Petitioner purchased this property through a deed recorded on April 1, 2004 in Book 4258, Page 963 of the New Hanover County Registry, a copy of which is attached.

41. An affidavit from Joe Benson, former Mayor and current City Councilman of Carolina Beach is attached as a stipulated exhibit. While this is a sworn statement, DCM cannot stipulate that these statements are fact.

42. Petitioner is a GC and worked in the Triangle before moving full-time to Carolina Beach in 2020 and now works on projects including bulkheads and homebuilding in Carolina Beach. Petitioner's background is included in his affidavit, attached as a stipulated exhibit. While this is a sworn statement, DCM cannot stipulate that these statements are fact.

43. There is a vacant lot immediately to the North of 1005 Canal that is owned by Tony and Camille Loretti. Petitioner met with former DCM Field Representative Bryan Hall in 2023 to have him flag a Coastal Wetland line on the Loretti lot to determine where a bulkhead could be placed. At that time, Mr. Hall flagged a Coastal Wetlands line approximately 20' from Canal Drive.

44. According to its website, The Northend Flood Mitigation Alliance (NFMA) was established by Carolina Beach homeowners and other stakeholders to provide community flood support in addressing flooding issues on the Northend. The alliance focuses on flood risk reduction by implementing programs aimed at decreasing the frequency of flooding, minimizing the duration that floodwaters remain on the streets, and fostering long-term resiliency." There are current efforts underway including a partnership between the NFMA and the Town of Carolina Beach to "seek funding for research and implementation of flood mitigation solutions while also raising funds to support flood mitigation and protect the harbor environment."

45. A powerpoint of ground and aerial photographs of the Site is attached as a stipulated Exhibit.

Stipulated Exhibits

1. Deep Water Management, Inc. Secretary of State filings x2
2. Deed 6545/1527
3. Plat 3/67
4. Tax Card for Site
5. Four Past CAMA Permits
6. NCSU Anarde Study of Sunny-day flooding in Carolina Beach, not attached but linked here: Wind and rain compound with tides to cause frequent and unexpected coastal floods - ScienceDirect
7. 7/28/23 Notice of Violation and restoration plan
8. NOV-related emails
9. CAMA Minor Permit Application Materials (including form, drawings, lab test, warranty)
10. Adjacent Riparian Owner Notice Forms
11. 1/30/24 Denial Letter
12. 9/25/24 email with Variance Petition
13. 6/13/24 Washington Post video/article
14. Petitioner's Affidavit
15. Statements in support from both adjacent neighbors
16. Affidavit of Joe Benson
17. Krichman deed for 1005 Canal Drive
18. Powerpoint slides from CRAC meetings in Nov '24/Feb '25 and Apr '25
19. 1998 Memo to CRC about vegetative buffers ahead of eventual 30' Buffer rule
20. Site Photos in Powerpoint

PETITIONER'S and STAFF'S POSITIONS **ATTACHMENT C**

I. Will strict application of the applicable development rules, standards, or orders issued by the Commission cause the petitioner unnecessary hardships? If so, the petitioner must identify the hardships.

Petitioners' Position: Yes.

Respected CAMA personnel and Coastal Resources Commission,

Thank you for your time in reviewing the Variance Request for 813 Canal Drive Carolina Beach.

Together we are faced with a unique challenge for properties on Canal Drive.

Together we can overcome this challenge in a safe, environmentally friendly manner.

Waterfront properties that adjoin the Carolina Beach Yacht Basin are experiencing an effect known to low lying coastal communities as "Sunny Day Flooding". This is a situation where properties may flood during weather events without rain such as king tides and strong winds or some combination of both that force water into a basin with no secondary outflow. During strong winds from the north and rising king tides, water is forced into the Carolina Beach Boat Basin on a regular basis. There are times when Canal Drive may flood over 10 days in a month. There are other times when it may not flood for a month. The flooding is getting significantly worse, taking place more than 60 days a year and creating hardships for property owners who care deeply about the environment as well as their properties.

When I personally bought property at 1005 Canal Drive in 2003 my next door neighbor's lot only flooded during extreme conditions. 20 years later, this very same property floods twice a day on every high tide and sends water pouring into Canal Drive over 60 times a year with King Tides and wind blown high tides.

The saltwater pours out of the basin across low lying lots, into Canal Drive, down the street and then into neighboring lots including those with bulkheads.

The catch basins along Canal Drive can not alleviate the water because their outlets are below water level during king tides and in fact many of the catch basins allow water to flow from the Carolina Beach Yacht Basin up and into the street and contribute to the flooding issue.

This saltwater is flooding into low lying properties and damaging the landscaping and ground covers that are designed to protect the property. This causes property damage including damaged ground covers and unstable footing.

When new houses are built there is the opportunity to raise the lot and put in landscaping that will stay above the salt water level other than hurricanes.

Existing homes with ground level structures that are inches to a couple of feet above the normal

high tide mark can not raise the grade in the yard in a way that puts the floor level of the structure below the outside grade.

The natural occurring sand in a yard needs to be protected to keep it from being washed away in these regular Sunny Day Flooding events. Natural grass is not a viable option for properties that are affected by continued salt water flooding. The amount of chemicals some waterfront property owners use to keep lawns alive in areas adjacent to our natural waters is creating significant impact to our water quality and wildlife. Large rocks are not a viable option, they make walking and access a significant challenge as well as covering a natural area with a hardened surface. Concrete and pavement limit permeability and are not an option for entire yards. Pervious pavers would allow walking and retain the sand in some but not all conditions while also creating waterfront properties that are entirely covered by man made looking, hardened products. Over time, pervious pavers that are subject to significant water flow over their surface will shift and become uneven. Many synthetic turf products will restrict water permeation, tear in adverse conditions and have potential to create water pollution. Earlier types of turf products were not capable of standing up to some of the conditions of the coastal environment.

It will be highly beneficial to waterfront property owners who experience Sunny Day Flooding to have a product that meets CAMA requirements while protecting their properties. It will be highly beneficial to CAMA to have a product that has been CAMA reviewed and meets requirements necessary for protecting our delicate and precious coastal environment.

After considerable research a product has been identified that can meet CAMA requirements while safely adding protection and beauty to waterfront properties who are subject to Sunny Day Flooding.

Tailor Made Grass Cali73 has the following benefits:

Tailor Made Grass Cali73 is permeable.
It has a perm rating of over 1000 inches/hr as tested with ASTM: F1551
Have a video and can demonstrate a 5 gallon bucket of water goes through the ground cover within seconds. It is permeable both directions.

It is 100% recyclable. 98% of synthetic turf sold today can not be recycled. This is a unique product that is produced by good stewards for our environment. The product is designed for this specific application.

This product utilizes a revolutionary pinnacle back that is 9x tougher to tears than original artificial turf.
This product can be fastened with stainless steel perimeter screws and infield stakes to insure the product stays in place.
The few seams in the product are as tough as the product itself.
The turf claw seaming system creates seams that will not separate and the additional stakes along seams insure the product will stay in place.
Cali73 has a grab tear strength of over 200 lbs as tested with ASTM: D-5034
Cali73 has a tuff bind of over 8 lbs as tested with ASTM: D-1335

Cali73 has a machine gauge of of 3/8” as tested by ASTM D-5793 with a fabric weight of 87.1 oz/sqyrd as tested by ASTM: D-5848

Cali73 is made from 12,600 Denier.
Cali73 is a tough, durable product designed to hold up to harsh environments.
Cali73 does not shrink and swell during temperature change as was previously seen with earlier versions of synthetic turf.

Cali73 has a product backing that is designed to prioritize both performance and the planet.
The product has a newly designed weed barrier on its back that can not clog.
There are no holes to clog, the entire material is permeable.
This is a new generation of turf.
This provides solutions to existing problems.

Like many materials used in coastal construction this product has a lifespan. The color may start to fade after 15-30 years but the durability will hold up and is expected to hold its form for 40 years. Decking, boat lift cables, ropes, cleats, pilings, shingles and treated wood all need to be replaced periodically. This product will want to be replaced when the color fades not from a breakdown of the structurally integrity of the product.

We have the unique opportunity to test this product in limited scope under vigilant surveillance by an interested, thoughtful, caring and proactive steward of the environment at 813 Canal Drive. As it performs as stated it could potentially be considered as an accepted material either now or in the future. If for any reason it does not perform as expected it would certainly be removed.

Attached you will find the following supporting documents:
Cali73 specification sheet
Permeability test results showing over 1000”/hr water permeability
15 year product warranty

After reviewing this background letter and supporting documentation we believe you will find:

Strict application of the regulations of the Commision would create the unnecessary hardship for this specific property with a low level structure from utilizing a viable option to protect the property in a safe ecological manner from the specific challenge of Sunny Day Flooding as well as named storms.

Such hardships result from the conditions of Sunny Day Flooding as well as storm surge specific to the location of this property on Canal Drive in Carolina Beach.

Actions by the petitioner had no bearing in creating the hardship of flooding on Canal Drive in Carolina Beach

The requested variance is consistent with the spirit, purpose and intent of the Commision’s rules, standards and orders; will secure the public safety and welfare; and will preserve justice.

If you would like further information or discussion, would be happy to discuss with you as well as connect you with Barclay Payne the developer of this environmentally conscious product.

Thank you for the time and energy you put into protecting our environment. Thank you for your consideration of this unique and groundbreaking product that is a viable solution for coastal property. Thank you for being open minded about new technology. Someone had to be the first to try the wheel, electric light bulb, and outboard motor before they became widely accepted.

This product is currently being successfully utilized in coastal communities in Jacksonville Fl, Boston, Miami, Seattle, and California.

Your consideration for our environment is greatly appreciated,

Andrew Krichman
813 Canal Dr
Carolina Beach NC 28428
919 801 0083

Strict application of the regulations of the Commission would create the unnecessary hardship for this specific property with a low level structure from utilizing a viable option to protect the property in a safe ecological manner from the specific challenge of Sunny Day Flooding as well as named storms. There are waterfront properties along Canal Dr. that have natural vegetation, as well as planted grass that is returning to wetlands due to the amount of sea water that is routinely getting on properties. Petitioner is respectively requesting a variance to allow the Tailor Made Grass Cali 73 to remain in place. It has been in place for two years and is successfully working in an environmentally safe manner. 80% of the installed Tailor Made Cali 73 is within the 30' CAMA buffer and is the most susceptible area to returning to wetlands. Petitioner has installed a quality bulkhead that is preventing the water from getting on the property from the water side of the property. Due to the height of the garage and driveway, the grading can not be raised enough to prevent water from entering property from flooding on Canal Dr. The flooding situation is worsening with no end in sight. Petitioner is respectfully requesting a variance to prevent the hardship of portions of his property returning to wetlands as he has witnessed on multiple neighboring properties.

Staff's Position: No.

Strict application of the Commission's 30-foot buffer rule on the Site does not cause Petitioner unnecessary hardships. Petitioner has identified concerns regarding the colonization of wetlands on his property due to flooding from Canal Drive. The General Assembly's definition of Coastal Wetlands in the Dredge & Fill Law at GS 113A-229(n) requires the presence of specific wetlands species as well as the property to be

> subject to regular or occasional flooding by tides, including wind tides (whether or not the tidewaters reach the marshland areas through natural or artificial watercourses), provided this shall not include hurricane or tropical storm tides.

Where Petitioners' lot is bulkheaded, it is unlikely to be claimed as a coastal wetland even if wetland species were present. Petitioner proposes to keep the artificial turf within the 30' CAMA Buffer where it was installed on his Site both inside and outside of the 30' Buffer. Petitioner undertook this installation without first seeking a CAMA permit, and apparently without knowing a CAMA permit could not be issued for artificial turf within the Commission's 30' Buffer. While petitioner is correct stating the turf has been in place for two years, this is due to DCM and the LPO halting enforcement action to allow Petitioner to apply for a CAMA permit denial to subsequently seek a variance as part of his restoration plan for the violation, and to allow the CRAC to consider the issue of allowing artificial turf within the 30' Buffer.

Additionally, prior to the situation at hand, he Commission was presented information on the history of the 30' buffer in 2021 and made a clear interpretative ruling stating artificial turf was not included in the "landscaping" exception to the 30' CAMA Buffer rule and therefore not allowable per the Commission's rules which would result in an application for a CAMA permit resulting in denial. This position of the Commission has not changed based on discussion at the 2021 CRC meeting and the CRAC voted not to recommend a rule change regarding artificial turf to the Commission at the April 2025 Commission meeting. The focus of the Commission's 30' Buffer is multifaceted with the objectives of providing a wildlife corridor immediately adjacent to the water, a vegetative buffer to reduce pollutant runoff to improve water quality and to provide aesthetic value to the general public. Without a variance, Petitioner could retain the artificial turf on those portions of the Site landward of the CAMA 30' Buffer and use landscaping and vegetation within his 30' Buffer area to address his stated erosion concerns behind his new bulkhead.

II. Do such hardships result from conditions peculiar to the petitioner's property, such as location, size, or topography of the property? Explain.

Petitioners' Position: Yes.

Such hardships result from the conditions of Sunny Day Flooding and wind blown events specific to the location of this property on Canal Drive in Carolina Beach. There are less than 50 homes on Canal Dr that are being affected by this issue. Less than 2% of the homes in Carolina Beach are affected by this issue. Less than 10% of the waterfront homes in Carolina Beach are affected by this issue. But it is a very significant issue that is peculiar to this property as well as a small number of other properties along Canal Dr. It is not the only property but it is one of only a very small percentage that are affected. The effects are quite significant and require being addressed thoughtfully as opposed to being blanket stamped with more regulation.

Staff's Position: No.

Staff agrees that the Town of Carolina Beach around the Yacht Basin and at this Site is subject to frequent sunny day flooding events, as described in the NCSU study by Dr. Anarde included in the exhibits discussed in the facts. However, that sunny-day flooding is not limited to Carolina Beach. Staff does not agree that any of Petitioner's alleged hardships are caused by conditions

peculiar to the property in question. The Site is adjacent to the Carolina Beach Yacht Basin and is generally low-lying, this is not peculiar within the Town of Carolina Beach or on other basins and canals in the coastal area.

III. Do the hardships result from the actions taken by the Petitioner? Explain.

Petitioners' Position: No.

Actions by the petitioner had no bearing in creating the hardship of flooding on Canal Drive in Carolina Beach.

Staff's Position: No.

Staff agree that while Petitioner should have contacted DCM or the Town of Carolina Beach LPO before having the turf installed, Petitioner did not contribute to the flooding near and on the Site. Staff also note that Petitioner put in a taller bulkhead and Petitioner added sand fill to the Site and recently reconstructed the bulkhead in attempts to mitigate flooding on the Site.

IV. Will the variance requested by the petitioner (1) be consistent with the spirit, purpose, and intent of the rules, standards, or orders issued by the Commission; (2) secure the public safety and welfare; and (3) preserve substantial justice? Explain.

Petitioners' Position: Yes.

The requested variance is consistent with the spirit, purpose and intent of the Commission's rules, standards and orders; will secure the public safety and welfare; and will preserve justice.

The solution utilized at 813 Canal Dr. specifically adheres to the first stated key purpose of the CRC rules, "The rules work to minimize loss of life and property caused by storms, flooding, and long-term erosion."

This is an application that is compatible with nature. The product is fully recyclable, fully permeable, looks 100% natural, is extremely durable and is a far superior choice to any sort of hardened structure, rocks, pavement, or even grass or natural vegetation that over time will allow development of wetlands when enough sea water is introduced to property over time. This product specifically addresses one of the primary intents of the CRC's core principles by minimizing the likelihood of significant damage to private property.

This coastal application does work to balance the needs of a growing population with economic development and environmental protection. It is congruent with recognizing the value of the coast

for industry, recreation, and residential use, while preventing unchecked development that could destroy these resources.

Removal of this product in this specific application would directly go against the spirit, purpose and intent of the Commission’s purpose to minimize loss of property caused by storms, flooding and long term erosion. In fact, this product was specifically designed to address these issues and is being successfully used in 100’s of waterfront applications with no issue.

The spirit, purpose and intent of the CRC rules as I understand them are:

The spirit, purpose, and intent of the North Carolina Coastal Resources Commission (CRC) rules are to protect, conserve, and manage the state's valuable coastal resources for the long-term benefit of the public. These rules are the mechanism for implementing the state's Coastal Area Management Act (CAMA) and the Dredge and Fill Law.

Core principles

1. Balance competing interests

The CRC rules aim to manage the coast in a way that balances the needs of a growing population with economic development and environmental protection. They recognize the value of the coast for industry, recreation, and residential use, while preventing unchecked development that could destroy these resources.

2. Ensure development is compatible with nature

A primary intent is to ensure that development within Areas of Environmental Concern (AECs) is compatible with the natural characteristics of the area. This minimizes the likelihood of significant damage to both private property and public resources. The CRC does not intend to stop development entirely, but rather to control "inappropriate or damaging development" in critical areas.

3. Recognize public trust resources

A foundational principle is that the beaches, sounds, and marshes are public trust resources that belong to everyone. The rules are designed to protect common-law and statutory public rights of access to coastal lands and waters.

Key purposes

- Protect public safety and welfare: The rules work to minimize loss of life and property caused by storms, flooding, and long-term erosion.

- Designate and manage Areas of Environmental Concern (AECs): The rules create standards for development within specific, designated AECs. This is the central function of the rules, focusing on areas particularly vulnerable to damage, such as estuarine systems, ocean hazards, coastal wetlands, and shorelines.

- Protect against erosion: The CRC adopts specific standards, such as building setbacks, to prevent permanent structures from encroaching on public beach areas and to preserve the natural ecological conditions of the dune and beach systems.

- Manage coastal hazards: The rules help manage the effects of coastal dynamics, such as erosion and flooding, and aim to reduce the public costs associated with improperly sited development and disaster relief.

- Coordinate management: The rules establish policies that create a coordinated management scheme across local, state, and federal levels of government, ensuring uniform standards for development and resource protection in coastal counties.

- Provide guidance and standards: The rules establish clear policies, criteria, and standards for both individuals and government agencies to ensure uniformity and consistency in coastal management.

Staff's Position: No.

Petitioner has proposed keeping the artificial turf he had installed on the Site, which is not allowed as part of the "landscaping" exception to the CAMA 30' Buffer rule, and this was affirmed specifically regarding artificial turf in 2021 through the Commission's action. While it may be that the installation method underlying Petitioner's artificial turf addresses some level of impervious surface and water quality concerns where he used sand and not rock or other underlayment materials, and where he did not use rubber filler used with other turf, the CAMA 30' buffer rule also requires that development in the buffer area is water dependent unless listed as one of the exceptions, which artificial turf is not. Additionally, Petitioner's use of this material is stated to be to prevent erosion but also to prevent migration of wetland species landward of his bulkhead. As stated prior, Petitioner's concerns regarding the colonization of wetlands on his property due to flooding from Canal Drive would not meet the General Assembly's definition of wetlands if it was not "regularly or occasionally" flooded and therefore would not be claimed as a wetland by the Division even if Coastal Wetlands species were present. Staff acknowledge that the issue of using artificial turf in the 30' CAMA Buffer was discussed in the three CRAC meetings in 2024 and 2025, but the CRAC voted not to recommend rulemaking to the Commission. Staff believe that if the Commission wishes to consider this issue again, it should be through the public rulemaking process in order to secure public safety and welfare and preserve substantial justice.

Petitioner’s Petition Materials
(without initial proposed facts or duplicative exhibits)

✓ A copy of the permit decision for the development in question;

✓ A copy of the deed to the property on which the proposed development would be located;

✓ A complete description of the proposed development including a site plan;

✓ A stipulation that the proposed development is inconsistent with the rule at issue;

✓ Proof that notice was sent to adjacent owners and objectors*, as required by 15A N.C.A.C. 07J .0701(c)(7);

___ Proof that a variance was sought from the local government per 15A N.C.A.C. 07J .0701(a), if applicable;

✓ Petitioner's written reasons and arguments about why the Petitioner meets the four variance criteria, listed above;

✓ A draft set of proposed stipulated facts and stipulated exhibits. Please make these verifiable facts free from argument. Arguments or characterizations about the facts should be included in the written responses to the four variance criteria instead of being included in the fa...

✓ This form completed, dated, and signed by the Petitioner or Petitioner's Attorney.

**Please contact DCM or the local permit officer for a full list of comments received on your permit application. Please note, for CAMA Major Permits, the complete permit file is kept in the DCM Morehead City Office.*

Due to the above information and pursuant to statute, the undersigned hereby requests a variance.

[signature]	6/26/24
Signature of Petitioner or Attorney	Date
Andrew C. Krichman	Andy@Krichco.com
Printed Name of Petitioner or Attorney	Email address of Petitioner or Attorney
PO Box 9400	(919) 801-0083
Mailing Address	Telephone Number of Petitioner or Attorney
Chapel Hill NC 27515	( )
City State Zip	Fax Number of Petitioner or Attorney

✓ A copy of the permit decision for the development in question;

✓ A copy of the deed to the property on which the proposed development would be located;

✓ A complete description of the proposed development including a site plan;

✓ A stipulation that the proposed development is inconsistent with the rule at issue;

✓ Proof that notice was sent to adjacent owners and objectors*, as required by 15A N.C.A.C. 07J .0701(c)(7);

___ Proof that a variance was sought from the local government per 15A N.C.A.C. 07J .0701(a), if applicable;

✓ Petitioner's written reasons and arguments about why the Petitioner meets the four variance criteria, listed above;

✓ A draft set of proposed stipulated facts and stipulated exhibits. Please make these verifiable facts free from argument. Arguments or characterizations about the facts should be included in the written responses to the four variance criteria instead of being included in the [illegible]

✓ This form completed, dated, and signed by the Petitioner or Petitioner's Attorney.

**Please contact DCM or the local permit officer for a full list of comments received on your permit application. Please note, for CAMA Major Permits, the complete permit file is kept in the DCM Morehead City Office.*

Due to the above information and pursuant to statute, the undersigned hereby requests a variance.

A. C. Krichman — 6/26/24

Signature of Petitioner or Attorney — Date

Andrew C. Krichman — Andy@Krichco.com

Printed Name of Petitioner or Attorney — Email address of Petitioner or Attorney

PO Box 9400 — (919) 801-0083

Mailing Address — Telephone Number of Petitioner or Attorney

Chapel Hill — NC — 27515 — ( )

City — State — Zip — Fax Number of Petitioner or Attorney

Stipulated Exhibits

1. Deep Water Management, Inc. Secretary of State filings x2
2. Deed 6545/1527
3. Plat 3/67
4. Tax Card for Site
5. Four Past CAMA Permits
6. NCSU Anarde Study of Sunny-day flooding in Carolina Beach, not attached but linked here: Wind and rain compound with tides to cause frequent and unexpected coastal floods - ScienceDirect
7. 7/28/23 Notice of Violation and restoration plan
8. NOV-related emails
9. CAMA Minor Permit Application Materials (including form, drawings, lab test, warranty)
10. Adjacent Riparian Owner Notice Forms
11. 1/30/24 Denial Letter
12. 9/25/24 email with Variance Petition
13. 6/13/24 Washington Post video/article
14. Petitioner's Affidavit
15. Statements in support from both adjacent neighbors
16. Affidavit of Joe Benson
17. Krichman deed for 1005 Canal Drive
18. Powerpoint slides from CRAC meetings in Nov '24/Feb '25 and Apr '25
19. 1998 Memo to CRC about vegetative buffers ahead of eventual 30' Buffer rule
20. Site Photos in Powerpoint

SOSID: 2368039
Date Filed: 3/3/2022 9:35:00 AM
Elaine F. Marshall
North Carolina Secretary of State
C2022 062 00812

State of North Carolina
Department of the Secretary of State

ARTICLES OF INCORPORATION

Pursuant to §55-2-02 of the General Statutes of North Carolina, the undersigned does hereby submit these Articles of Incorporation for the purpose of forming a business corporation.

1. The name of the corporation is: Deep Water Management, Inc.
2. The number of shares the corporation is authorized to issue is: 100,000
3. These shares shall be: *(check either a or b)*
   a. ☑ All of one class, designated as common stock; or
   b. ☐ Divided into classes or series within a class as provided in the attached schedule, with the information required by N.C.G.S. Section 55-6-01.
4. The name of the initial registered agent is: Kelly J. Mackay
5. The North Carolina street address and county of the initial registered office of the corporation is:
   Number and Street 240 Leigh Farm Road, Suite 100
   City Durham State NC Zip Code 27707 County Durham
6. The mailing address, *if different from the street address*, of the initial registered office is:
   Number and Street PO Box 51549
   City Durham State NC Zip Code 27717 County Durham
7. Principal office information: *(must select either a or b.)*
   a. ☐ The corporation has a principal office.
   The principal office telephone number: _____
   The street address and county of the principal office of the corporation is:
   Number and Street _____
   City _____ State _____ Zip Code _____ County _____
   The mailing address, *if different from the street address*, of the principal office of the corporation is:
   Number and Street _____
   City _____ State _____ Zip Code _____ County _____
   b. ☑ The corporation does not have a principal office.

8. Any other provisions, which the corporation elects to include, i.e., the purpose of the corporation, are attached.

9. The name and address of each incorporator is as follows:

Name	Address
Andrew C. Krichman	PO Box 9400, Chapel Hill, NC 27515

10. **(Optional):** Listing of Company Officers (See instructions on why this is important)

Name	Address	Title

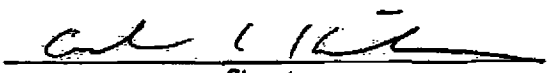
11. **(Optional):** Please provide a business e-mail address: _____.
The Secretary of State's Office will e-mail the business automatically at the address provided at no charge when a document is filed. The e-mail provided will not be viewable on the website. For more information on why this service is being offered, please see the instructions for this document.

12. These articles will be effective upon filing, unless a future date is specified:

_____

This the 2nd day of March 20 22

Deep Water Management, Inc.



Signature

Andrew C. Krichman, Incorporator

Type or Print Name and Title

NOTES:
1. **Filing fee is $125. This document must be filed with the Secretary of State.**

BUSINESS CORPORATION ANNUAL REPORT

050

1/6/2022

NAME OF BUSINESS CORPORATION: **Deep Water Management, Inc.**

SECRETARY OF STATE ID NUMBER: 2368039 STATE OF FORMATION: NC

REPORT FOR THE FISCAL YEAR END: 12/31/2023

Filing Office Use Only

E - Filed Annual Report
2368039
CA202410001928
4/9/2024 10:36

☒ Changes

SECTION A: REGISTERED AGENT'S INFORMATION

1. NAME OF REGISTERED AGENT: Mackay, Kelly J.

2. SIGNATURE OF THE NEW REGISTERED AGENT: _____

SIGNATURE CONSTITUTES CONSENT TO THE APPOINTMENT

3. REGISTERED AGENT OFFICE STREET ADDRESS **& COUNTY**

125 S Estes Drive #9400
Chapel Hill, NC 27515 Orange County

4. REGISTERED AGENT OFFICE MAILING ADDRESS

125 S Estes Drive #9400
Chapel Hill, NC 27515

SECTION B: PRINCIPAL OFFICE INFORMATION

1. **DESCRIPTION OF NATURE OF BUSINESS:** construction

2. **PRINCIPAL OFFICE PHONE NUMBER:** (984) 484-9389

3. **PRINCIPAL OFFICE EMAIL:** Privacy Redaction

4. PRINCIPAL OFFICE STREET ADDRESS

125 S Estes Drive #9400
Chapel Hill, NC 27515

5. PRINCIPAL OFFICE MAILING ADDRESS

125 S Estes Drive #9400
Chapel Hill, NC 27515

6. **Select one of the following if applicable. (Optional see instructions)**

☐ The company is a veteran-owned small business

☐ The company is a service-disabled veteran-owned small business

SECTION C: OFFICERS (Enter additional officers in Section E.)

NAME:	NAME:	NAME:
Andrew C. krichman		
TITLE: President	TITLE:	TITLE:
ADDRESS:	ADDRESS:	ADDRESS:
125 S Estes Drive #9400		
Chapel Hill, NC 27515		

SECTION D: CERTIFICATION OF ANNUAL REPORT. Section D must be completed in its entirety by a person/business entity.

Andrew C. krichman — SIGNATURE

4/9/2024 — DATE

Form must be signed by an officer listed under Section C of this form.

Andrew C. krichman — Print or Type Name of Officer

President — Print or Type Title of Officer

This Annual Report has been filed electronically.

MAIL TO: Secretary of State, Business Registration Division, Post Office Box 29525, Raleigh, NC 27626-0525

BK: RB 6545
PG: 1527 - 1529
RECORDED:
03/08/2022
03:26:57 PM
BY: ANGELA ENGLISH
DEPUTY

2022009075
NEW HANOVER COUNTY,
TAMMY THEUSCH PIVER
REGISTER OF DEEDS

NC FEE $26.00
REAL ESTATE
EXTX $1478.00

ELECTRONICALLY RECORDED

NORTH CAROLINA GENERAL WARRANTY DEED

Excise Tax: $1,478.00 Parcel Identifier No.: R08815-007-007-000

Mail after recording to: Deep Water Management, Inc., PO Box 9400, Chapel Hill, NC 27515

This instrument was prepared by: TriCity Lawyers, 1910 Sedwick Road, Suite 100B, Durham, NC 27713

Brief Description from the Index: Lot 17A, Block 14A, Carolina Beach: Plat Book 3, Page 67

THIS DEED made as of the date in the acknowledgment below, by and between

GRANTOR	**GRANTEE**
David V. Porter and Elizabeth K. Porter, husband and wife	Deep Water Management, Inc., a North Carolina Corporation
5719 Doncaster Drive Charlotte, NC 28211	PO Box 9400 Chapel Hill, NC 27515

Property Address: 813 Canal Drive, Carolina Beach, NC 28428

The designation Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine or neuter as required by context.

WITNESSETH, that the Grantor, for a valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, has and by these presents does grant, bargain, sell and convey unto the Grantee in fee simple, all that certain lot or parcel of land situated in City of Carolina Beach, New Hanover County, North Carolina and more particularly described as follows:

See Exhibit "A" Attached Hereto and Made a Part Hereof

The property herein described [ ] is or [X] is not the primary residence of the Grantors.

The property herein described was acquired by Grantor by instrument recorded in Book 5636, Page 401, New Hanover County Registry.

A map showing the above described property is recorded in Plat Book 3, Page 67, and referenced within this instrument.

Submitted electronically by "TriCity Lawyers"
in compliance with North Carolina statutes governing recordable documents
and the terms of the submitter agreement with the New Hanover County Register of Deeds.

TO HAVE AND TO HOLD the aforesaid lot or parcel of land and all privileges and appurtenances thereto belonging to the Grantee in fee simple.

And the Grantor covenants with the Grantee, that Grantor is seized of the premises in fee simple, has the right to convey the same in fee simple, that title is marketable and free and clear of all encumbrances, and that Grantor will warrant and defend the title against the lawful claims of all persons whomsoever except for the exceptions hereinafter stated.

Title to the property hereinabove described is subject to the following exceptions:

1. Taxes for the year 2022, and subsequent years, not yet due and payable and
2. Rights of way, protective or restrictive covenants of record, if any.

IN WITNESS WHEREOF, the Grantor has hereunto set his hand, or if corporate, has caused this to be signed in its corporate name by its duly authorized officers by authority of its Board of Directors, the day and year first above written.

David V. Porter

Elizabeth K. Porter

STATE OF NORTH CAROLINA
COUNTY OF Mecklenburg

I, Andrew Lowry, Notary Public, do hereby certify that David V. Porter and Elizabeth K. Porter personally appeared before me this day and acknowledged the due execution of the foregoing instrument. Witness my hand and official seal this 7 day of March, 2022.

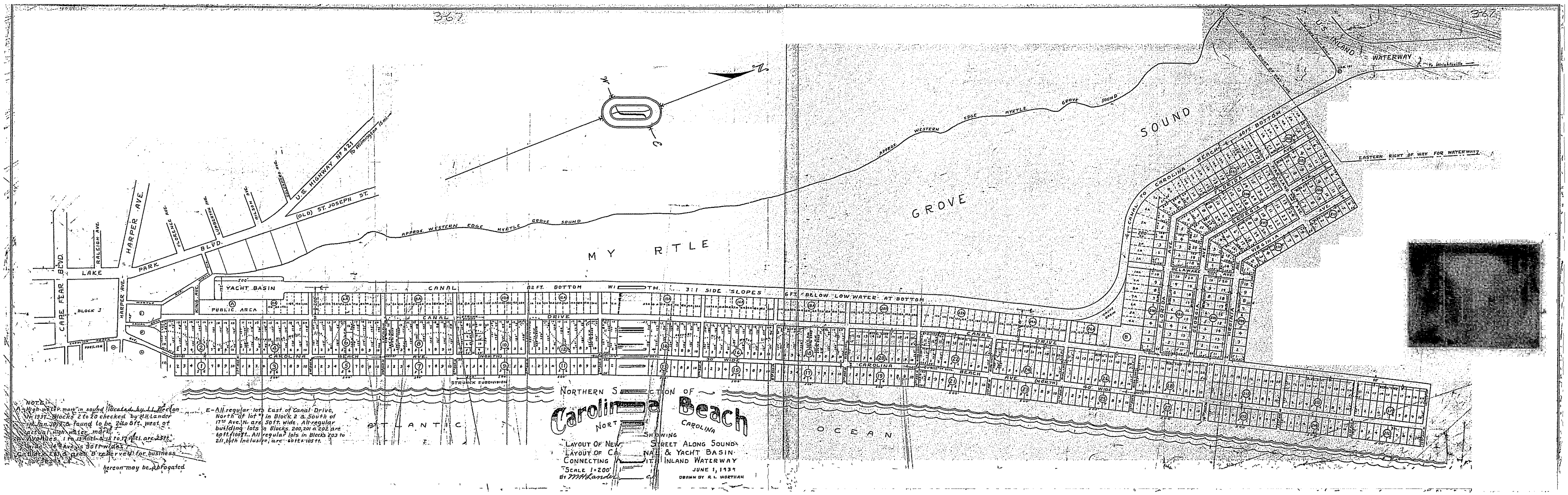
Official Signature of Notary
Printed or typed name of Notary
Andrew Lowry
My Commission Expires: 09-02-2025

ANDREW LOWRY
My Commission Expires
NOTARY
PUBLIC
09-02-25
UNION COUNTY, NC

Exhibit "A"

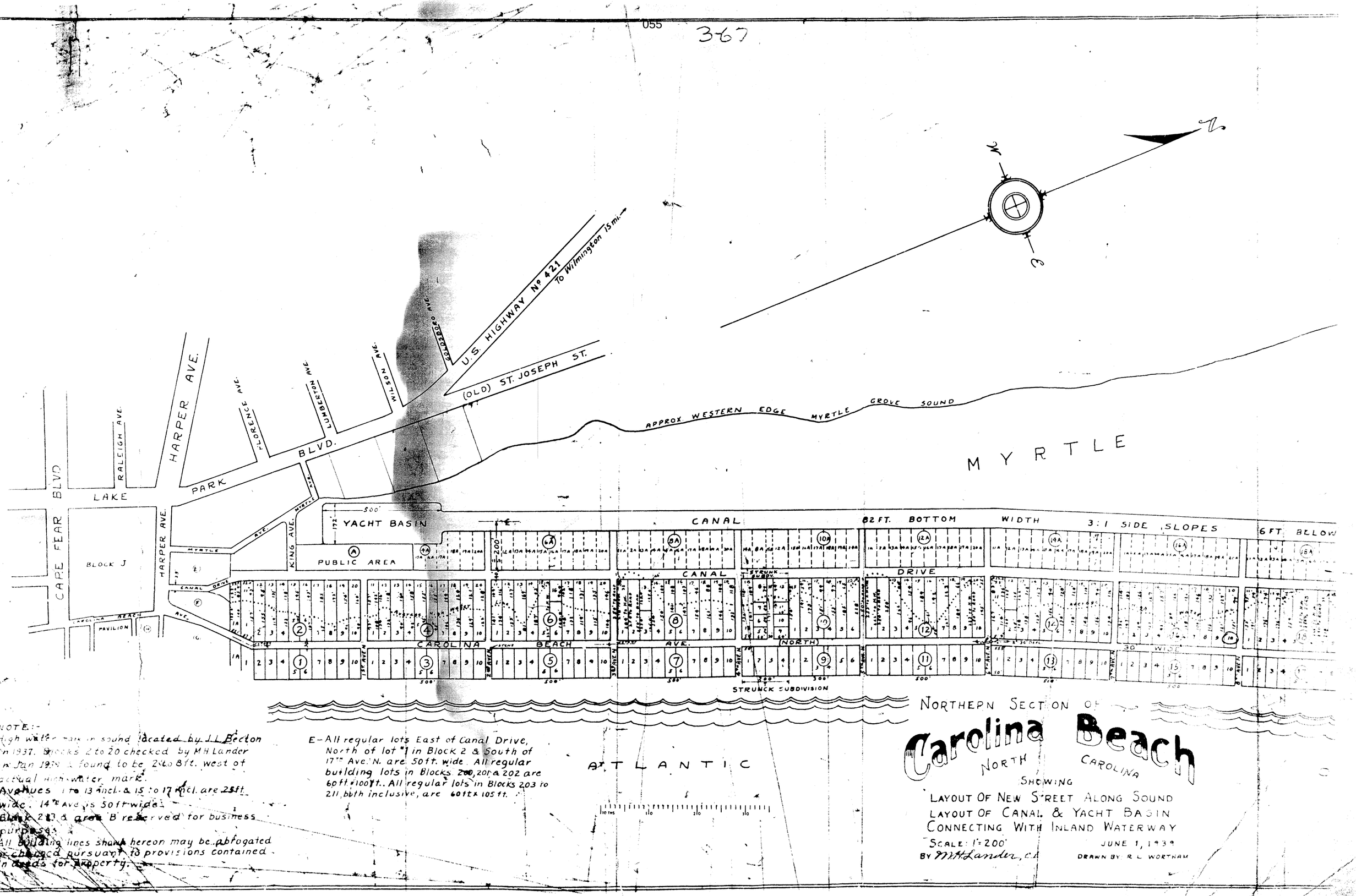
BEGINNING AT AN IRON PIPE IN THE WESTERN LINE OF CANAL DRIVE (40 FOOT RIGHT OF WAY) SAID IRON PIPE BEING LOCATED SOUTH 24 DEGREES WEST 150 FEET FROM THE INTERSECTION OF SAID LINE OF CANAL DRIVE WITH THE SOUTHERN LINE OF 7TH AVENUE NORTH; RUNNING THENCE SOUTH 24 DEGREES WEST ALONG SAID LINE OF CANAL DRIVE 50 FEET TO AN IRON PIPE; THENCE NORTH 66 DEGREES WEST 70.7 FEET TO AN IRON PIPE IN THE HIGH WATER LINE OF MYRTLE GROVE SOUND; THENCE NORTHWARDLY ALONG SAID HIGH WATER LINE TO AN IRON PIPE WHICH IS LOCAT ED NORTH 66 DEGREES WEST 61.6 FEET FROM THE BEGINNING POINT; THENCE SOUTH 66 DEGREES EAST 61.6 FEET TO THE BEGINNING; THE SAME BEING ALL OF LOT 17A OF BLOCK 14A OF CAROLINA BEACH AS SHOWN UPON THAT MAP OF SAID SUBDIVISION RECORDED IN THE NEW HANOVER COUNTY REGISTRY IN MAP BOOK 3 AT PAGE 67.

Tax Parcel Number: R08815-007-007-000
Property Address: 813 Canal Drive, Carolina Beach, NC 28428


367
Northern S ction of
Carolin a Beach
Nort Carolina
Showing
Layout of New Street Along Sound
Layout of Ca nal & Yacht Basin
Connecting it Inland Waterway
Scale 1=200'
By M.H. Lander
June 1, 1939
Drawn by R. L. Wortham
NOTE:
A-High water mark in sound located by J.L.Becton in 1937. Blocks 2 to 20 checked by M.H.Lander in Jan. 1939 & found to be 2 to 8 ft. west of actual high water mark.
B-Avenues 1 to 13 incl. & 15 to 17 incl. are 25 ft. wide. 14 Ave. is 50 ft. wide.
hereon may be abrogated
E-All regular lots East of Canal Drive, North of lot #1 in Block 2 & South of 17th Ave. N. are 50 ft. wide. All regular building lots in Blocks 200, 201 & 202 are 60 ft. x 100 ft.. All regular lots in Blocks 203 to 211, both inclusive, are 60 ft. x 105 ft.
Myrtle Grove Sound
Approx. Western Edge Myrtle Grove Sound
Atlantic Ocean
Canal
Canal Drive
Carolina Beach Ave. North
Yacht Basin
Public Area
Lake Park Blvd.
Cape Fear Blvd.
Harper Ave.
Raleigh Ave.
(Old) St. Joseph St.
U.S. Highway No. 421
Strunck Subdivision
Pavilion
Block 3
U.S. Inland Waterway
Eastern Right of Way for Waterway
Delaware Ave.
Virginia Ave.
Georgia Ave.
Florida Ave.

055

367



NOTE:-

A - High water mark in sound located by J.L. Becton in 1937. Blocks 2 to 20 checked by M.H. Lander in Jan 1939 & found to be 2 to 8 ft. west of actual high-water mark.

B - Avenues 1 to 13 incl. & 15 to 17 incl. are 25 ft. wide. 14th Ave. is 50 ft. wide.

C - Block 21 & area B reserved for business purposes.

D - All building lines shown hereon may be abrogated or changed pursuant to provisions contained in deeds for property.

E - All regular lots East of Canal Drive, North of lot "1" in Block 2 & South of 17th Ave. N. are 50 ft. wide. All regular building lots in Blocks 200, 201 & 202 are 60 ft x 100 ft.. All regular lots in Blocks 203 to 211, both inclusive, are 60 ft x 105 ft.

NORTHERN SECTION OF

Carolina Beach

NORTH CAROLINA

SHOWING

LAYOUT OF NEW STREET ALONG SOUND

LAYOUT OF CANAL & YACHT BASIN

CONNECTING WITH INLAND WATERWAY

SCALE: 1" = 200'

JUNE 1, 1939

BY M.H. Lander, C.E.

DRAWN BY R.L. WORTHAM

APPROX WESTERN EDGE MYRTLE GROVE SOUND

GROVE

SOUND

STONEWALL

SOUTHERN RIGHT OF WAY LINE

TO CAPE FEAR RIVER

U.S. INLAND WATERWAY

To Wrightsville

U.S.H. 101

EASTERN RIGHT OF WAY FOR WATERWAY

CANAL TO CAROLINA BEACH

60 FT. BOTTOM

FLORIDA

MARYLAND

GEORGIA

VIRGINIA

DELAWARE

AVE.

6 FT BELOW LOW WATER AT BOTTOM

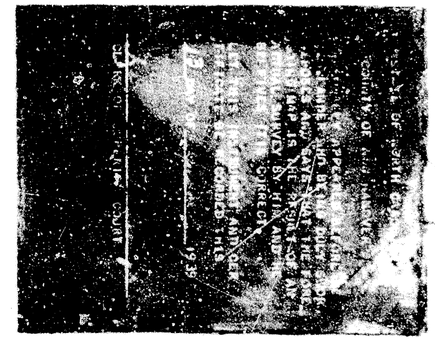
YACHT BASIN

CANAL DRIVE

CAROLINA BEACH AVE. (NORTH)

40' WIDE

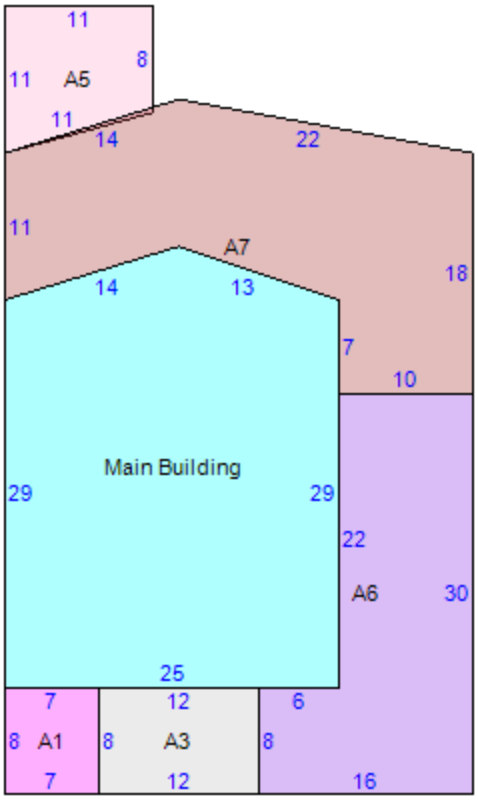
OCEAN



INCHES 1 2 3 4 5 6 7 8

PARID: R08815-007-007-000
DEEP WATER MANAGEMENT INC

813 CANAL DR



Item	Area
Main Building	775
PIER/PLNG - PP:PIER ON PILING	84
A1 - POR/WDK:OPEN PORCH/WOOD DECK	56
- UAP:UTILITY AMONG PILINGS	497
PORCH OPEN - PO:PORCH OPEN	357
A3 - POR/POR/WDK:OPEN PORCH/OPEN PORCH/WOOD DECK	96
PIER/PLNG - PP:PIER ON PILING	40
BOAT LIFT - BL:BOAT LIFT	1
A5 - WDK/WDK:WOOD DECK/WOOD DECK	105
PIER/PLNG - PP:PIER ON PILING	16
A6 - WDK:WOOD DECK	348
PIER/PLNG - PP:PIER ON PILING	49
A7 - CS/POR/BAS:CONCRETE SLAB/OPEN PORCH/1S FR ONE STORY FRAME	475

BULKHEAD - BKH:BULKHEAD	56
- UTL:UTILITY	630

Town of Carolina Beach
1121 N. Lake Park Blvd.
Carolina Beach, NC 28428
Tel: (910) 458-2999
Fax: (910) 458-2997

4/6/2023 Exemption Number – 12-23-Ex CB

DEEP WATER MANAGEMENT INC
PO BOX 9400
Chapel Hill, NC 27515

RE: EXEMPTED PROJECT (MINOR) - MAINTENANCE AND REPAIR (15A NCAC 07K .0103)

PROJECT ADDRESS – 813 Canal, Carolina Beach NC 28428
AREA OF ENVIRONMENTAL CONCERN - Estuarine Shoreline

Dear DEEP WATER MANAGEMENT INC:

I have reviewed the information submitted to this office in your inquiry concerning the necessary filing of an application for a minor development permit under the Coastal Area Management Act. After making a site inspection on 4/6/2023, I have determined that the activity you propose is exempt from needing a minor development permit as long as it remains consistent with your site drawing and materials list submitted on 3/24/2023, and meets the conditions specified below. If your plans should change and your project will no longer meet these conditions, please contact me before proceeding.

MAINTENANCE AND REPAIR - (G.S. 113-103(5)(B)(5) and 7K.0209) - Structures may be repaired in a similar manner, size and location as the original structure. No expansions or additions are permissible. The repairs are limited to 50% of the physical value of the existing structure and the following specific conditions.

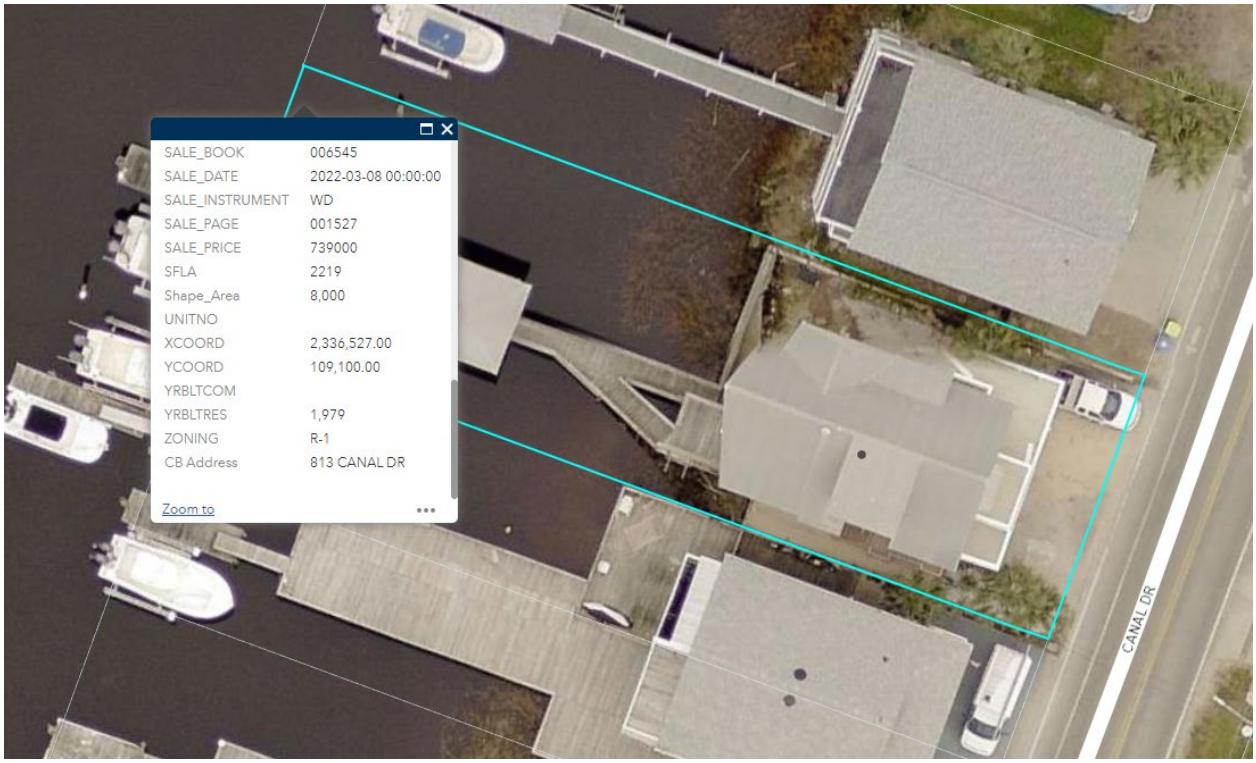
1. The project consists of the repair of pour new driveway on top of the existing driveway, as shown on the attached drawing.
2. The proposed repairs shall be consistent with all other applicable local ordinances and North Carolina Building Code standards.

This exemption to CAMA permit requirements does not alleviate the necessity of your obtaining any other State, Federal or Local authorization and N.C. Building Permits. This exemption expires 90 days from the date of the letter.

Sincerely,

Haley Moccia, LPO – Town of Carolina Beach
1121 N Lake Park Blvd
Carolina Beach, NC 28428

Cc: Bryan Hall


SALE_BOOK 006545
SALE_DATE 2022-03-08 00:00:00
SALE_INSTRUMENT WD
SALE_PAGE 001527
SALE_PRICE 739000
SFLA 2219
Shape_Area 8,000
UNITNO
XCOORD 2,336,527.00
YCOORD 109,100.00
YRBLTCOM
YRBLTRES 1,979
ZONING R-1
CB Address 813 CANAL DR
Zoom to
CANAL DR

☑ CAMA / ☐ DREDGE & FILL

061

No. 60

GENERAL PERMIT

☑ New ☐ Modification ☐ Complete Reissue ☐ Partial Reissue

Previous permit # _____

Date previous permit issued _____

orized by the State of North Carolina, Department of Environment and Natural Resources
Coastal Resources Commission in an area of environmental concern pursuant to 15A NCAC 7H . 2000

☒ Rules attached.

nt Name David Porter

s 813 Canal Drive

Carolina Beach State NC ZIP 28428

(910) 262-2243 Fax # (___) _____

zed Agent Daryl Ernie

d ☐ CW ☑ EW ☐ PTA ☐ ES ☐ PTS
: ☐ OEA ☐ HHF ☐ IH ☐ UBA ☐ N/A
☐ PWS: _____ ☐ FC: _____

yes / no **PNA** yes / no **Crit.Hab.** yes / no

Project Location: County New Hanover

Street Address/ State Road/ Lot #(s) Same

Subdivision _____

City _____ ZIP _____

Phone # (___) _____ River Basin C

Adj. Wtr. Body Alum (nat

Closest Maj. Wtr. Body Myrtle Grove Sd

of Project/ Activity Reconfiguration of existing docking facility within CB yacht Basin.

(Scale: 1"=

ock) length _____

m(s) _____

pier(s) _____

ength _____

umber _____

ad/ Riprap length _____

vg distance offshore _____

ax distance offshore _____

channel _____

ubic yards _____

mp _____

use/ Boatlift 2X (12'x24', 14'x15')

Bulldozing _____

floating dock 48'x6'

ne Length ~50'

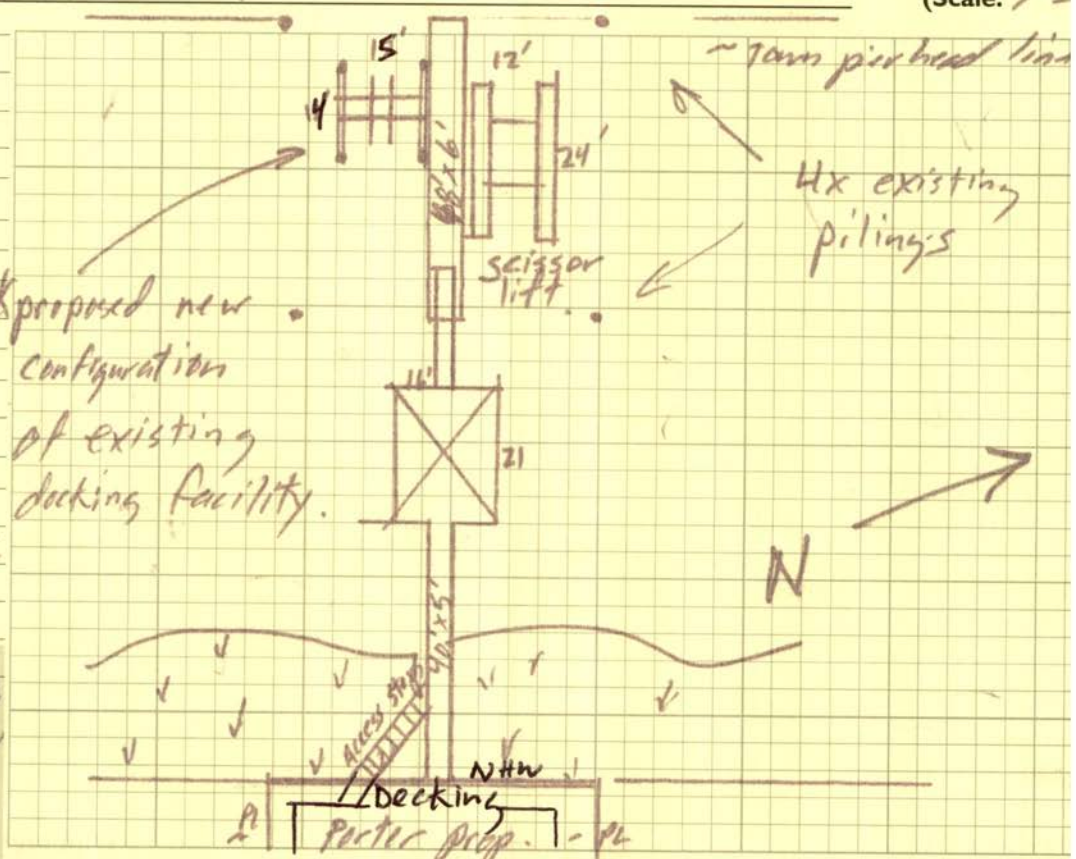
not sure yes no

gs: not sure yes no

rium: n/a yes no

yes no

Attached: yes no



ing permit may be required by: Town of Carolina Beach.

☐ See note on back regarding River Basin

Special Conditions Rules 7H .2000 apply

North Carolina Department of Environment and Natural Resources
Division of Coastal Management

verly Eaves Perdue
vernor

Braxton C. Davis
Director

Dee Freema
Secretar

AGENT AUTHORIZATION FORM

Date: _____

ne of **Property Owner** Applying for Permit:
David V. Porter

ner's ***Mailing*** Address:
5719 Doncaster Drive
Charlotte NC

ne Number (704) 607-7788

Name of **Authorized Agent** for this project:
Lighthorse Marine Const.
c/o Darrell Erny

Agent's ***Mailing*** Address:
P.O. Box 2532
Surf City NC 28445-002

Phone Number (910) 232-2243

tify that I have authorized the agent listed above to act on my behalf, for the purpose of applying and obtaining all CAMA Permits necessary to install or construct the following (activity):

_____

my property located at 813 Canal Drive Carolina Beach

certification is valid thru (date) _____.

David Porter By DPM
Property Owner Signature

_____
Date

RECEIVED
DCM WILMINGTON, N
SEP 17 2012

ADJACENT RIPARIAN PROPERTY OWNER STATEMENT

I hereby certify that I own property adjacent to David Porter's
(Name of Property Owner)

property located at 813 Canal St.
(Address, Lot, Block, Road, etc.)

on Yacht Basin, in Carolina Beach, N.C.
(Waterbody) (City/Town and/or County)

The applicant has described to me, as shown below, the development proposed at the above location.

✓ I have no objection to this proposal.

_____ I have objections to this proposal.

DESCRIPTION AND/OR DRAWING OF PROPOSED DEVELOPMENT

(Individual proposing development must fill in description below or attach a site drawing)

RECEIVED
DCM WILMINGTON, NC
SEP 17 2012

WAIVER SECTION

I understand that a pier, dock, mooring pilings, breakwater, boathouse, lift, or groin must be set back a minimum distance of 15' from my area of riparian access unless waived by me. (If you wish to waive the setback, you **must initial** the appropriate blank below.)

✓ I do wish to waive the 15' setback requirement.

_____ I **do not** wish to waive the 15' setback requirement.

(Property Owner Information)

David Porter
Signature

Print or Type Name

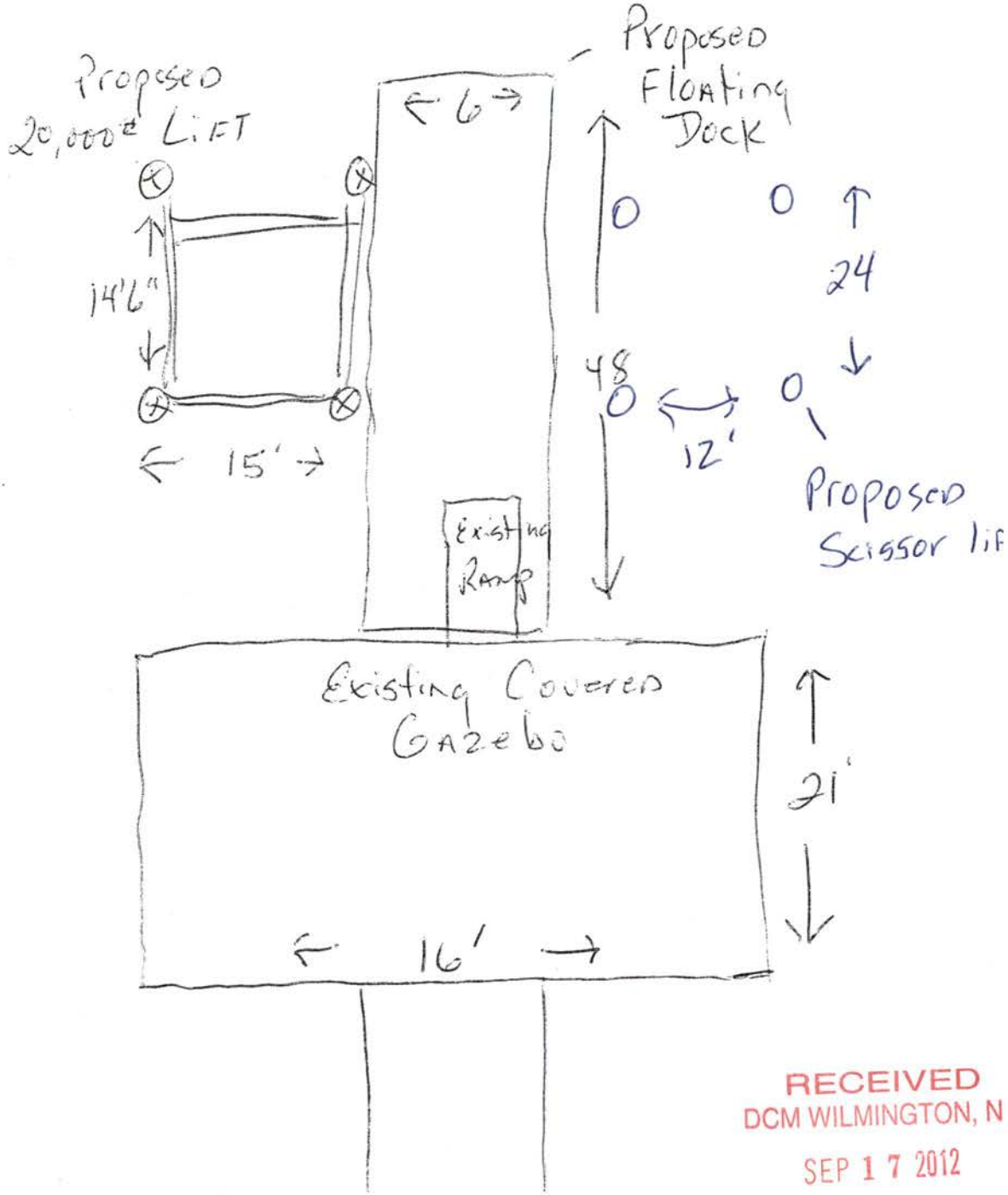
5719 Doncaster Drive

(Adjacent Property Owner Information)

James W. Eby
Signature

JAMES W. EBY
Print or Type Name

Porter



ADJACENT RIPARIAN PROPERTY OWNER STATEMENT

I hereby certify that I own property adjacent to David Porter 's
(Name of Property Owner)

property located at 813 Canal St.
(Address, Lot, Block, Road, etc.)

on Yacht Basin, in Carolina Beach, N.C.
(Waterbody) (City/Town and/or County)

The applicant has described to me, as shown below, the development proposed at the above location.

____ I have no objection to this proposal.

____ I have objections to this proposal.

DESCRIPTION AND/OR DRAWING OF PROPOSED DEVELOPMENT

(Individual proposing development must fill in description below or attach a site drawing)

RECEIVED
DCM WILMINGTON, NC
SEP 17 2012

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____ I do wish to waive the 15' setback requirement.

____ I **do not** wish to waive the 15' setback requirement.

(Property Owner Information)

David Porter
Signature

Print or Type Name

719 Doncaster Dr
Mailing Address

(Adjacent Property Owner Information)

Ronald S Powers
Signature

Ronald S Powers Jr
Print or Type Name

811 Canal Dr

IC Division of Coastal Mgt. Habitat Impact Computer Sheet

pplicant: David Porter

Permit #: 60726

ate: 9/17/12

escribe below the HABITAT disturbances for the application. **All values should match the name, and units of measurement ound in your Habitat code sheet.**

abitat Name	DISTURB TYPE Choose One	TOTAL Sq. Ft. (Applied for. Disturbance total includes any anticipated restoration or temp impacts)	FINAL Sq. Ft. (Anticipated final disturbance. Excludes any restoration and/or temp impact amount)	TOTAL Feet (Applied for. Disturbance total includes any anticipated restoration or temp impacts)	FINAL Feet (Anticipated final disturbance. Excludes any restoration and/or temp impact amount)
OW	Dredge ☐ Fill ☐ Both ☐ Other ☑	786	786		
	Dredge ☐ Fill ☐ Both ☐ Other ☐				
	Dredge ☐ Fill ☐ Both ☐ Other ☐				
	Dredge ☐ Fill ☐ Both ☐ Other ☐				
	Dredge ☐ Fill ☐ Both ☐ Other ☐				
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	Dredge ☐ Fill ☐ Both ☐ Other ☐				
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	Dredge ☐ Fill ☐ Both ☐ Other ☐				
	Dredge ☐ Fill ☐ Both ☐ Other ☐				

CK 3/30/23 LP

☒ CAMA ☒ DREDGE & FILL

GENERAL PERMIT

Nº 90517

A B C D

Previous permit _____

Date previous permit issued _____

☒ New ☐ Modification ☐ Complete Reissue ☐ Partial Reissue

As authorized by the State of North Carolina, Department of Environmental Quality and the Coastal Resources Commission in an area of environmental concern pursuant to:

15A NCAC 07H.1100 ☐ Rules attached. ☐ General Permit Rules available at the following link: www.deq.nc.gov/CAMArules

Applicant Name Deep Water Management Inc. c/o Andrew Krichman

Address 813 Canal Dr.

City Carolina Beach State NC ZIP 28428

Phone # (919) 801-0033

Email Andy@Krichco.com

Authorized Agent _____

Project Location (County): New Hanover

Street Address/State Road/Lot #(s) same

Subdivision _____

City Carolina Beach ZIP 28428

Affected ☐ CW ☒ EW ☒ PTA ☒ ES ☐ PTS

AEC(s): ☐ OEA ☐ IHA ☐ UW ☐ SPIMA ☐ PWS

ORW: yes (no) PNA: yes (no)

Adj. Wtr. Body CB Yacht Basin (nat/man/unk)

Closest Maj. Wtr. Body AICWW

Type of Project/ Activity Install bulkhead

Shoreline Length +/- 50'

Access Length —

Pier (dock) length —

Fixed Platform(s) —

Floating Platform(s) —

Finger pier(s) —

Total Platform area —

Groin length/# —

Bulkhead/Riprap length +/- 72'

Avg distance offshore 2'

Breakwater/Sill —

Max distance/ length 5'

Basin, channel —

Cubic yards —

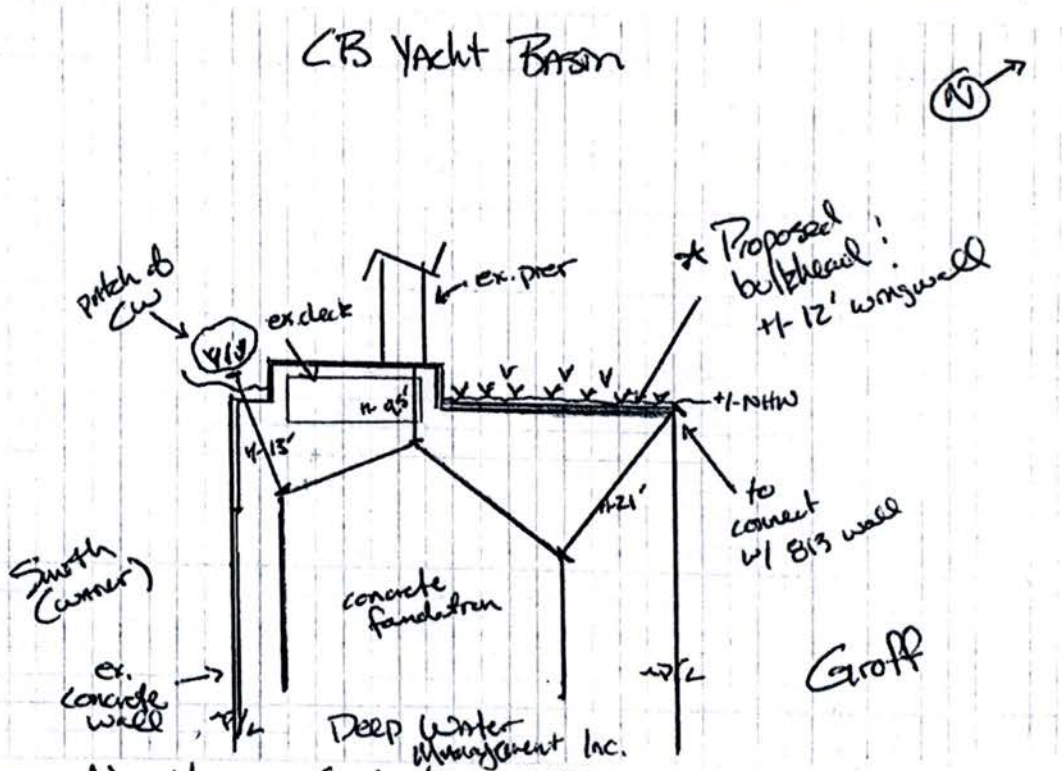
Boat ramp —

Boathouse/ Boatlift —

Beach Bulldozing —

Other 20' x 50' disturbed area

(Scale: NTS)



SAV observed: yes (no)

Moratorium: n/a yes (no)

Site Photos: yes (no)

Riparian Waiver Attached: (yes) no

A building permit/zoning permit may be required by: New Hanover County / Town of CB

Permit Conditions No filling of coastal wetlands authorized. All local, state, & federal regulations apply.

☐ TAR/PAM/NEUSE/BUFFER (circle one)

☐ See note on back regarding River Basin rules

☐ See additional notes/conditions on back

I AM AWARE OF STATUTES, CRC RULES AND CONDITIONS THAT APPLY TO THIS PROJECT AND REVIEWED COMPLIANCE STATEMENT. (Please initial) GLK

☒ Agent or Applicant PRINTED Name Andy Krichman

☒ Signature **Please read compliance statement on back of permit**

Permit Officer's PRINTED Name Bryan Hall

Signature

$400 Application Fee(s)

53833 Check #/Money Order

2/17/23 Issuing Date

6/17/23 Expiration Date

ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
BRAXTON DAVIS
Director

NORTH CAROLINA
Environmental Quality

NOTICE OF VIOLATION
7/28/23

CERTIFIED MAIL 7013 2630 0002 1133 7508
RETURN RECEIPT REQUESTED

Also sent electronically to: andy@krichco.com

Deep Water Management Inc. c/o Kelly Mackay
PO Box 51549
Durham, NC 27717

RE: NOTICE OF VIOLATION AND REQUEST TO CEASE UNAUTHORIZED DEVELOPMENT
CAMA VIOLATION #23-23D

Dear Ms. Mackay:

This letter confirms that on June 29, 2023, Andrew Krichman, Tara MacPherson, District Manager, and I met at your property located at 813 Canal Drive adjacent to the Carolina Beach Yacht Basin located in Carolina Beach, New Hanover County, North Carolina. The purpose of the visit was to investigate unauthorized development, including the installation of artificial turf grass within the 30' Estuarine Shoreline 30' buffer adjacent to the Carolina Beach Yacht Basin. This letter also confirms my July 12, 2023 email and my July 20, 2023, phone call with Mr. Krichman regarding this matter.

Information gathered by the Division of Coastal Management indicates that Deep Water Management Inc. has undertaken minor development in violation of the Coastal Area Management Act (CAMA). No person or entity may undertake Minor Development in a designated Area of Environmental Concern (AEC) without first obtaining a permit from the North Carolina Department of Environmental Quality. This requirement is imposed by North Carolina General Statute (N.C.G.S.) 113A-118.

I have information that indicates Deep Water Management Inc. has undertaken or are legally responsible for the installation of artificial turf grass on the aforementioned property. This activity took place in Estuarine Shoreline Area and Estuarine Shoreline 30' buffer that are contiguous with the Carolina Beach Yacht Basin. No CAMA permit was issued to you for this development. Based on these findings, I am initiating an enforcement action by issuing this ***Notice of Violation*** for violation of the Coastal Area Management Act.

I request that you immediately **CEASE AND DESIST** any further development and contact me about this matter. A civil assessment of up to $10,000 plus investigative costs may be assessed against any violator. Each day that the development described in this Notice is continued or repeated may constitute a separate violation that is subject to an additional assessment of $10,000. An injunction or criminal penalty may also be sought to enforce any violation in accordance with N.C.G.S. 113A-126.

It is the policy of the Coastal Resources Commission to assess a civil penalty plus investigative costs against all violations. This is done to recoup some of the costs of investigating the violation and/or to compensate the public for any damage to its natural resources. The amount assessed will depend upon several factors, including the nature and area of the resources that were affected and the extent of the damage to them.

Based upon the North Carolina Administrative Code, Title 15A, Subchapter 07H. State Guidelines for Areas of Environmental Concern, the activity undertaken, the installation of unauthorized artificial turf grass within the Estuarine Shoreline AEC and Estuarine Shoreline 30' buffer, is not consistent with Section 15A NCAC 07H .0209(10), which describes the development exceptions allowed within a distance of 30' landward of NHW and Section 15A NCAC 07J .0201 which states *that "Every person wishing to undertake any development in an area of environmental concern shall obtain a permit from the Department".* **Therefore, I am requesting that Deep Water Management Inc. remove the artificial turf grass from the Estuarine Shoreline 30' buffer or seek a variance from the Coastal Resources Commission (CRC). Please refer to the enclosed Restoration Agreement.**

If you intend to cooperate with my request, please sign one of the attached Restoration Agreements, on behalf of Deep Water Management Inc. and return it to me in the enclosed, self-addressed envelope within ten (10) days of receipt of this letter. Failure to comply with this request or respond back to this office prior to the requested deadline with an acceptable schedule for compliance will be interpreted as a refusal to cooperate and will result in a Notice of Continuing Violation, as well as a court injunction being sought ordering compliance.

The relevant statutes and regulations are available from this office, and I am willing to assist you in complying with the requirements of these laws. A site inspection will be made in the near future to determine whether this **REQUEST TO CEASE AND DESIST** has been complied with.

Thank you for your time and cooperation in resolving this important matter. If you have any questions about this or related matters, please call me at (910) 796-7423. Upon completion of the restoration as requested in the Restoration Plan Agreement to the satisfaction of the Division of Coastal Management, Deep Water Management Inc. will be notified as to the amount of the civil assessment for undertaking development without first obtaining the proper permit(s) and development that is inconsistent with Coastal Resources Commission rules.

Sincerely,

Bryan Hall
Coastal Management Representative

Cc: Tara MacPherson, District Manager, DCM
Amanda Cannon, MHC
Holley Snider, DWR
Gloria Abbotts, LPO
Haley Moccia, LPO

ENCLOSURE

RESTORATION PLAN

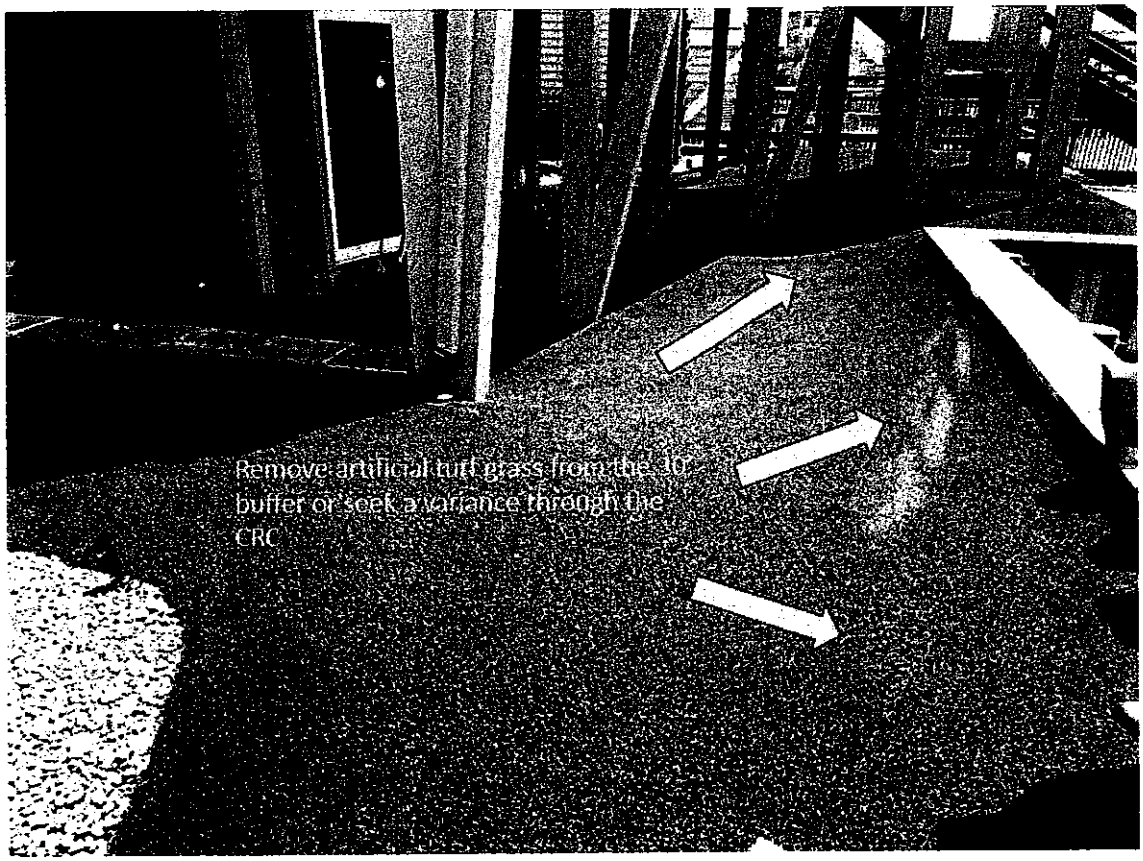
For

Deep Water Management Inc. c/o Kelly Mackay

CAMA Violation No. 23-23D

Property located at 813 Canal Drive, New Hanover County

1. Remove approximately 1,000 sq. ft. of artificial turf grass located within the Estuarine Shoreline 30' buffer.
2. Seek a variance from the CRC to allow for artificial turf grass within the Estuarine Shoreline 30' buffer.



I, Kelly Mackay, on behalf of Deep Water Management Inc. agree to complete this restoration to the satisfaction of the Division of Coastal Management (DCM) by August 28, 2023, or provide an explanation for non-compliance and a reasonable request for time extension. When corrective actions are complete, I will notify the DCM so the work can be inspected.

SIGNATURE: _____

DATE: _____

It is the policy of the Coastal Resources Commission to assess a civil penalty plus investigative costs against all violations. The amount assessed will depend upon several factors, including the nature and area of the resources that were affected and the extent of the damage to them. If restoration is not undertaken or satisfactorily completed, a substantially higher civil assessment will be levied and an injunction sought to require restoration.

North Carolina Department of Environmental Quality | Division of Coastal Management
Wilmington Office | 127 Cardinal Drive Extension | Wilmington, North Carolina 28405
910.796.7215

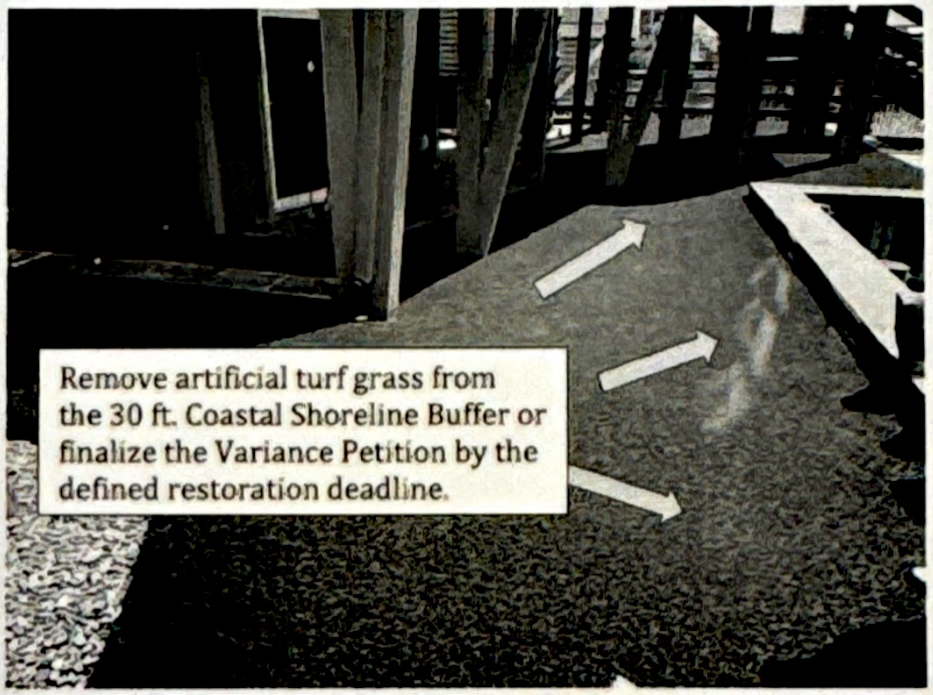
UPDATED RESTORATION PLAN

For
Deep Water Management Inc. c/o Andrew Krichman
CAMA Violation No. 23-23D
Property located at 813 Canal Drive, New Hanover County

1. Remove approximately 1,000 sq. ft. of artificial turf grass located within the Estuarine Shoreline 30' buffer.

OR

2. Proceed with a variance, including updating (if desired) the petitioners positions for the Variance Petition by ~~April 18~~ May 16, 2025, and finalize the agreement on Stipulated Facts and Stipulated Exhibits with DCM by May 14, 2025. These deadlines are in anticipation of a variance hearing at the CRC's June 11-12, 2025 meeting.



I, Andrew Krichman, on behalf of Deep Water Management Inc., agree to complete this restoration to the satisfaction of the Division of Coastal Management (DCM) by May 14, 2025, or provide an explanation for non-compliance and a reasonable request for time extension. When corrective actions are complete, I will notify the DCM so the work can be inspected.

SIGNATURE: _____

DATE: 4/1/25

It is the policy of the Coastal Resources Commission to assess a civil penalty plus investigative costs against all violations. The amount assessed will depend upon several factors, including the nature and area of the resources that were affected and the extent of the damage to them. If restoration is not undertaken or satisfactorily completed, a substantially higher civil assessment will be levied and an injunction sought to require restoration.

JOSH STEIN
Governor
D. REID WILSON
Secretary
TANCRED MILLER
Director

NORTH CAROLINA
Environmental Quality

NOTICE OF VIOLATION and REVISED RESTORATION PLAN
9/8/25

CERTIFIED MAIL 7021 0950 0001 1023 4003
RETURN RECEIPT REQUESTED

Also sent electronically to: andy@krichco.com and krichco@mindspring.com

Deep Water Management Inc. c/o Andrew Krichman
125 S Estes Drive #9400
Chapel Hill, NC 27515

RE: ***CAMA VIOLATION #23-23D***

Dear Mr. Krichman:

This letter is in reference to the July 28, 2023 NOV and April 10, 2024 updated Restoration Plan sent to Deep Water Management Inc regarding the installation of artificial turf grass within the 30' Estuarine Shoreline buffer adjacent to the Carolina Beach Yacht Basin at 813 Canal Drive adjacent to the Carolina Beach Yacht Basin located in Carolina Beach, New Hanover County, North Carolina.

Information gathered by the Division of Coastal Management indicates Deep Water Management Inc. has undertaken or are legally responsible for the installation of artificial turf grass on the aforementioned property. This activity took place in Estuarine Shoreline Area and Estuarine Shoreline 30' buffer that are contiguous with the Carolina Beach Yacht Basin. No CAMA permit was issued to Deep Water Management Inc. for this development. Based on these findings, I initiated an enforcement action by issuing a ***Notice of Violation on July 28, 2023,*** for violation of the Coastal Area Management Act.

Based upon the North Carolina Administrative Code, Title 15A, Subchapter 07H. State Guidelines for Areas of Environmental Concern, the activity undertaken, the installation of unauthorized artificial turf grass within the Estuarine Shoreline AEC and Estuarine Shoreline 30' buffer, is not consistent with Section 15A NCAC 07H .0209(10), which describes the development exceptions allowed within a distance of 30' landward of NHW and Section 15A NCAC 07J .0201 which states *that "Every person wishing to undertake any development in an area of environmental concern shall obtain a permit from the Department".* **Therefore, DCM requested that Deep Water Management Inc. either remove the artificial turf grass from the Estuarine Shoreline 30' buffer or seek a variance from the Coastal Resources Commission (CRC). Please refer to the enclosed updated Restoration Agreement.**

On January 30, 2024, Deep Water Management Inc. submitted a CAMA Minor Permit Application to the Town of Carolina Beach for the installation of artificial turf and associated drainage pipes. The Town of Carolina Beach subsequently issued a permit denial letter dated January 30, 2024. **The Division received a Variance Petition Request on September, 25, 2024 as outlined in the 7/28/23 Restoration Plan, which was signed on 10/17/23 indicating the intent to seek a variance. While you were working towards a hearing at the February 2025 CRC meeting, you and DCM agreed to push past the April 2025 CRC following the CRAC's consideration of the issue of artificial turf in the 30' Buffer. The June meeting was cancelled and you and Ms. Goebel did not agree to facts in time for the August meeting. Restoration is not complete at this time. The new and final timeline, outlined in the new restoration agreement attached with this letter, indicates that if you wish to continue to seek a variance at the next CRC Meeting November 19-20, 2025, the Stipulated Facts and Exhibits must be finalized and agreed upon by yourself and DCM through Ms. Goebel by October 1, 2025. In order to help accomplish meeting the October 1, 2025 fact deadline, please provide edits by email to the most recent version of facts sent by Ms. Goebel on August 22, 2025 by September 12, 2025.**

If you intend to cooperate with my request, please **sign** the attached Restoration Agreements and return it to me in the enclosed, self-addressed envelope within ten (10) days of receipt of this letter. Failure to comply with this request or respond back to this office prior to the requested deadline with an acceptable schedule for compliance will be interpreted as a refusal to cooperate and will result in a Notice of Continuing Violation, as well as a court injunction being sought ordering compliance.

If you have any questions about this or related matters, please contact me (910-796-7266) or Christine Goebel, Assistant General Counsel, at (919) 707-8554. Upon completion of the restoration as requested in the Restoration Plan Agreement to the satisfaction of the Division of Coastal Management, Deep Water Management Inc. will be notified as to the amount of the civil assessment for undertaking development without first obtaining the proper permit(s) and development that is inconsistent with Coastal Resources Commission rules.

Sincerely,

Hannah C. Mitchell
Field Representative

Cc: Tara MacPherson, District Manager
Christine Goebel, DCM counsel
Michael Mellinger, DWR
Gloria Abbotts, LPO
Haley Moccia, LPO

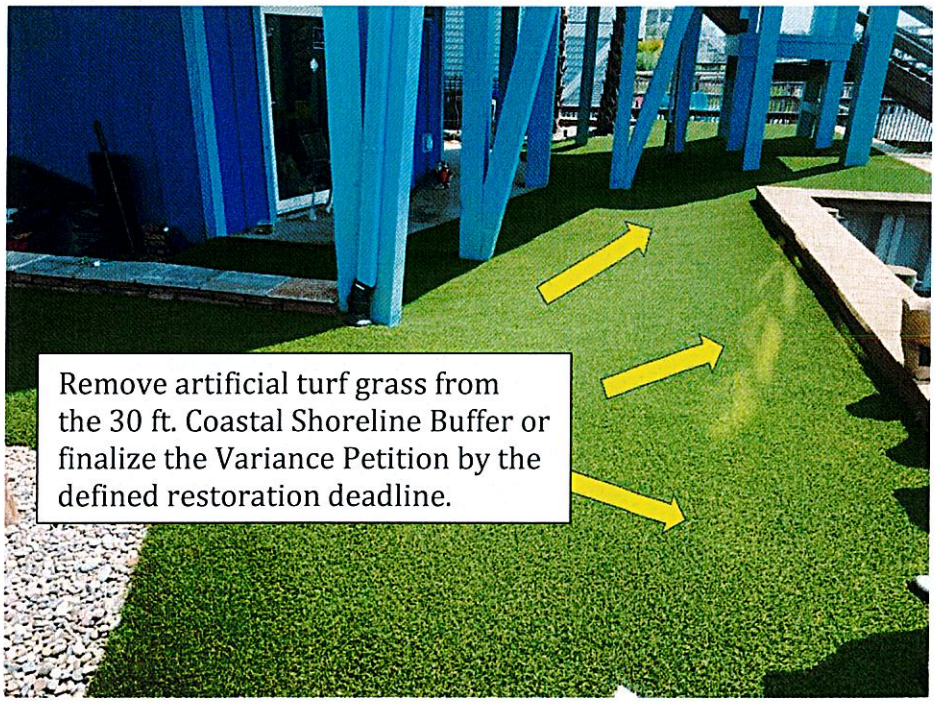
ENCLOSURE

UPDATED RESTORATION PLAN
For
Deep Water Management Inc. c/o Andrew Krichman
CAMA Violation No. 23-23D
Property located at 813 Canal Drive, New Hanover County

1. Remove approximately 1,000 sq. ft. of artificial turf grass located within the Estuarine Shoreline 30' buffer.

OR

2. Proceed with a variance, including updating (if desired) the petitioner's positions for the Variance Petition by September 15, 2025, and finalizing the agreement on Stipulated Facts and Stipulated Exhibits with DCM by October 1, 2025. Provide written edits of the August 22, 2025, version by email to Ms. Goebel by September 12, 2025. These deadlines are in anticipation of a variance hearing at the CRC's November 19-20, 2025, meeting.



I, Andrew Krichman, on behalf of Deep Water Management Inc., agree to complete this restoration to the satisfaction of the Division of Coastal Management (DCM) by **October 1, 2025**, or provide an explanation for non-compliance and a reasonable request for time extension. When corrective actions are complete, I will notify the DCM so the work can be inspected.

SIGNATURE: _____

DATE: _____

It is the policy of the Coastal Resources Commission to assess a civil penalty plus investigative costs against all violations. The amount assessed will depend upon several factors, including the nature and area of the resources that were affected and the extent of the damage to them. If restoration is not undertaken or satisfactorily completed, a substantially higher civil assessment will be levied and an injunction sought to require restoration.

UPDATED RESTORATION PLAN

For

Deep Water Management Inc. c/o Andrew Krichman

CAMA Violation No. 23-23D

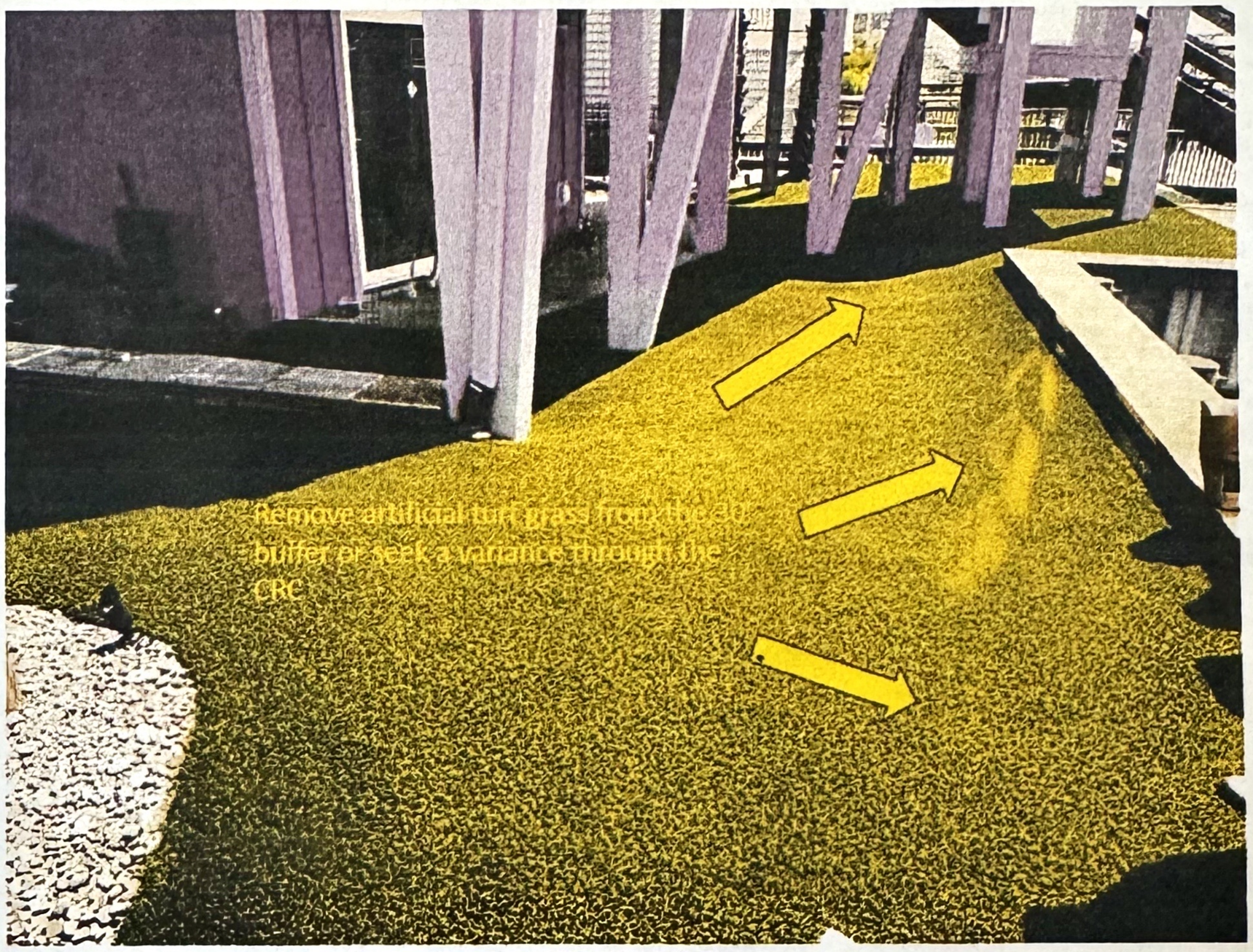
Property located at 813 Canal Drive, New Hanover County

---

1. Remove approximately 1,000 sq. ft. of artificial turf grass located within the Estuarine Shoreline 30' buffer.

or

2. Seek a Variance Petition from the CRC to be heard at either the August 28, 2024 or the November 14, 2024 meeting to regarding the installation of artificial turf grass within the Estuarine Shoreline 30' buffer.



I, Andrew Krichman, on behalf of Deep Water Management Inc. agree to complete this restoration to the satisfaction of the Division of Coastal Management (DCM) by November 14, 2024, or provide an explanation for non-compliance and a reasonable request for time extension. When corrective actions are complete, I will notify the DCM so the work can be inspected.

SIGNATURE: _____

DATE: 5/10/24

It is the policy of the Coastal Resources Commission to assess a civil penalty plus investigative costs against all violations. The amount assessed will depend upon several factors, including the nature and area of the resources that were affected and the extent of the damage to them. If restoration is not undertaken or satisfactorily completed, a substantially higher civil assessment will be levied and an injunction sought to require restoration.

North Carolina Department of Environmental Quality | Division of Coastal Management
Wilmington Office | 127 Cardinal Drive Extension | Wilmington, North Carolina 28405
910.796.7215

SITE DRAWING/APPLICATION CHECKLIST

Please make sure your site drawing includes the following information required for a CAMA minor development permit. The Local Permit Officer will help you, if requested.

PHYSICAL DIMENSIONS

_____ Label roads
_____ Label highways right-of-ways
_____ Label local setback lines
_____ Label any and all structures and driveways currently existing on property
_____ Label adjacent waterbody

PHYSICAL CHARACTERISTICS

_____ Draw and label normal high water line (contact LPO for assistance)
_____ Draw location of on-site wastewater system

If you will be working in the ocean hazard area:
_____ Draw and label dune ridges (include spot elevations)
_____ Draw and label toe of dunes
_____ Identify and locate first line of stable vegetation (contact LPO for assistance)
_____ Draw and label erosion setback line (contact LPO for assistance)
_____ Draw and label topographical features (optional)

If you will be working in a coastal shoreline area:
_____ Show the roof overhang as a dotted line around the structure
_____ Draw and label landward limit of AEC
_____ Draw and label all wetland lines (contact LPO for assistance)
_____ Draw and label the 30-foot buffer line

DEVELOPMENT PLANS

_____ Draw and label all proposed structures
_____ Draw and label areas that will be disturbed and/or landscaped
_____ Note size of piling and depth to be placed in ground
_____ Draw and label all areas to be paved or graveled
_____ Show all areas to be disturbed
_____ Show landscaping

NOTE TO APPLICANT

Have you:

- completed all blanks and/or indicated if not applicable?
- notified and listed adjacent property owners?
- included your site drawing?
- signed and dated the application?
- enclosed the $100.00 fee?
- completed an AEC Hazard Notice, if necessary? (Must be signed by the property owner)

FOR STAFF USE

Site Notice Posted _____ Final Inspection _____ Fee Received _____

Site Inspections

_____ _____
_____ _____
_____ _____

Date of Action: Issued _____ Exempted _____ Denied _____ Appeal Deadline (20 days from permit action) _____

Coastal Management
ENVIRONMENTAL QUALITY

APPLICATION FOR

CAMA MINOR DEVELOPMENT PERMIT

In 1974, the North Carolina General Assembly passed the Coastal Area Management Act (CAMA) and set the stage for guiding development in fragile and productive areas that border the state's sounds and oceanfront. Along with requiring special care by those who build and develop, the General Assembly directed the Coastal Resources Commission (CRC) to implement clear regulations that minimize the burden on the applicant.

This application for a minor development permit under CAMA is part of the Commission's effort to meet the spirit and intent of the General Assembly. It has been designed to be straightforward and require no more time or effort than necessary from the applicant. Please go over this folder with the Local Permit Officer (LPO) for the locality in which you plan to build to be certain that you understand what information he or she needs before you apply.

Under CAMA regulations, the minor permit is to be issued within 25 days once a complete application is in hand. Often less time is needed if the project is simple. The process generally takes about 18 days. You can speed the approval process by making certain that your application is complete and signed, that your drawing meets the specifications given inside and that your application fee is attached.

Other permits are sometimes required for development in the coastal area. While these are not CAMA-related, we urge you to check with the Local Permit Officer to determine which of these you may need. A list is included on page two of this folder.

We appreciate your cooperation with the North Carolina Coastal Management Program and your willingness to build in a way that protects the resources of our beautiful and productive coast.

Coastal Resources Commission
Division of Coastal Management

APPLICATION: 27-23CB

LOCALITY: Town of Carolina Beach

PERMIT ISSUED USING STATIC LINE EXCEPTION?
YES ☐ NO ☒

Locality Town of Carolina Beach Permit Number 27-23CB

Ocean Hazard ____ Estuarine Shoreline X ORW Shoreline ____ Public Trust Shoreline ____ Other ____

(For official use only)

GENERAL INFORMATION

LAND OWNER - MAILING ADDRESS

Name Deep Water Management

Address PO Box 9400

City Chapel Hill State NC Zip 27515 Phone 919 801-0083

Email Andy@Krichco.com

AUTHORIZED AGENT

Name Andy Krichman

Address 813 Canal Dr.

City Carolina Beach State NC Zip 28428 Phone 919 801-0083

Email Andy@Krichco.com

LOCATION OF PROJECT: (Address, street name and/or directions to site; name of the adjacent waterbody.)

813 Canal Dr Carolina Beach

DESCRIPTION OF PROJECT: (List all proposed construction and land disturbance.) Install drainage pipes with pervious artificial turf designed for proximity to wetlands application and fastned beyond manufacturers recommendations.

SIZE OF LOT/PARCEL: ____ square feet ____ acres

PROPOSED USE: Residential ☑ (Single-family ☐ Multi-family ☐) Commercial/Industrial ☐ Other ☐

COMPLETE EITHER (1) OR (2) BELOW (***Contact your Local Permit Officer if you are not sure which AEC applies to your property***)**:**

(1) OCEAN HAZARD AECs: TOTAL FLOOR AREA OF PROPOSED STRUCTURE: 0 square feet (includes air conditioned living space, parking elevated above ground level, non-conditioned space elevated above ground level but excluding non-load-bearing attic space)

(2) COASTAL SHORELINE AECs: SIZE OF BUILDING FOOTPRINT AND OTHER IMPERVIOUS OR BUILT UPON SURFACES: ____ square feet (includes the area of the foundation of all buildings, driveways, covered decks, concrete or masonry patios, etc. that are within the applicable AEC. Attach your calculations with the project drawing.)

STATE STORMWATER MANAGEMENT PERMIT: Is the project located in an area subject to a State Stormwater Management Permit issued by the NC Division of Energy, Mineral and Land Resources (DEMLR)?

YES____ NO____

If yes, list the total built upon area/impervious surface allowed for your lot or parcel: ____ square feet.

OTHER PERMITS MAY BE REQUIRED: The activity you are planning may require permits other than the CAMA minor development permit, including, but not limited to: Drinking Water Well, Septic Tank (or other sanitary waste treatment system), Building, Electrical, Plumbing, Heating and Air Conditioning, Insulation and Energy Conservation, FIA Certification, Sand Dnne, Sediment Control, Subdivision Approval, Mobile Home Park Approval, Highway Connection, and others. Check with your Local Permit Officer for more information.

STATEMENT OF OWNERSHIP:

I, the undersigned, an applicant for a CAMA minor development permit, being either the owner of property in an AEC or a person authorized to act as an agent for purposes of applying for a CAMA minor development permit, certify that the person listed as landowner on this application has a significant interest in the real property described therein. This interest can be described as: (check one)

✓ an owner or record title, Title is vested in name of Deep Water Management, see Deed Book ____ page ____ in the ____ County Registry of Deeds.

____ an owner by virtue of inheritance. Applicant is an heir to the estate of ____; probate was in ____ County.

____ if other interest, such as written contract or lease, explain below or use a separate sheet & attach to this application.

NOTIFICATION OF ADJACENT RIPARIAN PROPERTY OWNERS:

I furthermore certify that the following persons are owners of properties adjoining this property. I affirm that I have given **ACTUAL NOTICE** to each of them concerning my intent to develop this property and to apply for a CAMA permit.

	(Name)	(Address)
(1)	Paul Groff	815 Canal Dr.
(2)	Eric Smith	811 Canal Dr.
(3)		
(4)		

ACKNOWLEDGEMENTS:

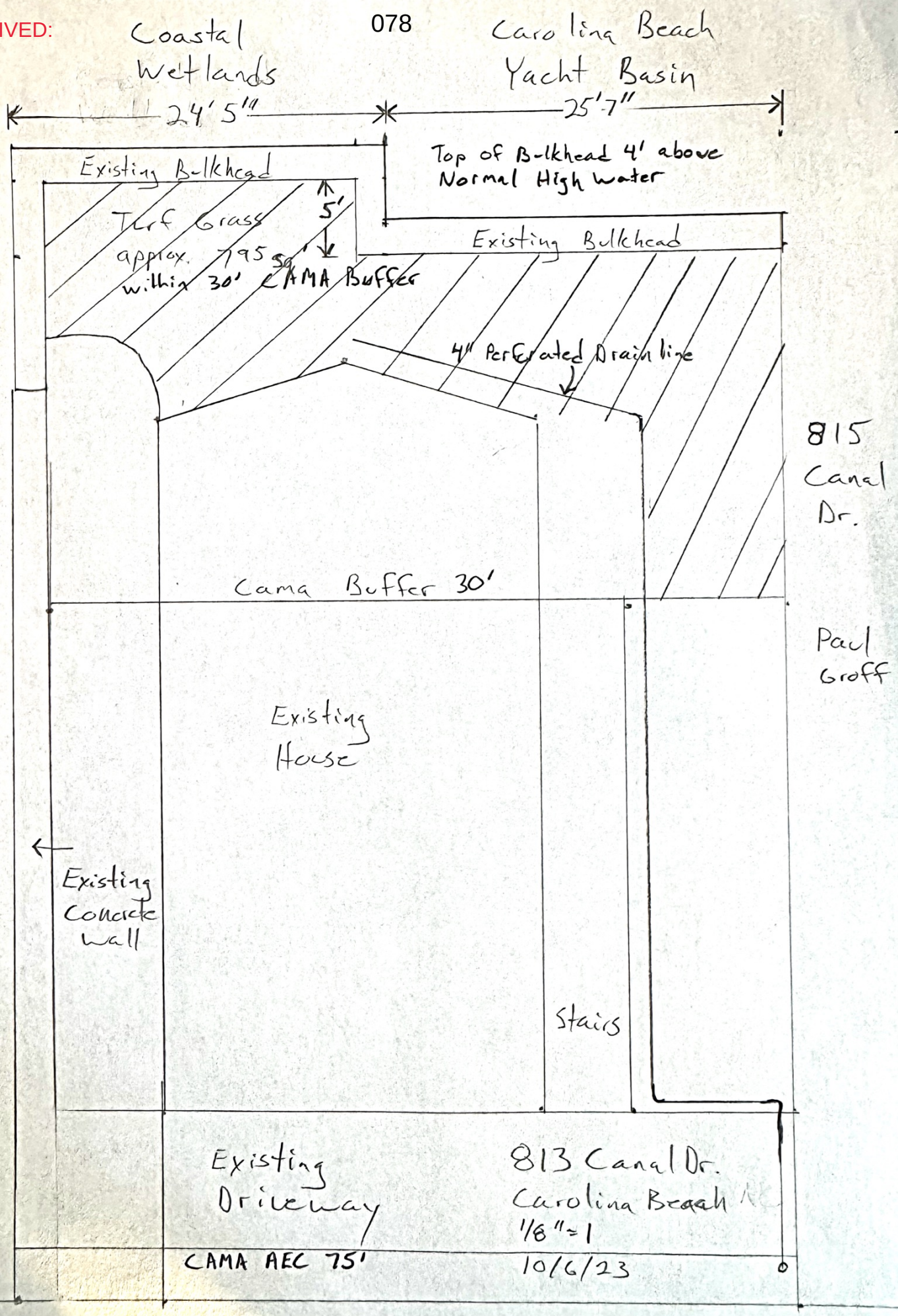
I, the undersigned, acknowledge that the land owner is aware that the proposed development is planned for an area which may be susceptible to erosion and/or flooding. I acknowledge that the Local Permit Officer has explained to me the particular hazard problems associated with this lot. This explanation was accompanied by recommendations concerning stabilization and floodproofing techniques.

I furthermore certify that I am authorized to grant, and do in fact grant, permission to Division of Coastal Management staff, the Local Permit Officer and their agents to enter on the aforementioned lands in connection with evaluating information related to this permit application.

This the 14th day of Sept., 2023

Landowner or person authorized to act as his/her agent for purpose of filing a CAMA permit application

This application includes: *general information (this form), a site drawing as described on the back of this application, the ownership statement, the Ocean Hazard AEC Notice where necessary, a check for $100.00 made payable to the locality, and any information as may be provided orally by the applicant. The details of the application as described by these sources are incorporated without reference in any permit which may be issued. Deviation from these details will constitute a violation of any permit. Any person developing in an AEC without permit is subject to civil, criminal and administrative action.*



AGENT AUTHORIZATION FOR CAMA PERMIT APPLICATION

Name of Property Owner Applying for Permit: Deep Water Management

Mailing address: PO Box 9400

Chapel Hill NC 27515

Phone Number: 919-801-0083

I certify that I have authorized Andy Krichman, Krichco Construction
Agent / Contractor

to act on my behalf, for the purpose of applying and obtaining all CAMA permits necessary for the proposed development of any work necessary for 613 Canal Dr.

at my property located at 613 Canal Dr. Carolina Beach, NC

in New Hanover County.

This certification is valid through 12/31/2034
Date

(Property Owner Information)

Signature

Andrew C Krichman
Print or Type Name

President
Title

10/6/23
Date

919-801-0083
Phone Number

Andy@Krichco.com
Email Address

N.C. DIVISION OF COASTAL MANAGEMENT
ADJACENT RIPARIAN PROPERTY OWNER NOTIFICATION (MINOR PERMIT)
CERTIFIED MAIL, RETURN RECEIPT REQUESTED or HAND DELIVERED

10/6/23
Date

Paul Groff
Name of Adjacent Riparian Property Owner
7041 Ebenezer Church Rd.
Address
Raleigh NC 27612
City, State Zip

To Whom It May Concern:

This correspondence is to notify you as a riparian property owner that I am applying for a CAMA Minor permit to have 100% recyclable, 1000 inch/hr. permeable artificial turf on my property at 813 Canal Dr., in New Hanover County, which is adjacent to your property. **A copy of the application and project drawing is attached/enclosed for your review.**

If you have no objections to the proposed activity, please mark the appropriate statement below and return to me as soon as possible. If no comments are received within 10 days of receipt of this notice, it will be considered that you have no comments or objections regarding this project.

If you have objections or comments, please mark the appropriate statement below and send your correspondence to: (Gloria Abbotts, Town of Carolina Beach, 1121 N Lake Park Blvd, Town of Carolina Beach, NC, 28428)

If you have any questions about the project, please do not hesitate to contact me at my address/number listed below, or contact (Gloria Abbotts) at (910-458-8380), or by email at: (gloria.abbotts@carolinabeach.org).

Sincerely,

Andy Krichman
Property Owner's Name

919-801-0083
Telephone Number

813 Canal Dr. Carolina Beach NC 28428
Address City State Zip

X I have no objection to the project described in this correspondence.
____ I have objection(s) to the project described in this correspondence.

Paul W Groff
Adjacent Riparian Signature

10/20/23
Date

Paul Groff
Print or Type Name

919 623-3984
Telephone Number

Address 815 Canal Drive City Carolina Beach State NC Zip 28428

Revised July 2021

N.C. DIVISION OF COASTAL MANAGEMENT
ADJACENT RIPARIAN PROPERTY OWNER NOTIFICATION (MINOR PERMIT)
CERTIFIED MAIL, RETURN RECEIPT REQUESTED or HAND DELIVERED

10/6/23
Date

Eric Smith
Name of Adjacent Riparian Property Owner
301 Kingsport Rd. Ste
Address
Holly Springs NC 27540
City, State Zip

To Whom It May Concern:

This correspondence is to notify you as a riparian property owner that I am applying for a CAMA Minor permit to have 100% recyclable, 1000 inch/hr. permeable artificial turf on my property at 613 Canal Dr., in New Hanover County, which is adjacent to your property. **A copy of the application and project drawing is attached/enclosed for your review.**

If you have no objections to the proposed activity, please mark the appropriate statement below and return to me as soon as possible. If no comments are received within 10 days of receipt of this notice, it will be considered that you have no comments or objections regarding this project.

If you have objections or comments, please mark the appropriate statement below and send your correspondence to: (Gloria Abbotts, Town of Carolina Beach, 1121 N Lake Park Blvd, Town of Carolina Beach, NC, 28428)

If you have any questions about the project, please do not hesitate to contact me at my address/number listed below, or contact (Gloria Abbotts) at (910-458-8380), or by email at: (gloria.abbotts@carolinabeach.org).

Sincerely,

Andy Krichman
Property Owner's Name

919-801-0083
Telephone Number

Address City State Zip

✓ I have no objection to the project described in this correspondence.
_____ I have objection(s) to the project described in this correspondence.

Adjacent Riparian Signature

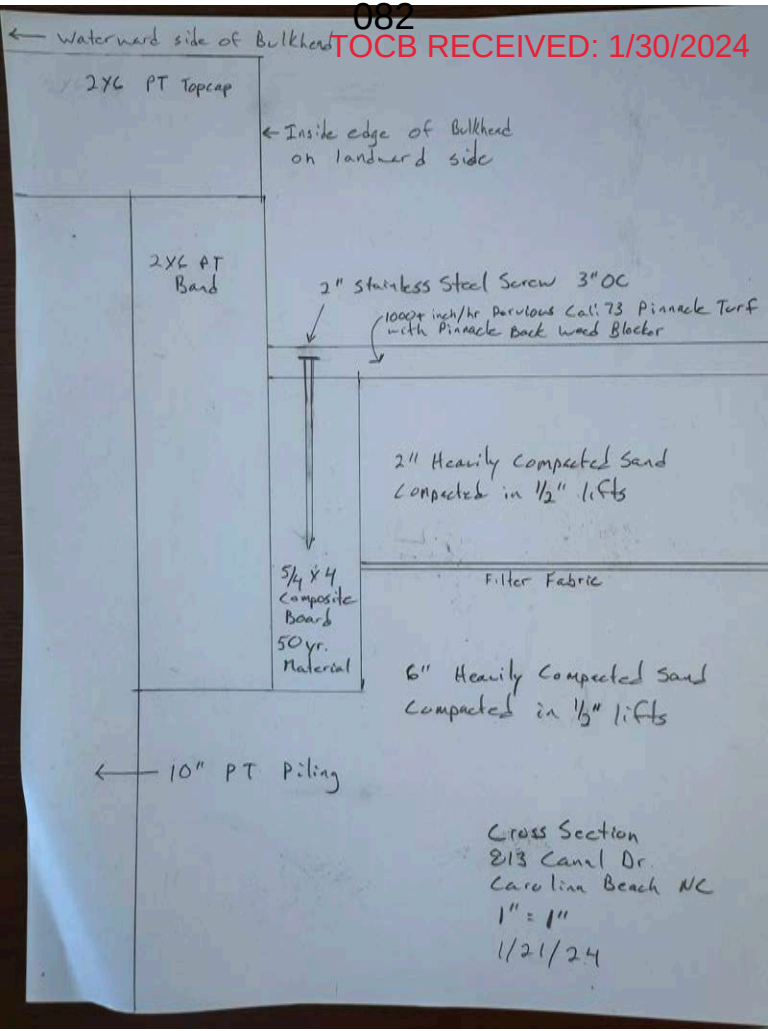
06 Oct 2023
Date

Eric T. Smith
Print or Type Name

(202) 253-1559
Telephone Number

Address City State Zip

Revised July



Cross Section
813 Canal Dr.
Carolina Beach NC
1" = 1"
1/21/24

www.testingservices-usa.com ▪ (706)226-1400
office@testingservices-usa.com

TOCB RECEIVED: 1/23/2024

CLIENT:

Company:	ProGlobal Products
Address:	PO Box 1432
	Dalton, GA 30722
Requested By:	Forrest Jaquith

TEST MATERIAL:

Date Material Received:	October 23, 2020
Material Type:	Synthetic Turf
Material Condition:	Excellent, New
Material ID:	60 oz
Infill:	None

TESTING METHODS REQUESTED:

Testing Services Inc. was instructed by the client to test for the following…			
Standard:	ASTM F1551	Test Method:	Standard Test Methods for Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials: Suffix-DIN 18-035, Part 6: Water Permeability of Synthetic Turf Systems and Permeable Bases

SAMPLING PLAN:

Sampling Date:	10/23/2020

- Specimen sampling is performed in the sampling department at TSI.
- The sampling size of specimens is determined by the test method requirements.
- In the event a specific sampling size is not called for, a determination will be made based on previous testing experience, and approved for use by an authorized manager.
- All samples are subjected to the outside environmental conditions of temperature and relative humidly.
- Sample requiring pre-determined exposure to specified environmental conditions based on a specific test method, take place in the departments in which they are tested

DEVIATION FROM TEST METHOD:

State reason for any Deviation from, Additions to, or Exclusions From Test Method.
None

PROCEDURE: This test method determines the rainfall drainage capacity (permeability) of the playing surface. Test data values represent drainage rates vertically thru the turf only, and do not take into account the percolation properties of an infill, pad and/or an underlying sub base. Three specimens, 11.5" diameter, were cut from the 15' turf roll, side-center-side manner. Each turf specimen was securely fastened to the permeability tube using mechanical flanges, ensuring vertical water flow thru the product. Water was pumped into the tube faster than could exit, until the water level reached 6". The water source was shut off, allowing the accumulated 6" water level to recede. The recede was timed via stopwatch until the water level exited the turf. The flow time was recorded in seconds. This procedure was repeated a total of 4 times where, the first pass was for conditioning, with passes 2,3,4 used for averaging. This process was repeated on the remaining specimens.

DEVIATION FROM TEST METHOD:

State reason for any Deviation from, Additions to, or Exclusions From Test Method.
None

TEST SUMMARY:

Specimen #	Drainage (Seconds)	gal/min/yd²	Rainfall Capacity (inches/hour)
1	4.7	430.1	1319.6
2	4.1	491.1	1506.7
3	4.3	474.2	1454.8
Average	4.4	465.1	1422.5

Uncertainty:
We undertake all assignments for our clients on a best effort basis. Our findings and judgments are based on the information to us using the latest test methods available.
TSI can only ensure the test results for the specific items tested.
Unless otherwise noted in the deviations sections of this report, all tests are performed in compliance with stated test method.

Test Report Approval:

Erle Miles, III, Lab Director Testing Services (TSI) LLC

TSi Accreditation: TSi is a certified independent testing laboratory by the STC (Synthetic Turf Council).

Testing Services (TSI) LLC
817 Showalter Avenue
PO Box 1343
Dalton, GA 30721

TAILOR MADE GRASS

LIMITED 15 YEAR LANDSCAPE WARRANTY

WARRANTY PERIOD

This Warranty shall be in force and remain in effect for a period of fifteen (15) years beginning on the date of invoice ("Effective Date") and, except as otherwise provided, covers North America including the United States and Canada.

WARRANTY

1. All synthetic turf is subject to normal wear and tear. Normal wear and tear are not a manufacturing defect and is not covered by this warranty.
2. Pile Retention Limited Warranty: Tailor Made Grass warrants that the Product will retain at least 50% of its pile fiber when:
   a. when properly installed by an installer who originally purchased the material from Tailor Made Grass;
   and
3. Proration of Warranty. Years 1-8 (100% product replacement), Years 9-15 (10%)

LIMITATIONS AND EXCLUSIONS TO THIS WARRANTY.

1. Purchaser may make a one-time transfer of this warranty to the owner of the project in the product(s) were installed. No further transfer, conveyance, or assignment of all or any rights under this warranty are permitted without prior written consent from Tailor Made Grass. Any such transfer or assignment without prior written consent shall void this warranty.
2. This Warranty covers first quality Products only, and is not applicable to Products sold as seconds, closeouts or irregulars.

3. This Warranty does not apply to product installed with known visual defects. Installer must notify manufacturer prior to installation of known problem else warranty will be void.
4. This Warranty specifically excludes defects or damages caused by:
   a. improper installation, joining of seams or repairs;
   b. Burns, cuts, accidents, vandalism, abuse, negligence, or neglect;
   c. Improper design or failure of the sub-base of the sports field, golf green, court, or lawn;
   d. Wear or abrasion caused by inadequate sub-base;
   e. Wear or abrasion under swing sets, slides, and other high friction play equipment;
   f. Wear or abrasion on high friction areas of field;
   g. Wear due to lack of infill/no infill;
   h. Shrinking or melting of fibers due to reflection or other sources of extreme heat;
   i. Texture variation of fibers (sub-pile/thatch products);
   j. Expansion / Contraction of product due to lack of infill, improper securing of edges;
   k. Use of infill products of an incorrect grade resulting in seam ruptures;
   l. Failure to maintain infill products at the correct level of 50% of pile height or otherwise noted on product specification sheets;
   m. Use of inappropriate footwear or sports equipment (or lack of footwear);
   n. Use of chemicals, herbicides, pesticides (unless approved by yarn manufacturer in writing)
   o. Use of improper cleaning methods
   p. Loss of tuft bind / fiber loss due to chemical and/or gas spills and leaks (includes leaks
   from equipment driven or used on turf surfaces);
   q. Wear / Fiber loss due to animals / animal traffic;
   r. Any harmful chemical reaction to the product caused by infill materials
   s. Acts of God or other conditions beyond the reasonable control of Purchaser or Tailor Made Grass;
   t. Post fibrillation after or during installation for purposes other than to get infill materials in place;
   u. Failure to install seams, lines, logos properly;
   v. Failure to properly maintain / repair seams, lines, logos;
   w. Packing, matting, or roll crush marks of Products as these are inherent characteristics of Products manufactured using polypropylene/olefin and nylon fibers;
   x. Product damage occurring during the shipping/transportation process. All shipping claims must be filed against the truck line in question, a signed BOL must me noted with any shipping defects at time of delivery / pickup;
   aa. Heat / temperatures of turf surface due to sources of natural

environment, including sunshine, high air temperatures, and underlayment pad products.

NO EXPRESS OR IMPLIED WARRANTIES

LIMITATIONS ON LIABILITY

Tailor Made Grass' sole liability for any and all damages resulting from any cause whatsoever, whether based in contract, negligence, strict liability, other torts, or otherwise shall be limited to the original price of the Product.
IN NO EVENT SHALL TAILOR MADE GRASS BE LIABLE FOR LOST PROFITS OR REVENUES, LOSS OF USE OR SIMILAR ECONOMIC LOSS, OR FOR INDIRECT SPECIAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR SIMILAR DAMAGES ARISING OUT OF OR IN CONNECTION WITH SUCH CAUSE.

PURCHASER'S OBLIGATION TO INSPECT UPON DELIVERY

Purchaser must promptly inspect all Products upon delivery and notify Tailor Made Grass in writing of any defects, shortages or non-conformities within 30 days of the date of delivery ("Delivery Date"). Notwithstanding anything herein to the contrary, if Purchaser fails to promptly inspect and identify any Product defects, shortages, or non-conformities which are discoverable by inspection within 30 days of the Delivery Date, Purchaser shall be deemed to have accepted the Products as is and Tailor Made Grass shall have no obligations and/or liability with respect to such defects, shortages.

MODIFICATION

THIS WARRANTY CONSTITUTES THE FINAL AND EXCLUSIVE WARRANTY TERMS FOR THE PRODUCTS AND MAY NOT BE MODIFIED EXCEPT BY AN OFFICER OF Tailor Made Grass.

GOVERNING LAW

This Warranty and its terms and conditions shall be exclusively governed by the laws of the State of Georgia without regard to its conflicts of law provisions. Purchaser agrees that the exclusive venue for any action pertaining to transactions between the Company and Tailor Made Grass shall be the Superior

Court of Murray County, Georgia Purchaser hereby waives all personal jurisdiction defenses with respect to said venue.

Town of Carolina Beach
Misc. Payment
Payment Date: 10/23/2023
Reprint Date: 10/23/2023

CUSTOMER NAME & DESC. OF PAYMENT
ANDY KRICHMAN

CAMA PERMIT 813 CANAL

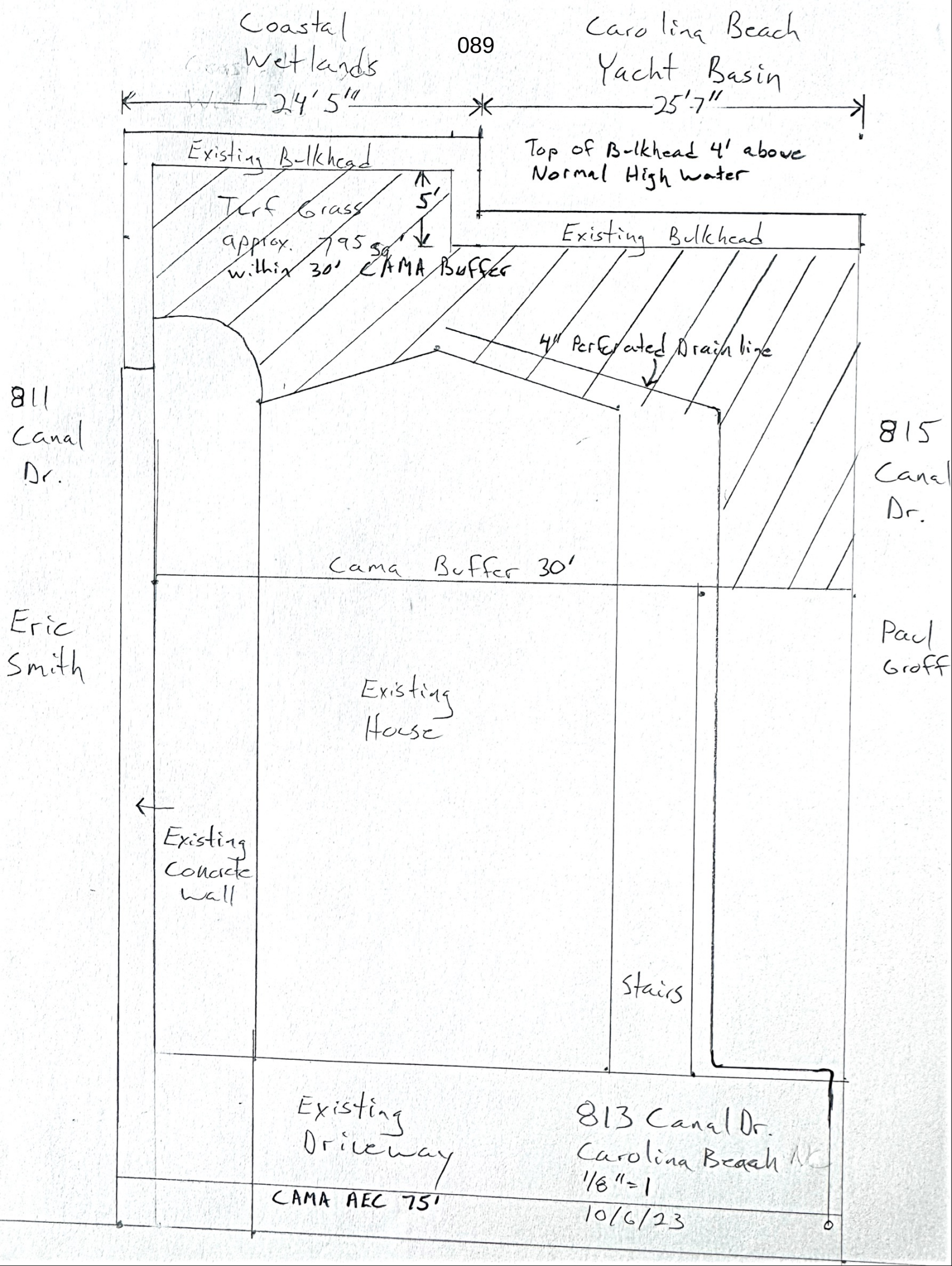
Cash:	$0.00
Check:	$0.00
Charge:	$103.00
MoneyOrder:	$0.00
Total Fee:	$103.00
TOTAL PAID:	$103.00
Change Due:	$0.00

Details:

CC SUR CHRG	$3.00
PP	$100.00

Operator: 76
Receipt#: 426196

THANK YOU!


Coastal Wetlands
Carolina Beach Yacht Basin
24' 5"
25'-7"
Existing Bulkhead
Top of Bulkhead 4' above Normal High Water
Turf Grass
5'
approx. 795 sq
within 30' CAMA Buffer
Existing Bulkhead
4" Perforated Drain line
811 Canal Dr.
815 Canal Dr.
Cama Buffer 30'
Eric Smith
Paul Groff
Existing House
Existing Concrete wall
Stairs
Existing Driveway
813 Canal Dr.
Carolina Beach NC
1/8"=1
10/6/23
CAMA AEC 75'

N.C. DIVISION OF COASTAL MANAGEMENT
ADJACENT RIPARIAN PROPERTY OWNER NOTIFICATION (MINOR PERMIT)
CERTIFIED MAIL, RETURN RECEIPT REQUESTED or HAND DELIVERED

10/6/23
Date

Eric Smith
Name of Adjacent Riparian Property Owner
301 Kingsport Rd. Ste
Address
Holly Springs NC 27540
City, State Zip

To Whom It May Concern:

This correspondence is to notify you as a riparian property owner that I am applying for a CAMA Minor permit to have 100% recyclable, 1000 inch/hr. permeable artificial turf on my property at 613 Canal Dr., in New Hanover County, which is adjacent to your property. **A copy of the application and project drawing is attached/enclosed for your review.**

If you have no objections to the proposed activity, please mark the appropriate statement below and return to me as soon as possible. If no comments are received within 10 days of receipt of this notice, it will be considered that you have no comments or objections regarding this project.

If you have objections or comments, please mark the appropriate statement below and send your correspondence to: (Gloria Abbotts, Town of Carolina Beach, 1121 N Lake Park Blvd, Town of Carolina Beach, NC, 28428)

If you have any questions about the project, please do not hesitate to contact me at my address/number listed below, or contact (Gloria Abbotts) at (910-458-8380), or by email at: (gloria.abbotts@carolinabeach.org).

Sincerely,

Andy Krichman
Property Owner's Name

919-801-0083
Telephone Number

Address City State Zip

✓ I have no objection to the project described in this correspondence.
_____ I have objection(s) to the project described in this correspondence.

Adjacent Riparian Signature

06 Oct 2023
Date

Eric T. Smith
Print or Type Name

(202) 253-1559
Telephone Number

Address City State Zip

N.C. DIVISION OF COASTAL MANAGEMENT
ADJACENT RIPARIAN PROPERTY OWNER NOTIFICATION (MINOR PERMIT)
CERTIFIED MAIL, RETURN RECEIPT REQUESTED or HAND DELIVERED

10/6/23
Date

Paul Groff
Name of Adjacent Riparian Property Owner
7041 Ebenezer Church Rd.
Address
Raleigh NC 27612
City, State Zip

To Whom It May Concern:

This correspondence is to notify you as a riparian property owner that I am applying for a CAMA Minor permit to have 100% recyclable, 1000 inch/hr. permeable artificial turf on my property at 813 Canal Dr., in New Hanover County, which is adjacent to your property. **A copy of the application and project drawing is attached/enclosed for your review.**

If you have no objections to the proposed activity, please mark the appropriate statement below and return to me as soon as possible. If no comments are received within 10 days of receipt of this notice, it will be considered that you have no comments or objections regarding this project.

If you have objections or comments, please mark the appropriate statement below and send your correspondence to: (Gloria Abbotts, Town of Carolina Beach, 1121 N Lake Park Blvd, Town of Carolina Beach, NC, 28428)

If you have any questions about the project, please do not hesitate to contact me at my address/number listed below, or contact (Gloria Abbotts) at (910-458-8380), or by email at: (gloria.abbotts@carolinabeach.org).

Sincerely,

Andy Krichman
Property Owner's Name

919-801-0083
Telephone Number

813 Canal Dr. Carolina Beach NC 28428
Address City State Zip

X I have no objection to the project described in this correspondence.
____ I have objection(s) to the project described in this correspondence.

Paul W Groff
Adjacent Riparian Signature

10/20/23
Date

Paul Groff
Print or Type Name

919 623-3984
Telephone Number

Address 815 Canal Drive City Carolina Beach State NC Zip 28428

Revised July 2021

Town of Carolina Beach
1121 N. Lake Park Blvd.
Carolina Beach, NC 28428
Tel: (910) 458-2999
Fax: (910) 458-2997

1/30/2024

CERTIFIED MAIL- 7022 3330 0001 6487 5339
RETURN RECEIPT REQUESTED

Electronic Delivery to: **krichco@mindspring.com**

***Deep Water Management Inc. c/o* Kelly MacKay (Registered Agent)**
P.O.BOX 51549 Durham, NC 27717

RE: DENIAL OF CAMA MINOR DEVELOPMENT PERMIT
APPLICATION NUMBER: ***27-23CB***
PROJECT ADDRESS: 813 Canal Dr, Carolina Beach NC 28428

Dear Ms. MacKay:

After reviewing Deep Water Management Inc.'s application, which was determined to be complete on 1/30/2024, the **Town of Carolina Beach** has determined that no permit may be granted for the proposed development.

Deep Water Management Inc. has applied to install artificial turf grass and an associated 4" drainage pipe within 30 ft. of Normal or Mean high water, which is inconsistent with the following rules of the N.C. Coastal Resources Commission, and/or the following provisions of the N.C. Coastal Area Management Act or N.C. Dredge and Fill Act:

Section 15A NCAC 07H .0209(10), which describes the development exceptions allowed within a distance of 30' landward of Normal High Water, specifically 15A NCAC 07H .0209(10)(G).

Given the preceding findings, it is necessary that the request for issuance of a CAMA Minor Permit under the Coastal Area Management Act be denied. This denial is made pursuant to N.C.G.S. 113A-120(a)(8), which requires denial for projects inconsistent with the state guidelines for Areas of Environmental Concern or a local land use plan.

If Deep Water Management Inc. wishes to appeal this denial, they are entitled to a contested case hearing. The hearing will involve appearing before an Administrative Law Judge who listens to the evidence and arguments of both parties before making a final decision on the appeal. The request for a hearing must be in the form of a written

petition, complying with the requirements of §150B of the General Statutes of North Carolina, and must be filed with the Office of Administrative Hearings, 6714 Mail Service Center, Raleigh, NC 27699-6714, within twenty (20) days from the date of this denial letter. The requirements for filing a contested case can be found at http://www.oah.state.nc.us/hearings. Although OAH cannot give legal advice, any questions regarding this process should be directed to OAH at 6714 Mail Service Center, Raleigh, NC 27699-6714 or via telephone at 919-431-3000, including questions regarding the filing fee (if a filing fee is required) and/or the details of the filing process.

A copy of Deep Water Management Inc.'s petition filed at OAH must be served on with DEQ's agent for service of process at the following address:

William F. Lane, General Counsel
Dept. of Environmental Quality
1601 Mail Service Center Raleigh, NC 27699-1601

Please also send a copy of the petition to the attention of Tancred Miller, Director, N.C. Division of Coastal Management, 400 Commerce Avenue, Morehead City, NC 28557, so that the petition may be forwarded to the attorney who will be representing the Respondent in the contested case proceeding.

In the alternative, Deep Water Management Inc. may petition the N.C. Coastal Resources Commission for a variance to undertake development that is prohibited by the Commission's rules (Note- a Commission variance cannot be granted if Deep Water Management Inc.'s project was denied due to an inconsistency with a CAMA Land Use Plan or other statutory provisions of the CAMA or NC D&F Law). Applying for a variance requires that they first stipulate that the Division of Coastal Management applied the Rules properly in issuing this denial. Applying for a variance means that Deep Water Management Inc. agrees that the legal restrictions are valid but request an exception to the restrictions because of hardships resulting from unusual conditions of the property. In seeking a variance, Deep Water Management Inc. is requesting that the Commission vary the rules at issue, and must state how they believe the request meets the four criteria found at N.C.G.S. § 113A-120.1. To apply for a variance, Deep Water Management Inc. must file a petition for a variance with the Director of the Division of Coastal Management and the State Attorney General's Office on a standard form, which must be accompanied by additional information on the nature of the project and the reasons for requesting a variance. The variance request may be filed at any time but must be filed a minimum of six weeks before a scheduled Commission meeting to be eligible to be heard at that meeting.

Deep Water Management Inc**.** may either appeal the permit decision or seek a variance. These are two separate paths and cannot be pursued simultaneously. If the appeal of the permit decision is denied, Deep Water Management Inc. may still seek a variance. However, Deep Water Management Inc. may not first seek a variance and if that is denied attempt to challenge the decision to deny the permit. Information about both a permit appeal in the Office of Administrative Hearings and the Variance process may be obtained at https://deq.nc.gov/about/divisions/coastal-management/coastal-management-permits/variances-appeals.

Respectfully yours,

Haley Moccia – Town of Carlina Beach LPO

Cc (by email): Robb Mairs, CAMA LPO Minor Permit Coordinator
Tara MacPherson, Wilmington Region District Manager
Bryan Hall, DCM Field Rep
Haley Moccia, Town of Carolina Beach LPO

Outlook

Re: [External] Updated Restoration Plan

From Andrew Krichman <krichco@mindspring.com>
Date Wed 9/25/2024 9:46 AM
To MacPherson, Tara <tara.macpherson@deq.nc.gov>
Cc Hall, Bryan L <Bryan.L.Hall@deq.nc.gov>; Andy Krichman <Andy@Krichco.com>

Good morning Tara,

Thank you for yours and Bryan's emails. I appreciate your reminder on the date to have the Variance Request turned in.
It is over 90% completed and will certainly get it turned in on time.
Had it on my schedule for last Monday and then we got hit with all that flooding and cleanup.
Last week was a rough week for CB.
Happy to report the bulkheads you guys approved and we built made a world of difference for the properties they were protecting.
Thank you to you and Bryan for your oversight and recommendations on these projects.
Without the bulkheads on these properties there would have been substantial damage.
The bulkheads performed very well, protected the properties and had the added benefit of helping protect neighboring properties as well.
There are some remaining properties on Canal Dr. that desperately need bulkheads and working to encourage owners to consider this for their own and neighbors benefit.
Been working with members of the town council on a long term Canal Dr. improvement project and making some headway there as well.

Will jump back on this Variance Request today and try to get it finished up this week.
Sorry to add to your workload with this.
Thank you for the reminder and look forward to finding a good solution that meets the intent of CAMA, and works well for this property, Andy

On Sep 24, 2024, at 3:03 PM, MacPherson, Tara <tara.macpherson@deq.nc.gov> wrote:

Hi Andy, I met with our Assistant General Counsel on this to provide a status update on restoration. She wanted me to inform you that DCM may need to seek Injunctive relief for removal of the unauthorized turf grass installed within the 30 ft. Coastal Shoreline Buffer if you do not move forward with the Variance Request. Please let us know what you intend to do and if you have any questions.

Thank you for your attention to this important matter.
Best,
Tara

Tara MacPherson
Wilmington Region District Manager
North Carolina Division of Coastal Management
Department of Environmental Quality

910 796-7266 office
tara.macpherson@deq.nc.gov

127 Cardinal Drive Ext
Wilmington, NC 28405

As part of DEQ's phased email update, all Division of Coastal Management emails are now @deq.nc.gov. Our email addresses may look different, but email performance will not be impacted.

Find a Field Rep (arcgis.com)
Join the DCM Interested Parties List

From: Hall, Bryan L <Bryan.L.Hall@deq.nc.gov>
Sent: Monday, September 23, 2024 9:26 AM
To: Andrew C. Krichman <krichco@mindspring.com>
Cc: Andy Krichman <Andy@Krichco.com>; MacPherson, Tara <tara.macpherson@deq.nc.gov>
Subject: RE: [External] Updated Restoration Plan

Hi Andy,

This is a reminder that the variance submittal deadline for the November Coastal Resource Commission meeting is Wednesday, October 2nd, which is the restoration deadline per the signed agreement. If no variance request is submitted, DCM will move forward with compliance. Let me know if you have any questions.

Thanks,

Bryan Hall
Field Representative
NC Division of Coastal Management
Department of Environmental Quality

(910) 796-7423 office
bryan.l.hall@deq.nc.gov

127 Cardinal Drive Ext
Wilmington, NC 28405

Please see below to ensure you are contacting the correct field rep:

Pender Co./Topsail Island- Jason.Dail@deq.nc.gov
Northern New Hanover- kelsey.beachman@deq.nc.gov.gov
Southern New Hanover - Bryan.L.Hall@deq.nc.gov.gov
Eastern Brunswick Co. (Oak Is/ HB)- Patrick.Amico@deq.nc.gov.gov
Western Brunswick Co. (OIB/SB)- phil.dangelis@deq.nc.gov
For Minor Permit Program questions please contact: Robb Mairs - robb.mairs@deq.nc.gov.gov

---

From: Hall, Bryan L
Sent: Friday, May 10, 2024 12:46 PM
To: Andrew C. Krichman <krichco@mindspring.com>
Cc: Andy Krichman <Andy@Krichco.com>; MacPherson, Tara <tara.macpherson@deq.nc.gov>
Subject: RE: [External] Updated Restoration Plan

Received, thanks Andy. DCM will be on the lookout for the variance submittal.

Bryan Hall
Field Representative
NC Division of Coastal Management
Department of Environmental Quality

(910) 796-7423 office
bryan.l.hall@deq.nc.gov - **Please note my new email address**

127 Cardinal Drive Ext
Wilmington, NC 28405

Find a Field Rep (arcgis.com)

From: Andrew C. Krichman <krichco@mindspring.com>
Sent: Friday, May 10, 2024 12:10 PM
To: Hall, Bryan L <Bryan.L.Hall@deq.nc.gov>

Cc: Andy Krichman <Andy@Krichco.com>
Subject: [External] Updated Restoration Plan

Sent from my iPhone

THE DROWNING SOUTH

ANATOMY OF A FLOOD

The Post installed cameras along the main road of one N.C. town to document the many ways rising seas exacerbate high-tide flooding.

Scroll to continue

By Brady Dennis, Niko Kommenda and Emily Wright

Videos by Ray Whitehouse for The Washington Post

June 11, 2024 at 5:00 a.m.

CAROLINA BEACH, N.C.

Nothing seemed amiss on a warm late-summer afternoon in this laid-back beach town south of Wilmington.

Surfers tested the waves rolling in from the Atlantic. Kayakers drifted across the sparkling bay just to the west. Bicyclists pedaled past colorful wood-frame houses with names such as Ship Faced and Sand Dollar Retreat.

But even on this postcard-perfect day, a threat was lurking — one that is growing more disruptive, more often, in coastal communities in the southeastern United

States:

Sea-level rise.

In a matter of hours, a particularly high tide would once again arrive in this town of nearly 7,000, overwhelming its outdated and overmatched infrastructure. The main drag of Canal Drive would once again become submerged by floodwaters.

The Washington Post had set up cameras in multiple places along the road, capturing in real time the many ways that ever-higher tides exacerbate flooding, and why local efforts to cope with this growing scourge are often falling short in communities where seas are rising the fastest.

The videos illustrate how, even on days without major storms, rising waters are compromising stormwater infrastructure, overtopping shorelines, elevating groundwater, and combining with rain to make flooding more persistent and more insidious over time.

Imagery and 3D buildings from Google Earth

The images add to growing evidence captured by scientists who, day after day, are documenting the frequency of these sunny-day floods in an area where sea levels have risen 7 inches since 2010 — among the highest in the country, according to a Post analysis.

In several coastal North Carolina communities, researchers have installed sensors inside stormwater drains and cameras along the streets above to record the causes and number of floods.

In Carolina Beach alone, they have documented 60 days over the past year when Canal Drive flooded, many of those during clear weather. That's far more than the four to eight high-tide floods projected by the federal government for the same period, based on measurements from a nearby tide gauge.

THE DROWNING SOUTH

Seas are rising across the South faster than almost anywhere. The Post explores what that means on the ground.

PART 1
The new face of flooding

PART
Wher
alarm

Tide gauges designed to record changes in sea levels "are only painting part of the picture" of what is happening on land, said Katherine Anarde, an assistant professor of coastal engineering at North Carolina State University who is helping to lead the research.

She and her colleagues, working to decipher a fuller picture in specific places, keep arriving at the same conclusion.

"It is flooding more than we know," she said.

Two days in Carolina Beach— the first clear and calm, the second marked by rain — show why fixing the deepening problems of sea rise poses such a daunting task.

DAY 1

A sunny late-August day in Carolina Beach. In the early afternoon, around low tide, Post journalists set up time-lapse cameras in several spots along Canal Drive to capture what happens as the evening high tide arrives.

2:45 p.m. – 7:15 p.m.

As the tide rolls in, a stormwater pipe at Seahorse Lane steadily becomes submerged by salt water.

The stormwater pipes and drains along this stretch of Carolina Beach were built generations ago, when they were above the high-tide line. But as this part of the southeast Atlantic coast experiences one of the most rapid sea-level surges on Earth, high tides regularly swallow the infrastructure that is supposed to drain city streets, leaving water nowhere to go.

“The higher tides are lingering more often. When we do have an event, it’s multiple days,” said Jeremy Hardison, planning and

development director for Carolina Beach. “There’s definitely more water in the pipes and drains than there used to be.”

City officials have worked to combat the worsening problems, but it’s an uphill battle. They have installed backflow preventers to try to keep seawater from filling outflow pipes, though such retrofitting can have uneven results. The harsh coastal environment speeds wear and tear. Barnacles grow on the edges of valves, compromising their watertight seal.

“Water doesn’t need much to penetrate in,” Hardison said. “In some areas, it has helped; in some areas, it hasn’t performed as we thought it should.”

Local leaders also have mulled raising roads and building more bulkheads, he said. But such approaches can prove expensive, face regulatory hurdles and public skepticism, and come with the risk of unintended consequences.

On this day, seawater eventually fills a pipe near Seahorse Lane, causing water to spew from a drain 45 feet away onto Canal Drive.

6:40 p.m. – 7:30 p.m.

As rising seawater fills a stormwater drain, the excess quickly floods onto Canal Drive.

Besides overwhelming drainpipes, rising sea levels also push up underground water levels — commonly known as the water table.

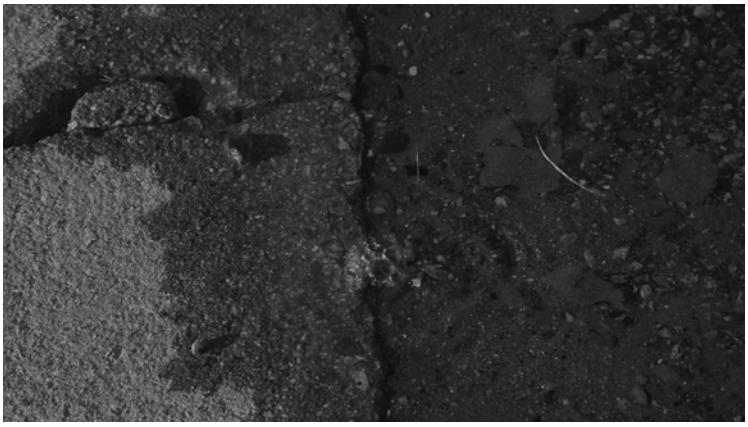
“As the sea level gets higher and higher,” Anarde said, “the groundwater table also increases.”

That means there’s only so much capacity for the ground to absorb any rain that might fall. “So even just a minor rainfall event can lead to ponding in low-lying areas and just can exacerbate the flooding in the roadway or in yards,” she said.

As high tide approaches on this clear day, puddles of water appear from seemingly nowhere in certain spots along the street and at the base of a nearby power pole and stop sign.

6:36 p.m.

As rising seas force groundwater to the surface, water starts to bubble up from cracks in the pavement.



The most obvious manifestation of rising seas is the higher tides that more easily send water creeping over shorelines.

That is what happens at this empty lot along Canal Drive — one of several places unprotected by a bulkhead.

5:15 p.m. – 7:50 p.m.

The incoming tide submerges a low-lying lot before spilling onto the main road. It pushes through marsh and across the once-dry land, turning it into a temporary pond. As sunset approaches, it continues to spill over onto the nearby street, covering it completely and making it impassable for many vehicles.

In a handful of hours, this combination of factors transforms a long stretch of Canal Drive into a canal. And most of that flooding arrives swiftly, overtaking the road in barely half an hour around high tide. As dusk arrives, the water is more than a foot deep in places, despite the clear, calm weather.

The city often must close the street to traffic on days with tides like this, said Hardison, the city planner. “It’s a given,” he said.

Police officers arrive to lower a series of gates the city installed several years ago that warn of the latest saltwater intrusion. “Road closed,” the signs read. “Saltwater flooding.”

A few drivers in trucks plow through anyway, sending ripples of water to lap off nearby carports and garage doors.

As sea levels continue to rise, Anarde says, these types of floods will happen during more high tides, linger longer and cause only more

damage. “It’s just going to get worse,” she said.

8:06 p.m.

By nightfall, the unstoppable tide stretches along Canal Drive and up side streets. Floodwaters creep up driveways and meander under some raised houses. Televisions flicker inside nearby homes, and the light from streetlamps dances across the water that has swallowed the road outside.

DAY 2

The remnants of Hurricane Idalia are barreling past the Carolinas. On this day, more than 3 inches of rain fall on Carolina Beach — not insignificant but also not an unheard-of amount for a storm along the coast. The day offers a firsthand lesson in how sea-level rise is making “compound” flooding more severe.

11:50 a.m.

A steady rain settles in over Carolina Beach. “When it’s high tide and it rains, there’s nowhere for that water to go,” said Hardison, the city

planner. “If there’s nowhere for that water to go, then it’s going to back up and fill up like a bathtub.”

3:30 p.m. – 6 p.m.

Stormwater pipes again fill up with seawater as high tide arrives, leaving no room for rainwater to drain.

Surging sea levels combined with even modest rains lead to what scientists call compound flooding, and it is happening more often in more places.

Pipes that once would have drained by gravity are now filled with salt water, leaving no escape for precipitation.

6:50 p.m. – 7:30 p.m.

“The system gets overwhelmed,” Anarde said of the rain that falls hard along Canal Drive. “As sea levels continue to rise and we see tides propagating higher and higher, plus the frequency of these

rainfall events, we're going to see more-frequent flooding for a lot of communities — even at moderate or lower tides."

As darkness arrives, Canal Drive is once again submerged, this time even deeper than the day before. Authorities once again lower the gates to block the street. It will be hours before the floodwaters subside.

Over the past year, researchers have logged dozens more flooding events along Canal Drive than official estimates from the National Oceanic and Atmospheric Administration, whose scientists say high-tide floods in the South are already happening five times as often as just several decades ago.

Federal tide gauges "are not actually intended to measure flooding on land," said Miyuki Hino, a University of North Carolina at Chapel Hill environmental social scientist.

It is a gap scientists are busy trying to better understand as this type of flooding worsens. "Measuring the floods correctly is a prerequisite for measuring the human impacts correctly," said Hino, Anarde's research partner.

As time goes on, and the trend continues — seas are predicted to rise as much as an additional foot along this stretch of coast by 2050 — these floods will force hard questions in coastal towns.

"Absent significant investments in adaptation, we'll see a rapid increase in the incidence of chronic flooding relative to what we are seeing right now," Hino said.

And definitely not just in Carolina Beach.

“A lot of coastal towns across North Carolina and across the U.S. are facing this problem,” Anarde said. “The last 10 years are not a good indicator of what the next 10 years will look like.”

About this story

John Muyskens contributed to this report.

Editing by Monica Ulmanu, John Farrell and Joe Moore.

Project editing by KC Schaper. Copy editing by Carey L. Biron and Martha Murdock.

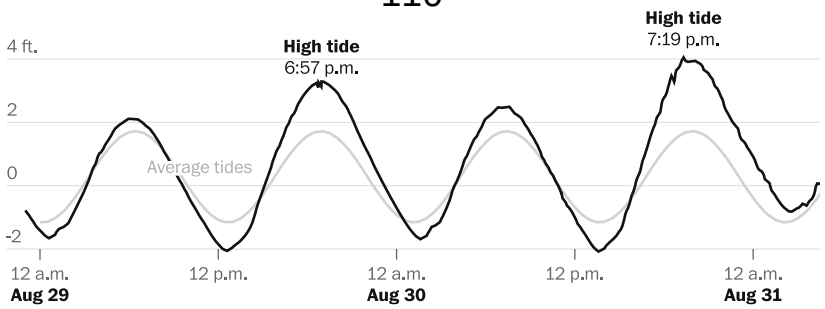
Additional support from Jordan Melendrez, Shibani Shah, Erica Snow, Kathleen Floyd and Victoria Rossi.

How we reported the story

Over two days late last August, The Post set up cameras in various locations along Canal Drive in Carolina Beach to capture flooding during multiple high tides. Each camera took a photo every 10 seconds. The photos were combined in postproduction to create the time-lapse videos in this story.

The Post’s visit coincided with a “king tide” — a term commonly used to describe some of the highest predicted annual tides at a particular location. These events occur several times a year in many coastal areas, and offer an opportunity to see what average water levels might look like in the future as sea levels continue to rise.

Water levels measured in the Carolina Beach Yacht Basin



Source: North Carolina Flood Inundation Mapping and Alert Network. Water levels are relative to a fixed reference elevation. Average tides are for 2023.

The approach to capturing the multiple drivers of flooding was informed by conversations with Katherine Anarde and Thomas Thelen at North Carolina State University, Miyuki Hino at the University of North Carolina at Chapel Hill, and Adam Gold of the Environmental Defense Fund. A paper they and other colleagues published in 2023 detailed how they used storm drain sensors and roadway cameras to determine that flooding in Beaufort, N.C., was happening more often than nearby tide gauge levels would have predicted.

Researchers continue to monitor the impacts and causes of such flooding in multiple communities in North Carolina, including in Carolina Beach, New Bern and Carteret County — part of an effort known as the Sunny Day Flooding Project.

3452 Comments

Brady Dennis

Brady Dennis is a Pulitzer Prize-winning national reporter for The Washington Post, focusing on environmental and climate stories, primarily around the Southeast. He previously has covered the Environmental Protection Agency, international climate policy, the Food and Drug Administration and the nation's economy. @brady_dennis

Niko Kommenda

Niko Kommenda is a graphics reporter on The Washington Post's climate and environment team. Before joining The Post, he worked as a visual journalist at the Financial Times and the Guardian. @niko_tinius

Emily Wright

Emily Wright is a designer and art director on The Washington Post's climate and environment team. @_emilywright_

Contact Us

Exhibit 14- Krichman Affidavit with attachments

Includes:

- Krichman Affidavit, signed and notarized
- Summary of Construction Experience
- New Artificial Turf Study from Europe 10/29/25 (not attached but at this link) https://enveurope.springeropen.com/articles/10.1186/s12302-025-01235-1
- Quotes from Washington Post article that Mr. Krichman believes are important
- Cali 73 Turf warranty information
- ASTM reports on permeability and tear rating

NORTH CAROLINA)
)
NEW HANOVER COUNTY)

AFFIDAVIT OF ANDREW KRICHMAN

The undersigned being duly sworn deposes and says that he has personal knowledge of the following facts:

1. I am Andrew Krichman. I am President and the Incorporator of Deep Water Management, Inc, Deep Water owns property located at 813 Canal Drive ("Site") in Carolina Beach through a 2022 deed.

2. Since 2022, I have observed flooding on the Site from both named storms and sunny day flooding. Based on my observations, the water enters Canal Drive from non-bulkheaded lots, failed bulkheaded lots, storm sewer drains, as well as groundwater, and flows down Canal Drive and then up my driveway onto the Site. Based on my observations, I contend that flooding on this Site from sunny day flooding would cause erosion of the sandy soil on the Site if the artificial turf were removed. I believe artificial turf is preventing erosion.

3. After the bulkhead was developed on the Site in 2023 pursuant to CAMA General Permit #90517D, I witnessed when the Site was backfilled with sand purchased from Chambers Landscaping. The sand was compacted with a bobcat and then a tamp. A layer of filter fabric was installed on top of the tamped sand and then covered with another 2" layer of sand. I had artificial turf installed at the Site on top including within the 30' CAMA Buffer area. I was unaware that the installation of artificial turf required CAMA Permit approval.

4. The kind of artificial turf is called Cali73. It was fastened around the perimeter with stainless steel screws 3" on center. The field of the Cali73 turf is fastened with 5" galvanized spikes 1' on center.

5. I spent months researching many types of artificial turf materials before choosing Tailor made Cali 73. I specifically chose to stay away from artificial turf made from crumb rubber because of the harmful environmental effects. Tailor made Cali 73 has no crumb rubber, and absolutely no tire products. Tailor made Cali 73 has no latex or polyurethane. It is a unique product that is fully recyclable, much more durable than other artificial turf products, does not move in temperature changes, fully permeable both directions, and has a weed barrier on the back of the turf that will not clog. The color may start to fade after 15 - 30 years but I am told by the manufacturer that the material will not break down in this time period. Products currently approved by CAMA like wood pilings, wooden docks, and fasteners will break down, need to be replaced and are not recyclable. I looked long and hard for a superior product, that is safer to use in environmentally sensitive areas. Tailor made Cali 73 is a specific type of artificial turf that was specifically designed and engineered for environmentally sensitive areas such as waterfront installations such as this.

6. Artificial Turf and CAMA Rules presentations to the CRAC dated Nov '24, Feb '25 and April '25, attached as stipulated exhibits, describe situations where properties are sloped towards bodies of water. At the direction of CAMA representatives I was directed to slope the grade of this property from the waterline towards the road and not the water. I specifically constructed the new bulkhead with long lasting materials and made it slightly taller than the typical height to account for continued sea level rise and scientifically researched and projected increase in amounts of water entering the yacht basin. This will ensure significantly less chance of water coming over the bulkhead and onto the property. To date, water has not even come close to coming over the bulkhead yet we have had 100's of times when water has come onto the property from the road and of course from the sky. The slight slope we engineered to run the water from the bulkhead towards the road works well to keep water on the property from entering directly to the yacht basin from the property. The slight downhill slope towards Canal Drive is terminated by a low concrete and stone retaining wall that prevents runoff from entering the road directly. All water that enters the property must go through the Cali 73 and into the sand. It does not go directly to the road. This is a natural sand filtration process using the all natural product of sand which was carefully designed into this specific product installation. I believe that this sand filtration process is superior to water runoff being filtered only by vegetation. This is not a typical product or installation as described in current Artificial Turf and CAMA Rules. It is not like any other artificial turf installation I have witnessed. This is a very specific installation researched and designed to protect both this specific property and the environment. I have worked diligently in this effort and strongly believe this specific product and installation meets the intent of the CAMA rules and is superior to only a vegetative buffer.

7. The artificial turf has been on my property for two years (Since September 2023) and it is my opinion that it has held up in all types of weather and flooding. In September of 2024, the property received 18" of rain in 12 hours and it is my opinion that the turf performed as expected where the rainwater went through the turf and the turf held the underlying sand in place.

8. Barclay Payne at Tailor Made Grass stated to me that the Tailor Made turf has been successfully used on many waterfront properties in coastal communities in the Southeast including Ft. Lauderdale, FL, Miami, FL, Savanah, GA, and Charleston, SC with great success. Mr. Payne told me that it has also been successfully utilized in Boston, MA, Seattle, WA, and many locations in California. He provided me with photographs of examples of it being used in these other states, attached.

9. There is a current published scientific study attached, that was just released 11/2/25 that presents scientific research on testing for microplastics in conjunction with the more advanced and environmentally conscious artificial turfs such as Cali 73 that do not have any crumb rubber and are specifically designed for environmentally sensitive areas such as waterfront applications. A copy of this study is attached.

10. It is my opinion that this is a high-quality product and while it is considerably more expensive, it is more environmentally friendly than alternatives, easy to maintain, looks very attractive and does an excellent job of protecting sandy soils from erosion.

11. I have been a licensed General Contractor in the state of North Carolina for over 30 years and hold an Unlimited building license. I founded and actively managed Krichco Construction, inc., and successfully completed over $100 Million of construction. Krichco Construction has built some of the finest estate homes in Durham and Orange Counties including homes for the CEO of Duke Medical Center, many well respected Duke Physicians, UNC Chapel Hill representatives and the home that Coach K lives in.

12. Many of these estate homes are situated on 20, 50, or 100 acres and I am well versed in walking land to determine best use as well as sighting the home, road access, gates, guest houses, pool houses, horse barns, and pastures. The most meaningful part of this work is creating a sustainable estate that takes into account the natural setting while working with and enhancing the land and property.

13. My experiences have included sitting on numerous boards. Including multiple board positions with the Durham, Orange, Chatham Home Builders Association as well as being the President of the DOC HBA and being responsible for hiring the replacement Executive Director when former Durham Mayor Nick Tennyson left his role to become Deputy Secretary of Transportation under his good friend Pat McCrory. The woman I hired, Holly Fraccaro has been the Executive Director of the DOC HBA for over 10 years and is highly respected.

14. In New Hanover County, I have overseen construction and consulted on multiple waterfront construction projects including bulkheads and docks as well as renovated and maintained waterfront homes.

15. In my over 20 years of owning, observing and consulting on waterfront properties in Carolina Beach I have learned quite a bit and made some very interesting observations.

16. I have consulted on the property at 1013 Canal Dr. Carolina. This property had an existing bulkhead. Sea level rise was causing areas of the property to get saltwater infiltration that was in the early stages of wetlands development in areas landward of the existing bulkhead. In a meeting with CAMA representative Bryan Hall in 2022 I observed the corners of this property in the early stages of wetlands development where there were no wetlands previously. Mr. Hall flagged an allowable bulkhead location based on the vegetation present. I understood at that time that if a bulkhead was not built, the wetlands vegetation could continue to migrate landwards, reducing the usable area of the property. This wetlands migration would limit areas of the property to be utilized for foot traffic, landscaping, or any personal use. It was my understanding that once usable, privately owned land reverted to wetlands future personal use would be strictly regulated.

17. I have consulted on the property immediately to the North at 1015 Canal Drive with more advanced levels of wetlands that make portions of the property currently unbuildable. By not protecting the coastline with a bulkhead the wetlands continue to creep further back into the property every year creating portions of this property that are unbuildable.

18. I have consulted on the property at 1007 Canal Dr. Carolina Beach. In 2003 this property very rarely had tidal waters on it. In 2025 the high tide covers the property twice a day on every high tide. This lot was a viable buildable lot in 2003. In 2022 this lot was deemed unbuildable by CAMA representatives due to the amount of wetlands encroachment on the property.

19. I have personally witnessed the growth of wetlands and the transition of entirely buildable lots to partially buildable and fully unbuildable.

20. The town of Carolina Beach has been unable to stop the flow of tidal waters onto Canal Drive and there is no plan in place to do so any time in the near future.

21. I feel it my responsibility to take actions to protect the land I currently own from becoming partially wetlands. I request that the CRC work with me on reasonable and agreeable practices.

22. Beginning in 2021, I worked with the Lorettis regarding their property at 1007 Canal Drive and discussed potential development on their property including developing a bulkhead. I witnessed changes on the Loretti lot over 20 years as the next-door neighbor. At the time of my purchase of 1005 Canal Dr in early 2000's the neighboring Loretti lot rarely had water on it and was a viable building lot. I have witnessed the water level steadily rise over the past 20 years. Today the very same property that rarely flooded is covered by water twice a day on every single high tide with water over a foot deep. During King Tides and wind blown events, the water is not contained on the property and rushes into Canal Dr over 50 times a year and is the largest contributor to the flooding on Canal Dr. The water in the street at times becomes 2' deep.

23. I believe that on the Loretti Lot, over time, Coastal Wetlands have migrated onto the lot where seawater extends onto the lot because there is no bulkhead. I have witnessed the transformation of the lot adjacent to his becoming unbuildable because the sea water was not kept off of the lot and today the majority of the lot has been deemed wetlands by the CAMA representative.

24. I have witnessed the development of coastal wetlands over time on lots in Carolina Beach along Canal Drive where there was none previously. The corners and ends of waterfront properties that are getting more water on them more frequently are becoming wetlands. I have witnessed numerous Canal Drive waterfront properties lose significant buildable square footage due to water level rise establishing a larger wetlands footprint.

25. I personally witnessed the worsening issue of my next door neighbors grassed lot at 1007 Canal Drive reverting to wetlands over a 20 year period. In my opinion, a Million dollar plus property is now worth a small fraction of that since it is now not buildable. The property could have been protected, was not protected, is a huge contributor to sunny day flooding of Canal Drive, and was featured prominently in Washington Post video and news story- (would like this to be included in presentation somewhere as it clearly shows what is truly happening on Canal Drive from the viewpoint of a nationally recognized and respected news firm)

26. I have witnessed extreme loss of property from properties not being protected from sea level rise. I have watched owners' properties return to wetlands in front of my eyes which has created significant concern for my property. I am highly concerned about his property now and in the future and is trying to protect his property from returning to wetlands.

27. I have gone to great lengths to protect his property including the construction of a sea wall, adding sand fill and protecting that sand fill. I have spent $100,000 protecting my property including $40,000 on the most environmentally safe artificial turf he could find. I cannot keep the water from Canal Dr from entering his property as the sea level rises.

28. I have met numerous times with former Carolina Beach Mayor and current town council member Joe Benson as well as the North End Flood Mitigation Alliance to come up with plans to slow down the north end flooding.

29. City councilman Joe Benson told me that the pipes below Canal Dr will need a full replacement, remaining privately owned lots without bulkheads or with failing bulkheads will need significant work and there is no uniform consensus on how to address the flooding situation. It is going to continue to worsen.

30. I have significant concern for the viability of his property due to sea level rise and flooding. The town of Carolina Beach has been unable to solve the issue and there is no sign of the issue being solved anytime soon. The $100,000 the petitioner has spent to protect his property is working as currently installed. I believe that removal of the artificial turf will leave his property susceptible to return to wetlands. The petitioner is stuck between a town that is not able to correct the flooding and a well-intentioned state regulatory agency that will not allow him to protect his land with a safe product that is working as installed.

31. I have spent considerable time and money to solve this issue in a safe, environmentally friendly manner and respectfully requests the CRC to work with him and allow the artificial turf to stay in place.

32. I believe that the artificial turf has been safely in place on his property for two years, protected his property and not caused any environmental issues. Removal of the artificial turf would leave his unprotected property susceptible to revision to wetlands.

This the 12th day of November, 2025.

Andrew Krichman

Grand Cayman ~~COUNTY, NORTH CAROLINA~~

Sworn to and subscribed before me this 12th day of November, 2025.

Official Signature of Notary

Himna McLaughlin, Notary Public
[Print name]

My commission expires: 31-Jan-2026

Himna McLaughlin
Notary Public in and for the Cayman Islands
My commission expires 31 January, 2026
Date: 12 - NOV - 2025

+

From: Andrew Krichman <krichco@mindspring.com>

Subject: Brief Construction Background

Date: October 7, 2025 at 7:33:26 AM EST

To: "Goebel, Christine A" <Christine.Goebel@deq.nc.gov>

Andrew Krichman has been a licensed General Contractor in the state of NC for over 30 years and holds an Unlimited building License. He founded and actively managed Krichco Construction Inc.and has successfully completed over $100 Million of construction. Krichco Construction has built some of the finest estate homes in Durham and Orange Counties including homes for the CEO of Duke Medical Center, many well respected Duke Physicians, UNC Chapel Hill representatives and the home that Coach K lives in.

Many of these estate homes are situated on 20, 50, or 100 acres and I am well versed in walking land to determine best use as well as sighting the home, road access, gates, guest houses, pool houses, horse barns, and pastures. The most meaningful part of this work is creating a sustainable estate that takes into account the natural setting while working with and enhancing the land and property.

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In New Hanover County, I have overseen construction and consulted on multiple waterfront construction projects including bulkheads and docks as well as renovated and maintained waterfront homes.

RESEARCH

Open Access

Simultaneous sampling for microplastics and environmental contaminants from artificial turf: development of a new integrated microplastics eluate lysimeter

Maria Kittner[1*], Bianca Coesfeld[1], Thomas Werischak[1], Sven Schlau[1], Korinna Altmann[1] and Ute Kalbe[1]

Abstract

To get a better understanding of potentially harmful contaminant emissions from soils or materials into the environment, politics demand practical and holistic sampling concepts for environmental samples such as leachates containing polycyclic aromatic hydrocarbons (PAH) or heavy metals, and hazardous particulate matter like microplastics (MP). Of particular concern are MP emissions from artificial turf sports pitches. So far, there has been only very limited data on MP mass emissions from artificial turf potentially posing a risk to the groundwater and no sampling device that allowed simultaneous sampling for dissolved and particulate contaminants. In this study, a novel integrative microplastics eluate lysimeter was developed to determine contaminant emissions from three artificial turf systems at different ageing states (fabric-new, artificially aged, real-time aged). For the accelerated ageing, all environmental simulation parameters were based on Central German conditions and simulated outdoor stress during the turf service lifespan of 15 years. MP masses from eluates were analysed using thermal extraction desorption-gas chromatography/mass spectrometry, PAH concentrations using gas chromatography/mass spectrometry and heavy metals using inductively coupled plasma-optical emission spectroscopy. Results showed that no PAH or heavy metal concentrations from the seepage water were above German legal limits for alternative granular construction materials considering soil and groundwater protection. Furthermore, it was found that only minimal MP emissions were released from new turf systems into the seepage water (< 1 mg/m^2). Ageing of the artificial turf increased MP formation, especially from rubber infill and grass fibres, which are then carried into the seepage water. The highest total MP emissions over a simulated turf lifespan of 15 years were detected in two real-time aged turf systems ranging from 136.4–252.5 mg/m^2. Considerably less total MP emissions were detected in accelerated aged artificial turf systems, one of which contained a synthetic rubber infill (5.4–8.0 mg/m^2) and one without rubber infill (0.2–5.3 mg/m^2). In summary, it was demonstrated that the newly developed MEL generated reliable and reproducible data and has thus proven itself as an integrated, straightforward and automated sampling device for simultaneous monitoring of particulate and dissolved pollutant emissions from simple soil matrices.

Keywords Lysimeter, Microplastics, Artificial turf, Thermal extraction desorption-gas chromatography/mass spectrometry, TED-GC/MS, Polycyclic aromatic hydrocarbons, PAH, Heavy metals, Soil samples

Background

Public and political awareness of potentially harmful emissions of man-made plastics into the environment is steadily increasing. In addition to health concerns about released pollutants (e.g. polycyclic

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aromatic hydrocarbons, PAH), particulate matter such as microplastics (MP) is also constantly gaining in relevance [12, 46, 54]. Based on the precautionary principle, the European Commission has therefore introduced the new Directive 2023/2055 in September 2023 to reduce MP emissions into the environment, which includes the sale and use of intentionally added MP [33]. This ban explicitly applies to the use of synthetic rubber infill in artificial turf systems because of its particle size < 5 mm. However, the ban also raises concerns about the impact on football clubs and recreational sport and thus the future of artificial turf sports pitches.

In general, the amount of artificial turf pitches in Europe is steadily increasing. This is because artificial turf has established itself in recreational sports due to many advantages. Compared to natural turf, artificial turf requires less maintenance (e.g. fertilisation, watering) and is playable throughout the year in almost any weather condition. Therefore, it allows for intensive usage, which is particularly crucial to cover the demand for recreational sports in high-density living areas. According to the ECHA, there were 13,000 artificial turf pitches in the EU in 2019 [31]. There is no official data on the number and area of artificial turf pitches in Germany [14]. However, it was estimated from the DIN NA 005–01–22 AA Working Committee on Artificial Surfaces and Artificial Turf Surfaces in 2019 [24] that there are a total of around 7,000 artificial turf pitches in Germany, varying in surface area and infill type. Most of them (ca. 5,000 pitches) are large pitches with an average size (ØA) of 7,000 m^2, of which ca. 3,500 pitches are filled with rubber granules, ca. 1,000 pitches are purely sand filled and ca. 500 are unfilled hockey pitches. In addition, there are approx. 200 small pitches (ØA: 700 m^2) and 1,400 mini pitches (ØA: 260 m^2), which are also filled with rubber granulates. Presently in Germany, synthetic infill made of EPDM (ethylene propylene diene monomer rubber, Fig. 1c) is most commonly used. EPDM is considered to be more environmentally friendly than the formerly used granules made from shredded end-of-life car tyres, which include, among others, SBR (styrene butadiene rubber) and can partially contain hazardous additives, e.g., heavy metals like zinc and lead or PAH [2, 31, 44]. Synthetic rubber infill, or the so-called performance infill, is added to artificial turf to protect players from injuries and the grass fibres and backing from abrasion. It improves material longevity to maximise the artificial turf service lifespan, which is typically around 12–15 years. In general, artificial turfs for sports pitches are highly developed and complex multi-component systems and consist of multiple synthetic polymers from which MP can potentially emit. Especially, abrasion of grass fibres is also considered to be a relevant MP source [13]. The calculation of an overall mass balance for MP emissions from artificial turf pitches is very complex, as the individual site-specific conditions can vary greatly from pitch to pitch. The following parameters are important: i) climate zone (Nordic countries show a much higher discharge due to snow); ii) generation of artificial turf (third-generation systems show reduced discharge behaviour); iii)

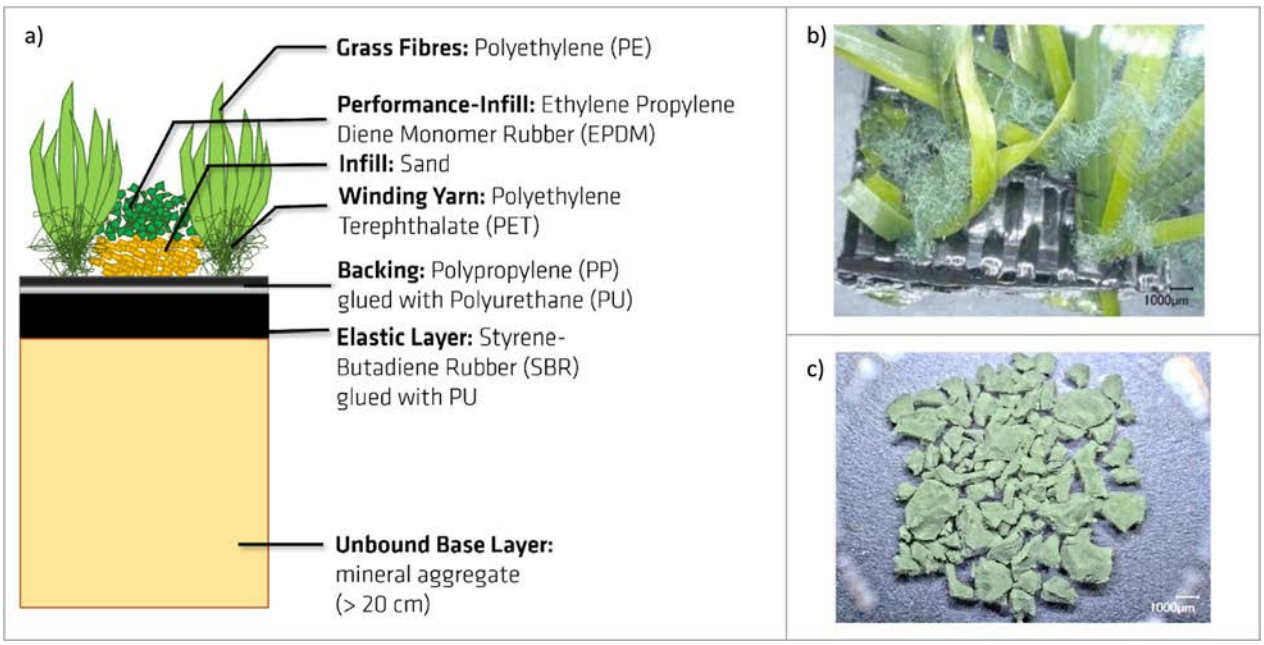

Fig. 1 Artificial turf composition: **a**) schematic overview, **b**) microscopic picture of artificial turf and **c**) of EPDM granules

structural installations (with/without drainage system, type and quantity of infill). There have already been various studies from a wide variety of organisations in the past, mainly focusing on the emissions of rubber granules [4, 47, 48]. Based on surveys of associations, local authorities and experts in planning, construction, supply and production, as well as the experience of its members, the DIN NA 005–01–22 AA (2019) estimated that approx. 60–80% of granule losses are due to a lack of or improper maintenance measures and techniques, approx. 5–15% to snow clearing, approx. 10–20% to heavy rainfall events and wind drift and approx. 3–5% to adhesion to athletes' clothing, bodies and shoes. Depending on the construction of the artificial turf pitch, the seepage water is either passed through a drainage system into a sewage treatment plant or surface water, or it infiltrates through the soil into the groundwater.

So far, to our best knowledge, there is no reliable data to estimate total MP emissions from seepage water from artificial turf sports pitches. Furthermore, no holistic sampling concepts and devices are available to allow simple and fast analysis of dissolved and particulate contaminants in eluates from soil media [39]. However, this is of great political interest and regulatory importance in view of the forthcoming revision of the European Water Framework Directive. It is proposed that it should include the assessment of MP emissions into surface water and groundwater to ensure good qualitative and quantitative status of all European water bodies [32, 34]. But this requires the development of suitable research monitoring methodologies.

In previous projects, a methodology has been established using laboratory-scaled column percolation tests to assess the environmental compatibility of artificial turf and sports surface systems regarding the release of contaminants and their transport via the soil–groundwater transfer pathway [38, 43]. Results showed that it is necessary to take the entire structure of such systems into account, as there are no direct assessment criteria for the individual turf components. Such investigations were carried out for several common sports pitch installations. The contaminant concentrations in the eluates were compared with the limit values of a German regulation for the use of recycling materials in construction [5] which has been set into force in 2023. The concept for the risk assessment considering soil and groundwater protection has already been discussed [49]. According to the state of the art, up-flow column percolation tests under saturated conditions are used following standardised guidelines [17, 27, 30, 51]. So far, lysimeters using unsaturated conditions and somewhat larger dimensions have not yet been standardised, although they can provide a more realistic assessment of the leaching behaviour of contaminated soils. Laboratory lysimeters are usually irrigated from the top, which is closer to field conditions. The obtained eluates are subsequently analysed for organic and inorganic contaminants. Since MP science is a relatively new research field, to date, there are no standardised protocols for MP sampling from leaching tests to analyse and evaluate the transfer behaviour of MP through soil. Furthermore, classical lysimeters are i) not suitable because components can be made of target-polymers and thus do not fit the contaminant-specific material requirements (risk of cross-contamination); and ii) not made for MP sampling during long-term experiments. The main reason is that standard lysimeters do not have accessible filters that could allow for MP sampling. The only option would be an additional manual eluate filtering step of the large eluate glass collecting bottle, which can weigh up to 5 kg when empty. Consequently, the full heavy eluate collection bottles (total weight with sample: up to 25 kg) would have to be manually lifted for filtering and multiple rinsing, which is physically difficult to impossible and time-consuming. Additionally, this can pose high risks of injuries and cross-contamination when sampling for MP and dissolved contaminants.

To close this gap, we developed, constructed and in-house manufactured an innovative microplastics eluate lysimeter (MEL) which combines the simultaneous sampling of MP and released contaminants in one integrative laboratory lysimeter system to assess emissions from seepage water into groundwater layers or drainage water. The main objectives of the MEL construction were firstly to develop an automated, straightforward and easy-to-use system, which requires minimum maintenance for time-efficient long-term tests and could therefore be used for routine monitoring. Secondly, it had to meet all contaminant-specific material requirements: for MP detection the use of plastic-free materials or materials from non-target polymers, for heavy metals the non-use of brass components, and for PAH the use of polytetrafluoroethylene (PTFE) tubes. Finally, the system had to be safe and robust to generate reliable data regarding representativeness and reproducibility. Therefore, the MEL is based on a classic lysimeter setup, which has been upgraded and modified by the integration of a novel MP filter module. The module allows the direct filtration of the eluate through stainless-steel MP filter crucibles made with a geometric pore size of 5 µm [7, 8]. Ahead of the MP filter module, a stainless-steel sieve is installed to retain the soil sample (mesh size: 1,000 µm). Therefore, the MEL allows MP sampling of the health-relevant particle sizes of $1{,}000 \geq 5$ µm. The MP filter crucibles can be directly measured by thermal extraction desorption-gas chromatography/mass spectrometry (TED-GC/MS) without sample transfer losses and thus

reduced cross-contamination risks. TED-GC/MS is a fast automated method for the determination of MP masses, which uses polymer-specific decomposition products for MP detection [25, 26, 41]. Since its first introduction in 2015, TED-GC/MS established itself as an analytical MP monitoring method (ISO/DIS 16094–3: 2024, ISO/TR 21960: 2020), which provides robust data for various environmental matrices [9, 42, 53].

The key objective of this study was to evaluate the contaminant releases from artificial turf systems via seepage water by developing and optimising the MEL to obtain reliable and reproducible data. Therefore, this study compared environmental contaminant emissions of three artificial turf scenarios at different ageing states (fabric-new/unaged, artificially aged and real-time aged): i) the past (oTurf: old, fossil-based turf with synthetic infill), ii) the present (fTurf: most commonly installed turf in Germany, fossil-based with EPDM infill) and iii) the future (rTurf: turf with recycled grass fibres and no synthetic rubber infill). To simulate the outdoor stress during the turf lifespan of approximately 15 years, fabric-new turfs and EPDM granulate were accelerated aged by UV weathering and subsequent mechanical stress. Complementary to TED-GC/MS analyses for MP masses, the eluates were also analysed for PAH using gas chromatography/mass spectrometry (GC/MS) and for heavy metals using inductively coupled plasma-optical emission spectroscopy (ICP-OES).

Methods

Materials

Artificial turf components

Artificial turf pitch components were fabric-new and provided by Polytex Sportbeläge Produktions-GmbH (Grefrath, Germany), concretely rTurf (turf with recycled polyethylene (PE) grass fibres, LT Cross R 235 18/8), fTurf (fossil-based turf, LT Cross 235 18/8), the elastic layer and EPDM and sand infill. Figure 1a gives an exemplary schematic overview of an artificial turf system. rTurf and fTurf consisted of PE grass fibres which are tufted with winding yarn of polyethylene terephthalate (PET) into a geotextile or carpet backing of polypropylene (PP), which is glued on the back with polyurethane (PU) to secure the grass fibres (Fig. 1b). Additionally, sand infill is used to weigh down the artificial turf and to keep the grass fibres upright. For fTurf, additional EPDM granules were added (4.2 kg/m^2, Fig. 1c).

Underneath the artificial turf is an elastic layer mostly consisting of SBR granules from end-of-life car tyres bound with PU for better performance. Finally, an unbound base layer of mineral aggregates functions as a drainage layer and as a frost protection layer. The two analysed real-time aged old turfs (oTurf^1/oTurf^2) including their respective sand/synthetic infill mixtures, were provided by the artificial turf recycling company FormaTurf (Essen, Germany). oTurf^1 consisted of PE grass fibres, PP backing and PET winding yarn, a polystyrene-based glue and an EPDM/sand infill mixture. oTurf^2 was composed of PE grass fibres, PP backing and winding yarn, SBR-based glue and an unspecified thermoplastic elastomer (TPE) and sand infill mixture. All synthetic rubber/infill mixtures were representatively divided using a stainless-steel riffle splitter. All turf samples were first cut to pieces 20 cm in diameter and then nine small holes were randomly added into the backing to allow drainage of the eluent.

Unbound base layer

100 kg quartz gravel of different grain size fractions was washed and homogenised using an Eirich intensive mixer to obtain a grain size distribution in accordance with requirements for building material mixtures for frost protection layers [20, 35]. Thereby, the quartz fractions were mixed as follows: 2–4 mm (45%), 4–8 mm (45%) and 8–16 mm (10%). The gravel was then sieved to separate the fine fraction (< 2 mm), which was generated during mixing. Next, the gravel was divided into representative 25 kg portions and annealed overnight at 600 °C in ceramic trays to remove any potential plastic particles. After cooling down, the gravel was washed several times with deionised water until the water was clear to remove fine particles < 1 mm and then dried at 30 °C. Each MEL was filled with 10 kg gravel and irrigated for 7 h to remove the last fine adhesive gravel particles, which could potentially clog the MP filter crucibles. Stainless-steel round filters (mesh size: 5 µm, Gebr. Kufferath AG, Düren, Germany) were inserted into the MP filter module to remove larger gravel particles, which could potentially clog the small PTFE tubes. The gravel was then left in the MEL for approx. 2 d to allow residual water to run off. As the gravel was still moist, it was necessary to determine the saturation time using a complete test system to prevent residual water from the gravel being collected within the first fraction. The saturation time was 1 h.

Accelerated ageing of artificial turf

To simulate the outdoor weathering during the turf service lifespan of 15 years, the artificial turfs (rTurf/fTurf) and EPDM infill were accelerated aged using a combination of UV weathering and mechanical stress. First, the samples were UV irradiated in a weathering device (Global UV Test 200, Weiss Umwelttechnik GmbH, Reiskirchen, DE) using UVA-340 nm fluorescent lamps in accordance with DIN EN ISO 4892–3:2016 [22]. The temperature range was −10 to 70 °C, simulating both cold and warm exposure or summer and winter phases. A

24 h cycle was as follows: 1:13 h heating up, 21:04 h constant 70 °C, 1:13 h cooling down, 0:30 h constant −10 °C. The long 70 °C phases served as a temperature-induced reaction accelerator for polymer ageing. The artificial turf samples (dimensions: 80×40 cm) were vertically attached in the weathering device with metal hooks. EPDM granules were UV weathered horizontally with deflection mirrors in nine stainless-steel containers with sample weights of 150 g each (total: 1.35 kg). The artificial turf could not be subjected to irrigation or wet exposure, because potentially formed MP would have been flushed into the UV weathering device. As a compromise, a constant relative humidity of 90% was chosen. Since the EPDM granules were UV weathered horizontally, they were additionally exposed to moisture by daily manual watering of 100 mL of deionised water for each container. For the calculation of the irradiation time, the target irradiation of 15 years in Potsdam (2,700 MJ/m^2 UV, Deutscher Wetterdienst [15]) was used as an example for central German UV conditions. Thus, the artificial turf was UV irradiated for 16 d and the EPDM granules for 35 d. Further details on the UV irradiation time calculation can be found in Kittner et al. [40]. After UV weathering, the mechanical stress on artificial turf and its EPDM granules over its service lifespan of 15 years was simulated in a Lisport wear device (Labosport, Le Mans, FR) in accordance with DIN EN 15306: 2014 and FIFA guidelines [36]. For this purpose, the samples were subjected to 60,000 cycles with two stainless-steel rollers with polyamide cleats, each weighing 28.5 kg, whereby the second roller rotated at a 40% lower speed than the first roller. The sand and EPDM infill masses varied depending on the artificial turf type and were based on the manufacturer installation specifications for real sports pitches. Therefore, rTurf was mechanically stressed using 24.0 kg/m^2 sand, while for fTurf a mixture of 15.3 kg/m^2 sand and 4.2 kg/m^2 EPDM was used.

Construction of the microplastics eluate lysimeter

The MEL consists of three main components (Fig. 2a + b): 1. control module with irrigation system; 2. glass lysimeter with MP filter module and 3. eluate collecting bottles with vacuum coupling. Figure 2d shows the control module (BMT Fluid Control Solutions GmbH, Friedrichsdorf, DE), which is connected to the in-house deionised water supply (pressure: 5–6 bar). First, a water detector with an upstream solenoid shut-off valve is installed and the water detector placed on the laboratory floor as a safety measure to shut off the water supply in the event of a leakage. Subsequently, a water pressure regulator reduces the in-house line pressure to a water pressure of 1 bar for optimal irrigation of the mist spray nozzle. Following is a digital timer with a solenoid valve which allows automatic long-term experiments with variable irrigation intervals. The control module is connected via silicon hose with the irrigation system (Fig. 2e). There, the silicon hose is attached to a height-adjustable rod into which a nozzle head (spray angle: 80°, full cone spray pattern, Micro Rain Systems, Altenburg, DE) is screwed. The height adjustment enables different irrigation angles and sample filling heights. The irrigation characteristics can be changed by using different nozzle heads. This allows the simulation of fine mist, drizzle or rain. The rod is screwed into the lysimeter lid, which sits in the upper flange on top of the glass lysimeter (outer/inner diameter: 215/200 mm, height: 650 mm), which is firmly mounted to a table. The upper lid, upper and lower flange, rod and nozzle head are made of the non-target polymer polyvinyl chloride. The transparent glass cylinder allows the monitoring of the correct functioning of the MEL system and the general experiment process. The sample configuration corresponded to the schematic structure in Fig. 1a up to the building ground (Fig. 2f). The cylinder is placed on the lower flange (Fig. 2b + g), which is funnel-shaped for improved eluate run off.

On top of the lower flange is a stainless-steel sieve that retains large solid particles but allows MP (< 1 mm) to pass through. Following next is the MP filter module (Fig. 2h), which is newly constructed to automatically filtrate the eluate through MP filter crucibles (Fig. 2i, Gebr. Kufferath AG) and contain MP ≥ 5 µm, but can also be used with round filters. Finally, the eluate is collected through a PTFE hose in a 20-L glass bottle coupled with a vacuum pump that generates a low vacuum (700 mbar, Fig. 2a) to facilitate filtration through the small-mesh MP filter crucibles. Figure 2g shows an additional safety overflow (height: 200 mm) with a built-in sieve (mesh size: 5 µm) so that—in the event of MP filter crucible clogging—the eluate can be collected in a 10-L safety glass bottle. Both eluate collecting bottles are placed on a rolling board to transfer the bottles to a water pump and scale for i) collecting 1 L eluate samples for subsequent PAH and heavy metal analyses, ii) weighing the eluate for determination of the flow rate and liquid-to-solid ratio (l/s) of the fractions and iii) emptying the collecting bottles. For easy and fast emptying of the MEL after the experiments, a stainless-steel auxiliary device has been manufactured (Fig. 2c), which is secured around the MEL with a tension belt.

Simultaneous sampling concept

To unite the specific analysis requirements of the different environmental contaminants, a joint sampling concept was developed based on a similar to DIN 19528–23: 2023 [17] (up-flow laboratory-scaled column percolation test). The l/s ratios were determined using the total

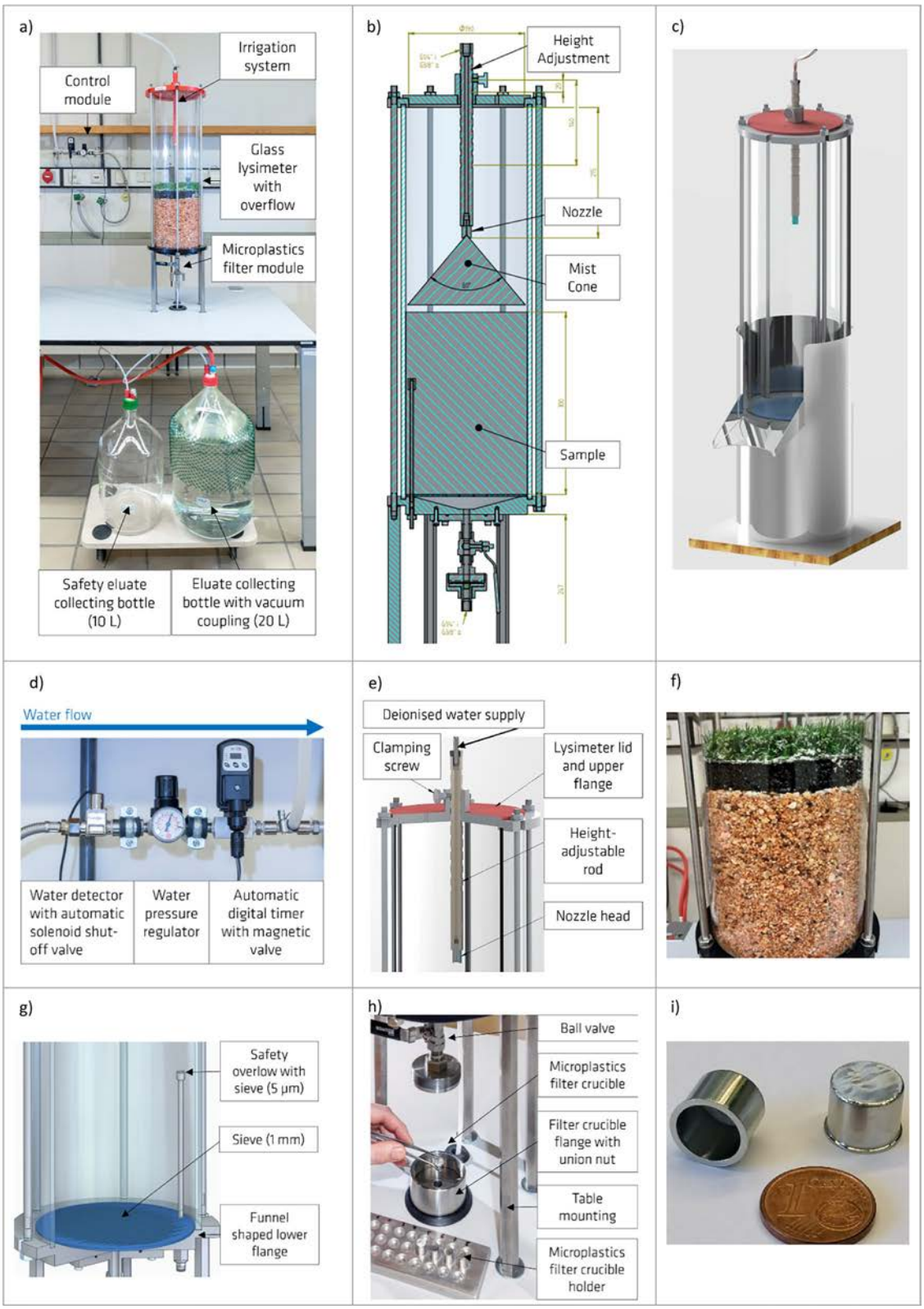

Fig. 2 Structure and main elements of the MEL: **a**) overview, **b**) technical drawing, **c**) auxiliary emptying device, **d**) control module, **e**) irrigation system, **f**) artificial turf system, **g**) lower flange with overflow, **h**) MP filter module, **i**) MP filter crucibles

sample masses (dry matter) and eluent volume resulting from the flow rate and percolation time (without saturation time). The targeted l/s of the fractions were modified and ranged from l/s 0.3 to 25. The total eluent volume was calculated corresponding to field conditions of the natural precipitation in Central Germany of an artificial turf sports pitch over its service lifespan of 15 years. Here, Potsdam served as a regional benchmark with an average annual precipitation of 585.8 L/m^2 [16]. Based on the glass cylinder area of 0.03 m^2, this corresponds to 18.4 L/year or a total target irrigation volume of 276 L for the simulation of 15 years. For time efficiency of the long-term experiments, in total four MEL were constructed and sampled simultaneously. To compare the effects of accelerated ageing on contaminant emissions, the MEL experiments were carried out with both farbric-new and accelerated aged artificial turf of the same sample (rTurf/fTurf), each over the same irrigation volume of 276 L. The eluent flow rate was measured twice: i) before the start of the experiment by collecting and weighing the obtained eluate over a defined time period and ii) continuously during the experiment by weighing the eluate volume obtained from the individual fractions. The irrigation time of the individual fractions was controlled by an automated time switch. To prevent clogging of the MP filter crucibles (Fig. 2f), the irrigation intervals were adapted to the expected MP emissions and were either set to 7 h or 3 h. At a flow rate of approx. 45 mL/min, this corresponded to eluate volumes of approx. 18 L or 8 L, respectively. Consequently, the number of fractions analysed varied between 18 and 35 microfilter crucibles per experiment.

For the determination of the solid matter content, the densities of the individual components were measured in accordance with DIN 66137–2:2023 [18] using a gas pycnometer (Ultrapyc 5000, Anton Paar, Ostfildern-Scharnhausen, DE) under a helium atmosphere at 20 °C. The density of the complete system was calculated as the mean value of the densities of the individual components, taking into account the mass fractions of the individual components in the complete system. Additionally, the total density of the complete system is required for further calculations of the flow regime parameters, e.g. pore volume, flow rate and contact time. The detailed data on the individual turf components of the column packaging can be found in the Supplementary Information (SI) in SI-Tab. 1.

Heavy metal analysis

The eluates were analysed for heavy metals using ICP-OES (iCAP7400, Thermo Fisher Scientific, DE, USA) in accordance with the current standards DIN EN ISO 22036: 2022 [23] and EN ISO 11885: 2009 [28]. Aliquots of 20 mL were taken from the eluates and preserved with five drops of 65% nitric acid based on DIN EN ISO 5667–3: 2018 [29] (pH < 2). Analyses were performed using the QTEGRA software (Thermo Fisher Scientific). The limits of quantification (LOQ) were determined in accordance with DIN 32645: 2008 [19], Formula 14, and can be found in SI-Tab. 2.

PAH analysis

PAH is a class of substances comprising several hundred individual compounds, which consist of interconnected aromatic benzene ring systems. For this assessment, 16 substances selected by the US EPA are analysed and summed up (^{16}PAH), which cover the spectrum from naphthalene with two aromatic rings to the higher molecular PAH up to six rings. The limit values were set for an l/s of 2 L/kg which has been proven to be suitable for risk assessment. PAH concentrations in the eluates were determined in accordance with DIN EN 17503: 2022 [21] using GC/MS. For sample preparation, 900 mL eluate was weighed in a 1-L DURAN® glass bottle and spiked with 100 µL internal standard (PAH-Mix 31, Dr Ehrenstorfer GmbH, Augsburg, DE, diluted with acetonitrile to a concentration of 1 mg/L each of naphthalene-d8, acenaphthene-d10, phenantrene-d10, chrysene-d12 and perylene-d12). 50 mL hexane was added and the mixture agitated in a horizontal shaker for 1 h at 125 rpm. The content of the glass bottle was then transferred to a 1 L separatory funnel by rinsing with ultrapure water and, after sufficient separation, the aqueous phase was isolated from the organic phase. The latter was transferred to a 200-mL Erlenmeyer flask and dried using sodium sulphate (Na_2SO_4) for a minimum of 30 min. The dry extract was then transferred to a 450 mL special vessel and residual Na_2SO_4 was washed three times with 20 mL hexane. The wash solution was combined with the extract in the Rocket vessel. To this mixture, 50 µL iso-octane was added as a keeper. The extract was then concentrated to approx. 200 µL using an evaporator (Rocket Synergy, Genevac Ltd., Ipswich, UK) with the "MTBE 100" method (35 °C, ΔT, final stage 2 min, cooler: −10 °C). The concentrated extract was quantitatively transferred to the volumetric flask and diluted up to 1 mL with hexane. Subsequently, the PAH in the extract were analysed using a GC/MS system with automatic autosampler (6890N, 7683B, Agilent, Santa Clara, CA, USA). The compounds were firstly separated in a chromatographic column (ZB-PAH-EU, Zebron, 2 min 50 °C, heating rate: 30 °C/min to 120 °C, 5 °C/min to 320 °C 6 min hold, helium flow: 0.8 mL/min) and then analysed in a mass spectrometer (ion source: 230 °C, quadrupole: 150 °C, electron impact ionisation: 70 eV, 5973, Agilent). The injection volume was 1 µL and the injector temperature 280 °C. The LOQ

was also determined in accordance with DIN 32645: 2008, Formula 14 [19] (see SI-Tab. 3).

Microplastics analysis

After sampling, the MP filter crucibles were oven-dried at 40 °C and weighed. MP masses were identified by TED-GC/MS using polymer-specific thermal degradation products and their specific retention times (t_R) and characteristic fragment ions. First, the crucibles were pyrolysed from 200 to 500 °C at a heating rate of 10 K/min using a thermogravimetric analyser (TGA2, Mettler Toledo Columbus, OH, USA, nitrogen atmosphere, flow rate: 50 mL/min). The operating temperature was optimised to the narrower temperature range of 200–500 °C (in previous work: 25–600 °C), as this is the range in which most polymers pyrolyse. As a result, only the thermal degradation products of the relevant temperature range are sampled, the solid-phase adsorber gets less loaded with irrelevant thermal degradation products (e.g. of environmental matrices) and the TED-GC/MS analysis is faster. Further details on the new methodological optimisations of the TED-GC/MS analysis will be soon available in Wiesner et al. (tba) [52]. The GC/MS measurements of the solid-phase adsorber (polydimethylsiloxane adsorber, Envea GmbH, Karlsfeld, DE) were performed in a gas chromatograph (7890, 5977B, Agilent), which allowed the analysis of the mass-to-charge ratio (m/z) from 35 to 350. Further information on the TED-GC/MS measurement principles and parameters is described in detail in the literature [1, 25, 41]. Within this work, the TED-GC/MS polymer marker pool was expanded and new polymer marker compounds for EPDM and PU were determined. An overview of all polymer marker compounds used for MP detection is given in SI Tab. 4. The polymer-specific limits of detection (LOD) and LOQ were determined from the fivefold or tenfold signal-to-noise ratio using the polymer marker compound and its m/z used for quantification and the enhanced ChemStation software (version 2015, Agilent). The determined LOD's were 1.1 µg for PE, 0.03 µg for PP, 0.2 µg for PET, 0.05 µg for SBR, 2.1 µg for EPDM and 0.3 µg for PU. For MP quantification, the polymer-specific response factors were determined by one-point calibrations of the respective turf system components. The LOQ's were as follows: 2.2 µg for PE, 0.06 µg for PP, 0.4 µg for PET, 0.1 µg for SBR, 4.2 µg for EPDM and 0.6 µg for PU. All presented TED-GC/MS results are above LOQ.

Quality control and assurance

To reduce the risks of cross-contamination, the MEL fulfils all contaminant-specific material requirements (MP: plastic-free or non-target polymer materials, PAH: PTFE hosing, heavy metals: no brass materials). Further, all laboratory work was carried out under maximum plastic-free conditions, with minimal sample exposure times and plastic-free equipment (e.g. stainless-steel or glass). After the experiments, all parts of the MEL were dismantled and thoroughly cleaned. The glass cylinder and all glass collecting bottles were first washed with soap, then rinsed with deionised water, ethanol and finally with acetone. The smaller MEL components (1 mm sieve, overflow filter, MP filter module, MP filter crucibles) were also first washed with soap, subsequently rinsed with deionised water and then cleaned in an ultrasonic bath, first with ethanol and then with acetone for 15 min each. The upper part of the MP filter module containing the ball valve needed to be cleaned manually due to avoiding damage to the sealing rings. Additionally, the PTFE and silicone hoses were rinsed with ethanol. For quality assurance and to avoid possible carry-over and contamination, blank values were carried out by irrigating the empty, sample-free MEL for 7 h or 18 L and subsequent TED-GC/MS, GC/MS and ICP-OES analyses, each in duplicate. The TED-GC/MS blank results showed minimal MP contamination in one blank with 0.01 mg/m^2 PP and 0.01 mg/m^2 PET, whereas the second blank was MP-free. Additionally, analytical blank measurements were carried out for TED-GC/MS analyses before each sample measurement, which corresponds to the procedural blank measurements.

Further, an initial screening of MP recovery rates was performed using a polymer mixture of two certified MP reference materials of PET (BAM-P206) and PE (BAM-P210) as well as a PP reference material candidate. Details about their particle size distributions can be found in the respective data sheets and reports in the BAM webshop (https://webshop.bam.de). Duplicate determinations were carried out to simulate different magnitudes of MP emissions: one with 0.3 mg each and a second one with 1 mg each of PET, PE and PP. The polymer mixtures were evenly distributed on the metal sieve of an empty MEL and irrigated for 7 h. The average flow rate was 44 ± 3 mL/min, resulting in a total irrigation volume of 18 L. The filter crucibles were then oven-dried at 40 °C and subsequently analysed by TED-GC/MS.

Results and discussion

Heavy metal emissions

The release of heavy metals from seepage water from artificial turf has been reported in previous studies [6, 45]. The strongest limit values of the German regulation [5] to be kept at l/s 2 L/kg for soil materials are 210 µg/L for zinc, 41 µg/L for copper, 31 µg/L for nickel and 19 µg/L for chrome. For recycling materials (quality RC-1), the limit values are less stringent: 110 µg/L for

copper, 150 µg/L for chrome and no limits for zinc and nickel. Figure 3 illustrates the results for these heavy metals for all turf system scenarios investigated. It shows that at l/s 2 L/kg there were no exceedances of the strongest German limit values. Only the initial concentrations for nickel were somewhat higher, representing the easily mobile fraction (so-called first flush) of nickel.

This could be due to a surface wash-off, particularly in the case of the new turf containing recycled grass fibres (rTurf_new). The zinc concentrations of real-time aged turf (oTurf^{2}) were at a higher level (up to 123 µg/L) in comparison to the values for the other turf systems. This indicates that in earlier productions of artificial turf components, here most likely the TPE rubber infill, more zinc oxide was used, which serves to vulcanise rubber. This is further emphasised by the fact that no Zinc was found in the eluates of the new, unaged turf systems. Zinc is mainly released from old tyres that are processed into SBR granules and used in the elastic base layer. Due to the varying quality of tyres, the zinc concentrations also fluctuated greatly in previous studies [10, 37, 38]. Ageing did not influence the chrome release significantly. But for zinc copper and nickel, the ageing led to somewhat higher releases, as can be seen in Fig. 3. There were no critical concentrations measured for other metals in the eluates. All heavy metal emission results can be found in detail in SI-Tab. 2.

PAH release

Figure 4 illustrates the release of the sum of ^{16}PAH ($\sum$ ^{16}PAH) during the MEL experiments. Results showed that all PAH concentrations were below the legal limits of BMUV [5] for $\sum$ ^{16}PAH at l/s 2 L/kg, although naphthalene is not considered for the limit values of eluates due to its volatile character. For all turf systems investigated, a decrease in PAH release is observed with increasing l/s. The highest initial concentration with $\sum$ ^{16}PAH of 1.4 µg/L was found in the new turf containing recycled

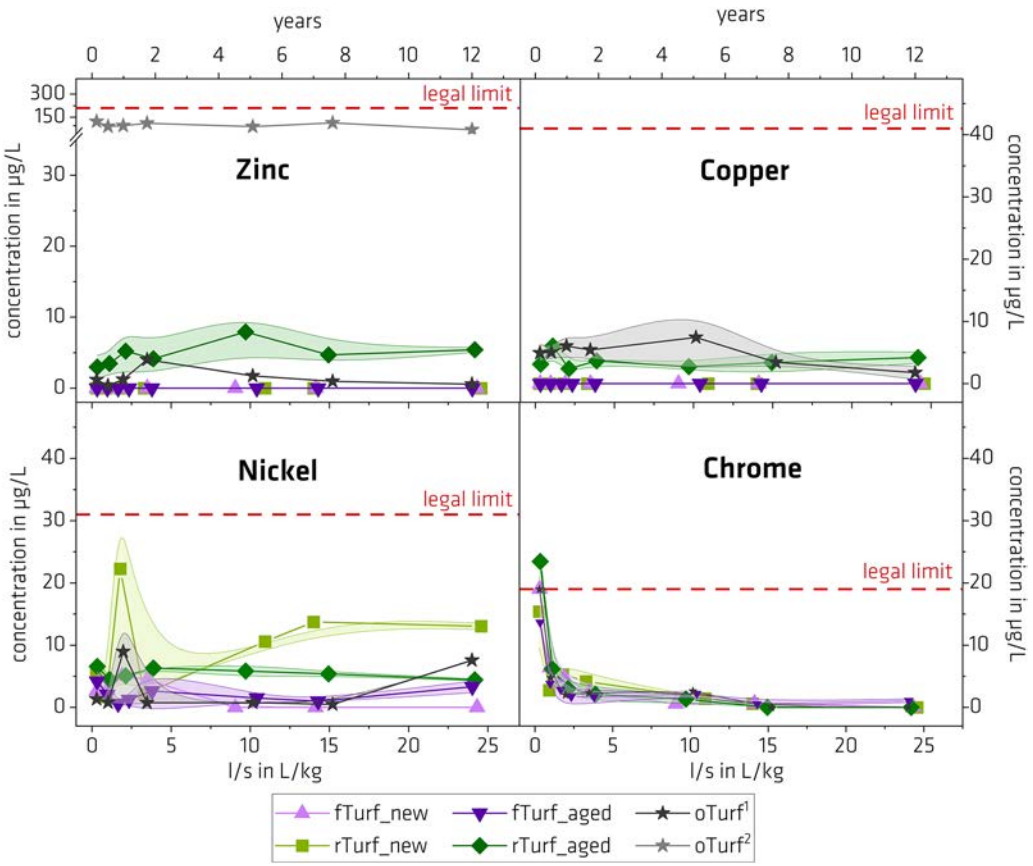

Fig. 3 Heavy Metals results of MEL experiments using ICP-OES. Shown are the mean metal concentrations with their ranges in µg/L with their ranges of the different ageing status of the analysed artificial turf scenarios over the course of the analysed liquid-to-solid ratio (l/s). As a rule of thumb, it can be assumed that an l/s of 2 L/kg represents roughly one year of irrigation under German conditions. Additionally, the red dashed lines present the respective German legal limits for soil materials at l/s 2 L/kg [5]. Since just the zinc concentrations of both real-time aged turfs (oTurf^{1}/oTurf^{2}) varied greatly, their zinc results are presented separately. For copper, nickel and chrome their values were similar and thus shown together

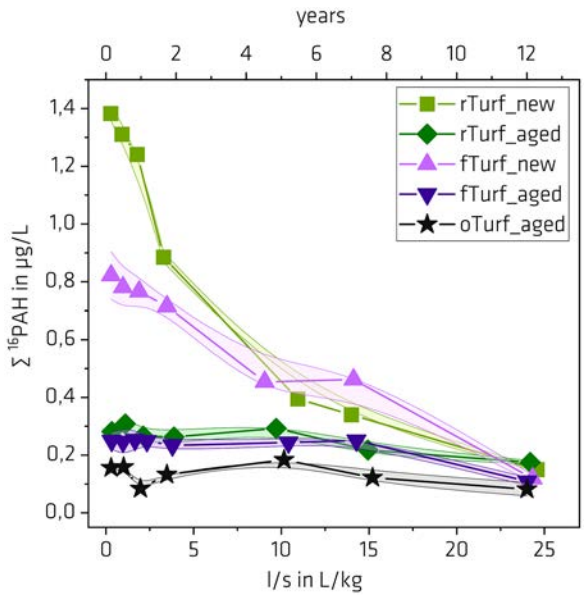

Fig. 4 PAH results of MEL experiments using GC/MS. Presented are the mean ∑ ^{16}PAH concentrations of all analysed artificial turfs systems at different ageing status with their ranges in µg/L over the course of the liquid-to-solid ratio (l/s). As a rule of thumb, it can be assumed that an l/s of 2 L/kg represents roughly one year of irrigation under German conditions. Both real-time aged turf (oTurf^{1}/oTurf^{2}) ∑ ^{16}PAH results were similar and thus shown together

grass fibres (rTurf_new), followed by the fabric-new turf containing fossil-based fibres (fTurf_new) with 0.8 µg/L. The limit value for the best quality of recycling material (RC-1 according to BMUV [5]) is 4 µg/L for ∑ ^{15}PAH (without naphthalene). The main amount of PAH in the eluates consisted of naphthalene, especially for the fabric-new systems (see Tab. SI–3). Additionally, acenaphthene, which is used in polymer production, is present in measurable concentrations, although its water solubility is relatively low. At the final l/s of the experiments (25 L/kg), the concentration of ∑ ^{16}PAH decreased to a comparable low level between 0.1 and 0.2 µg/L for all turf systems investigated, since the PAH with better water solubility are very likely almost depleted. It can be expected that the PAH release remains at a similar level in the following due to the very low water solubility of the substances with molecules of a larger size (higher number of aromatic rings). Ageing of turf components caused a lower release of PAH, as a loss of PAH occurred in the course of ageing. The concentration levels in the fabric-new systems can be considered maximum values for PAH emissions. For soil material, there is a limit value for benzo-a-pyrene of 0.2 µ/L available [5], which refers to the most cancerogenic PAH and was always kept for the eluates of all analysed artificial turf systems at l/s 2 L/kg.

Microplastics emissions

Recovery rates

The MP recovery rates differed depending on the polymer type. The individual mean recovery rates with their ranges were as follows: 91.1 ± 31.8% for PE, 45.4 ± 2.7% for PP and 95.4 ± 15.9% for PET. There are multiple potential reasons for the partially low recovery rates and high deviations. Under-quantification could occur due to the filtering setup with the MP filter crucibles, as only MP ≥ 5 µm is retained. Furthermore, over-quantification could be due to the release of residual MP particles from previous experiments that could not be removed by cleaning of the MEL, as the recovery rate experiments were performed after the experiments with the turf samples. However, the different particle size distributions of the representative test materials probably had the greatest influence on the recovery rates. Here, D50 is a central parameter that describes the median particle size distribution or the equivalent particle diameter of the measured volume, below which 50.3% of the particles lie [3]. Complementary analyses showed the following D50 values of the polymer test materials: 18.0 ± 0.2 µm for PE (BAM-P210, n = 30 measurements), 62.6 ± 1.9 µm for PET (BAM-P206, n = 30 [3]) and 261.7 ± 4.5 µm for PP (BAM-P208, n = 30). Therefore, PE had the lowest median particle size while having the highest recovery rate deviation and PP had the highest median particle sizes while having the lowest deviation. Since the recovery rate is a percentual value, the loss or gain of individual particles can have high influences on the recovery rate, which was particularly true for PP, which had the largest mean particle sizes. As a result, the surface tension of the water was probably too strong inside the MEL, and the relatively fine irrigation mist was too weak to transport the large and heavy PP particles to the filter crucibles.

Challenges of EPDM analysis using TED-GC/MS

For the quantification of MP emissions from synthetic rubber infill, the TED-GC/MS polymer marker pool had to be expanded to include EPDM detection. Using non-target analyses of different EPDM granules and a literature review [11, 50], a homologous series of triplets each consisting of methyl alkene, alkene and alkane were identified as the main thermal decomposition products. Since alkanes and alkenes are non-specific thermal decomposition products which can originate from different aliphatic compounds, seven methyl alkenes were chosen as characteristic polymer marker compounds for TED-GC/MS analysis (see SI-Tab. 4). For validation in soil matrices, two terrestrial middle earths (organic contents: < 1%) were spiked with two different EPDM granules at different weight percentages (wt%), in duplicate. The soil

sample masses were 20 mg and 50 mg and EPDM masses between 0.2 and 0.3 mg, corresponding to 0.5 wt% and 1 wt% EPDM. Although some polymer markers (EPDM-1, EPDM-2, EPDM-6) were difficult to detect due to coelutions with organic compounds from the soil matrix, the results showed overall a good identifiability of most EPDM markers (EPDM-3, EPDM-4, EPDM-5, EPDM-7) in both matrices at different concentrations. However, the recovery rates revealed that the quantifiability of EPDM in both soil matrices is affected by matrix compounds. As a result, at high EPDM concentrations (1 wt%), the uncertainties were lower with recovery rates of 67% and 100% than at low EPDM concentrations (0.5 wt%) with recovery rates of 163% and 243%.

In the next validation step, EPDM granules were analysed in a polymer matrix consisting of artificial turf components (PE, PP, PET, PU). The results showed a recovery rate of EPDM of 127 ± 8% and thus an over-quantification, indicating that the new EPDM markers were also present in other turf components. Detailed TED-GC/MS analyses showed that the EPDM markers were only found in the analysis of pure PE of the grass fibres, but not in the other turf components. Therefore, using methyl alkenes as EPDM markers could potentially lead to EPDM over-quantification when PE particles are present in the sample. The similarity of the thermal decomposition products of EPDM and PE can be explained by their polymeric molecular structures, as both contain ethylene units. Since EPDM also consists of a propylene and a diene unit, here 5-ethylidene-2-norbonene according to the manufacturer, less dominant thermal degradation products were further examined to overcome this analytical challenge. Unfortunately, this approach was not successful because either the EPDM thermal pyrolysis degradation products described by other researchers, e.g. 3- and 4-ethylidene-1-cyclopentene [11], were not detectable or non-specific. Another approach was indirect detection via EPDM vulcanisation agents, e.g. benzothiazole or 2-methyl-benzothiazole. However, detailed analyses of TED-GC/MS results showed that this was unsuitable due to high detection inconsistencies and thus posed the risk of EPDM under-quantification.

In conclusion, the analytical challenges of EPDM detection using TED-GC/MS analysis have not yet been resolved and both analytical approaches can lead to either potential over- or under-quantification of EPDM mass contents in unknown samples. Due to a lack of alternatives and because risk assessment is of crucial importance within this project, the decision was made to use the seven methyl alkenes listed in SI-Tab. 4, knowing well that this could lead to a potential over-determination. For this reason, the best identifiable thermal decomposition product, 2-methyl-1-undecene (EPDM-3), was used for EPDM quantification to estimate maximum MP emissions of EPDM rubber infill.

Microplastics masses

Figure 5 shows the summed total mean MP results (log) over the total irrigation volume, which can be found in detail in Table 1. The highest MP contents were detected in both real-time aged oTurf[1]/oTurf[2] representing the past scenario (∑MP: 136.4–252.5 mg/m^2). The main MP emissions sources were the synthetic rubber infills (∑EPDM/TPE: 42.2–192.5 mg/m^2) and the grass fibres (∑PE: 21.7–38.7 mg/m^2). This can be explained by the fact that on an artificial turf, outdoor stress caused by weathering (e.g. by UV radiation or photo-oxidation) and mechanical stress (e.g. by sand infill, studs on football shoes, artificial turf maintenance machines) mainly affect the rubber granules and the grass fibres, leading to material fragmentation. In this context, it was surprising that only comparably low PP contents formed by the backing surfaces were detected in both real-time aged oTurfs (∑PP: 1.9–2.3 mg/m^2), since they were also exposed to real outdoor stress. This indicates that the backing is protected by the rubber granules against the outdoor stress, especially from the abrasion effects caused by the sand infill.

Additionally, high contents of the backing glue were detected in oTurf[1] with 69.6 mg/m^2 and oTurf[2] with 19.5 mg/m^2. This is probably due to the sample placement in the MEL glass cylinder, as i) the backing glue was

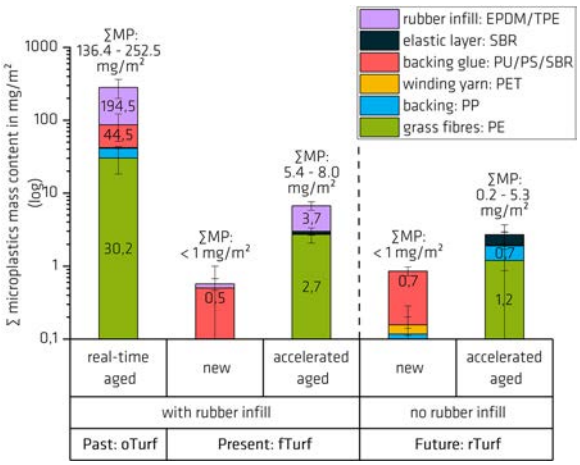

Fig. 5 MP mass results of MEL experiments using TED-GC/MS. Shown are the mean ∑MP masses in mg/m^2 with their ranges (log), subdivided in artificial turf scenarios with and without synthetic rubber infill and their ageing status. The polymer abbreviations are as follows: polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET) polyurethane (PU), polystyrene (PS), styrene butadiene rubber (SBR), ethylene propylene diene monomer rubber (EPDM), thermoplastic elastomer (TPE)

Table 1 Summary of MP emissions of all analysed artificial turf scenarios of different ageing states expressed in mg/m^2

Polymer type	Artificial turf component	Microplastics masses of artificial turf scenarios in mg/m^2					
		Past: oTurf		Present: fTurf		Future: rTurf	
		Real-time aged oTurf [1]	Real-time aged oTurf [2]	Fabric-new	Accelerated aged	Fabric-new	Accelerated aged
EPDM	Rubber infill	42.15	–	0–0.15	3.06–4.32	–	–
TPE	Rubber infill	–	192.54	–	–	–	–
PE	Grass fibres	21.70	38.65	–	2.31–3.18	0–0.26	0–2.39
PP	Backing	2.28	1.89	–	0.04–0.05	0–0.03	0.01–1.46
PET	Winding yarn	–	–	–	–	0.01–0.07	0–0.11
SBR	Elastic layer/backing glue	0.67	19.47	–	0–0.48	–	0–1.42
PS	Backing glue	69.58	–	–	–	–	–
PU	Backing glue	–	–	0.13–0.79	–	0.58–0.76	–
∑MP in mg/m^2		**136.38**	**252.54**	**0.13–0.94**	**5.41–8.02**	**0.83–0.89**	**0.16–5.28**

Since duplicate determinations were carried out, the polymer mass contents are shown with their value ranges. A hyphen indicates that no MP content above the limit of quantification was detected

already brittle and ii) cutting out the round 20 cm turf samples could have led to fraying of the edges and thus to increased MP formation. Further, it is important to note that the backing glue of oTurf[2] was SBR-based and had therefore the same thermal decomposition products as SBR, making them analytically indistinguishable from the SBR elastic layer. However, since the backing glue was so brittle, it can be assumed that the majority of the detected SBR can be assigned to MP emissions from the backing glue.

The TED-GC/MS results of the present scenario showed that for the fabric-new fTurf, minimal total MP emissions (∑MP: 0.1–0.9 mg/m^2). This was mainly from the PU backing glue, probably due to residual particles produced when cutting the turf samples. Additionally, only minimal emissions from the rubber infill (∑EPDM: 0–0.2 mg/m^2) were detected. These were probably smaller particles formed during production or transport, as the granules are produced with a target size > 1 mm (Fig. 1c). The accelerated ageing of fTurf led to MP increases of approximately tenfold and thus to total MP emissions of 5.4–8.0 mg/m^2, mainly from the rubber infill (∑EPDM: 3.1–4.3 mg/m^2) and grass fibres (∑PE: 2.3–3.2 mg/m^2). Further, minor emissions of the PP backing and SBR elastic layer were detected.

The future scenario had overall the lowest MP emissions of all analysed turf scenarios. Like the present scenario, the fabric-new rTurf had only minor total MP emissions (∑MP: 0.8–0.9 mg/m^2), mainly from the backing glue (∑PU: 0.6–0.8 mg/m^2) which was probably due to particle residues formed during the sample cutting. After accelerated ageing, the MP emissions also increased by approximately a fivefold to a total MP content of 0.2–5.3 mg/m^2. Here, the main MP emission rTurf components were the grass fibres (∑PE: 0–2.4 mg/m^2), backing (∑PP: 0–1.5 mg/m^2) and the elastic layer (∑SBR: 0–1.4 mg/m^2). For comparison, e.g. with field data, all MP results are also available in SI-Tab. 4 expressed in the unit µg/L. The MP contents in µg/L differ marginally from those in mg/m^2, as the irrigation volume per MEL differed slightly per experiment.

Microplastics emissions per artificial turf sports pitch

All MP results are expressed in the unit mg/m^2 to form a database that enables an extrapolation of MP emissions per artificial turf pitch of any size. The aim here is to get an idea of the approximate order of magnitude of maximum MP emissions. When extrapolating the MP results for an aged standard artificial turf sports pitch (7,000 m^2) during its service lifespan of 15 years, the MP emissions from seepage water into the groundwater layers or drainage water correlated to 954.7–1,767.8 g for the past, 3.8–56.1 g for the present, and 1.1–37.0 g for the future scenario. To our best knowledge, this is the first published data on experimentally determined mass content-based results of MP emissions from seepage water of artificial turf sports pitches. Overall, the MEL results are indicating that MP emissions towards the groundwater layers or drainage water are comparably low, which confirms the theoretical evaluation of Bertling et al. [4]. However, all MP emission paths must be included in a total MP assessment, e.g. wind, water run-off and artificial turf maintenance.

Conclusions

Although there is data on the release of pollutants for individual components of artificial turf systems, it is not possible to derive an assessment of the risk to soil

and groundwater from this. Instead, the approach of considering the entire structure of artificial turf systems has once again proven its worth in this project since it was also suitable for quantifying the discharge of MP. The artificial turf results showed that all contaminant emissions of PAH and heavy metals were under the German legal limits and thus uncritical—also for the aged samples. Regarding the MP emissions, all fabric-new turf showed minimal MP emissions, while turf ageing led to MP increases, mainly from synthetic rubber infill and grass fibres. In practice, the newly developed MEL proved to be a suitable holistic sampling device for simple, straightforward and automated monitoring of particulate and dissolved contaminant emissions from simple soil matrices, like artificial turf, from seepage water into the groundwater layers. Additionally, the MEL could also be used for emission analyses of other materials, e.g. for building or construction, to investigate MP transports and potential leaching of hazardous substances. In conclusion, the MEL has the potential for implementation in future research concepts and may be applied to other matrices to obtain data in the context of the European Water Framework Directive and future European regulations.

Abbreviations

EPDM	Ethylene propylene diene monomer rubber
fTurf	Artificial turf with fossil-based PE fibres with EPDM rubber infill representing the present scenario
GC/MS	Gas chromatography/mass spectrometry
ICP-OES	Inductively coupled plasma-optical emission spectrometry
l/s	Liquid-to-solid ratio
LOD	Limit of detection
LOQ	Limit of quantification
m/z	Mass-to-charge ratio
MEL	Microplastics eluate lysimeter
MP	Microplastics
oTurf	Old, real-time aged artificial turf with fossil-based PE fibres and synthetic rubber infill representing the past scenario:
oTurf[1]	With EPDM infill, oTurf[2] with TPE infill
PAH	Polycyclic aromatic hydrocarbons
PE	Polyethylene
PET	Polyethylene terephthalate
PP	Polypropylene
PTFE	Polytetrafluoroethylene
PU	Polyurethane
rTurf	Artificial turf with recycled PE fibres without rubber infill representing the future scenario
SBR	Styrene butadiene rubber
TED-GC/MS	Thermal extraction desorption-gas chromatography/mass spectrometry
TPE	Thermoplastic elastomer
t_R	Retention time
wt%	Weight percentage

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12302-025-01235-1.

Supplementary file 1

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Author contributions
MK supervised the project, curated the data, visualised the figures and wrote the original draft. All authors reviewed and edited the final manuscript. UK and KA acquired the funding, with UK being the project administration. UK, KA, MK, BC and SS conceptualised the study. The methodology was developed and validated by MK, BC, KA and UK. SS designed and engineered the Microplastics Eluate Lysimeter. The experimental investigations were carried out by MK, BC and TW. The data were formally analysed by MK and UK.

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Data availability
The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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Publisher's Note

Krichman Affidavit Attachment: his quotes from WaPo articles he thinks are important:

The following 3 quotes are from a Washington Post video specifically addressing the flooding on Canal Drive in Carolina Beach. Video was produced by Ray Whitehouse with reporting by Brady Davis and Niko Kommenda. June 13th 2024.

“As much as an additional foot of seas level rise is expected along this stretch of the coast by 2050.”

“That, Scientists say, means that sunny day flooding will become only more chronic in Carolina Beach.”

This “forces difficult questions about how to adapt to this changing reality” - Washington Post video by Ray Whitehouse with reporting by Brady Davis and Niko Kommenda. June 13th 2024.

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Quotes from another Washington post article “The Drowning South, Anatomy of a Flood” June 11th 2024 by Brady Dennis, Niko Commend and Emily Wright for the Washington Post
This article specifically is speaking about Canal Drive in Carolina Beach

The Washington Post had set up cameras in multiple places along the road, capturing in real time the many ways that ever-higher tides exacerbate flooding, and why local efforts to cope with this growing scourge are often falling short in communities where seas are rising the fastest.

"local efforts to cope with this growing scourge are often falling short in communities where seas are rising the fastest."

"flooding more persistent and more insidious over time.”

"in an area where sea levels have risen 7 inches since 2010 — among the highest in the country, according to a Post analysis.”

"In Carolina Beach alone, they have documented 60 days over the past year when Canal Drive flooded, many of those during clear weather. That’s far more than the four to eight high-tide floods projected by the federal government for the same period, based on measurements from a nearby tide gauge.”

“Seas are rising across the South faster than almost anywhere.”

“She and her colleagues working to decipher a fuller picture in specific places, keep arriving at the same conclusion. “It is flooding more than we know,” she said- Professor Katherine Anarde “

“The deepening problems of sea rise poses such a daunting task”

“The stormwater pipes and drains along this stretch of Carolina Beach were built generations ago, when they were above the high-tide line. But as this part of the Southeast Atlantic coast experiences **one of the most rapid sea-level surges on earth,** high tides regularly swallow the infrastructure that is supposed to drain city streets, leaving water nowhere to go.”

“But such approaches can prove expensive, face regulatory hurdles”

“As sea levels continue to rise, Anarde says, these types of floods will happen during more high tides, linger longer, and cause only more damage. “It’s just going to get worse,” she said.”

“Over the past year, researchers have logged dozens more flooding events along Canal Drive than official estimates from the National Oceanic and Atmospheric Administration, whose scientists say high-tide floods in the South are already happening five times as often as just several decades ago.”

“As times go on, and the trend continues- seas are predicted to rise as much as an additional foot along this stretch of coast by 2050- these floods will force hard questions in coastal towns.”

“Absent significant investments in adaptation, we’ll see a rapid increase in the incidence of chronic flooding relative to what we are seeing right now,” “Hino said”. Miyuki Hino, University of North Carolina at Chapel Hill

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Following Quotes from “Land-based Sensors Reveal High Frequency of Coastal Flooding” Studying flood sensors in Carolina Beach NC
Authors: Miyuki Hino, Tessa Fridell and Anthony Whipple, University of North Carolina at Chapel Hill; Katherine Anarde, Ryan McCune, Thomas Thelen, Elizabeth Farquhar and Perri Woodard, North Carolina State University
Published: June 2, 2025 Nature Communications Earth & Environment
This work was done with support from the U.S. Department of Homeland Security under grant number 2015-ST-061-ND0001-01.

“In addition to being inaccurate in terms of how often it is flooding, our findings also show that the actual duration of the floods is longer than is captured by the HTF and NWF thresholds,” Hino says. “Essentially, the thresholds don’t adequately account for how long it takes water to drain off of land. “Every community is unique, so there’s no one-size-fits-all solution,” says Hino. “But with more accurate data, we can help communities assess what response strategy is best for them, now and in the future.”

Anarde says. “For example, Carolina Beach had 65 days of flooding.”

“More accurate information on coastal flooding can inform where and how we invest resources in building more resilient communities,” says Anarde.

TAILOR MADE GRASS

LIMITED 15 YEAR LANDSCAPE WARRANTY

WARRANTY PERIOD

This Warranty shall be in force and remain in effect for a period of fifteen (15) years beginning on the date of invoice ("Effective Date") and, except as otherwise provided, covers North America including the United States and Canada.

WARRANTY

1. All synthetic turf is subject to normal wear and tear. Normal wear and tear are not a manufacturing defect and is not covered by this warranty.
2. Pile Retention Limited Warranty: Tailor Made Grass warrants that the Product will retain at least 50% of its pile fiber when:
   a. when properly installed by an installer who originally purchased the material from Tailor Made Grass;
   and
3. Proration of Warranty. Years 1-8 (100% product replacement), Years 9-15 (10%)

LIMITATIONS AND EXCLUSIONS TO THIS WARRANTY.

1. Purchaser may make a one-time transfer of this warranty to the owner of the project in the product(s) were installed. No further transfer, conveyance, or assignment of all or any rights under this warranty are permitted without prior written consent from Tailor Made Grass. Any such transfer or assignment without prior written consent shall void this warranty.
2. This Warranty covers first quality Products only, and is not applicable to Products sold as seconds, closeouts or irregulars.

3. This Warranty does not apply to product installed with known visual defects. Installer must notify manufacturer prior to installation of known problem else warranty will be void.
4. This Warranty specifically excludes defects or damages caused by:
   a. improper installation, joining of seams or repairs;
   b. Burns, cuts, accidents, vandalism, abuse, negligence, or neglect;
   c. Improper design or failure of the sub-base of the sports field, golf green, court, or lawn;
   d. Wear or abrasion caused by inadequate sub-base;
   e. Wear or abrasion under swing sets, slides, and other high friction play equipment;
   f. Wear or abrasion on high friction areas of field;
   g. Wear due to lack of infill/no infill;
   h. Shrinking or melting of fibers due to reflection or other sources of extreme heat;
   i. Texture variation of fibers (sub-pile/thatch products);
   j. Expansion / Contraction of product due to lack of infill, improper securing of edges;
   k. Use of infill products of an incorrect grade resulting in seam ruptures;
   l. Failure to maintain infill products at the correct level of 50% of pile height or otherwise noted on product specification sheets;
   m. Use of inappropriate footwear or sports equipment (or lack of footwear);
   n. Use of chemicals, herbicides, pesticides (unless approved by yarn manufacturer in writing)
   o. Use of improper cleaning methods
   p. Loss of tuft bind / fiber loss due to chemical and/or gas spills and leaks (includes leaks
   from equipment driven or used on turf surfaces);
   q. Wear / Fiber loss due to animals / animal traffic;
   r. Any harmful chemical reaction to the product caused by infill materials
   s. Acts of God or other conditions beyond the reasonable control of Purchaser or Tailor Made Grass;
   t. Post fibrillation after or during installation for purposes other than to get infill materials in place;
   u. Failure to install seams, lines, logos properly;
   v. Failure to properly maintain / repair seams, lines, logos;
   w. Packing, matting, or roll crush marks of Products as these are inherent characteristics of Products manufactured using polypropylene/olefin and nylon fibers;
   x. Product damage occurring during the shipping/transportation process. All shipping claims must be filed against the truck line in question, a signed BOL must me noted with any shipping defects at time of delivery / pickup;
   aa. Heat / temperatures of turf surface due to sources of natural

environment, including sunshine, high air temperatures, and underlayment pad products.

NO EXPRESS OR IMPLIED WARRANTIES

LIMITATIONS ON LIABILITY

Tailor Made Grass' sole liability for any and all damages resulting from any cause whatsoever, whether based in contract, negligence, strict liability, other torts, or otherwise shall be limited to the original price of the Product.
IN NO EVENT SHALL TAILOR MADE GRASS BE LIABLE FOR LOST PROFITS OR REVENUES, LOSS OF USE OR SIMILAR ECONOMIC LOSS, OR FOR INDIRECT SPECIAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR SIMILAR DAMAGES ARISING OUT OF OR IN CONNECTION WITH SUCH CAUSE.

PURCHASER'S OBLIGATION TO INSPECT UPON DELIVERY

Purchaser must promptly inspect all Products upon delivery and notify Tailor Made Grass in writing of any defects, shortages or non-conformities within 30 days of the date of delivery ("Delivery Date"). Notwithstanding anything herein to the contrary, if Purchaser fails to promptly inspect and identify any Product defects, shortages, or non-conformities which are discoverable by inspection within 30 days of the Delivery Date, Purchaser shall be deemed to have accepted the Products as is and Tailor Made Grass shall have no obligations and/or liability with respect to such defects, shortages.

MODIFICATION

THIS WARRANTY CONSTITUTES THE FINAL AND EXCLUSIVE WARRANTY TERMS FOR THE PRODUCTS AND MAY NOT BE MODIFIED EXCEPT BY AN OFFICER OF Tailor Made Grass.

GOVERNING LAW

This Warranty and its terms and conditions shall be exclusively governed by the laws of the State of Georgia without regard to its conflicts of law provisions. Purchaser agrees that the exclusive venue for any action pertaining to transactions between the Company and Tailor Made Grass shall be the Superior

Court of Murray County, Georgia Purchaser hereby waives all personal jurisdiction defenses with respect to said venue.

LABORATORY TEST REPORT

Report # 81620B
Lab Test Number: 3230-4985
Report Date: November 4, 2020

ASTM F1551; Suffix DIN 18-035 Water Permeability

TESTING SERVICES
www.testingservices-usa.com ▪ (706)226-1400
office@testingservices-usa.com

CLIENT:

Company:	ProGlobal Products
Address:	PO Box 1432
	Dalton, GA 30722
Requested By:	Forrest Jaquith

TEST MATERIAL:

Date Material Received:	October 23, 2020
Material Type:	Synthetic Turf
Material Condition:	Excellent, New
Material ID:	60 oz
Infill:	None

TESTING METHODS REQUESTED:

Testing Services Inc. was instructed by the client to test for the following...			
Standard:	ASTM F1551	Test Method:	Standard Test Methods for Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials: Suffix-DIN 18-035, Part 6: Water Permeability of Synthetic Turf Systems and Permeable Bases

SAMPLING PLAN:

Sampling Date:	10/23/2020

- Specimen sampling is performed in the sampling department at TSI.
- The sampling size of specimens is determined by the test method requirements.
- In the event a specific sampling size is not called for, a determination will be made based on previous testing experience, and approved for use by an authorized manager.
- All samples are subjected to the outside environmental conditions of temperature and relative humidly.
- Sample requiring pre-determined exposure to specified environmental conditions based on a specific test method, take place in the departments in which they are tested

DEVIATION FROM TEST METHOD:

State reason for any Deviation from, Additions to, or Exclusions From Test Method.
None

PROCEDURE:

This test method determines the rainfall drainage capacity (permeability) of the playing surface. Test data values represent drainage rates vertically thru the turf only, and do not take into account the percolation properties of an infill, pad and/or an underlying sub base. Three specimens, 11.5" diameter, were cut from the 15' turf roll, side-center-side manner. Each turf specimen was securely fastened to the permeability tube using mechanical flanges, ensuring vertical water flow thru the product. Water was pumped into the tube faster than could exit, until the water level reached 6". The water source was shut off, allowing the accumulated 6" water level to recede. The recede was timed via stopwatch until the water level exited the turf. The flow time was recorded in seconds. This procedure was repeated a total of 4 times where, the first pass was for conditioning, with passes 2,3,4 used for averaging. This process was repeated on the remaining specimens.

DEVIATION FROM TEST METHOD:

State reason for any Deviation from, Additions to, or Exclusions From Test Method.
None

TEST SUMMARY:

Specimen #	Drainage (Seconds)	gal/min/yd²	Rainfall Capacity (inches/hour)
1	4.7	430.1	1319.6
2	4.1	491.1	1506.7
3	4.3	474.2	1454.8
Average	4.4	465.1	1422.5

Uncertainty:
We undertake all assignments for our clients on a best effort basis. Our findings and judgments are based on the information to us using the latest test methods available.
TSI can only ensure the test results for the specific items tested.
Unless otherwise noted in the deviations sections of this report, all tests are performed in compliance with stated test method.

Test Report Approval:

Digitally signed by Erle Miles
DN: cn=Erle Miles, o=Testing Services Inc., ou, email=tsioffice@optilink.us, c=US
Date: 2020.11.05 14:34:22 -05'00'

Erle Miles, III, Lab Director Testing Services (TSI) LLC

TSi Accreditation: TSi is a certified independent testing laboratory by the STC (Synthetic Turf Council).

Testing Services (TSI) LLC
817 Showalter Avenue
PO Box 1343
Dalton, GA 30721

COASTAL
SYNTHETIC TURF


COASTAL
SYNTHETIC TURF

Krichman Variance

Statements of support from Neighbors Amy Groff (815 Canal Drive) and Justin Cox (811 Canal Drive)

On Feb 24, 2025, at 8:45 AM, Goebel, Christine A <Christine.Goebel@deq.nc.gov> wrote:

Received. Thank you Ms. Groff.

From: amyogroff@gmail.com <amyogroff@gmail.com>
Sent: Monday, February 24, 2025 8:34 AM
To: Goebel, Christine A <Christine.Goebel@deq.nc.gov>
Subject: [External] Turf on 813 Canal

You don't often get email from amyogroff@gmail.com. Learn why this is important

CAUTION: External email. Do not click links or open attachments unless verified. Report suspicious emails with the Report Message button located on your Outlook menu bar on the Home tab.

My name is Amy Groff and I own the property at 815 Canal Dr, immediately to the north of 813 Canal Dr. When Andy Krichman bought the property at 813 Canal Drive the high tide washed up onto his property twice a day and the property was in rough shape. (Prior to Andy buying it we had actually been told it was going to be a tear down and the lot was not rebuildable). He has done a tremendous job with the property and made many improvements. The property looks great! The addition of the artificial turf is very asthetically pleasing and stabilizes the ground. There is never any standing water on it, he doesn't need to put chemicals down like natural grass, and the ground stays in place as opposed to some of the nearby properties that have experienced sinkholes recently. In my opinion, it would create an undue hardship for him to have to remove the turf. I also believe if he is able to leave this artificial turf in place it would make sense to allow others to utilize the product as well. I had bought turf for my side yard, but was told within a few days that I needed to remove it, which I did immediately. I then had to pay for sod as well as have the expense of turf I could not return.
I am in favor of allowing the artificial turf to remain in place at 813 Canal Dr. I will be very curious to confirm if turf is going to be allowed in the future! I do think there are some positives to it and am interested to learn if moving forward turf will be allowed.

Amy Groff
Sent from my iPhone

From: Justin Cox <justin.brycecox@gmail.com>
Subject: Turf on Canal
Date: February 11, 2025 at 2:08:42 PM EST
To: christine.goebel@deq.nc.gov
Cc: andy@krichco.com

Hi Christine

My name is Justin Cox and I own the property at 811 Canal Dr, just to the south of 813 Canal Dr. I have seen pictures of the property at 813 Canal Dr. before Andy Krichman bought the property. . The property was in terrible condition with water washing across the property every day. I would not have purchased the property next door in that condition. Andy has dramatically improved the property. The artificial turf he has installed looks and works very well. In my opinion, it makes his and my property safer. I would like to see the artificial turf stay in place. Please let me know if I can do or say anything to assist in a positive outcome for he and others to be able to use good quality artificial turf in a responsible, environmentally safe manner such as he has done.

Thank you,

Justin Cox
811 Canal Dr
Carolina Beach NC

NORTH CAROLINA)
)
NEW HANOVER COUNTY)

AFFIDAVIT OF JOE BENSON

The undersigned being duly sworn deposes and says that he has personal knowledge of the following facts:

1. I'm Joe Benson, a resident of Carolina Beach and a member of Town Council. In addition to four years of service as a council member, I served Carolina Beach as its mayor for two years.

2. Since entering office, I've championed efforts at reducing the impacts of flooding, be it storm-related or tidal-induced (aka Sunny Day flooding). The crippling impacts of flooding have energized the Town to take immediate steps to modernize and expand stormwater infrastructure. Stormwater management is priority #1. While every corner of Carolina Beach is susceptible to flooding, no part of town experiences flooding more than the Northend, most especially along Canal Drive--ground zero.

3. I'm intimately familiar with Sunny Day flooding on Canal Drive. This issue has multiple contributing factors, including sea level rise; wind-driven events which push water southward into Myrtle Grove Sound; and crumbling, decades-old infrastructure underground. In my opinion, this worsening issue needs a multi-faceted, comprehensive solution. To date, however, there's no consensus on how to solve the problem. Arriving at a solution will require buy-in from the entirety of town Council, the town's residents and business owners and various State and Federal agencies. Resolving the issue--or at least mitigating its impacts--will cost millions of dollars.

4. I have met with Andrew (Andy) Krichman many times in regards to Northend flooding and how it continues to affect his property. During our meetings, Andy and I discussed multiple properties on Canal Drive. He offered novel, workable solutions which, if adopted, could significantly reduce flooding at those locations. Andy is highly experienced in construction, marine construction, water management and working on properties with timber management plans, ponds and other water management issues.. I was impressed with the solid, well-built bulkhead which has prevented further erosion while protecting his property from wetlands encroachment.

5. Upon completion of his bulkhead, Andy laid down artificial turf Cali 73. Beyond its pleasing aesthetics, this pervious artificial turf ensures the percolation of both tidal and storm water. Taken in total, Andy's construction of a new bulkhead and installation of artificial turf underscore his desire to not only protect his property but also surrounding private and public property.

6. I've witnessed that Cali 73 has been working well and functioning successfully at 813 Canal Drive for over two years. In my opinion, at this point, requiring Mr. Krichman to remove the artificial turf he has installed would create an undue hardship for the long-term

protection of his property. Requiring Mr. Krichman to remove the artificial turf contradicts an underlying theme of the CRC, which seeks to "minimize loss of life and property caused by storms, flooding and long-term erosion."

7. I strongly support Andy's pursuit of a variance for the use of Cali 73 and I respectfully request the CRC grant his request to allow artificial turf Cali 73 to remain on his property at 813 Canal Drive. I understand the criticality of the Commission's role. Thank you for taking the time to consider Andy's request.

This the 31ST day of OCTOBER, 2025.

Joe Benson

New Hanover COUNTY, NORTH CAROLINA

Sworn to and subscribed before me this 31ST day of October, 2025.

Kimberlee Ward
Official Signature of Notary

Kimberlee Ward, Notary Public
[Print name]

My commission expires: 3-3-2030

KIMBERLEE WARD
My Commission Expires
NOTARY PUBLIC
March 3, 2030
NEW HANOVER COUNTY, NC

2007055189

FOR REGISTRATION REGISTER OF DEEDS
REBECCA P SMITH
NEW HANOVER COUNTY, NC
2007 NOV 16 12:55:39 PM
BK:5251 PG:2729-2732 FEE:$20.00

INSTRUMENT # 2007055189

No Revenue

Parcel ID# R08815-001-003-000

This instrument drafted by: Scott Allen, The Rosen Law Firm (no title examination performed).

After recording, mail to: Scott Allen, 4101 Lake Boone Trail, Suite 500, Raleigh, North Carolina 27617.

Brief Description for the index: LOT 14A, BLOCK 18A, Carolina Beach

NORTH CAROLINA :
: **QUITCLAIM DEED**
NEW HANOVER COUNTY :

This deed made and entered into this 2nd day of July, 2007, by and between Abigail S. Krichman ("Grantor"), of Orange County, North Carolina, and Andrew C. Krichman ("Grantee"), of Orange County, North Carolina.

WITNESSETH:

WHEREAS this deed is made pursuant to a valid consent order between the parties hereto and entered with the court, and is for a valuable consideration set out in said Agreement, the receipt of which is hereby acknowledged;

WHEREAS the purpose of this conveyance is to sever the tenancy by the entirety in the property described herein under N.C. Gen. Stat. § 39-13.3 (c) and to vest sole title in the name of the Grantee and allow the Grantee henceforth to convey and encumber said property or any portion thereof without the consent or joinder of the Grantor; and

WHEREAS it is the intention of the parties hereto that the property described herein shall be considered the separate property of the Grantee under the Equitable Distribution Act (N.C. Gen. Stat. § 50-20); and NOW, THEREFORE, Grantor, for the valuable consideration set out in the parties' said Agreement, the receipt of which is hereby acknowledged, has remised and released and by these

Grantee Address: Andrew C. Krichman,
PO Box 9400
Chapel Hill, NC 27515

presents does remise, release, and forever quitclaim unto the Grantee and his heirs and assigns all right, title, claim, and interest of the Grantor in and to a certain tract or parcel of land lying and being in the **County of New Hanover** and **State of North Carolina**, _____**Township**, which is more particularly described as follows:

> BEING ALL of Lot 14A, in Block 18A, of Carolina Beach as the same is shown on a map thereof, recorded in Map Book 3, Page 67 of the New Hanover County Registry, reference to which map is hereby made for a more particular and detailed description. Together with all improvements located on said property.

The property hereinabove described was acquired by Grantor by instrument recorded in Plat **Book 4258**, **Page 963-965**, of the New Hanover County Registry.

A map showing the above described property is recorded **in Book of Maps 3, Page 67** of the New Hanover County registry.

TO HAVE AND TO HOLD the aforesaid lot or parcel of land and all privileges and appurtenances thereto belonging to the Grantee and his heirs and assigns free and discharged from all right, title, claim, or interest of the Grantor or anyone claiming by, through, or under her.

Grantor hereby further relinquishes: (1) All rights to administer the Grantee's estate under N.C. Gen. Stat. § 28A-4-1 with respect to the real estate described herein; (2) all right of intestate succession to the Grantee's estate under N.C. Gen. Stat. § 29-14; (3) the right to an elective life estate in the Grantee's estate under N.C. Gen. Stat. § 29-30; (4) the right to receive an elective share of Grantee's estate under N.C. Gen. Stat. § 30-3.1, et seq., and (5) the right to a year's allowance in the Grantee's estate under N.C. Gen. Stat. § 30-15.

In Testimony Whereof, the Grantor has hereunto set her hand and seal the day and year first above written.

Abigail D Krichman

(SEAL) D.
Abigail S. Krichman

****

STATE OF NORTH CAROLINA

COUNTY OF WAKE

ACKNOWLEDGEMENT

I, the undersigned, a Notary Public of the County and State aforesaid, certify that **Abigail S. D. Krichman** Grantor personally appeared before me this day and acknowledged the execution of the foregoing instrument. Witness my hand and official stamp or seal, this 3rd day of July, 2007.

Notary Public: Kevin J. Stanfield KEVIN J. STANFIELD

SEAL: KEVIN J. STANFIELD NOTARY PUBLIC LEE COUNTY, NC

My commission expires: May 2012

****

The foregoing Certificate(s) of_____
_____

is/are certified to be correct. This instrument and this certificate are duly registered at the date and time and in the Book and Page shown on the first page hereof.

_____REGISTER OF DEEDS FOR NEW HANOVER COUNTY

By _____Deputy/Assistant – Register of Deeds

REBECCA P. SMITH
REGISTER OF DEEDS, NEW HANOVER
216 NORTH SECOND STREET

WILMINGTON, NC 28401

****

Filed For Registration:	**11/16/2007 12:55:39 PM**
Book:	**RE 5251 Page: 2729-2732**
Document No.:	**2007055189**
	QCD 4 PGS $20.00
Recorder:	**JOHNSON, CAROLYN**

State of North Carolina, County of New Hanover

YELLOW PROBATE SHEET IS A VITAL PART OF YOUR RECORDED DOCUMENT. PLEASE RETAIN WITH ORIGINAL DOCUMENT AND SUBMIT FOR RE-RECORDING.

2007055189

2007055189

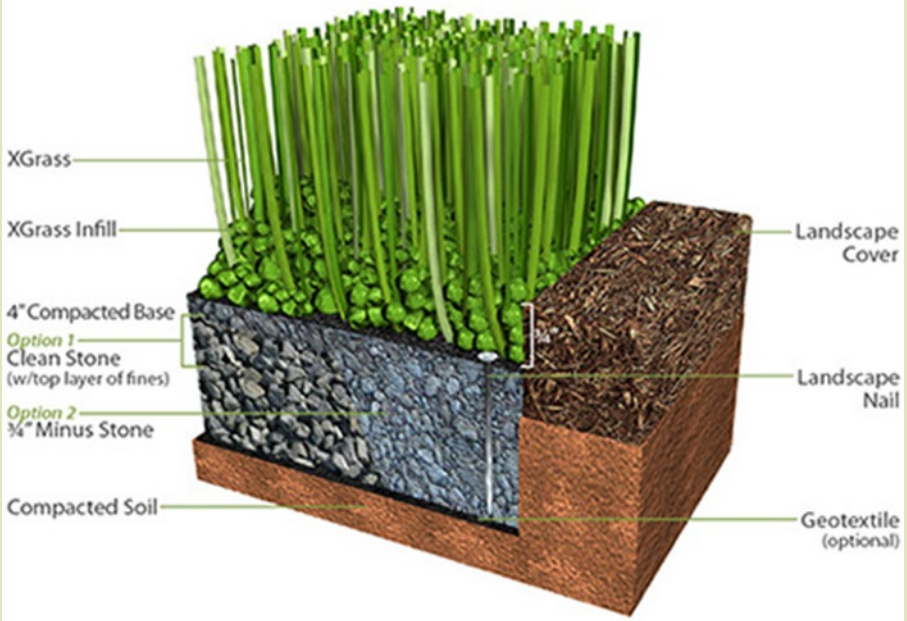
Artificial Turf Grass and CAMA Rules
November 13, 2024

Jonathan Lucas

NC Dept of Environmental Quality

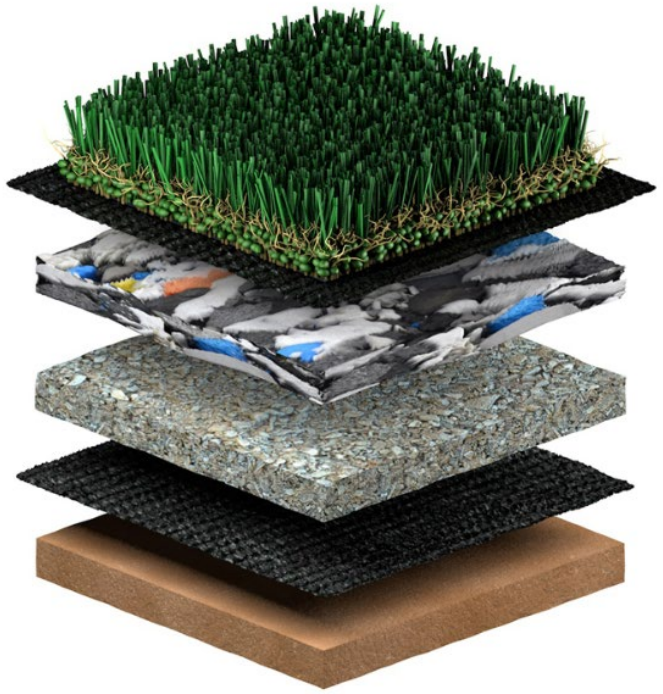
Division of Coastal Management

SYNTHETIC TURF FOR LANDSCAPES
Without Nailer Board



Compacted Base Depth - 4"
Infill Depth - ¾"

To accommodate this application prepare your site 4 ¾" below grade.

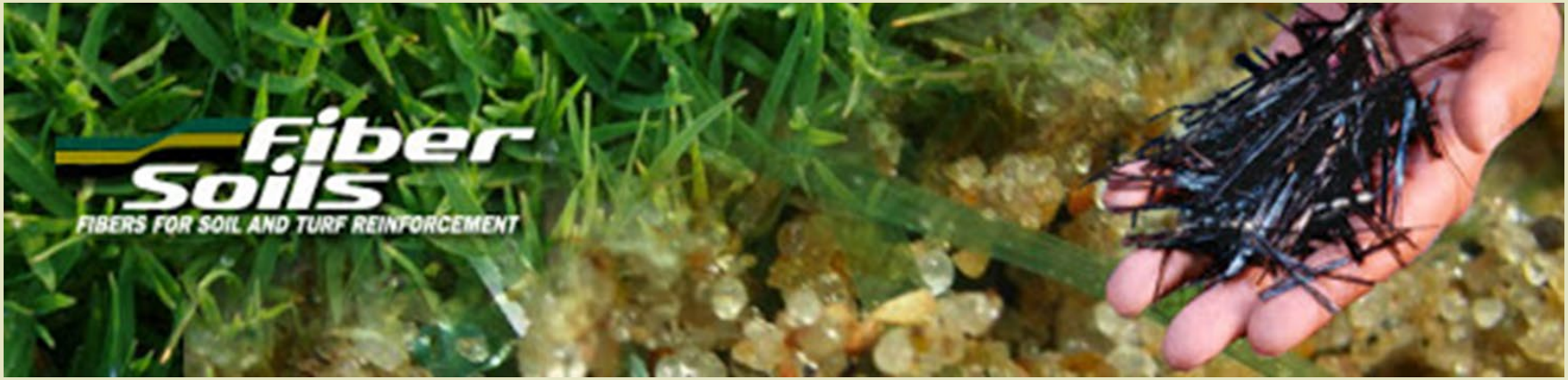


SYSTEM HIGHLIGHTS:

- Innovative *XGrass* Fibers
- Eco-friendly *Envirofill* Infill
- Ultra-permeable All-Purpose Backing
- Playground-tested *PolyGreen* Padding
- Cost-effective Drain Tile
- Proven Installation Products

XGRASS

www.xgrass.com


Fiber
Soils
FIBERS FOR SOIL AND TURF REINFORCEMENT

Division of Coastal Management

LANDSCAPE GRASS CROSS SECTION

PRECISION GREENS
SYNTHETIC TURF GOLF GREENS & LAWNS

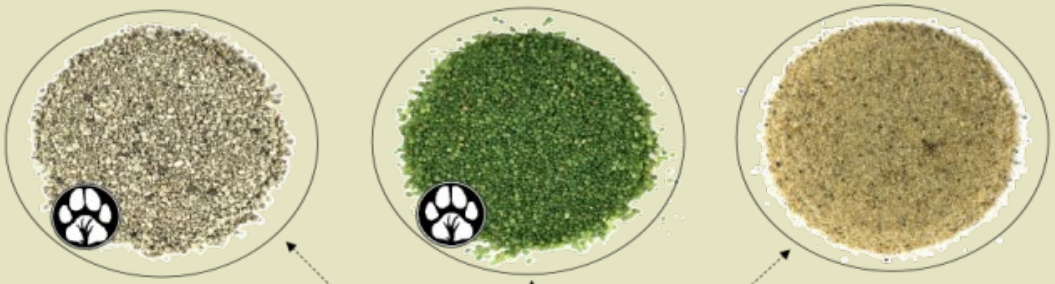
PRECISION GREENS RECOMMENDED INFILL OPTIONS

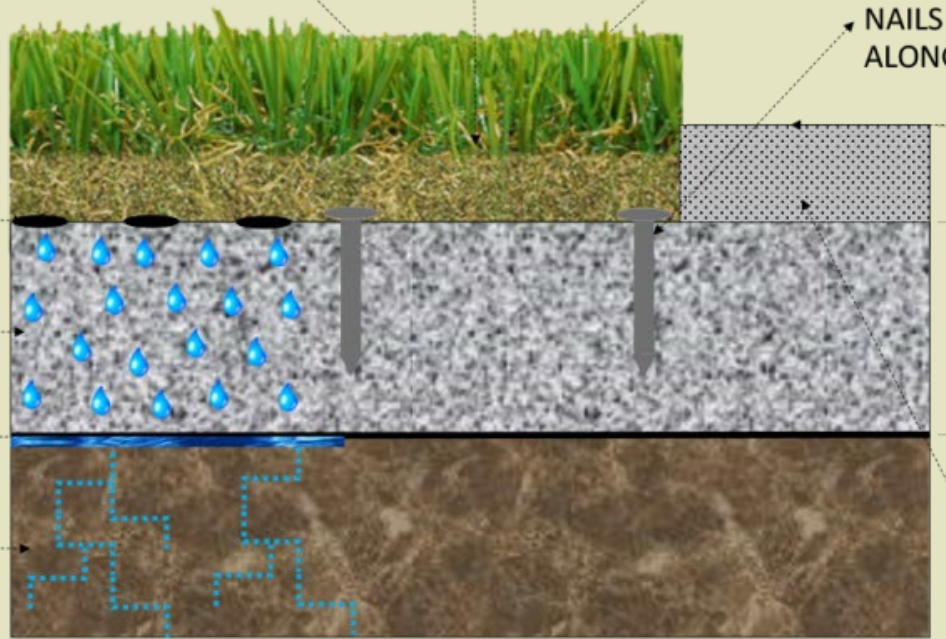
NOTE:
IF CUSTOMER HAS A PET YOU MUST USE PURE ZEO OR ENVIROFILL

PURE ZEO
(1.5-2 IBS PER SQ FT)

ENVIROFILL
(2.5-3 IBS PER SQ FT)

20/40 SILICA SAND
(2.5-3 IBS PER SQ FT)





www.precisiongreens.com

Photo source from 321Turf.com

Coastal Shoreline AEC Category

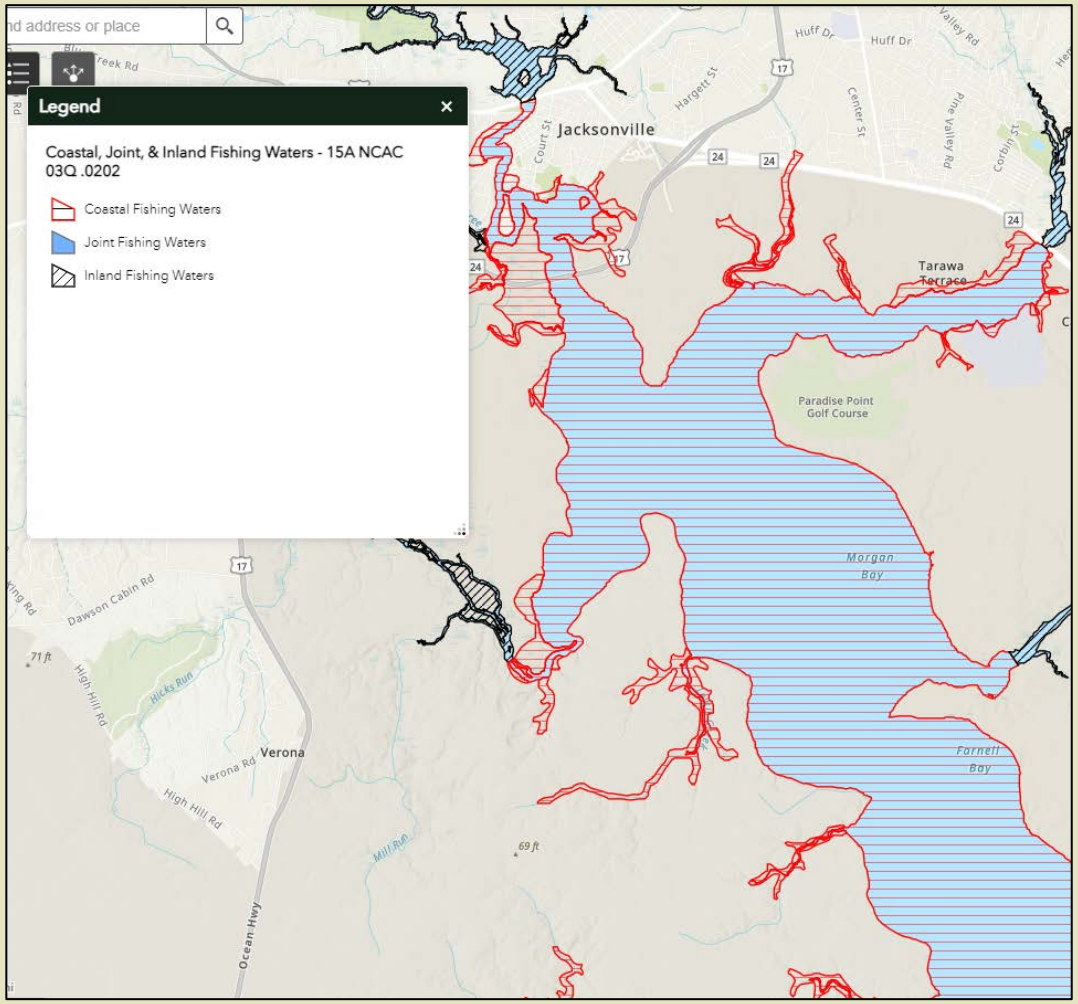
Estuarine Shoreline AEC - in effect to the end of Coastal Fishing Waters.

- Inland 75 ft* from Normal High Water

Public Trust Shoreline AEC - in effect to the extent of navigability.

- Inland 30 ft from Normal High Water

Together comprise the Coastal Shorelines AEC category

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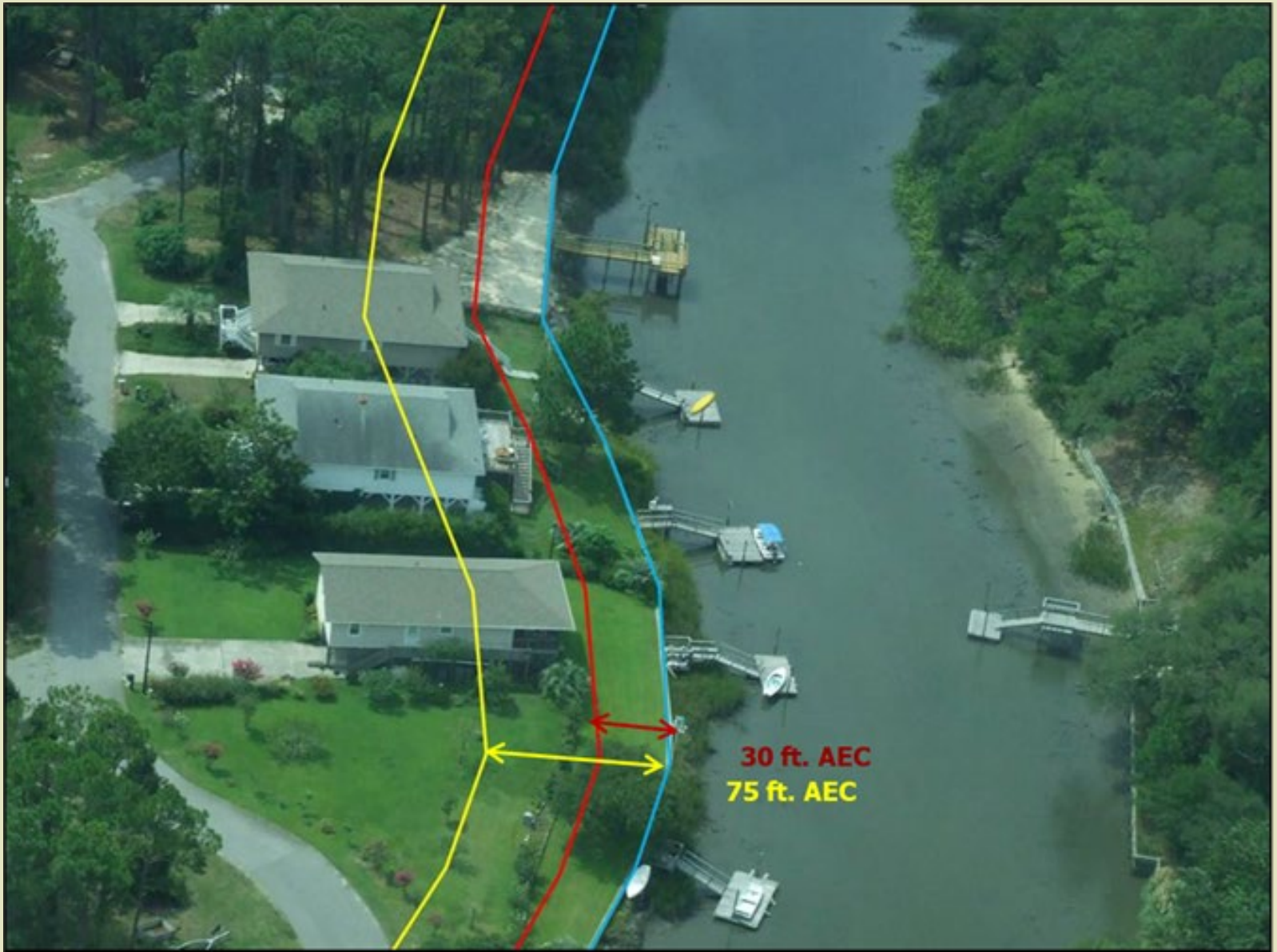
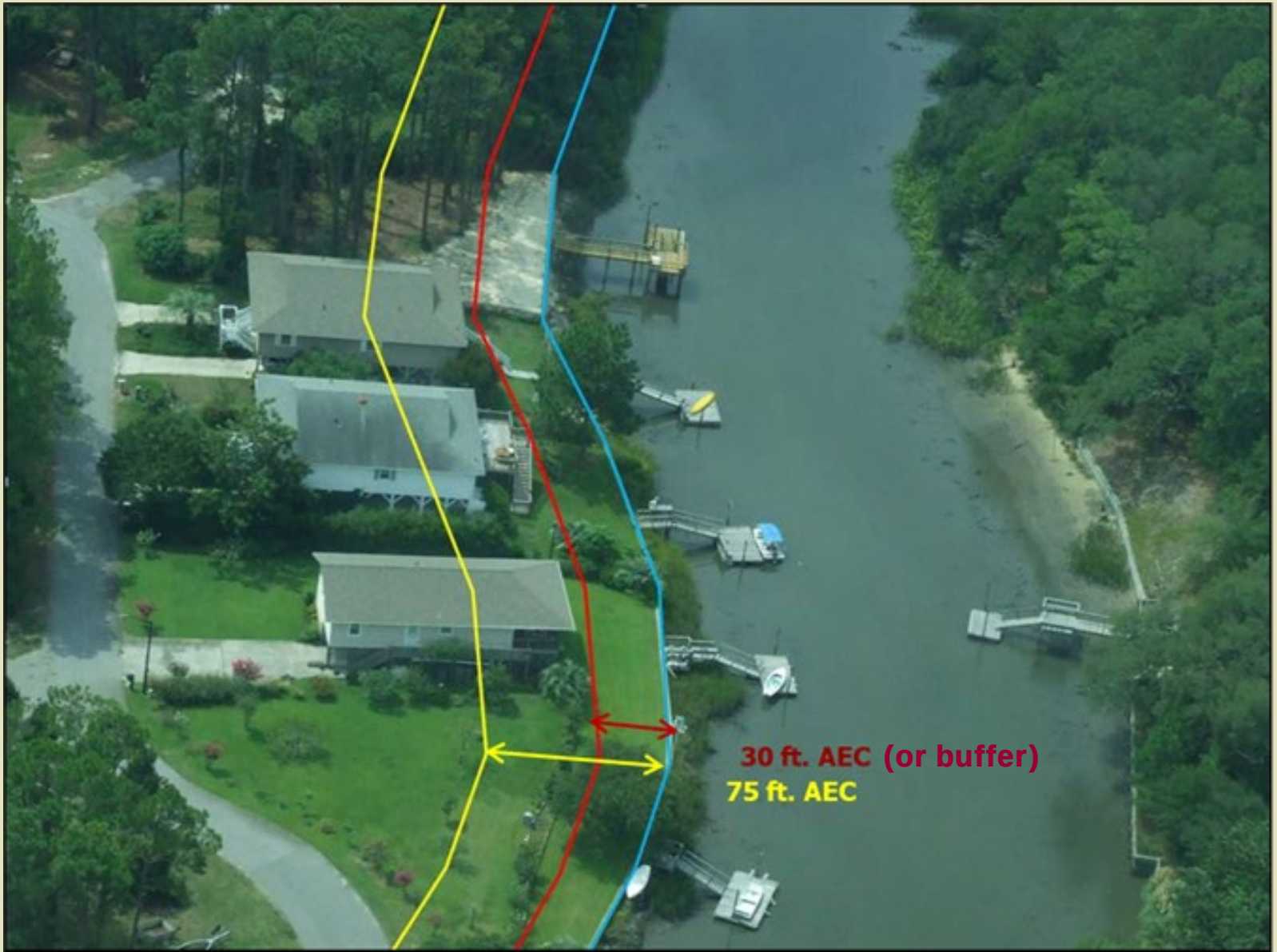

30 ft. AEC
75 ft. AEC


170


30 ft. AEC (or buffer)
75 ft. AEC

Buffer Rule 15A NCAC 07H .0209(d)(10)

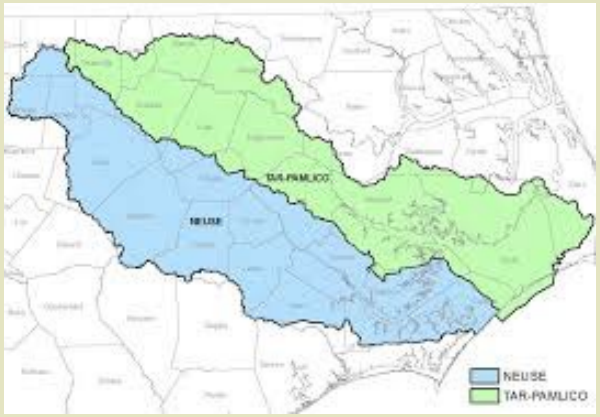
- **Permitted Water-dependent Structures**
  Docks, Piers, Boat Ramps, Bulkheads, Accessways.

- **Non-water Dependent Exceptions**

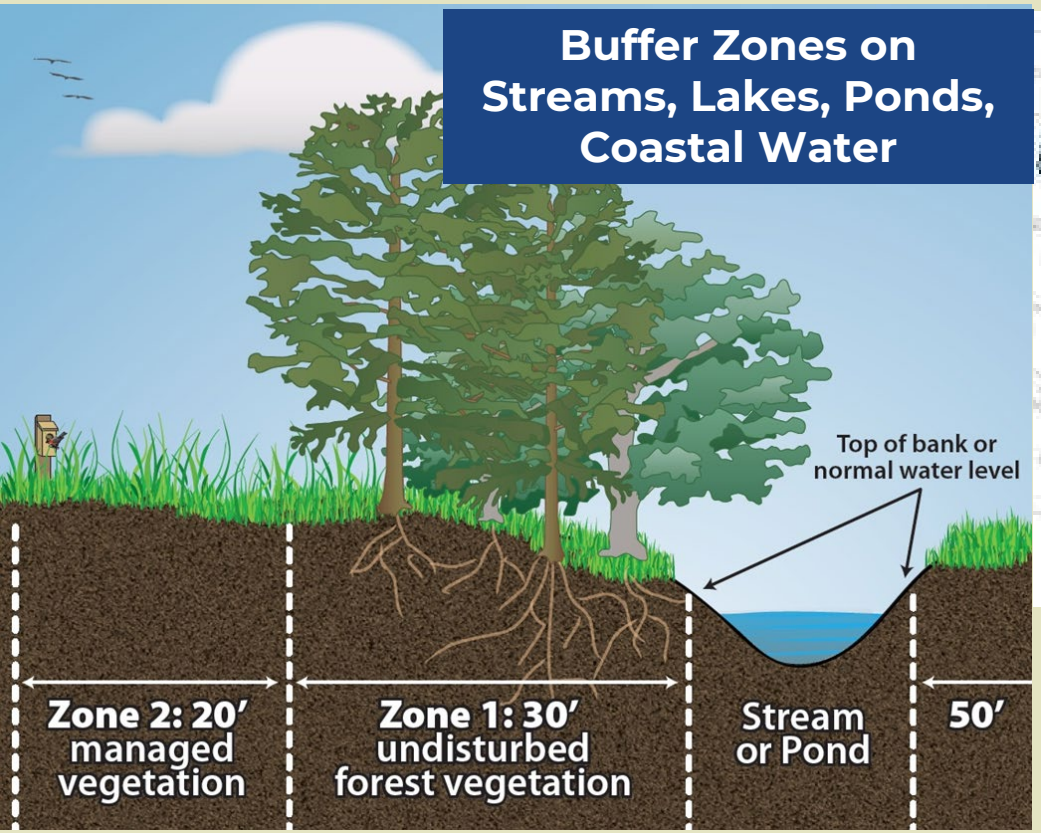
  Pile Supported Signs, Fences, Elevated Slatted Wooden Boardwalks (6 ft wide), Crab Shedders, Decks/Observation Decks (200 sq.ft.), grading, excavation, and **landscaping** with no wetland fill.

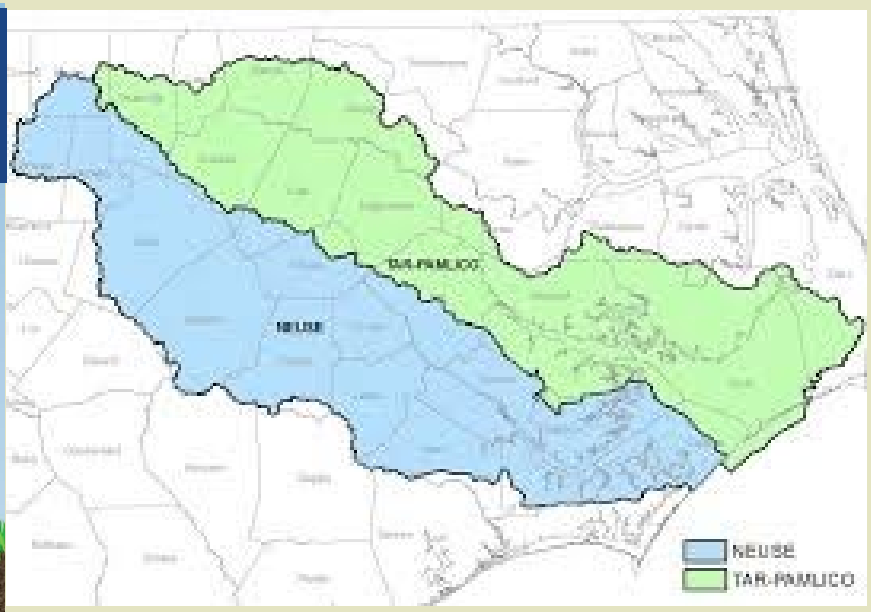
Shoreline Jurisdictions

- Estuarine Shoreline AEC extends 75’ landward from NHW/NWL (575’ adjacent to ORWs).
- 30’ Buffer - extends landward from NHW/NWL.
- Exception: CAMA Buffer does not apply in areas (Neuse and Tar-Pamlico) where the EMC has adopted buffers.



NCDWR Buffer Rules





15A NCAC 02B .0734 Tar Pam Maintenance of Existing Riparian Buffers

15A NCAC 02B .0714 Neuse Maintenance of Existing Riparian Buffers

NCDEMLR-Coastal State Stormwater Rules 15A NCAC 02H .1019(6)(b)

VEGETATED SETBACKS. For all subject projects within the Coastal Counties, vegetated setbacks from perennial waterbodies, perennial streams, and intermittent streams shall be at least 50 feet in width for new development and at least 30 feet in width for redevelopment and shall comply with Rule .1003(4) of this Section.

Local Level Buffer Ordinance

New Hanover County Unified Development (9/3/2024)
5.7.5. Vegetated Buffer Controls for Conservation

(C) Buffer Standards

1. Buffers shall extend 35 feet measured horizontally from the edge of the conservation resource and on a line perpendicular to and landward of the conservation resource.

2. The plant material in the buffer zone must be either retained in a natural, minimally disturbed condition, or properly managed in accordance with the management standards presented in subsection 5 below. In cases where vegetation does not exist within the buffer, the County shall require restoration efforts which include, but are not limited to, replanting of the buffer zone with plant species as recommended in the “Reference Lists and Publications for Guidance in the Selection of Vegetated Buffer Plants.”

ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
BRAXTON DAVIS
Director

NORTH CAROLINA
Environmental Quality

August 31, 2021

CRC-21-24

MEMORANDUM

TO: Coastal Resources Commission
FROM: Robb Mairs
SUBJECT: Artificial Turfgrass within the Coastal Shoreline Buffer

"In order to retain the effectiveness of the 30' buffer in filtering runoff, Staff request that the Commission confirm DCM's interpretation that **the application of artificial turf within an Area of Environmental Concern requires a CAMA permit,** and that **it is not allowable under the "landscaping" exception to the 30' buffer** at 15A NCAC 07H.0209(d)(10)(G).

While DCM can permit this material **within the 75' or 575' AEC, it may be deemed as impervious surface** based on a case-by-case review and therefore count toward the maximum allowable impervious surface coverage (depending on installation methods and materials, and any existing impervious surfaces)."

North Carolina Department of Environmental Quality | Division of Coastal Management
Wilmington Office | 127 Cardinal Drive Extension | Wilmington, North Carolina 28405
910.796.7215

Buffer Implementation

- **Clear Intent**
  - CRC considered wide range of uses
  - Consistent in not allowing non-water dependent uses
- **Buffer Identified as Crucial to Water Quality**
  - Filtering contaminants from runoff
  - Infiltration
  - Stabilizing soil
  - Slowing floodwaters
  - Preserving natural character of shorelines

In 2021, the CRC confirmed DCM's interpretation that the application of **artificial turf <u>within an AEC</u> requires a CAMA permit, and that it is NOT allowable under the "landscaping" exception to the <u>30' buffer</u>.**

Built-upon area as per General Statute

N.C.G.S.143-214.7D (September 2024 update) For purposes of implementing State or local government stormwater programs, "built-upon area" means impervious surface and partially impervious surface to the extent that the partially impervious surface does not allow water to infiltrate through the surface and into the subsoil. “Built-upon area” does not include:

- A slatted deck
- The water area of a swimming pool;
- A surface of number 57 stone, as designated by the American Society for Testing and Materials, laid at least four inches thick over a geotextile fabric;
- A trail as defined in G.S. 113A-85 that is either unpaved or paved as long as the pavement is porous with a hydraulic conductivity greater than 0.001 centimeters per second (1.41 inches per hour); or
- Landscaping material, including, but not limited to, gravel, mulch, sand, and vegetation, placed on areas that receive pedestrian or bicycle traffic or on portions of driveways and parking areas that will not be compacted by the weight of a vehicle.
- **Artificial turf, manufactured to allow water to drain through the backing of the turf, and installed according to the manufacturer’s specifications over a pervious surface.**

AECs in the Ocean Hazard System

- Ocean Erodible Area
  - Boundary: Erosion rate x 90 (min. 180 ft)

- Inlet Hazard Areas
  - Boundary pre-determined by CRC

Ocean Hazard Setback

A building or other structure less than 5,000 square feet requires a minimum **setback** of 60 feet or 30 times the shoreline erosion rate, whichever is greater.


Artificial turf is not listed as a permitted exception in the oceanfront setback, as per 15A NCAC 07H .0309

Permitted exceptions in the oceanfront setback

15A NCAC .0309(a)

1. Campsites
2. Driveways and parking areas with clay, packed sand, or gravel;
3. Elevated decks not exceeding a footprint of 500 square feet. Existing decks exceeding a footprint of 500 square feet may be replaced with no enlargement beyond their original dimensions;
4. Beach accessways consistent with Rule .0308(c) of this Section;
5. Unenclosed, uninhabitable gazebos with a footprint of 200 square feet or less;
6. Uninhabitable, single-story storage sheds with a foundation or floor consisting of wood, clay, packed sand or gravel, and a footprint of 200 square feet or less;
7. Temporary amusement stands consistent with Section .1900 of this Subchapter;
8. Sand fences;
9. Swimming pools
10. Fill not associated with dune creation that is obtained from an upland source and is of the same general characteristics as the sand in the area in which it is to be placed.

Artificial Turf Grass and CAMA Rules – Part II
February 26, 2025

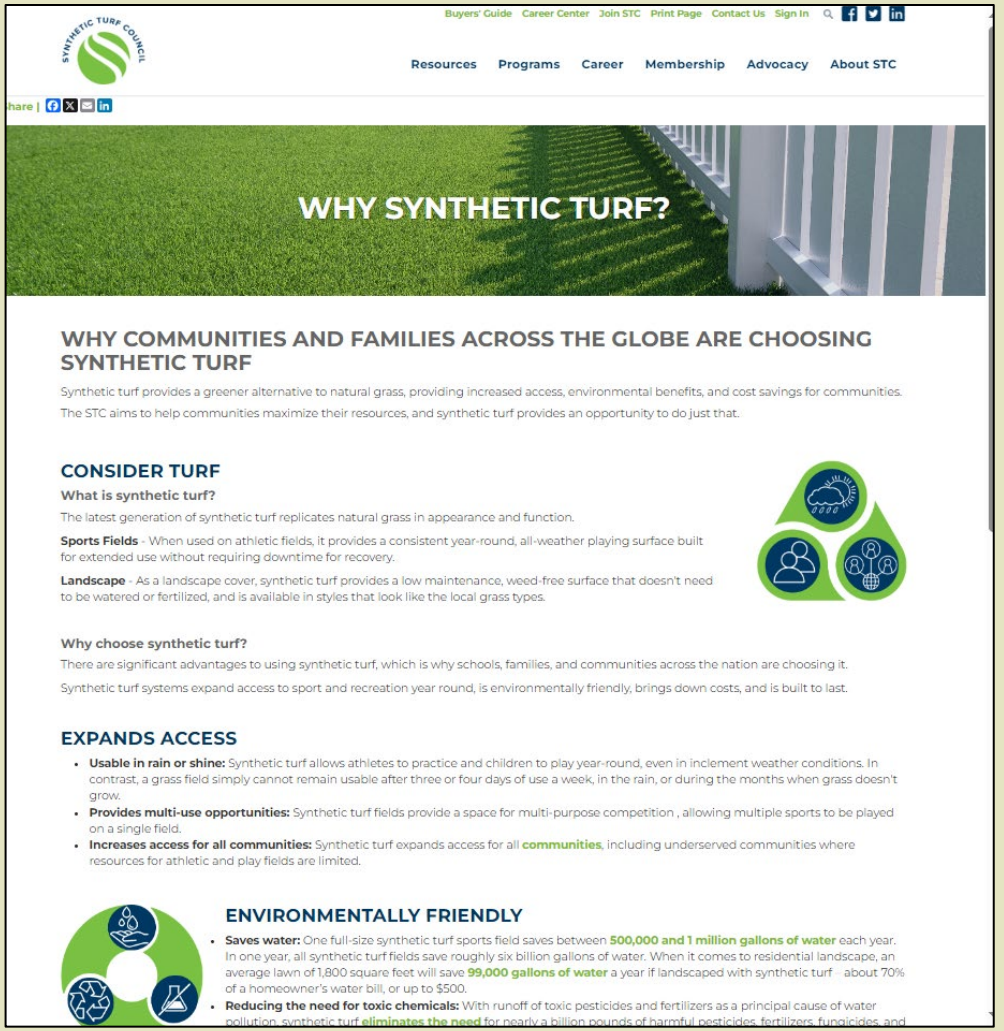
Jonathan Lucas

NC Dept of Environmental Quality

Division of Coastal Management

Positive claims about artificial turf

- No fertilizer
- No pesticides
- No watering
- No gasoline used for mowing
- It is durable
- Rubber infill keeps tires out of landfills



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WHY SYNTHETIC TURF?

WHY COMMUNITIES AND FAMILIES ACROSS THE GLOBE ARE CHOOSING SYNTHETIC TURF

Synthetic turf provides a greener alternative to natural grass, providing increased access, environmental benefits, and cost savings for communities. The STC aims to help communities maximize their resources, and synthetic turf provides an opportunity to do just that.

CONSIDER TURF

What is synthetic turf?

The latest generation of synthetic turf replicates natural grass in appearance and function.

Sports Fields - When used on athletic fields, it provides a consistent year-round, all-weather playing surface built for extended use without requiring downtime for recovery.

Landscape - As a landscape cover, synthetic turf provides a low maintenance, weed-free surface that doesn't need to be watered or fertilized, and is available in styles that look like the local grass types.

Why choose synthetic turf?

There are significant advantages to using synthetic turf, which is why schools, families, and communities across the nation are choosing it.

Synthetic turf systems expand access to sport and recreation year round, is environmentally friendly, brings down costs, and is built to last.

EXPANDS ACCESS

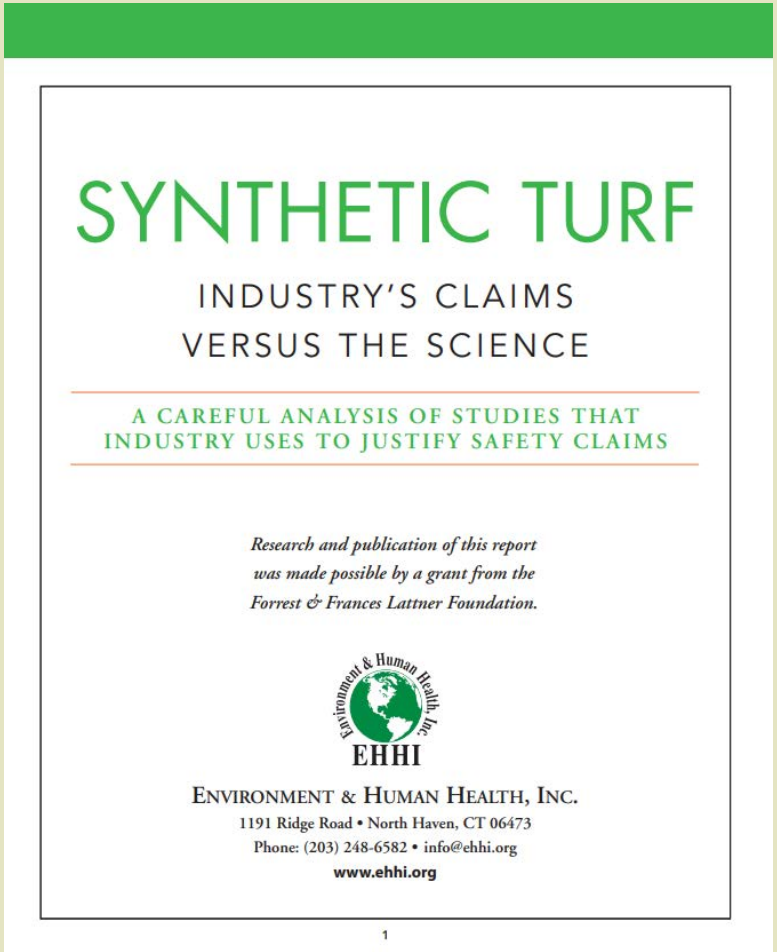
- **Usable in rain or shine:** Synthetic turf allows athletes to practice and children to play year-round, even in inclement weather conditions. In contrast, a grass field simply cannot remain usable after three or four days of use a week, in the rain, or during the months when grass doesn't grow.
- **Provides multi-use opportunities:** Synthetic turf fields provide a space for multi-purpose competition , allowing multiple sports to be played on a single field.
- **Increases access for all communities:** Synthetic turf expands access for all communities, including underserved communities where resources for athletic and play fields are limited.

ENVIRONMENTALLY FRIENDLY

- **Saves water:** One full-size synthetic turf sports field saves between **500,000 and 1 million gallons of water** each year. In one year, all synthetic turf fields save roughly six billion gallons of water. When it comes to residential landscape, an average lawn of 1,800 square feet will save **99,000 gallons of water** a year if landscaped with synthetic turf - about 70% of a homeowner's water bill, or up to $500.
- **Reducing the need for toxic chemicals:** With runoff of toxic pesticides and fertilizers as a principal cause of water pollution, synthetic turf **eliminates the need** for nearly a billion pounds of harmful pesticides, fertilizers, fungicides, and

Negative claims about artificial turf

- Artificial turf contains toxic and carcinogenic chemicals
- Exposure from inhaling the dust, accidental ingestion, absorbance into skin
- These chemicals can leach into the environment



SYNTHETIC TURF

INDUSTRY'S CLAIMS VERSUS THE SCIENCE

A CAREFUL ANALYSIS OF STUDIES THAT INDUSTRY USES TO JUSTIFY SAFETY CLAIMS

Research and publication of this report was made possible by a grant from the Forrest & Frances Lattner Foundation.

EHHI

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Phone: (203) 248-6582 • info@ehhi.org
www.ehhi.org

1

Crumb rubber and human health

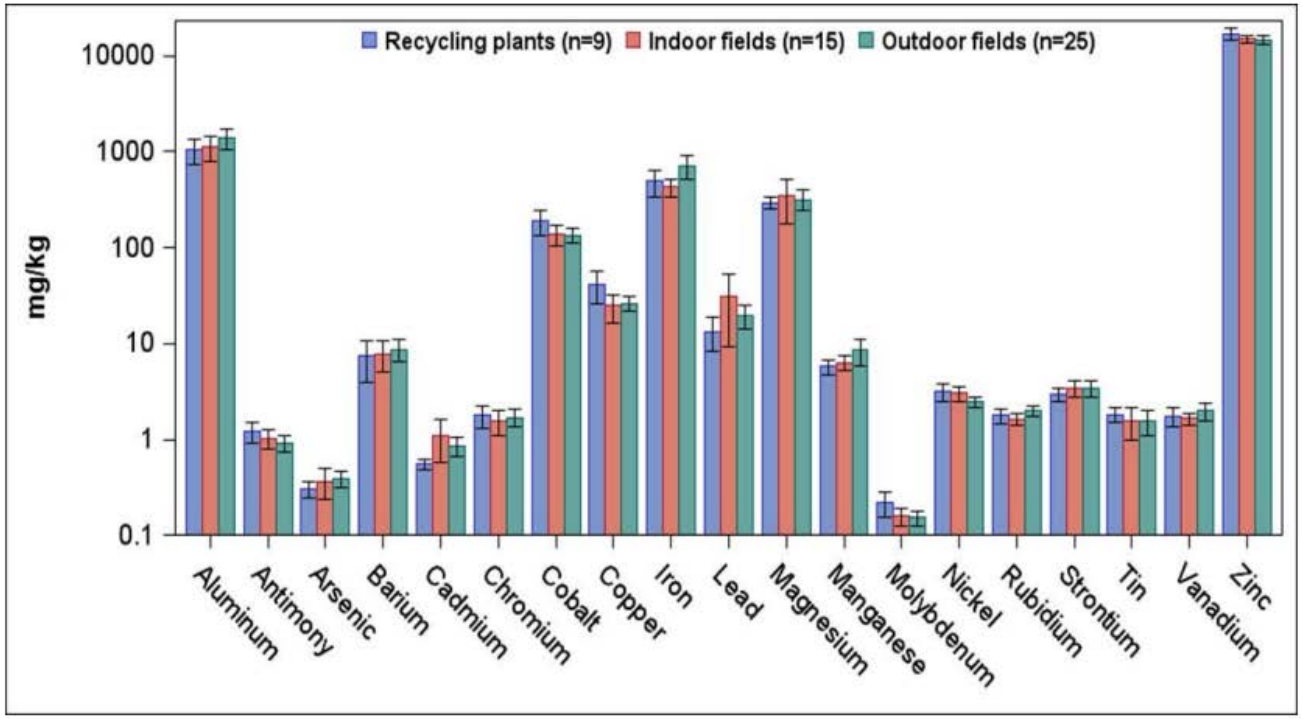
Opponents	Proponents
Tire crumb rubber contains toxic and carcinogenic chemicals including heavy metals and Polycyclic Aromatic Hydrocarbons (PAHs).	

Crumb rubber and human health

EPA United States Environmental Protection Agency

Example Results
Metals in Tire Crumb Rubber

ATSDR



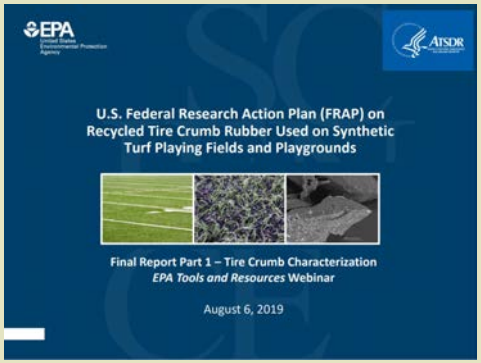
Concentrations of different metals varied widely

Crumb rubber and human health

Opponents	Proponents
Tire crumb rubber contains toxic and carcinogenic chemicals including heavy metals and Polycyclic Aromatic Hydrocarbons (PAHs).	
	Scientific studies have not found the exposure levels of these chemicals to pose a risk to humans.

Crumb rubber and human health

- **"…while chemicals are present as expected in the tire crumb rubber, human exposure appears to be limited..."** *U.S. Federal Action Plan on Recycled Tire Crumb Rubber Used on Synthetic Turf Playing Fields and Playgrounds*



- **"Health risk assessment studies suggested that users of artificial turf fields, even professional athletes, were not exposed to elevated risks."** Cheng et al 2014, *Environmental Science and Technology*

Crumb rubber and human health

Opponents	Proponents
Tire crumb rubber contains toxic and carcinogenic chemicals including heavy metals and Polycyclic Aromatic Hydrocarbons (PAHs).	
	• Scientific studies have not found the exposure levels of these chemicals to pose a risk to humans
• **“Exposures to many carcinogens at the same time can cause cancer, even when individual levels of each carcinogen are low.”** • **“Many of the chemicals found in crumb rubber have had no toxicity testing by the federal government, and therefore their toxic effects are unknown.” (EHHI 2017)**	

Crumb rubber and human health

Opponents	Proponents
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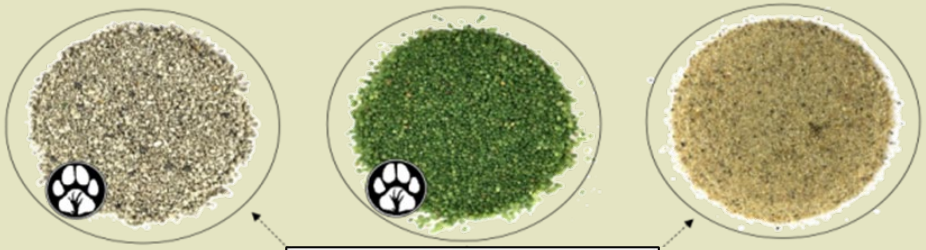
	• Scientific studies have not found the exposure levels of these chemicals to pose a risk to humans
• "Exposures to many carcinogens at the same time can cause cancer, even when individual levels of each carcinogen are low." • "Many of the chemicals found in crumb rubber have had no toxicity testing by the federal government, and therefore their toxic effects are unknown." (EHHI 2017)	
	If tire rubber were a concern, officials would be much more concerned about universal exposure to tire wear particles from vehicles on roads.

PURE ZEO
(1.5-2 IBS PER SQ FT)

ENVIROFILL
(2.5-3 IBS PER SQ FT)

20/40 SILICA SAND
(2.5-3 IBS PER SQ FT)



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SYNTHETIC TURF GOLF GREENS & LAWNS

GreenFill
Biodegradable grass infill

by Senbis

Motz Safeshell®

GEO COOLFILL
COOLER. ORGANIC. PREFERRED.

BROCKFILL
THE ENGINEERED INFILL FOR ATHLETES

GREENPLAY
NATURALLY SAFE ORGANIC INFILL

FRANPLAST
TPE-S SPECIALISTS

Artificial Turf Weathering and Lifespan

- Lifespan of artificial turf is 10 years for a sports field, 20 years for a lawn
- Signs that maintenance is needed (as per Turfix® Synthetic Sports Field Specialists)
  - Splitting and shedding turf fibers
  - Color dulls to grayish-green
  - Accumulation of infill on the sides of the field
- The maintenance process: decompaction and infill replenishment

Artificial Turf Weathering and Lifespan

Infill Extraction

Photos: Artificial Grass Recyclers

Artificial Turf Weathering and Lifespan

Cut into strips

Photos: Artificial Grass Recyclers

Artificial Turf Weathering and Lifespan

Photos: Artificial Grass Recyclers

Division of Coastal Management

Artificial Turf Weathering and Lifespan

VARA Broadcasting: https://www.youtube.com/watch?v=Y5o3J7uy4Tk

Artificial Turf in the Coastal Environment

- The material is durable, but does not last forever
  - Artificial grass blades will split and shed.
- Escape of infill particles
- Infiltration and runoff

Infiltration and runoff

ELSEVIER

Urban Forestry & Urban Greening

Volume 63, August 2021, 127232

Artificial lawns exhibit increased runoff and decreased water retention compared to living lawns following controlled rainfall experiments

Thomas J. Simpson, Robert A. Francis

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Abstract

Artificial lawns are an increasingly popular alternative to their living counterparts, but their environmental impacts are undocumented. The hydrological impacts of artificial (synthetic polymer) grass were investigated in comparison to living grass in a series of controlled rainfall experiments, representing daily short rainfall events of different volumes (750 mL, 1000 mL, 1250 mL). Two varieties of artificial grass with varying pile height (short vs long) were compared with a living grass control. Infiltration was measured as drainage (total, initial and delayed) and retention. Significant differences in runoff were observed across all treatments, demonstrating that both types of artificial grass displayed greater volumes and proportion of runoff than living grass, and that long artificial grass had significantly greater runoff than short artificial grass. Living grass was

- "Two varieties of artificial grass with varying pile height (short vs long) were compared with a living grass control."
- "…both types of artificial grass displayed **greater volumes and proportion of runoff than living grass**, and that long artificial grass had significantly greater runoff than short artificial grass. **Living grass was also significantly better at retaining water and delaying drainage compared to both artificial grasses**…"
- "Plastic thatch and grass fibres were also shed from the artificial grass installations during the experiments and were carried in the runoff."

Infiltration and runoff

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- **"Plastic thatch and grass fibres were also shed from the artificial grass installations during the experiments and were carried in the runoff."**

Artificial Turf in the Coastal Environment

- Microplastic pollution
- Chemicals that leach via water runoff

Artificial Turf in the Coastal Environment


https://www.irlspecies.org/misc/benthic_story.php

"Sedimentary exposure to tyre particles affects terrestrial organisms, inducing ***oxidative stress*** *in the earthworm Eisenia fetida (Sheng et al., 2021) and* ***reducing reproduction and survival*** *in the springtail Folosomia candida (Selonen et al., 2021). Aquatic exposure* ***affects growth and swimming behaviour*** *in estuarine species; the springtail Menidia beryllina and the mysid shrimp Americamysis bahia (Siddiqui et al., 2022).* ***As well as the physical effects caused by ingestion of particles, tyre wear particles can exert chemical effects through leaching of a cocktail of organic additives and metals into the surrounding water column and sediments*** *(Halsband et al., 2020),* ***or directly from the particles into the gastrointestinal fluids of organisms****, as has been observed in fish (Masset et al., 2022; Masset et al., 2021). Leachates, with the particles removed,* ***have proved lethal*** *to marine copepods with an LC50 of 35 g.L−1 for Calanus sp. and <5 g.L−1 for Acartia longiremis (Halsband et al., 2020), whilst exposure to leachates of 30 g.L−1 tyre particles* ***impaired swimming behaviour and caused oxidative stress*** *in Limnocalanus macrurus (Lehtiniemi et al., 2021). A leachate concentration of 0.08 g.L−1 was associated with* ***elevated markers of lipid peroxidation and membrane instability*** *in the mussel M. galloprovincialis (Capolupo et al., 2021).* ***This suggests that the chemical additives associated with tyre particles that leach into the water column, are toxic to aquatic animals."***

S.L. Garrard, J.I. Spicer, R.C. Thompson "Tyre particle exposure affects the health of two key estuarine invertebrates" in the journal *Environmental Pollution*


6/25/21

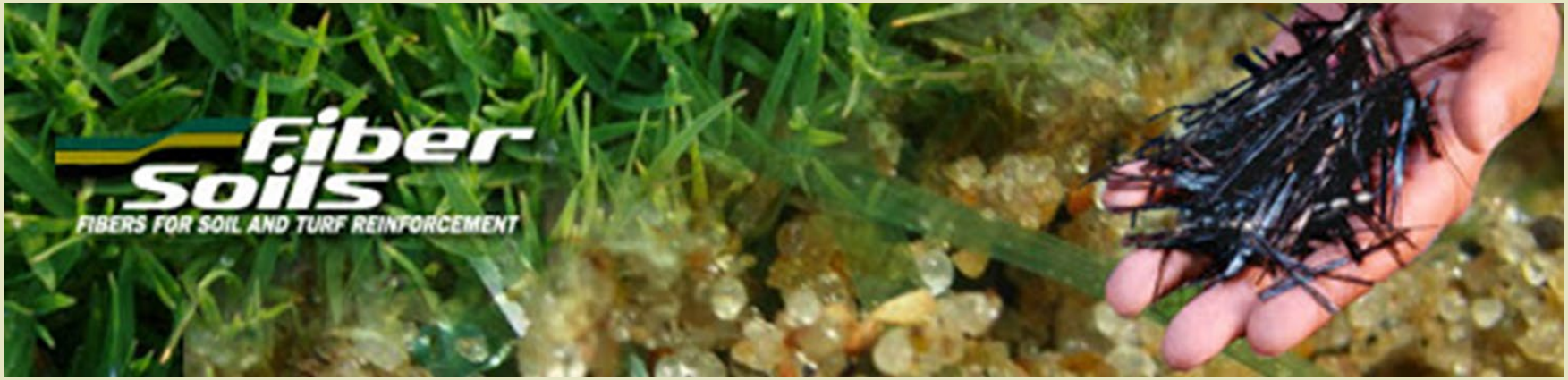

Fiber
Soils
FIBERS FOR SOIL AND TURF REINFORCEMENT

Photo: NC Coastal Federation

Potential rule recommendations

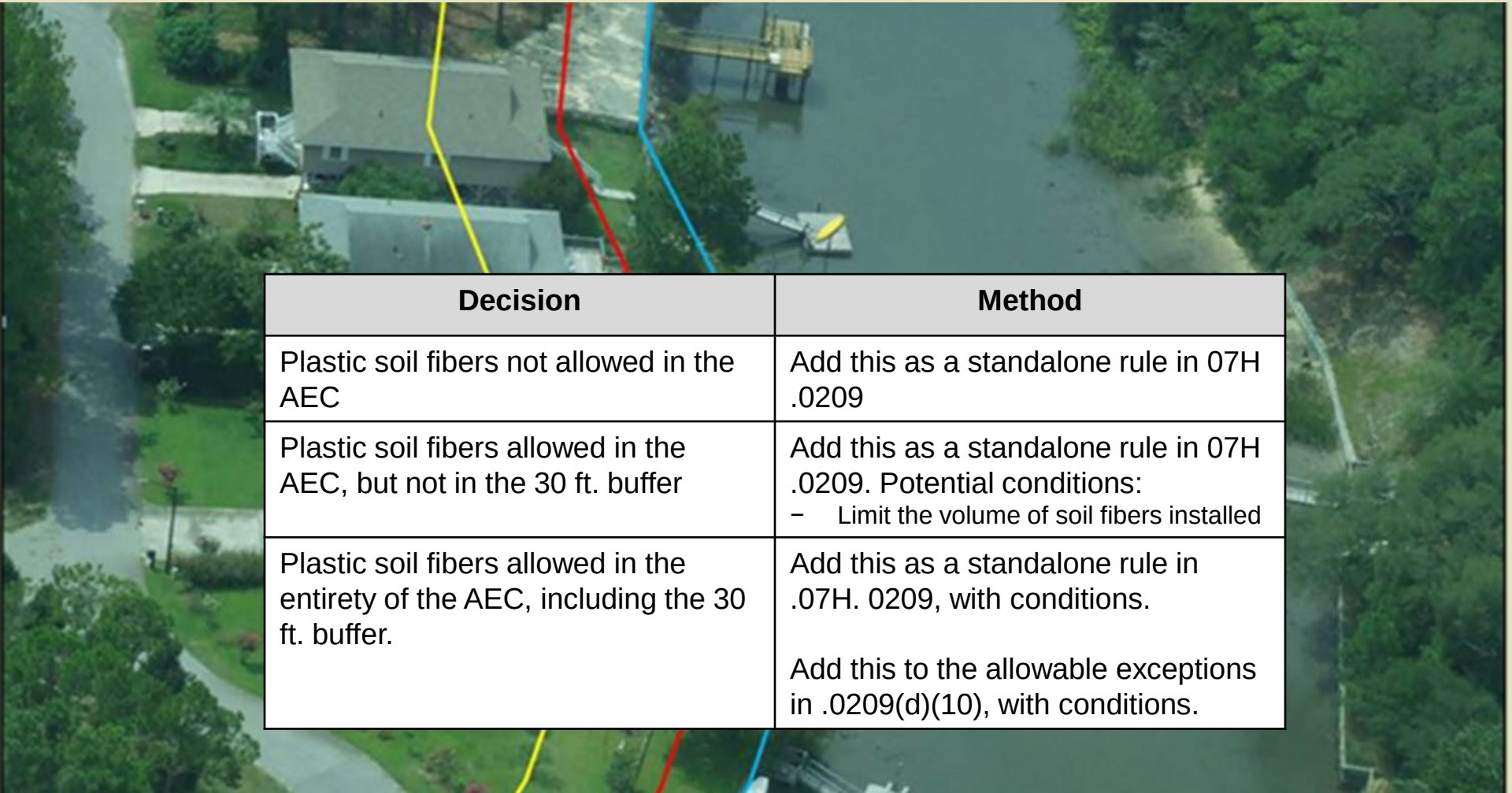
Coastal Shoreline AEC – Artificial Turf

Decision	Method
Artificial turf not allowed in the AEC.	Add this as a standalone rule in 07H .0209
Artificial turf allowed in the AEC, but not in the 30' buffer	Add this as a standalone rule in 07H .0209. Potential conditions: − State that it must meet the pervious standards of the General Statute − Regulate the infill − Limit square footage
Artificial turf allowed in the entirety of the AEC, including 30 ft. buffer.	Add this as a standalone rule in .07H. 0209, with conditions. Add this to the allowable exceptions in .0209(d)(10), with conditions.

Ocean Hazard AEC – Artificial Turf

Decision	Method
Artificial turf not allowed in the AEC.	Add this as a standalone rule in 07H .0308
Artificial turf allowed in the AEC, but not in the Ocean Hazard setback.	Add this as a standalone rule in 07H .0308. Potential conditions: − State that it must meet the pervious standards of the General Statute − Regulate the infill − Limit square footage
Artificial turf allowed in the entirety of the AEC, including the setback.	Add this as a standalone rule in .07H .0308, with conditions. Add this to the allowable exceptions in .0309(a), with conditions.

Coastal Shoreline AEC – Plastic soil fibers



Decision	Method
Plastic soil fibers not allowed in the AEC	Add this as a standalone rule in 07H .0209
Plastic soil fibers allowed in the AEC, but not in the 30 ft. buffer	Add this as a standalone rule in 07H .0209. Potential conditions: − Limit the volume of soil fibers installed
Plastic soil fibers allowed in the entirety of the AEC, including the 30 ft. buffer.	Add this as a standalone rule in .07H. 0209, with conditions. Add this to the allowable exceptions in .0209(d)(10), with conditions.

State of North Carolina
Department of Environment,
Health and Natural Resources
Division of Coastal Management

James B. Hunt, Jr., Governor
Wayne McDevitt, Secretary
Roger N. Schecter, Director

DEHNR

MEMORANDUM

TO: Coastal Resources Commission **I&S 424b**
FROM: Bill Crowell
SUBJECT: Estuarine Shoreline Initiative
DATE: January 9, 1998

INTRODUCTION

Recent events, such as fish kills, algal blooms, shellfish closures, sediment washes, hurricanes, increased coastal development, tourism and recreation, loss of wildlife habitat, and scenic degradation of coastal view sheds have increased our awareness of the need to preserve, protect and restore our coastal resources. In recent meetings the CRC and DCM staff have discussed their concerns about the CRC's current estuarine shoreline rules. This is not the first time that the Commission has reviewed the adequacy of these rules in maintaining coastal water quality and in protecting coastal resources. Twelve years ago, staff reported to the CRC on nonpoint source pollution and the estuarine shoreline. At that time the staff stated that "it is evident that existing regulations are not adequately protecting our fragile estuarine waters from the activities taking place adjacent to them."(McCullough, 1985)

This memorandum will provide information on methods designed to mitigate, protect and restore the quality of North Carolina's estuarine system through the use of **vegetated buffers (1)**, various **shoreline stabilization methods (2)**, and limits on **impervious surface area - density (3)**. The information provided is not intended to be a complete review of the scientific literature.

References

McCullough, M. 1985. Memorandum to CRC: Urban runoff impacts and management strategies. Division of Coastal Management. Raleigh, NC.

1. VEGETATED BUFFERS

The term vegetated buffer "is currently used in many contexts, and there is no agreement on any single concept of what constitutes a buffer, what activities are acceptable in a buffer zone, or what is an appropriate buffer width" (EPA, 1993). Although numerous definitions for vegetated buffers exist in the literature, a buffer in this text is generally a naturally vegetated transitional zone between differing land uses that functions as a barrier to, and filter of, surface water runoff. The effectiveness of any buffer zone is related to its width, slope, soil type, vegetation coverage, type of surface water runoff, and size of drainage area.

Vegetated buffer zones have been applied since the 1950's as best management practices (BMPs) in the fields of forestry and agriculture to protect in-stream habitats from degradation by inputs from sediments and nutrients. Today, vegetated buffer zones are routinely applied in both engineered and natural settings for the control of nonpoint source pollutants (Desbonnet *et al.*, 1994).

Coastal buffer zones provide multiple benefits. Where applied, these benefits include, but are not limited to, the following: protection of water quality, protection of coastal habitat, erosion and flood control, and protection of scenic and aesthetic quality. These multiple benefits and uses signify the inherent ability of vegetated buffers to perform a diverse array of functions. Numerous studies have shown that vegetated buffer zones reduce the negative impacts of runoff (see attached extended bibliography). Vegetated buffers and wetlands along the shoreline have been shown to stabilize soil, reduce sediment runoff (Lee *et al.*, 1989), reduce runoff speed (Williams and Nicks, 1986), and enhance infiltration. Buffers have also been shown to reduce bacterial loads (Castelle *et al.*, 1992), nutrient loads (Gilliam 1994), pollutant loads (Zirschky *et al.*, 1989), and viral and bacterial dispersion (Groffman *et al.*, 1991). Vegetated buffers also provide and enhance wildlife habitat (Groffman *et al.*, 1991) and contribute to the overall scenic quality of the shoreline environment. The multiple benefits/uses of vegetated buffers provide a solid means for justification of vegetated buffer implementation along North Carolina's sensitive shoreline.

Protection of water quality

Vegetated buffer zones along the margin of coastal water bodies are effective in trapping sediments and pollutants, absorbing nutrients from surface runoff, and promoting groundwater flow. These buffers function to reduce adverse impacts to water quality by controlling the severity of soil erosion and removing a variety of pollutants from storm water runoff (Shisler *et al.*, 1987). Removal of pollutants, sediments and bacteria by vegetated buffer zones can be of particular importance in areas abutting poorly flushed bodies of water. Gilliam (1994) reported that buffers remove as much as 90 percent of sediment and nitrate and up to 50 percent of phosphorous. The effectiveness of vegetated buffer zones is dependent on their ability to reduce the velocity of surface flow to allow for the deposition of sediments, and the filtration and biological removal of nutrients and bacteria. Fundamentally, the effectiveness of any buffer zone is related to its width, slope, soil type and vegetation type.

Buffer Width

Buffer widths vary greatly and are dependent on the site's slope, soil type, vegetation coverage, type of surface water runoff, and the size of drainage area. While the buffer width is changeable, the factors that are used to determine the width are often unchangeable (*i.e.*, soil type, slope). Buffers effective in controlling nonpoint source pollution which remove at least 50%, and up to 90% of sediments and nutrients range from 15 feet (5 meters) to 600 feet (185 meters) in width (Desbonnet *et al.*, 1994). Phillips (1989) studied nonpoint source pollution from estuarine shoreline development in Carteret County's estuarine *ACE*. The results indicated that a 75 foot (23 meter) buffer is an inadequate width for filtering the pollutant runoff and recommended a 260 foot (80 meter) buffer width. Appendix 1 contains several tables of recommended buffer widths based on various criteria.

Slope

Slope is very important in the effectiveness of a buffer. Steep slopes generally increase surface flow velocity and often do not allow for adequate retention time for absorption of pollutants, nutrients, and sediments. Slopes of less that 15 percent reportedly allow adequate retention time and pollutant removal (Palstrom 1991 as reported in Desbonnet *et al.*, 1994). Clark (1977) provides some examples of minimum buffer widths for the protection of water quality, according to slope and soil erodibility: 10 meters for areas with no slope on slightly erodible soil, extending to 50 meters for 30 percent slopes on severely erodible soils. Others have suggested adding an additional 0.6 to 1.2 meters of vegetation for water quality protection (Desbonnet *et al.*, 1994).

Even some densely vegetated steep slopes are ineffective at removing sediments, nutrients and pollutants. Some very steep slopes promote erosion and channelization of surface runoff. In order for a vegetated buffer to be effective in removing pollutants, nutrients and sediments, the surface water flow through the buffer zone must be slow, shallow and uniform (Dillaha *et al.*, 1989a). The slow flow allows for the deposition of sediments (which often have pollutants attached) into the surface soil layer (Lee *et al.*, 1989). The slow flow and settling also allow for the utilization of nutrients by plants. A proper functioning buffer depends on its ability to resist channelization (Broderson, 1973). Channelization through buffer areas greatly reduces (40 to 95 percent) the effectiveness of the buffer to absorb sediment and nutrients (Lee *et al.*, 1989). The channelization of water through buffers was reported as a major problem and limit to buffer effectiveness during a review of riparian buffers implemented on agricultural lands in Virginia (Desbonnet *et al.*, 1994). In order for buffers to be effective, the surface flow should be evenly spread into sheet flow (Dillaha *et al.*, 1989b). Williams and Nicks (1988) reported that rough surfaces reduce flow velocity, promoting sheet flow and resulting in a greater pollutant, nutrient and sediment removal than found with smooth surfaces.

Soils

As with slope, soils are very important in the effectiveness of a buffer to trap and filter pollutants and nutrients. As pollutants enter the soil layer, they become incorporated through physical, chemical, and biological interactions (Desbonnet *et al.*, 1994). Numerous studies have shown that most pollutants and nutrients transported by surface runoff are attached to sediments. Runoff that contains sediment-bound pollutants need only to move through a buffer that is able

to remove the sediment load. The effectiveness of this buffer zone is related to its soil (sediment load and buffer area), slope, width type, vegetation type, and pollutant concentration.

Pollutants contained in surface runoff are generally bound to small soil particles such as silts and clays. Thus the overall effectiveness of a buffer is related to its ability to remove the finer materials. As particle size decreases, the buffer width required to remove a greater percentage of those particles increases (Karr and Schlosser, 1978). Neibling and Alberts (1979) reported that 37 percent of clay-sized sediments and particles were removed within a 0.6 meter (~2 feet) width of a grassed buffer, while 91 percent of the total sediment load was removed within the same buffer width.

Relatively narrow buffers, provided they promote shallow sheet flow (generally with little or no slope), will effectively remove coarse-grained sediments and their associated pollutants (Desbonnet *et al.*, 1994). Wider buffers are generally required to remove the smaller particles and pollutants. Greater sized buffers may be required to trap pollutants in dissolved forms, as they may require removal by chemical interactions, plant uptake, or microbial transformation (Desbonnet *et al.*, 1994).

Vegetation

The vegetated cover contributes to the overall effectiveness of the buffer by removing pollutants and nutrients, providing various habitat, and creating an aesthetic quality. Vegetation within a buffer zone assists in soil stabilization, reduces velocity of surface water runoff, and reduces channelization, while promoting absorption and infiltration. The type, density, structure and age of the vegetation are important in determining functioning properties of the buffer. Vegetation can be manipulated, often in a cost-effective manner, to better achieve the purpose of the buffer (Desbonnet *et al.*, 1994). Vegetation reduces the erosional effects of water movement by minimizing undercutting and bank collapse (Barling and Moore, 1994).

Vegetation in buffer zones in the coastal area aid in controlling flooding and damage from flooding by reducing velocity of runoff and by encouraging infiltration of precipitation and runoff into the ground rather than into low lying areas. Additionally, the use of a vegetated buffer necessitates that structures and development be set back for areas that would naturally be prone to flooding.

Vegetated buffers may be natural or planted. Buffers may be either grass, shrubs, or forested. Grass buffers are effective in reducing flow velocities and in trapping nutrients and sediment. Gilliam *et al.* (1997) demonstrated that the effectiveness of a well maintained grass buffer in sediment removal may be as high as 90-95 percent. Forested buffers may remove various nutrients that grassed areas are unable to uptake. Although it is not practical in many areas, the ideal buffer would have a grass buffer leading to a forested zone, then to the shoreline.

Protection of coastal habitat

Native plants and animals are essential to the preservation of North Carolina's coastal ecosystem. Vegetated buffer zones provide habitat for native plants and animals. Vegetation provides cover from predation and weather, and habitat for nesting and feeding by resident and

migratory species. Several species found in this transition area from open water and wetland habitats to uplands are now relatively uncommon, while others are considered rare, threatened or endangered. Buffers are especially important along rivers that serve as spawning areas for anadromous fish (Rulifoson as cited in Doll and Coburn, 1996). In order to protect anadromous fish, buffers should extend to the point of identified anadromous fish spawning areas that are currently used and those that were historically known (Doll and Coburn, 1996).

While most studies have focused on the use of buffers for water quality and pollution abatement, buffers have also been noted for their importance to wildlife. Values of wetland buffers include: increased species richness, sites for foraging, corridors for dispersal, refuge from flooding, sites for hibernation, areas for breeding and nesting, areas of predator protection, and refuge from upland and open water disturbances (*i.e.*, construction, jet skis) (Groffman *et al.*, 1991). Effectiveness of vegetated buffers as natural habitat is dependent on buffer width and vegetation type. In general, wider buffers provide greater values as wildlife habitat. Most importantly, buffers which possess native vegetation provide a move valuable habitat for sustaining resident species and promote a greater diversity of species within the buffer and the region overall (Desbonnet *et al.*, 1994).

Erosion control and flood control

Buffer zones provide a natural transition zone between open water or wetlands and uplands. As stated previously, vegetation within a buffer zone assists in soil stabilization, reduces velocity of surface water runoff, reduces channelization, and promotes absorption and infiltration. Roots of vegetation also reduce the tendency of the soil to erode during coastal storms by stabilizing underlying soils (Desbonnet *et al.*, 1994). Vegetation reduces undercutting and bank collapse (Barling and Moore, 1994). Vegetated buffers have been used as best management practices to control erosion and the offsite impacts of construction activities for many years.

Vegetated buffers also have value as flood control areas. Vegetated buffer zones in coastal areas aid in controlling flooding and damage from flooding by reducing velocity of runoff and by encouraging infiltration of precipitation and runoff into the ground rather than into low lying areas. The use of buffers requires that structures and development be set back for areas that would naturally be prone to flooding. The capacity of the buffer area to provide flood protection will be dependent on the local rainfall and runoff intensity, as well as the amount of adjoining buffer lands (Desbonnet *et al.*, 1994). Under ideal conditions the ability of a buffer to act as a flood mitigation area will be related to the water source area (*i.e.*, surface runoff flooding vs. river flooding).

Protect of scenic and aesthetic quality

One of the unique benefits and qualities of North Carolina's coastal area is its scenic value. Vegetated buffers may be used in order to preserve the natural character of the shoreline, while mitigating the visual impacts of development. The aesthetic value of vegetated buffers is mainly based on subjective factors, and therefore not fully transferable to economic or protective terms. "Although no criteria for aesthetic values of vegetated buffers exist, aesthetics will continue to be included as an intrinsic value" (Desbonnet *et al.*, 1994).

Summary

Vegetated buffer zones provide multiple benefits. Buffers provide protection of water quality by trapping sediments, pollutants, pathogens and absorbing nutrients from surface runoff and promoting groundwater flow. Vegetated buffer zones aid in the protection of coastal habitat for wildlife, fish, and other organisms, by increased species richness, and providing sites for refuge, foraging, breeding, nesting and dispersal (Groffman *et al.*, 1991). Buffer zones promote flood and erosion control. Additionally buffers protect the scenic and aesthetic quality that is important to many of the people who live, work or visit in coastal counties. These multiple benefits and uses signify the inherent ability of vegetated buffers to perform a diverse array of functions. They generally work by slowing and spreading surface flow, increasing time for infiltration and settling to occur, and providing mechanisms for the absorption of nutrients.

Although there is no agreement on any single concept of what constitutes a buffer, the effectiveness of any buffer is related to its width, slope, soil type, vegetation coverage, type of surface water runoff, and size of drainage area. Vegetated buffer zones are routinely and successfully applied in both engineered and natural settings. Vegetated buffers are an important tool in protecting the aquatic environment from land based activities. Appendix 2 contains a listing of buffer and setback widths used by other states in their coastal management programs.

Staff Recommendations

The staff recommends that vegetated buffers be used in the protection of coastal waters and shorelines. We recognize that the current rules promoting the use of buffers are inadequate for the protection of North Carolina's coastal resources. Vegetated buffers are needed along all shorelines to protect aquatic resources from land based activities. Buffer widths and types should be dependent on the resource to be protected, the adjoining land development, slope, soil type, and size of drainage area. However, rules must reflect a realistic implementation of standards (*i.e.*, a buffer size and type requirements should be based on the adjoining water body's classifications or types of upland development). We recommend that a panel be assembled to develop draft rule changes that will implement the use of vegetated buffers along North Carolina's shorelines.

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2. ESTUARINE SHORELINE STABILIZATION

As North Carolina's coastal population grows, the development pressure along the estuarine shoreline also increases. Many waterfront property owners (mainly residential) have applied for permits for the construction of bulkheads. There is growing concern about the effects of bulkheads on sediment transport, foreshore erosion, marsh migration and estuarine organisms.

Bulkheads and other shoreline stabilization measures are placed in dynamic ecotones that form transition areas between water and upland. These areas are ecologically unique, combining many of the characteristics of both upland and aquatic environments. They harbor a diverse array of plants and provide habitat to many different organisms. " A major physical intrusion, such as a bulkhead, has many ramifications" (Watts, 1987).

The negative impacts of bulkheads and other shoreline stabilization measures are often questioned, and there is some dispute concerning the magnitude of the impacts. As construction of bulkheads and other shoreline stabilization measures continues on our estuarine shoreline, environmental management must be based on our best existing knowledge. The purpose of this memorandum is to synthesize the existing information on the effects of bulkheads and other shoreline stabilization measures. Vegetated buffers are often used to mitigate the effects of erosion along the land water interface, while bulkheads, riprap, breakwaters, groins and vegetation are used to protect the shoreline from erosion. The use of bulkheads is of the highest environmental concern for shoreline stabilization and will be the topic of this review. Riprap is also often used as a shoreline stabilization measure and depending on its placement and use, may have some of the same effects as bulkheads. Breakwaters, and groins are often constructed of the same material as bulkheads and also change the littoral flow, thus many of the concerns are the same. Vegetation and bioengineering methods are beginning to be used more frequently and are generally preferred to hardened structures.

Impacts of bulkheads

Bulkheads are generally vertical structures that are built parallel to the shoreline in order to prevent erosion of the upland. Bulkheads are often constructed of wood, metal (steel or aluminum), concrete or vinyl sheet piling that is driven into the substrate to an approximate depth of 4 feet. The height above the water surface varies from location to location. Tie rods are used to add support to the structure by anchoring the wall on the landward side. Filter cloth is often used behind the sheet pile to reduce fill seepage through the bulkhead. Bulkheads may have a non-vertical face, but this is rare in North Carolina.

Short-term effects

Several short-term impacts are the result of bulkhead construction activities: bank erosion, suspension of sediments, underwater sediment accretion, and general habitat disturbance (Watts, 1987). Soil disturbing construction activities (*i.e.*, tie rod placement, pile driving, backfilling) often cause short-term bank erosion, which can in turn cause an increase in the suspended sediment in the water column. These suspended sediments reduce light and may lead to a temporary decrease in primary production. The sediment may also interfere with the

respiratory and feeding mechanisms of fishes and other organisms (Watts, 1987). Construction activities may also cause the resuspension of bottom sediments, releasing heavy metals and other toxins (Mulvihill *et al.,* 1980). Sea grasses, such as eelgrass, may be able to cope with short-term light reductions but may not survive the sediment accretion that results from the upland erosion (Thayer *et al.,* 1984). Severe sediment accretion may also kill many benthic organisms including some shellfish, such as oysters. Recovery can then only occur through the repopulation by organisms from non-impacted areas.

Long-term effects

Bulkheads have several long-term effects on the estuarine shoreline. Bulkheads have several long-term effects on the estuarine shoreline. Long-term effects include: increased non-point pollution, increased wave scour, and increased erosion of adjacent lands. Hardened shorelines also produce losses in shellfish habitat, shallow water habitat, juvenile fish nursery areas, submerged vegetation, wildlife and ecotone habitat, and wetland areas.

Placement Impacts

The construction of a bulkhead generally destroys the established vegetation in the ecotone between open water or wetlands and the upland. In the majority of cases, the land is graded and sloped toward the bulkhead. Then the area is planted with grasses and other lawn species, effectively removing the natural buffer for surface water runoff. This activity sets the stage for an increase in runoff of nutrients and toxins. The increase in nutrients (mainly fertilizers) used to maintain the lawns is allowed direct runoff into the estuarine waters. These nutrients may cause algal blooms and reduce oxygen in adjacent waters (Watts, 1987). This reduction in oxygen often leads to fish kills. Toxins (pesticides, petroleum, etc.) may be carried in surface runoff with storm water into the adjacent waters, where they may accumulate in the native organisms (*i.e.*, shellfish). The buildup of toxins in shellfish may pose a human health hazard. The increased runoff velocity may enhance the numbers of bacterial and viral agents that reach the estuarine waters (Kirby-Smith, pers. comm.). The degree of damage is related to the proximity to the water, type of vegetation, type of soil, the type of drainage, the amount of runoff and the time and method of application (Clark, 1974).

Physical Impacts

Bulkheads, seawalls and other hard structures have been prohibited on North Carolina's oceanfront since the passage of CAMA in 1974. One of the main reasons these structures are forbidden is their effect on reducing the beach area over time. Bulkheads in the estuarine environment produce the same effect. These structures promote scour, or the removal of underwater material by waves and currents, especially at the base or toe of a shoreline structure. As waves break against a vertical structure, the wave energy is deflected upward and downward. Scouring occurs as the downward movement of water dislodges bottom sediments. The power and extent of the erosion is dependent on many different facts such as fetch, orientation, soils, boat traffic and storm frequency (Pilkey as cited in Watts, 1987).

Scouring results in the destruction of any beach in front of the bulkhead that is subject to wave action. In some locations, the scouring wave action may only take place during storms. Bulkheads placed adjacent to a shallow water habitat will scour and eventually deepen the area.

Beaches in front of bulkheads are almost certain to disappear (Rogers, 1981) Bulkheads change the irregular shoreline into a linear shoreline. In oceanfront studies, the wave impact increases with the length of the seawall structures (McDougal *et al.*, 1987); thus the cumulative impact of adjacent bulkheads may have a large scale detrimental effect on the estuarine shoreline ecosystem. The greater the length of the bulkhead, the greater the scouring action.

Within CAMA permits, bulkheads are placed on the water's edge or landward of significant wetland vegetation. Bulkheads can lead to destruction of these wetlands in two different ways. First, bulkheads do not allow the landward retreat of wetland vegetation as the sea level rises. The bulkhead provides a physical barrier to the natural migration of wetlands. Bulkheads may also contribute to the increased flooding and expansion of neighboring wetlands (Titus *et al,*. 1984) . Secondly, the redirected wave energy disrupts the substrate, and diminishes the suitable habitat for wetland plants. The turbulence and scouring often prohibits vegetation from reestablishing after construction or from establishing as the water depth changes (Knutson, 1977). Garbisch and others (1973) showed that *Spartina alternifolia* (smooth saltmarsh cordgrass) plantings in front of a bulkhead experienced a 63 percent fatality while those in front of a natural shoreline averaged a 12 percent fatality. Tidal flats, beaches and some wetlands are often replaced by permanently flooded areas, destroying the habitat of any organism that required the previous conditions.

Bulkheads also accelerate the erosion of adjacent shorelines (COE, 1984). This often requires the adjacent property owner to take action to stop the erosion process. The erosion may result from deflected wave energy or an alteration of the circulation pattern or from an obstruction of the littoral drift of sediments (Mulvihill *et al.*, 1980). By affecting the littoral drift, adjacent wetland areas may lose the sediment load necessary for their continued existence. Zabawa *et al.* (1981) showed that bulkheads removed the protected shore as a sediment source, but did not change the sediment budget. Thus the annual amount of sediment movement was generated for the areas seaward of the bulkheads and the estuary. However, the hardening of the shoreline does reduce upland erosion and may lead reduced littoral movement of sediments that are necessary for sustaining sand on oceanfront beaches (COE, 1984).

Fish and Wildlife Impacts

In addition to the vegetation loss associated with bulkheads, wildlife, fisheries, and shellfish habitat are also disturbed or eliminated. Routes of access are also destroyed for many animals (Watts, 1987). Turtles, frogs, raccoons, and many birds must find non-bulkheaded routes to reach the water. Additionally, the change in water depth and loss of vegetation due to scouring is often responsible for loss of juvenile fish habitat. Hylton and others (1986) determined that bank stabilization structures did reduce littoral fish populations. Ellifrit and others (1972) found that bulkheads provide less favorable conditions for clam larvae (*Venerupis japanica*) settling and survival, and a reduced availability of nutrients and food. These factors lead to fewer clams in bulkheaded areas than in adjacent natural areas (Ellifrit *et al.*, 1972). Gilmorte and Trent (1974) found that benthic macro-invertebrates were more abundant in marshes than in bulkheaded canals, and crustaceans were over three times as abundant in the marsh. Mock (1966) compared the abundance of brown shrimp (*Penaeus aztecus*) and white shrimp (*Penaeus stiferus*) in front of a naturally vegetated shoreline and a bulkheaded shoreline.

The study found that the number of shrimp were five times greater along the vegetated shoreline than the bulkheaded shore. The difference was attributed to the lower organic detritus and benthic macro-invertebrates, deeper water and reduced intertidal vegetation.

Chemical Impacts

Wooden bulkheads comprise approximately ninety percent of all permitted shoreline stabilization projects in North Carolina (Skrabel, pers. comm, 1997). Most of the structures have involved the use of pressure treated lumber. The wood is injected with toxins to prevent marine organisms from consuming the organic material. The wood is most often injected with a chromated copper arsenate mixture (CCA). Each of these chemicals is toxic to marine organisms. Chromium is carcinogenic and mutagenic and has been reported to accumulate in phytoplankton (Weis and Weis, 1994). Copper in high levels is toxic to algae and mollusks. Arsenic is known to be carcinogenic, mutagenic, and teratogenic (Weis and Weis, 1994), and has been shown to bioaccumulate in estuarine ecosystems (Sanders *et al*, 1994). Studies have indicated that leachates from the treated wood are toxic to a variety of estuarine organisms such as fiddler crabs, sea urchin embryos, and some fish embryos. These toxins may be transferable to consumers from the affected species, often resulting in deleterious effects to the consumer (Weis and Weis, 1996). The local effects of these leachates may be minimal, but the cumulative effect of miles of wooden bulkheads may pose a concern for the health of the estuarine system. Presently some state and local governments are restricting the use of CCA-treated products in the interest of protecting the shallow estuarine environment.

Summary

There is growing concern about the effects of bulkheads and other hardened shoreline structures on sediment transport, foreshore erosion, marsh migration and estuarine organisms. Bulkheads can lead to destruction of these wetlands by not allowing the natural landward retreat of wetland vegetation as the sea level rises, and by producing conditions that accelerate the loss of suitable habitat for wetland plants, submerged plants and shallow water habitat. Bulkheads also accelerate the erosion of adjacent shorelines, often requiring the adjacent property owner to take action to stop the erosion process. Bulkheads installations often leads to the loss of important habitats. In addition to the vegetation loss associated with bulkheads, wildlife, fisheries, and shellfish habitat are also disturbed or eliminated. Erosion related to bulkheads is often responsible for loss of juvenile fish habitat, reduced littoral fish populations and loss of shellfish habitat.

Most of the shoreline protection structures in North Carolina involve the use of chromated copper arsenate pressure treated lumber. Each of the chemicals is toxic to marine organisms and have been reported to bioaccumulate in estuarine ecosystems. The cumulative effect of miles of wooden bulkheads may pose a concern for the overall health of the estuarine system.

Staff Recommendations

The staff recommends that hardened structures only be used in areas where there is a demonstrated need for the protection of upland property from excessive erosion when no other alternative is feasible. Vegetated buffers should also be used in conjunction with any shoreline protection measure. Nontoxic methods of erosion abatement are preferred. The staff recognizes that current rules regarding the installation of harden structures are inadequate for the protection of our coastal resources. We recommend that a panel be assembled to develop draft rule changes. The panel will outline the requirements for demonstrating the erosional need for a hardened structure, and set forth rules for the implementation of these recommendations along North Carolina's shorelines.

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3. IMPERVIOUS SURFACE AREA - DENSITY

As North Carolina's coastal population grows, the development pressure along the estuarine shoreline also increases. The population density of a given area is correlated with its percentage of impervious cover (Arnold and Gibbons, 1996). Land development alters the natural balance between runoff and natural absorption areas by replacing pervious areas with greater amounts of impervious surface. Therefore, imperviousness is directly proportional to the degree of land development. Research shows a strong correlation between the imperviousness of a drainage basin and the health of its receiving waters. Impervious coverage is a readily identifiable, measurable aspect of the landscape, facilitating its use in both planning and regulatory applications (Arnold and Gibbons, 1996).

Definition

Impervious surfaces can be defined as any impenetrable material that prevents infiltration of water into the soil. Rooftops, roads and parking lots are the most prevalent and easily identified impervious surfaces, although the list also includes sidewalks, patios, gravel drives, bedrock outcrops, and compacted soil. As development alters the natural landscape in coastal counties, the percentage of the land covered by impervious surfaces increases, initiating a chain of events that begins with alterations in the hydrologic cycle, works its way through physical and ecological impacts on riparian areas, adds water pollution, and culminates in degraded water resources (Arnold and Gibbons, 1996). Water is often conveyed from impervious areas by pipes, gutters and ditches, which promotes increased runoff velocity and volumes due to the absence of areas for infiltration and absorption. In turn, impervious areas often add to the volume of toxins, nutrients and pollutants associated with stormwater runoff.

Transportation related impervious areas that are in the public domain are often overlooked in estimates of imperviousness. The transportation component can, in terms of totally impervious area created, exceed the rooftop component within a watershed. Additionally, these areas often exert a greater hydrological impact than rooftop or residential imperviousness (Schueler, 1994). In residential areas runoff can be spread over pervious areas such as lawns. Roads, bridges and parking lots are usually directly connected to storm drainage systems, which in this case is most often observed in suburban areas. Measurements of impervious surface area in eleven residential, multifamily and commercial areas revealed that transportation related imperviousness comprised 63 percent to 70 percent of the total impervious surface cover (City of Olympia, 1994). Additionally, streets have been shown to produce the highest pollutant loads in most lost use categories (Bannerman et al., 1993).

Impacts

Imperviousness is integrative, indicating cumulative water resource impacts without regard to specific factors. Research from the past 15 years consistently demonstrates a strong correlation between the imperviousness of a drainage basin and the health of its receiving waters (Arnold and Gibbons, 1996). Many studies have focused on macroinvertebrate diversity and populations, fish population and health, shellfish habitat, and water quality.

The loss of many of our water related natural resources can be correlated with increases in impervious surface development. A number of studies have examined the link between imperviousness and the biologic diversity in streams (Schueler, 1994). Degradation of stream habitat is reported to occur at a 30 percent to 100 percent impervious coverage. The threshold of initial degradation fall within the 10 to 20 percent range. This range of initial degradation is exceptionally consistent under different methods of analysis (Schueler, 1994). Therefore, impervious coverage is often a reliable indicator of the impact of development on water resources.

Macroinvertebrate Impacts

Macroinvertebrates are often used as indicators of the overall health of aquatic ecosystems. Klein (1979) found the macroinvertebrate diversity dropped sharply in urban streams when the watershed impervious surface area exceeded 10 to 15 percent. Jones and Clark (1987) monitored benthic insect diversity in Northern Virginia, and found a change in composition after the watershed population exceeded four individuals per acre. The population density roughly translates to half-acre or one acre lots residential land use (10 to 20 percent imperviousness). Shaver *et al,* (1995) reported a sharp drop in macroinvertebrate diversity at 12 to 15 percent imperviousness in streams in the coastal plain and piedmont of Delaware.

Fishery Impacts

Few studies have been completed on the effects of imperviousness on fish habitats and populations. Holland (1997) reported that finfish populations in coastal creeks in South Carolina markedly decrease at a 30 percent impervious coverage. Anadromous fish eggs and larvae have been noted to sharply decline after a 10 percent impervious threshold was surpassed (Limburg and Schmidt, 1990).

Shellfish Impacts

Even relatively low levels of development can yield high levels of bacteria, derived from surface runoff or failing septic systems (Schueler, 1994). Shellfish harvesting areas are often closed in areas that receive high runoff. Some North Carolina shellfish areas are closed only after rainfall has occurred in the area, indicating that surface runoff is a major pollutant source. Fecal coliform counts are often high in areas that receive increased stormwater runoff. Shellfish closure has also been attributed to septic system failure. The density of development may play a role in increased bacterial loads. Duda (1982) presented that is difficult to prevent closure of shellfish areas when more than one septic drain field is present per seven acres. As the population in the coastal counties increases, the amount of impervious area also increases with development and in turn the number of shellfish closure areas has increased. The resulting increase in closed shellfish areas and possible closure in recreation areas can have severe economic impacts on North Carolina (Maiolo and Tschetter, 1981).

Water Quality Impacts

Impervious surfaces collect and accumulate pollutants deposited from various sources (Schueler, 1994). Stormwater runoff rapidly transports these pollutants to pipes, gutters, ditches, and eventually to an aquatic system. In some areas, stormwater runoff is sent to retention and detention ponds for the settling of sediments and pollutants. Others are sent through vegetated buffer zones before reaching open water. This action promotes increased

runoff velocity and volumes due to the absence of areas for infiltration and absorption. In turn, impervious areas often add to the volume of toxins, nutrients and pollutants associated with stormwater runoff. Monitoring and modeling studies have consistently indicated that urban pollutant loads are directly related to watershed impervious surface coverage (Schueler, 1994). Many nonpoint source pollutant problems can be tied to the amount and location of impervious surfaces.

Limiting impervious surface areas

Limiting impervious cover is a management technique that mitigates the adverse effects inherent to development. Impervious cover limitations and buffer zone requirements have been proven to maintain the basic hydrologic balance (Arnold and Gibbons, 1996). Limiting imperviousness reduces the potential for flooding and the discharging of pollutants into aquatic systems. Maintaining natural hydrologic conditions benefits water quality by reducing erosion, pollution, and by maintaining salinity levels.

Imperviousness is rarely specified or addressed in community goals, policies or regulations (Arnold and Gibbons, 1996). When addressed, zoning has strongly emphasized and regulated the rooftops, commercial development and general residential development (*i.e.*, tennis courts, driveways) and largely neglected the transportation component. While the rooftop component is may be fixed in density zoning, the transportation component is not. As an example, many zoning codes set forth the maximum density for an area, based on dwelling units (Schueler, 1994). Thus, in a given area, no more than one single family home can be located on each acre of land, and so forth. Thus, a wide range in impervious cover is often seen for the same zoning classification.

Limits on impervious surface area is implemented by several methods. While analysis is often conducted on a watershed level; it may not be always feasible to apply limits at this scale. This is particularly true in watersheds with existing development. Regulations limiting impervious surface area are often conducted on a lot-by-lot basis with resource protection as a goal. Other methods involve zoning standards based on land use intensity or resource protection. Reducing impervious through planning and design often reduce expenses in construction and maintenance for local governments.

Summary

Research shows a strong correlation between the imperviousness of a drainage basin and the health of its receiving waters. Impervious coverage is a readily identifiable, measurable aspect of the landscape, facilitating its use in both planning and regulatory applications. The loss of many of water-related natural resources can be associated with increases in impervious surface development. A number of studies have examined the link between imperviousness and ecosystem health. The threshold of initial degradation of many organisms fall within the 10 to 20 percent imperviousness range. The biodiversity of macroinvertebrates and anadromous fish eggs and larvae have been shown to drop within this range. Finfish populations are reported to markedly decrease at a 30 percent impervious coverage. Impervious areas often add to the volume of toxins, nutrients and pollutants associated with stormwater runoff. Shellfish resources and general water quality are also reported to be effected by a number of different impacts taht can be associated with the magnitude of impervious.

Limiting impervious cover is a management technique that mitigates the adverse effects inherent to development. Limiting imperviousness reduces the potential for flooding and the discharging of pollutants into aquatic systems. Transportation related impervious areas are often overlooked in estimates of imperviousness and often exert a greater hydrological impact than rooftop or residential imperviousness. Imperviousness is rarely addressed in community policies or regulations. Limits on impervious surface area can be implemented by several methods. Regulations limiting impervious surface areas are often conducted on a lot-by-lot basis with resource protection as a goal. Other methods involve zoning standards based on land use intensity or protection of a particular resource. Reducing impervious through planning and design often reduce expenses in construction and maintenance for local governments and landowners.

Staff Recommendations

The staff recognizes that current rules regarding impervious surfaces and density of development are inadequate for the protection of North Carolina's coastal resources. Based solely on scientific information available, limits on impervious surface area should be implemented on a watershed basis. It is recognized by the staff that implementation of a watershed-based method is currently not feasible. Therefore, the staff recommends that a more stringent limit on impervious surface areas be developed for application on a lot-by-lot basis, within all jurisdictional areas along North Carolina shorelines — perhaps lowering the current standard to 10 to 20 percent imperviousness, or even lower for highly sensitive resource areas (*e.g.*, primary nursery areas, shellfish beds, outstanding resource waters). Transportation surfaces should be included in the watershed impervious count. Engineered alternatives are acceptable if documented to be successful in similar applications. Local governments should be encouraged to implement zoning and planning which mitigates the effects of imperviousness. We recommend that a panel be assembled to develop draft rule changes that will implement these recommendations.

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Appendix 1.
Tables from Desbonnet *et al.*, (1994)

Table 3. Recommended vegetated buffer widths for pollutant removal, giving the desired effect of the implemented buffer. The reported values are generally intended as minimum buffer width values to achieve the desired purpose. [1 meter = 3.28 feet]

Author(s)	Width (m)	Objective	Specifics
in: Comerford et al. 1992	2	Maintain stream channel stability	Ozark Mts
Ahola. 1990	2 - 10	Stream habitat protection	
Ahola. 1990	5 - 20	River/lake protection	
Scheuler and Bley. 1987	7	Low level pollutant removal	Grassed buffer
in: Comerford et al.. 1992	7 - 12	General purpose use	Low slope: rural land
Palmstrom. 1991	7.6	General purpose use	
Doyle et al.. 1975	7.6	Protect water quality from animal wastes	Forested buffer
in: Comerford et al.. 1992	8	Protect general water quality	
in: Comerford et al.. 1992	9	Protect water quality from ground-based herbicide applications	
Martin et al.. 1985	10	Protect water quality from clear-cut	Forested buffer
Clark. 1977	10	General purpose use	0% slope over slightly erodible soils
Swift. 1986	10 - 19	Protect general water quality	Road runoff sediment
Trimble & Sartz. 1957	10.6 - 12.2	Protect water quality from logging	<10% slope
Florida Div. Forestry. 1990	11	Protect general water quality	Primarily streamside
in: Comerford et al.. 1992	11	Protect small stream water quality	Forested buffer
in: Comerford et al.. 1992	12 - 24	Protect general water quality	Forested buffer
in: Comerford et al.. 1992	12 - 85	Moderate erosion protection	Forested
in: Comerford et al.. 1992	15	Protect water quality from pesticides	
Phillips. 1989b	15 - 60	Protect general water quality	Well-drained soils
in: Comerford et al.. 1992	15 - 105	Severe erosion protection	Forested buffer
Corbett & Lynch. 1985	20 - 30	Protect water quality from logging	Forested buffer
Clark. 1977	23	Protect water quality from logging	Forested buffer
Moring. 1982	30	Protect salmon egg and juvenile development	Forested buffer
Erman et al.. 1977	30	Protect stream water quality from logging	Forested buffer
USACE. 1991	30	90% removal of TSS	Grassed buffer
in: Comerford et al.. 1992	30	Protect water quality from aerial herbicide applications	
in: Comerford et al.. 1992	31	Protect large stream/river water quality	Forested buffer
Phillips. 1989b	40-80	Protect general water quality	Poorly drained soils
Clark. 1977	45	Protect general water quality	30% slope over severely erodible soils
Clark. 1977	46	Protect general water quality	
in: Comerford et al.. 1992	91	Protect private residences from aerial herbicide applications	
Phillips. 1989b	95	Protect stream water quality	Under all conditions
Roman & Good. 1983	100	Wetland protection	NJ Pinelands habitat
Brown et al.. 1990	178	Protect wetland water quality	

Table 4. A summary of pollutant removal effectiveness values according to width of the vegetated buffer. Removal efficiency values are given as percent removal for each of the various pollutants treated in the vegetated buffer — sediment, TSS, total nitrogen, total phosphorus, and nitrate-nitrogen. [1 meter = 3.28 feet]

		Pollutant Removal (%)				
Author(s)	Width (m)	Sediment	TSS	N	P	NO_3
Doyle et al., 1977	0.5				9%	0%
Neibling & Alberts, 1979	0.6	91%				
Neibling & Alberts, 1979	0.6	37%				
Neibling & Alberts, 1979	1.2	78%				
Doyle et al., 1977	1.5				8%	57%
Neibling & Alberts, 1979	2.4	82%				
Doyle et al., 1975	3.8			95%	99%	
Doyle et al., 1977	4.0				62%	68%
Young et al., 1980	4.06			84%	83%	9%
Dillaha et al., 1988	4.6		31%	0%	2%	
Dillaha et al., 1988	4.6		87%	61%	63%	
Dillaha et al., 1988	4.6		76%	67%	52%	3%
Magette et al., 1987	4.6		72%	17%	41%	
Dillaha et al., 1986b	4.6	63%		63%	63%	
Neibling & Alberts, 1979	4.9	83%				
Neibling & Alberts, 1979	6.1	90%				
Doyle et al., 1975	7.6			96%	99%	
Schellinger & Clausen, 1992	7.6		4%	15%	6%	
Schellinger & Clausen, 1992	7.6		27%	16%	18%	
Dillaha et al., 1988	9.1		58%	7%	19%	
Dillaha et al., 1988	9.1		95%	77%	80%	4%
Dillaha et al., 1988	9.1		88%	71%	57%	17%
Dillaha et al., 1986b	9.1	78%		78%	78%	
Magette et al., 1987	9.2		86%	51%	53%	
Thompson et al., 1978	12			45%	55%	46%
Bingham et al., 1978	13			28%	25%	28%
Mannering & Johnson, 1974	15	45%				
Doyle et al., 1977	15.2			97%	99%	
Lake & Morrison, 1977	15.2	46%				
Peterjohn & Correll, 1984	19	90%		62%	0%	60%
Young et al., 1980	21.3	81%				
Young et al., 1980	21.3	75%				
Schwer & Clausen, 1989	26		95%	92%	89%	
Young et al., 1980	27.4	93%				
Young et al., 1980	27.4		66%	87%	88%	
Young et al., 1980	27.4		82%	84%	81%	
Edwards et al., 1983	30		23%	31%	29%	
Doyle et al., 1975	30.5			98%	99%	
Patterson et al., 1977	35		71%			
Thompson et al., 1978	36			69%	61%	62%
Wong & McCuen, 1982	45	90%				
Woodard, 1988	57	99%				
Edwards et al., 1983	60		87%	83%	84%	
Baker & Young, 1984	79			99%		
Karr & Schlosser, 1978	91	55%	50%			
Karr & Schlosser, 1978	215	97.5%	90%			
Karr & Schlosser, 1978	304	99%	97%			
Lowrance et al., 1984				85%	30-42%	83%
Jacobs & Gilliam, 1985						99%
Rhodes et al., 1985						99%
Reuter et al., 1992			85%		97%	85-90%
Schipper et al., 1989						98%

Table 4. A summary of pollutant removal effectiveness values according to width of the vegetated buffer. Continued

Runoff source	Vegetation	Slope	Other
Dairy manure	Grass-fescue	10%	90 mT/ha
Bare soil	Grass	7%	For coarse-grained sediments
Bare soil	Grass	7%	For clay-sized particles
Bare soil	Grass	7%	For clay-sized particles
Dairy manure	Grass		90 mT/ha
Bare soil	Grass	7%	For clay-sized particles
Dairy manure	Forest/scrub	35-40%	Gravely, silt-loam soils
Dairy manure	Grass		
Dairy feedlot		4%	
Dairy manure	Orchard grass	5%	Concentrated flow
Dairy manure	Orchard grass	11%	Av. 10.000 kg/ha manure application
Dairy manure	Orchard grass	16%	Av. 10.000 kg/ha manure application
Dairy manure	Forest/scrub	35-40%	Gravely, silt-loam soils
Fertilized cropland	Orchard grass		
Bare soil	Grass	7%	For clay-sized particles
Bare soil	Grass	7%	For clay-sized particles
Dairy yard runoff	Fescue & rye mix	2%	Poorly drained, surface sample
Dairy yard runoff	Fescue & rye mix	2%	Poorly drained, subsurface sample
Dairy manure	Orchard grass	5%	Concentrated flow
Dairy manure	Orchard grass	11%	Av. 10.000 kg/ha manure application
Dairy manure	Orchard grass	16%	Av. 10.000 kg/ha manure application
Dairy manure	Orchard grass		
Poultry manure	Fescue	6-8%	
	Bluegrass sod		
Dairy manure	Forest/scrub	35-40%	90 mT/ha; Gravely, silt-loam soils
	Bluegrass sod		
Agricultural runoff	Forested		
Feedlot runoff	Corn	4%	
	Oats	4%	
Milk house waste	Fescue & rye mix	2%	
	Corn	4%	25-year, 24-hour storm simulation
	Orchard grass	4%	25-year, 24-hour storm simulation
	Sorghum/grass	4%	25-year, 24-hour storm simulation
Feedlot runoff	Fescue	2%	Settling basin, then through 60 m of grass buffer
Dairy manure	Forest/scrub	35-40%	Gravely, silt-loam soils
Liquid dairy waste	Fescue	3.4%	
	Natural, mixed		
Feedlot effluent	Fescue	2%	Moved through 2 consecutive 30m VFS
Fertilizers	Grass		
	Bermuda grass		
	Forested		
	Forest/wetland		79.5 ha undisturbed watershed
Fertilized field runoff	Man-made gravel		
Sewage spray	Forested pine		

Table 6. Recommended buffer widths for wildlife habitat. The reported widths are generally intended as minimum values to provide the desired habitat requirement to meet the given objective. [1 meter = 3.28 feet]

Author(s)	Width (m)	Objective	Specifics
Triquet et al., 1990	15 - 25	General avian habitat	Riparian wooded area
Snisler et al., 1987	15 - 30	Protect wetland habitat from low-intensity disturbances	Densely growing mixed species buffer
Tassone, 1981	30	Wildlife travel corridor	
Snisler et al., 1987	30 - 45	Protect wetland habitat from high-intensity disturbances	Densely growing mixed species buffer
Howard and Allen, 1989	60	General wildlife habitat	
Tassone, 1981	60	Breeding sites for fragment-sensitive bird species	
Groffman et al., 1991b	60 - 100	General wildlife habitat	
Cross, 1985	67	Small mammal habitat	Wooded riparian area
Groffman et al., 1991b	91.5	Protect significant wildlife habitat	Natural vegetation
Brown et al., 1990	178	Wetland habitat protection	
Scheuler, 1987	200	Diverse songbird community	
U.S. ACE, 1991	<200	For all but large mammals	Riparian forest

Appendix 2.
Table from Desbonnet *et al.*, (1994)

Table 8. A listing of buffer and setback widths that coastal states have established through their coastal zone management programs. M denotes the width is mandated, while R denotes that the width is recommended only. [1 foot = 0.305 meters]

State	Buffer Width	Status	Setback Width	Status	Comments
Alabama			40'; Applies to Gulf Coast only	M	Primarily for dune protection and preservation
Alaska			100' city/state lands: 66' private property	M	Applies only to timber harvest operations
California	100' around wetlands	R			Mainly for habitat preservation
Connecticut					Through local ordinances
Delaware			50' from mean high water mark	M	Also through local ordinances
Florida					Through local ordinances
Georgia					No CZMP at present
Hawaii			40' from shoreward vegetation line: 20' if hardship shown	M	Applies to all islands in the Hawaiian islands group
Louisiana					Through local ordinances
Maine	75' along entire coast: 250' along sensitive wetland areas	M			Also has a buffer management program
Maryland	100' along Chesapeake Bay shore	M			Case-by-case on non-Chesapeake Bay shores
Massachusetts					In process of development
Mississippi					Rarely case-by-case
New Hampshire	100' along wetlands	M			The definition of wetlands includes the entire NH coast
New Jersey	0-300' on a case-by-case basis	R			Only along sensitive areas; local zoning supersedes state
New York			75' from wetlands (30' in New York City)	M	Vegetation not required in the setback
North Carolina	30' around significant waters	M			Vegetation not required in buffer
Oregon					Through local ordinances
Rhode Island	0-200' on a case-by-case basis	R	50' from the coastal feature	M	New buffer program being reviewed
South Carolina			Variable, according to erosional rates	R	Only applicable in coastal dunes; vegetation not required
Texas					CZMP being developed
Virginia	100' along Chesapeake Bay shore	M			Not required along other state coastal areas
Washington					Through local ordinances

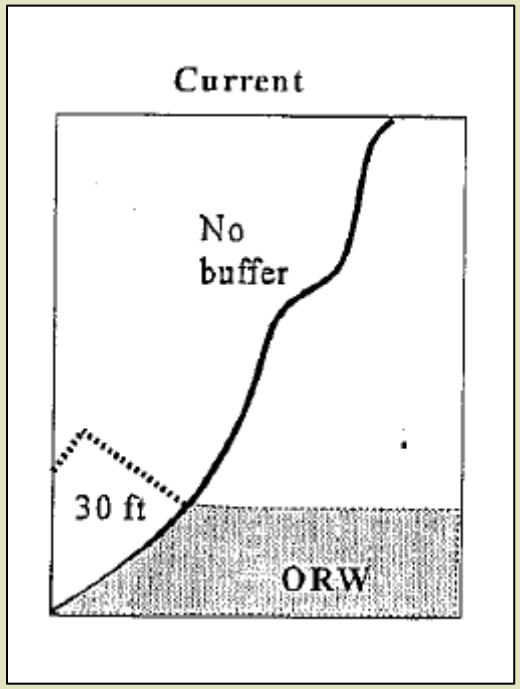
Artificial Turf Grass and CAMA Rules – Part III
April 30, 2025

Jonathan Lucas

NC Dept of Environmental Quality

Division of Coastal Management

- CRC has authority to designate AECs
- CRC has authority to regulate development in AECs



- First implementation of 15A NCAC 07H .0209 “Estuarine Shorelines”
- 30’ buffer only adjacent to ORW
- Also - AEC extends only to limit of Coastal/Joint Fishing waters

"It is evident that existing regulations are not adequately protecting our fragile estuarine waters from the activities taking place in them."

- CRC considered amending the estuarine shoreline use standards in response to stormwater management rules being developed by EMC.
- CRC decided to delay action until EMC had codified their rules

- **January 1998** – Implementation and Standards Committee
  - Discussion on expanding the Estuarine Shoreline AEC
  - Discussion on vegetative buffers

- I&S Memo 424b (January 1998) - Benefits of buffers
  - Stabilize soil
  - Reduce sediment runoff
  - Reduce runoff speed
  - Enhance infiltration
  - Reduce bacterial, nutrient, and pollutant loads
  - Reduce viral and bacterial dispersion
  - Provide wildlife habitat

"The effectiveness of any buffer zone is related to its width, slope, soil type, and vegetation."

Pollutants and nutrients attach to sediment particles in surface flow

Surface flow is slowed by vegetation, allowing deposition of the sediment particles into the soil

Biological removal of pollutants and nutrients

- **March 1998** – Implementation and Standards Committee
  - DCM Director recommended to that CRC establish a vegetative buffer along all jurisdictional waters.
  - CRC directed staff to draft rule language
- **Early 1999** – Buffer rule (and public trust shoreline AEC) approved for public hearing
- **November 1999** Meeting
  - CRC adopted the rule. Went into effect August 1, 2000

- **January 2021** – CRC discusses adding buffer exceptions to the rule
- **March 2001** – CRC approves proposed exceptions for public hearing
- Exceptions went into effect as .0209(d)(10)

ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
BRAXTON DAVIS
Director

NORTH CAROLINA
Environmental Quality

CRC-21-24

August 31, 2021

MEMORANDUM

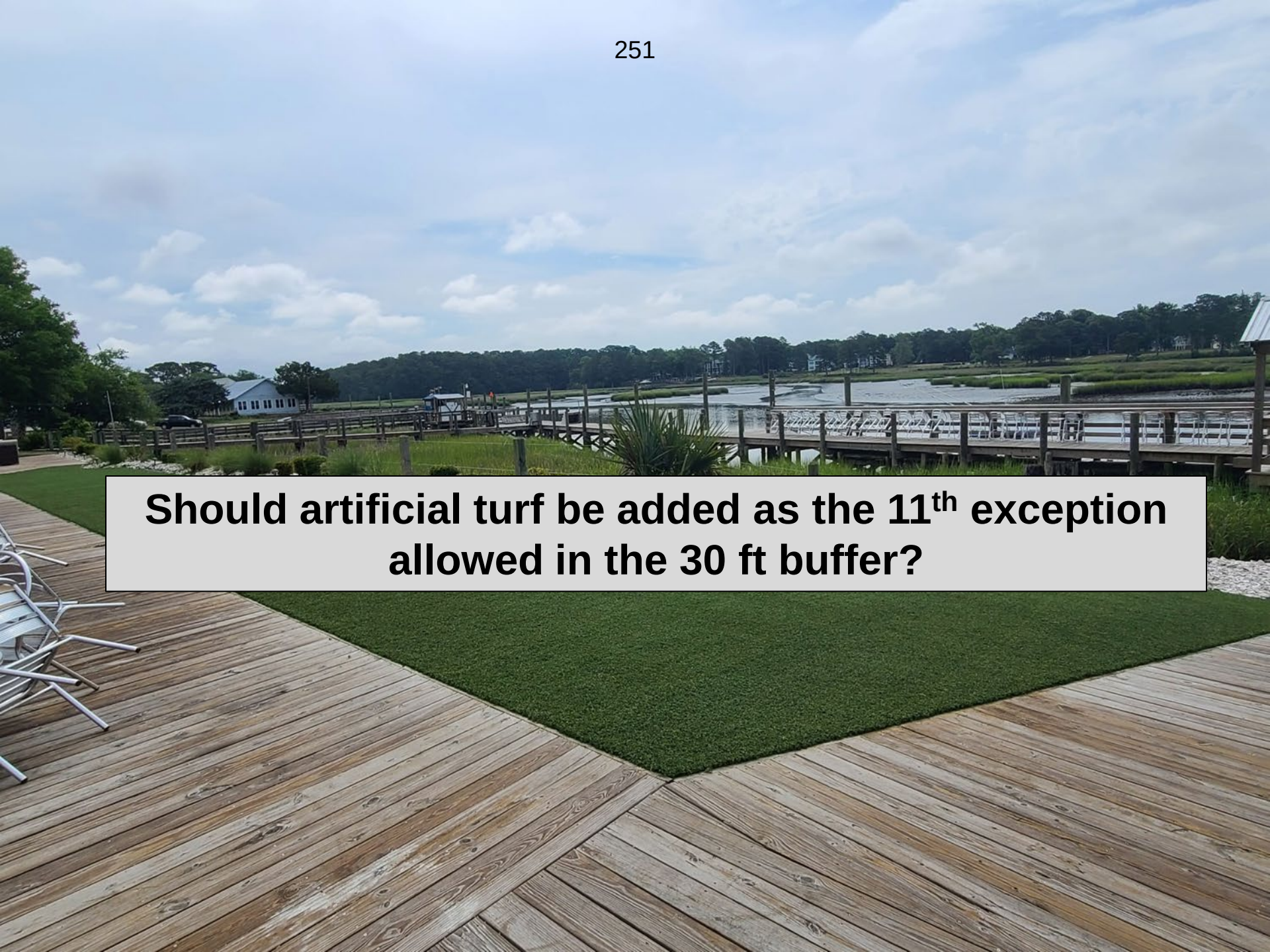
TO: Coastal Resources Commission
FROM: Robb Mairs
SUBJECT: Artificial Turfgrass within the Coastal Shoreline Buffer

"In order to retain the effectiveness of the 30' buffer in filtering runoff, Staff request that the Commission confirm DCM's interpretation that **the application of artificial turf within an Area of Environmental Concern requires a CAMA permit,** and that **it is not allowable under the "landscaping" exception to the 30' buffer** at 15A NCAC 07H.0209(d)(10)(G)."

the rule to preserve buffer function for nutrient removal. Furthermore, in some cases small plastic fibers are mixed into the soil under the turf during installation to enhance soil compaction, and turf "infill" (small silica, rubber or plastic beads) is also sometimes applied to the surface of the artificial turf to stand up the blades following installation. DWR staff expressed concerns with the potential for these small plastic fibers, and rubber or silica beads, to enter nearby receiving waters and potentially lead to water quality standards violations.

Since adoption of the 30-foot buffer rule in 2000, the Commission has had a clear intent and has been consistent in not allowing non-water-dependent amenities within the buffer that could undermine the purposes and effectiveness of the buffer. The buffer area has been identified as crucial in protecting water quality by filtering contaminants from runoff, allowing infiltration, stabilizing soil, slowing floodwaters and preserving the natural character of the shoreline. When the Commission has granted variances, it has usually involved a habitable structure, and these variances have typically been conditioned on the use of an engineered stormwater system.

In order to retain the effectiveness of the 30' buffer in filtering runoff, Staff request that the Commission confirm DCM's interpretation that the application of artificial turf within an Area of Environmental



Should artificial turf be added as the 11th exception allowed in the 30 ft buffer?

Coastal Shoreline AEC – Artificial Turf

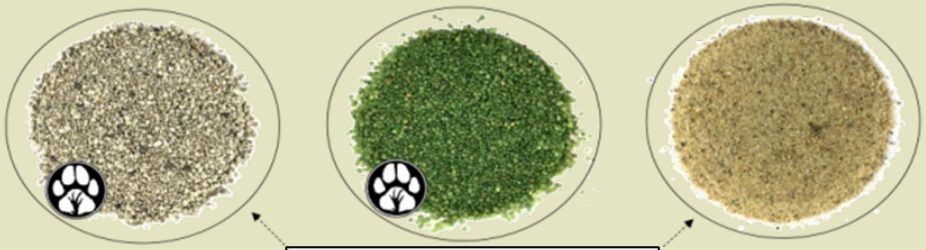
Decision	Method
Artificial turf not allowed in the AEC.	Add this as a standalone rule in 07H .0209
Artificial turf allowed in the AEC, but not in the 30' buffer	Add this as a standalone rule in 07H .0209. **Potential conditions** i.e.: − State that it must meet the pervious standards of the General Statute − Regulate the infill − Limit square footage
Artificial turf allowed in the entirety of the AEC, including 30 ft. buffer.	Add this as a standalone rule in .07H. 0209, **with potential conditions**. Add this to the allowable exceptions in .0209(d)(10), **with potential conditions**.

Division of Coastal Management

PURE ZEO
(1.5-2 IBS PER SQ FT)

ENVIROFILL
(2.5-3 IBS PER SQ FT)

20/40 SILICA SAND
(2.5-3 IBS PER SQ FT)



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FRANPLAST
TPE-S SPECIALISTS

Crumb rubber	
Other plastic	
Silica sand	
Silica beads	
Plant material	

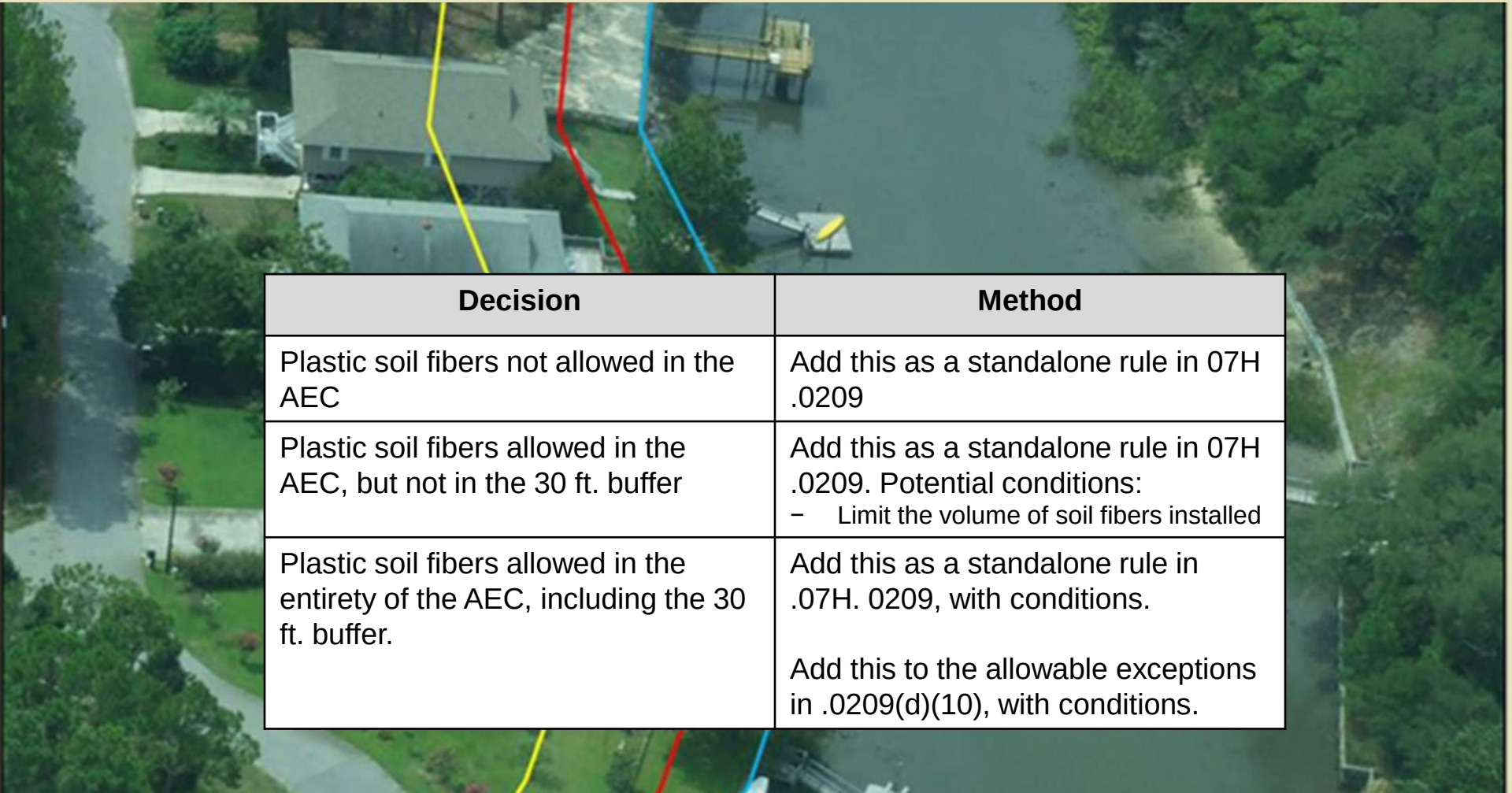
Source: William James Topley, Topley Studio / Library and Archives Canada, MIKAN 3422387
https://ottawacitizen.com/opinion/columnists/boswell-the-pollution-scourge-of-1866-was-sawdust

Crumb rubber	
Other plastic	
Silica sand	
Silica beads	
Plant material	✓

Coastal Shoreline AEC – Artificial Turf

Decision	Method
Artificial turf not allowed in the AEC.	Add this as a standalone rule in 07H .0209
Artificial turf allowed in the AEC, but not in the 30' buffer	Add this as a standalone rule in 07H .0209. Potential conditions: − State that it must meet the pervious standards of the General Statute − Regulate the infill − Limit square footage
Artificial turf allowed in the entirety of the AEC, including 30 ft. buffer.	Add this as a standalone rule in .07H. 0209, with conditions. Add this to the allowable exceptions in .0209(d)(10), with conditions.

Coastal Shoreline AEC – Plastic soil fibers



Decision	Method
Plastic soil fibers not allowed in the AEC	Add this as a standalone rule in 07H .0209
Plastic soil fibers allowed in the AEC, but not in the 30 ft. buffer	Add this as a standalone rule in 07H .0209. Potential conditions: − Limit the volume of soil fibers installed
Plastic soil fibers allowed in the entirety of the AEC, including the 30 ft. buffer.	Add this as a standalone rule in .07H. 0209, with conditions. Add this to the allowable exceptions in .0209(d)(10), with conditions.

Division of Coastal Management

NC COASTAL RESOURCES COMMISSION MEETING

November 19-20, 2025

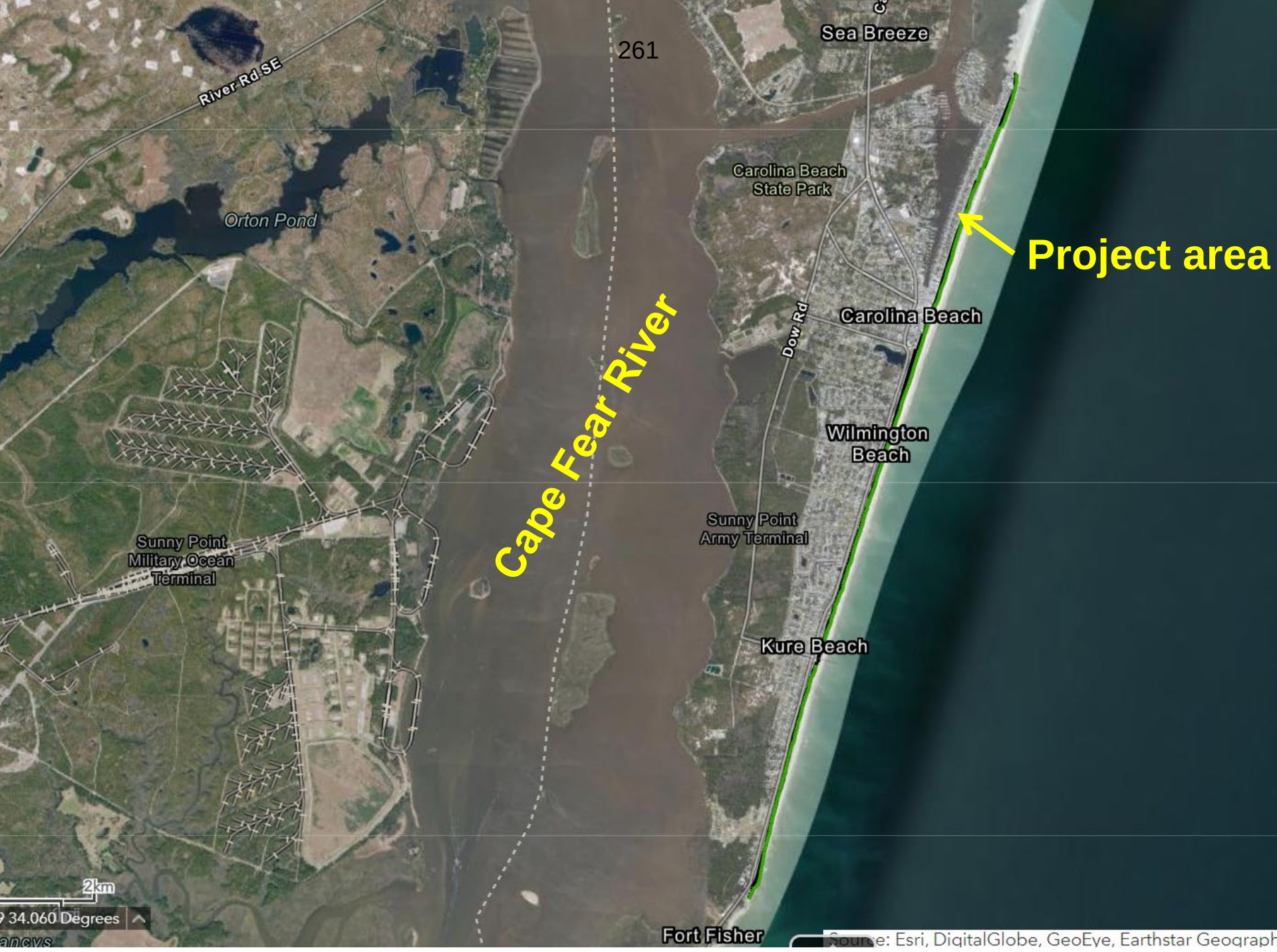
Artificial Turfgrass within 30-foot Buffer

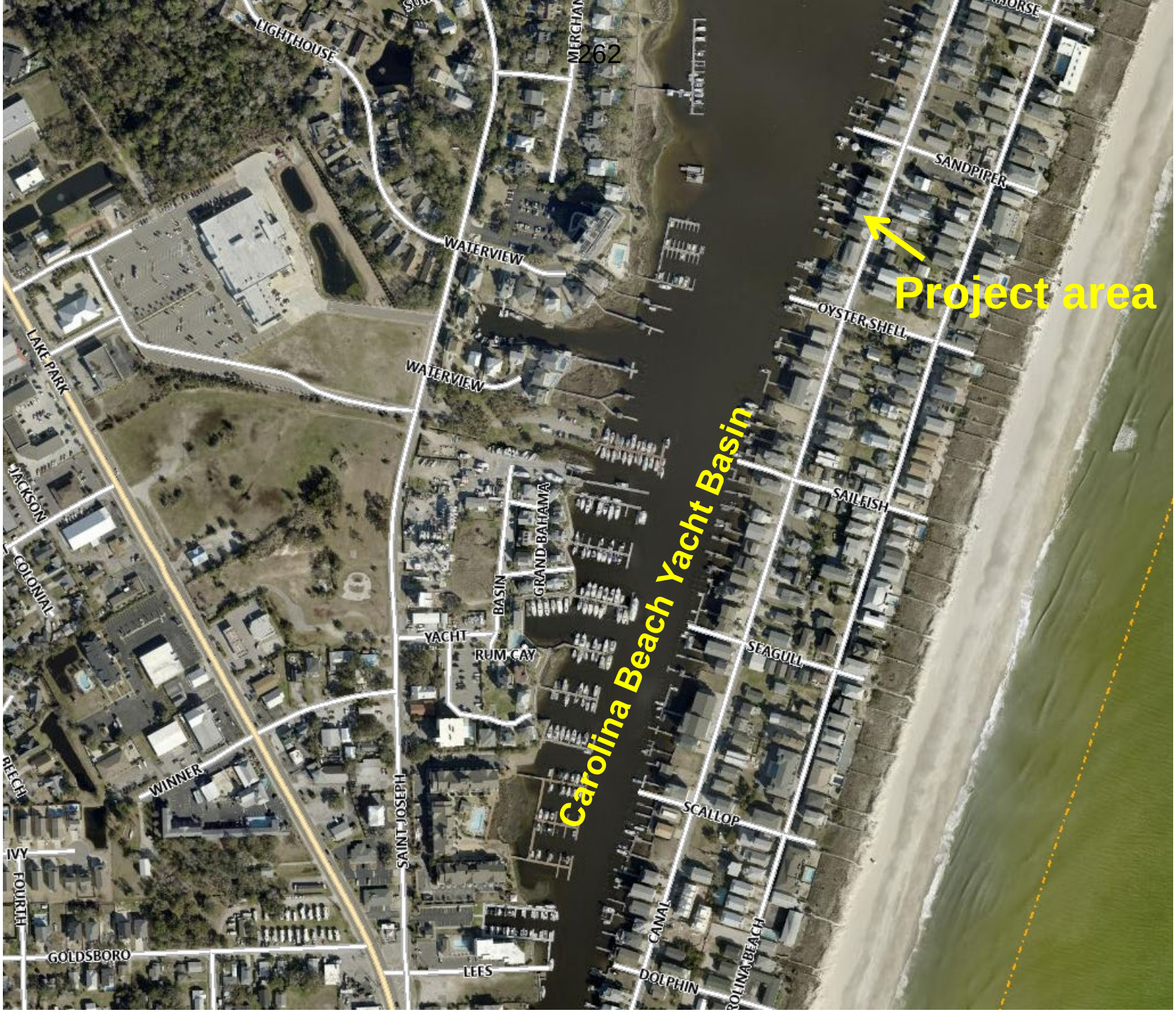
Andrew Krichman

(CRC-VR-24-11)

813 Canal Drive

Carolina Beach, New Hanover


261
Sea Breeze
River Rd SE
Orton Pond
Carolina Beach
State Park
Project area
Cape Fear River
Dow Rd
Carolina Beach
Wilmington
Beach
Sunny Point
Army Terminal
Sunny Point
Military Ocean
Terminal
Kure Beach
Fort Fisher
2km
34.060 Degrees


Project area
Carolina Beach Yacht Basin
LIGHTHOUSE
WATERVIEW
WATERVIEW
LAKE PARK
JACKSON
COLONIAL
BEECH
WINNER
IVY
FOURTH
GOLDSBORO
SAINT JOSEPH
LEES
BASIN
GRAND BAHAMA
YACHT
RUM CAY
CANAL
DOLPHIN
SCALLOP
SEAGULL
SAILFISH
OYSTER SHELL
SANDPIPER

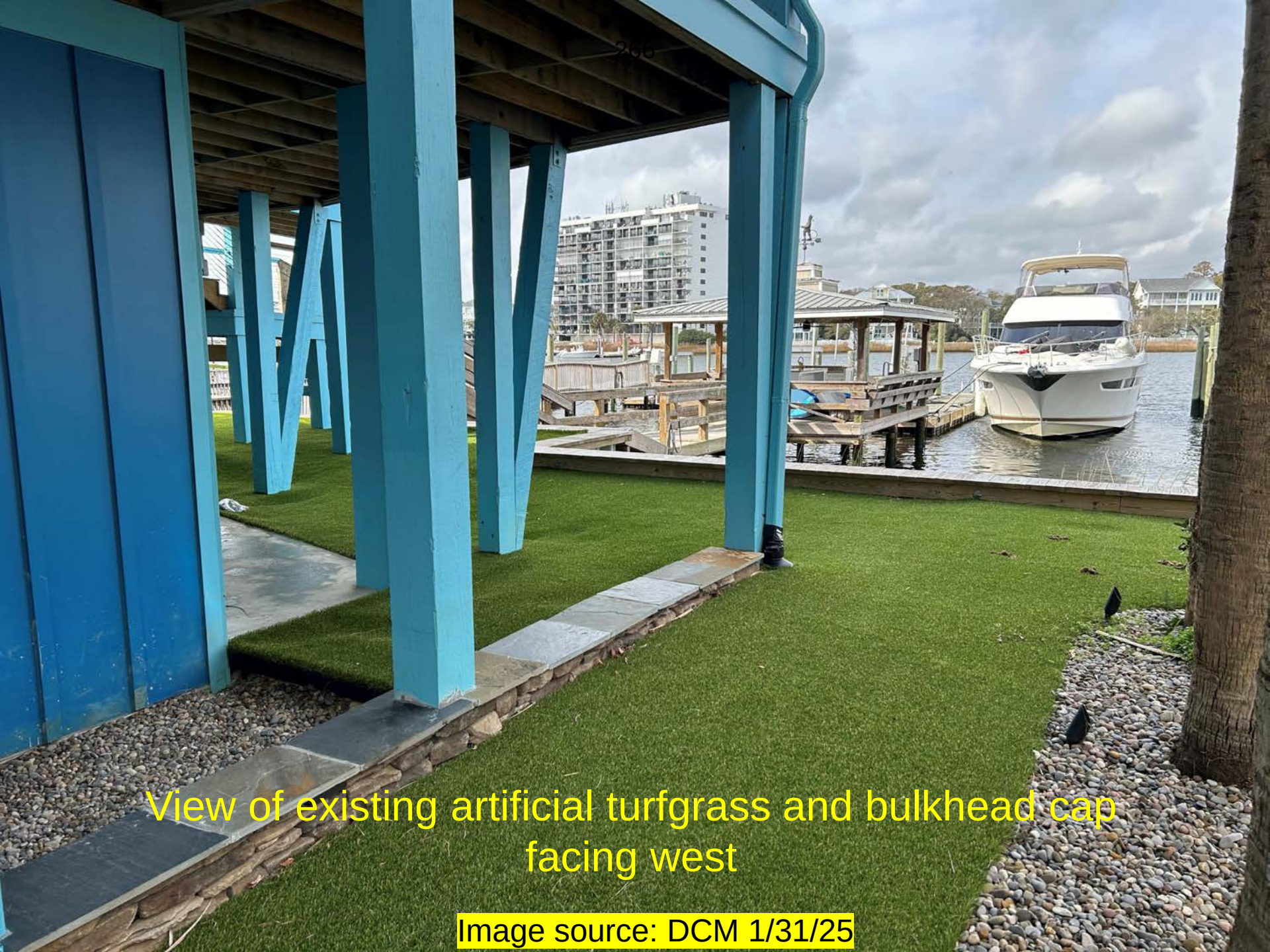

Carolina Beach Yacht Basin
Project Site
813 Canal Drive
Image Source:
New Hanover Co.
GIS 2023 Aerial

View of existing single-family residence facing west

Image source: DCM 1/31/25

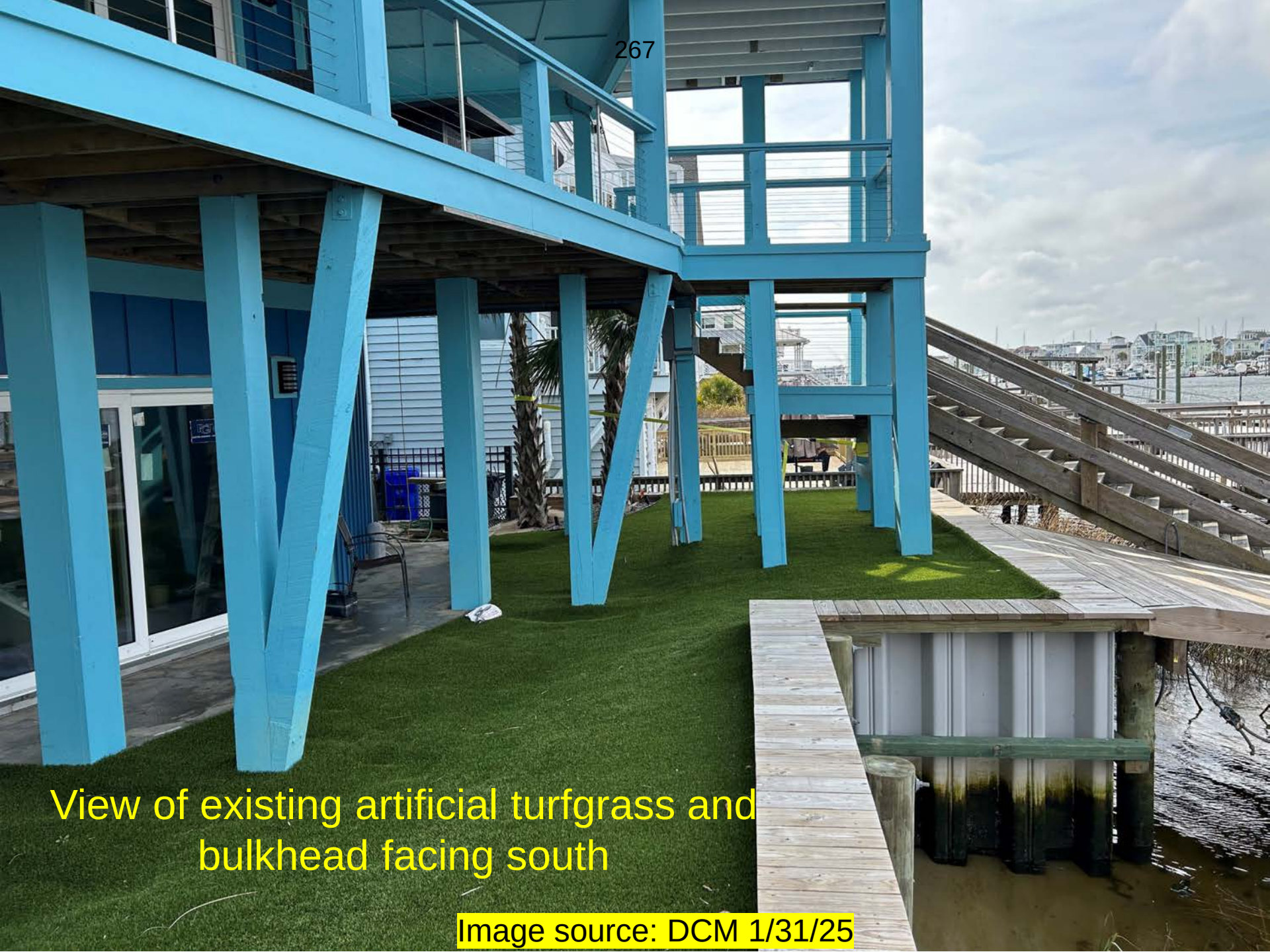
View of existing bulkhead and single-family resident facing east

Image source: DCM 1/31/25



View of existing artificial turfgrass and bulkhead cap facing west

Image source: DCM 1/31/25



View of existing artificial turfgrass and bulkhead facing south

Image source: DCM 1/31/25

View of existing artificial turfgrass, bulkhead cap and adjacent property facing north

Image source: DCM 1/31/25

VARIANCE CRITERIA

G.S. 113A-120.1
To grant a variance, the Commission must affirmatively find Petitioner must show each of the four factors listed in G.S. 113A-120.1(a).

(1) that unnecessary hardships would result from strict application of the development rules, standards, or orders issued by the Commission;
(2) that such hardships result from conditions peculiar to the petitioner's property such as location, size, or topography;
(3) that such hardships did not result from actions taken by the petitioner; and
(4) that the requested variance is consistent with the spirit, purpose and intent of the Commission's rules, standards or orders; will secure the public safety and welfare; and will preserve substantial justice.

(b) The Commission may impose reasonable and appropriate conditions and safeguards upon any variance it grants.