
Town of Duck - Neighborhood Resiliency Study

N.C. Resilient Coastal Communities Program (Phase 3)

N.C. Division of Coastal Management

PREPARED FOR



Town of Duck
Department of Community
Development
1200 Duck Road
Duck, NC 27949

PREPARED BY



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Introduction

The Town of Duck is an approximately 2.42-square mile beach community located in Dare County, North Carolina. The abundance of natural resources (beach, maritime forest, willow swamp) contributes to Duck's high quality of life and need for a focused resiliency strategy. The Town was recently successful in being selected as one of the communities in the new N.C. Division of Coastal Management's (DCM) Resilient Coastal Communities Program (RCCP). The RCCP is assisting local communities with technical and financial assistance to advance coastal resilience efforts. Phase 1 and Phase 2 of the process have been completed and documented in *N.C. Resilient Coastal Communities Program (Phase 1 & 2)* by VHB dated June 2022.

This report documents the Town's efforts for Phase 3 of the program. As the Town has been proactive in planning for a resilient future, much of the information has been integrated from community input through three phases of meetings, both virtual and online, North Carolina Department of Environmental Quality (NCDEQ) Approved Stormwater Control Measures, a geotechnical report and common resiliency strategies being developed by VHB for similar east coast-based counties, cities, and towns.

The five study areas analyzed in Phase 3 are situated in low lying topography between the oceanfront dunes and Currituck Sound, where they have had repetitive losses for flooding. The study areas are shown in *Appendix A: Study Area Maps* and are named as follows:

- 1. North Duck**
- 2. Schooner Ridge**
- 3. Teresa Ct/Duck Hunt Club**
- 4. Georgetown Sands**
- 5. Ocean Crest**



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Regulatory Requirements

The five study areas are located in a Coastal County as designated in Section 15A North Carolina Administrative Code NCAC 02H.1002.6 of the NCAC. Most of the areas drain to an Aquatic Life, Secondary Contact Recreation, Tidal Salt Water (Class SC) water body per the North Carolina Department of Environmental and Natural Resources (NCDENR) Surface Water Classification Map (Currituck Sound - Stream Index 30-1). The areas are considered High-Density development (over 24% impervious cover). As such, the following stormwater-related regulations and guidelines apply to the proposed site development:

1. NCDEQ - NPDES Construction Program

- All construction activities disturbing one or more acres of land are subject to stormwater permitting requirements under the National Pollutant Discharge Elimination System (NPDES).

2. NCDOT - Guidelines for Drainage Studies and Hydraulic Design

- To protect the quality of the receiving surface waters, the stormwater storage facilities are to be sized for the 10-year storm.

3. NCAC - Definitions –Section 15A NCAC 02H .1002

- "Coastal Counties" is defined as any of the following counties: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell, and Washington.

4. NCAC - Requirements that Apply to All Projects - Section 15A NCAC 02H .1003

- DESIGN REQUIREMENTS FOR HIGH DENSITY PROJECTS: Stormwater Control Measures (SCM(s)) shall be designed, constructed, and maintained so that the project achieves either "runoff treatment" or "runoff volume match".
- STORMWATER OUTLETS: No new outlets are proposed with this study.

5. NCAC - Coastal Counties - Section 15A NCAC 02H .1019

- STORMWATER REQUIREMENTS: One-year, 24-hour storm is the required storm depth for High Density Projects.
- RUNOFF TREATMENT WITH NON-DISCHARGING SCM(s): SCM(s) shall provide runoff treatment without discharging more than the pre-development conditions during the one-year, 24-hour storm event. The runoff volume more than the one-year, 24-hour runoff volume shall be released at a non-erosive velocity at the edge of the vegetated setback or to an existing stormwater drainage system.

6. NCAC - MDC For Infiltration Systems - Section 15A NCAC 02H .1051

- SOIL INVESTIGATION: A site-specific soil investigation shall be performed to establish the hydraulic properties and characteristics of the soil within the proposed footprint and at the proposed elevation of the infiltration system.
- SEPARATION FROM THE SEASONAL HIGH-WATER TABLE (SHWT): The lowest point of the infiltration system shall be a minimum of two feet above the SHWT. However, the separation may be reduced to no less than one foot if the applicant provides a hydrogeologic evaluation that demonstrates that the water table will subside to its pre-storm elevation within five days or less.
- SOIL SUBGRADE SURFACE: The surface of the soil subgrade shall have a slope of less than or equal to two percent. Terraces and baffles may be installed to achieve a level subgrade.
- PRETREATMENT: Pretreatment devices shall be provided to prevent clogging. Pretreatment devices may include measures such as sumps in catch basins, gravel verges, screens on roof and patio drains, filters, filter strips, grassed swales, and forebays. Rooftop runoff that is discharged to the surface of an infiltration system shall not require pretreatment.
- DRAW DOWN TIME: Infiltration systems shall be designed to dewater the design volume to the bottom of the infiltration device within 72 hours or less. In-situ soils may be removed and replaced with infiltration media or infiltration media may be placed on top of in-situ soils if the applicant provides a soils report that demonstrates that the modified soil profile allows for infiltration of the design volume within 72 hours or less.
- OBSERVATION PORT: For infiltration devices located under the ground surface, a minimum of one inspection port shall be provided



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Existing Conditions

3.1 Topography

Topographic surveys have not been conducted with this study phase. The source of topographic information for this study is GIS level contours provided by Dare County GIS available at the time of this study. The contours are shown in *Appendix A: Study Area Maps*.

The contours were validated with neighborhood meetings to identify areas of recurring flooding. The flooding areas correspond with the lowest GIS contours on the maps. The five study areas are all very similar in topography. The five study areas are all situated between the oceanfront dunes reaching an elevation of roughly 12' to 20' and the sound side dunes reaching an elevation of 8' to 12'. The lowest elevations in the study areas, which have the most flooding problems, are roughly elevation 4' to 8' on NAVD88 Vertical Datum. More specifically, Study Area #1 (North Duck) has the lowest average elevation of all study areas.

3.2 Geotechnical Information

A geotechnical engineering field exploration and analysis has been provided with this study. According to the *Geotechnical Engineering Report* dated January 26, 2023, by GET/Terracon Consultants, Inc. (see Appendix G: Geotechnical Report), the soils have an average infiltration rate of 4.1 in/hour to 13.1 in/hour. For final modeling and design, these rates should be reduced by 50% to allow for sedimentation and life-cycle infiltration rates.

In addition, groundwater was found between elevations 1.5 and 4.0 feet, in December 2022, on NAVD88 Vertical Datum. With ground elevations as low as 4.0 feet in some study area locations, caution should be taken to provide adequate separation between the bottom of proposed infiltration facilities and groundwater, to provide additional water quality control. However, for quantity control (flood protection) the separation is not required.

3.3 Wetlands Information

Field wetland delineations have not been provided with this study phase. The source of wetlands information is the National Wetlands Inventory and Dare County GIS, both were available at the time of this study. There are a few resiliency/stormwater solutions that will require a more detailed study of wetlands to implement the solution. These areas are shown on the maps in *Appendix A: Study Area Maps*.

3.4 CAMA Buffer Information

From the Town of Duck website located here:

[CAMA Information & Permits - Town of Duck, North Carolina](#)

The shorelines within the Town of Duck, adjacent to both the ocean and sound, fall under the jurisdiction of the North Carolina Coastal Area Management Act (CAMA). CAMA was enacted to protect the resources of the coast as well as human lives and property. CAMA regulations require permits for certain “development” activities located within what CAMA refers to as the Area of Environmental Concern (AEC). This is the area within 75 feet of the normal waterline of the Currituck Sound and the area along the oceanfront, directly adjacent to the frontal and primary dune system which is subject to greater risk of flooding and coastal erosion.

The solutions in this study are not specifically located within 75 feet of the normal waterlines of the oceanfront or the Currituck Sound. However, if these solutions are implemented closer to the two bounding water bodies, field delineation may be required.

3.5 Tidal and Boundary Condition

Tidal elevations generally should not have an impact on the solutions provided with this study. The solutions in this study are more likely to be affected by groundwater elevation, infiltration rates, and the 100-year floodplain and Sea Level Rise. Per the National Oceanic and Atmospheric Association, the mean high tide of the oceanfront is approximately elevation 3’-4’ and the normal water level of the Currituck Sound is approximately elevation 1.0’ with a documented 50-year storm elevation of approximately 5.5’. Wind driven tides are less predictable but more problematic on the Currituck Sound side of the Town. Modeling wind driven tides is being explored by many municipalities on the east coast. Eventually this information is likely to be found on FEMA mapping, but currently it is undocumented.

3.6 Floodplain and Sea Level Rise Considerations

Floodplain maps are provided in *Appendix D: FEMA Floodplain Information*. The 100-year floodplain along the oceanfront is elevation 12'-13' and includes effects from the velocity zone. The 100-yr floodplain in the Currituck Sound is 4'-5'. All elevations are in NAVD88 Vertical Datum.

Many studies have been done on sea level rise in the world and in the United States. Documentation of data available for both Sea Level Rise and Subsidence cannot be denied. The Outer Banks is subject to both constraints for development.

Sea level rise is defined as the effect of thermal expansion (as ocean water warms, it expands), land-based ice melting and movement of water in the ocean causing the tidal elevations to increase in relation to a land-based datum. Additionally, subsidence is the motion of a surface (usually, the Earth's surface) as it shifts downward relative to a datum such as sea-level.

While data is still being processed and refined, it is obvious that the risk of flooding in low lying areas is increasing. Specifically, the Town of Duck may see some of the worst increases in flooding due to its proximity to tidal waters and low-lying topography.

These are factors to consider when permitting for new development and retrofitting existing neighborhoods with resiliency solutions.



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Resiliency Solutions Menu

4.1 Resiliency Solutions Matrix

VHB has provided a Decision Support System (DSS) of maps and figures/matrices. The following figures are the Resiliency Solutions Menu for each study area. Solutions are provided at the individual homeowner level, the neighborhood level (per Homeowner Association), and some more regional type facilities. There is a figure provided for each study area, and three tables per figure.

The DSS in the tables comes from calculating a storage volume per square foot for each recommended solution. Given the surface area indicated on the maps, a total storage volume can be calculated. A cost per square foot, and/or cubic foot, has been provided. The unit costs are based on recent construction plans and bids near the Town of Duck. Ultimately, a cost per cubic foot of storage volume is calculated and the solutions are prioritized based on the least costly, to the most costly, per the storage volume provided. However, other factors may need to be considered once topographic survey and utility designations are completed, to construct the solutions.

Figure 1A, 1B, 1C: Study Area 1

Figure 1A: Stormwater Control Measures and Costs										
Neighborhood	SCM Number	SCM Option	Street/Location	SCM Size (SF)	SCM Vol/SF	SCM Total Storage Vol (CF)	SCM \$/SF *	SCM Total Cost	SCM \$/CF	Notes
Ocean Pines	1-1A	Dry Detention (dry pond)	Ocean Pines Drive tennis court	5869	1.57	9220	\$15.00	\$88,040.96	\$9.55	Check for utility
	1-1B	Removal of Pavement	Ocean Pines Drive tennis court	5869	0.50	2935	\$5.00	\$29,347.00	\$10.00	
	1-2	Permeable Pavers	Ocean Pines Drive parking	1707	0.80	1366	\$20.00	\$34,138.00	\$25.00	Keeps parking spaces
Gulls Flight	1-11	Bioretention	Flight Drive Cul-de-sac	935	2.90	2712	\$25.00	\$23,375.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Flight Drive Cul-de-sac	2913	0.80	2330	\$20.00	\$58,260.00	\$25.00	
		Dry detention (1' swale)	Flight Drive Cul-de-sac	1080	0.50	540	\$15.00	\$16,200.00	\$30.00	Check for utility
	1-3	Dry detention (1' swale)	Flight Drive	3726	0.50	1863	\$15.00	\$55,890.00	\$30.00	Check for utility
Sound Sea Village	1-7	Dry Detention (dry pond)	116 & 118 Ocean Bay Blvd	12274	1.57	19280	\$15.00	\$184,113.44	\$9.55	Check for utility; Existing pond expansion
	1-4	Dry detention (1' swale)	Acorn Oak Ave	7035	0.50	3518	\$15.00	\$105,525.00	\$30.00	Check for utility
	1-5	Dry detention (1' swale)	Sound Sea Ave	6840	0.50	3420	\$15.00	\$102,597.00	\$30.00	Check for utility
Caffey's Inlet	1-6	Bioretention	Carrol Drive Cul-de-sac median island	935	2.90	2712	\$25.00	\$23,378.00	\$8.62	Checked for EM VEH turning
		Dry Detention (2' swale)	Carrol Drive Cul-de-sac	1571	1.00	1571	\$15.00	\$23,571.00	\$15.00	Check for utility
		Permeable Pavers	Carrol Drive Cul-de-sac	4118	0.80	3295	\$20.00	\$82,364.20	\$25.00	
	1-9	Bioretention	114 Carrol Drive Residence	3382	2.90	9808	\$25.00	\$84,550.00	\$8.62	Checked for EM VEH turning
	1-8	Bioretention	Hillside Ct Cul-de-sac median island	935	2.90	2712	\$25.00	\$23,378.00	\$8.62	Checked for EM VEH turning
		Dry detention (2' swale)	Hillside Ct	2054	1.00	2054	\$15.00	\$30,805.50	\$15.00	Check for utility
		Permeable Pavers	Hillside Ct	3485	0.80	2788	\$20.00	\$69,691.40	\$25.00	
		Dry detention (1' swale)	Hillside Ct	377	0.50	188	\$15.00	\$5,649.00	\$30.00	Check for utility
	1-10	Bioretention	Carrol Drive Cul-de-sac median island	935	2.90	2712	\$25.00	\$23,375.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Carrol Drive Cul-de-sac	3566	0.80	2853	\$20.00	\$71,319.97	\$25.00	
		Dry detention (1' swale)	Carrol Drive Cul-de-sac	847	0.50	424	\$15.00	\$12,708.00	\$30.00	Check for utility

*Prices sourced from recent construction projects

Note: Area 1 neighborhood focus area = ~27 ac

Figure 1B: Rainwater Harvesting and Costs										
Neighborhood	Approx. No. of Units	Rain Barrel Size (gal)	Rain Barrel Volume (CF)	No. of Rain Barrels Per Unit	Total Storage Vol Per Unit (CF)	Storage Provided Per Neighborhood (CF)	Price (4 Barrels w/ Gutters)	Total Neighborhood Cost	SCM \$/CF	Notes
Ocean Pines	34	50	7	4	27	909	\$10,000.00	\$340,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	2273	\$12,500.00	\$425,000.00	\$187.00	Grants available to help cover costs
Gulls Flight	19	50	7	4	27	508	\$10,000.00	\$190,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	1270	\$12,500.00	\$237,500.00	\$187.00	Grants available to help cover costs
Sound Sea Village	103	50	7	4	27	2754	\$10,000.00	\$1,030,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	6885	\$12,500.00	\$1,287,500.00	\$187.00	Grants available to help cover costs
Caffey's Inlet	44	50	7	4	27	1176	\$10,000.00	\$440,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	2941	\$12,500.00	\$550,000.00	\$187.00	Grants available to help cover costs

Figure 1C: Boring Groundwater Elevation					
Neighborhood	B/HA Name*	FT Below Grade	Existing Grade (FT)	GW Elevation (FT)	Notes
Ocean Pines	B1-1	3.5	5	1.5	
	HA1-1	2.5	5	2.5	
Sound Sea Village	B1-2	4	5	1	
	HA1-2	2.5	5	2.5	

*B = Boring HA = Hand Auger

Figure 2A, 2B, 2C: Study Area 2

Figure 2A: Stormwater Control Measures and Costs										
Neighborhood	SCM Number	SCM Option	Street/Location	SCM Size (SF)	SCM Vol/SF	SCM Total Storage Vol (CF)	SCM \$/unit*	SCM Total Cost	SCM \$/CF	Notes
Poteskeet Village	2-7	Bioretention	Wampum Drive Cul-de-sac median island	935	2.90	2712	\$25.00	\$23,378.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Wampum Drive Cul-de-sac	3857	0.80	3085	\$20.00	\$77,136.80	\$25.00	
		Dry detention (1' swale)	Wampum Drive Cul-de-sac	1366	0.50	683	\$15.00	\$20,490.00	\$30.00	Check for utility
	2-8	Dry detention (2' swale)	Wampum Drive	8195	1.00	8195	\$15.00	\$122,925.00	\$15.00	Check for utility
Schooner Ridge	2-6	Dry detention (dry pond)	169 Schooner Ridge Drive	7424	1.57	11662	\$15.00	\$111,360.00	\$9.55	Check for utility; vacant lot?
	2-1A	Dry Detention (dry pond)	0 Schooner Ridge Drive	6013	1.57	9446	\$15.00	\$90,201.45	\$9.55	Check for utility; removes parking
	2-1B	Permeable Pavers	0 Schooner Ridge Drive	6013	0.80	4811	\$20.00	\$120,268.60	\$25.00	Keeps parking
	2-2	Dry detention (1' swale)	Schooner Ridge Drive	2932	0.50	1466	\$15.00	\$43,980.00	\$30.00	Check for utility
	2-9	Dry detention (2' swale)	Schooner Ridge Drive	3882	1.00	3882	\$15.00	\$58,230.00	\$15.00	Check for utility
	2-10	Permeable Pavers	Schooner Ridge Drive	1465	0.80	1172	\$20.00	\$29,300.00	\$25.00	
Duck Landing	2-4B	Dry Detention (dry pond)	Duck Landing Lane tennis court	7076	1.57	11114	\$15.00	\$106,134.86	\$9.55	Check for utility; removes parking
	2-4A	Permeable Pavers	Duck Landing Lane parking	7076	0.80	5661	\$20.00	\$141,513.14	\$25.00	Keeps parking
	2-5	Dry detention (2' swale)	Duck Landing Lane	6892	1.00	6892	\$15.00	\$103,380.00	\$15.00	Check for utility
	2-3	Permeable Pavers	Duck Landing Lane parking	2919	0.80	2335	\$20.00	\$58,375.19	\$25.00	Keeps parking
	2-11	Bioretention	Duck Landing Lane Cul-de-sac median island	935	2.90	2712	\$25.00	\$23,378.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Duck Landing Lane Cul-de-sac	3600	0.80	2880	\$20.00	\$72,000.00	\$25.00	
		Dry detention (1' swale)	Duck Landing Lane Cul-de-sac	1010	0.50	505	\$15.00	\$15,150.00	\$30.00	Check for utility

*Prices sourced from recent construction projects

Note: Area 2 neighborhood focus area = ~7 ac

Figure 2B: Rainwater Harvesting and Costs										
Neighborhood	Approx. No. of Units	Rain Barrel Size (gal)	Rain Barrel Volume (CF)	No. of Rain Barrels Per Unit	Total Storage Vol Per Unit (CF)	Storage Provided Per Neighborhood (CF)	Price (4 Barrels w/ Gutters)	Total Neighborhood Cost	SCM \$/CF	Notes
Poteskeet Village	45	50	7	4	27	1203	\$10,000.00	\$450,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	3008	\$12,500.00	\$562,500.00	\$187.00	Grants available to help cover costs
Schooner Ridge	101	50	7	4	27	2701	\$10,000.00	\$1,010,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	6751	\$12,500.00	\$1,262,500.00	\$187.00	Grants available to help cover costs
Duck Landing	51	50	7	4	27	1364	\$10,000.00	\$510,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	3409	\$12,500.00	\$637,500.00	\$187.00	Grants available to help cover costs

Figure 2C: Boring Groundwater Elevation					
Neighborhood	B/HA Name*	FT Below Grade	Existing Grade (FT)	GW Elevation (FT)	Notes
Schooner Ridge	B2-1	4.5	8	3.5	
	HA2-1	2.5	7	4.5	
Duck Landing	B2-2	6.5	8	1.5	

*B = Boring HA = Hand Auger

Figure 3A, 3B, 3C: Study Area 3

Figure 3A: Stormwater Control Measures and Costs										
Neighborhood	SCM Number	SCM Option	Street/Location	SCM Size (SF)	SCM Vol/SF	SCM Total Storage Vol (CF)	SCM \$/unit*	SCM Total Cost	SCM \$/CF	Notes
Poteskeet	3-12	Bioretention	Cherokee Court Cul-de-sac median island	935	2.90	2711.50	\$25.00	\$23,375.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Cherokee Court Cul-de-sac	3600	0.80	2880.00	\$20.00	\$72,000.00	\$25.00	
		Dry detention (1' swale)	Cherokee Court Cul-de-sac	1337	0.50	668.50	\$15.00	\$20,055.00	\$30.00	Check for utility
	3-13	Bioretention	Rakiock Court Cul-de-sac median island	935	2.90	2711.50	\$25.00	\$23,375.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Rakiock Court Cul-de-sac	3600	0.80	2880.00	\$20.00	\$72,000.00	\$25.00	
		Dry detention (1' swale)	Rakiock Court Cul-de-sac	1215	0.50	607.50	\$15.00	\$18,225.00	\$30.00	Check for utility
	3-14	Bioretention	Arrowhead Court Cul-de-sac median island	935	2.90	2711.50	\$25.00	\$23,375.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Arrowhead Court Cul-de-sac	3600	0.80	2880.00	\$20.00	\$72,000.00	\$25.00	
		Dry detention (1' swale)	Arrowhead Court Cul-de-sac	1215	0.50	607.50	\$15.00	\$18,225.00	\$30.00	Check for utility
Ocean Dunes	3-6	Bioretention	Teresa Court Cul-de-sac median island	935	2.90	2711.85	\$25.00	\$23,378.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Teresa Court Cul-de-sac	2881	0.80	2305.06	\$20.00	\$57,626.45	\$25.00	
		Dry detention (1' swale)	Teresa Court Cul-de-sac	1366	0.50	683.00	\$15.00	\$20,490.00	\$30.00	Check for utility
	3-8	Dry detention (2' swale)	Christopher Drive	12985	1.00	12984.70	\$15.00	\$194,770.50	\$15.00	Check for utility
		Dry detention (1' swale)	Christopher Drive	5239	0.50	2619.55	\$15.00	\$78,586.50	\$30.00	Check for utility
	3-9	Bioretention	Victoria Court Cul-de-sac median island	935	2.90	2711.85	\$25.00	\$23,378.00	\$8.62	Checked for EM VEH turning
		Dry detention (2' swale)	Victoria Court Cul-de-sac	3036.4	1.00	3036.40	\$15.00	\$45,546.00	\$15.00	Check for utility
		Permeable Pavers	Victoria Court Cul-de-sac	3728	0.80	2982.40	\$20.00	\$74,560.00	\$25.00	
	3-15	Bioretention	Betsy Court Cul-de-sac median island	935	2.90	2711.50	\$25.00	\$23,375.00	\$8.62	Checked for EM VEH turning
Permeable Pavers		Betsy Court Cul-de-sac	3600	0.80	2880.00	\$20.00	\$72,000.00	\$25.00		
Dry detention (1' swale)		Betsy Court Cul-de-sac	1365	0.50	682.50	\$15.00	\$20,475.00	\$30.00	Check for utility	
Sea Pines	3-2	Bioretention	Scarborough Lane Cul-de-sac median island	1691	2.90	4904.01	\$25.00	\$42,275.96	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Scarborough Lane Cul-de-sac	4355	0.80	3484.00	\$20.00	\$87,100.00	\$25.00	
	3-3	Bioretention	Scarborough Lane Cul-de-sac median island	1691	2.90	4904.01	\$25.00	\$42,275.96	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Scarborough Lane Cul-de-sac	4355	0.80	3484.00	\$20.00	\$87,100.00	\$25.00	
	3-4	Bioretention	Scarborough Lane Cul-de-sac median island	1691	2.90	4904.01	\$25.00	\$42,275.96	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Scarborough Lane Cul-de-sac	4355	0.80	3484.00	\$20.00	\$87,100.00	\$25.00	
	3-5	Bioretention	Scarborough Lane Cul-de-sac median island	1691	2.90	4904.01	\$25.00	\$42,275.96	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Scarborough Lane Cul-de-sac	4355	0.80	3484.00	\$20.00	\$87,100.00	\$25.00	
	3-1	Permeable Pavers	Scarborough Lane Parking	1329	0.80	1063.48	\$20.00	\$26,587.00	\$25.00	Keeps parking
Four Seasons	3-7	Dry detention (2' swale)	Duck Hunt Club Lane	5139	1.00	5139.20	\$15.00	\$77,088.00	\$15.00	Check for utility
		Dry detention (1' swale)	Duck Hunt Club Lane	2552	0.50	1276.15	\$15.00	\$38,284.50	\$30.00	Check for utility
	3-10	Bioretention	Four Seasons Lane Cul-de-sac median island	630	2.90	1828.16	\$25.00	\$15,760.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Four Seasons Lane Cul-de-sac	2182	0.80	1745.60	\$20.00	\$43,640.00	\$25.00	
Dry detention (1' swale)		Four Seasons Lane Cul-de-sac	786	0.50	392.75	\$15.00	\$11,782.50	\$30.00	Check for utility	
3-11	Bioretention	Four Seasons Lane Cul-de-sac median island	630	2.90	1828.16	\$25.00	\$15,760.00	\$8.62	Checked for EM VEH turning	
	Permeable Pavers	Four Seasons Lane Cul-de-sac	2182	0.80	1745.60	\$20.00	\$43,640.00	\$25.00		
	Dry detention (1' swale)	Four Seasons Lane Cul-de-sac	786	0.50	392.75	\$15.00	\$11,782.50	\$30.00	Check for utility	
3-17	Bioretention	Lala Court Cul-de-sac median island	935	2.90	2711.50	\$25.00	\$23,375.00	\$8.62		
	Permeable Pavers	Lala Court Cul-de-sac	3600	0.80	2880.00	\$20.00	\$72,000.00	\$25.00		
	Dry detention (1' swale)	Lala Court Cul-de-sac	1447	0.50	723.50	\$15.00	\$21,705.00	\$30.00	Check for utility	

*Prices sourced from recent construction projects

Note: Area 3 neighborhood focus area = ~24 ac

Figure 3B: Rainwater Harvesting and Costs										
Neighborhood	Approx. No. of Units	Rain Barrel Size (gal)	Rain Barrel Volume (CF)	No. of Rain Barrels Per Unit	Total Storage Vol Per Unit (CF)	Storage Provided Per Neighborhood (CF)	Price (4 Barrels w/ Gutters)	Total Neighborhood Cost	SCM \$/CF	Notes
Ocean Dunes	93	50	7	4	27	2487	\$10,000.00	\$930,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	6217	\$12,500.00	\$1,162,500.00	\$187.00	Grants available to help cover costs
Sea Pines	67	50	7	4	27	1791	\$10,000.00	\$670,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	4479	\$12,500.00	\$837,500.00	\$187.00	Grants available to help cover costs
Four Season	134	50	7	4	27	3583	\$10,000.00	\$1,340,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	8957	\$12,500.00	\$1,675,000.00	\$187.00	Grants available to help cover costs

Figure 3C: Boring Groundwater Elevation					
Neighborhood	B/HA Name*	FT Below Grade	Existing Grade (FT)	GW Elevation (FT)	Notes
Sea Pines	B3-1	6	9	3	Trace organics at 9.5' to 10'
	B3-2	6	9	3	
Four Seasons	HA3-1	3.8	8	4.2	

*B = Boring HA = Hand Auger

Figure 4A, 4B, 4C: Study Area 4

Figure 4A: Stormwater Control Measures and Costs										
Neighborhood	SCM Number	SCM Option	Street/Location	SCM Size (SF)	SCM Vol/SF	SCM Total Storage Vol (CF)	SCM \$/unit*	SCM Total Cost	SCM \$/CF	Notes
Sea Acres	4-9	Bioretention	Plover Drive Cul-de-sac median island	935	2.90	2711.50	\$25.00	\$23,375.00	\$8.62	Checked for EM VEH turning
		Dry detention (2' swale)	Plover Drive Cul-de-sac	2289	1.00	2289.10	\$15.00	\$34,336.50	\$15.00	Check for utility
		Permeable Pavers	Plover Drive Cul-de-sac	3581	0.80	2864.74	\$20.00	\$71,618.51	\$25.00	
	4-10	Dry detention (2' swale)	Plover Drive	14640	1.00	14640.00	\$15.00	\$219,600.00	\$15.00	Check for utility
Duck Blind Villas	4-1	Permeable Pavers	Plover Drive	10349	0.80	8279.18	\$20.00	\$206,979.38	\$25.00	Just for parking spaces
Georgetown Sands	4-2A	Bioretention	Georgetown Sands Road Condos	1024	2.90	2969.60	\$25.00	\$25,600.00	\$8.62	Checked for EM VEH turning
	4-2B	Permeable Pavers	Georgetown Sands Road Condos	1024	0.80	819.20	\$20.00	\$20,480.00	\$25.00	
	4-3	Permeable Pavers	Georgetown Sands Road Condos	968	0.80	774.66	\$20.00	\$19,366.40	\$25.00	
	4-4	Bioretention	Georgetown Sands Road Condos	2680	2.90	7772.00	\$25.00	\$67,000.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Georgetown Sands Road Condos	1361	0.80	1088.80	\$20.00	\$27,220.00	\$25.00	
	4-6A	Bioretention	Georgetown Sands Road Condos	788	2.90	2286.33	\$25.00	\$19,709.75	\$8.62	Checked for EM VEH turning; removes parking
	4-6B	Permeable Pavers	Georgetown Sands Road Condos	788	0.80	630.40	\$20.00	\$15,760.00	\$25.00	Keeps parking
	4-8	Dry detention (dry pond)	Georgetown Sands Road Condos	12962	1.57	20360.66	\$15.00	\$194,430.00	\$9.55	Check for utility
4-13	Permeable Pavers	Georgetown Sands Road Condos	1440	0.80	1152.00	\$20.00	\$28,800.00	\$25.00		
Sand Dollar Shores	4-5	Dry detention (2' swale)	Sea Breeze Drive	16126	1.00	16126.30	\$15.00	\$241,894.50	\$15.00	Check for utility
	4-11	Bioretention	Sea Breeze Drive Cul-de-sac median island	935	2.90	2711.50	\$25.00	\$23,375.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Sea Breeze Drive Cul-de-sac	3600	0.80	2880.00	\$20.00	\$72,000.00	\$25.00	
		Dry detention (1' swale)	Sea Breeze Drive Cul-de-sac	1292	0.50	646.00	\$15.00	\$19,380.00	\$30.00	Check for utility
	4-12	Bioretention	Sea Breeze Drive Cul-de-sac median island	935	2.90	2711.50	\$25.00	\$23,375.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Sea Breeze Drive Cul-de-sac	3600	0.80	2880.00	\$20.00	\$72,000.00	\$25.00	
Dry detention (1' swale)		Sea Breeze Drive Cul-de-sac	1292	0.50	646.00	\$15.00	\$19,380.00	\$30.00	Check for utility	
Sea Hawk	4-7	Dry detention (2' swale)	Seahawk Drive	4503	1.00	4502.60	\$15.00	\$67,539.00	\$15.00	Check for utility
		Dry detention (1' swale)	Seahawk Drive	2373	0.50	1186.40	\$15.00	\$35,592.00	\$30.00	Check for utility

*Prices sourced from recent construction projects

Note: Area 4 neighborhood focus area = ~14 ac

Figure 4B: Rainwater Harvesting and Costs										
Neighborhood	Approx. No. of Units	Rain Barrel Size (gal)	Rain Barrel Volume (CF)	No. of Rain Barrels Per Unit	Total Storage Vol Per Unit (CF)	Storage Provided Per Neighborhood (CF)	Price (4 Barrels w/ Gutters)	Total Neighborhood Cost	SCM \$/CF	Notes
Duck Blind Villas	28	50	7	4	27	749	\$10,000.00	\$280,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	1872	\$12,500.00	\$350,000.00	\$187.00	Grants available to help cover costs
Georgetown Sands	51	50	7	4	27	1364	\$10,000.00	\$510,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	3409	\$12,500.00	\$637,500.00	\$187.00	Grants available to help cover costs
Sand Dollar Shores	44	50	7	4	27	1176	\$10,000.00	\$440,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	2941	\$12,500.00	\$550,000.00	\$187.00	Grants available to help cover costs
Sea Hawk	44	50	7	4	27	1176	\$10,000.00	\$440,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	2941	\$12,500.00	\$550,000.00	\$187.00	Grants available to help cover costs

Figure 4C: Boring Groundwater Elevation					
Neighborhood	B/HA Name*	FT Below Grade	Existing Grade (FT)	GW Elevation (FT)	Notes
Georgetown Sands	B4-1	5	6	1	
	HA4-1	3.8	8	4.2	
Sea Hawk	B4-2	5	7	2	

*B = Boring HA = Hand Auger

Figure 5A, 5B, 5C: Study Area 5

Figure 5A: Stormwater Control Measures and Costs										
Neighborhood	SCM Location	SCM Option	Street/Location	SCM Size (SF)	SCM Vol/SF	SCM Total Storage Vol (CF)	SCM \$/unit	SCM Total Cost	SCM \$/CF	Notes
The Tides	5-1C	Bioretention	Tides Drive	190	2.90	552	\$25.00	\$4,760.88	\$8.62	Checked for EM VEH turning
	5-1B	Removal of Pavement	Tides Drive	5189	0.50	2595	\$5.00	\$25,945.00	\$10.00	
	5-1A	Permeable Pavers	Tides Drive	5189	0.80	4151	\$20.00	\$103,780.00	\$25.00	
Tuckahoe	5-7	Bioretention	Sea Eider Court Cul-de-sac median island	197	2.90	571	\$25.00	\$4,925.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Sea Eider Court Cul-de-sac	2822	0.80	2258	\$20.00	\$56,440.00	\$25.00	
		Dry detention (1' swale)	Sea Eider Court Cul-de-sac	941	0.50	470.50	\$15.00	\$14,115.00	\$30.00	Check for utility
	5-8	Bioretention	Thrush Court Cul-de-sac median island	197	2.90	571	\$25.00	\$4,925.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Thrush Court Cul-de-sac	2822	0.80	2258	\$20.00	\$56,440.00	\$25.00	
		Dry detention (1' swale)	Thrush Court Cul-de-sac	941	0.50	470.50	\$15.00	\$14,115.00	\$30.00	Check for utility
	5-9	Bioretention	Sunflower Court Cul-de-sac median island	197	2.90	571	\$25.00	\$4,925.00	\$8.62	Checked for EM VEH turning
		Permeable Pavers	Sunflower Court Cul-de-sac	2822	0.80	2258	\$20.00	\$56,440.00	\$25.00	
		Dry detention (1' swale)	Sunflower Court Cul-de-sac	941	0.50	470.50	\$15.00	\$14,115.00	\$30.00	Check for utility
Bias Shores	5-3	Bioretention	Bias Lane Cul-de-sac median island	190	2.90	552	\$25.00	\$4,760.90	\$8.62	Checked for EM VEH turning
		Dry detention (2' swale)	Bias Lane Cul-de-sac & Bias Lane	2505	1.00	2505	\$15.00	\$37,575.00	\$15.00	Check for utility
		Permeable Pavers	Bias Lane Cul-de-sac	4227	0.80	3382	\$20.00	\$84,540.00	\$25.00	
	5-12	Dry detention (2' swale)	Bias Lane	6882	1.00	6882	\$15.00	\$103,230.00	\$15.00	Check for utility
Ocean Crest	5-2	Bioretention	Vivian Court Cul-de-sac median island	190	2.90	552	\$25.00	\$4,760.90	\$8.62	Checked for EM VEH turning
		Dry detention (2' swale)	Vivian Court Cul-de-sac	1950	1.00	1950	\$15.00	\$29,253.00	\$15.00	Check for utility
		Permeable Pavers	Vivian Court Cul-de-sac	4100	0.80	3280	\$20.00	\$81,998.96	\$25.00	
	5-4	Dry detention (2' swale)	E Charles Jenkins Lane	5173	1.00	5173	\$15.00	\$77,592.00	\$15.00	Check for utility
	5-5	Bioretention	Ocean Crest Way Cul-de-sac median island	197	2.90	570	\$25.00	\$4,912.50	\$8.62	Checked for EM VEH turning
		Dry detention (2' swale)	Ocean Crest Way Cul-de-sac	2656	1.00	2656	\$15.00	\$39,846.00	\$15.00	Check for utility
		Permeable Pavers	Ocean Crest Way Cul-de-sac	4319	0.80	3456	\$20.00	\$86,388.00	\$25.00	
	5-6	Bioretention	Ocean Crest Way Cul-de-sac median island	197	2.90	570	\$25.00	\$4,912.50	\$8.62	Checked for EM VEH turning
		Dry detention (2' swale)	Ocean Crest Way Cul-de-sac	2656	1.00	2656	\$15.00	\$39,846.00	\$15.00	Check for utility
		Permeable Pavers	Ocean Crest Way Cul-de-sac	4319	0.80	3456	\$20.00	\$86,388.00	\$25.00	
	5-10	Permeable Pavers	E Charles Jenkins Lane	1835	0.80	1468	\$20.00	\$36,700.00	\$25.00	
	5-11	Bioretention	Yolanda Terrace Cul-de-sac median island	197	2.90	571	\$25.00	\$4,925.00	\$8.62	Checked for EM VEH turning
		Dry detention (2' swale)	Yolanda Terrace Cul-de-sac	2677	1.00	2677	\$15.00	\$40,155.00	\$15.00	Check for utility
		Permeable Pavers	Yolanda Terrace Cul-de-sac	4335	0.80	3468	\$20.00	\$86,700.00	\$25.00	

*Prices sourced from recent construction projects

Note: Area 4 neighborhood focus area = ~8 ac

Figure 5B: Rainwater Harvesting and Costs										
Neighborhood	Approx. No. of Units	Rain Barrel Size (gal)	Rain Barrel Volume (CF)	No. of Rain Barrels Per Unit	Total Storage Vol Per Unit (CF)	Storage Provided Per Neighborhood (CF)	Price (4 Barrels w/ Gutters)	Total Neighborhood Cost	SCM \$/CF	Notes
The Tides	9	50	7	4	27	241	\$10,000.00	\$90,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	602	\$12,500.00	\$112,500.00	\$187.00	Grants available to help cover costs
Bias Shores	18	50	7	4	27	481	\$10,000.00	\$180,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	1203	\$12,500.00	\$225,000.00	\$187.00	Grants available to help cover costs
Ocean Crest	38	50	7	4	27	1016	\$10,000.00	\$380,000.00	\$374.00	Grants available to help cover costs
		125	17	4	67	2540	\$12,500.00	\$475,000.00	\$187.00	Grants available to help cover costs

Figure 5C: Boring Groundwater Elevation					
Neighborhood	B/HA Name*	FT Below Grade	Existing Grade (FT)	GW Elevation (FT)	Notes
Bias Shoes	B5-1	4	6	2	
Ocean Crest	B5-2	3	6	3	
	HA5-1	3.5	6	2.5	

*B = Boring HA = Hand Auger



5

Recommendations

5.1 Resiliency Solutions Menu (DSS)

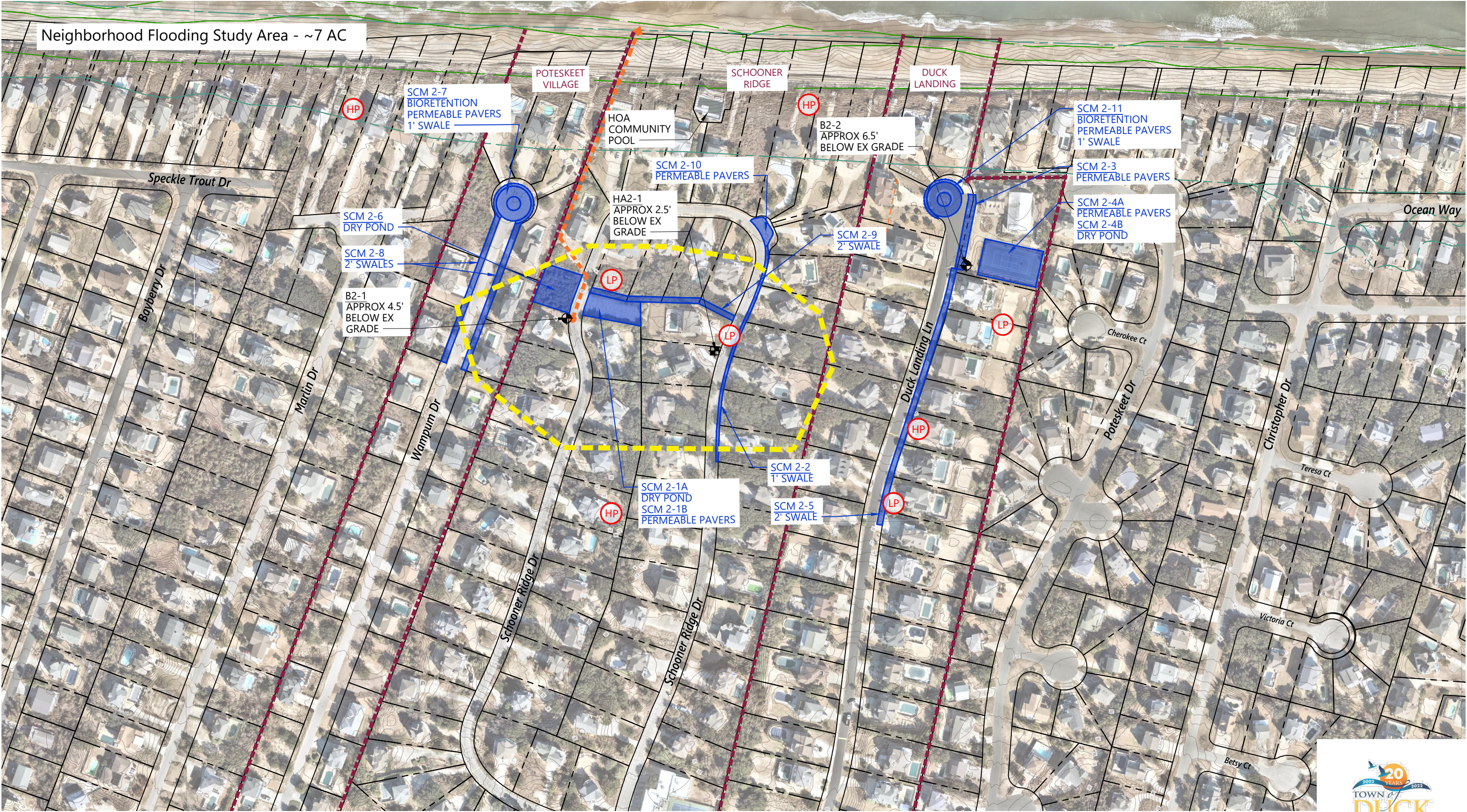
VHB suggests moving forward with the solutions identified in this study, as organized in the DSS figures above. Other considerations when constructing the solutions will be private property availability and easements, available right-of-way, Homeowner and Homeowner Association cooperation, permitting the improvements with the Town of Duck, and possibly permitting with NCDOT and NCDEQ, depending on the size of the projects undertaken at one time and subsequent land disturbance thresholds. Although the number of solutions needed to be limited within this study, these solutions can generally be applied to every neighborhood in the Town of Duck.

5.2 Code Changes

In many flood-prone communities the regulations to develop commercial property have gotten more demanding, requiring elevated finish floors, compensatory storage volume for fill, and more stormwater control measures. Review of the Town's regulations related to single family home development, and redevelopment, should be considered to reduce flooding for all residents. Areas of the regulations where further study can be focused are:

1. Filling of single-family lots
2. Increasing impervious coverage and decreasing green spaces
3. SCM(s) on single-family lots
4. Preservation of existing trees and provision of new vegetative cover
5. Regulated accessory structure additions
6. Maintenance on installed SCM(s)
7. Swimming pools in low lying areas

Appendix A – Study Area Maps (Five Total)



SOURCES: NEARMAP, TOWN OF DUCK NORTH CAROLINA, DARE COUNTY NORTH CAROLINA GIS, FEMA, AND NATIONAL WETLANDS INVENTORY.
THIS PLAN IS COMPILED FROM AVAILABLE EXISTING INFORMATION AND IS FOR CONCEPTUAL PLANNING ONLY.

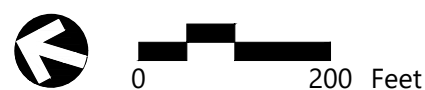
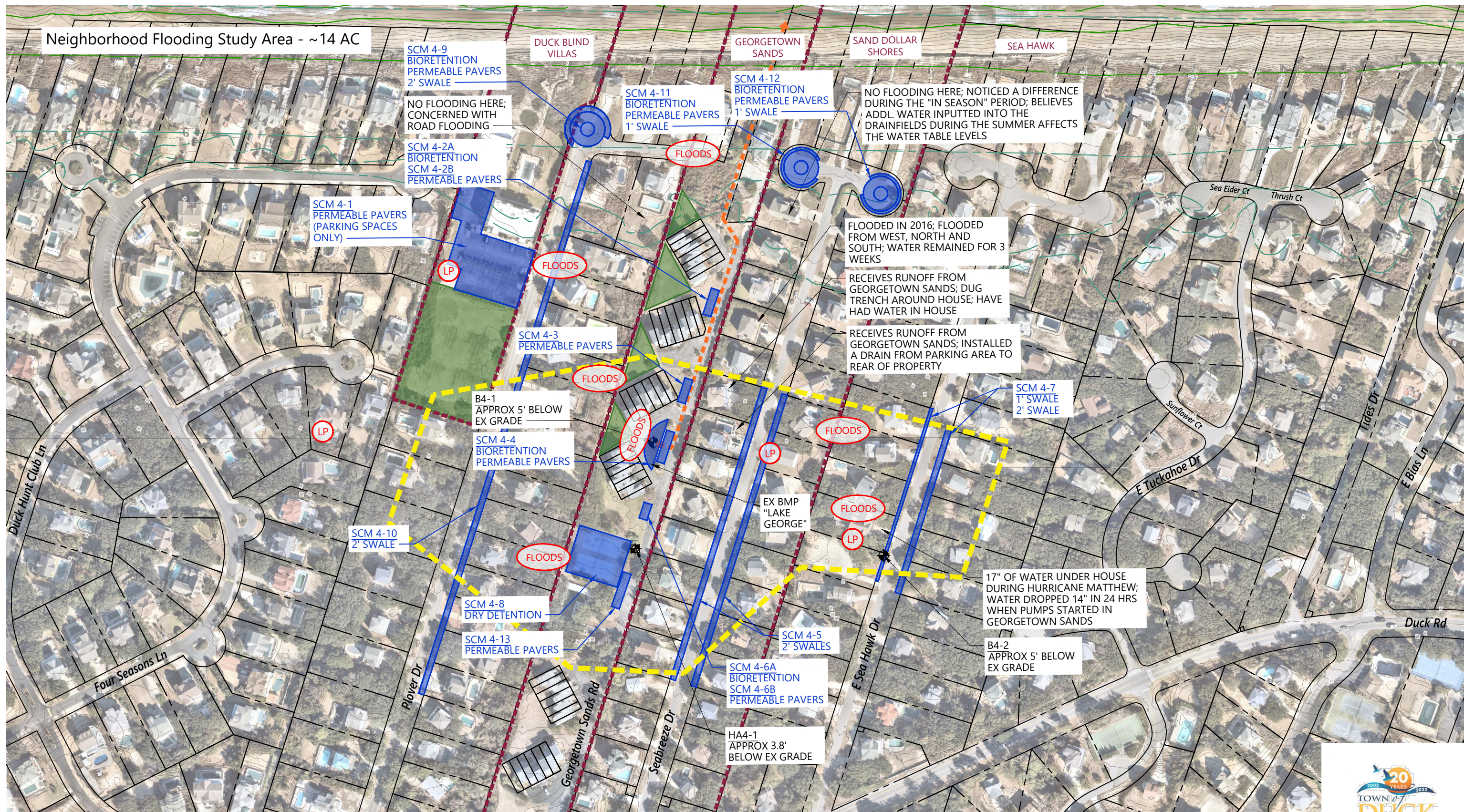
LEGEND

- Parcel Boundary
- NWI Wetlands
- FEMA Flood Zone
- Study Area
- Neighborhood Boundary
- Stormwater Control Measure (SCM)
- Approximate Extents of Existing Drain Field
- Flood Area
- Emergency Water Discharge Plan
- Elevation Point
- Boring Location
- Hand Auger Location

Resiliency Solutions
Study Area 2 - Schooner Ridge
Duck Neighborhood Stormwater Study
Town of Duck, NC

April 20, 2023





SOURCES: NEARMAP, TOWN OF DUCK NORTH CAROLINA, DARE COUNTY NORTH CAROLINA GIS, FEMA, AND NATIONAL WETLANDS INVENTORY.

THIS PLAN IS COMPILED FROM AVAILABLE EXISTING INFORMATION AND IS FOR CONCEPTUAL PLANNING ONLY.

LEGEND

- Parcel Boundary
- NWI Wetlands
- FEMA Flood Zone

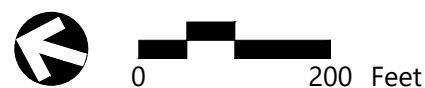
- Study Area
- Neighborhood Boundary
- Stormwater Control Measure (SCM)
- Approximate Extents of Existing Drain Field
- Flood Area

- Emergency Water Discharge Plan
- XX Elevation Point
- ⊕ Boring Location
- ⊕ Hand Auger Location

Resiliency Solutions
Study Area 4 - Georgetown Sands
Duck Neighborhood Stormwater Study
Town of Duck, NC

April 20, 2023





SOURCES: NEARMAP, TOWN OF DUCK NORTH CAROLINA, DARE COUNTY NORTH CAROLINA GIS, FEMA, AND NATIONAL WETLANDS INVENTORY.
THIS PLAN IS COMPILED FROM AVAILABLE EXISTING INFORMATION AND IS FOR CONCEPTUAL PLANNING ONLY.

LEGEND

- Parcel Boundary
- NWI Wetlands
- FEMA Flood Zone

- Study Area
- Neighborhood Boundary
- Stormwater Control Measure (SCM)
- Approximate Extents of Existing Drain Field
- Flood Area

- Emergency Water Discharge Plan
- Elevation Point
- Boring Location
- Hand Auger Location

Resiliency Solutions
Study Area 5 - Ocean Crest
Duck Neighborhood Stormwater Study
Town of Duck, NC

April 20, 2023



Appendix B – Community Outreach Information

Phase 1

Public engagement for the Stormwater Study began in November of 2022. The Town and the project team hosted 5 neighborhood meetings at the Town of Duck Town Hall. These meetings were offered both in-person and virtually. Advertisements to make the community aware of the neighborhood meetings were shared via the Town's social media, the Town's website, e-mail blast, and emails were sent from town staff to Homeowner Association (HOA) point of contacts for each of the neighborhood focus areas.

The first Neighborhood meeting was focused on North Duck. Seven individuals were in attendance either virtually or in-person. Feedback received was regarding flooding in Caffey's Inlet, Carrol Drive, along Duck Road, in Sound Sea Village, and in Ocean Pines.

The second meeting was focused on Schooner Ridge. Two individuals were in attendance.

Feedback received was regarding flooding on Schooner Ridge Drive and Chip Court.

The third meeting was focused on Duck Hunt/Four Seasons. Five individuals were in attendance. Feedback received was regarding flooding on Duck Hunt Lane, Scarborough Lane, and Ocean Way.

The fourth meeting was focused on Georgetown Sands. Seventeen individuals were in attendance. Feedback received was regarding flooding on Plover Drive, Amy Lane, Seabreeze Drive, Georgetown Sands, and Seahawk East.

The fifth meeting was focused on Ocean Crest. Five individuals were in attendance. Feedback received was regarding flooding on East Bias Lane, Charles Jenkins, and West Pines Lane.

The five neighborhood meetings were followed by an evening Open House presentation. The presentation described the goals of the Stormwater Study, various challenges as part of the topography of the Town of Duck, opportunities for stormwater management, and the next steps in the project.

Meanwhile, the project team also hosted an online project map and comment form. This map allowed residents to place points on a map and add a comment to where they experience flooding or gathering of water in various areas of their community and properties. A total of 84 comments were received via the online map. The online map was open for a total of 4 weeks of respondents to comment on.

Phase 2

The second phase of engagement included a brief presentation to the Town of Duck's Town

Council in mid-February of 2023. This was then followed by an email blast to HOA representatives, community members who had previously been involved in the study, multiple social media posts, and a website update to include a Menu of Solutions the project team preliminarily recommended in various communities. This menu was accompanied by a survey, asking for specific input from community members on preliminary recommendations to their neighborhood for stormwater management. The survey was released in early March and closed two weeks later. The survey received 96 responses.

Phase 3

The last phase of engagement included an in-person presentation and open house in late-March 2023. During this presentation, the project team presented a more refined Menu of Solutions after feedback from Phase 2 of engagement. After this third and final phase of engagement, the project team will finalize the Report of recommendations to the Town for improved stormwater management and flooding resiliency.

Round 1 Engagement - Online Map Comments

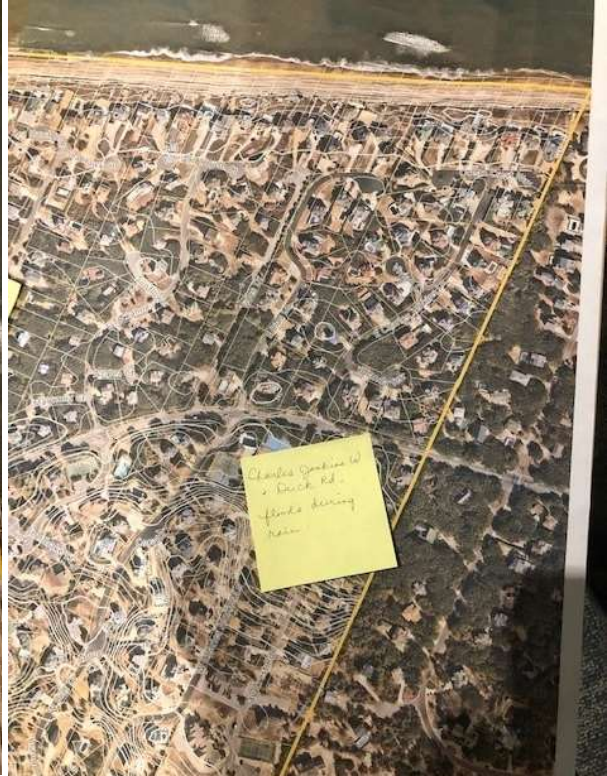
Community Feedback								
TARGET_FID	Comment (1000 character max.)	Commenter Name	Email Address (Optional)	Neighborhood	Neighborhood Area	Recorded Location	y	x
10	Front and west side of property floods with heavy rain	Stephen Pirato	spirato318@gmail.com	North Duck Neighborhood	1	119 Ocean Bay Blvd, Kitty Hawk, North Carolina, 27949	36.2039	-75.762
28	After heavy rainfall, there is standing water in the yard along Clay Ave. Also, on the east side of the property, there is sometimes standing water between 115 Acorn Oak and 117 Acorn Oak.	Katherine Clagett	<Null>	North Duck Neighborhood	1	115 Acorn Oak Ave, Kitty Hawk, North Carolina, 27949	36.20322	-75.7631
53	Our vacant lot next to our home has flooded during very heavy rainfalls in the past. Most of the flooding is the section of the lot facing north and west.	James and Elizabeth Watson	eawat301@gmail.com	North Duck Neighborhood	1	122 Acorn Oak Ave, Kitty Hawk, North Carolina, 27949	36.20367	-75.7615
57	stormwater runoff onto this property in almost every major rain event. My house was lifted FEMA compliant but the lot underneath floods regularly as do some of my neighbors on Sound Sea Ave and Maple in SSV	Jeanne Nielsen	jwnreddirt@yahoo.com	North Duck Neighborhood	1	141 Sound Sea Ave, Kitty Hawk, North Carolina, 27949	36.20256	-75.7618
82	After heavy rainfalls, we often get standing water surrounding the outside edges of our lot (our home is elevated). This is between our lot and 117 Acorn Oak Ave. and our lot and 121 and Acorn Oak Ave. The roadway on the north of property is often filled with standing water even after normal rains. The neighbor's lot directly to the south of us completely floods including their septic field on Sound Sea Avenue.	Joe McDonald	<Null>	North Duck Neighborhood	1	121 Acorn Oak Ave, Kitty Hawk, North Carolina, 27949	36.20319	-75.762
83	This comment was accidentally logged into 121 Acorn Oak. Please correct for 119 Acorn Oak Ave. After heavy rainfalls, we often get standing water surrounding the outside edges of our lot (our home is elevated). This is between our lot and 117 Acorn Oak Ave. and our lot and 121 and Acorn Oak Ave. The roadway on the north of property is often filled with standing water even after normal rains. The neighbor's lot directly to the south of us completely floods including their septic field on Sound Sea Avenue.	Joe/Barb McDonald	<Null>	North Duck Neighborhood	1	119 Acorn Oak Ave, Kitty Hawk, North Carolina, 27949	36.2033	-75.7623
84	This property has flooded since a house was built on it in the 1970s. Hurricane Matthew in 2016 brought as much as 1 foot of rain water into the garage.	Sylvia Umphlett Betz	<Null>	North Duck Neighborhood	1	120 Acorn Oak Ave, Kitty Hawk, North Carolina, 27949	36.20367	-75.762
13	Each rain event, storm water pools in my driveway and yard (139 Wampum Drive) and in the street adjacent to my property.	Clyde Mays	the_mays5@yahoo.com	Schooner Ridge	2	134 Wampum Dr, Kitty Hawk, North Carolina, 27949	36.16851	-75.7469
25	After heavy rain events my driveway and yard flood as well as the adjacent street. During tropical events the same areas flood and the water rises and floods the lower level of our home.	Jeff Grillo	jeffgrillo59@gmail.com	Schooner Ridge	2	156 Schooner Ridge Dr E, Kitty Hawk, North Carolina, 27949	36.16705	-75.7463
47	Standing water at end of driveway and in the street after rainfall	Angie McAtee	Angela.mcatee5@gmail.com	Schooner Ridge	2	173 Schooner Ridge Dr E, Kitty Hawk, North Carolina, 27949	36.16772	-75.7477
58	Area between 137 Schooner Ridge past 143 Schooner Ridge floods with heavy rains	Lee Anastasi	leeanastasi@verizon.net	Schooner Ridge	2	143 Schooner Ridge Dr E, Kitty Hawk, North Carolina, 27949	36.1667	-75.7465
22	Cul de sac of Teresa Court floods due to excessive rain. Several driveways become flooded as well.	Brian Mistretta	<Null>	Teresa Ct / Duck Hunt Club	3	173 Teresa Ct, Kitty Hawk, North Carolina, 27949	36.16284	-75.7459
23	We have had three high water issues at 183 Teresa Court during the past six years. Our entire cul-de-sac flooded during each of these events. I can provide photos if needed.	<Null>	<Null>	Teresa Ct / Duck Hunt Club	3	173 Teresa Ct, Kitty Hawk, North Carolina, 27949	36.16292	-75.746
37	Four Seasons standing water on Duck Hunt Club Lane whenever it rains and pushes water into the driveway	Coggeshall	<Null>	Teresa Ct / Duck Hunt Club	3	105 Duck Hunt Club Ln, Kitty Hawk, North Carolina, 27949	36.16058	-75.7458
46	This is a problem after any rain! The extremely large puddle is unpassable by foot. It is 5 inches deep and spreads a good 25 ft long on street. At times of very hard rains, the flood extends up into 1/2 my driveway. This area of flooding takes days to go down.	Joanne von Bischoffshausen	Jjvonmom@aol.com	Teresa Ct / Duck Hunt Club	3	161 Victoria Ct, Kitty Hawk, North Carolina, 27949	36.16326	-75.7467
51	This is very low point in the design of the streets and neighborhood. Lost entire trees in the area. It will now "fill" like a seasonal pond, lol, during heavy rainfall or storms.	FSL Owner	<Null>	Teresa Ct / Duck Hunt Club	3	144 Four Seasons Ln, Kitty Hawk, North Carolina, 27949	36.15967	-75.7451
7	This entire area ponds after a heavy rain event and can take days to drain.	Monica Thibodeau	monica.thibodeau@carolinadesigns.com	Georgetown Sands	4	113 Sea Hawk Dr E, Kitty Hawk, North Carolina, 27949	36.15548	-75.743
27	The street in front of my property ay 121 Seabreeze Dr floods after a moderate shower and heavy rains cause the street to be flooded for several days. Our property tends to flood as well however we recently spread additional sand which has mitigated this.	Kevin Lasher	lasherk124@gmail.com	Georgetown Sands	4	121 Seabreeze Dr, Kitty Hawk, North Carolina, 27949	36.15643	-75.7433
32	Property regularly floods after minimal rainfall. Drainage is very slow. This property is the lowest point over multiple streets. Standing water can take up to 3 weeks to drain after heavy storm/hurricane. Created berm on left and right side of house. Excavated to help water flow to back of property to avoid flooding under the house. Added #5 stone to back of property to aid in drainage. This helps for small rain showers, but any repairs attempted are easily overwhelmed in larger storms.	Kenny Jordan	kennyjordan0149@yahoo.com	Georgetown Sands	4	114 Sea Hawk Dr E, Kitty Hawk, North Carolina, 27949	36.15594	-75.7433
55	Several places on Plover drive have standing water after rain around 133 to 135 and 147-149. Durring heavy rains water from Georgetown Sands and the properties of 139 to 143 collect behind 141 Plover drive. Last year it came about 10 feet from the pool decking.	Eric Myers	myrs_rc2@yahoo.com	Georgetown Sands	4	101-199 Plover Dr, Kitty Hawk, North Carolina, 27949	36.15817	-75.7435
56	During periods of heavy/steady rain, water flows & accumulates in and around homes in the mid section of Sea Hawk Drive East. This water stands on the road, driveways, yards and around the homes in this area. This sometimes causes damage to the homes and property in this area. I was told by a Dare County official there was an old dried up water channel running from above Sea Hawk, down & through Sea Hawk Drive East.	B. Perry	<Null>	Georgetown Sands	4	117 Sea Hawk Dr E, Kitty Hawk, North Carolina, 27949	36.15564	-75.7427
66	I have not seen flooding at my property at 112 Seabreeze Drive; however, I have only owned the property for two years. Several times I have seen Seabreeze Drive flood between my house and the beach access, and sometimes it does not drain even after the rain subsides. I believe the HOA has provided you with information on the past pumping efforts when there has been standing water.	Brenda Foos	<Null>	Georgetown Sands	4	112 Seabreeze Dr, Kitty Hawk, North Carolina, 27949	36.15678	-75.7449
43	This area pools water in most rain events, however in significant events such as Hurrucane Matthew or even the rains experienced 2/18 to 2/21 2021 , a temporary stream develops which flows from north (E Bias Ln) to Vivian Ct. Water reaching Vivian Ct then flows both east and west, with the west flow often contributing to flooding in the intersection of Vivian and Charles Jenkins, both flows can threaten properties in the cul-de-sac	Bill Hannon	hannonwb@msn.com	Ocean Crest	5	112 Vivian Ct, Kitty Hawk, North Carolina, 27949	36.15225	-75.7404
8	Standing water forms in multiple locations on Bufflehead Road following summer rainstorms.	<Null>	<Null>	North Duck	North Duck	145-153 Bufflehead Rd, Kitty Hawk, North Carolina, 27949	36.19243	-75.756
9	A lot of water stands here after normal amounts of rain	Neighbor	<Null>	North Duck	North Duck	104-112 Dianne St, Kitty Hawk, North Carolina, 27949	36.19714	-75.7602

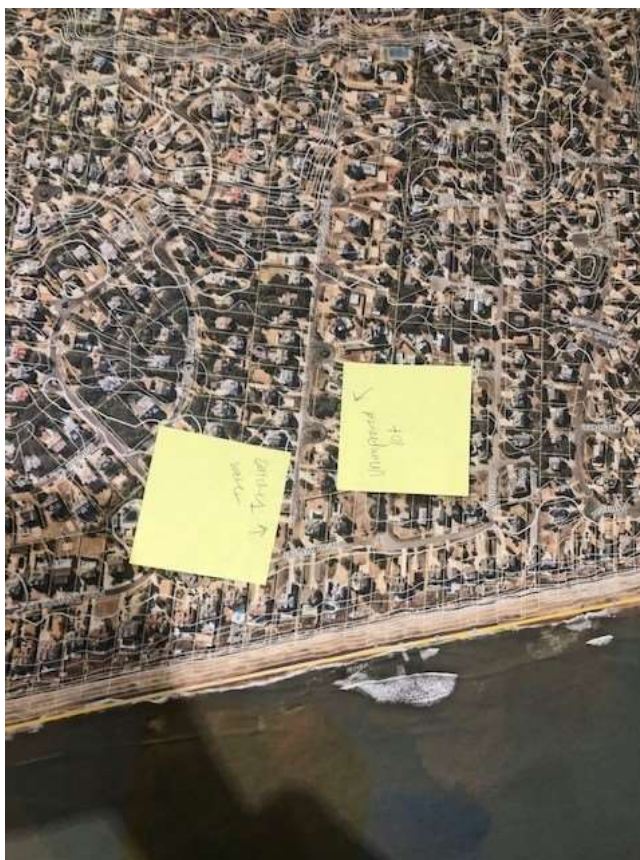
TARGET_FID	Comment (1000 character max.)	Commenter Name	Email Address (Optional)	Neighborhood	Neighborhood Area	Recorded Location	y	x
14	I have owned a home at 100 Acorn Oak Ave for 10 years now and lived in it for 7 of them. My front yard and driveway floods everytime there is a heavy rain and all the homes that added fill and sit higher drain into my yard. Often times there is standing water for over a week that I have to walk through to get to the street or roll out trash cans or get into my car.	John Mausteller	Jmausteller@gmail.com	North Duck	North Duck	100 Acorn Oak Ave, Kitty Hawk, North Carolina, 27949	36.20356	-75.7652
17	Stormwater 3" deep even during light rain events	Christopher Blunck	chris@thebluncks.com	North Duck	North Duck	2-198 Pintail Dr, Kitty Hawk, North Carolina, 27949	36.1931	-75.7563
18	Low spot in roadway causes large puddle to form and then drain onto driveway on 101 Widgeon	Christopher Blunck	chris@thebluncks.com	North Duck	North Duck	98 Widgeon Dr, Kitty Hawk, North Carolina, 27949	36.19122	-75.7603
19	Huge volume of water flows down Bald Pate and empties into this area, causing flooding	Christopher Blunck	chris@thebluncks.com	North Duck	North Duck	109 Baldpate Dr, Kitty Hawk, North Carolina, 27949	36.19062	-75.7591
20	<Null>	Daniel Weinberg	daniel.h.weinberg@gmail.com	North Duck	North Duck	100-198 N Snow Geese Rd, Kitty Hawk, North Carolina, 27949	36.19012	-75.7552
26	Low spot results in flooded road whenever it rains	Howard Goldfine	<Null>	North Duck	North Duck	109 Old Squaw Dr, Kitty Hawk, North Carolina, 27949	36.1959	-75.7605
30	we have a large pool of water (up to 4-5" deep) that forms at the base of our driveway at 1475 Duck Road which has four townhouses. I have previously sent photos to NOAA. This is being filed on behalf of the Salthouse Homeowner's Association.	Barney Skladany	barneyskladany@comcast.net	North Duck	North Duck	1475-1495 Duck Rd, Kitty Hawk, North Carolina, 27949	36.22527	-75.772
31	Duck Road floods in front of the newly renovated rest stop. The map shows this as 99 Wood Duck Road, but the actual ponding occurs on Duck Road, opposite my mailbox at 1350 Duck Road	Bruce Martin	profbrucemartin@gmail.com	North Duck	North Duck	99 Wood Duck Dr, Kitty Hawk, North Carolina, 27949	36.19273	-75.7615
33	Soundside flooding during heavy/fast rain and/or sustained west to southwest winds of >20MPH. High water table. Intermittent creek to the immediate south of property also floods into north property.	Kevin Wright	kvwkmw@gmail.com	North Duck	North Duck	112 Quail Way, Kitty Hawk, North Carolina, 27949	36.21572	-75.7701
34	Rain water runs down driveway from the road flooding our driveway area to the point where we dug a 40' trench and inserted a drain pipe along side of house to help mitigate the flooding and get rid of standing water in driveway. West side of yard also floods in heavy storms	Vera Ross	vera@rossstudio.com	North Duck	North Duck	1370 Duck Rd, Kitty Hawk, North Carolina, 27949	36.19477	-75.762
35	This location experiences noticeable drainage problems after heavy rains. It is in fact the location in the photo used in the Duck E News to illustrate this stormwater study.	Greg Redding	<Null>	North Duck	North Duck	130 Waxwing Ln, Kitty Hawk, North Carolina, 27949	36.21482	-75.767
36	Street (Vireo Way) floods in front of house as does our front and side yard and occasionally under our house.	Heidi Gillis	<Null>	North Duck	North Duck	119 Vireo Way, Kitty Hawk, North Carolina, 27949	36.21745	-75.7687
39	Water and debris 75' in from normal shoreline	Louis Fedele	louis.fedele@gmail.com	North Duck	North Duck	1532 Duck Rd, Kitty Hawk, North Carolina, 27949	36.21818	-75.7703
40	This area has significant flooding after heavy rainfall	Robert Harris	rharris@harrislawdc.com	North Duck	North Duck	115 Waxwing Ln, Kitty Hawk, North Carolina, 27949	36.21477	-75.7675
41	This area has significant flooding after heavy rainfall	Robert Harris	rharris@harrislawdc.com	North Duck	North Duck	115 Waxwing Ln, Kitty Hawk, North Carolina, 27949	36.21461	-75.7676
42	This area has significant flooding after heavy rainfall	Robert Harris	rharris@harrislawdc.com	North Duck	North Duck	115 Waxwing Ln, Kitty Hawk, North Carolina, 27949	36.21471	-75.7677
44	Bottom of hill at Spyglass and Spindrift standing water after heavy rain	S McMasters	<Null>	North Duck	North Duck	123-129 Spindrift Ln, Kitty Hawk, North Carolina, 27949	36.1881	-75.7541
45	bottom of driveway collects rain=erosion of hill	S McMasters	<Null>	North Duck	North Duck	111 Sand Castle Ct, Kitty Hawk, North Carolina, 27949	36.18782	-75.7572
48	During a heavy rain storm Gannet Lane in front of our house, and on the entire right side of the street accumulates storm water. I would appreciate suggestions on how to curtail this storm water issue on our street and specifically on Gannet in front of my house.	Amanda O'Brien (homeowner)	amanda_obrien@mac.com	North Duck	North Duck	101-199 Gannet Ln, Kitty Hawk, North Carolina, 27949	36.21493	-75.7687
59	water collects at the driveway on most rain storms and next to the house.	J Verner	<Null>	North Duck	North Duck	123 Oyster Catcher Ln, Kitty Hawk, North Carolina, 27949	36.20577	-75.7638
60	Erosion around the pond is now 1 foot per year	Verner	<Null>	North Duck	North Duck	105 Skimmer Way, Kitty Hawk, North Carolina, 27949	36.20705	-75.7651
61	After almost every rain storm standing water collects at the intersection of Duck Road and Station Bay Drive. Depending on the rainfall amount, the pooled water can last for several days. The standing water has degraded the road surface, which has been patched, but is still falling apart.	Chris Cimko	Chris@chriscimko.com	North Duck	North Duck	105 Station Bay Dr, Kitty Hawk, North Carolina, 27949	36.22063	-75.7702
62	Standing water on Quail Way after light rain	Gene Schwarz	gene.schwarz@yahoo.com	North Duck	North Duck	100-298 Quail Way, Kitty Hawk, North Carolina, 27949	36.21711	-75.7696
64	Flooding and debris from Hurricane blocked Oyster Catcher Lane and Skimmer Way (Irene) Town had to remove debris	J Verner	<Null>	North Duck	North Duck	Oyster Catcher Ln, Kitty Hawk, North Carolina, 27949	36.2065	-75.7664
65	Debris and Flooding from Hurricane Irene blocked road. Town of Duck had to clear roadway for 110 residents. HOA removed debris	J Verner	<Null>	North Duck	North Duck	100-112 Skimmer Way, Kitty Hawk, North Carolina, 27949	36.20673	-75.7662
67	The road of the Portside Condominiums (1318 Duck Road) floods everytime there is significant rainfall. With heavy rainfall, the water rises to levels that flood storage units and up to middle of car tires.	Richard Schlegel	richard.schlegel@georgetown.edu	North Duck	North Duck	1318 Duck Rd, Kitty Hawk, North Carolina, 27949	36.18869	-75.7602
69	Standing water forms in front of our cottage at 113 Buffellhead Road, pretty much each time it rains.	Marc R. Paul	marc.paul@bakermckenzie.com	North Duck	North Duck	113 Buffell Head Rd, Kitty Hawk, North Carolina, 27949	36.19613	-75.7575
71	Water pools under carport and rear yard during heavy rain, also along the shared driveway	Emily Vlkojan	evlkojan@gmail.com	North Duck	North Duck	110 Pelican Way, Kitty Hawk, North Carolina, 27949	36.21058	-75.7647
72	Excessive flooding under carport during heavy rain	Emily Vlkojan	evlkojan@gmail.com	North Duck	North Duck	116 Pelican Way, Kitty Hawk, North Carolina, 27949	36.21035	-75.7644
73	Water pools at the entrance of Blue Heron	Emily Vlkojan	evlkojan@gmail.com	North Duck	North Duck	101 Blue Heron Ln, Kitty Hawk, North Carolina, 27949	36.21133	-75.7664
74	Water pools in driveway during heavy rain	Emily Vlkojan	<Null>	North Duck	North Duck	107 Pelican Way, Kitty Hawk, North Carolina, 27949	36.21064	-75.7652
75	Driveway floods during heavy rain- gravel and sand has been added to help	Emily Vlkojan	evlkojan@gmail.com	North Duck	North Duck	110 Pelican Way, Kitty Hawk, North Carolina, 27949	36.21045	-75.765

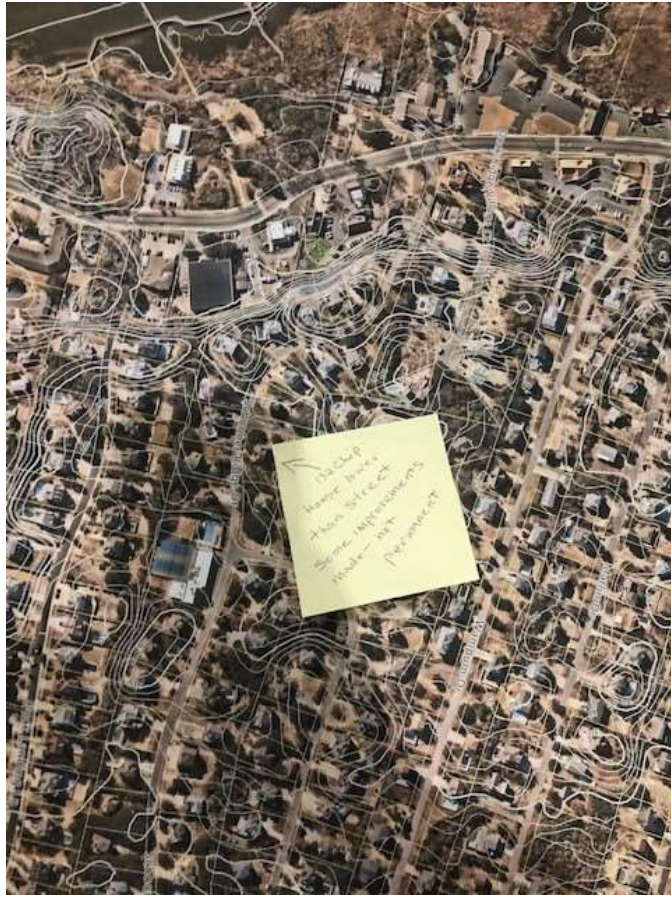
TARGET_FID	Comment (1000 character max.)	Commenter Name	Email Address (Optional)	Neighborhood	Neighborhood Area	Recorded Location	y	x
76	Road floods during heavy rain	Emily Vlkogan	<Null>	North Duck	North Duck	104 Blue Heron Ln, Kitty Hawk, North Carolina, 27949	36.21141	-75.7655
77	Road floods during heavy rain at entrance to neighborhood	Emily Vlkogan	evlkojan@gmail.com	North Duck	North Duck	1405-1411 Duck Rd, Kitty Hawk, North Carolina, 27949	36.20666	-75.7666
78	Entrance/sidewalk floods during heavy rain	Emily Vlkogan	<Null>	North Duck	North Duck	100-298 Ocean Pines Dr, Kitty Hawk, North Carolina, 27949	36.20499	-75.7664
79	Sidewalk floods	Emily Vlkogan	<Null>	North Duck	North Duck	100 Blue Heron Ln, Kitty Hawk, North Carolina, 27949	36.21172	-75.7664
80	Sidewalk completely underwater during heavy rain	Emily Vlkogan	<Null>	North Duck	North Duck	115 Station Bay Dr, Kitty Hawk, North Carolina, 27949	36.22227	-75.7711
4	Roadway floods during strong southwest winds - testing this for ease	Sandra M Cross	scross@townofduck.com	South Duck	South Duck	1254-1254 Duck Rd, Kitty Hawk, North Carolina, 27949	36.17287	-75.7565
5	Every morning there is a pond of water on the street. Size varies but usually the water expands across the entire width of the street. I believe a residence lawn sprinklers contribute to the water but isn't the only cause.	Barbara	<Null>	South Duck	South Duck	101-199 Scarborough Ln, Kitty Hawk, North Carolina, 27949	36.16153	-75.7511
6	Intersection of Charles Jenkins West & Duck Rd. floods during rainstorms	Lynne Alterman	lpalterman@aol.com	South Duck	South Duck	100-198 Charles Jenkins Ln W, Kitty Hawk, North Carolina, 27949	36.15221	-75.7426
11	This area frequently floods in heavy rain.	Sara Buffington	sara@buffington.tv	South Duck	South Duck	127 Charles Jenkins Ln W, Kitty Hawk, North Carolina, 27949	36.15235	-75.7481
12	This area along Duck Road has already been discussed, I believe. It gets deep enough here that soundside vehicles (sedans, in particular) can get stranded.	Sara Buffington	sara@buffington.tv	South Duck	South Duck	100-198 Charles Jenkins Ln W, Kitty Hawk, North Carolina, 27949	36.15224	-75.7425
15	Water build up after every rain	Andreya Risser	<Null>	South Duck	South Duck	116 Sea Colony Dr, Kitty Hawk, North Carolina, 27949	36.17298	-75.7533
16	Flooding on Duck Road near the Sound and Sea Colony Road is an issue during high water periods.?	Dennis Zaenger	Dzaenger@yahoo.com	South Duck	South Duck	1254-1254 Duck Rd, Kitty Hawk, North Carolina, 27949	36.17282	-75.7566
21	The area at the intersection of Poteskeet Drive and Mantoac Court floods whenever there is a significant rainfall.	Kevin Davis	kdavis43054@yahoo.com	South Duck	South Duck	148-198 Poteskeet Rd, Kitty Hawk, North Carolina, 27949	36.16473	-75.7448
24	Floods even in minor storms. Have had our car submerged. Been stranded trying to get in and out of the street. Worried that first responders cannot not get in if need be.	Jennifer Claflin	mom2curvykids@gmail.com	South Duck	South Duck	101-199 Charles Jenkins Ln W, Kitty Hawk, North Carolina, 27949	36.15212	-75.7428
29	Extreme flooding around 106, 108, 107 and 109 jaycrest rd duck nc	Kevin Keane	keanekm@verizon.net	South Duck	South Duck	106 Jaycrest Rd, Kitty Hawk, North Carolina, 27949	36.15169	-75.7434
38	We experience flooding everytime there is a heavy rain that the wind is going east. The rain comes right down the street into our court and down our driveway. The court itself is higher in the middle which pushes the rain towards our home.	Cindy & Jim Cohagan	poteskeet145@gmail.com	South Duck	South Duck	145 Arrowhead Ct, Kitty Hawk, North Carolina, 27949	36.16453	-75.7466
49	Bottom of the hill on Jaycrest Road, pools significant amount of water after every rain storm., right around 107 - 109 Jaycrest Road. If raining all day, the road becomes almost impassable for regular sedans.	JAYCREST RESIDENT	<Null>	South Duck	South Duck	109 Jaycrest Rd, Kitty Hawk, North Carolina, 27949	36.15134	-75.7434
50	This area becomes heavily flooded after significant rainfall, sometimes takes 2-3 days to remedy.	FSL Owner	<Null>	South Duck	South Duck	100-198 Turnbuckle Ct, Kitty Hawk, North Carolina, 27949	36.15941	-75.7489
52	Have been stranded both at our house and trying to get back to the house. Our car was flooded trying to get back to our house.	Glenn Plomchok	<Null>	South Duck	South Duck	123 Charles Jenkins Ln W, Kitty Hawk, North Carolina, 27949	36.15207	-75.7437
54	Water pools in this area of Jaycrest Road in every storm, causing frequent potholes in the same area.	Nantucket Owner	<Null>	South Duck	South Duck	2-998 Jaycrest Rd, Kitty Hawk, North Carolina, 27949	36.15158	-75.7434
63	We experience flooding under our house after any significant rain event. It appears water flows south and ponds in our driveway and under the house. In addition to the water, we find debris and sediment. Flooding occurrences have increased over the years. At times, we have seen upwards of 4-5 inches or more of standing water and debris.	Bruce Robertson	pewterrabbit@yahoo.com	South Duck	South Duck	153 Poteskeet Dr, Kitty Hawk, North Carolina, 27949	36.16442	-75.7453
68	Water collects at the entrance to Sandy Ridge Subdivision	Georgia	<Null>	South Duck	South Duck	100 Ships Watch Dr, Kitty Hawk, North Carolina, 27949	36.17701	-75.7554
70	Significant ponding of water at the intersection of Duck Ridge Village Ct and Duck Rd after rain. Drain in the street takes an excessive amount of time to carry flood water away.	Julia Massie	5massies@comcast.net	South Duck	South Duck	100-198 Duck Ridge Village Ct, Kitty Hawk, North Carolina, 27949	36.16743	-75.7548
81	Water has crested and flooded the road during heavy rain	Emily Vlkogan	<Null>	South Duck	South Duck	Barrier Island Station at Duck	36.17459	-75.7565

Round 1 Engagement

In-Person Comments







Round 2 Engagement - Emailed Comments

Email	Name	Comment
lpalterman@aol.com	Lynne Alterman	Who would be responsible for paying for these suggested solutions? The Town? The HOA's? Individual homeowners? It's difficult to respond to the survey without knowing the answer to this question.
bethguertin@aol.com	Beth Guertin	Thanks for the response. I would like to point out the the covenants for Caffey's were not created by the Homeowners Association. Rather, the Homeowner's Association was created by the covenants. I'm not a lawyer, but I think the town or the county enforces the covenants. And as far as I know, the Association has never taken action to enforce any of its by-laws. We're a pretty easy going bunch of beach dwellers But on another note, I have looked at the materials regarding the Stormwater Study. To be clear, I have only looked at the part which pertains to Caffey's Inlet. The lot next to mine (125 Carroll) is outlined in green and marked "Drain Field". What does that mean? It is definitely not a drain field as it has been raised above all the surrounding area. I have looked at the survey. I am finding the survey very confusing. For Caffey's, the survey is asking for my support of a "Dry Pond", "Bioretention", or "Swales." I don't really have enough information to know which, if any, would be a better choice than any other. What would these solutions look like in our cul-de-sacs? Is there room for anything in our cul-de-sacs? The trash/recycle vehicles already have a tough time navigating around them. And how would any of the possible solutions improve the drainage for lots which are not located on a cul-de-sac? I support any solution which will improve the flooding in Caffey's and the surrounding neighborhoods. I will send out the Town's survey request to all the owners in Caffey's. I hope you will get meaningful feedback from the community.
jesshelhorse@gmail.com	Joseph Shelhorse	The Caffey's Inlet site map indicates and notes permeable pavers in the cul-de-sac(s) but the survey calls for ponds, that's really confusing, Mosquitos barrels are tested exactly that, giant mosquito barrels. My neighbor had one, it was the equivalent of 10 abandoned tires with stagnant water.... Had anyone tested the barrels before recommending them??? The existing mosquito populations are problems enough, don't need anymore larvae..
jesshelhorse@gmail.com	Joseph Shelhorse	Also, The turning radius of the waste management trucks on pick up days, it is the responsible of Town of Duck to inform hired consultants that the turning radius and tbd weight of trucks will have a dramatic impact of permeable concrete pavers. If the waste management truck speed and heavy turns of the trucks can actually uplift pavers...
jesshelhorse@gmail.com	Joseph Shelhorse	A permeable road bed sounds like a great idea.... Terms: Heat Island Effect: Black Asphalt creates the "Heat Island Effect", it's a very anti green not good for the environment solution, concrete is a much better (green) surface, because it is white, it is reflective and does not absorb heat, and keeps the neighborhood 10-15 degrees cooler. Permeable concrete sounds even better.... Plus, drivers will drive slower on permeable concrete, and the Town of Duck Police will like that better. The Caffey's Inlet road bed is nearing the end of its life cycle. As a test case, why not do the entire road as permeable concrete as a test case?? Need to be respectable to beach walkers so some of it should be smooth concrete for pedestrian pathways planned into the roadbed. Recently, Dare County distributed free live oaks. Live oaks are a really great natural long term solution to storm water management, just need to wait a long time. I would suggest heavy fines for anyone that cuts a mature live oak that can be preserved outside a building footprint. I am still horrified by the tragedy that occurred at 135 Carroll Drive when a dozen mature live oaks were removed without approval, that owner is long gone, but, the damage and negative long term effects on storm water management are ongoing.
emorymiller1@gmail.com	Emory Miller	I have one comment that I hope can be addressed. I notice the circle of pavers recommended for our cul de sac is not a complete circle. My comment is——If it were a complete circle, the solution would look more like an enhancement to the neighborhood than a "fix to a problem." I would think the additional pavers and work would be relatively nominal to achieve this improvement.
judylotas@gmail.com	Judy Lotas	I don't know if JayCrest is on the official Duck map—just know that water collects at the bottom of the hill and I feel sorry for those property owners who get the overflow!
rosemarygordon@gmail.com	Rosemary Gordon	Hi Sandy, I'm sending this email for the record. There is nothing mentioned in this Stormwater Management Study/Solution or survey about the flooding at the bottom of Amy Lane. Note that except for maybe 4 days, there has been a standing pond at the bottom of Amy Lane for almost 2 months. This is a health hazard especially in the Summer season. I requested that this problem be included in the Stormwater Management Study meetings back in December since Amy Lane's issue of ponding happens with every rainfall not just with big storms. There needs to be a swale or retaining area along the west side of Duck Road on both sides of Amy Lane.

ieshelhorse@gmail.com	Joseph Shelhorse	I spoke with the Dare County Health Department, Dare County Water Department and observed failing septic systems, new septic fields protruding 60" out of the ground because the water table rose 20" on Hatteras Island...This is all official Dare County government records. And seeing is believing. On Farrow Drive in salvo, an older development, 4 existing septic fields were just replaced because they were over taken by the rising water table. After seeing all this, Town of Duck will have to accept this new reality and protect its tax payers by approving variances to property owners to address the rising water table, see photo.. I can also provide documentation of existing homes with recently failed septic systems, it basically, the same photo...Planting vegetation, maintaining large live oaks that absorb water from the water table is a good thing. Granting variances to owners that need relief because there property elevation grades are low, need to be given. I also heard the water table will continue to rise..
marollin@icloud.com	Miriam Rollin	Just wanted to make sure you got the email below with photos (the puddling is identical to what's happening today!); I realized I didn't include the "RCCP Phase 3" in the original email subject line, and I didn't include the other staff and partners' emails, so I wanted to re-send to make sure it's part of the effort! I tried to access the Stormwater Study interactive map, but was unsuccessful. (It wanted me to use "git hub" or some such thing that I don't have; it could be user error on my part!)In any case, I'm sending you two pics from after the rains mid-day today 12/31/22 on Plover Dr. Both are typical of the storm water accumulation on Plover Drive. The first is in front of our house (149 Plover Dr). The second are the two typical areas of puddling in front of 133 & 135 Plover Dr.
112seabreeze@gmail.com	Brenda Foos	I am writing because the storm water management study survey didn't have any opportunity to provide comments or additional details on the answers, at least in the section for Georgetown Sands and Sand Dollar Shores. I hope that you will be able to combine this input with the survey results. The Menu of Solutions document is very informative. I think that the swales along Seabreeze Drive could help, but at 2' deep I am not sure that they will be dry most of the time. I encourage you to look closely at any data that would inform the assumption that these will be dry retention. If the swales are are not dry most of the time, then I think they will be an eyesore. I don't think that streets with muddy ditches are a part of the town appeal that Duck has been working to cultivate, and definitely not what I would like to see on Seabreeze Drive. Perhaps several bioretention ponds would look better. I am also concerned that frequently wet swales will breed mosquitos, which feels less than ideal - like trading the flooding problem for a mosquito problem. Specific to my own property, I would like to know how the terminus of the swales will be constructed, as the plans show that they end between my house and the next. Perhaps most importantly, I request that you include pumping routinely when there is flooding, and not just in emergency situations as labeled in the Menu of Solutions. I would also like to recommend the substitution of more permeable pavers and concrete for the traditional materials, as this seems like a solution with fewer negative tradeoffs (i.e, you can still drive/park in those places). Lastly, I would suggest that many houses already have some gutters that are not connected to rain barrels, and collecting that water would be significantly less expensive than the estimates that include adding gutters

hoa@sanddollarshoreshoa.com	Sand Dollar Shores HOA	<p>It appears that ten sites had test borings to establish groundwater depths which ranged from 2.5' to 6.5' below grade. We are not informed of the dates of the borings and whether soil samples were obtained and analyzed. No boring samples are reported for Seabreeze Drive.</p> <p>The proposed fix for Seabreeze Drive appears to be a 2.0' deep swale on both sides of the road, in the area we call "Lake Seabreeze" located near mid-center on the roadway and potentially affecting 16 to 18 houses along the street. Given the small lot sizes of Seabreeze (10,000 sqft), we strongly recommend consideration using the center of the street for some subsurface storage, similar to many effective septic tank drain fields. We believe this, or a similar water capture system, was used to alleviate some flooding on Rt 12? It is likely some of the proposed Lagoon or bio-type temporary storage areas suggested may not fit on the smaller sites of Sand Dollar Shores (Seabreeze Drive).</p> <p>It is also not clear how the costing of any remedial action(s) is based, but we recommend that given the periodic severity of the flooding in these five sites that sewer systems be included in the long-term program for anticipated expense projections. The Town of Duck would benefit from a holistic water management approach. Our SDS-HOA is concerned about the potential negative impacts on property values of the directly affected homeowners, and any solution (or effectiveness of the effort) may affect the entire street. Equally, the Seabreeze Drive water and flooding issues are affected by the actions/non-actions taken on adjacent communities (e.g.-Georgetown Sands and/or Sea Hawk). Lastly, a cost-benefit review should include a pumping alternative whereby the advantages of pumping for brief periods of time may prove to be a less expensive and more effective solution. Jim Duffield will be the Sand Dollar Shores contact person for this project.</p>
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Duck Stormwater Study

Thursday, March 16, 2023

Powered by  SurveyMonkey®

96

Total Responses

Date Created: Tuesday, February 21, 2023

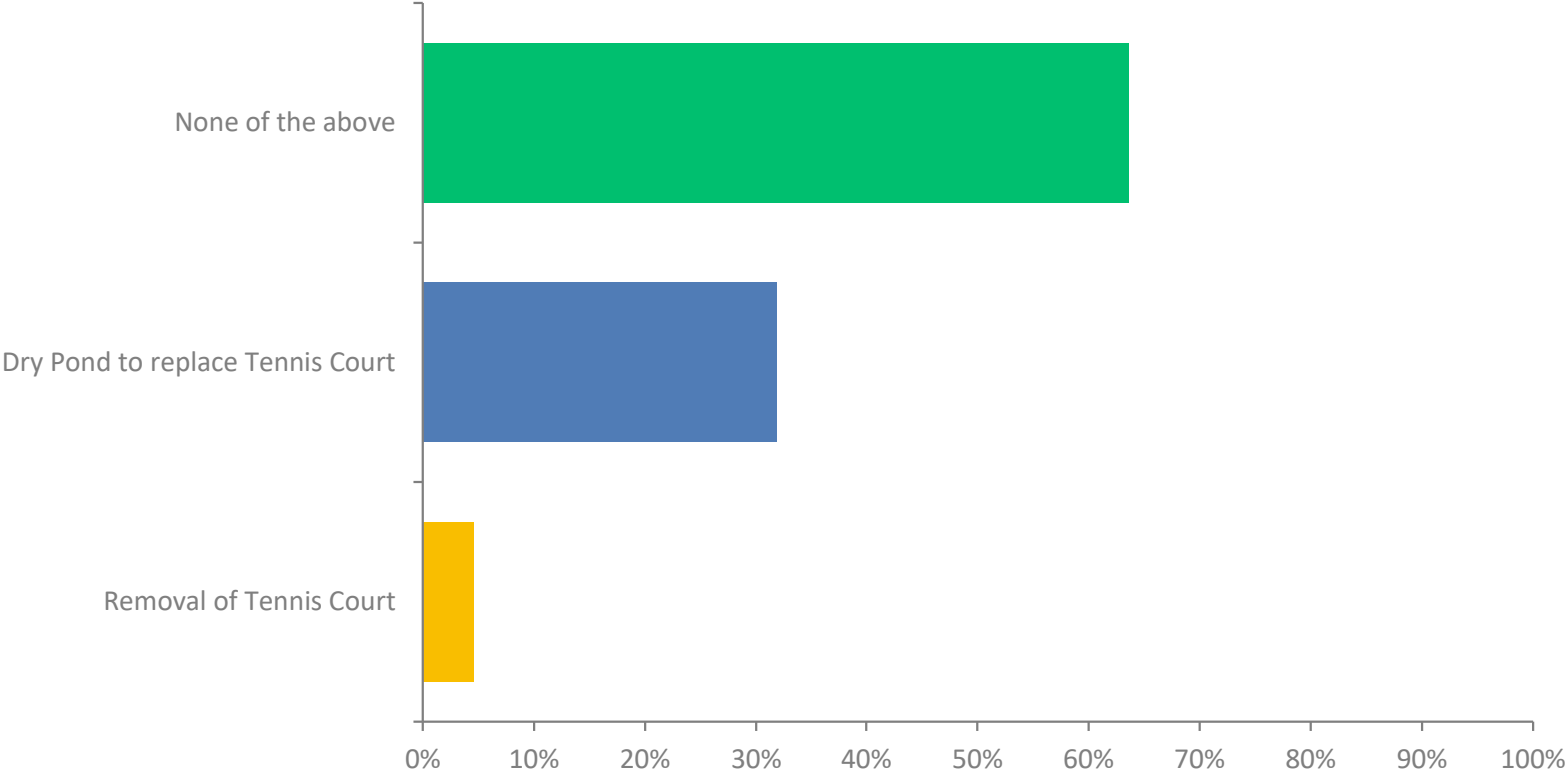
Complete Responses: 96

Powered by  SurveyMonkey®

Ocean Pines

Q1: Please choose the improvement you prefer:

Answered: 44 Skipped: 52



Ocean Pines

Q1: Please choose the improvement you prefer:

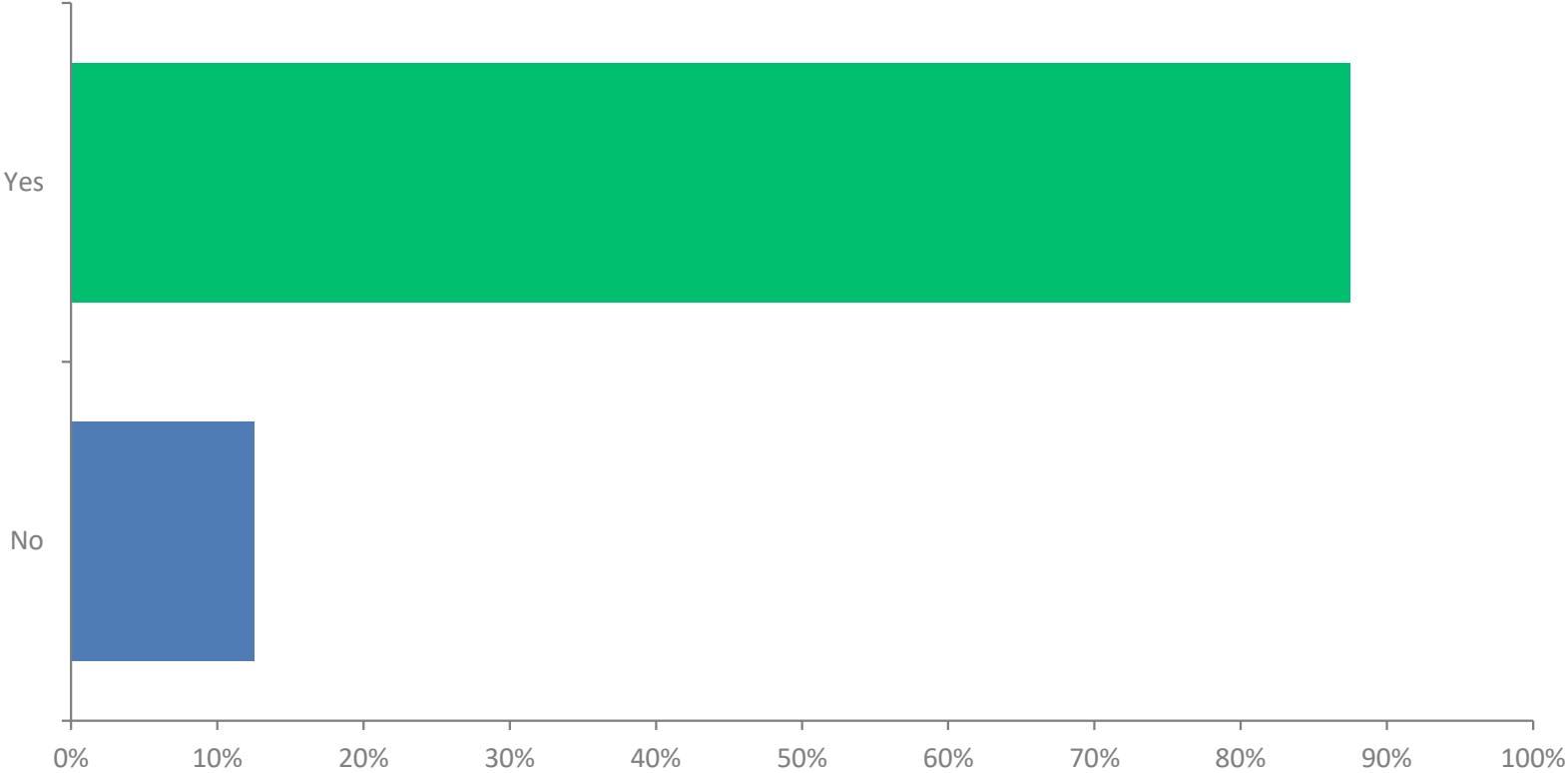
Answered: 44 Skipped: 52

ANSWER CHOICES	RESPONSES	
None of the above	63.64%	28
Dry Pond to replace Tennis Court	31.82%	14
Removal of Tennis Court	4.55%	2
TOTAL		44

Ocean Pines

Q2: Do you support implementation of permeable pavers at the Ocean Pines parking?

Answered: 40 Skipped: 56



Ocean Pines

Q2: Do you support implementation of permeable pavers at the Ocean Pines parking?

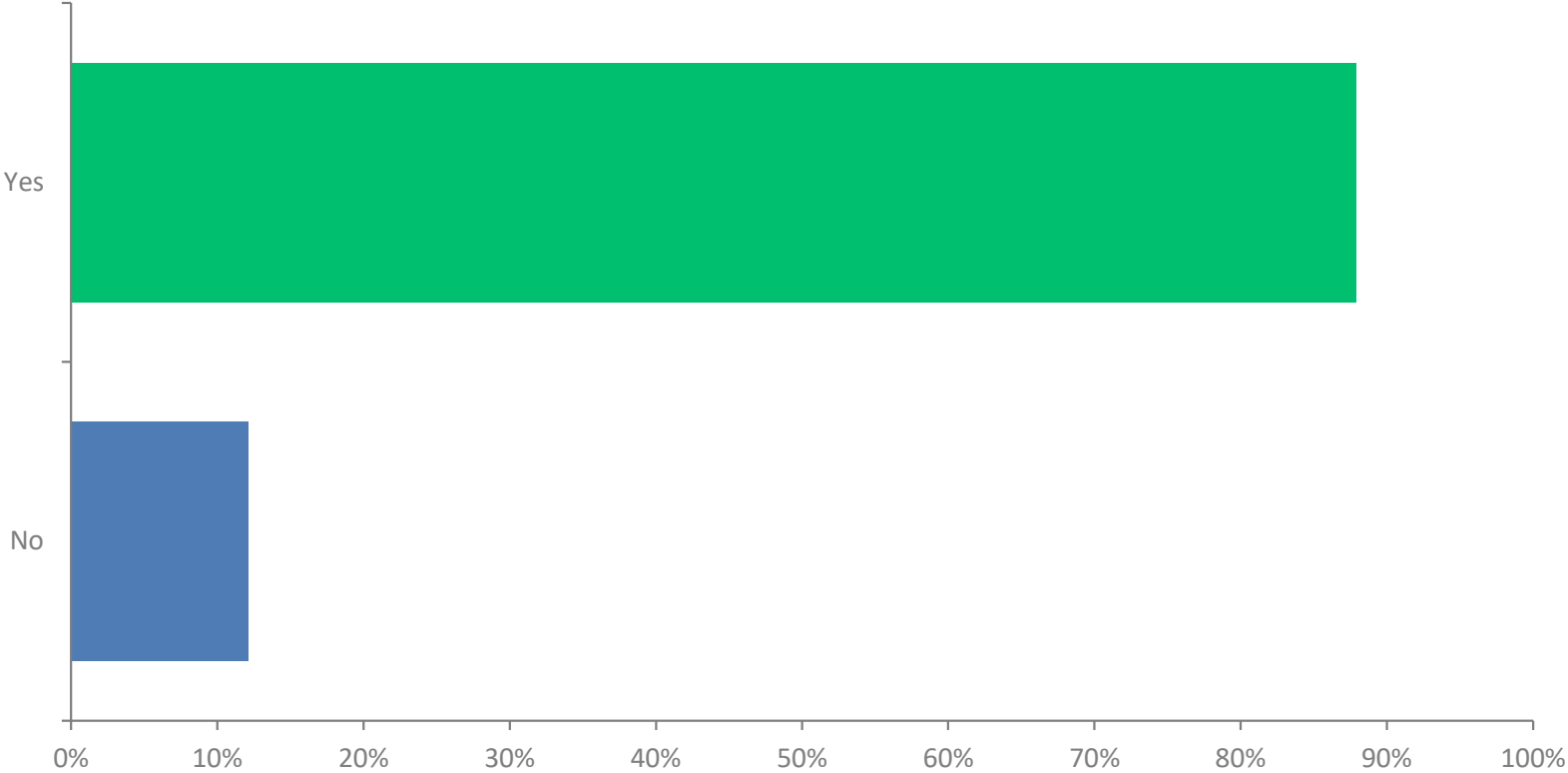
Answered: 40 Skipped: 56

ANSWER CHOICES	RESPONSES	
Yes	87.50%	35
No	12.50%	5
TOTAL		40

Gulls Flight

Q3: Do you support a swale at Flight Drive?

Answered: 33 Skipped: 63



Gulls Flight

Q3: Do you support a swale at Flight Drive?

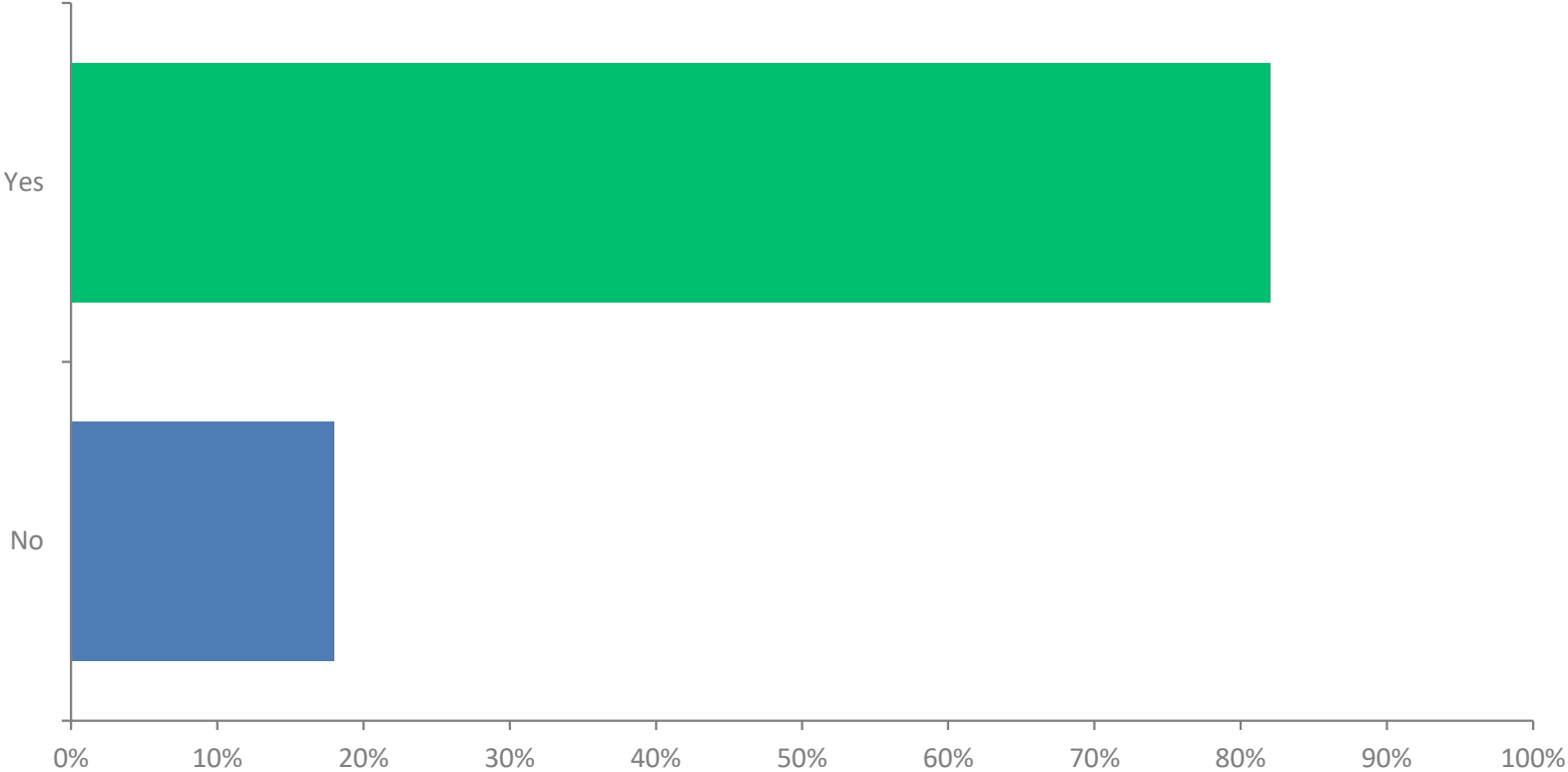
Answered: 33 Skipped: 63

ANSWER CHOICES	RESPONSES	
Yes	87.88%	29
No	12.12%	4
TOTAL		33

Sound Sea Village

Q4: Do you support a dry pond at 116 and 118 Ocean Bay Blvd?

Answered: 39 Skipped: 57



Sound Sea Village

Q4: Do you support a dry pond at 116 and 118 Ocean Bay Blvd?

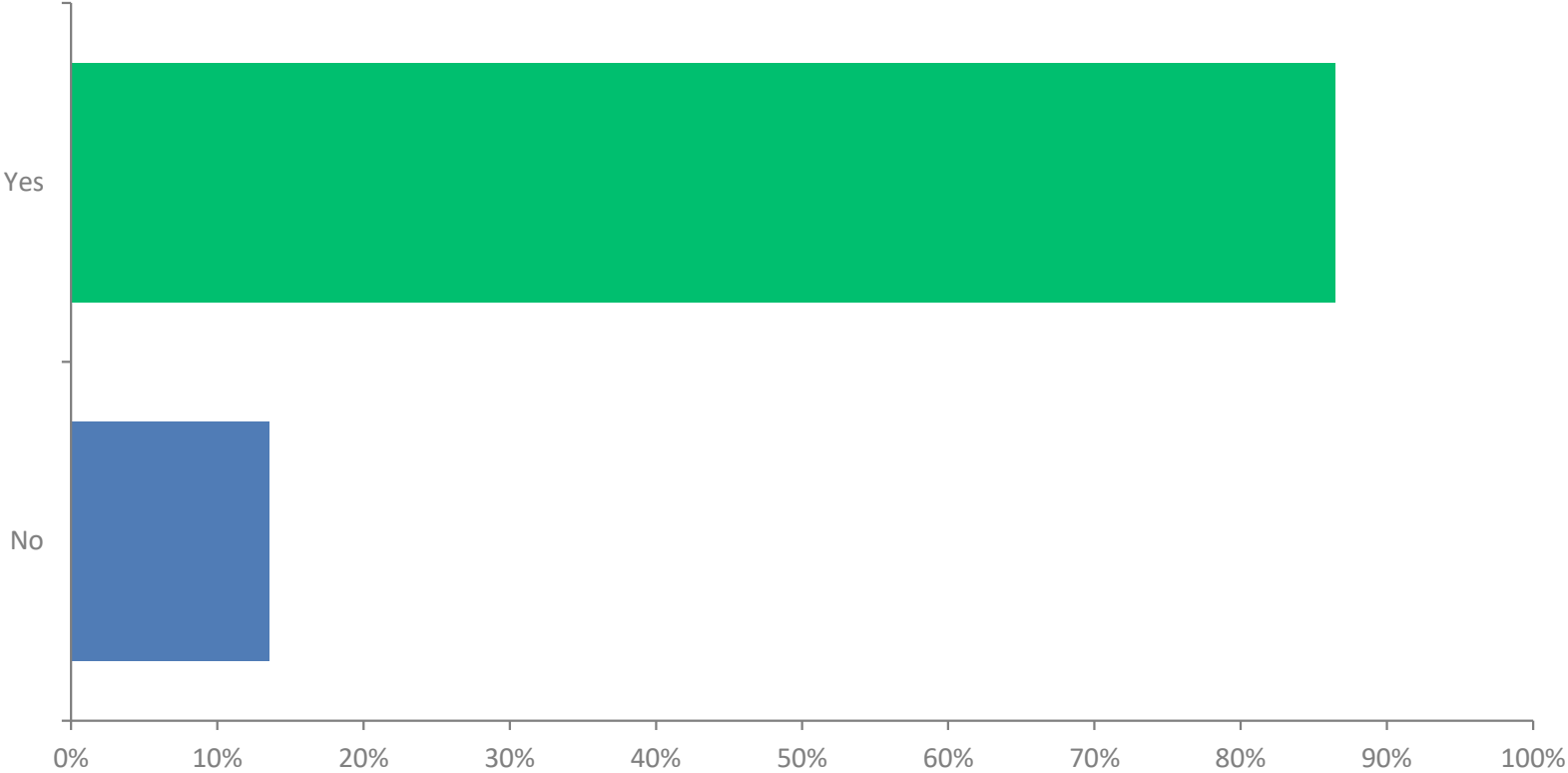
Answered: 39 Skipped: 57

ANSWER CHOICES	RESPONSES	
Yes	82.05%	32
No	17.95%	7
TOTAL		39

Sound Sea Village

Q5: Do you support a swale at Acorn Oak Ave?

Answered: 37 Skipped: 59



Sound Sea Village

Q5: Do you support a swale at Acorn Oak Ave?

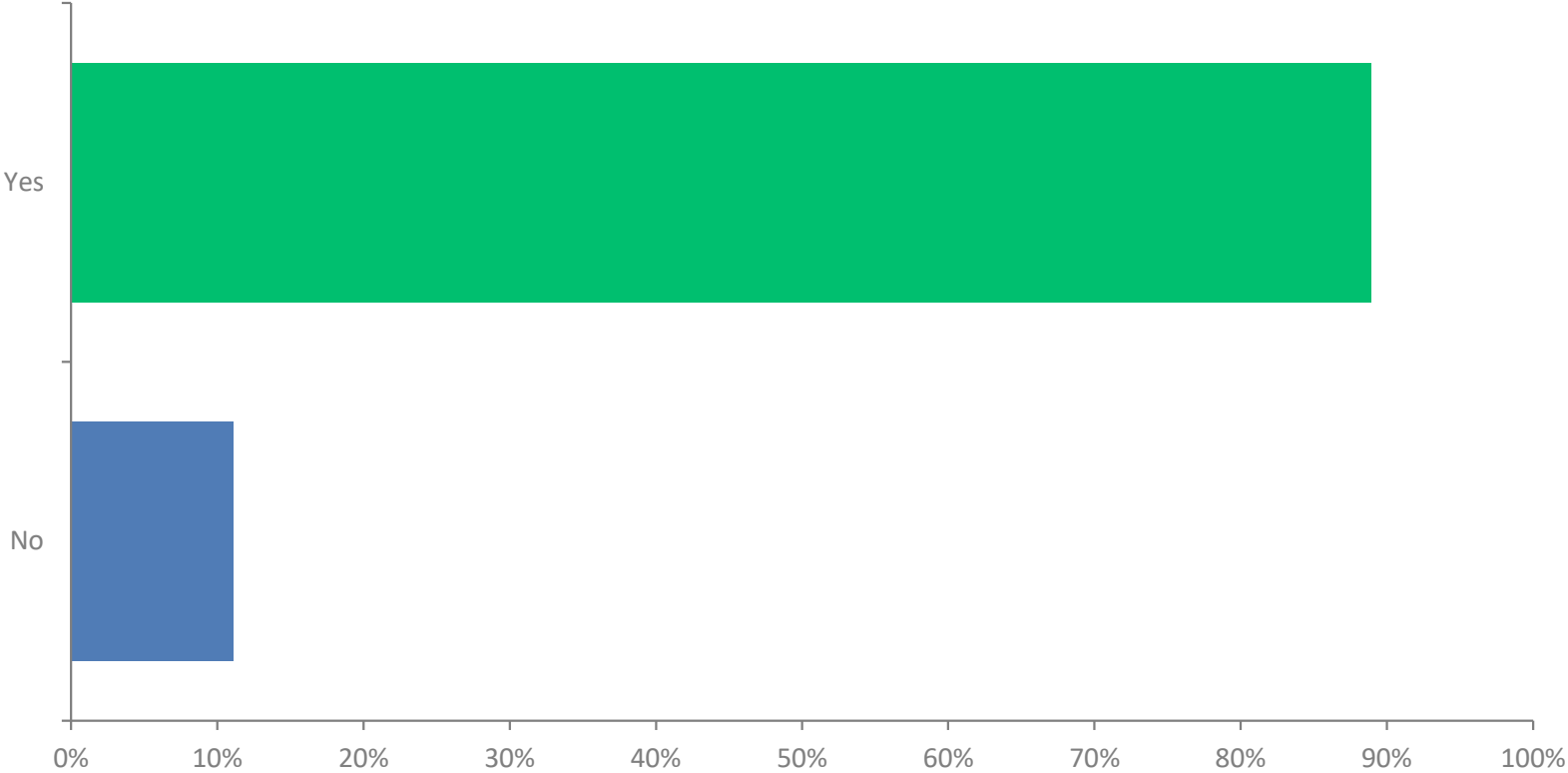
Answered: 37 Skipped: 59

ANSWER CHOICES	RESPONSES	
Yes	86.49%	32
No	13.51%	5
TOTAL		37

Sound Sea Village

Q6: Do you support a swale at Sound Sea Ave?

Answered: 36 Skipped: 60



Sound Sea Village

Q6: Do you support a swale at Sound Sea Ave?

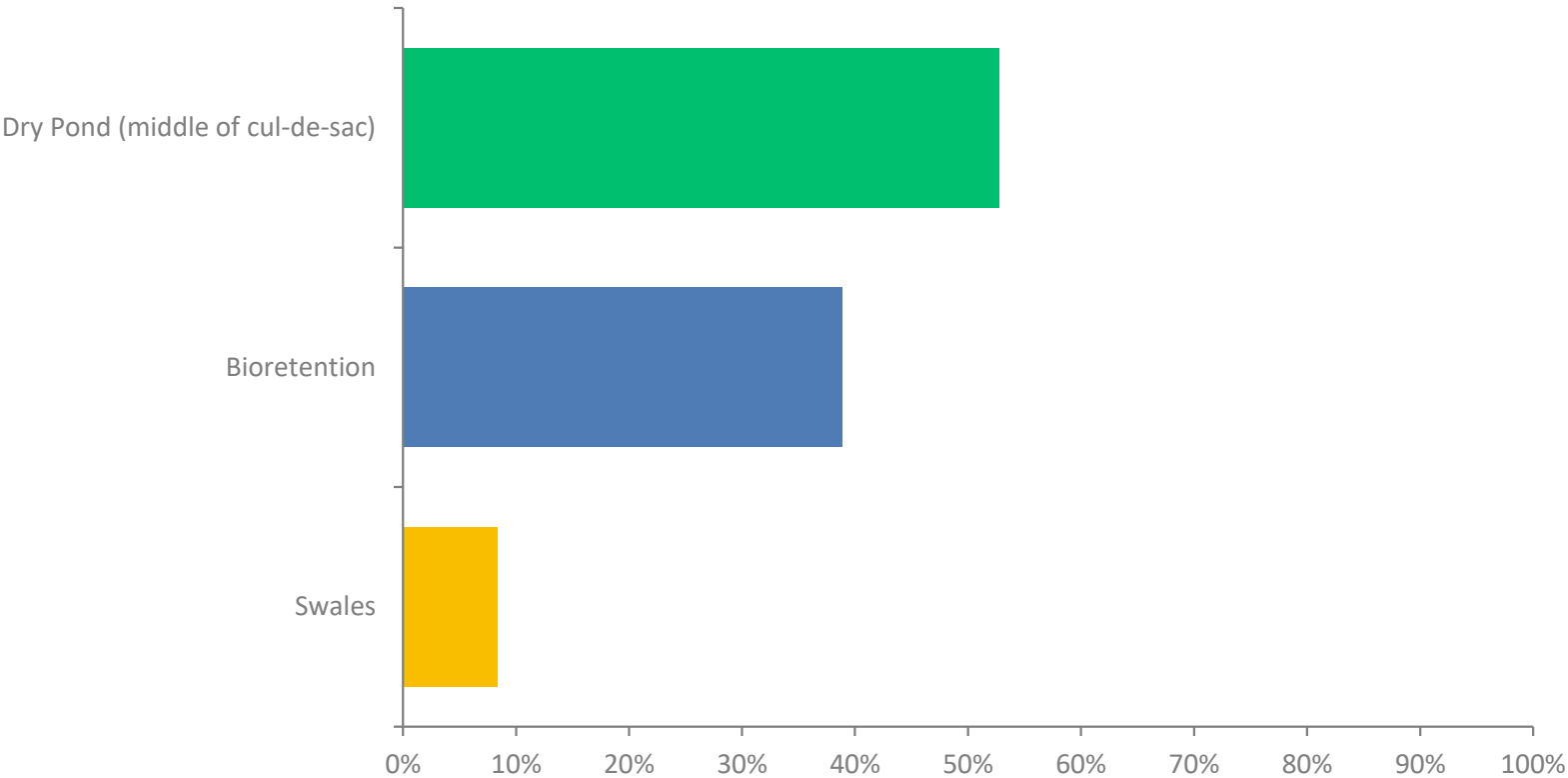
Answered: 36 Skipped: 60

ANSWER CHOICES	RESPONSES	
Yes	88.89%	32
No	11.11%	4
TOTAL		36

Caffey's Inlet

Q7: Please choose the improvement you prefer at Carrol Drive cul-de-sac:

Answered: 36 Skipped: 60



Caffey’s Inlet

Q7: Please choose the improvement you prefer at Carrol Drive cul-de-sac:

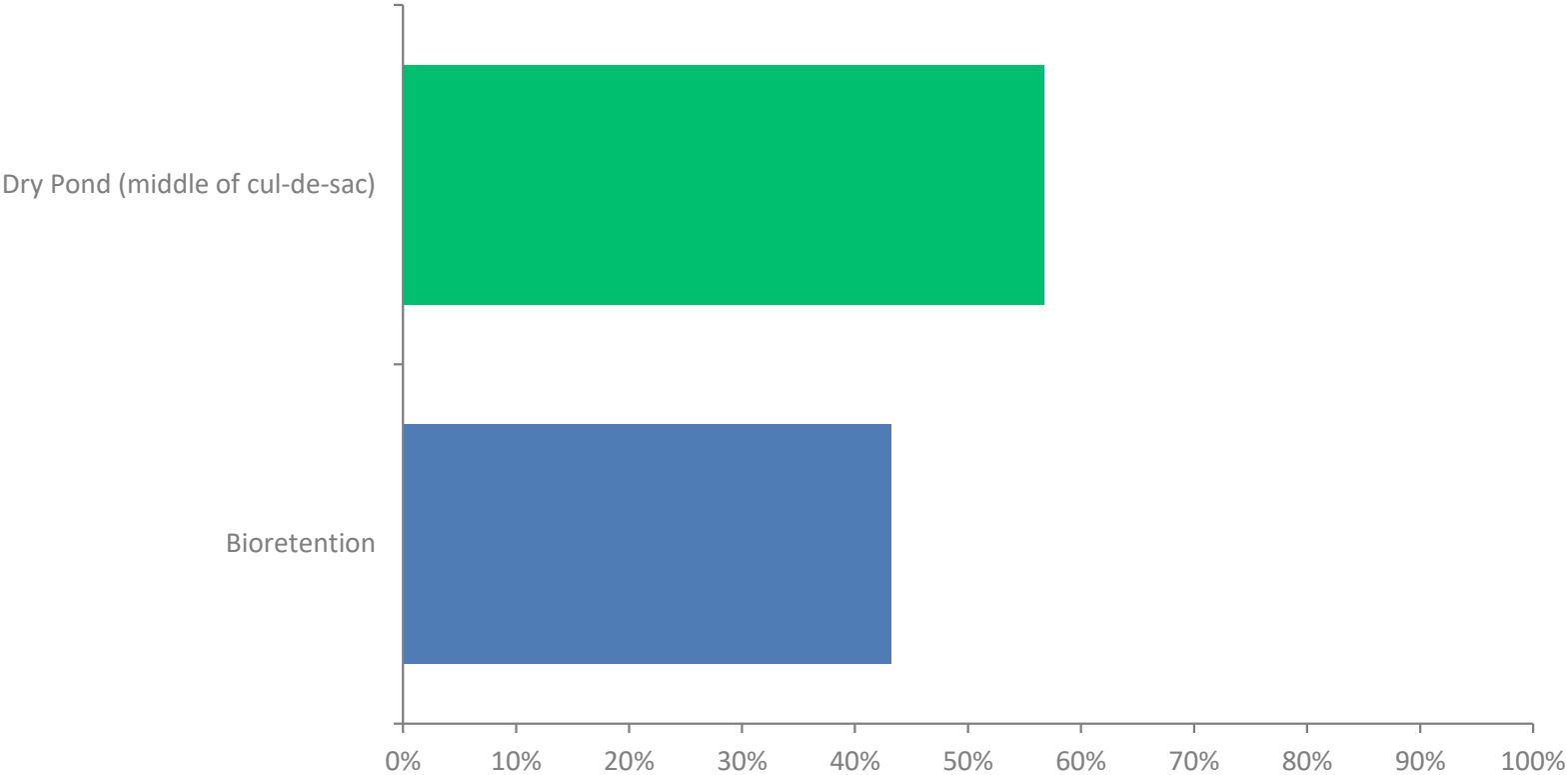
Answered: 36 Skipped: 60

ANSWER CHOICES	RESPONSES	
Dry Pond (middle of cul-de-sac)	52.78%	19
Bioretention	38.89%	14
Swales	8.33%	3
TOTAL		36

Caffey's Inlet

Q8: Please choose the improvement you prefer at Hillside Court cul-de-sac:

Answered: 37 Skipped: 59



Caffey's Inlet

Q8: Please choose the improvement you prefer at Hillside Court cul-de-sac:

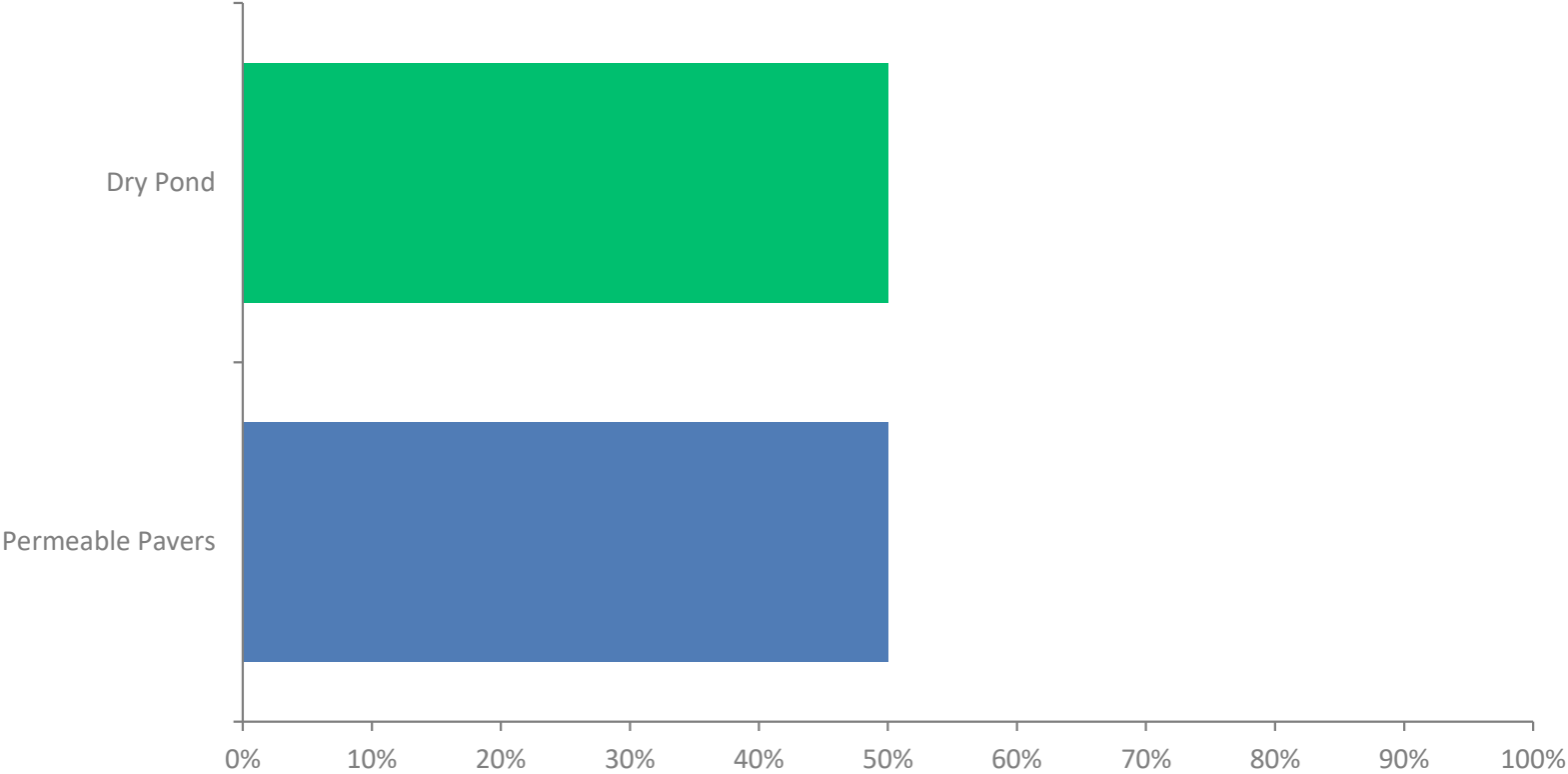
Answered: 37 Skipped: 59

ANSWER CHOICES	RESPONSES	
Dry Pond (middle of cul-de-sac)	56.76%	21
Bioretention	43.24%	16
TOTAL		37

Schooner Ridge

Q9: Please choose the improvement you prefer at 0 Schooner Ridge Drive:

Answered: 40 Skipped: 56



Schooner Ridge

Q9: Please choose the improvement you prefer at 0 Schooner Ridge Drive:

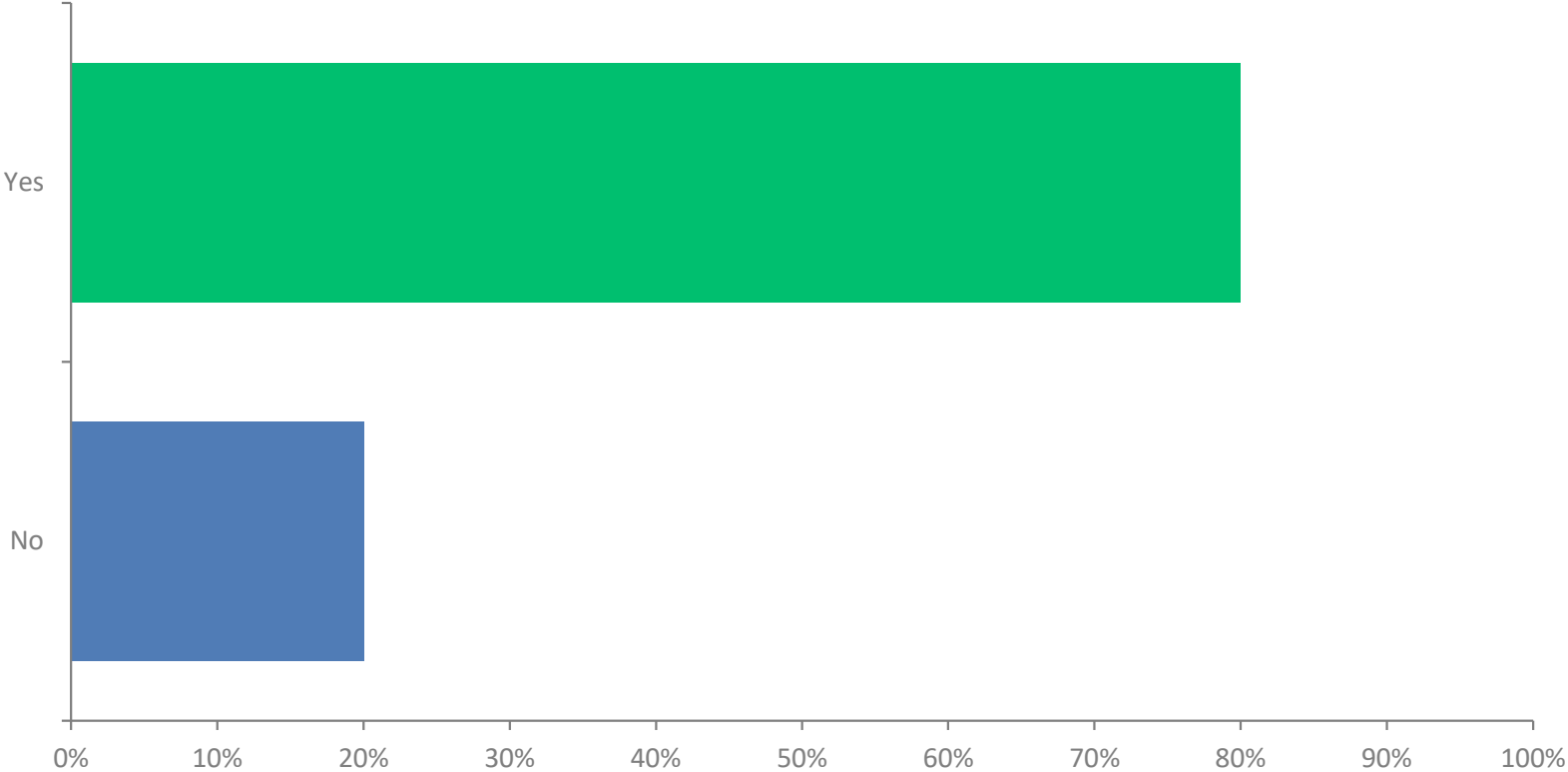
Answered: 40 Skipped: 56

ANSWER CHOICES	RESPONSES	
Dry Pond	50.0%	20
Permeable Pavers	50.0%	20
TOTAL		40

Schooner Ridge

Q10: Do you support a dry pond at 169 Schooner Ridge Drive?

Answered: 40 Skipped: 56



Schooner Ridge

Q10: Do you support a dry pond at 169 Schooner Ridge Drive?

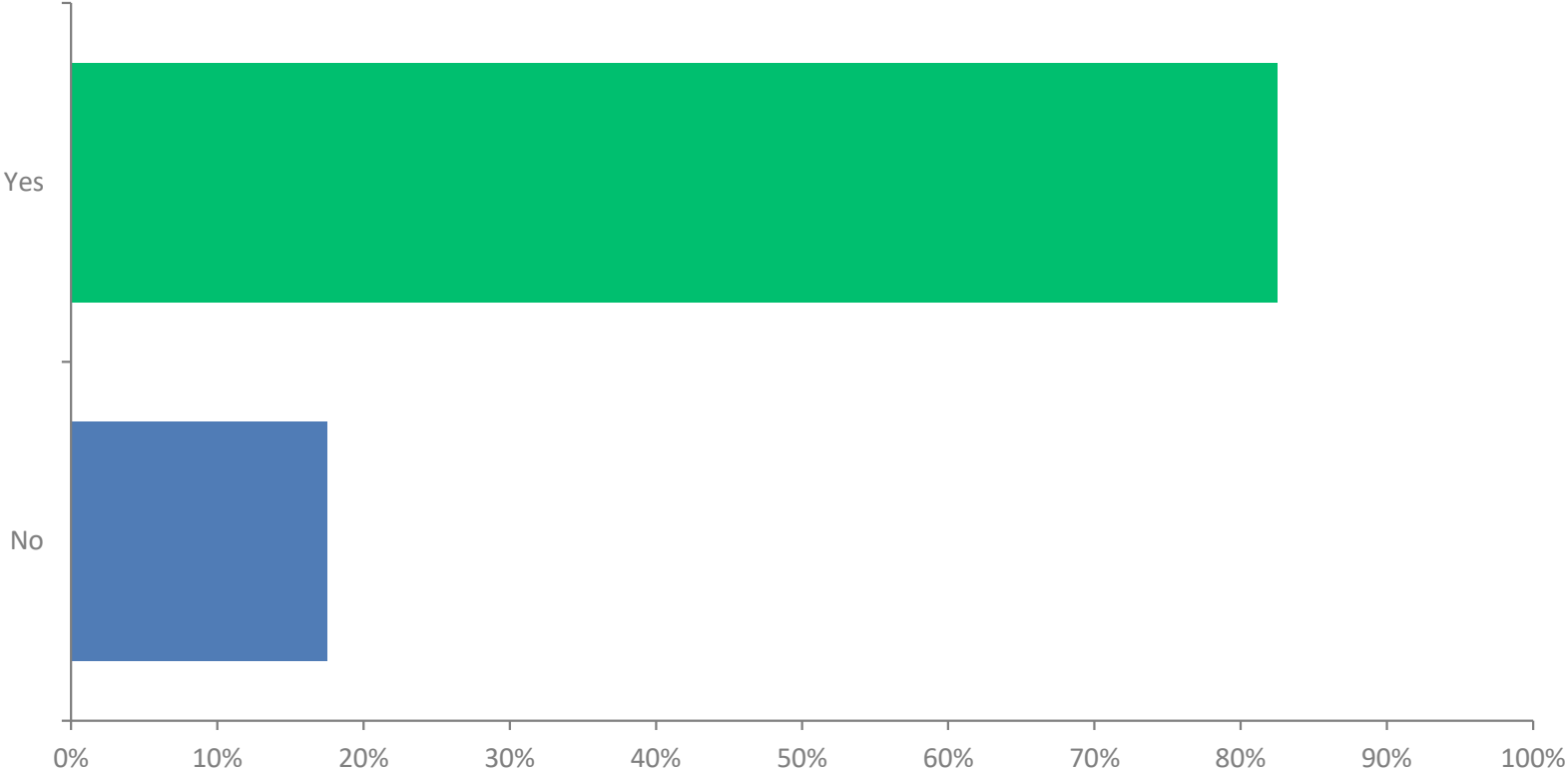
Answered: 40 Skipped: 56

ANSWER CHOICES	RESPONSES	
Yes	80.0%	32
No	20.0%	8
TOTAL		40

Schooner Ridge

Q11: Do you support a swale along Schooner Ridge Drive?

Answered: 40 Skipped: 56



Schooner Ridge

Q11: Do you support a swale along Schooner Ridge Drive?

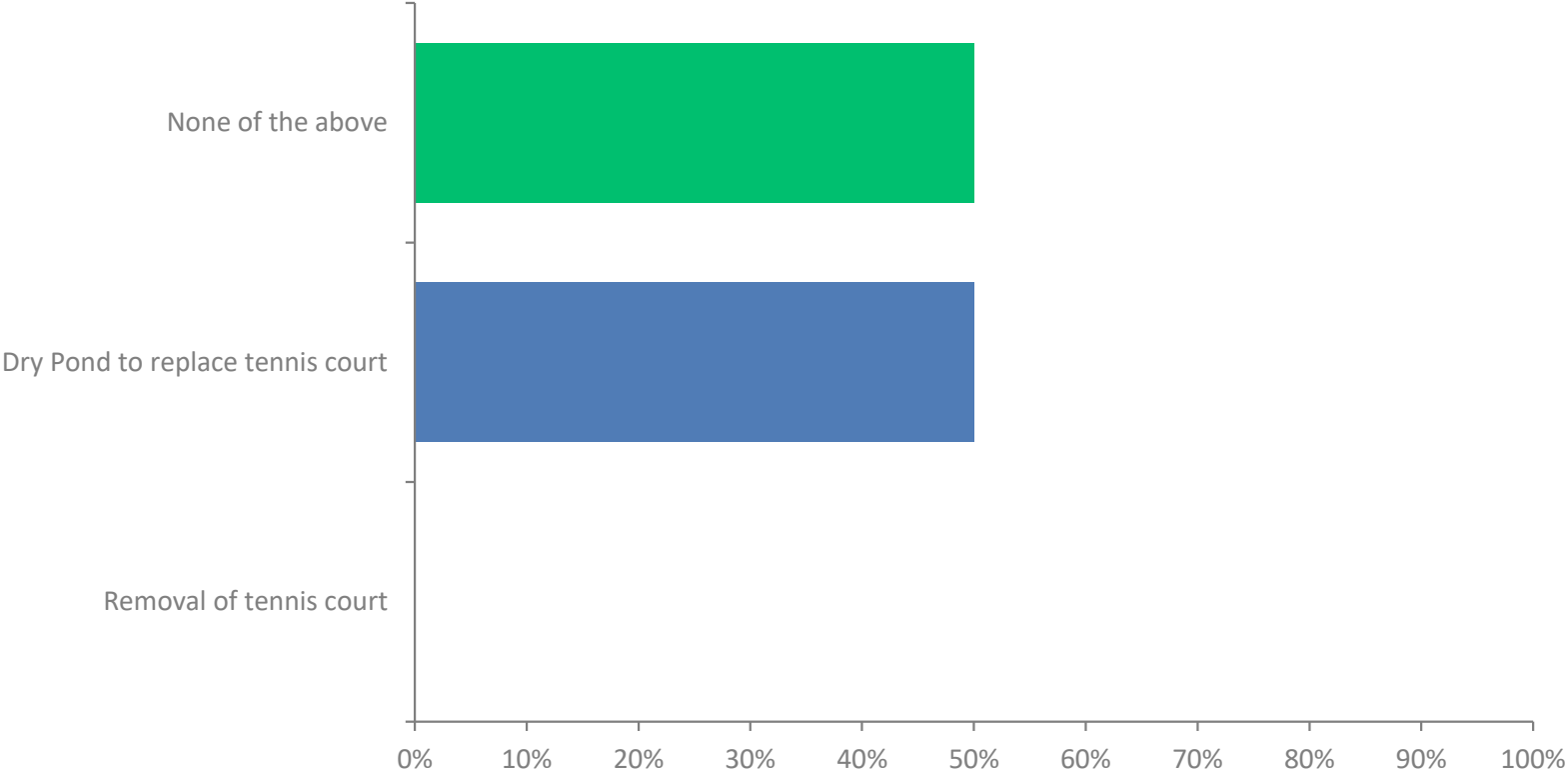
Answered: 40 Skipped: 56

ANSWER CHOICES	RESPONSES	
Yes	82.50%	33
No	17.50%	7
TOTAL		40

Duck Landing

Q12: Please choose the improvement you prefer at Duck Landing Lane:

Answered: 30 Skipped: 66



Duck Landing

Q12: Please choose the improvement you prefer at Duck Landing Lane:

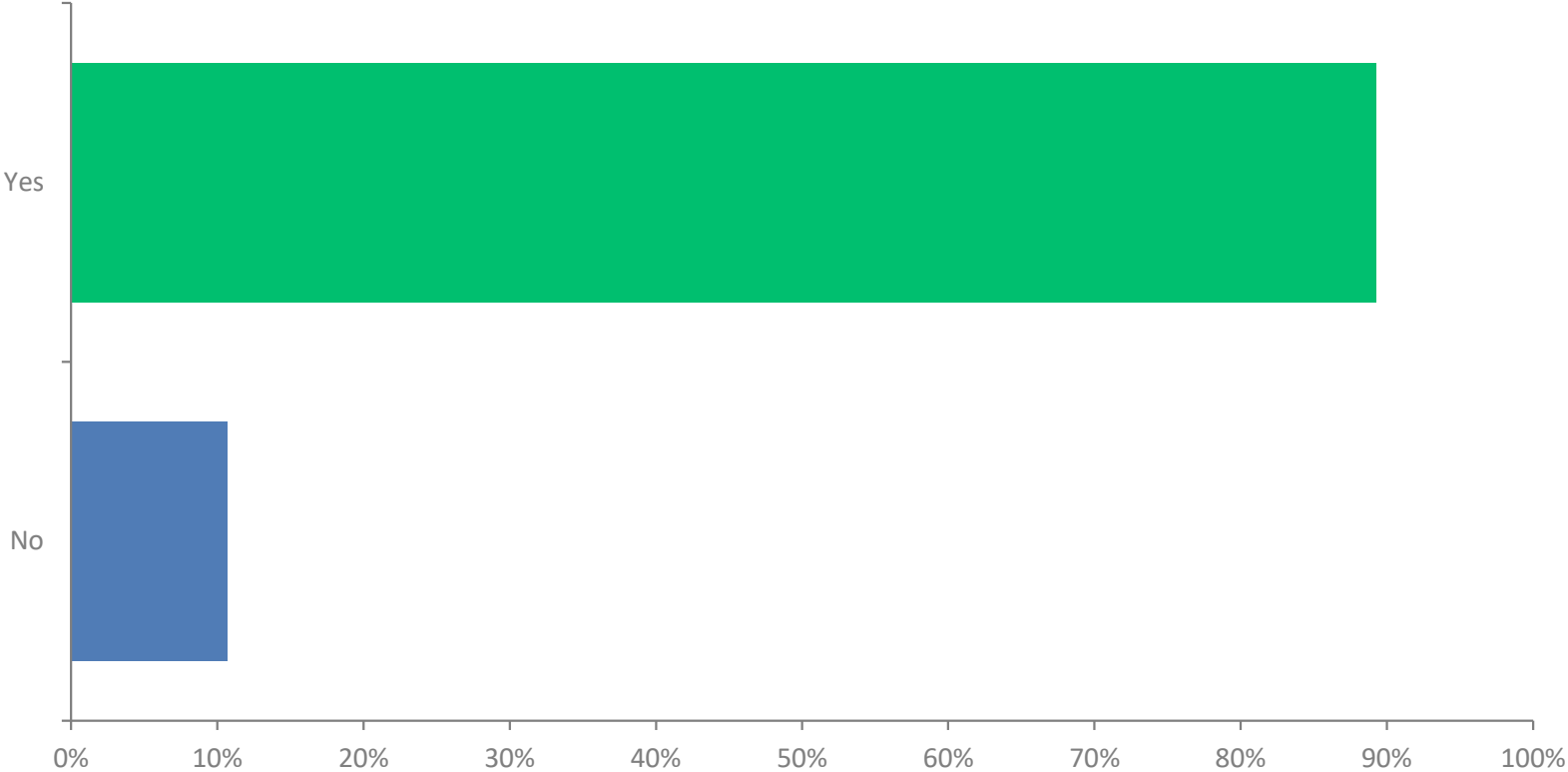
Answered: 30 Skipped: 66

ANSWER CHOICES	RESPONSES	
None of the above	50.0%	15
Dry Pond to replace tennis court	50.0%	15
Removal of tennis court	0%	0
TOTAL		30

Duck Landing

Q13: Do you support a swale on Duck Landing Lane?

Answered: 28 Skipped: 68



Duck Landing

Q13: Do you support a swale on Duck Landing Lane?

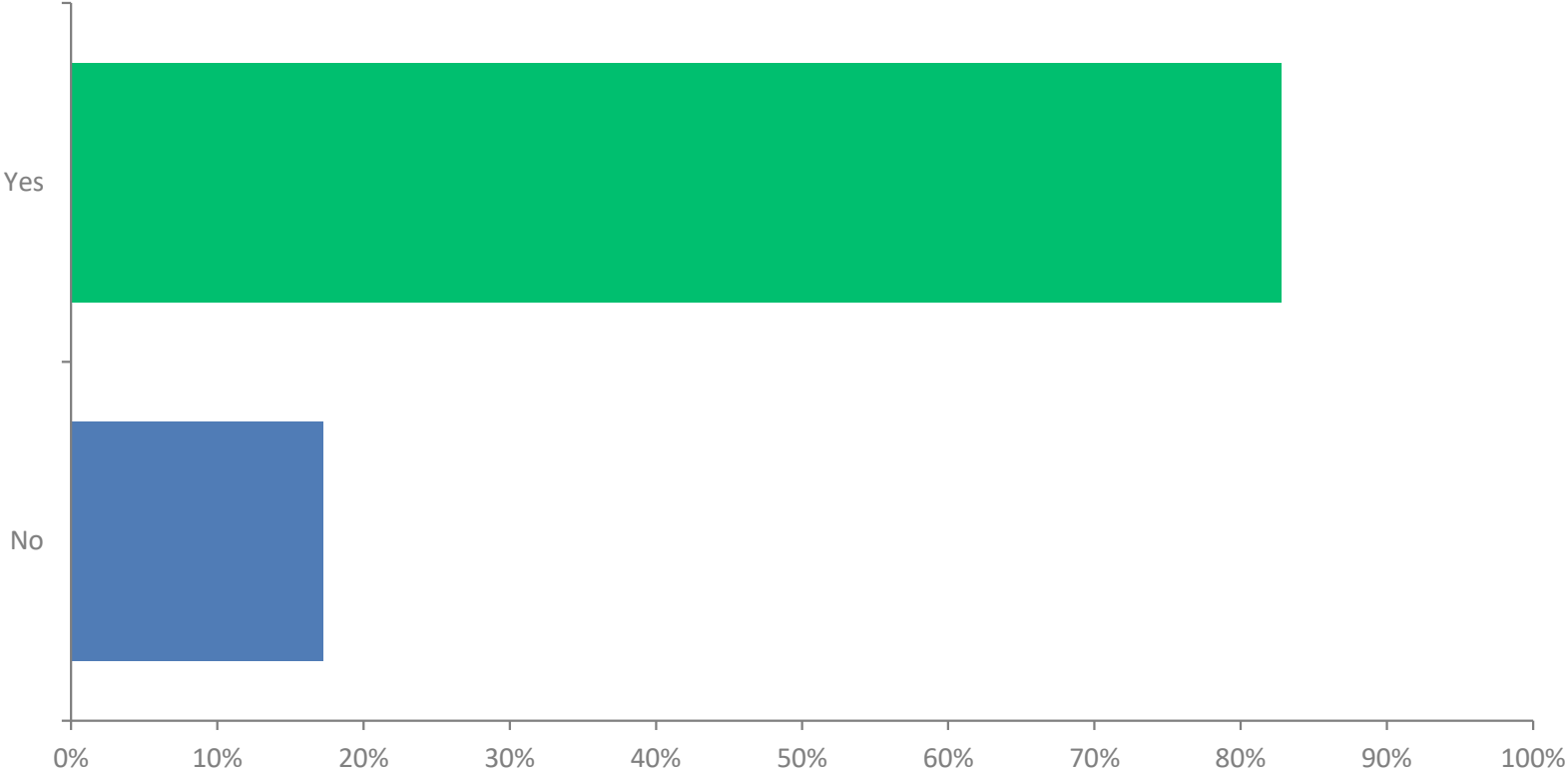
Answered: 28 Skipped: 68

ANSWER CHOICES	RESPONSES	
Yes	89.29%	25
No	10.71%	3
TOTAL		28

Duck Landing

Q14: Do you support making Duck Landing Lane parking permeable pavers instead?

Answered: 29 Skipped: 67



Duck Landing

Q14: Do you support making Duck Landing Lane parking permeable pavers instead?

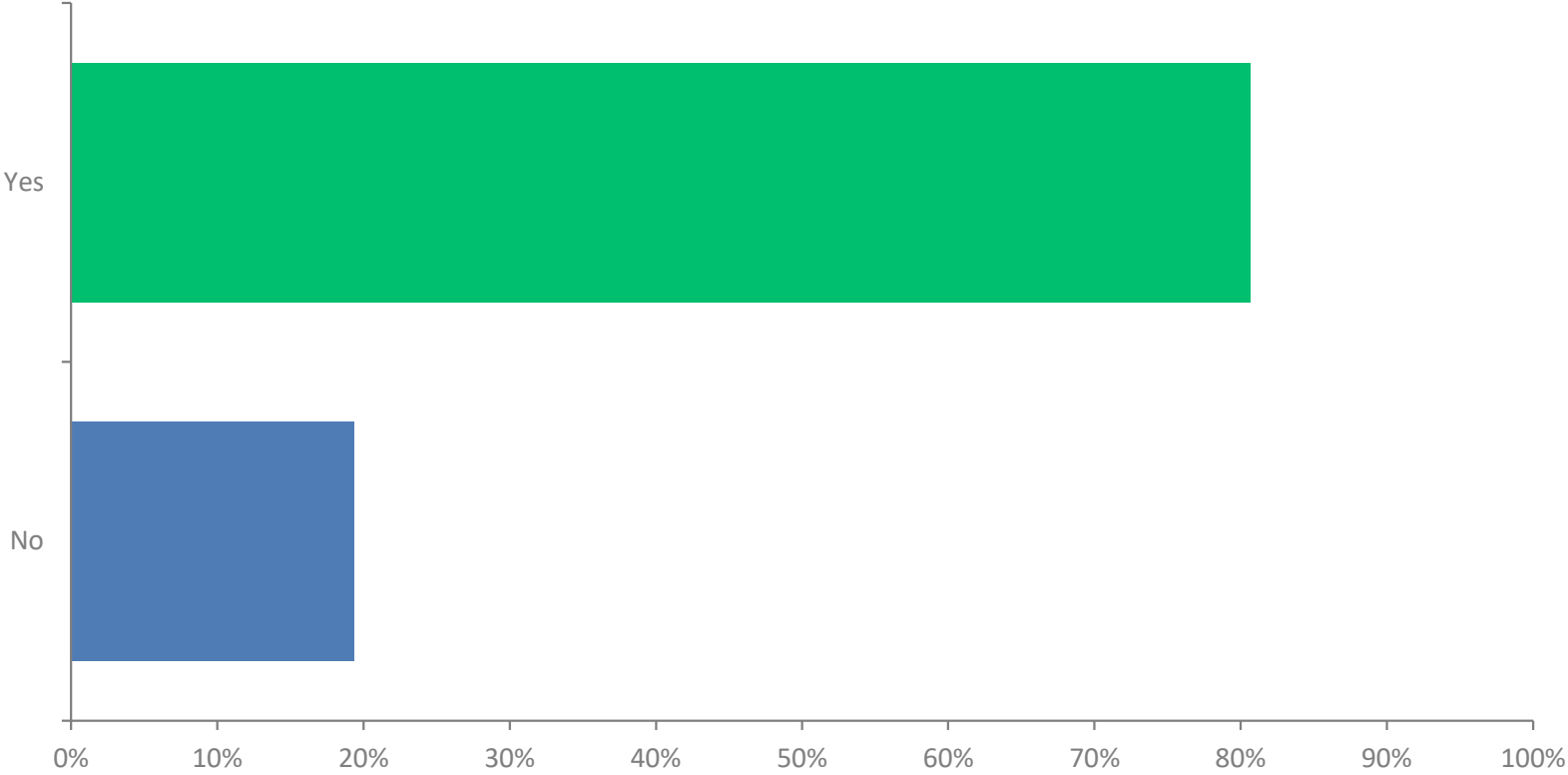
Answered: 29 Skipped: 67

ANSWER CHOICES	RESPONSES	
Yes	82.76%	24
No	17.24%	5
TOTAL		29

Ocean Dunes

Q15: Do you support adding bioretention, permeable pavers, and a swale at the Teresa Court cul-de-sac?

Answered: 31 Skipped: 65



Ocean Dunes

Q15: Do you support adding bioretention, permeable pavers, and a swale at the Teresa Court cul-de-sac?

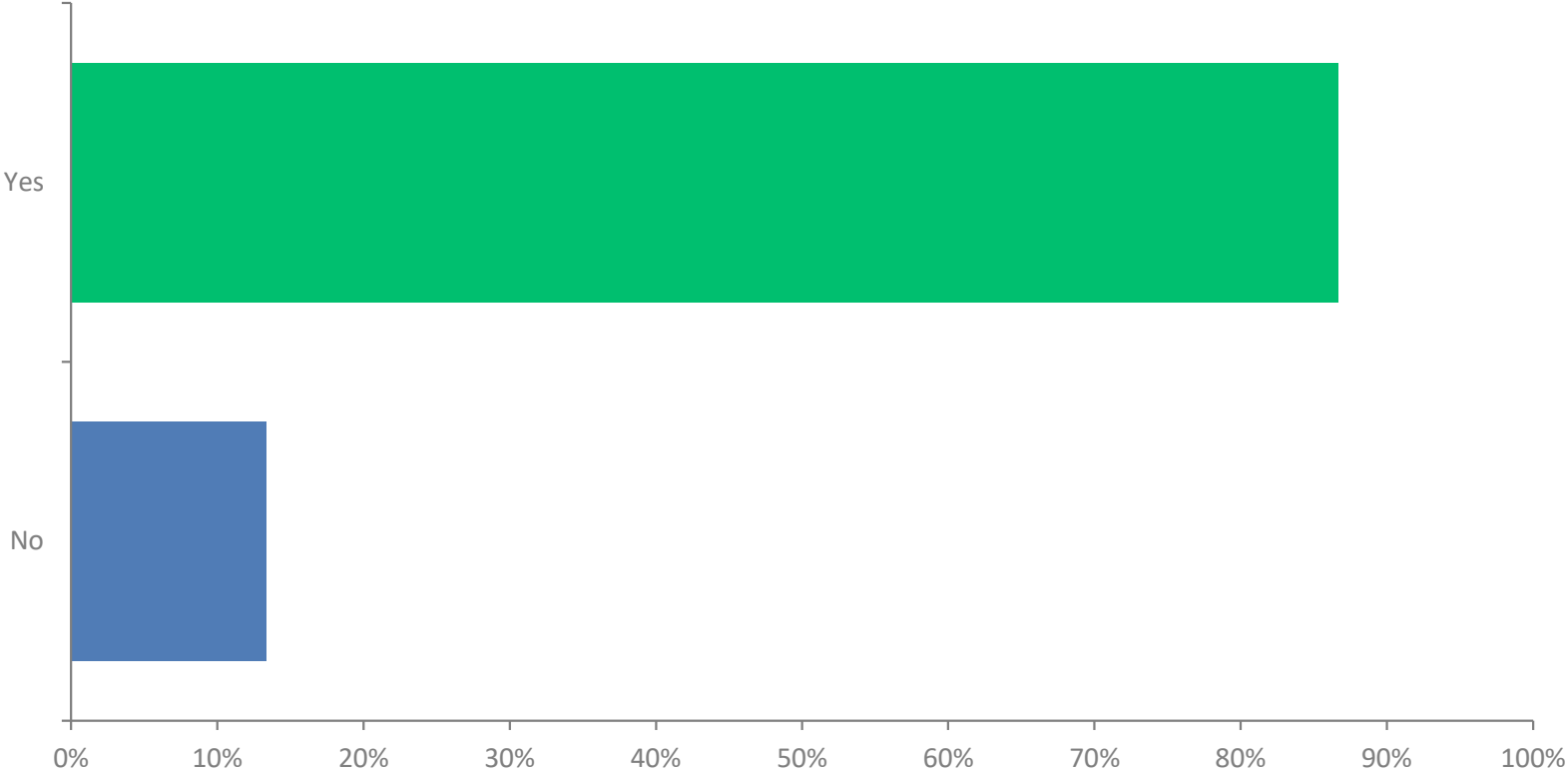
Answered: 31 Skipped: 65

ANSWER CHOICES	RESPONSES	
Yes	80.65%	25
No	19.35%	6
TOTAL		31

Ocean Dunes

Q16: Do you support bioretention at each cul-de-sac on Scarborough Lane?

Answered: 30 Skipped: 66



Ocean Dunes

Q16: Do you support bioretention at each cul-de-sac on Scarborough Lane?

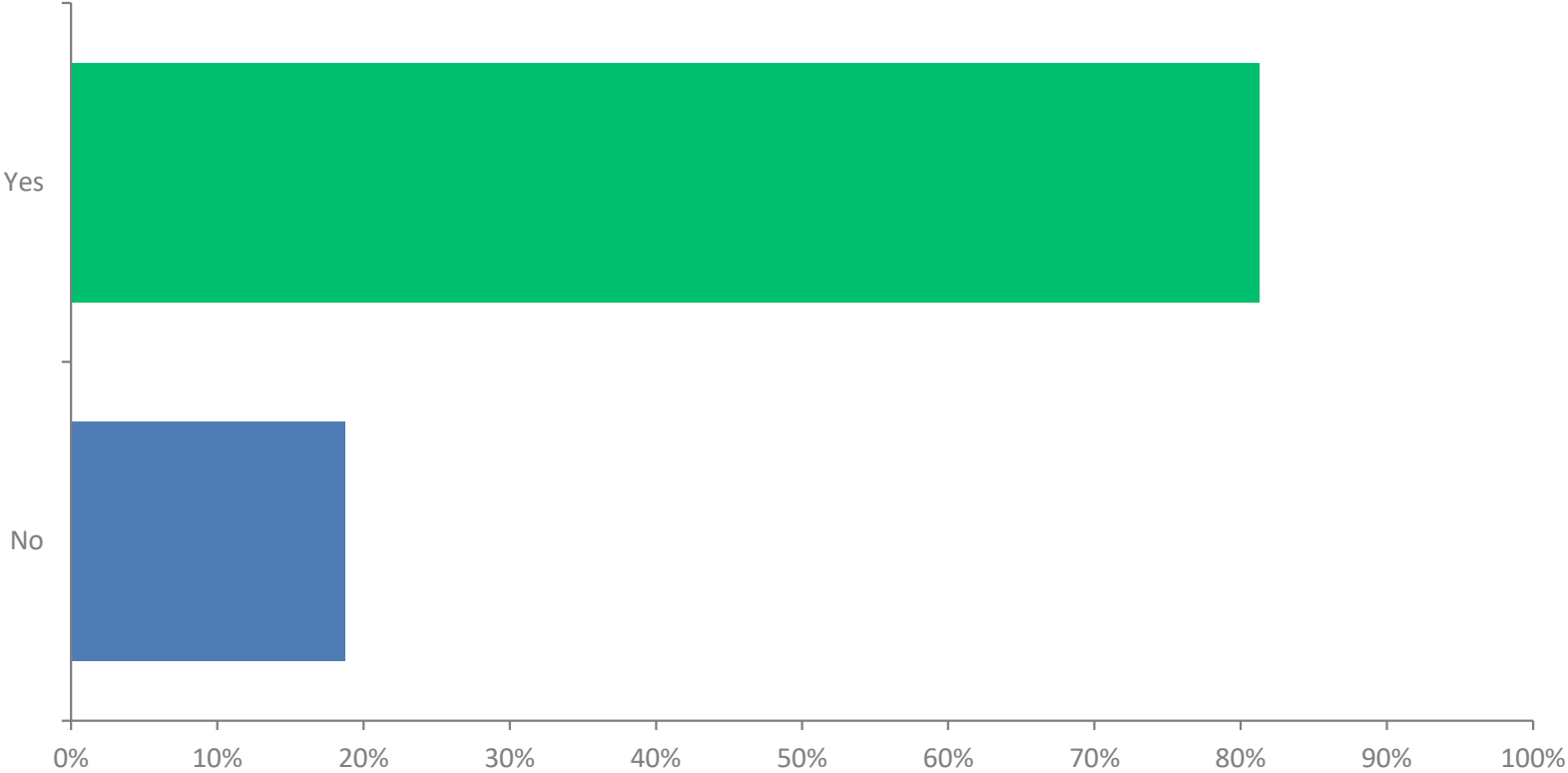
Answered: 30 Skipped: 66

ANSWER CHOICES	RESPONSES	
Yes	86.67%	26
No	13.33%	4
TOTAL		30

Ocean Dunes

Q17: Do you support making Scarborough Lane parking permeable pavers instead?

Answered: 32 Skipped: 64



Ocean Dunes

Q17: Do you support making Scarborough Lane parking permeable pavers instead?

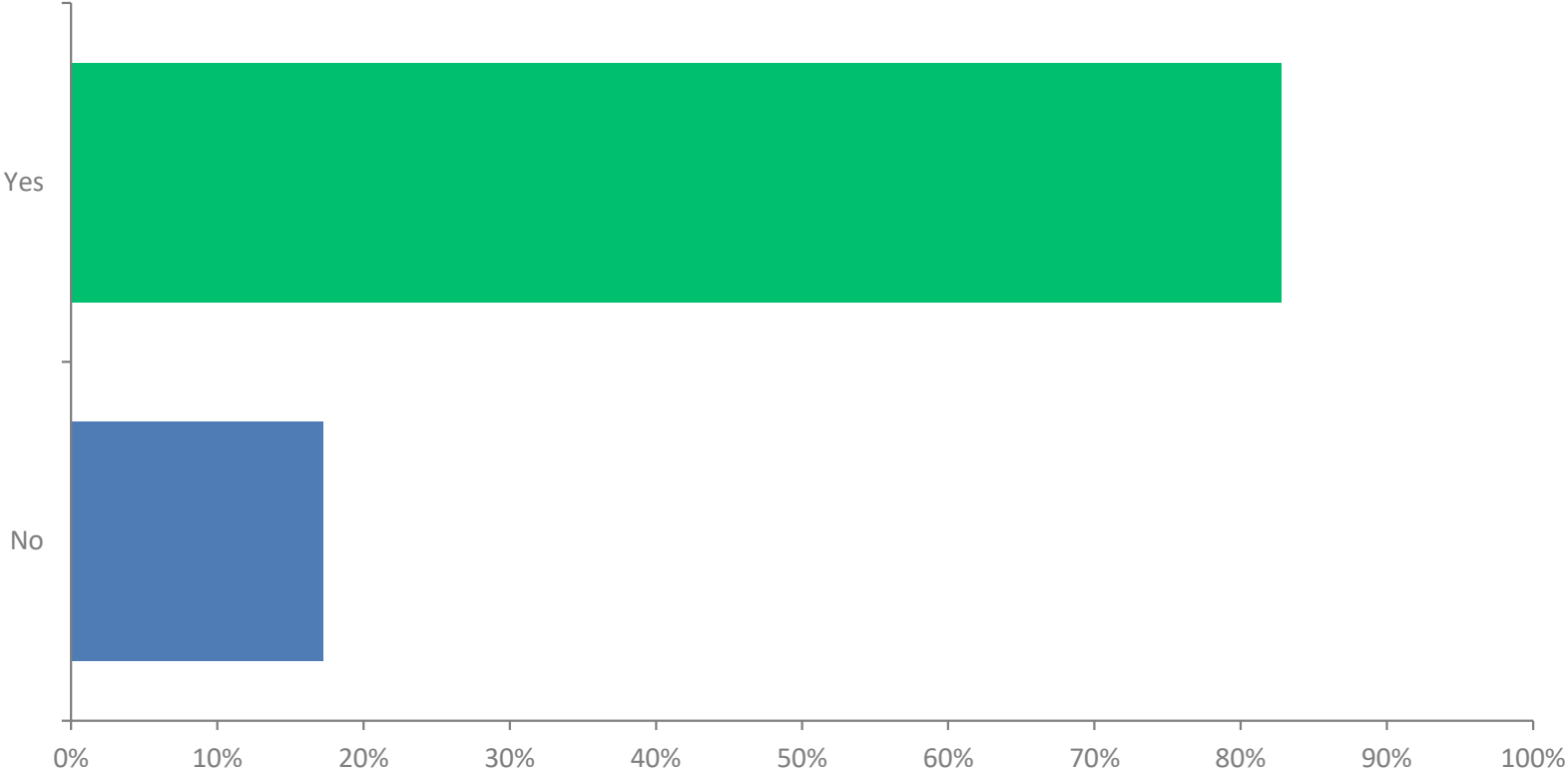
Answered: 32 Skipped: 64

ANSWER CHOICES	RESPONSES	
Yes	81.25%	26
No	18.75%	6
TOTAL		32

Four Seasons

Q18: Do you support swales on Duck Hunt Club Lane?

Answered: 29 Skipped: 67



Four Seasons

Q18: Do you support swales on Duck Hunt Club Lane?

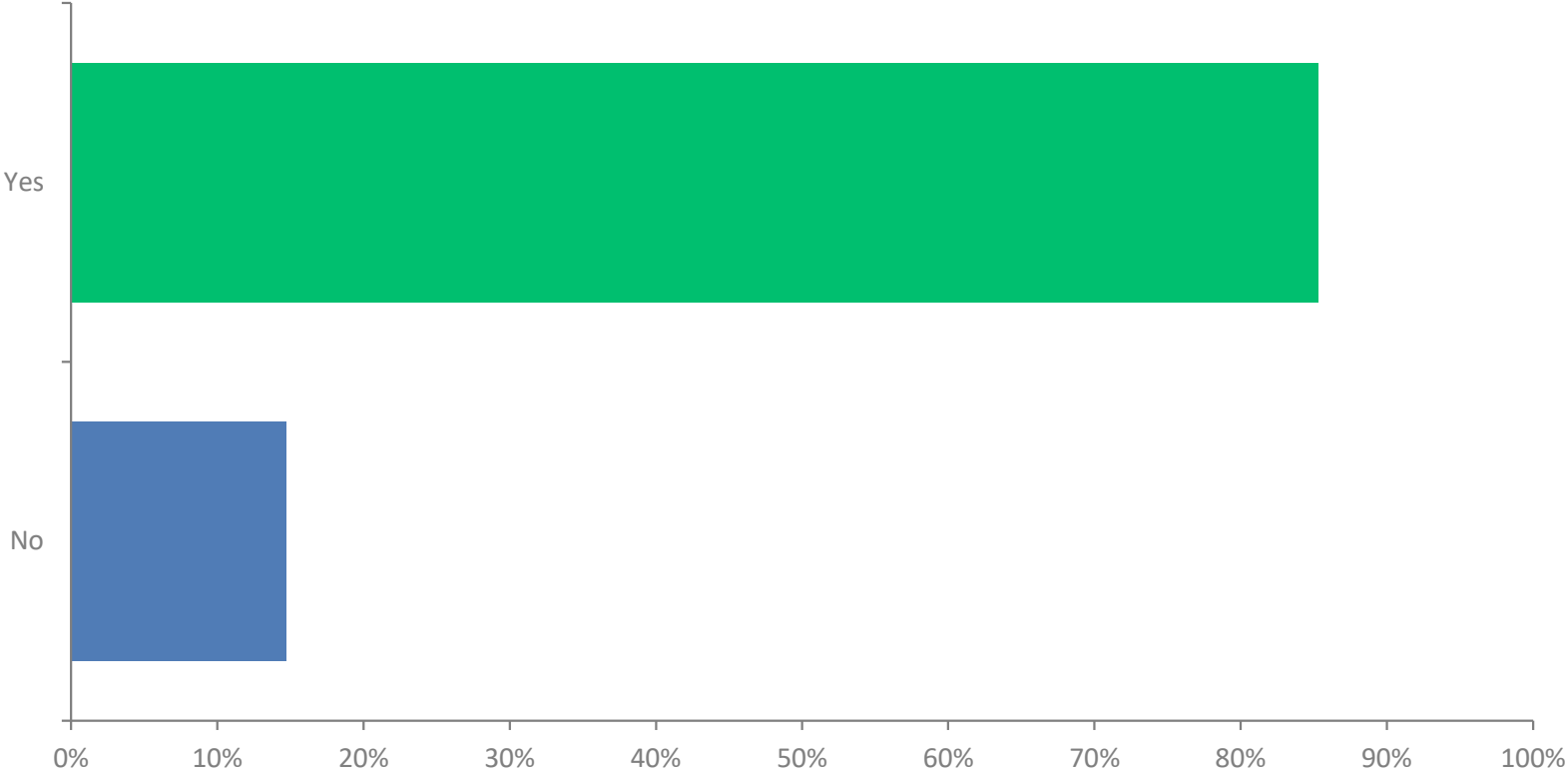
Answered: 29 Skipped: 67

ANSWER CHOICES	RESPONSES	
Yes	82.76%	24
No	17.24%	5
TOTAL		29

Duck Blind Villas

Q19: Do you support permeable pavers on Plover Drive?

Answered: 34 Skipped: 62



Duck Blind Villas

Q19: Do you support permeable pavers on Plover Drive?

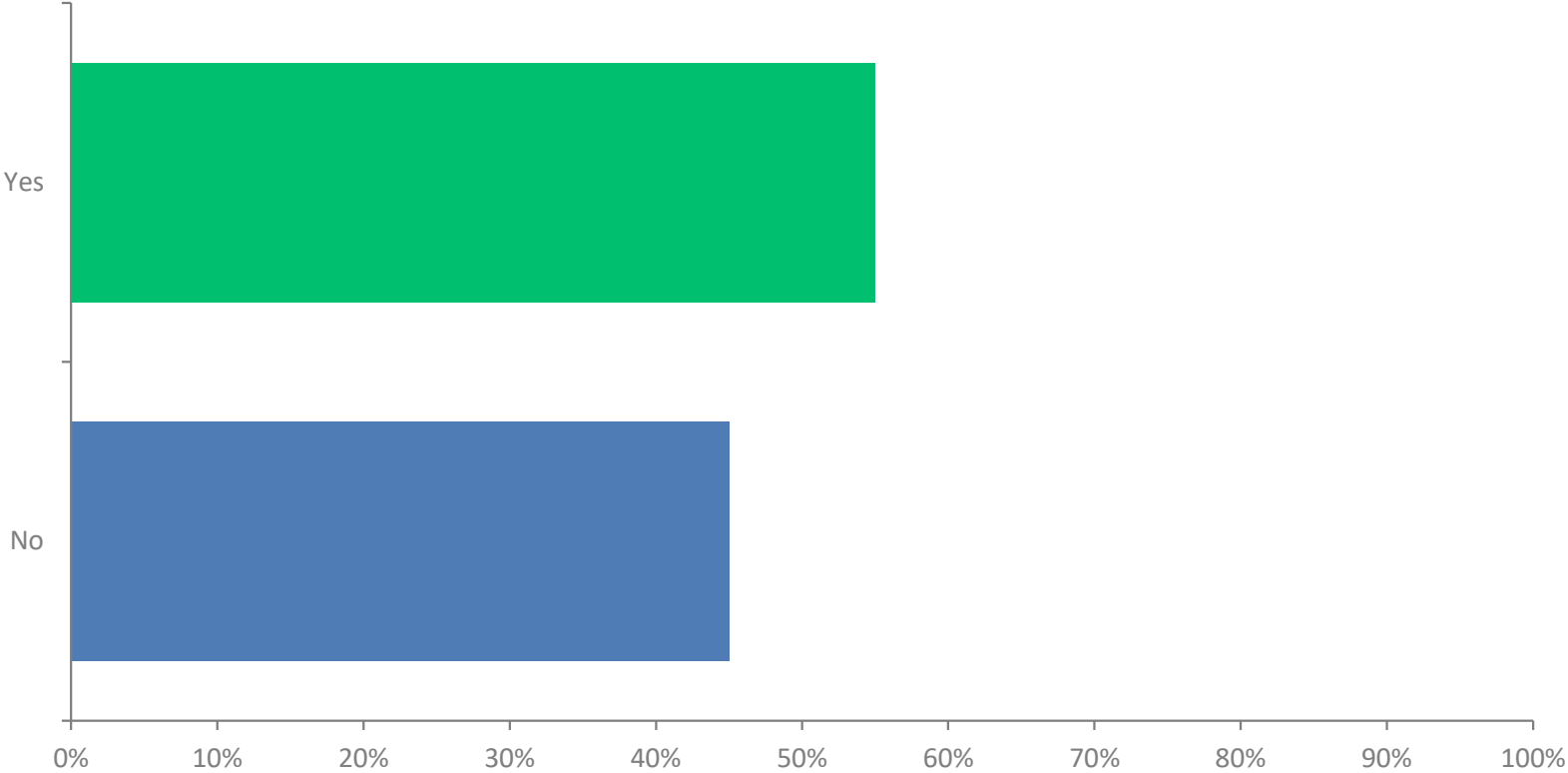
Answered: 34 Skipped: 62

ANSWER CHOICES	RESPONSES	
Yes	85.29%	29
No	14.71%	5
TOTAL		34

Georgetown Sands

Q20: Do you support replacing the tennis court at Georgetown Sands with a dry pond?

Answered: 40 Skipped: 56



Georgetown Sands

Q20: Do you support replacing the tennis court at Georgetown Sands with a dry pond?

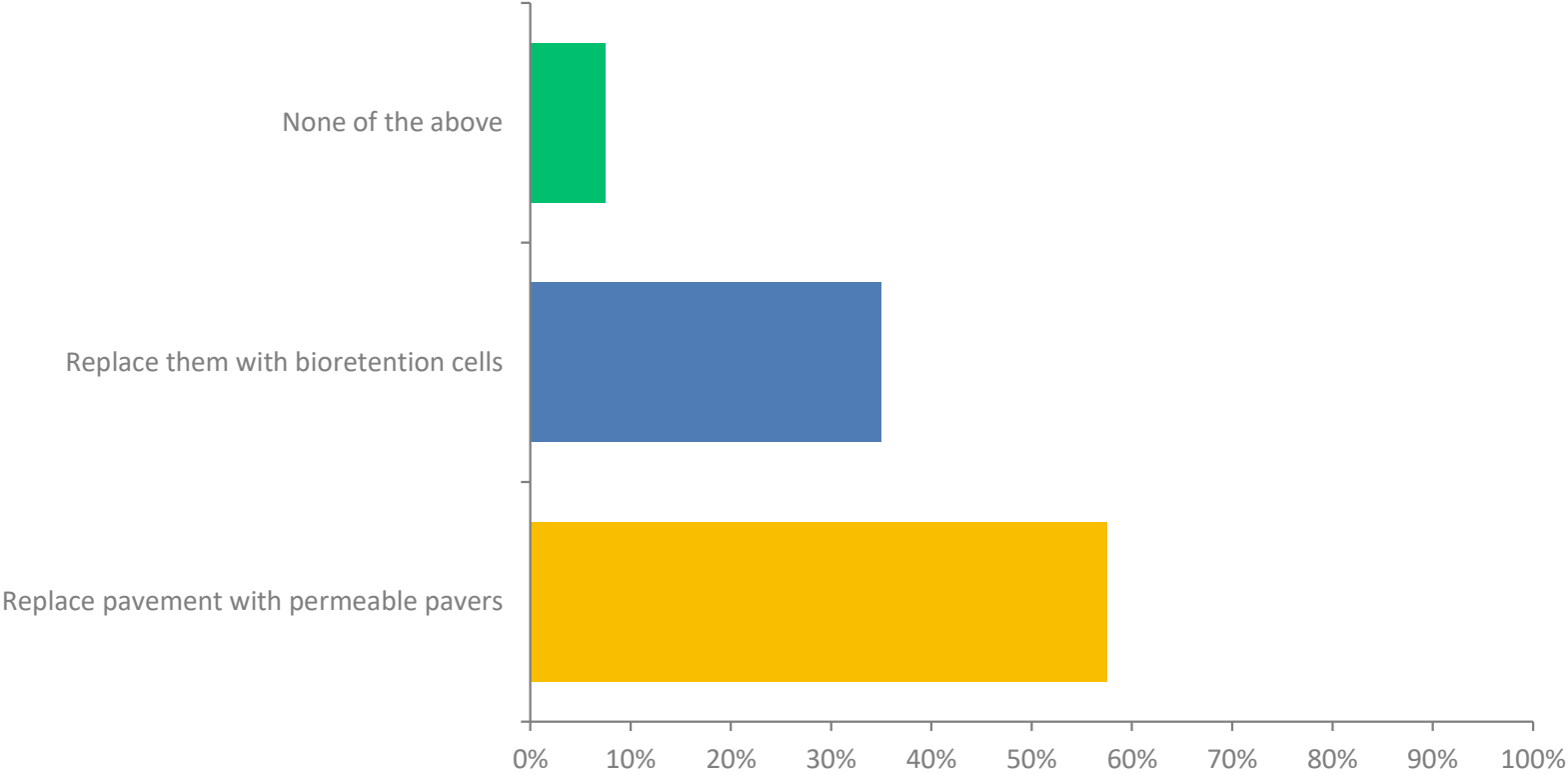
Answered: 40 Skipped: 56

ANSWER CHOICES	RESPONSES	
Yes	55.00%	22
No	45.00%	18
TOTAL		40

Georgetown Sands

Q21: Please choose the improvement you prefer at the parking spaces that are adjacent to Georgetown Sands Road:

Answered: 40 Skipped: 56



Georgetown Sands

Q21: Please choose the improvement you prefer at the parking spaces that are adjacent to Georgetown Sands Road:

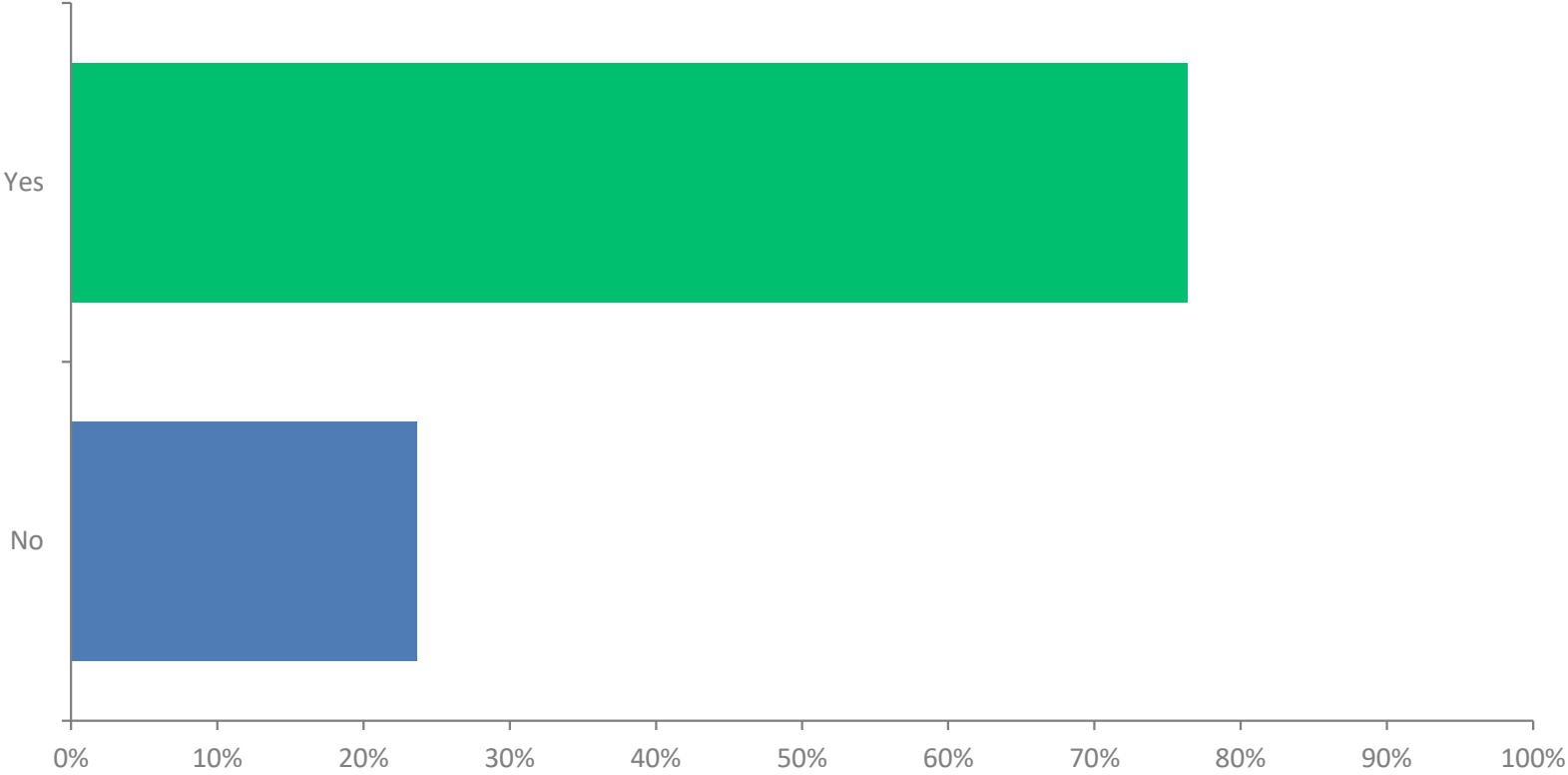
Answered: 40 Skipped: 56

ANSWER CHOICES	RESPONSES	
None of the above	7.50%	3
Replace them with bioretention cells	35.00%	14
Replace pavement with permeable pavers	57.50%	23
TOTAL		40

Sand Dollar Shores

Q22: Do you support a swale along Sea Breeze Drive?

Answered: 38 Skipped: 58



Sand Dollar Shores

Q22: Do you support a swale along Sea Breeze Drive?

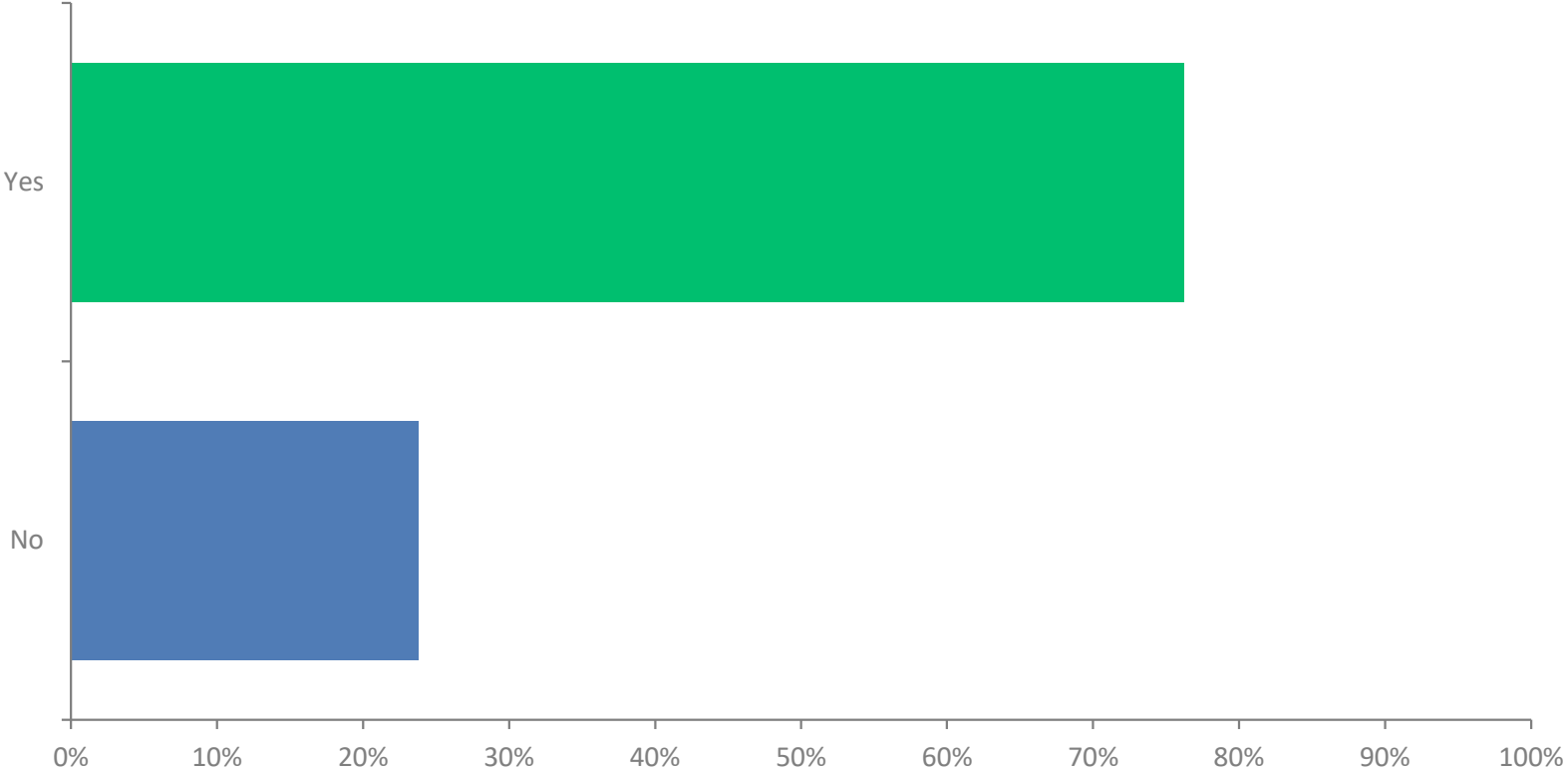
Answered: 38 Skipped: 58

ANSWER CHOICES	RESPONSES	
Yes	76.32%	29
No	23.68%	9
TOTAL		38

Sea Hawk

Q23: Do you support a swale along Seahawk Drive?

Answered: 42 Skipped: 54



Sea Hawk

Q23: Do you support a swale along Seahawk Drive?

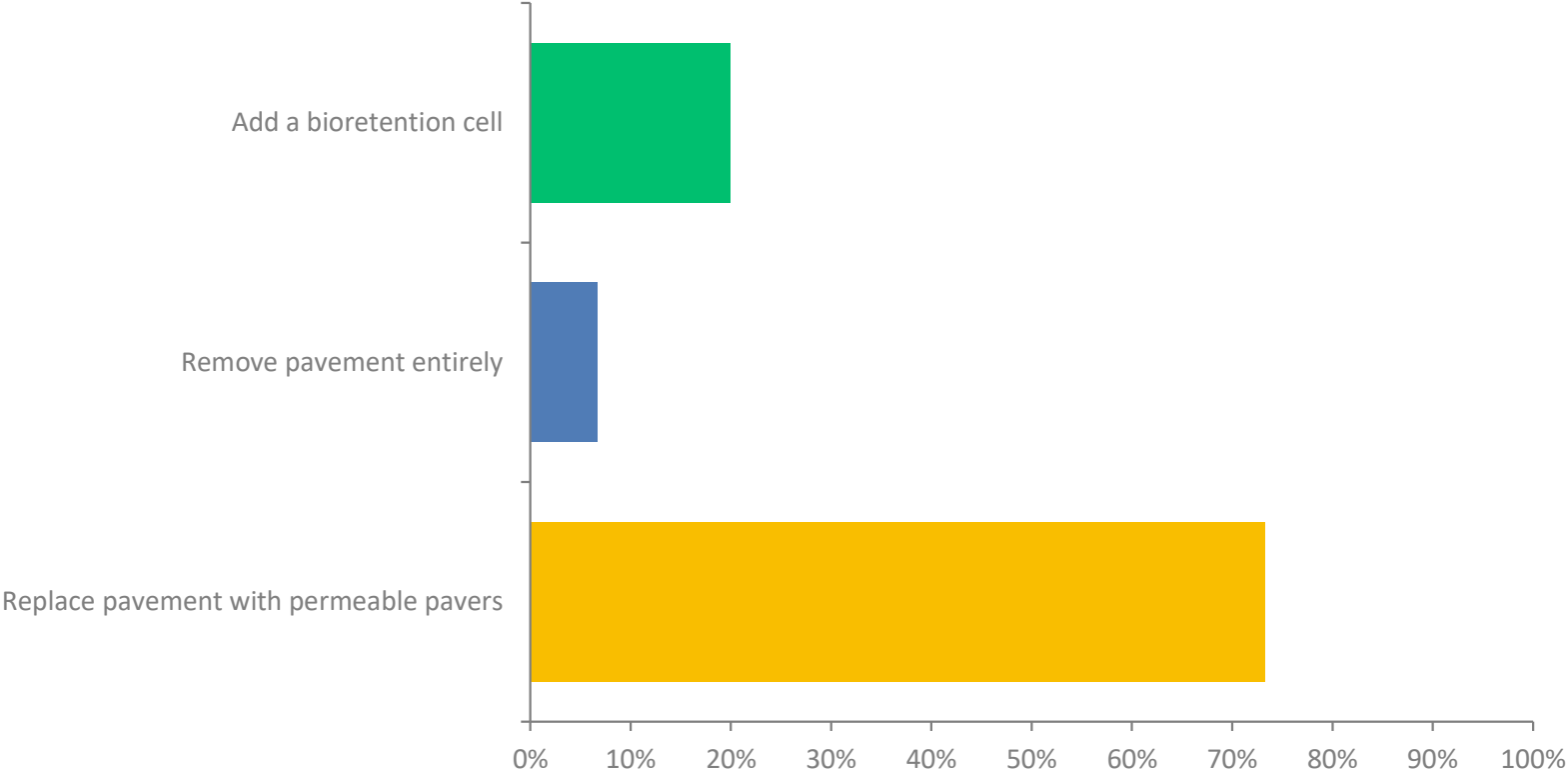
Answered: 42 Skipped: 54

ANSWER CHOICES	RESPONSES	
Yes	76.19%	32
No	23.81%	10
TOTAL		42

The Tides

Q24: Please choose the improvement you prefer at the cul-de-sac area on Tides Drive:

Answered: 30 Skipped: 66



The Tides

Q24: Please choose the improvement you prefer at the cul-de-sac area on Tides Drive:

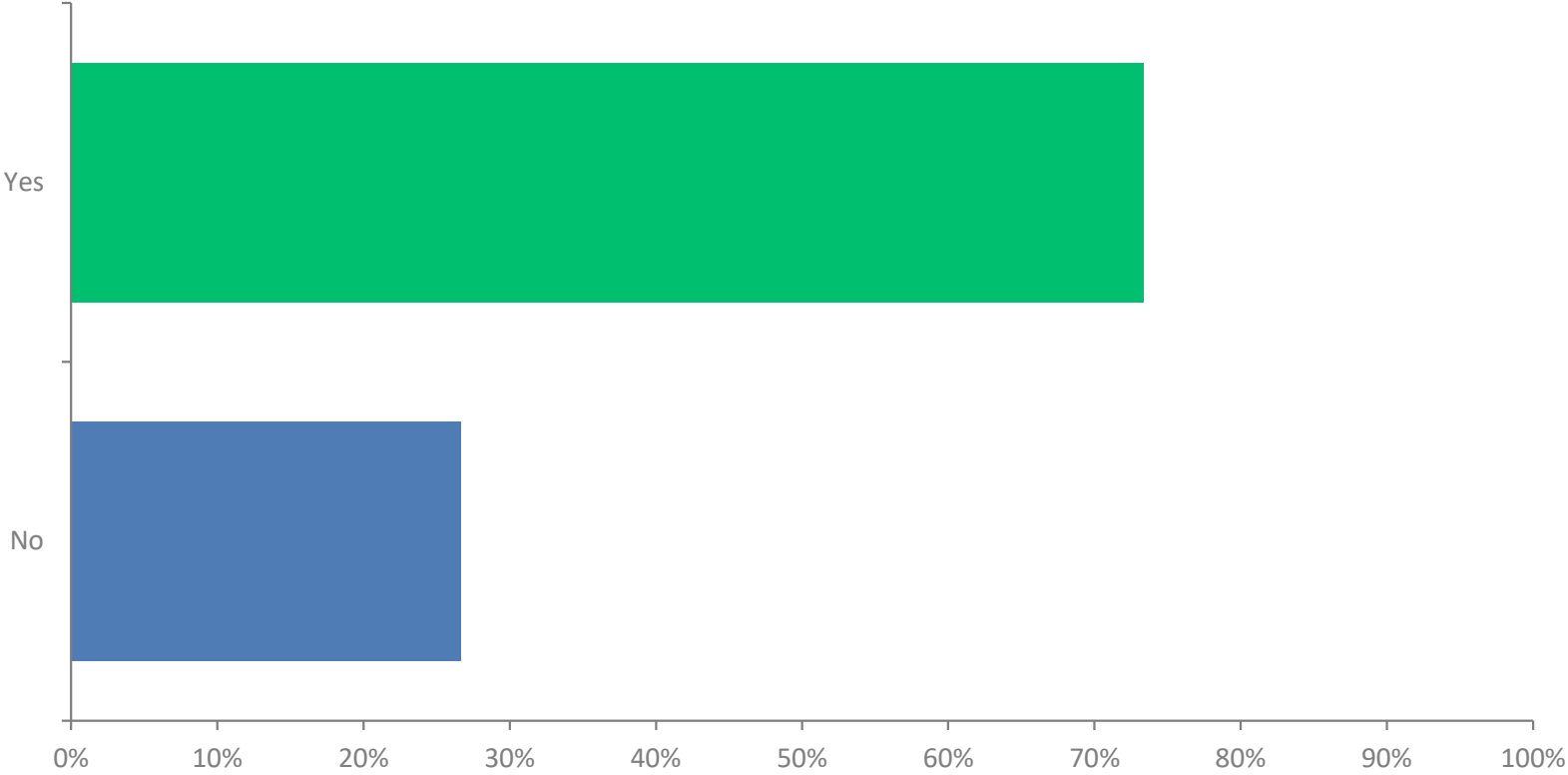
Answered: 30 Skipped: 66

ANSWER CHOICES	RESPONSES	
Add a bioretention cell	20.0%	6
Remove pavement entirely	6.67%	2
Replace pavement with permeable pavers	73.33%	22
TOTAL		30

Bias Shores

Q25: Do you support a swale along Bias Lane?

Answered: 30 Skipped: 66



Bias Shores

Q25: Do you support a swale along Bias Lane?

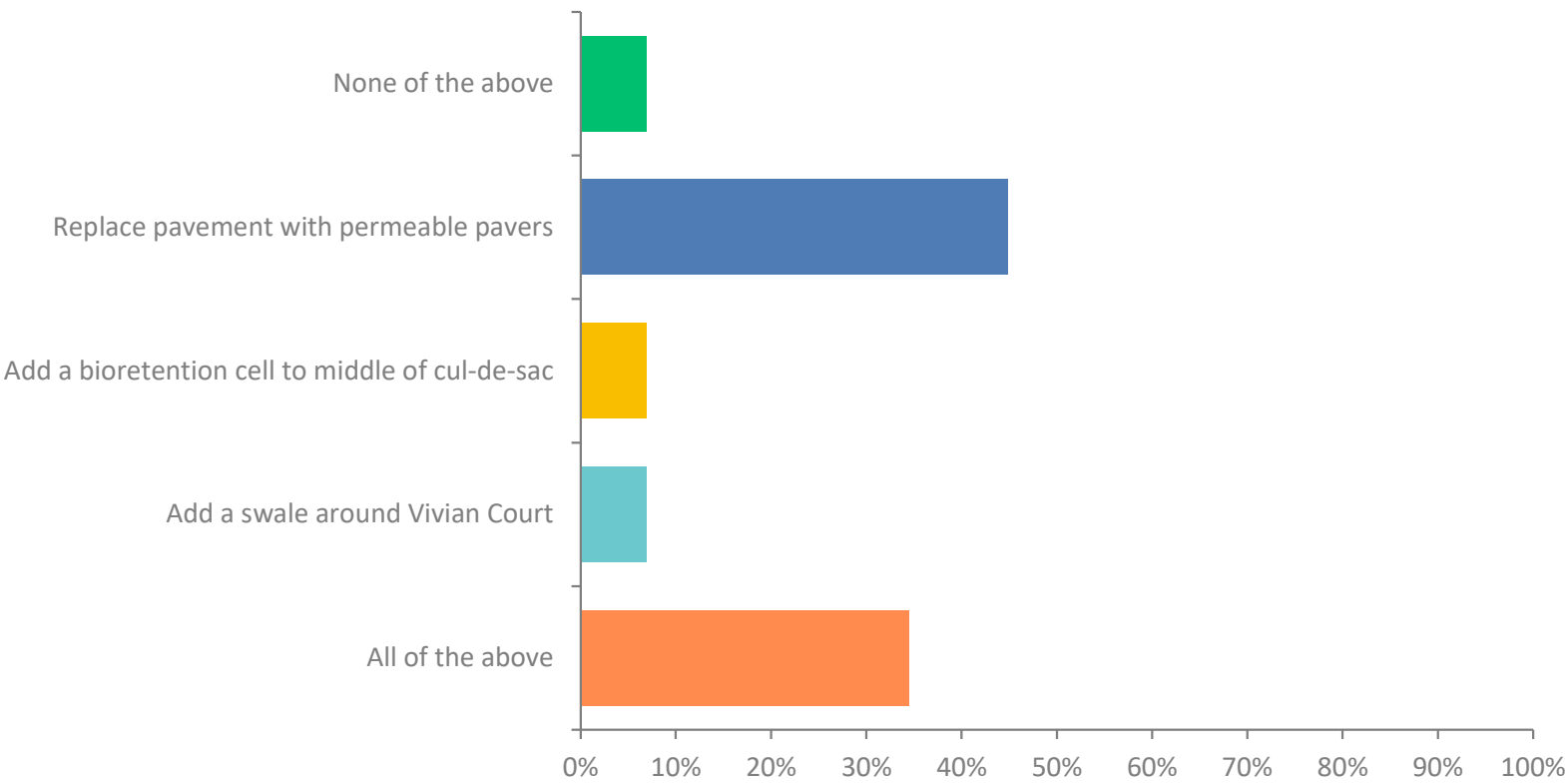
Answered: 30 Skipped: 66

ANSWER CHOICES	RESPONSES	
Yes	73.33%	22
No	26.67%	8
TOTAL		30

Ocean Crest

Q26: Please choose the improvement you prefer at the Vivian Court cul-de-sac:

Answered: 29 Skipped: 67



Ocean Crest

Q26: Please choose the improvement you prefer at the Vivian Court cul-de-sac:

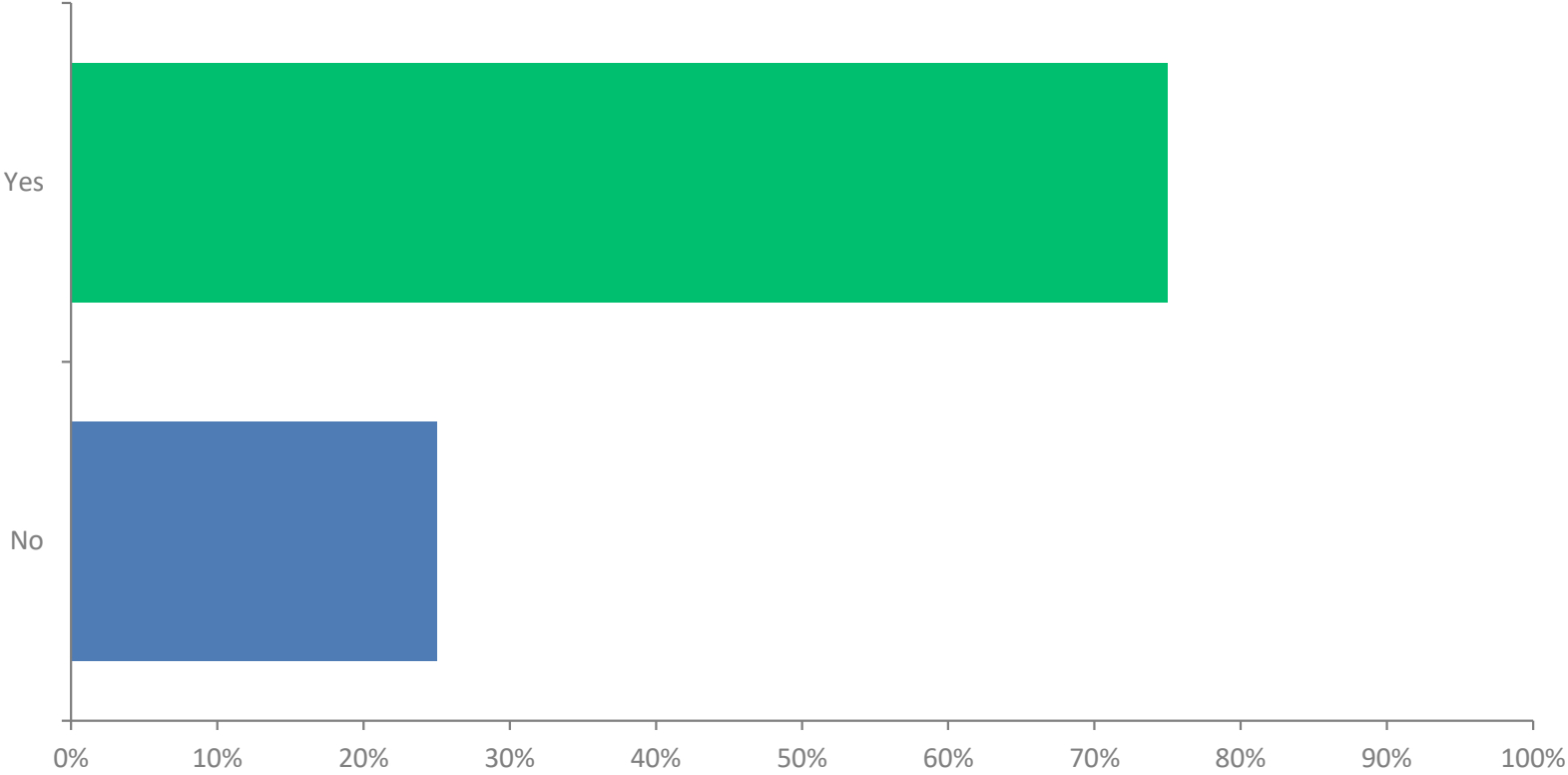
Answered: 29 Skipped: 67

ANSWER CHOICES	RESPONSES	
None of the above	6.90%	2
Replace pavement with permeable pavers	44.83%	13
Add a bioretention cell to middle of cul-de-sac	6.90%	2
Add a swale around Vivian Court	6.90%	2
All of the above	34.48%	10
TOTAL		29

Poteskeet Village

Q27: Do you support adding bioretention, permeable pavers, and a swale at the cul-de-sac?

Answered: 12 Skipped: 84



Poteskeet Village

Q27: Do you support adding bioretention, permeable pavers, and a swale at the cul-de-sac?

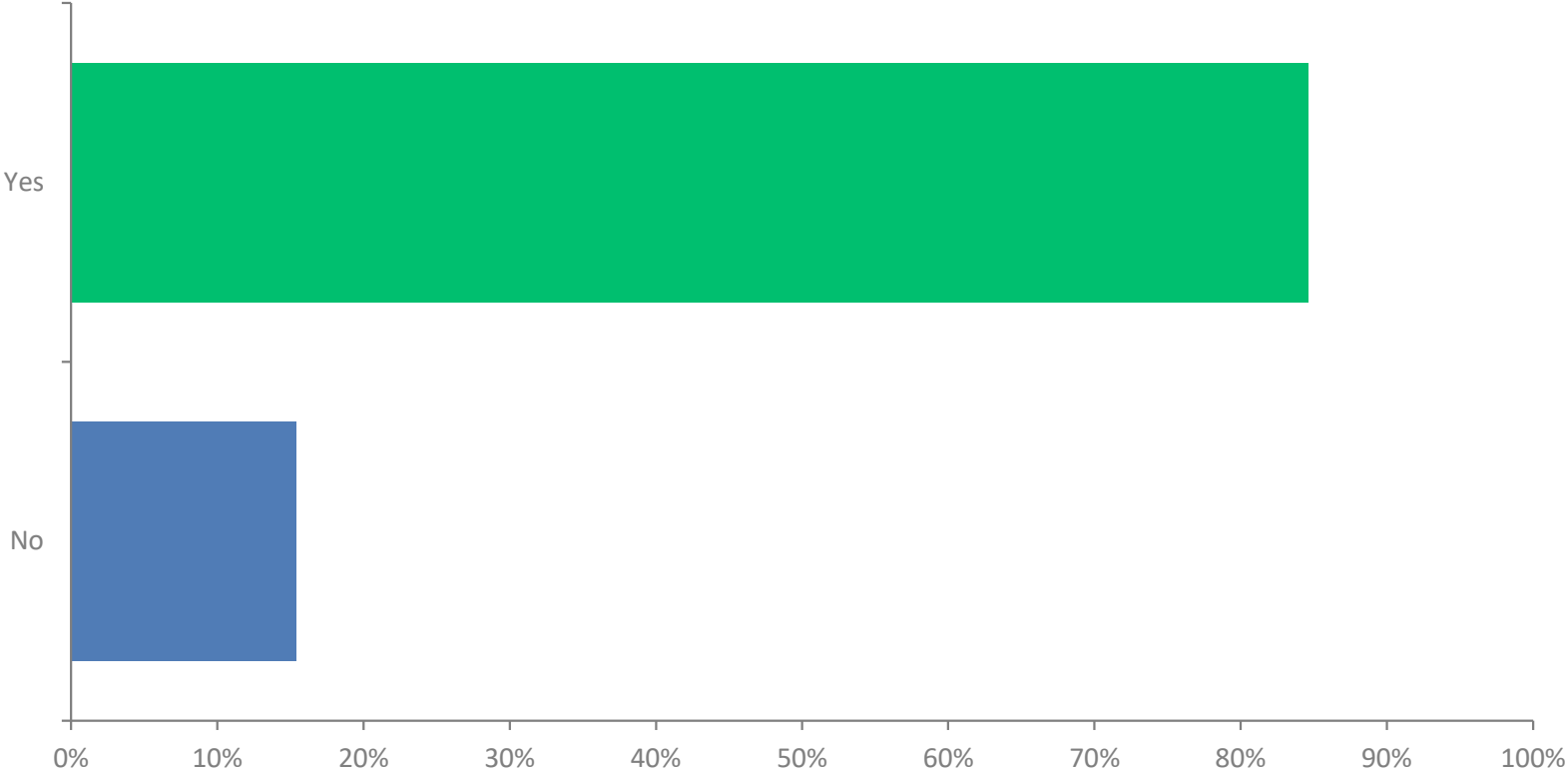
Answered: 12 Skipped: 84

ANSWER CHOICES	RESPONSES	
Yes	75.00%	9
No	25.00%	3
TOTAL		12

Poteskeet Village

Q28: Do you support adding swales along the roadway?

Answered: 13 Skipped: 83



Poteskeet Village

Q28: Do you support adding swales along the roadway?

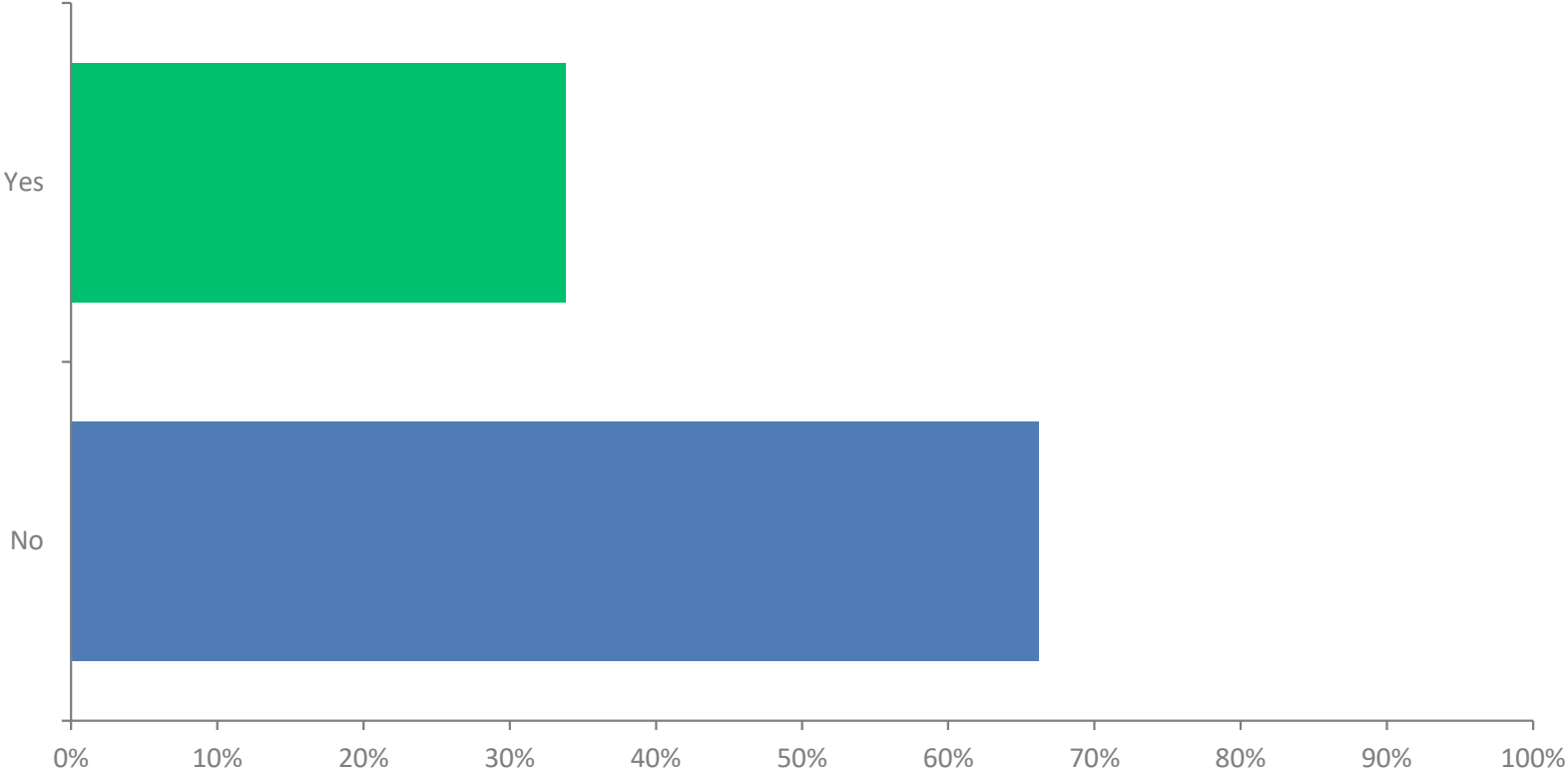
Answered: 13 Skipped: 83

ANSWER CHOICES	RESPONSES	
Yes	84.62%	11
No	15.38%	2
TOTAL		13

Pertaining to All Homeowners

Q29: Would you be interested in implementing your own Rain Barrell System?

Answered: 68 Skipped: 28



Pertaining to All Homeowners

Q29: Would you be interested in implementing your own Rain Barrell System?

Answered: 68 Skipped: 28

ANSWER CHOICES	RESPONSES	
Yes	33.82%	23
No	66.18%	45
TOTAL		68

Appendix C – Maintenance Costs

Sample Operation and Maintenance Provisions for Bioretention Cells

Potential Problems	How to Remediate the Problem	Maint Cost	Yearly Maint Cost Budget
The entire bioretention cell	Replace Facility every 25 years	~\$25/SF	
The entire bioretention cell: Trash/debris is present.	Remove the trash/debris.	\$500	\$500
The perimeter of the bioretention cell: Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, plant ground cover and water until it is established. Provide lime and a one-time fertilizer application.	\$1,000	
The inlet: The pipe is clogged (if applicable)	Unclog the pipe and dispose of any sediment in a location where it will not cause impacts to streams or the SCM.	\$1,000	
The inlet: The pipe is cracked or otherwise damaged (if applicable).	Replace or repair the pipe.	\$200/LF	
The inlet: Erosion is occurring in the swale (if applicable).	Regrade the swale if necessary and provide erosion control devices such as reinforced turf matting or riprap to avoid future erosion problems.	\$500	
The inlet: Stone verge is clogged or covered in sediment (if applicable).	Remove sediment and clogged stone and replace with clean stone	\$250	\$250
The pretreatment system: Flow is bypassing pretreatment area and/or gullies have formed.	Regrade if necessary to route all flow to the pretreatment area. Restabilize the area after grading.	\$2,500	
The pretreatment system: Sediment has accumulated to a depth greater than three inches.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the SCM.	\$1,500	
The pretreatment system: Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.	\$1,000	
The pretreatment system: Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.	\$250	\$250
Bioretention cell vegetation: Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices. Maintain lines of sight between 2'-6'.	\$250	\$250
Bioretention cell vegetation: Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary. If sod was used, check to see that it was not grown on clay or impermeable soils. Replace sod if necessary.	\$5,000	
Bioretention cell vegetation: Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.	\$250	\$250
Bioretention cell vegetation: Tree stakes/wires are present six months after planting.	Remove tree stake/wires (which can kill the tree if not removed).	\$250	\$250

Bioretention cell mulch and media: Mulch is breaking down or has floated away.	Spot mulch if there are only random void areas. Replace whole mulch layer if necessary. Remove the remaining mulch and replace with triple shredded hard wood mulch at a maximum depth of four inches.	\$250	\$250
Bioretention cell mulch and media: Soils and/or mulch are clogged with sediment.	Determine the extent of the clogging - remove and replace either just the top layers or the entire media as needed. Dispose of the spoil in an appropriate off-site location. Use triple shredded hard wood mulch at a maximum depth of four inches. Search for the source of the sediment and remedy the problem if possible.	\$1,500	
Bioretention cell mulch and media: An annual soil test shows that pH has dropped or heavy metals have accumulated in the soil media.	Dolomitic lime shall be applied as recommended per the soil test and toxic soils shall be removed, disposed of properly and replaced with new planting media.	\$1,500	
The underdrain, filter fabric element, and outlet system: Clogging has occurred.	Wash out the underdrain system.	\$2,000	
The underdrain, filter fabric element, and outlet system: Clogging has occurred.	Clean out the drop inlet. Dispose of the sediment off-site.	\$250	
The underdrain, filter fabric element, and outlet system: The drop inlet is damaged.	Repair or replace the drop inlet.	\$2,500	
The receiving water: Erosion or other signs of damage have occurred at the outlet.	Repair the damage and improve the flow dissipation structure.	\$1,500	
The receiving water: Discharges from the bioretention cell are causing erosion or sedimentation in the receiving water.	Contact the local NCDEQ Regional Office.		
Total Yearly Budget			\$2,000

SOURCE: NCDEQ Stormwater Design Manual & VHB

Sample Operation and Maintenance Provisions for Dry Ponds

Potential Problems	How to Remediate the Problem	Cost	Yearly Maint Cost Budget
The entire SCM: Trash/debris is present.	Remove the trash/debris.	\$500	\$500
The perimeter of the dry pond: Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, plant ground cover and water until it is established. Provide lime and a one-time fertilizer application.	\$1,000	
The inlet device: The pipe is clogged (if applicable).	Unclog the pipe. Dispose of the sediment in a location where it will not cause impacts to streams or the SCM.	\$1,000	
The inlet device: The pipe is cracked or otherwise damaged (if applicable).	Repair or replace the pipe.	\$200/LF	
The inlet device: Erosion is occurring in the swale (if applicable).	Regrade the swale if necessary and provide erosion control devices such as reinforced turf matting or riprap to avoid future erosion problems.	\$500	
The forebay: Sediment has accumulated to a depth greater than the original design depth for sediment storage.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the SCM.	\$500	
The forebay: Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.	\$1,000	
The forebay: Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.	\$250	\$250
The main treatment area: Sediment has accumulated to a depth greater than the original design sediment storage depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the SCM.	\$500	\$500
The main treatment area: Water is standing more than 5 days after a storm event.	Check the outlet structure for clogging. If it is a design issue, consult an appropriate professional.	\$500	
The main treatment area: Weeds and noxious plants are growing in the main treatment area.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.	\$250	\$250
The embankment: Shrubs have started to grow on the embankment.	Remove shrubs immediately.	\$500	
The embankment: Evidence of muskrat or beaver activity is present. A tree has started to grow on the embankment.	Consult a professional to remove muskrats or beavers and repair any holes or erosion. Consult a dam safety specialist to remove the tree.	\$1,500	
The embankment: An annual inspection by an appropriate professional shows that the embankment needs repair.	Make all needed repairs immediately.	\$1,500	

The outlet device: Clogging has occurred.	Clean out the outlet device. Dispose of the sediment in a location where it will not cause impacts to streams or the SCM.	\$500	
The outlet device: The outlet device is damaged.	Repair or replace the outlet device.	\$2,500	
The receiving water: Erosion or other signs of damage have occurred at the outlet.	Repair the damage and improve the flow dissipation structure.	\$2,500	
The receiving water: Discharges from the dry pond are causing erosion or sedimentation in the receiving water.	Contact the local NCDEQ Regional Office.		
Total Yearly Budget			\$1,500

SOURCE: NCDEQ Stormwater Design Manual & VHB

Sample Operation and Maintenance Provisions for Treatment Swales (Dry Swales)

Potential Problems	How to Remediate the Problem	Cost	Yearly Maint Cost Budget
The entire length of the swale: Trash/debris is present.	Remove the trash/debris.	\$500	\$500
The entire length of the swale: Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, re-sod (or plant with other appropriate species) and water until established. Provide lime and a one-time fertilizer application.	\$1,500	
The entire length of the swale: Sediment covers the grass at the bottom of the swale.	Remove sediment and dispose in an area that will not impact streams or SCMs. Re-sod if necessary.	\$1,000	
The entire length of the swale: Vegetation is too short or too long.	Maintain vegetation at a height of approximately six inches.	\$500	
The entire length of the swale: Grass is dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if necessary.	\$1,000	
The entire length of the swale: Trees and/or other woody vegetation are present in the treatment swale.	Remove the trees and woody vegetation from the treatment swale, regrade the treatment swale if necessary and re-establish grass as shown on the approved plans.	\$2,000	
The receiving water: Erosion or other signs of damage have occurred at the outlet.	Repair the damage and improve the flow dissipation structure.	\$500	\$500
The receiving water: Discharges from the treatment swale are causing erosion or sedimentation in the receiving water	Contact the local NCDEQ Regional Office.		
Total			\$1,000

SOURCE: NCDEQ Stormwater Design Manual & VHB

Sample Operation and Maintenance Provisions for Permeable Pavement

Potential Problems	How to Remediate the Problem	Cost	Yearly Maint Cost Budget
The perimeter of the permeable pavement: Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, plant ground cover and water until established. Provide lime and a one-time fertilizer application.	\$1,000	
The perimeter of the permeable pavement: A vegetated area drains toward the pavement.	Regrade the area so that it drains away from the pavement, then plant ground cover and water until established.	N/A	
The surface of the permeable pavement: Trash/debris present	Remove the trash/debris.	\$250	\$250
The surface of the permeable pavement: Weeds.	Do not pull the weeds (may pull out media as well). Spray them with a systemic herbicide such as glyphosate and then return within the week to remove them by hand. (Another option is to pour boiling water on them or steam them.)	\$250	\$250
The surface of the permeable pavement: Sediment has accumulated on the permeable pavement surface.	Remove the sediment with a mechanical sweeper, regenerative air cleaner or vacuum truck as appropriate.	\$1,000	\$1,000
The surface of the permeable pavement: The permeable pavement surface is rutting, cracking, slumping or otherwise damaged.	Consult an appropriate professional.	\$2,500	
Observation well: Water is present more than three days after a storm event.	Clean out clogged underdrain pipes. Consult an appropriate professional for clogged soil subgrade.	\$500	
Educational sign: The sign is missing or damaged.	Replace the sign.	N/A	
The receiving water: Erosion or other signs of damage have occurred at the outlet.	Repair the damage and improve the flow dissipation structure.	\$2,500	
The receiving water: Discharges from the permeable pavement are causing erosion or sedimentation in the receiving water.	Contact the local NCDEQ Regional Office.		
Total			\$1,500

SOURCE: NCDEQ Stormwater Design Manual & VHB

Sample Operation and Maintenance Provisions for Rainwater Harvesting (Rain Barrels)

Potential Problems	How to Remediate the Problem	Cost	Yearly Maint Cost Budget
The entire system: A component of the system is damaged or leaking.	Replace the System		
The entire system: Water is flowing out of the overflow pipe during a design rainfall or smaller event when there has not been another rainfall event during the past five days.	<p>Check system for clogging and damage. Repair as needed so the design volume is stored properly without discharging during a design storm.</p> <p>Check that the pump is operating properly and that the water is actually being used at the volume designed.</p> <p>If it is still not operating properly, then consult an appropriate professional.</p>	\$200	\$200
The captured roof area: Excess debris or sediment is present on the rooftop.	Remove the debris or sediment as soon as possible.		
The gutter system: Gutters are clogged, or water is backing up out of the gutter system.	Unclog and remove debris. Install gutter screens to prevent future clogging if necessary.	\$200	\$200
The gutter system: Rooftop runoff is not making it into the gutter system.	Correct the positioning or installation of gutters. Replace if necessary to capture the roof runoff.	\$200	\$250
The cistern: Sediment accumulation of 5% or more of the design volume.	Remove sediment.	\$250	
The cistern: Algae growth is present inside the cistern.	Do not allow sunlight to penetrate the cistern. Treat the water to remove/prevent algae.	\$250	
The cistern: Mosquitoes are present in the cistern.	Check screens for damage and repair/replace them if necessary. Treat with 'mosquito dunks' if necessary.	\$100	\$100
The screens and filters: Debris and/or sediment has accumulated. Screens and filters are clogged.	Search for the source of the debris/sediment and remedy the problem if possible. Clean/clear debris/sediment from the screen or filter. Replace if it cannot be cleaned.	\$200	
The pump: Pump is not operating properly.	Check to see if the system is clogged and flush if necessary. If it is still not operating, then consult an appropriate professional.	N/A	
The overflow pipe: Erosion is evident at the overflow discharge point.	Stabilize immediately.	\$100	
The overflow pipe: The overflow pipe is clogged.	Unclog the pipe, or replace if it cannot be unclogged.	\$100	
The overflow pipe: The outflow pipe is damaged.	Repair or replace the pipe.	\$100	
Total			\$750

SOURCE: NCDEQ Stormwater Design Manual & VHB

Sample Operation and Maintenance Provisions for Wet Ponds

Potential Problems	How to Remediate the Problem	Cost	Yearly Maint Cost Budget
The entire SCM: Trash/debris is present.	Remove the trash/debris.	\$500	\$500
The perimeter of the wet pond: Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, plant ground cover and water until it is established. Provide lime and a one-time fertilizer application.	\$1,000	
The inlet device: The inlet pipe is clogged (if applicable).	Unclog the pipe. Dispose of the sediment in a location where it will not cause impacts to streams or the SCM.	\$500	
The inlet device: The inlet pipe is cracked or otherwise damaged (if applicable).	Repair or replace the pipe.	\$200/LF	
The inlet device: Erosion is occurring in the swale (if applicable).	Regrade the swale if necessary and provide erosion control devices such as reinforced turf matting or riprap to avoid future erosion problems.	\$500	
The forebay: Sediment has accumulated to a depth greater than the original design depth for sediment storage.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the SCM.	\$500	\$500
The forebay: Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.	\$1,000	
The forebay: Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.	\$250	\$250
The vegetated shelf: Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices.	\$1,500	
The vegetated shelf: Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary.	\$2,500	
The vegetated shelf: Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.	\$500	
The main treatment area: Sediment has accumulated to a depth greater than the original design sediment storage depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the SCM.	\$2,000	
The main treatment area: Algal growth covers over 50% of the area.	Consult a professional to remove and control the algal growth.	\$1,000	

The main treatment area: Cattails, phragmites or other invasive plants cover 50% of the basin surface.	Remove the plants by wiping them with pesticide (do not spray).	\$1,500	
The embankment: Shrubs have started to grow on the embankment.	Remove shrubs immediately.	\$1,000	
The embankment: Evidence of muskrat or beaver activity is present.	Consult a professional to remove muskrats or beavers and repair any holes or erosion.	\$1,500	
The embankment: A tree has started to grow on the embankment.	Consult a dam safety specialist to remove the tree.	\$1,500	
The embankment: An annual inspection by an appropriate professional shows that the embankment needs repair.	Make all needed repairs immediately.	\$2,000	
The outlet device: Clogging has occurred.	Clean out the outlet device and dispose of any sediment in a location where it will not cause impacts to streams or the SCM.	\$500	\$500
The outlet device: The outlet device is damaged.	Repair or replace the outlet device.	\$2,500	
The floating wetland (if applicable): Weeds or volunteer trees are growing on the mat.	Remove the weeds or trees.	\$500	
The floating wetland (if applicable): The anchor cable is damaged, disconnected or missing.	Restore the anchor cable to its design state.	\$500	
The receiving water: Erosion or other signs of damage have occurred at the outlet.	Repair the damage and improve the flow dissipation structure	\$2,500	
The receiving water: Discharges from the wet pond are causing erosion or sedimentation in the receiving water.	Contact the local NCDEQ Regional Office.		
Total			\$1,750

SOURCE: NCDEQ Stormwater Design Manual & VHB

Appendix D – FEMA Floodplain Information

National Flood Hazard Layer FIRMMette



Duck Study Area 1(A)

75°46'4"W 36°12'31"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/16/2023 at 1:19 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMMette



Duck Study Area 1(B)

75°46'W 36°12'13"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



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This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

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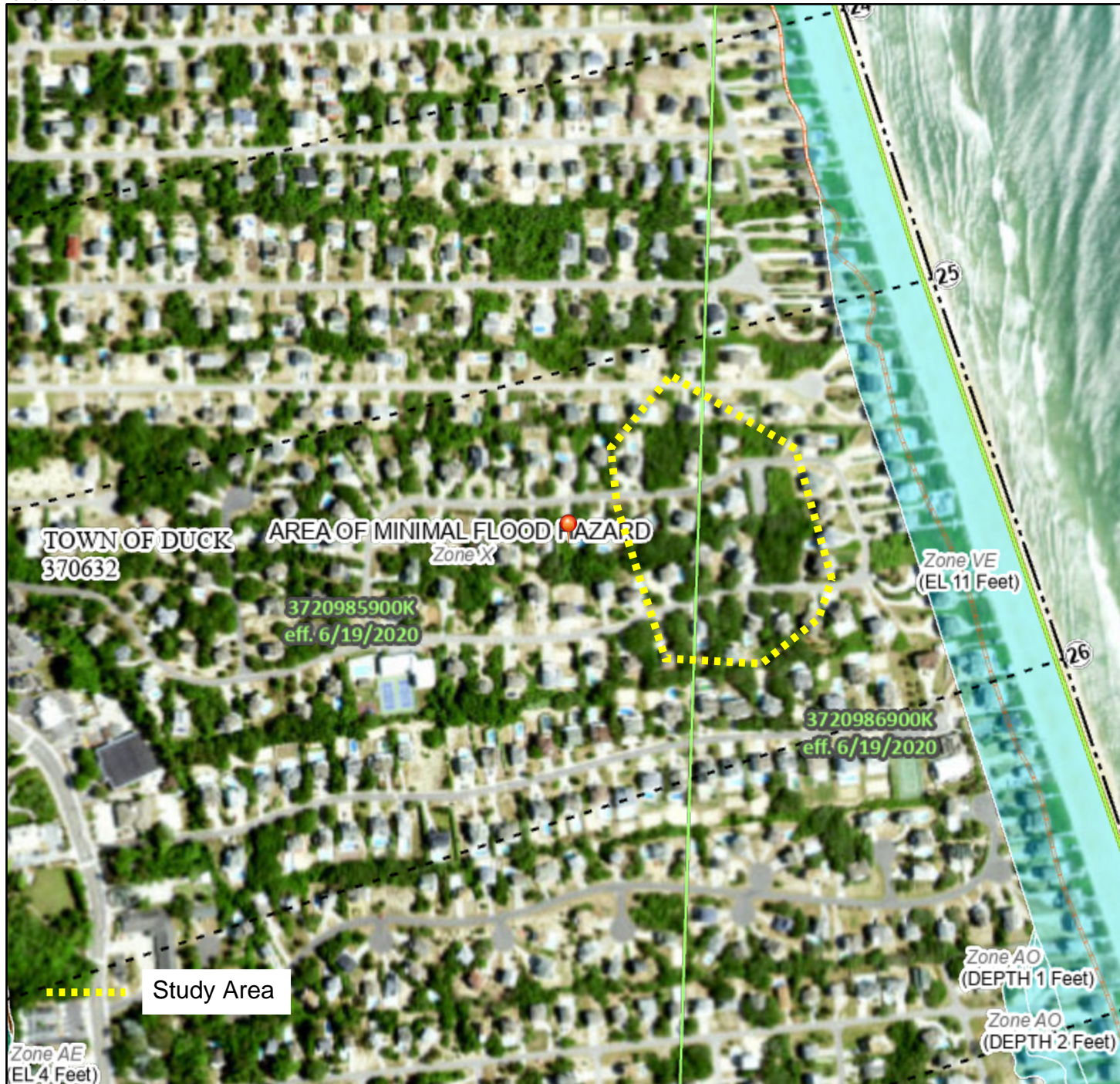
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMMette



Duck Study Area 2

75°45'13"W 36°10'17"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

75°44'36"W 36°9'48"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



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This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

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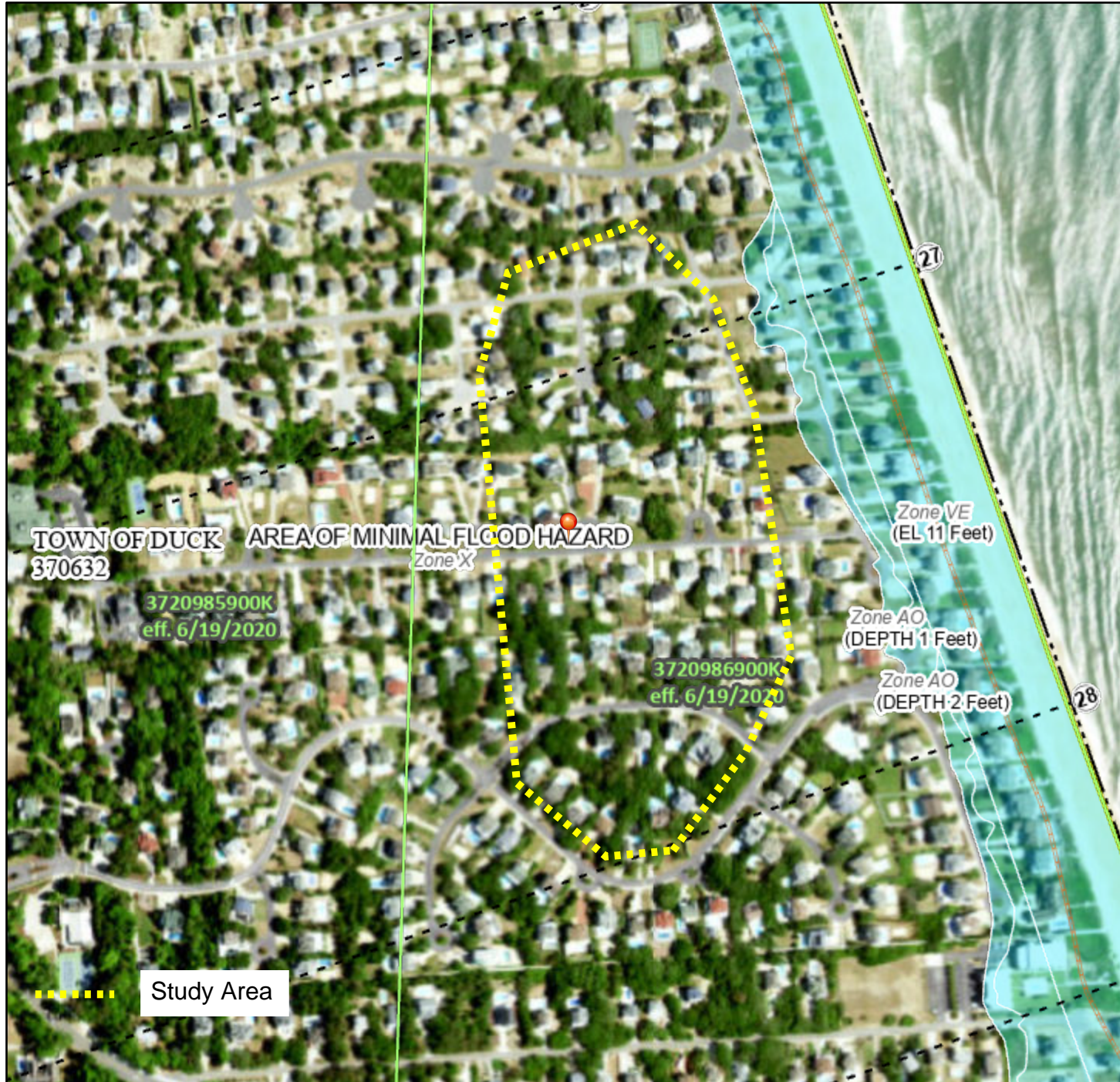
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette



Duck Study Area 3

75°45'4"W 36°9'57"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



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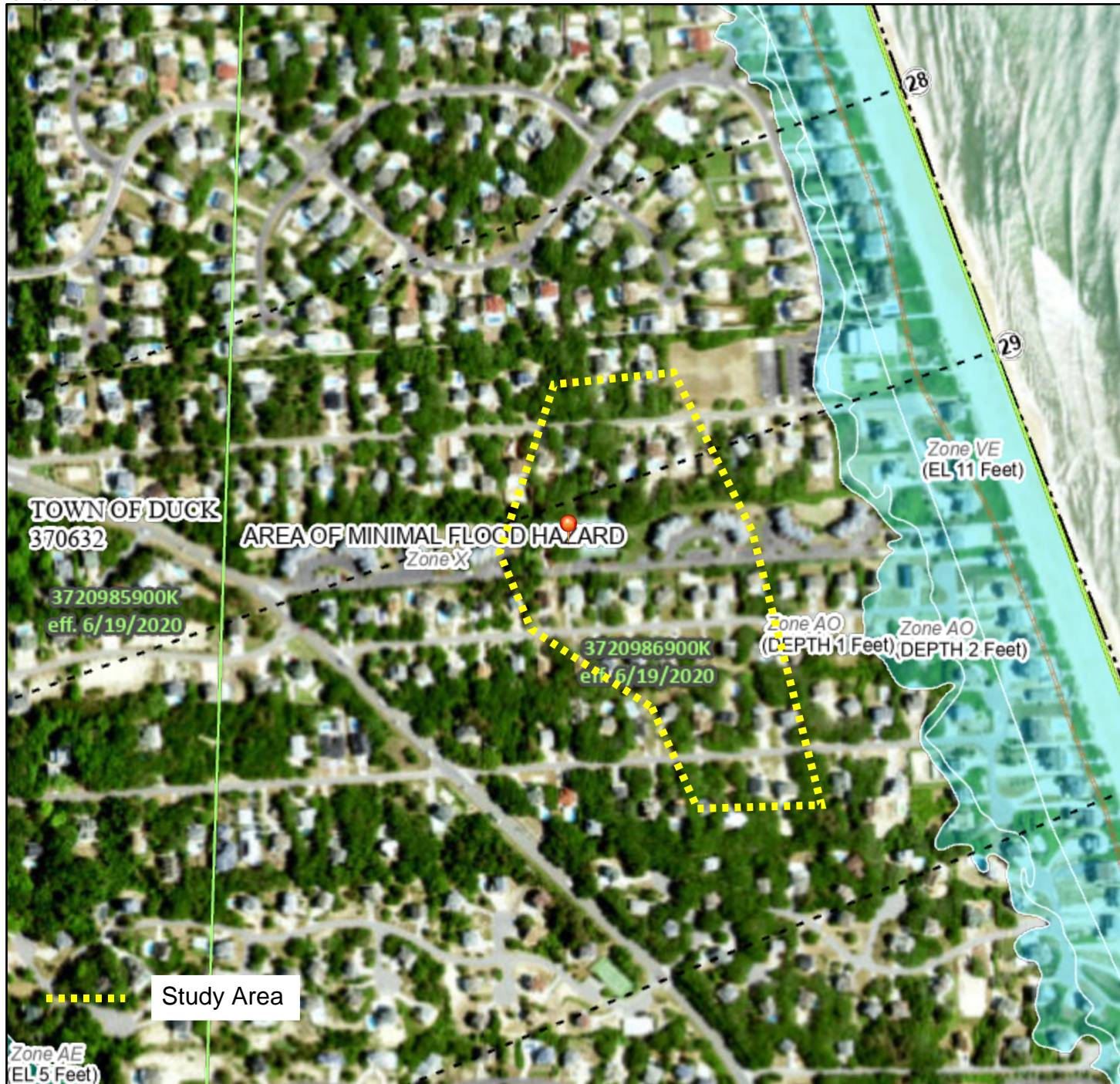
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National Flood Hazard Layer FIRMette



Duck Study Area 4

75°44'59"W 36°9'41"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

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National Flood Hazard Layer FIRMette



Duck Study Area 5

75°44'50"W 36°9'23"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

75°44'13"W 36°8'54"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

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Appendix E – Wetlands Information



U.S. Fish and Wildlife Service

National Wetlands Inventory

Duck Study Area 1



March 15, 2023

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

- Lake
- Other
- Riverine

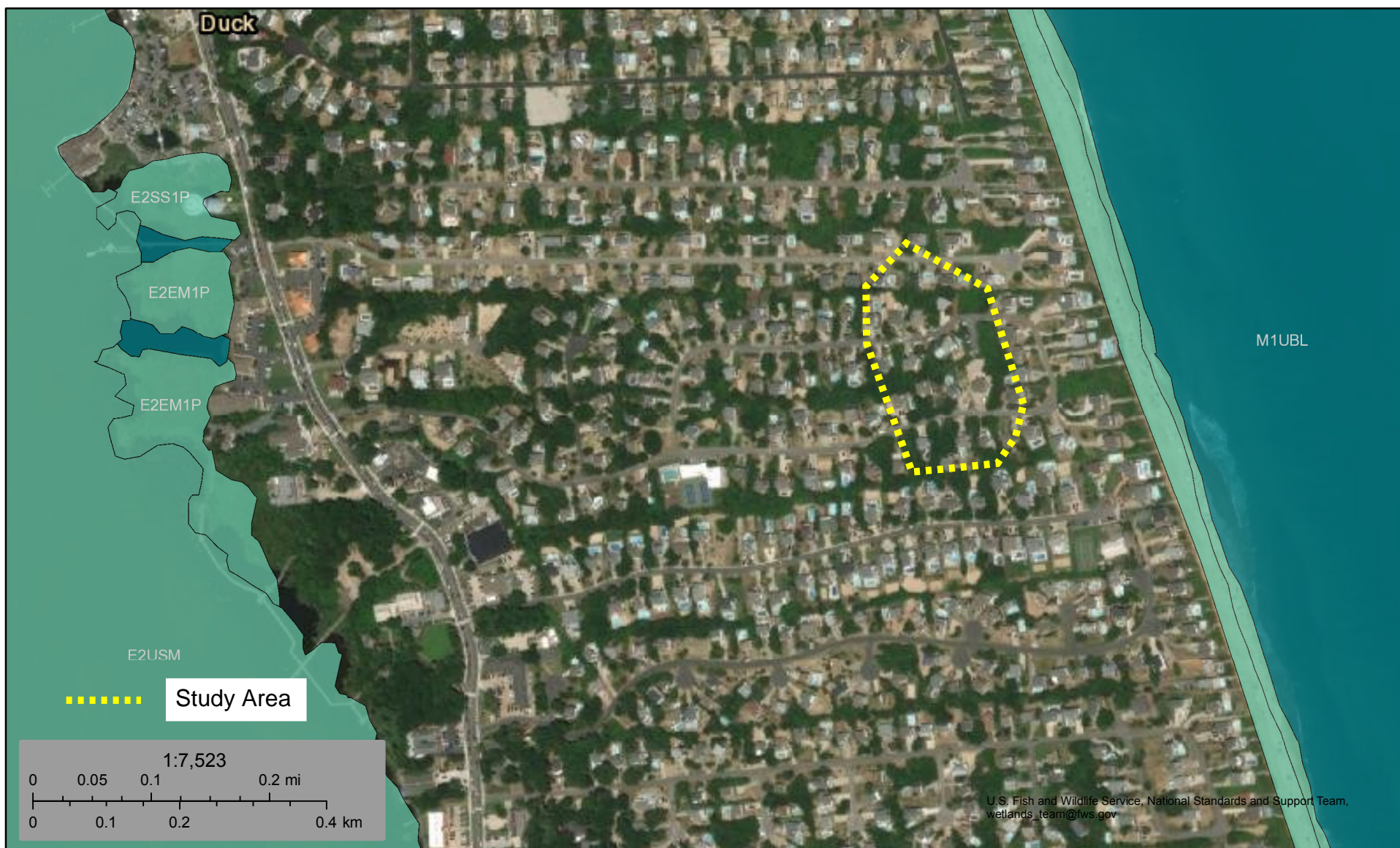
This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.



U.S. Fish and Wildlife Service

National Wetlands Inventory

Duck Study Area 2



March 15, 2023

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

- Lake
- Other
- Riverine

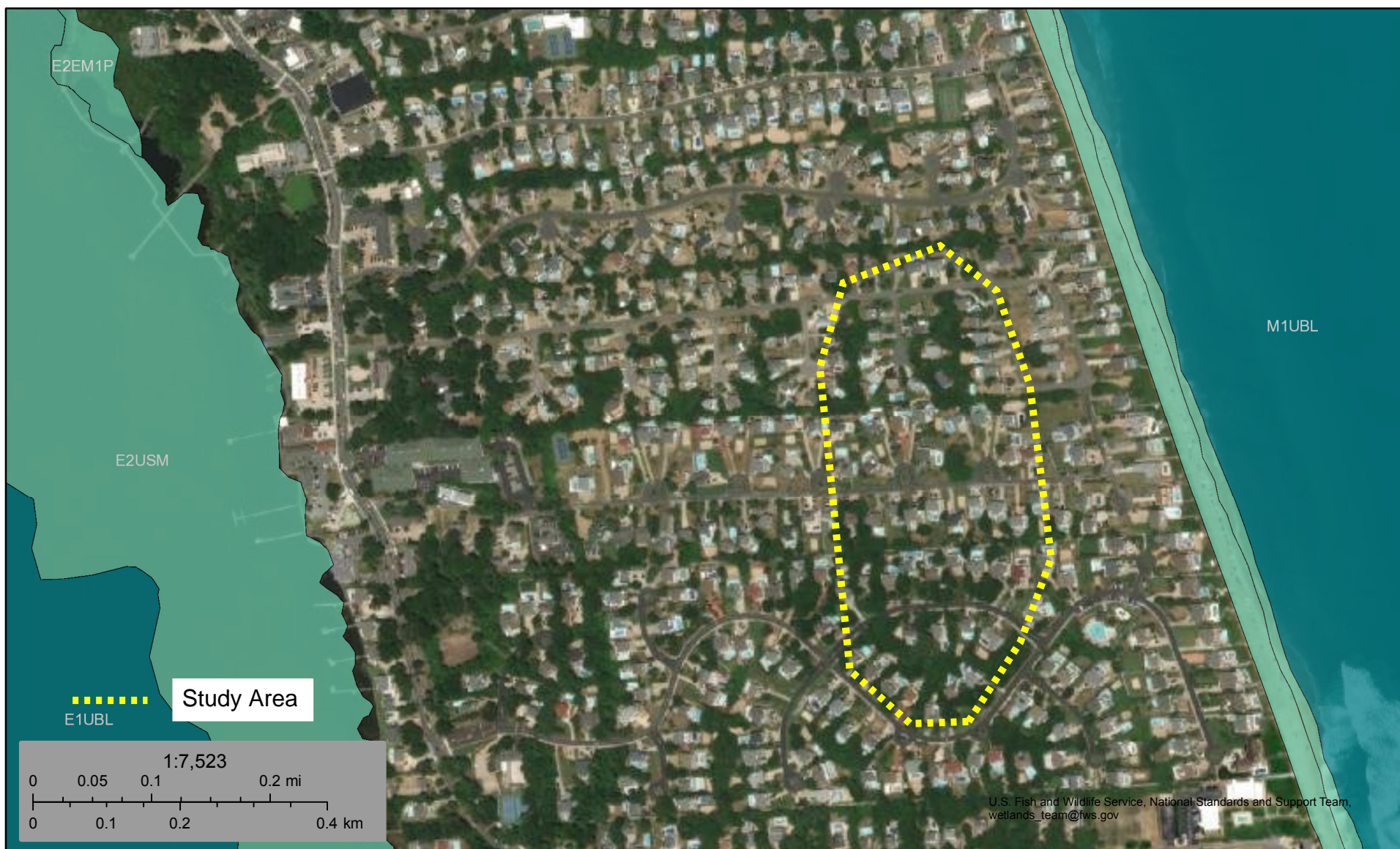
This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.



U.S. Fish and Wildlife Service

National Wetlands Inventory

Duck Study Area 3



March 15, 2023

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

- Lake
- Other
- Riverine

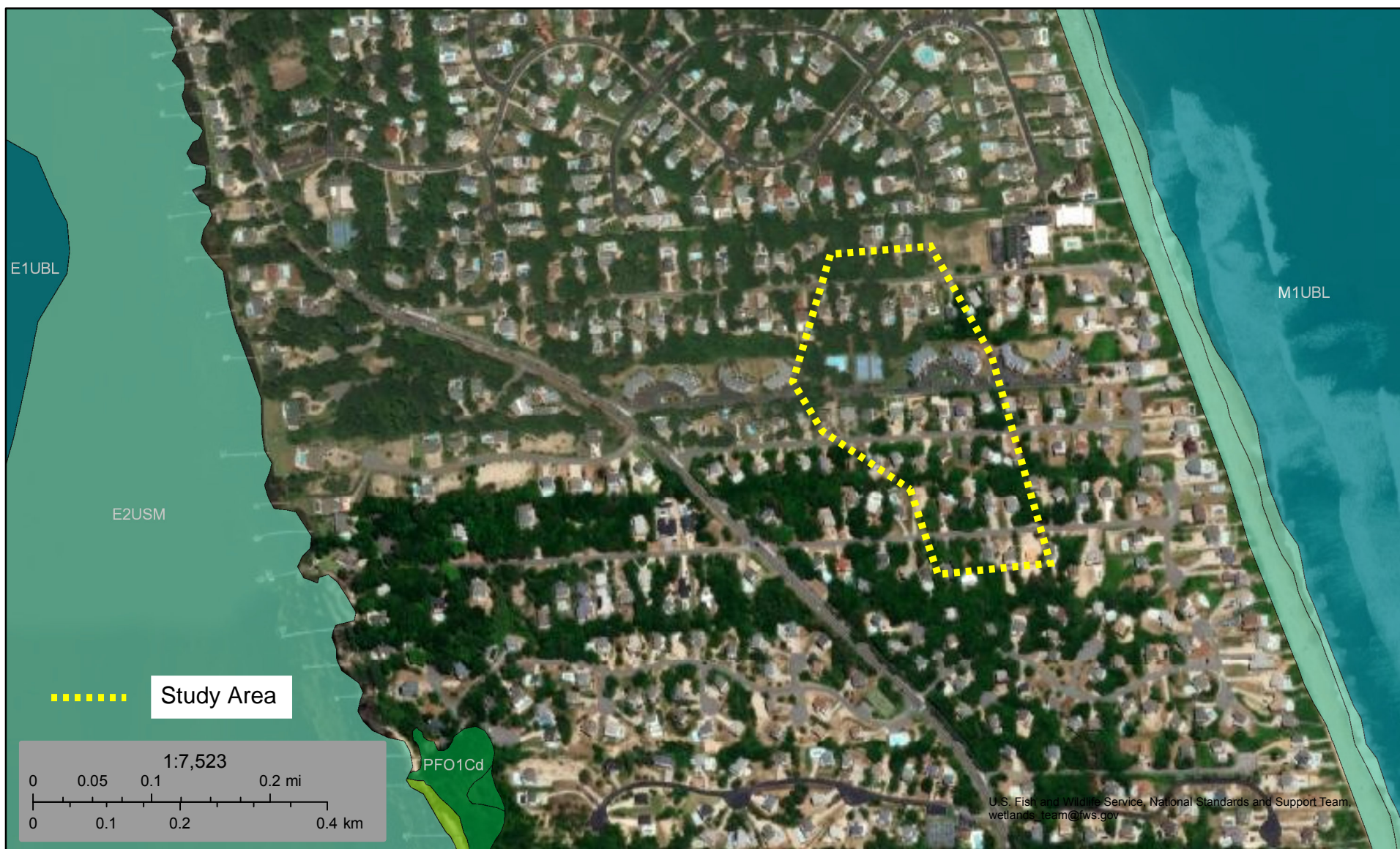
This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.



U.S. Fish and Wildlife Service

National Wetlands Inventory

Duck Study Area 4



March 15, 2023

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.



U.S. Fish and Wildlife Service

National Wetlands Inventory

Duck Study Area 5



March 15, 2023

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

Appendix F – Duck Emergency Pumping Plan

Town of Duck

Floodwater Management Discharge Plan



February 2020

Town of Duck Floodwater Management Discharge Plan

Purpose

Following storm events, emergency discharge of floodwater may be necessary to maintain emergency vehicle access, remove threats to public health and safety, and provide relief from flooding impacts. Emergency pumping activities are not intended to address routine flooding, but to address flooding that occurs from a single weather event or storm system which creates emergency conditions where public health and safety are endangered.

The Town of Duck Floodwater Management Discharge Plan (FMDP) is intended to expedite the emergency approval process of the State of North Carolina so that the Town can respond in a timely and efficient manner to emergency flooding circumstances.

Definitions

Floodwater: Water that accumulates on a road or property as the result of a storm event. The storm event can be a single, high volume rain event or a storm system, such as a hurricane, that can result in a high volume of rain, ocean, and/or sound overwash conditions.

Emergency Floodwater Condition:

- An emergency floodwater condition will be deemed to exist on a road when water is six inches (6") or more in depth at the centerline of the road and the water has not decreased to below six inches (6") after 48 hours of the cessation of rainfall or sound and/or ocean inundation.
- An emergency floodwater condition will be deemed to exist on property if there is a complete or partial inundation of water of a depth of ten inches (10") or more on two (2) or more acres of normally dry land or two (2) or more properties after 48 hours of the cessation of rainfall or sound and/or ocean inundation.

Locations

Based on experience during past flooding events and local knowledge of the Town of Duck, there are several identified locations that have experienced emergency flooding conditions on multiple occasions of a magnitude and scope requiring intervention by the Town of Duck or private entities with the Town's support to discharge floodwater to the Atlantic Ocean:

Ocean Crest/Bias Shores/Tides of Duck: Flooding impacts the streets and properties along E. Charles Jenkins Lane, E. Bias Lane, and Tides Drive. The pump intake will be situated at the low spot in E. Bias Lane. The line will run eastward along E. Bias Lane and cross the dune within an existing beach access easement. Discharge will be into the Atlantic Ocean.

Sea Hawk/Sand Dollar Shoes/Georgetown Sands/Plover Drive: Flooding impacts the streets and properties along E. Sea Hawk Drive, Seabreeze Drive, Georgetown Sands Road, and Plover Drive. The pump intake will be situated at the low spot adjoining Georgetown Sands Road. The

line will run eastward along Georgetown Sands Road and cross the dune within an existing beach access easement. Discharge will be into the Atlantic Ocean.

Four Seasons: Flooding impacts the street and properties along the eastern end of Duck Hunt Club Lane. The pump intake will be situated at the low spot on Duck Hunt Club Lane. The line will run northward along two property lines to a walkway owned by the community association, then eastward alongside the walkway. Discharge will be into the Atlantic Ocean.

Sea Pines/Ocean Dunes: Flooding impacts the streets and properties along Scarborough Lane and several cul-de-sacs off Christopher Drive. The pump intake will be situated at the low spot on Ocean Front Drive. The line will run eastward along Christopher Drive and cross the dune within an existing beach access easement. Discharge will be into the Atlantic Ocean.

Schooner Ridge: Flooding impacts the streets and properties along both sides of the loop in Schooner Ridge Drive. The pump intake will be situated at the low spot on the northern loop of Schooner Ridge Drive. The line will run northward along two property lines and extend eastward along the rear of the properties within an existing utility easement. Discharge will be into the Atlantic Ocean.

Gulls Flight/Ocean Pines: Flooding impacts the streets and properties along Flight Drive and Ocean Pines Drive. The pump intake will be situated at the low spot near the Ocean Pines community facilities on Ocean Pines Drive. The line will run eastward along the existing beach access. Discharge will be into the Atlantic Ocean.

Sound Sea Village: Flooding impacts the streets and properties along Sound Sea Avenue, Acorn Oak Avenue, and Ocean Bay Boulevard. The pump intakes will be situated at the low spots on Ocean Bay Boulevard, Acorn Oak Avenue, and Sound Sea Avenue. The lines will run eastward along the front of properties and cross the dune within existing beach accesses. Discharges will be into the Atlantic Ocean.

Attachment A includes maps and specific information on those areas discussed in the preceding section that have previously experienced emergency flooding conditions.

As different storm events can produce different impacts due to the intensity, path of the storm, and duration of the event, areas not identified in the preceding section may experience emergency flooding. If areas not identified in this plan present emergency conditions, then additional information will be submitted to the State as needed to obtain a separate floodwater discharge permit and/or revise this plan. Any areas of flooding that involve NC 12 or other State maintained roads will need to be coordinated with the N.C. Department of Transportation and National Park Service.

Process

If following a storm event, flooding conditions necessitating discharge activities are identified, then a request to the North Carolina Division of Water Resources (NCDWR) shall be made by the Town of Duck. Such requests may be made by the Town of Duck itself or on behalf of a

property owners/homeowners association or a group of property owners consistent with the Town of Duck's Emergency Pumping of Stormwater Policy (**Attachment B**).

Conditions for Emergency Discharge Requests

Public health and safety shall serve as the basis for any emergency discharge request. One or more of the following conditions shall be cited in any request submitted to the NCDWR.

1. Standing water impeding road access for vehicles used by police officers, firefighters, emergency medical responders, damage assessment teams, and building inspectors.
2. Presence of enterococci, fecal coliform, and e. coli in standing floodwater.
3. Potential of mosquito, pest, and vermin infestation exacerbated by standing water.
4. Damage to utility infrastructure including on-site wastewater systems, drinking water, and electricity.

Public Notice

- Once approval is granted by the NCDWR, the Town of Duck will post notification signs around the discharge area advising people about the pumping activities.
- These signs will be placed at regular intervals as needed according to the size of the discharge location. Posted signs will prohibit swimming and recreational use of any water bodies within 200 yards of the discharge location.
- For safety purposes, signs may also be posted near the pump and along the discharge hose.
- A name and telephone number for the Town's project contact will be included on the signs. An example of signage used during past incidents is included as **Attachment C**.
- Additionally, residents and/or occupants of properties abutting the discharge area may be verbally advised about the pumping operations.
- If the discharge activities are conducted in conjunction with a property owners/homeowners association, the staff or management company of the POA/HOA may assist the Town with posting of signs and other notification efforts.

Pumping Operations

- When possible and feasible, non-discharge alternatives (such as soil infiltration) will be considered.
- Pumping operations may occur continuously or for extended periods of time depending on availability of monitoring staff and the surrounding residential areas that may be impacted by the pumping operations.
- Measures will be taken to ensure efficient pumping operations and prevent erosion and scouring in discharge areas. An adequate length of discharge hose/pipe will be used. If discharging to a water body, the nozzle of the discharge hose will be placed in close proximity to the receiving water body to minimize the area of erosion.
- Wooden pallets and plywood or other appropriate materials will be placed under the pipe nozzle at the point of discharge. A diagram of typical pallet configurations is included with this plan as **Attachment D**.
- If necessary to further limit access to the discharge area, yellow caution tape may also be used to mark the discharge location and/or pump location.

- Monitoring of pumping activities will be conducted by Town staff or other designated individuals to check flooding levels and discharge sites. Staff will maintain photographs and a written log regarding daily hours of pumping. Status reports shall be provided by email to the NCDWR.
- If the discharge activities are conducted in conjunction with a property owners/homeowners association, the staff or management company of the POA/HOA may assist the Town with equipment set-up and monitoring of pumping activities.

Cessation of Pumping

- Pumping operations are not intended to pump down existing stormwater basins or ponds to levels beyond their normal, non-emergency conditions.
- Pumping operations will cease once floodwaters have been discharged to an acceptable level whereby public health and safety are no longer impacted.
- The determination that non-emergency levels have been reached will be made by monitoring personnel in consultation with the Town Manager.
- Upon this determination, the Town of Duck will notify the NCDWR about the termination of pumping activities.

Post-Event Reporting

After termination of pumping, the Town of Duck will file a post-event report with the NCDWR. The report will include the following:

1. Name and title of on-site official(s) who monitored the site and pumping activities.
2. Map of area and discharge points
3. Times and duration of discharges
4. Approximate total flow of discharge (based on pump capacity and daily hours)
5. Photographs of site and discharge area

Attachments

Attachment A – Maps and Plans for Emergency Pumping Areas

Attachment B – Town of Duck Emergency Pumping of Stormwater Policy

Attachment C – Pumping Discharge Warning Sign

Attachment D – Diagram of Discharge Pallet Configuration

ATTACHMENT A

Maps and Plans for Emergency Pumping Areas

Bias Shores Pump-Outfall Locations



Georgetown Sands Pump-Outfall Locations



2003/2018

© 2018 Pictometry

Four Seasons Pump-Outfall Locations



20032018

© 2018 Pictometri

Ocean Dunes Pump-Outfall Locations



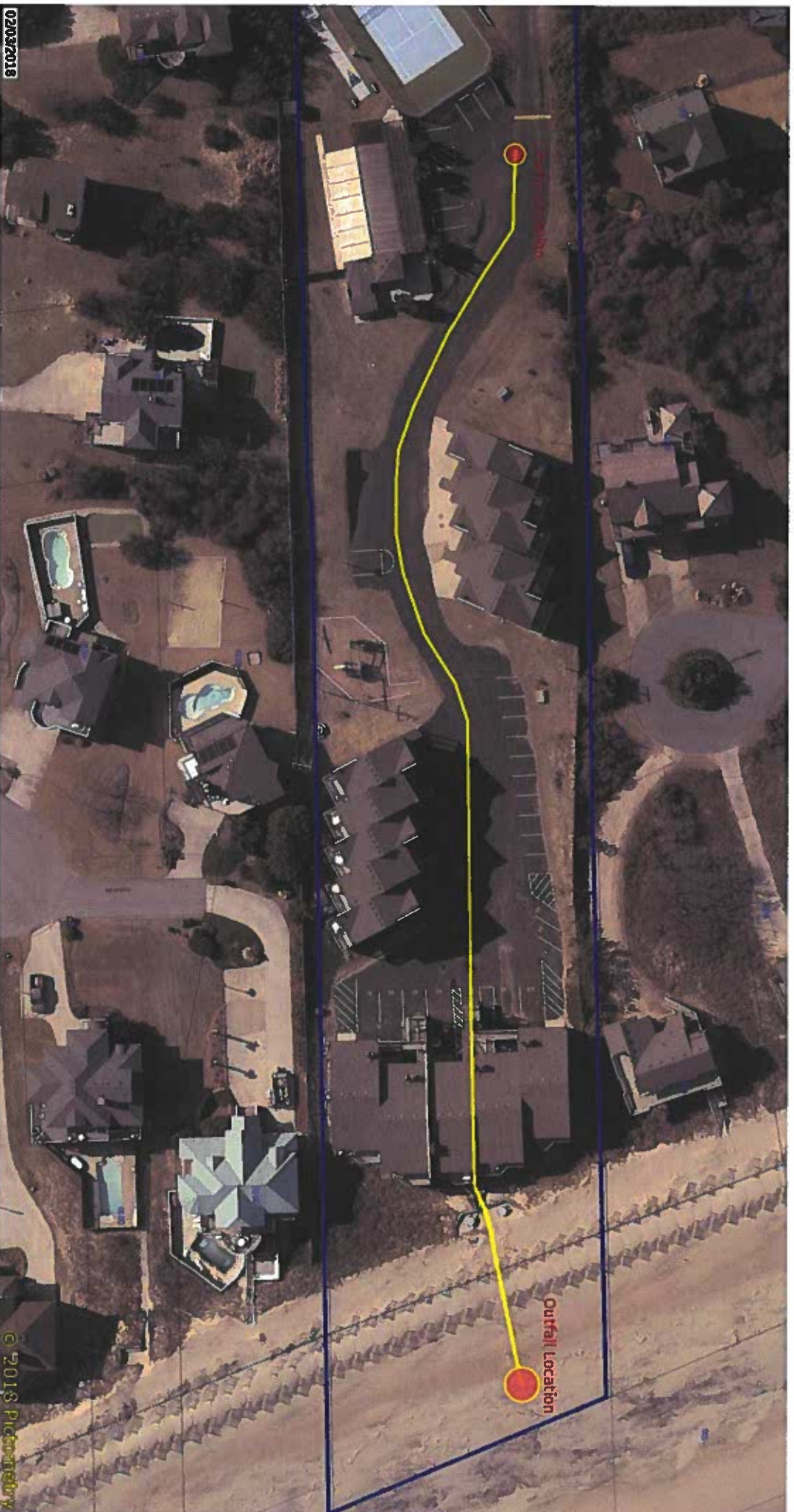
203/2018

© 2018 Pictometr

Schooner Ridge Pump-Outfall Locations



Ocean Pines Pump-Outfall Locations



ATTACHMENT B

Town of Duck Emergency Pumping of Stormwater Policy

A RESOLUTION OF THE TOWN COUNCIL OF THE TOWN OF DUCK, NORTH
CAROLINA, ESTABLISHING A POLICY RELATED TO THE EMERGENCY PUMPING
OF FLOODWATER

Resolution No. 18-05

WHEREAS, the Town of Duck, North Carolina, is located on a barrier island and is subject to severe storm events, including, but not limited to hurricanes; and

WHEREAS, these storms can produce high volumes of rain and also can result in overwash from the Atlantic Ocean and/or the Currituck Sound that causing flooding of roads and property; and

WHEREAS, this flooding can impact the health, safety and welfare of the Duck community by preventing public safety and other vehicles from accessing roads and providing services to residents and visitors and can impact septic systems and result in an increased risk of waterborne diseases; and

WHEREAS, to assist in the mitigation of floodwater, the North Carolina Department of Environmental Quality, Division of Water Resources, allows for the pumping of floodwater to the Atlantic Ocean or Currituck Sound if an emergency situation exists and a permit is obtained.

NOW, THEREFORE, BE IT RESOLVED THIS 5TH DAY OF SEPTEMBER, 2018, that the Town Council of the Town of Duck, North Carolina, does hereby adopt the following policy related to the emergency pumping of floodwater:

Section 1: Purpose:

This policy is designed to provide guidance and outline the roles and responsibilities of Town staff and to provide direction to Homeowners and Property Owners Associations, private property owners, and the general public, associated with emergency pumping activities that may occur or be requested after major storm events, the results of which are large-scale flooding of roads and properties. The goal of emergency pumping is to maintain emergency vehicle access and to remove threats to public health and safety. Nothing in this policy is intended to obligate the Town to engage in emergency pumping activities.

Section 2: Definition of Floodwater; Emergency Condition:

For the purpose of this policy, floodwater is defined as water that accumulates on a road or property as the result of a storm event. The storm event can be a single, high volume rain event or a storm system, such as a hurricane, that can result in a high volume of rain or ocean and/or sound overwash conditions.

On a Road

An emergency floodwater condition will be deemed to exist on a road when water on a road is 6 (six) inches or more in depth at the centerline of the road and the water has not decreased to below 6 (six) inches after 48 hours of the cessation of rainfall or sound and/or ocean inundation.

On Property

An emergency floodwater condition will be deemed to exist on property if there is a complete or partial inundation of water of a depth of 10 (ten) inches or more on 2 (two) or more acres of normally dry land or 2 (two) or more properties after 48 hours of the cessation of rainfall or sound and/or ocean inundation.

Section 3: Permits required:

Pumping on to Private Property

No permit is required if emergency pumping occurs on private property or to private property on which express permission is provided. Emergency pumping on or to private property is prohibited if it results in visible impacts to adjoining property.

Pumping to the Atlantic Ocean or Currituck Sound

A permit is required if emergency pumping results in the discharge of floodwater into the Atlantic Ocean or the Currituck Sound. In order to request a permit to discharge into the Atlantic Ocean or Currituck Sound, the Town of Duck Director of Community Development shall be contacted. The Director of Community Development will review the request and, if deemed to meet the definition of an emergency condition, will submit a request for a permit to the North Carolina Department of Environmental Quality, Division of Water Resources (DWR). If approved by DWR, the Director of Community Development will coordinate with the permit requestor specific standards and conditions associated with the permit approval.

Section 4: Responsibility for Emergency Pumping; Priorities:

The Town of Duck does not own or maintain any roads within the Town limits. Roads in Duck are either privately owned, though accessible to the general public, or state owned.

Emergency Pumping on State Maintained Roads

Due to the importance of maintaining safe access along State Highway 12 (NC 12), in the event of flooding, the Town of Duck's first priority shall be to maintain access along NC 12. If the Town conducts emergency pumping and a permit from DWR is required, the Town shall initiate the request for a permit. The determination of the priority for emergency pumping of roads, other than NC 12, shall be made by the Town Manager in consultation with Public Safety and Town staff.

On state-maintained roads other than State Highway 12 (NC 12), the Town may, at its sole discretion, but in consultation with the appropriate authority and in accordance with this policy, conduct emergency pumping. If the Town conducts emergency pumping on state-maintained roads, the water depth will be pumped down to levels deemed safe for public safety vehicles to traverse. If the Town conducts emergency pumping and a permit from DWR is required, the Town shall initiate the request for a permit. Nothing in this policy will prevent a Homeowners or Property Owners Association located on a state maintained road from requesting that the Town submit a request for a permit through DWR provided the costs associated with the emergency pumping operations will be funded through the Homeowners or Property Owners Association.

Emergency Pumping on Private Roads and Property

For the purposes of this policy, private roads shall be treated as private property; however, if floodwater on private roads exceeds what is deemed safe by the Town Manager for public safety

vehicles to traverse, the Town may, at its sole discretion with the concurrence of the applicable authority or at the request of the applicable authority and in accordance with this policy, conduct emergency pumping. If the Town conducts emergency pumping on private roads, the water depth will be pumped down to levels deemed safe for public safety vehicles to traverse.

In accordance with this policy, the Town of Duck will not conduct emergency pumping on private property; however, private property owners and Homeowners and Property Owners Associations may request that the Director of Community Development review and submit a permit to discharge floodwater into the Atlantic Ocean or Currituck Sound to DWR on behalf of the private property owners and/or Homeowners and Property Owners Associations.

Section 5. Emergency Pumping Equipment:

The Town of Duck owns limited pumping related equipment, does not own any equipment that would be suitable for long distance pumping to the Atlantic Ocean or Currituck Sound and has limited personnel resources. When needed, the Town rents pumping equipment from regional vendors.

For emergency pumping operations that are initiated and under the direct supervision of the Town, the Town will acquire the equipment necessary to conduct the work.

Acquisition of Rental Equipment

If emergency pumping operations are initiated by private property owners, including Homeowners and Property Owners Associations, the Town may assist, if requested, with the acquisition of equipment by providing contact information for pump rental companies. In addition, the Town, if necessary to expedite the rental of equipment, may assist with the acquisition of equipment by allowing Homeowners and Property Owners Associations, but not individual property owners, with the express permission of the Town, to utilize Town accounts with pumping equipment rental companies.

Section 6.

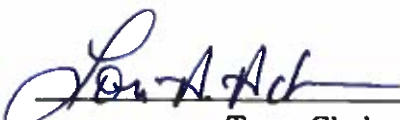
This policy is not intended to satisfy the requirements of the North Carolina Department of Environmental Quality, Division of Water Resources (DWR), for a "Floodwater Management Discharge Plan."

Adopted this 5th day of September, 2018.



Mayor

ATTEST:



Town Clerk

ATTACHMENT C

Pumping Discharge Warning Sign

WARNING!

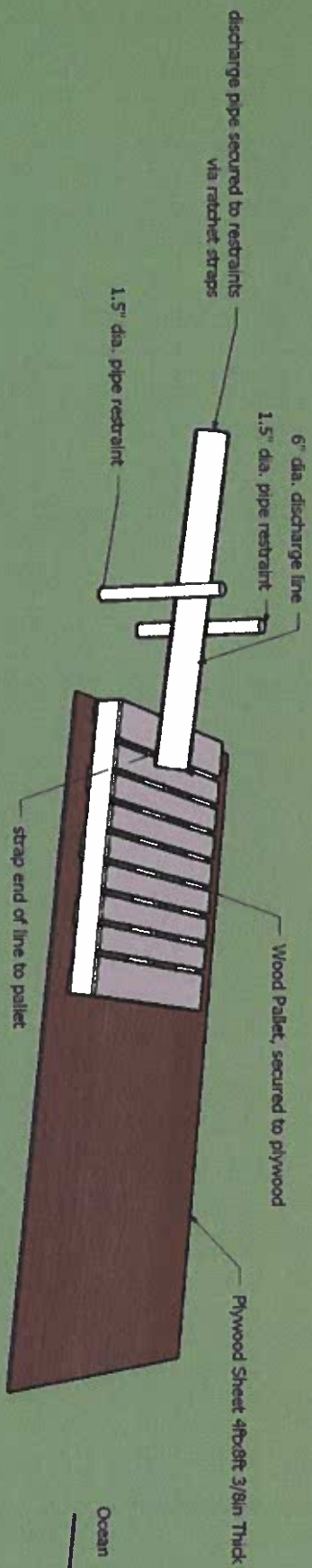


**STORMWATER DISCHARGE
AREA SWIMMING WITHIN
200 FT OF THIS SIGN MAY
INCREASE THE RISK OF
WATERBORNE ILLNESS**

**CONTACT TOWN OF DUCK AT
252.255.1234
FOR MORE INFORMATION**

ATTACHMENT D

Diagram of Discharge Pallet Configuration



Discharge Pipe Energy Dissipater Detail

Appendix G – Geotechnical Report

GEOTECHNICAL ENGINEERING REPORT

Neighborhood Stormwater Study

Duck, North Carolina

January 26, 2023

Terracon Project No. K5225061

Prepared for:

VHB, Inc.

4500 Main Street, Suite 400

Virginia Beach, VA 23462

Prepared by:

Terracon Consultants, Inc.

Elizabeth City, North Carolina





January 26, 2023

TO: **VHB, Inc.**
4500 Main Street, Suite 400
Virginia Beach, VA 23462

Attn: Mr. J.D. Hines, P.E.

RE: Geotechnical Engineering Report
Neighborhood Stormwater Study
Duck, North Carolina
Terracon Project No: K5225061

Dear: Mr. Hines:

In compliance with your instructions, we have completed our Subsurface Exploration and Geotechnical Engineering Services for the above referenced project. The results of this study, together with our recommendations, are presented in this report.

Often, because of design and construction details that occur on a project, questions arise concerning subsurface conditions. **Terracon** would be pleased to continue its role as Geotechnical Engineer during the project implementation.

We appreciate the opportunity to work with you on this project. We trust that the information contained herein meets your immediate need, and should you have any questions or if we could be of further assistance, please do not hesitate to contact us.

Respectfully Submitted,
Terracon

Gerald W. Stalls Jr., P.E.
Senior Project Engineer
NC Reg. # 034336



Camille A. Kattan, P.E.
Principal Engineer
NC Reg. # 014103



Terracon Consultants, Inc. 106 Capital Trace, Unit E Elizabeth City, North Carolina 27909
P (252) 335 9765 F (252) 335 9766 terracon.com

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EXECUTIVE SUMMARY

The project includes five (5) study areas (sites) along the east side of NC Hwy 12 within the residential portions of Duck, North Carolina. The existing site conditions consist of residential structures, roadways, pedestrian walkways, landscaped medians, as well as grass and/or sand covered areas. The proposed construction is to consist of new stormwater improvements that may potentially include new drainage swales, infiltration basins, subsurface stormwater storage areas, and/or pump stations.

Our field exploration program included drilling ten (10) 20-foot deep Standard Penetration Test (SPT) borings and six (6) 3.5-to 5-foot deep hand augers borings within the proposed new stormwater improvement areas. Initial groundwater level was measured to occur at depths ranging from about 2.5 to 6.5 feet below the existing grades at the boring locations corresponding to groundwater elevations ranging from 1.5 to 4 feet (NAVD88) as estimated from the existing topographic information provided on the project site plans as well as Google Earth Imagery. However, the project site plans appeared to provide limited and generalized existing topographic information. As such, the above noted groundwater elevations may be of limited accuracy. Additionally, variations in the groundwater elevations should be expected to occur throughout the sites considering the varying existing surface elevations. A summary of the subsurface and groundwater conditions encountered at the boring locations is presented in Section 3 of this report.

The following evaluations and recommendations were developed based on our field exploration and laboratory-testing program:

- A field testing program may be required for this project and should be determined by the Engineer of Record with considerations to the North Carolina State Building Code (2018 International Building Code with North Carolina Amendments).
- The shallow subsurface soils encountered below the surficial materials (Topsoil, asphalt pavement section, landscaping Gravel) and extending to the boring termination depths ranging from 3.5 to 20 feet consist of SAND (SP, SP-SM). These soils appear to meet the criteria recommended in this report for reuse as structural fill.

This summary briefly discusses some of the major topics mentioned in the attached report. Accordingly, this report should be read in its entirety to thoroughly evaluate the contents.

1.0 PROJECT INFORMATION

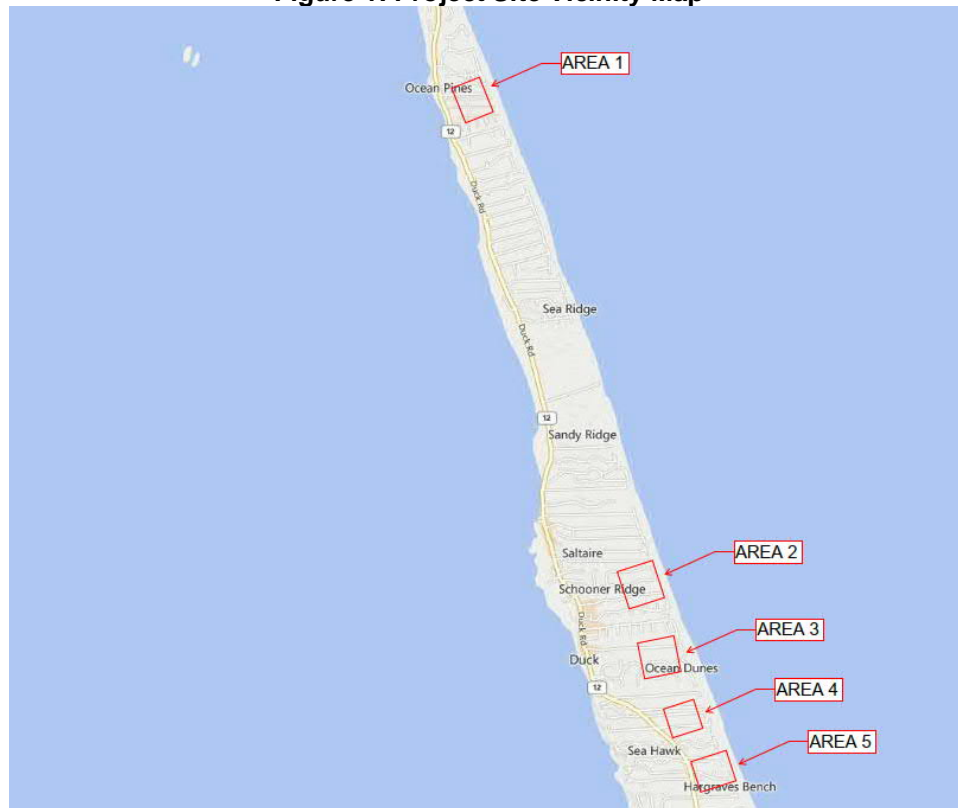
1.1 Project Authorization

Terracon has completed our subsurface exploration and geotechnical engineering services for the proposed Neighborhood Stormwater Study located in Duck, North Carolina. The geotechnical engineering services were conducted in general accordance with the scope presented in **Terracon** Proposal No. PK5225061. Authorization to proceed with our services was received from the client in the form of a Subconsultant Authorization form executed on the date of December 1, 2022.

1.2 Project Site Location and Description

The project includes five (5) study areas (sites) along the east side of NC Hwy 12 within the residential portions of Duck, North Carolina. The existing sites' conditions consist of residential structures, roadways, pedestrian walkways, landscaped medians, as well as grass and/or sand covered areas. Based on the sites' topographic information provided on the project site plans completed by VHB, Inc. as well as Google Earth imagery, the existing surface elevations occurring at the explored locations generally ranged from about 5 to 8 feet (NAVD88). A site vicinity map is provided in Figure 1 with the project sites indicated.

Figure 1: Project Site Vicinity Map



1.3 Project Construction Description

The proposed construction is to consist of new stormwater improvements that may potentially include new drainage swales, infiltration basins, subsurface stormwater storage areas, and/or pump stations. Finished grade elevations of the proposed stormwater improvements are unknown at this time. However, it is anticipated that the majority of sites' grading will generally include a cut depth ranging from about 1 to 2 feet. More substantial stormwater improvement areas such as infiltration basins and/or subsurface stormwater storage areas may require cut depths up to about 6 feet. Deeper excavations will likely be required for pump station structures (if required).

If any of the noted information is incorrect or has changed, please inform Terracon so that we may amend the recommendations presented in this report, if appropriate.

1.4 Purpose and Scope of Services

The purpose of this study was to obtain information on the general subsurface conditions at the proposed project sites. The subsurface conditions encountered were then evaluated with respect to the available project characteristics. In this regard, engineering assessments for the following items were formulated:

- General assessment of the soils revealed by the borings performed at the proposed development.
- General location and description of potentially deleterious material encountered in the borings that may interfere with construction progress or structure performance, including existing fills or surficial/subsurface organics.
- Stormwater design parameters based on the results of our field explorations, testing, and experience with similar soil conditions.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic material in the soil, bedrock, surface water, groundwater or air, on or below or around these sites. Prior to development of these sites, an environmental assessment is advisable.

2.0 FIELD AND LABORATORY PROCEDURES

2.1 Field Exploration

In order to explore the general subsurface soil types and to aid in developing associated design parameters and recommendations, the following exploration program was performed:

- Ten (10) 20-foot deep SPT borings (designated as B1-1, B1-2, B2-1, B2-2, B3-1, B3-2, B4-1, B4-2, B5-1, B5-2) were drilled within the stormwater improvement areas. Due to potential conflicts with existing utilities, the borings identified as B4-2 and B5-1 were performed within the adjacent pavements which were cored with a 4-inch diameter hollow core barrel. More detailed information regarding the proposed and completed boring locations are identified on the boring location plan provided in Appendix A.
- Six (6) 3.5- to 5-foot hand auger borings (designated as HA1-1, HA1-2, HA2-1, HA3-1, HA4-1, HA5-1) were performed within the proposed stormwater improvement areas. The explored depths of these hand auger borings were limited due to cave-ins occurring as a result of the encountered water table.

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586. The tests were performed continuously from the existing ground surface to depths of 10 to 12 feet, and at 5-foot intervals thereafter, starting at a depth of 13 feet below grade. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches, using an automatic safety hammer. The number of blows required to drive the sampler each 6-inch increment of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value (uncorrected for automatic hammer and overburden pressure). A representative portion of each disturbed split-spoon sample was collected with each SPT, placed in a sealed glass jar, and returned to our laboratory for review. Following the exploration procedures, the borings were backfilled with a neat cement grout mix in accordance with NCDENR requirements for aquifer protection.

The boring locations were established by VHB, Inc. and subsequently staked in the field by a representative of **Terracon** with the use of GPS coordinates as well as by referencing the project site plans (completed by VHB, Inc.). The GPS coordinates used for boring locating were determined based on the NC State Plane coordinates provided by VHB, Inc. Approximate soil boring locations are shown on the attached "Boring Location Plan" sheets (Appendix A) which include the above referenced site plans.

2.2 Field and Laboratory Testing

Soil testing provided by **Terracon** was performed in accordance with American Society for Testing and Materials (ASTM) standards. All soils and materials tests were performed in our AASHTO re:source (formally AMRL) certified Elizabeth City laboratory.

2.2.1 Soil Classification and Index Testing

Representative portions of all soil samples collected during drilling operations were labeled, preserved and transferred to our laboratory in accordance with ASTM D4220 for classification and analysis. Soil descriptions on the boring logs are provided using visual-manual methods in general accordance with ASTM D2488 using the Unified Soil Classification System (USCS). Soil samples that were selected for index testing were classified in general accordance with ASTM D2487. It should be noted that some variation can be expected between samples classified using the visual-manual procedure (ASTM D2488) and the USCS (ASTM D2487). A summary of the soil classification system is provided in Appendix B.

Representative split-spoon samples were selected and subjected to natural moisture and #200 sieve wash testing in order to corroborate the visual classification. These test results are presented in Appendix C and on the soil test boring logs provided in Appendix D. Generalized subsurface soil profiles are provided in Appendix E.

2.2.3 In-Situ Permeability Testing

Hydraulic conductivity testing, using a constant-head borehole permeameter, was performed at boring locations HA1-1, HA1-2, HA2-1, HA3-1, HA4-1, and HA5-1 at depths ranging from approximately 1.3 to 1.7 feet below existing grades given the relatively shallow depths of the groundwater levels encountered at the hand auger boring locations. The boreholes were prepared utilizing a planar auger to remove soil clippings from the base. Hydraulic conductivity testing was then conducted within the vadose zone utilizing a Johnson Precision Permeameter and the following testing procedures.

A support stand was assembled and placed adjacent to the borehole. This stand holds a calibrated reservoir (2000 ml) and a cable used to raise and lower the water control unit (WCU). The WCU establishes a constant water head within the borehole during testing by use of a precision valve and float assembly. The WCU was attached to the flow reservoir with a 2-meter (6.6 foot) braided PVC hose and then lowered by cable into the borehole to the test depth.

As required by the Glover solution, the WCU was suspended above the bottom of the borehole at an elevation of approximately 5 times the borehole diameter. The shut-off valve was then opened allowing water to pass through the WCU to fill the borehole to the constant water level elevation. The absorption rate slowed as the soil voids became filled and an equilibrium developed as a wetting bulb developed around the borehole.

Water was continuously added until the flow rate stabilized. The reservoir was then re-filled in order to begin testing. During testing, as the water drained into the borehole and surrounding soils, the water level within the calibrated reservoir was recorded as well as the elapsed time during each interval. The test was continued until relatively consistent flow rates were documented. During testing the quick release connections and shutoff valve were monitored to ensure that no leakage occurred. The flow rate (Q), height of the constant water level (H), and borehole diameter (D) were used to calculate Ks utilizing the Glover Solution.

Based on the field testing, the hydraulic conductivity of the soils is presented in Table II below. The comprehensive hydraulic conductivity worksheet is provided in Appendix J.

Table II – Constant Head Borehole Permeameter Test Results

Boring ID	Test Depth ¹ (ft)	K _{sat} Value (in/hr)	K _{sat} Value (cm/sec)	K _{sat} Class	Soil Material
HA1-1	1.3	4.1	2.89E-03	High	SAND (SP)
HA1-2	1.3	8.2	5.78E-03	High	SAND (SP)
HA2-1	1.3	5.8	4.13E-03	High	SAND (SP)
HA3-1	1.7	7.4	5.25E-03	High	SAND (SP-SM)
HA4-1	1.5	7.5	5.26E-03	High	SAND (SP)
HA5-1	1.5	13.1	9.24E-03	High	SAND (SP)

¹. Depth below the existing grades.

The hydraulic conductivity test results provided in this report are the result of testing at the location and depth indicated. Varying site conditions, including soil compositions, man-made debris, soil density, stratum depth, and stratum thickness should be expected throughout the sites, which may result in varying hydraulic conductivity rates at unexplored / untested locations.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Geology

The project sites lies within a major physiographic province called the Atlantic Coastal Plain. Numerous transgressions and regressions of the Atlantic Ocean have deposited marine, lagoonal, and fluvial (stream lain) sediments. The regional geology is very complex, and generally consists of interbedded layers of varying mixtures of sands, silts and clays. Based on our review of existing geologic and soil boring data, the geologic stratigraphy encountered in our subsurface explorations generally consisted of marine deposited Sands.

3.2 Recent Land Reclamation and Site Development

Based on a review of historical United States Geological Survey (USGS) topographic maps of Dare County, North Carolina produced between the years of 1940 and 2019, the project sites do not appear to be located within a previously reclaimed area. However, the project sites were previously developed including the existing residential structures, pavement areas, and/or stormwater management areas. As such, excavations may be required to remove subsurface utilities where in conflict with the proposed construction.

3.3 Subsurface Soil Conditions

The surficial materials encountered at the explored locations generally consisted of Topsoil, asphalt pavement sections, or open graded landscaping GRAVEL (GP) having a thickness generally ranging from 2 to 6 inches. Underlying the Topsoil, asphalt pavement section, and/or landscaping Gravel the subsurface soils generally consisted of very loose to very dense SAND (SP, SP-SM) having varying amounts of Silt and/or Marine Shell Fragments. Finally, the granular soils encountered at the location of boring B3-2 at a depth of 9.5 and extended to 10 feet below existing grades were noted to have trace to little Organics. A summary of the subsurface soil conditions encountered at the SPT boring locations is presented in Table II on the following page of this report.

Table II – Subsurface Soil Conditions

Average Depth (ft)	Stratum	Description	Ranges of SPT ⁽¹⁾ N-Values
0 to 0.17 – 0.25	Topsoil ⁽²⁾	Topsoil	-
0 to 0.3 – 0.5	Pavement Section ⁽³⁾	2 to 4 inches of Asphalt Pavement Existing Asphalt Pavement was underlain by 4 inches of GRAVEL (GP-GM) at boring B5-1 only	-
0 to 0.5	Surficial ⁽⁴⁾	Open Graded Landscaping Gravel	-
0.17 – 0.25 to 20	I ⁽⁵⁾	SAND (SP, SP-SM) having varying amounts of Silt and/or Marine Shell Fragments <ul style="list-style-type: none"> The granular soils encountered at the location of boring B3-2 from 9.5 to 10 feet were noted to contain trace to little Organics 	2 to 78

Note(s): (1) SPT = Standard Penetration Test, N-Values in Blows-per-foot (uncorrected)

(2) Not encountered at borings B4-2, B5-1, and HA3-1 only

(3) Encountered at borings B4-2 and B5-1 only

(4) Encountered at boring HA3-1 only

(5) All borings terminated in this Stratum

The subsurface descriptions are of a generalized nature provided to highlight the major soil strata encountered. The records of the subsurface exploration are included in Appendix D (Boring Log sheets), in Appendix E (Generalized Soil Profiles), and in Appendix F (Core Logs) which should be reviewed for specific information as to the individual borings. The stratifications shown on the records of the subsurface exploration represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the transition may be gradual.

3.4 Groundwater Discussion

The groundwater level was recorded at the boring locations and as observed through the relative wetness of the recovered soil samples during the drilling operations. The initial groundwater level was measured to occur at depths ranging from about 2.5 to 6.5 feet below the existing grades at the boring locations corresponding to groundwater elevations ranging from 1.5 to 4.0 feet (NAVD88) as estimated from the existing topographic information provided on the project site plans as well as Google Earth Imagery. However, the project site plans appeared to provide limited and generalized existing topographic information. As such, the above noted groundwater elevations may be of limited accuracy. Additionally, variations in the groundwater elevations should be expected to occur throughout the sites considering the varying existing surface elevations.

The soils encountered at the explored locations and at the corresponding initial groundwater levels consisted of relatively porous soils generally containing less than 12 percent fines (SAND: SP, SP-SM). Drilling fluids (water) are introduced into the bore holes during the drilling operations further impairing the ability to accurately determine the groundwater levels. In addition, as subsurface soils begin to dry, moisture moves upwards through the soil profile by means of capillary action. Based on the subsurface soil compositions, these initial groundwater level readings (based on the relative wetness of the soils) could be in part attributed to the capillary action of the soils. Additionally, the sites are located within an active coastal environment. As such, the reported initial groundwater levels may not be indicative of the static groundwater level and/or are potentially affected by tidal fluctuations including wind driven tides. The SPT boreholes were backfilled upon completion for safety considerations as well as in accordance with NCDENR requirements for aquifer protection.

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, sidewalks, etc.). In the project's area, seasonal groundwater fluctuations of +/-1.5 to 3 feet or more are common; however, greater fluctuations have been documented. We recommend that the Contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on the construction procedures, if necessary.

4.0 EVALUATIONS AND RECOMMENDATIONS

Our recommendations are based on the previously discussed project information, our interpretation of the soil test borings and laboratory data, and our observations during our site reconnaissance. If the proposed construction should vary from what was described, we request the opportunity to review our recommendations and make any necessary changes.

This project may require pump stations for the purpose of dewatering areas during various inclement weather events. In order to provide design recommendations for these structures (allowable bearing capacity, settlement analysis, and/or soil design parameters for below grade structures), additional SPT borings should be performed at these specific locations.

4.1 Structural Fill and Placement

Following the approval of the natural subgrade soils by the Geotechnical Engineer, the placement of the fill required to establish the design grades may begin. Any material to be used for structural fill should be evaluated and tested by **Terracon** prior to placement to determine if they are suitable for the intended use. Suitable structural fill material should consist of sand or gravel containing less than 20% by weight of fines (SP, SM, SW, GP, GW), having a liquid limit less than 20 and plastic limit less than 6, and should be free of rubble, organics, clay, debris and other unsuitable material.

All structural fill should be compacted to a dry density of at least 95% of the Standard Proctor maximum dry density (ASTM D 698) unless specified differently in this report. In general, the compaction should be accomplished by placing the fill in maximum 10-inch loose lifts and mechanically compacting each lift to at least the specified minimum dry density. A representative of **Terracon** should perform field density tests on each lift as necessary to assure that adequate compaction is achieved.

Backfill material in utility trenches within the construction areas should consist of structural fill (as described above) and should be compacted to at least 95% of ASTM D 698. This fill should be placed in 4- to 6-inch loose lifts when hand compaction equipment is used.

Care should be used when operating the compactors near existing structures to avoid transmission of the vibrations that could cause settlement damage or disturb occupants. In this regard, it is recommended that the vibratory roller remain at least 25 feet away from existing structures; these areas should be compacted with small, hand-operated compaction equipment.

4.2 Suitability of On-site Soils

Based on the laboratory testing program, the subsurface soils classified as SAND (SP, SP-SM) encountered below the surficial materials (Topsoil, Asphalt pavement section, and/or Landscaping Gravel) encountered at the boring locations and extending to the boring termination depths ranging from 3.5 to 20 feet generally appear to meet the criteria recommended in this report for reuse as structural fill. These soils should be segregated from any Organic laden soils as well as unsuitable FILL and/or Sand containing construction debris (if encountered), which are not considered to be suitable for re-use as structural fill. Finally, moisture manipulation is expected as these soils are located above and/or below the groundwater table. This manipulation may require the addition of water during placement and/or compaction. Conversely, those soils excavated below the groundwater level may require temporary stockpiling to drain excess moisture. The goal of these methods is to adjust the moisture content of the soils to within ± 2 percentage points of their optimum moisture at the time of compaction.

Further classification testing (natural moisture content, gradation analysis, and Proctor testing) should be performed in the field during construction to evaluate the suitability of excavated soils for reuse as structural fill. The project's budget should include an allowance for imported structural fill.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Anticipated Excavation Characteristics

Based on the results of this exploration, fairly uniform soil conditions and compositions are expected to be encountered throughout the project limits. Open-cut excavations will extend through natural soils that are considered to be relatively “clean” (i.e. soil that is relatively free of deleterious debris that may hinder excavation or installation). Debris typically considered unsuitable consist of wood, glass, organics, plastics, coal, brick or any other material larger than 2 inches in diameter. Based on these characteristics, it is anticipated that some of the subsurface materials encountered within the project sites (SP, SP-SM) may be reusable as backfill, but may require segregation from the unsuitable soils (if encountered). Soils containing appreciable amounts of deleterious debris should be discarded; however, an effort should be made during excavation to segregate potentially suitable in-situ soils for reuse.

5.2 Excavation Stability

The subsurface soils within the project limits are comprised of sandy soils of which have relatively no cohesion and have a considerable potential for caving. Additionally, some water seepage at varying elevations should be expected within the side walls of the open cut areas, increasing the potential for caving. Based on these mentioned characteristics, it is recommended that all subsurface soils be considered Type C in accordance with Occupational Safety and Health Administration (OSHA) criteria.

5.2.1 Temporary Slopes

In Federal Register, Volume 54, No. 209 (October, 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its “Construction Standards for Excavations, 29 CFR, part 1926, Subpart P”. This document was issued to better ensure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavations, or footing excavations, be constructed in accordance with the new (OSHA) guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the Contractor could be liable for substantial penalties.

Temporary slopes may not be a feasible option. The Contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The Contractor’s responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the Contractor’s safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

Where temporary slopes are not feasible, shoring by means of sheeting and/or trench shields may be appropriate. Where the stability of adjoining structures, pavements, or other improvements is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to provide structural stability. Shoring, bracing, or underpinning required for this project (if required) should be designed by a professional engineer.

5.2.2 Shoring

Shoring design and installation should be the responsibility of the Contractor. Shoring systems required for this project should be designed by a professional engineer. Shoring systems should be designed to provide positive restraint of trench walls in an effort to protect against lateral deformation that may result in ground cracks, settlement, and/or other ground movements that may affect adjacent underground utilities and pavements as well as surface improvements. The Contractor should be made aware of this potential condition in order that preventative measures can be implemented or repair measures provided for.

Depending on the shoring system used, the removal process may create voids along the walls of the excavations. If these voids are left in place and are significant, backfill and/or the retained soil may shift laterally resulting in settlement of overlying structures/pavements. As such, care should be taken to remove the shoring systems and backfill the trenches in a manner as to not create these voids.

In all cases, the Contractor should select an excavation and/or shoring scheme that will protect adjacent and overlying improvements, including below grade utilities.

We are providing this information solely as a service to our client. **Terracon** is not assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

5.3 Dewatering

It is expected that dewatering will be required for excavations that extend near or below the existing groundwater table. Dewatering above the groundwater level (varying from 2.5 to 6.5 feet below existing grades) could probably be accomplished by pumping from sumps. Dewatering at depths below the groundwater level will require well pointing and possibly shoring. Since temporary dewatering will impact construction and be dependent on construction methods and scheduling, we recommend the Contractor be solely responsible for the design, installation, maintenance, and performance of all temporary dewatering systems. Where shoring is employed, the dewatering system should be compatible with the type of shoring to be used. We recommend the Contractor verify groundwater conditions and evaluate dewatering requirements prior to construction.

Lowering the groundwater table during dewatering activities will result in an increase in effective stresses and may induce settlements of the soils underlying adjacent structures/pavements. Additionally, hydraulic compaction of predominately granular soils (e.g. SP, SP-SM soils) should be anticipated as a result of lowering the groundwater table. We recommend that the dewatering be performed such that the groundwater level is lowered no more than approximately 5 feet below the proposed excavation depth. It may be advantageous to install settlement monuments in areas where dewatering by means of well pointing is required.

5.4 Site Utility Installation

The base of the utility trenches should be observed by a qualified inspector prior to the pipe placement to verify the suitability of the bearing soils. It is expected that the utilities will be located above or near the groundwater level (at the time of this reporting varying from 2.5 to 6.5 feet below current grades), bearing in moist to wet granular soils. In these instances, the bearing soils may require some stabilization to provide suitable bedding. This stabilization is commonly accomplished by adding 12 inches or more of bedding stone (Type NCDOT No. 57). The resulting excavations should be backfilled with well compacted structural fill, as recommended in Section 4.1 of this report. Imported fill should be included in the construction budget for backfilling the utility excavations within the construction areas.

6.0 REPORT LIMITATIONS

The recommendations submitted are based on the available soil information obtained by **Terracon** and the information supplied by the client and their designated agents for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, **Terracon** should be notified immediately to determine if changes in the foundation recommendations are required. If **Terracon** is not retained to perform these functions, **Terracon** cannot be responsible for the impact of those conditions on the geotechnical recommendations for the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the Geotechnical Engineer should be provided the opportunity to review the final design plans and specifications to make sure our engineering recommendations have been properly incorporated into the design documents, in order that the earthwork and foundation recommendations may be properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations.

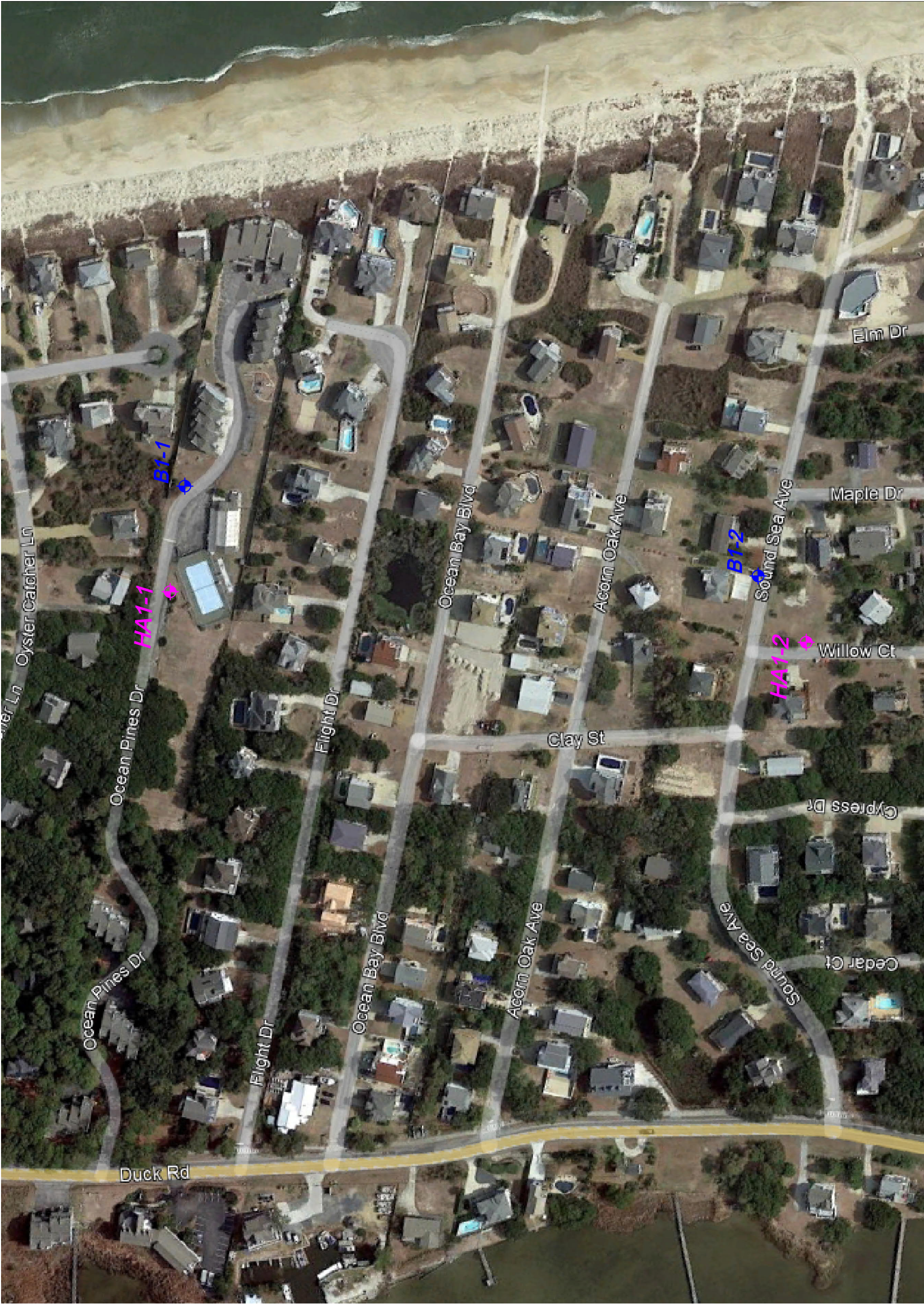
This report has been prepared for the exclusive use of the client and their designated agents for the specific application to the proposed Neighborhood Stormwater Study in Duck, North Carolina.

APPENDICES

APPENDIX A	BORING LOCATION PLAN
APPENDIX B	CLASSIFICATION SYSTEM FOR SOIL EXPLORATION
APPENDIX C	SUMMARY OF LABORATORY CLASSIFICATION RESULTS
APPENDIX D	BORING LOGS
APPENDIX E	GENERALIZED SOIL PROFILE
APPENDIX F	SATURATED HYDRAULIC CONDUCTIVITY TEST RESULTS

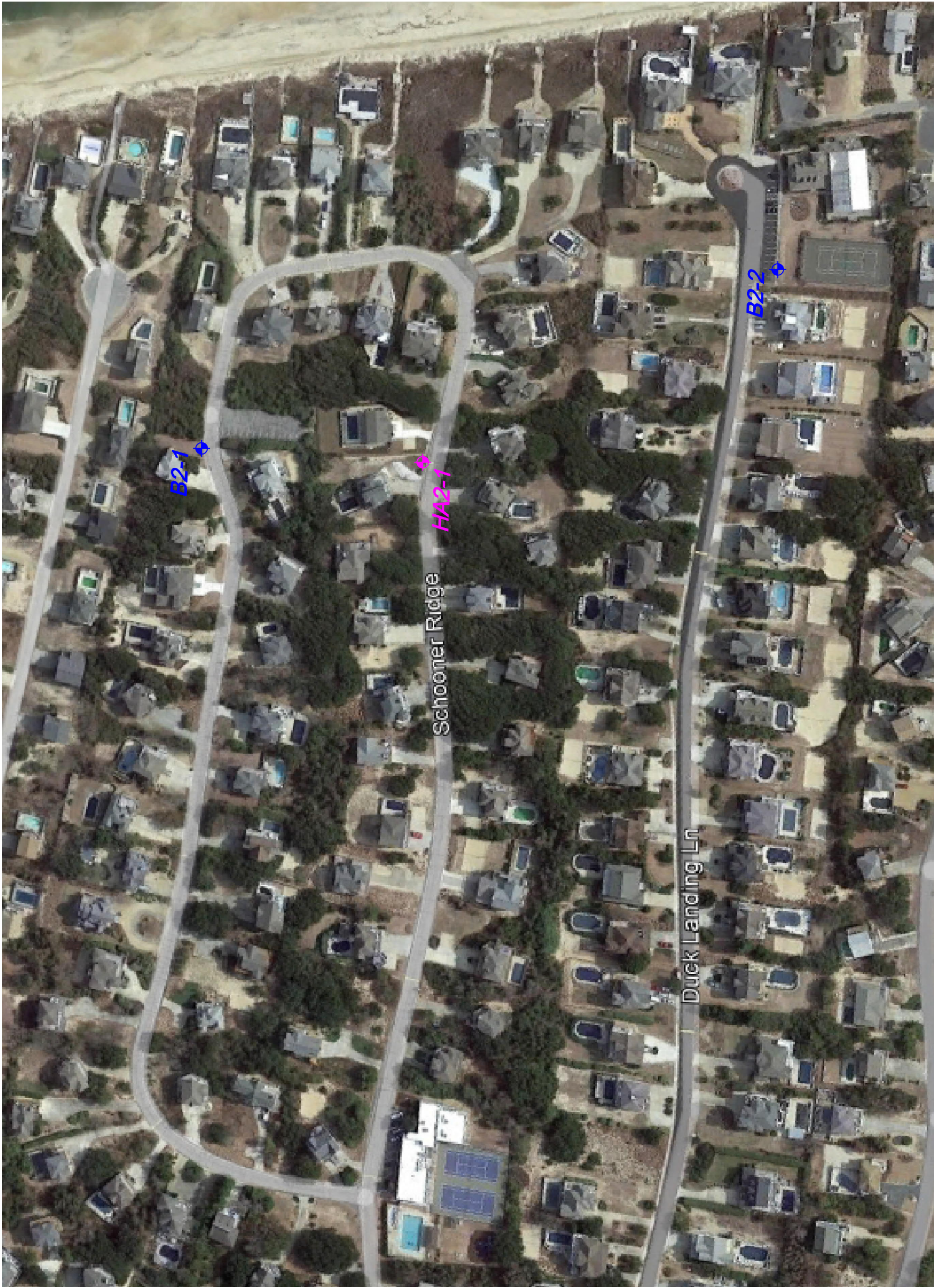
APPENDIX A


BORING LOCATION PLAN



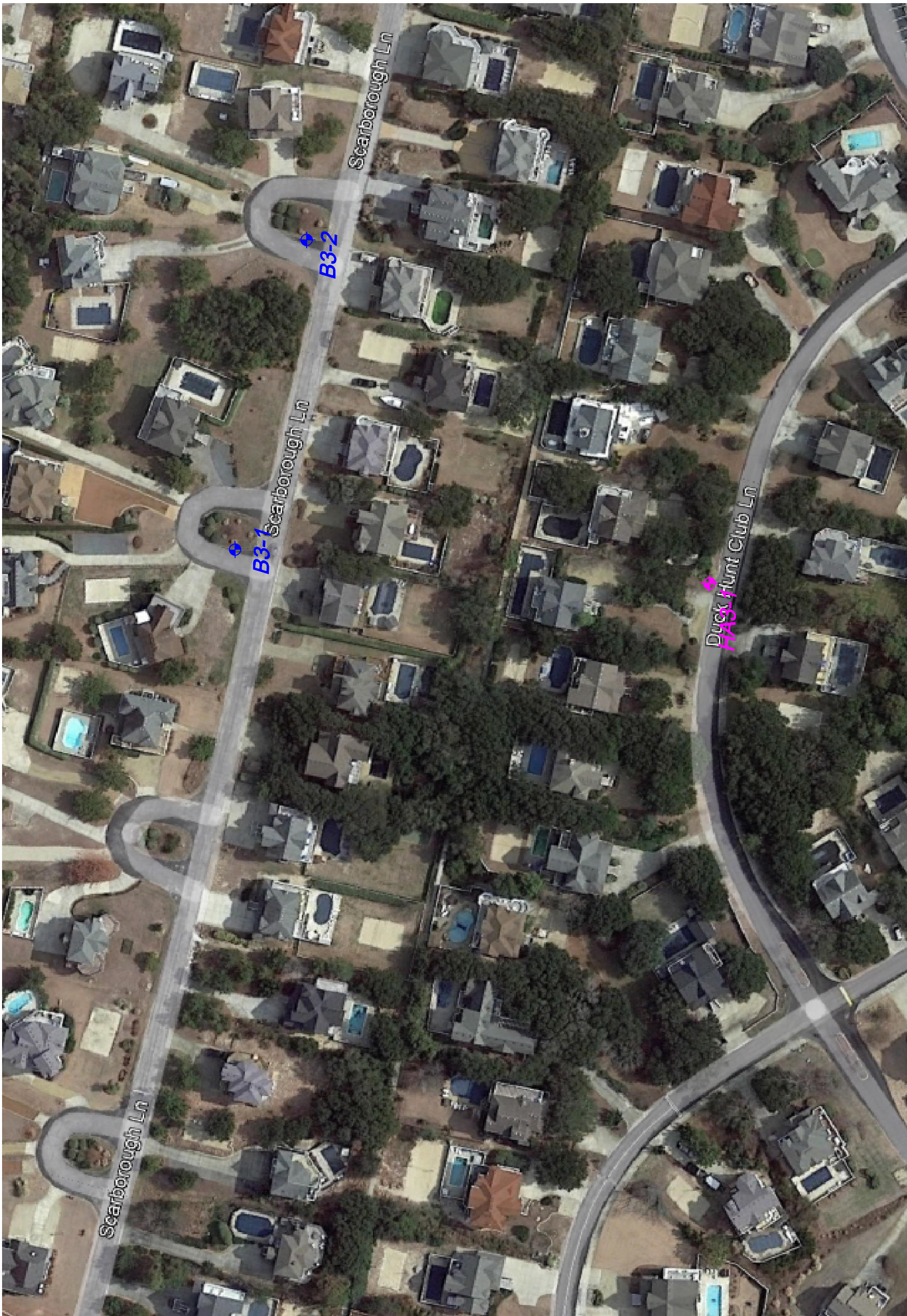
LEGEND	
	— APPROXIMATE BORING LOCATIONS

NEIGHBORHOOD STORMWATER STUDY - AREA 1 DUCK, NORTH CAROLINA	
Project No.: KS225061	Figure No.: 1
Date: 1/26/2023	SCALE: NOT TO SCALE
BORING LOCATION PLAN	



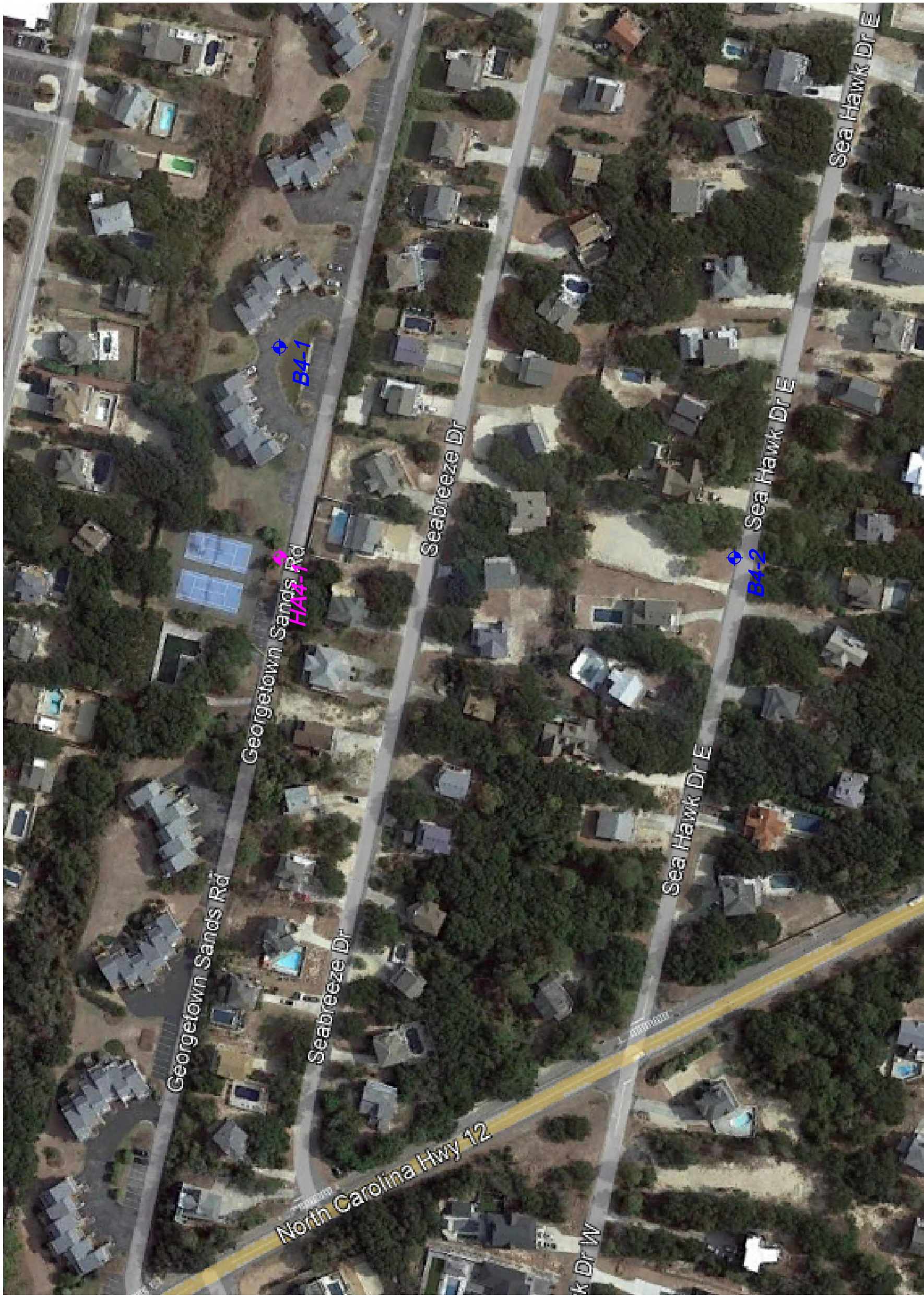
LEGEND	
	— APPROXIMATE BORING LOCATIONS



			
NEIGHBORHOOD STORMWATER STUDY - AREA 2 DUCK, NORTH CAROLINA			
Project No. K5225061	Date: 1/26/2023	Figure No. 1	
BORING LOCATION PLAN		SCALE: NOT TO SCALE	



LEGEND	
	— APPROXIMATE BORING LOCATIONS


		NEIGHBORHOOD STORMWATER STUDY - AREA 3 DUCK, NORTH CAROLINA	
Project No.	K5225061	Date	1/26/2023
BORING LOCATION PLAN		Figure No.	1
		SCALE	NOT TO SCALE



LEGEND	
	— APPROXIMATE BORING LOCATIONS
	

		
NEIGHBORHOOD STORMWATER STUDY - AREA 4 DUCK, NORTH CAROLINA		
Project No: K5225061	Date: 1/26/2023	Figure No: 1
BORING LOCATION PLAN		SCALE: NOT TO SCALE



LEGEND	
	— APPROXIMATE BORING LOCATIONS

 Terracon	
NEIGHBORHOOD STORMWATER STUDY - AREA 5 DUCK, NORTH CAROLINA	
Project No.: K5225061	Figure No.: 1
Date: 1/26/2023	SCALE: NOT TO SCALE
BORING LOCATION PLAN	

APPENDIX B

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION



Virginia Beach
5465 Greenwich Road
Virginia Beach, VA 23462
(757) 518-1703

Williamsburg
701 Alexander Lee Parkway
Williamsburg, Virginia 23185
(757) 564-6452

Elizabeth City
106 Capital Trace, Unit E
Elizabeth City, NC 27909
(252) 335-9765

Jacksonville
415-A Western Boulevard
Jacksonville, NC 28546
(910) 478-9915

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

Standard Penetration Test (SPT), N-value

Standard Penetration Tests (SPT) were performed in the field in general accordance with ASTM D 1586. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches. The number of blows required to drive the sampler each 6-inch increment (4 increments for each soil sample) of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value.

NON COHESIVE SOILS

(SILT, SAND, GRAVEL and Combinations)

Relative Density

Very Loose	4 blows/ft. or less
Loose	5 to 10 blows/ft.
Medium Dense	11 to 30 blows/ft.
Dense	31 to 50 blows/ft.
Very Dense	51 blows/ft. or more

Particle Size Identification

Boulders	8 inch diameter or more
Cobbles	3 to 8 inch diameter
Gravel	Coarse 1 to 3 inch diameter
	Medium $\frac{1}{2}$ to 1 inch diameter
	Fine $\frac{1}{4}$ to $\frac{1}{2}$ inch diameter
Sand	Coarse 2.00 mm to $\frac{1}{4}$ inch (diameter of pencil lead)
	Medium 0.42 to 2.00 mm (diameter of broom straw)
	Fine 0.074 to 0.42 mm (diameter of human hair)
Silt	0.002 to 0.074 mm (cannot see particles)

CLASSIFICATION SYMBOLS (ASTM D 2487 and D 2488)

Coarse Grained Soils

More than 50% retained on No. 200 sieve

GW - Well-graded Gravel
GP - Poorly graded Gravel
GW-GM - Well-graded Gravel w/Silt
GW-GC - Well-graded Gravel w/Clay
GP-GM - Poorly graded Gravel w/Silt
GP-GC - Poorly graded Gravel w/Clay
GM - Silty Gravel
GC - Clayey Gravel
GC-GM - Silty, Clayey Gravel
SW - Well-graded Sand
SP - Poorly graded Sand
SW-SM - Well-graded Sand w/Silt
SW-SC - Well-graded Sand w/Clay
SP-SM - Poorly graded Sand w/Silt
SP-SC - Poorly graded Sand w/Clay
SM - Silty Sand
SC - Clayey Sand
SC-SM - Silty, Clayey Sand

Fine-Grained Soils

50% or more passes the No. 200 sieve

CL - Lean Clay
CL-ML - Silty Clay
ML - Silt
OL - Organic Clay/Silt
Liquid Limit 50% or greater
CH - Fat Clay
MH - Elastic Silt
OH - Organic Clay/Silt

Highly Organic Soils

PT - Peat

COHESIVE SOILS

(CLAY, SILT and Combinations)

Consistency

Very Soft	2 blows/ft. or less
Soft	3 to 4 blows/ft.
Medium Stiff	5 to 8 blows/ft.
Stiff	9 to 15 blows/ft.
Very Stiff	16 to 30 blows/ft.
Hard	31 blows/ft. or more

Relative Proportions

<u>Descriptive Term</u>	<u>Percent</u>
Trace	0-5
Few	5-10
Little	15-25
Some	30-45
Mostly	50-100

Strata Changes

In the column "Description" on the boring log, the horizontal lines represent approximate strata changes.

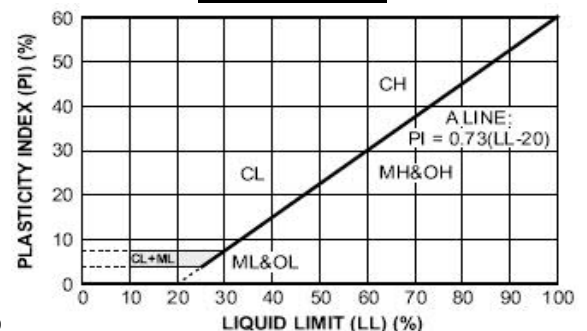
Groundwater Readings

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as tidal influences and man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, side walks, etc.).

Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent	GW, GP, SW, SP
More than 12 percent	GM, GC, SM, SC
5 to 12 percent	Borderline cases requiring dual symbols

Plasticity Chart





Terracon

KEY TO MATERIAL GRAPHICS

CLIENT VHB, Inc.

PROJECT NAME Neighborhood Stormwater Study

PROJECT NUMBER K5225061

PROJECT LOCATION Duck, North Carolina

LITHOLOGIC SYMBOLS (Unified Soil Classification System)



ASPHALT: Asphalt



GP-GM: USCS Poorly-graded Gravel with Silt



SP-SM: USCS Poorly-graded Sand with Silt



TOPSOIL: Topsoil

APPENDIX C

SUMMARY OF LABORATORY CLASSIFICATION RESULTS



Terracon

SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

CLIENT VHB, Inc.

PROJECT NAME Neighborhood Stormwater Study

PROJECT NUMBER K5225061

PROJECT LOCATION Duck, North Carolina

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
B1-1	1.0				0.075	0	SP	9.3			
B1-1	3.0				0.075	0	SP	27.2			
B1-2	3.0				0.075	1	SP	24.2			
B1-2	5.0				0.075	1	SP	29.6			
B2-1	3.0				0.075	0	SP	6.7			
B2-1	5.0				0.075	0	SP	27.2			
B2-2	7.0				0.075	0	SP	25.5			
B3-1	1.0				0.075	6	SP-SM	7.8			
B3-1	7.0				0.075	0	SP	24.7			
B4-1	3.0				0.075	0	SP	16.9			
B4-1	5.0				0.075	1	SP	24.0			
B4-2	5.0				0.075	2	SP	22.2			
B5-2	3.0				0.075	1	SP	19.0			
B5-2	5.0				0.075	1	SP	27.4			
HA1-1	1.3				0.075	0	SP	12.4			
HA1-2	1.3				0.075	0	SP	10.4			
HA2-1	1.3				0.075	0	SP	6.4			
HA3-1	1.5				0.075	6	SP-SM	9.1			
HA4-1	1.5				0.075	0	SP	4.7			
HA5-1	1.5				0.075	1	SP	4.2			

APPENDIX D

BORING LOGS



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach
5465 Greenwich Road
Virginia Beach, VA 23642
757-518-1703

Williamsburg
1592-E Penniman Road
Williamsburg, VA 23185
757-564-6452

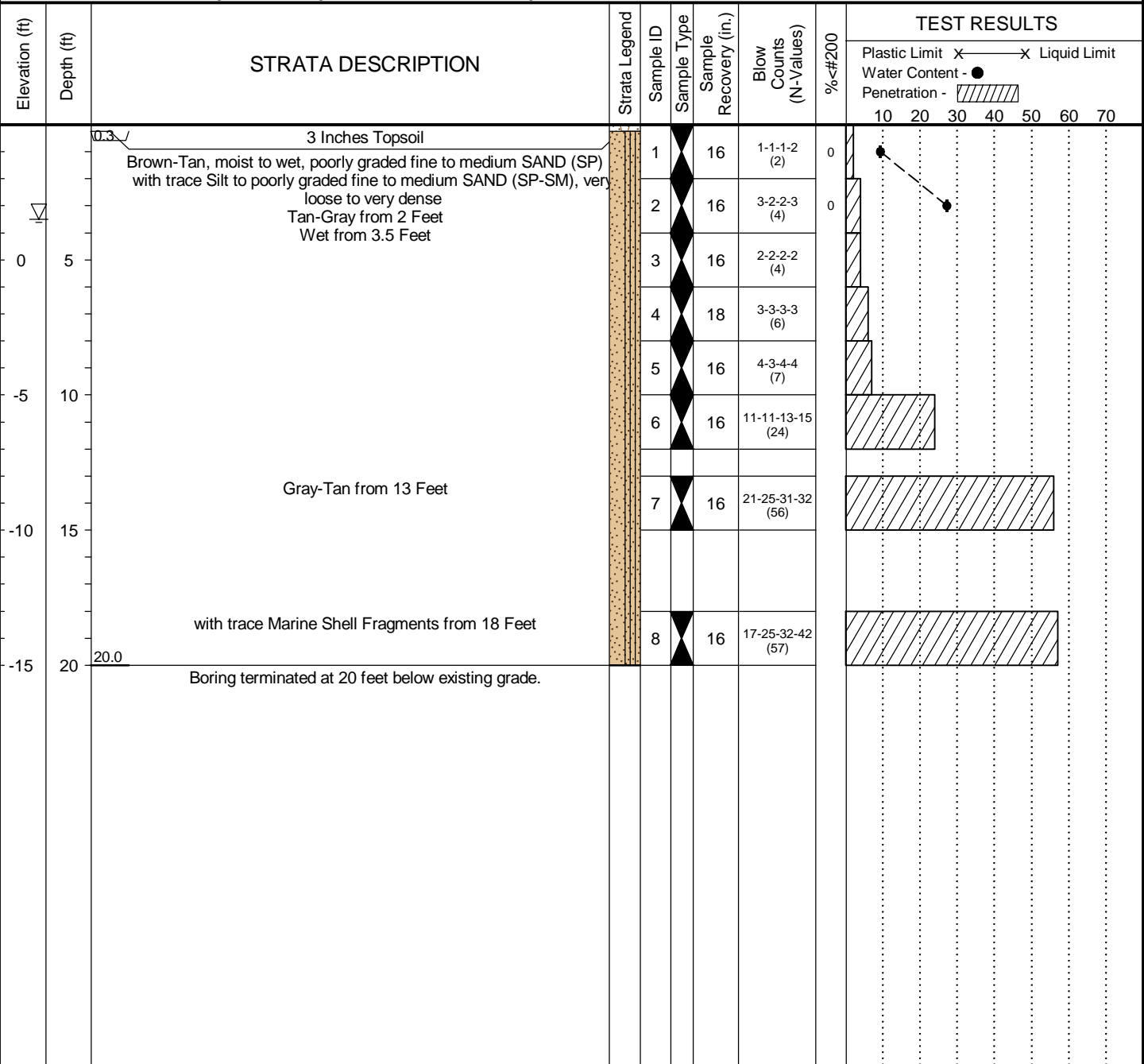
Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID
B1-1

PROJECT NAME: **Neighborhood Stormwater Study**
CLIENT: **VHB, Inc.**
PROJECT LOCATION: **Duck, North Carolina**
BORING COORDINATES: **EAST: 75.762765 NORTH: 36.205313**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ∇ : **3.5** AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **K5225061**
SURFACE ELEVATION (MSL) (ft): **5**
LOGGED BY: **J. Meads**
DATE STARTED: **1/5/2023**
DATE COMPLETED: **1/5/2023**
DRILLER: **Hofler Drilling Inc.**



Sample Type(s):

SPT - Standard Penetration Test

Notes:

This information pertains only to this boring and should not be interpreted as being indicative of the site.



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach
5465 Greenwich Road
Virginia Beach, VA 23642
757-518-1703

Williamsburg
1592-E Penniman Road
Williamsburg, VA 23185
757-564-6452

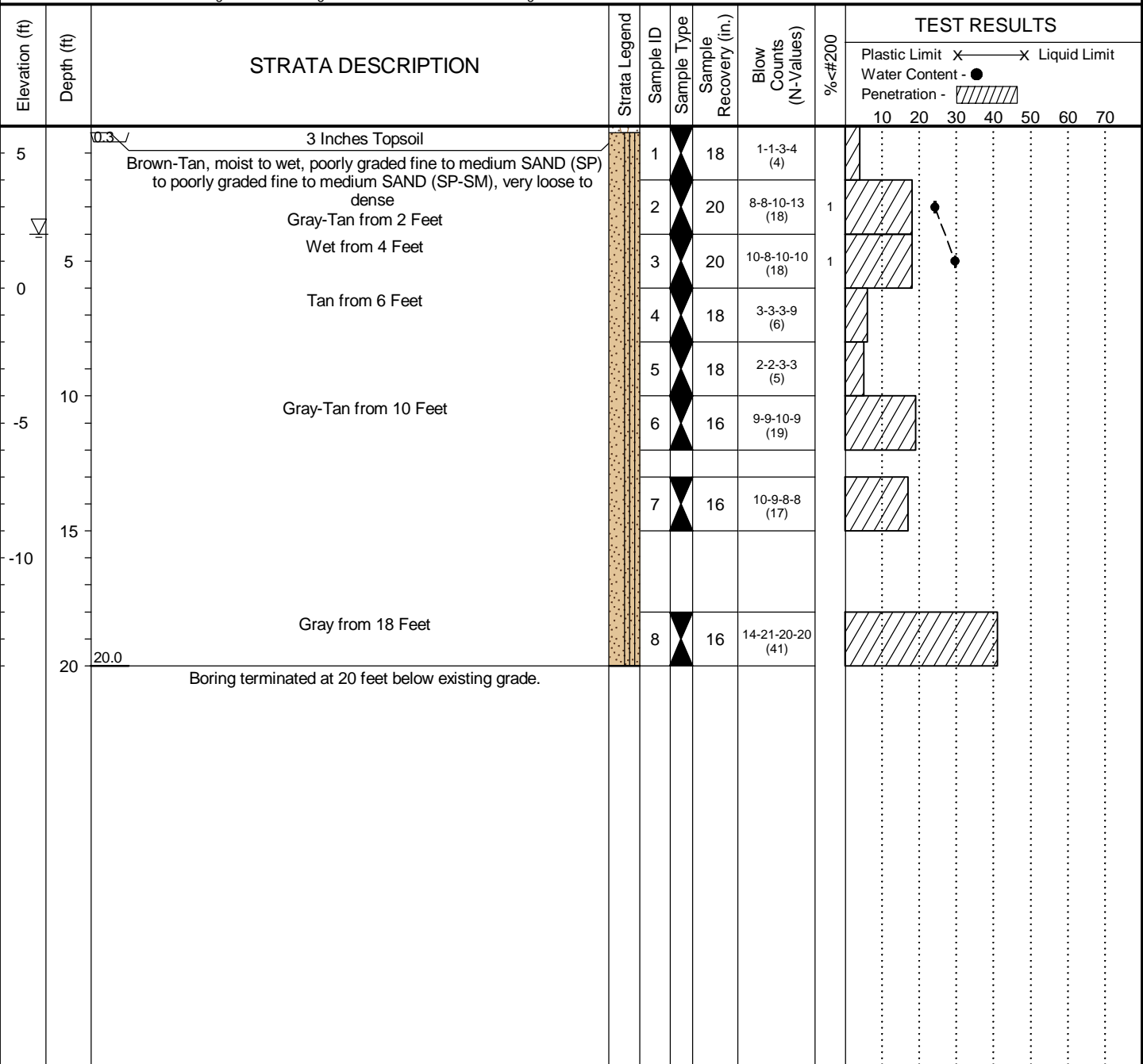
Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID
B1-2

PROJECT NAME: **Neighborhood Stormwater Study**
CLIENT: **VHB, Inc.**
PROJECT LOCATION: **Duck, North Carolina**
BORING COORDINATES: **EAST: 75.762455 NORTH: 36.20282**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ∇ : **4** AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **K5225061**
SURFACE ELEVATION (MSL) (ft): **6**
LOGGED BY: **J. Meads**
DATE STARTED: **1/5/2023**
DATE COMPLETED: **1/5/2023**
DRILLER: **Hofler Drilling Inc.**



Sample Type(s):

SPT - Standard Penetration Test

Notes:

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Virginia Beach
5465 Greenwich Road
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757-564-6452

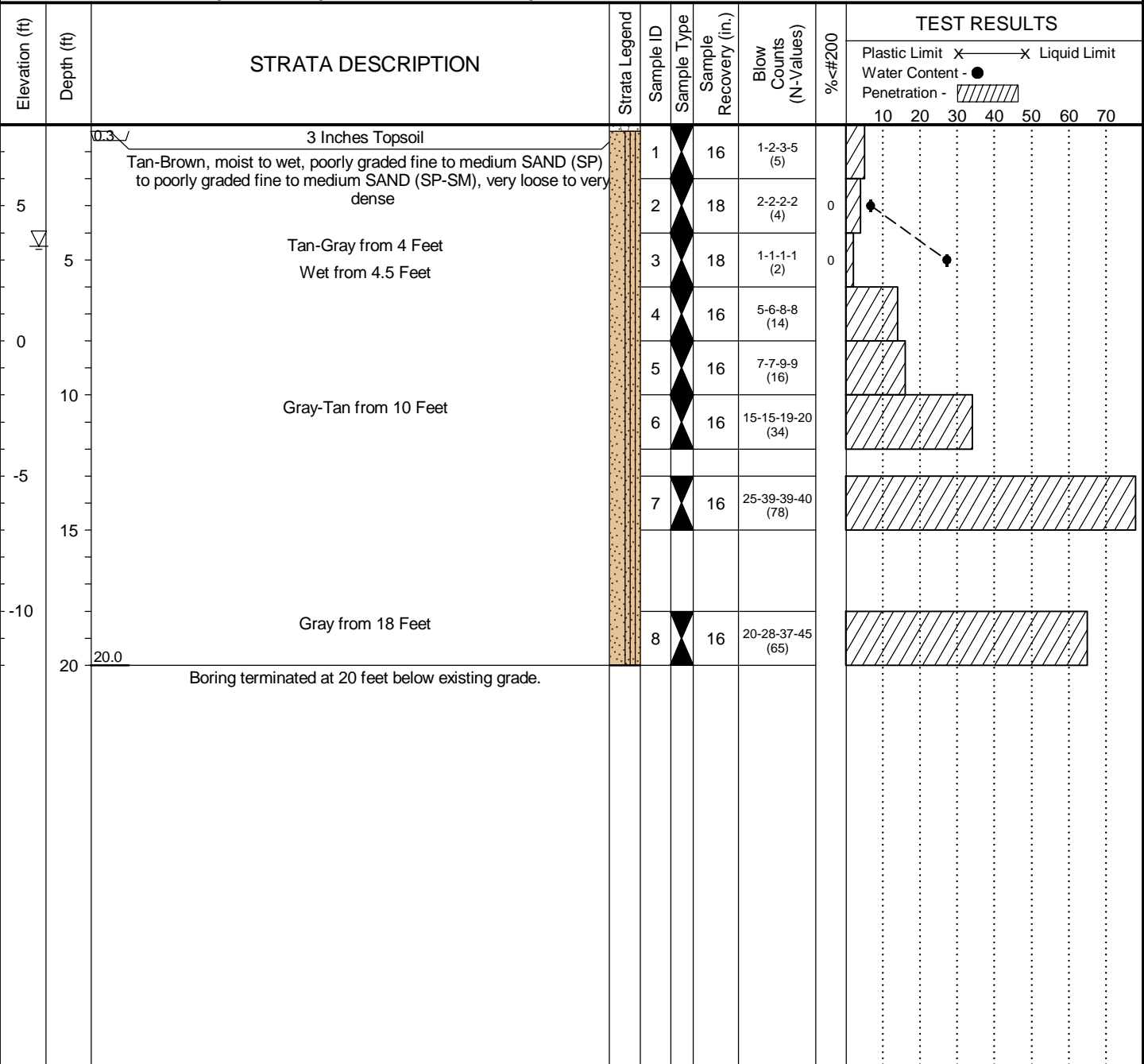
Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID
B2-1

PROJECT NAME: **Neighborhood Stormwater Study**
CLIENT: **VHB, Inc.**
PROJECT LOCATION: **Duck, North Carolina**
BORING COORDINATES: **EAST: 75.746853 NORTH: 36.16795**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ∇ : **4.5** AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **K5225061**
SURFACE ELEVATION (MSL) (ft): **8**
LOGGED BY: **J. Meads**
DATE STARTED: **1/5/2023**
DATE COMPLETED: **1/5/2023**
DRILLER: **Hofler Drilling Inc.**



Sample Type(s):

SPT - Standard Penetration Test

Notes:

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Virginia Beach
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Williamsburg
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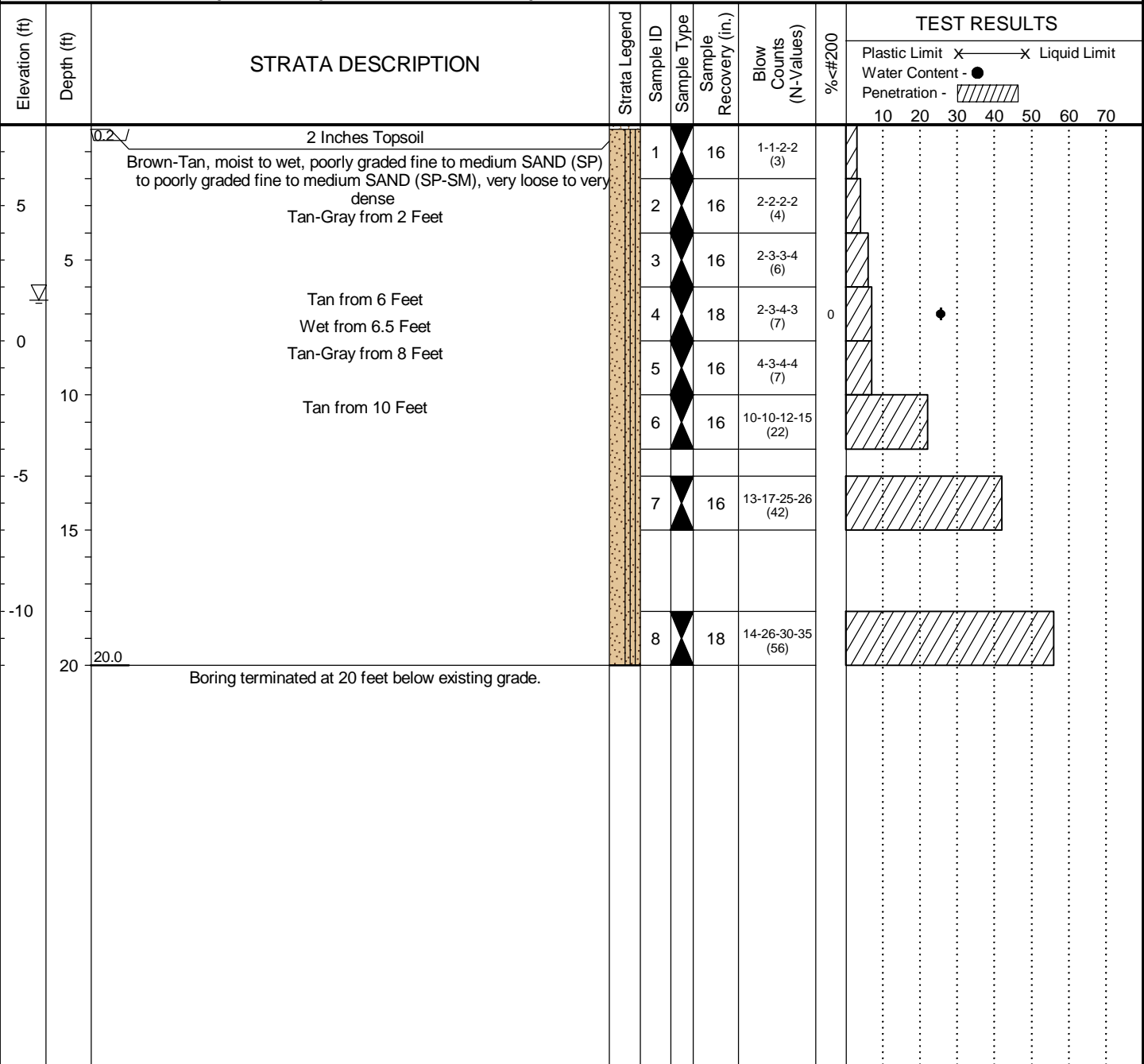
Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID B2-2

PROJECT NAME: **Neighborhood Stormwater Study**
CLIENT: **VHB, Inc.**
PROJECT LOCATION: **Duck, North Carolina**
BORING COORDINATES: **EAST: 75.745426 NORTH: 36.165827**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ▽: **6.5** AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⚡: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **K5225061**
SURFACE ELEVATION (MSL) (ft): **8**
LOGGED BY: **J. Meads**
DATE STARTED: **1/5/2023**
DATE COMPLETED: **1/5/2023**
DRILLER: **Hofler Drilling Inc.**



Sample Type(s):

SPT - Standard Penetration Test

Notes:

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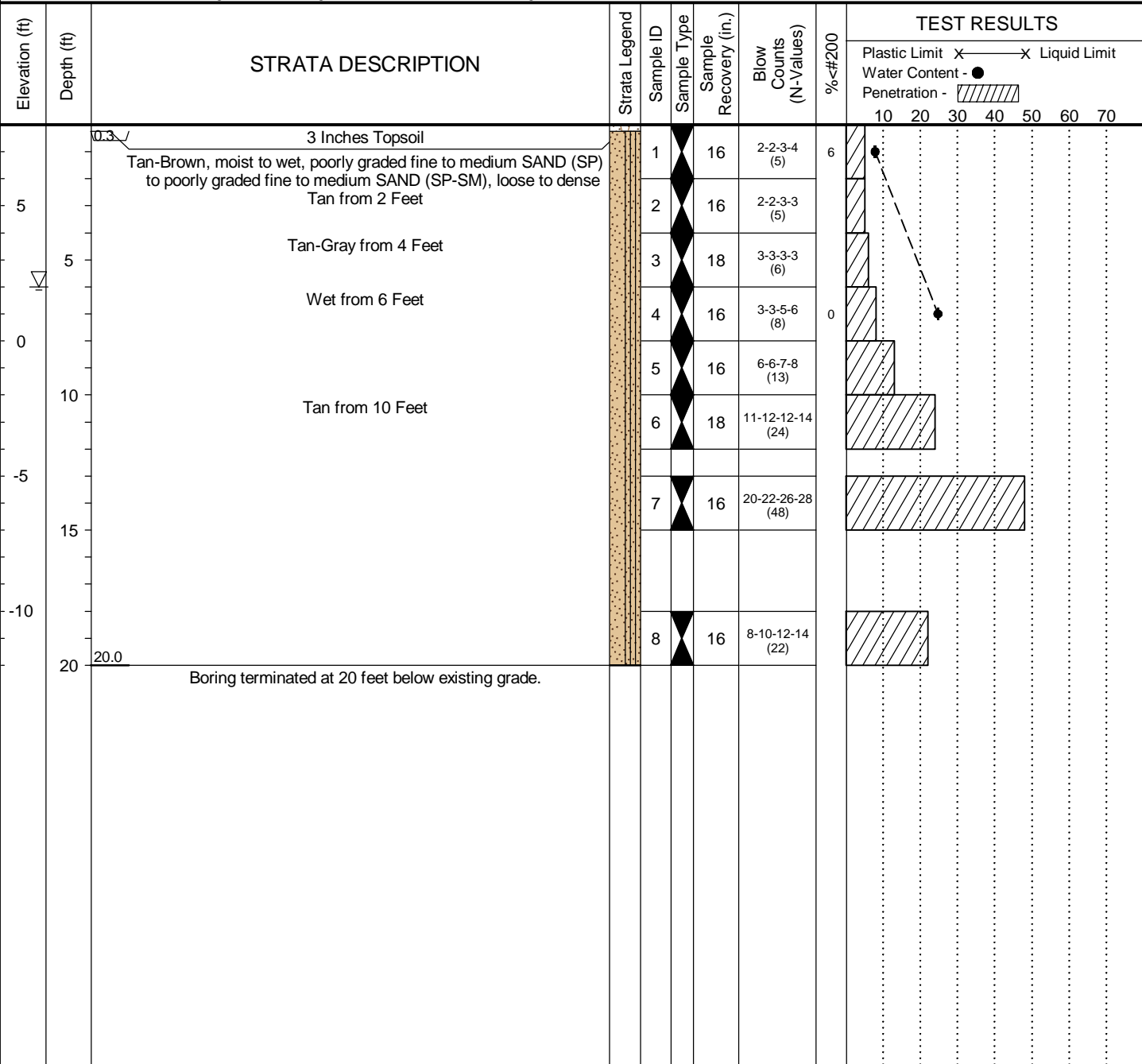
Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID
B3-1

PROJECT NAME: **Neighborhood Stormwater Study**
CLIENT: **VHB, Inc.**
PROJECT LOCATION: **Duck, North Carolina**
BORING COORDINATES: **EAST: 75.745874 NORTH: 36.161851**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ∇ : **6** AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **K5225061**
SURFACE ELEVATION (MSL) (ft): **8**
LOGGED BY: **J. Meads**
DATE STARTED: **1/5/2023**
DATE COMPLETED: **1/5/2023**
DRILLER: **Hofler Drilling Inc.**



Sample Type(s):

SPT - Standard Penetration Test

Notes:

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Elizabeth City, NC 27909
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910-478-9915

BORING ID
B3-2

PROJECT NAME: **Neighborhood Stormwater Study**

CLIENT: **VHB, Inc.**

PROJECT LOCATION: **Duck, North Carolina**

BORING COORDINATES: **EAST: 75.744859 NORTH: 36.161902**

DRILLING METHOD(S): **Rotary wash "mud"**

GROUNDWATER*: INITIAL (ft) ∇ : **6** AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____

PROJECT NUMBER: **K5225061**














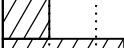




SURFACE ELEVATION (MSL) (ft): **8**

LOGGED BY: **J. Meads**

DATE STARTED: **1/5/2023**

DATE COMPLETED: **1/5/2023**

DRILLER: **Hofler Drilling Inc.**

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS													
									Plastic Limit X X Liquid Limit													
									Water Content - ●													
										Penetration - 												
										10 20 30 40 50 60 70												
	0.2	2 Inches Topsoil		1		16	1-2-2-3 (4)															
5		Reddish-Brown, moist to wet, poorly graded fine to medium SAND (SP) to poorly graded fine to medium SAND (SP-SM), very loose to very dense		2		16	3-4-4-5 (8)															
		Tan from 2 Feet		3		18	6-5-4-4 (9)															
	5	Tan-Gray from 4 Feet		4		16	2-2-2-2 (4)															
		Wet and Reddish Tan from 6 Feet		5		16	3-5-5-8 (10)															
0		Tan-Brown from 8 Feet		6		16	12-13-13-19 (26)															
	10	Trace to little Organics from 9.5 to 10 Feet																				
		Gray from 10 Feet																				
		Gray-Tan from 13 Feet		7		18	20-26-38-44 (64)															
	15																					
		Gray with trace Marine Shell Fragments		8		18	8-8-10-15 (18)															
	20	Boring terminated at 20 feet below existing grade.																				

Sample Type(s):

SPT - Standard Penetration Test

Notes:

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Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID
B4-1

PROJECT NAME: **Neighborhood Stormwater Study**

CLIENT: **VHB, Inc.**

PROJECT LOCATION: **Duck, North Carolina**

BORING COORDINATES: **EAST: 75.743262 NORTH: 36.157259**

DRILLING METHOD(S): **Rotary wash "mud"**

GROUNDWATER*: INITIAL (ft) ∇ : **4** AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____

PROJECT NUMBER: **K5225061**

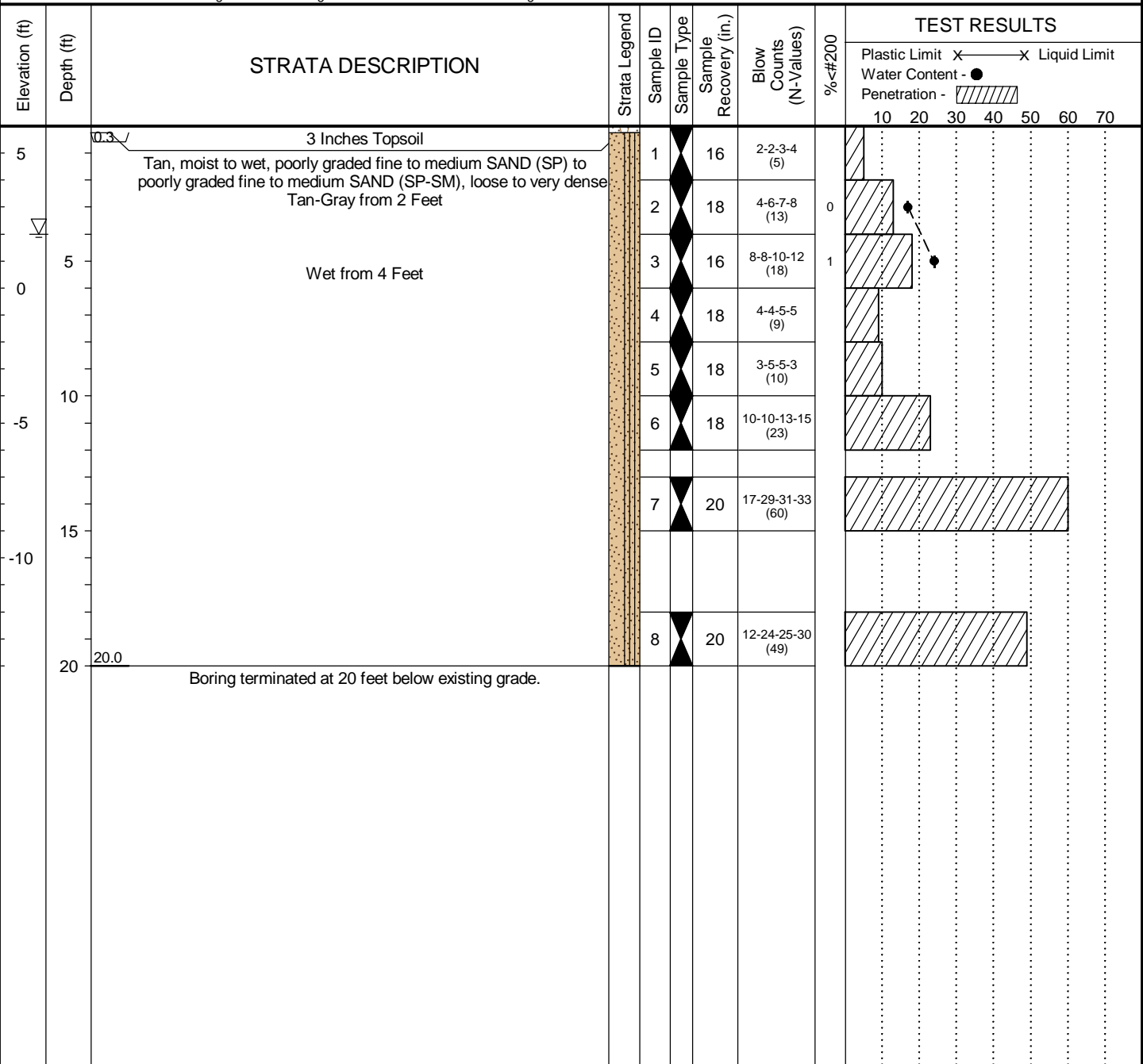
SURFACE ELEVATION (MSL) (ft): **6**

LOGGED BY: **J. Meads**

DATE STARTED: **1/6/2023**

DATE COMPLETED: **1/6/2023**

DRILLER: **Hofler Drilling Inc.**



Sample Type(s):

SPT - Standard Penetration Test

Notes:

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Virginia Beach
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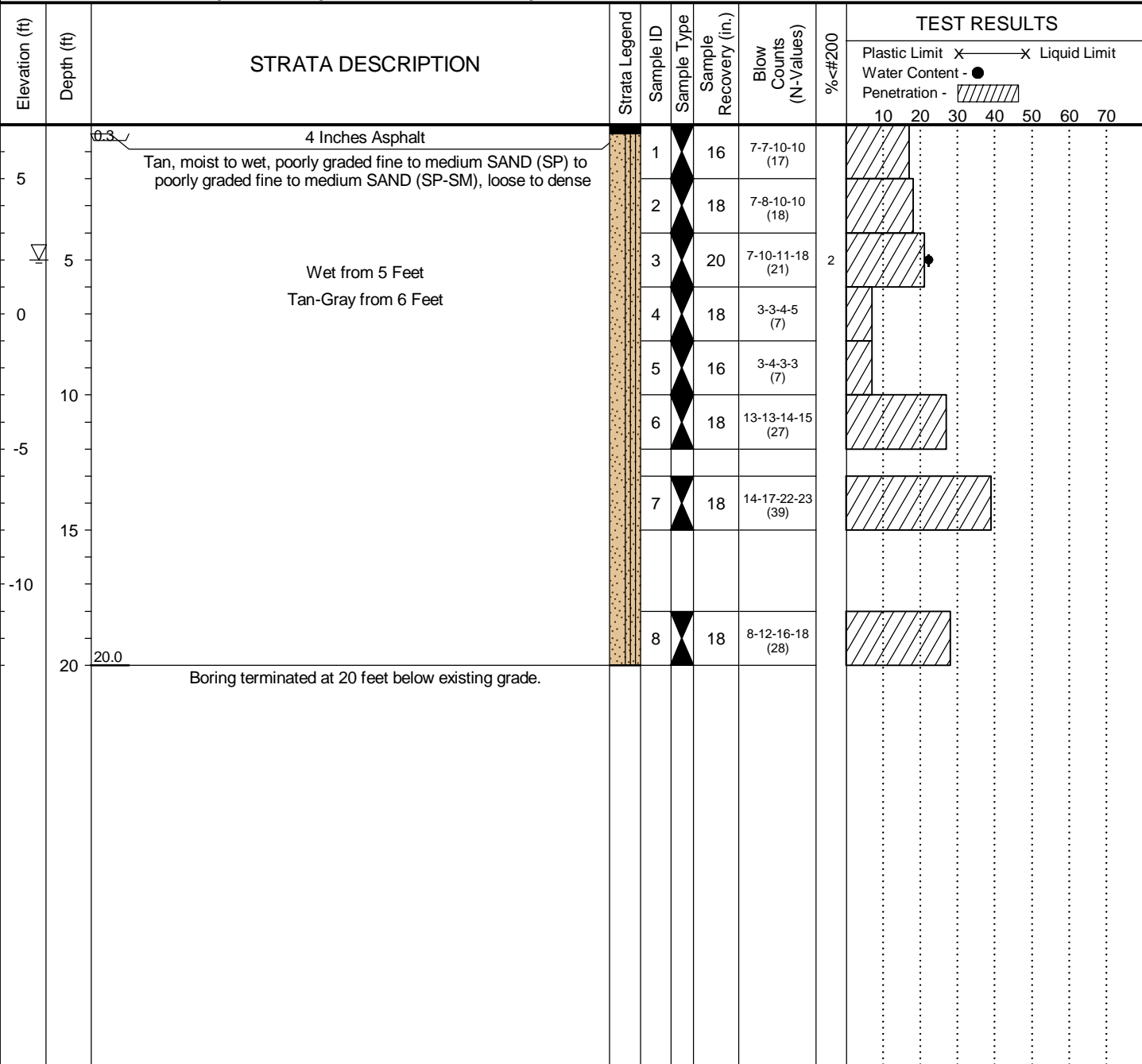
Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID B4-2

PROJECT NAME: **Neighborhood Stormwater Study**
CLIENT: **VHB, Inc.**
PROJECT LOCATION: **Duck, North Carolina**
BORING COORDINATES: **EAST: 75.743429 NORTH: 36.155727**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ▽: **5** AFTER _____ HOURS (ft) ▼: _____ CAVE-IN (ft) ⚡: _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **K5225061**
SURFACE ELEVATION (MSL) (ft): **7**
LOGGED BY: **J. Meads**
DATE STARTED: **1/6/2023**
DATE COMPLETED: **1/6/2023**
DRILLER: **Hofler Drilling Inc.**



Sample Type(s):

SPT - Standard Penetration Test

Notes:

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106 Capital Trace Unit E
Elizabeth City, NC 27909
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Jacksonville
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Jacksonville, NC 28546
910-478-9915

BORING ID
B5-1

PROJECT NAME: **Neighborhood Stormwater Study**
CLIENT: **VHB, Inc.**
PROJECT LOCATION: **Duck, North Carolina**
BORING COORDINATES: **EAST: 75.740653 NORTH: 36.152904**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ∇ : **4** AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **K5225061**
SURFACE ELEVATION (MSL) (ft): **6**
LOGGED BY: **J. Meads**
DATE STARTED: **1/6/2023**
DATE COMPLETED: **1/6/2023**
DRILLER: **Hofler Drilling Inc.**

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
									Plastic Limit	Water Content	Penetration	Liquid Limit	10	20	30	40	50	60	70																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
5	0.2	2 Inches Asphalt		1		18	5-6-6-8 (12)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						</

Sample Type(s):

SPT - Standard Penetration Test

Notes:

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RECORD OF SUBSURFACE EXPLORATION

Virginia Beach
5465 Greenwich Road
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Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID
B5-2

PROJECT NAME: **Neighborhood Stormwater Study**
CLIENT: **VHB, Inc.**
PROJECT LOCATION: **Duck, North Carolina**
BORING COORDINATES: **EAST: 75.740204 NORTH: 36.151733**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ∇ : **3.5** AFTER _____ HOURS (ft) ∇ : _____ CAVE-IN (ft) \odot : _____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **K5225061**
SURFACE ELEVATION (MSL) (ft): **5**
LOGGED BY: **J. Meads**
DATE STARTED: **1/6/2023**
DATE COMPLETED: **1/6/2023**
DRILLER: **Hofler Drilling Inc.**

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS			
									Plastic Limit - X	Liquid Limit - X	Water Content - ●	Penetration -
		3 Inches Topsoil		1		16	4-2-4-4 (6)					
		Tan-Gray, moist to wet, poorly graded fine to medium SAND (SP) to poorly graded fine to medium SAND (SP-SM), loose to dense		2		18	4-4-5-5 (9)	1				
		Wet from 3.5 Feet		3		16	8-10-12-13 (22)	1				
		Gray from 6 Feet		4		18	4-4-5-8 (9)					
		Tan-Gray from 8 Feet		5		18	3-4-6-10 (10)					
				6		16	10-11-11-15 (22)					
				7		18	15-17-22-22 (39)					
				8		16	10-19-20-22 (39)					
		Boring terminated at 20 feet below existing grade.										

Sample Type(s):

SPT - Standard Penetration Test

Notes:

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Virginia Beach
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Elizabeth City, NC 27909
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Jacksonville, NC 28546
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HAND AUGER BORING ID HA1-1

PROJECT NAME: Neighborhood Stormwater Study
CLIENT: VHB, Inc.
PROJECT LOCATION: Duck, North Carolina
BORING COORDINATES: EAST: 75.763296 NORTH: 36.205264
DRILLING METHOD(S): Hand Auger
GROUNDWATER*: INITIAL (ft) ∇ : 2.5 AFTER HOURS (ft) ∇ : CAVE-IN (ft) \ominus :
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: K5225061
SURFACE ELEVATION (MSL) (ft): 5
LOGGED BY: J. Meads
DATE STARTED: 1/13/2023
DATE COMPLETED: 1/13/2023
DRILLER: Terracon

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	%<#200	TEST RESULTS									
								Plastic Limit	X	—	X	Liquid Limit	Water Content	●	Penetration	/ / / /	
								10	20	30	40	50	60	70			
	0.3	3 Inches Topsoil															
	1	Tan-Gray, moist to wet, poorly graded fine to medium SAND (SP) to poorly graded fine to medium SAND (SP-SM)		1		12											
	2			2		12	0										
	3	Wet from 2.5 Feet		3		12											
	3.5	Cave In at 3.5 Feet below existing grade		4		6											
		Boring terminated at 3.5 feet below existing grade.															

Sample Type(s):

AUGER - Auger Sample

Notes:

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Virginia Beach
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


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HAND AUGER BORING ID HA1-2

PROJECT NAME: Neighborhood Stormwater Study
CLIENT: VHB, Inc.
PROJECT LOCATION: Duck, North Carolina
BORING COORDINATES: EAST: 75.762795 NORTH: 36.202568
DRILLING METHOD(S): Hand Auger
GROUNDWATER*: INITIAL (ft) ∇ : 2.6 AFTER HOURS (ft) ∇ : CAVE-IN (ft) \ominus :
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: K5225061
SURFACE ELEVATION (MSL) (ft): 6
LOGGED BY: J. Meads
DATE STARTED: 1/13/2023
DATE COMPLETED: 1/13/2023
DRILLER: Terracon

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	%<#200	TEST RESULTS															
								Plastic Limit	X	Liquid Limit	X	Water Content - ●	Penetration - 	10	20	30	40	50	60	70			
5	0.3	3 Inches Topsoil																					
		Tan-Gray, moist to wet, poorly graded fine to medium SAND (SP) to poorly graded fine to medium SAND (SP-SM)		1		12																	
	1			2		12																	
	2			3		12																	
	3			4		6																	
	3.5	Cave In at 3.5 Feet below existing grade																					
		Boring terminated at 3.5 feet below existing grade.																					

Sample Type(s):

AUGER - Auger Sample

Notes:

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Virginia Beach
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

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106 Capital Trace Unit E
Elizabeth City, NC 27909
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Jacksonville
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910-478-9915

HAND AUGER BORING ID HA4-1

PROJECT NAME: Neighborhood Stormwater Study
CLIENT: VHB, Inc.
PROJECT LOCATION: Duck, North Carolina
BORING COORDINATES: EAST: 75.744044 NORTH: 36.157132
DRILLING METHOD(S): Hand Auger
GROUNDWATER*: INITIAL (ft) ∇ : 3.8 AFTER HOURS (ft) ∇ : CAVE-IN (ft) \odot :
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: K5225061
SURFACE ELEVATION (MSL) (ft): 7
LOGGED BY: J. Meads
DATE STARTED: 1/13/2023
DATE COMPLETED: 1/13/2023
DRILLER: Terracon

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	%<#200	TEST RESULTS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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Sample Type(s):

AUGER - Auger
Sample

Notes:



RECORD OF SUBSURFACE EXPLORATION

Virginia Beach
5465 Greenwich Road
Virginia Beach, VA 23642
757-518-1703

Williamsburg
1592-E Penniman Road
Williamsburg, VA 23185
757-564-6452


Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

HAND AUGER BORING ID HA5-1

PROJECT NAME: Neighborhood Stormwater Study
CLIENT: VHB, Inc.
PROJECT LOCATION: Duck, North Carolina
BORING COORDINATES: EAST: 75.740104 NORTH: 36.152242
DRILLING METHOD(S): Hand Auger
GROUNDWATER*: INITIAL (ft) ∇ : 3.6 AFTER HOURS (ft) ∇ : CAVE-IN (ft) \ominus :
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: K5225061
SURFACE ELEVATION (MSL) (ft): 6
LOGGED BY: J. Meads
DATE STARTED: 1/13/2023
DATE COMPLETED: 1/13/2023
DRILLER: Terracon

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	%<#200	TEST RESULTS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Sample Type(s):

AUGER - Auger Sample

Notes:

This information pertains only to this boring and should not be interpreted as being indicative of the site.

APPENDIX E

GENERALIZED SOIL PROFILE



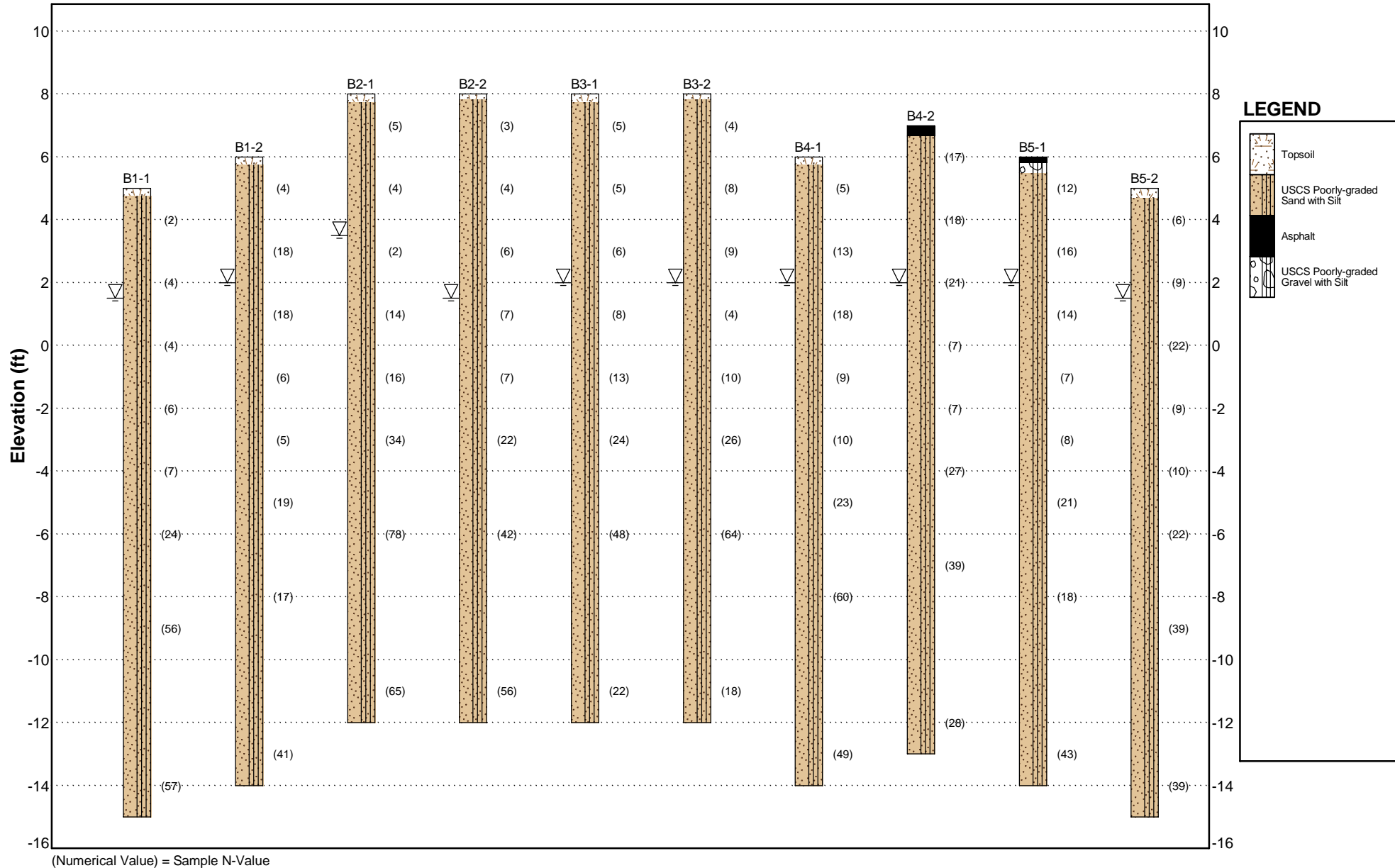
GENERALIZED SOIL PROFILE

PROJECT NAME: Neighborhood Stormwater Study

PROJECT NUMBER: K5225061

PROJECT LOCATION: Duck, North Carolina

CLIENT: VHB, Inc.





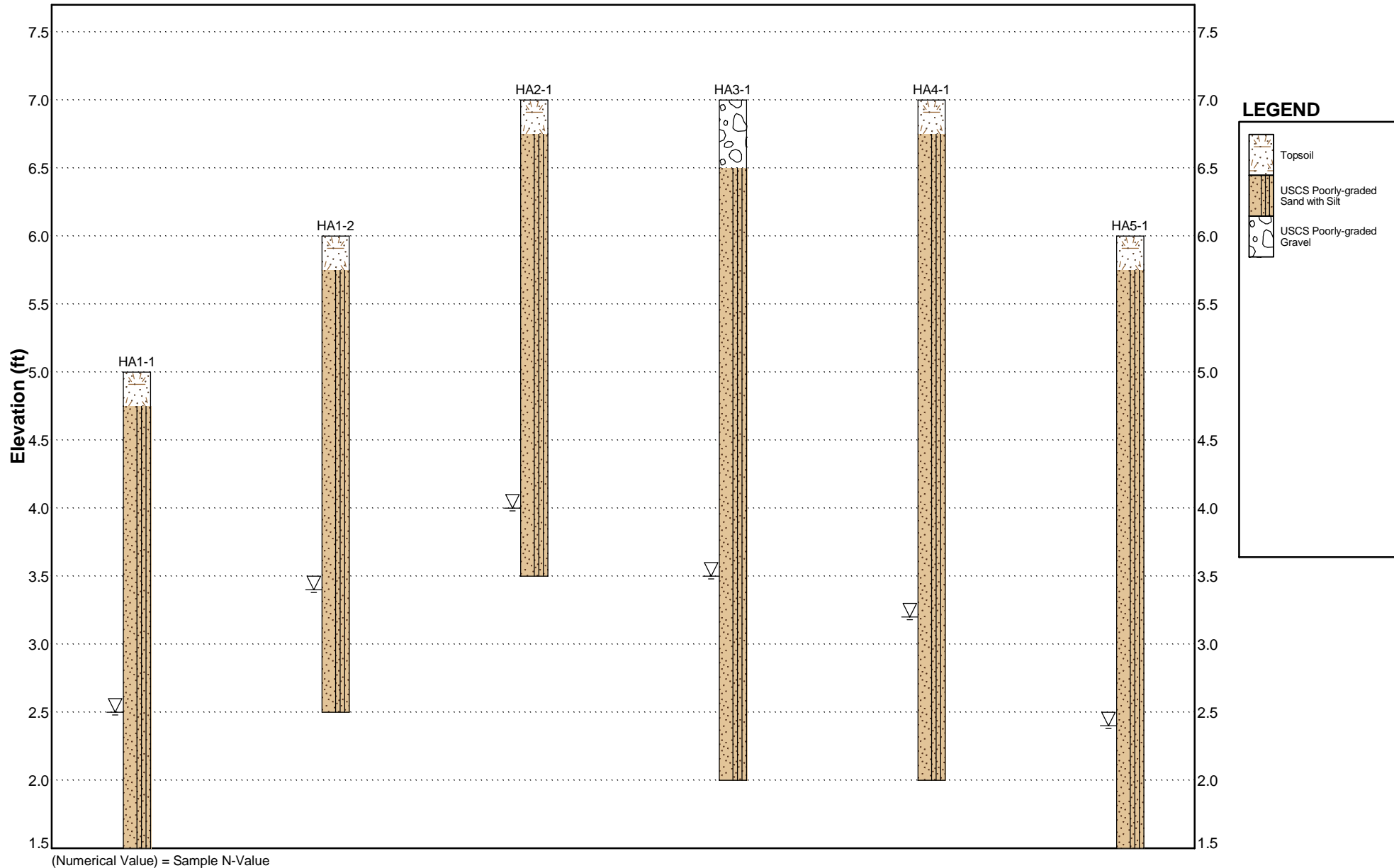
GENERALIZED SOIL PROFILE

PROJECT NAME: Neighborhood Stormwater Study

PROJECT NUMBER: K5225061


PROJECT LOCATION: Duck, North Carolina


CLIENT: VHB, Inc.



APPENDIX F


SATURATED HYDRAULIC CONDUCTIVITY TEST RESULTS


Constant-Head Borehole Permeameter Test					Analytical Method: Glover Solution					
Project Name.....: Neighborhood Stormwater Study		Project No.....: K5225061		Terminology and Solution (R. E. Glover Solution)*						
Boring No.....: HA1-1		Proj. Location...: Duck, NC		Ksat _B : (Coefficient of Permeability) @ Base Tmp. T _B (°C) 13						
Investigators.....: T. Kellogg		Date.....: 1/13/22		Q: Rate of flow of water from the borehole						
Boring Depth.....: 1.3 ft (m, cm, ft, in)		WCU Base Ht. h: 15.0 cm		H: Constant height of water in the borehole						
Boring Diameter...: 8.3 cm		WCU Susp. Ht. S: 5.1 cm		r: Radius of the cylindrical borehole						
Boring Radius r...: 4.15 cm		Const. Wtr. Ht. H: 20.1 cm		V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T _B						
Soil/Water Temp. T: 13 °C		H/r **: 4.8		Ksat = Q[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁻⁵ + r/H]/(2πH ²) [Basic Glover Solu.]						
Dyn. Visc. @ T °C.: 0.001202 kg/m-s		Dyn. Visc. @ T _B °C.: 0.001202 kg/m-s		Ksat _B = QV[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁻⁵ + r/H]/(2πH ²) [Tmp. Correction]						
VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time		Flow Rate Q (ml/min)	----- Ksat _B Equivalent Values -----				
			(hr:min:sec)	(min)		(cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
1,900		9:30:00 AM								
1,800	100	9:30:20 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
1,700	100	9:30:40 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
1,600	100	9:31:00 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
1,500	100	9:31:20 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
1,400	100	9:31:40 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
1,300	100	9:32:00 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
1,200	100	9:32:20 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
1,100	100	9:32:40 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
1,000	100	9:33:00 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
900	100	9:33:20 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
800	100	9:33:40 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
700	100	9:34:00 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
600	100	9:34:20 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189
500	100	9:34:40 AM	0:00:20	0.33	300.00	0.173	2.89E-03	249.592	4.094	8.189


Constant-Head Borehole Permeameter Test					Analytical Method: Glover Solution					
Project Name.....: Neighborhood Stormwater Study		Project No.....: K5225061		Terminology and Solution (R. E. Glover Solution)*						
Boring No.....: HA1-2		Proj. Location...: Duck, NC		Ksat _B : (Coefficient of Permeability) @ Base Tmp. T _B (°C) 13						
Investigators.....: T. Kellogg		Date.....: 1/13/22		Q: Rate of flow of water from the borehole						
Boring Depth.....: 1.3 ft (m, cm, ft, in)		WCU Base Ht. h: 15.0 cm		H: Constant height of water in the borehole						
Boring Diameter...: 8.3 cm		WCU Susp. Ht. S: 5.1 cm		r: Radius of the cylindrical borehole						
Boring Radius r...: 4.15 cm		Const. Wtr. Ht. H: 20.1 cm		V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T _B						
Soil/Water Temp. T: 13 °C		H/r **: 4.8		Ksat = Q[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁻⁵ + r/H]/(2πH ²) [Basic Glover Solu.]						
Dyn. Visc. @ T °C.: 0.001202 kg/m-s		Dyn. Visc. @ T _B °C.: 0.001202 kg/m-s		Ksat _B = QV[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁻⁵ + r/H]/(2πH ²) [Tmp. Correction]						
VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time		Flow Rate Q (ml/min)	----- Ksat _B Equivalent Values -----				
			(hr:min:sec)	(min)		(cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
1,900		8:30:00 AM								
1,800	100	8:30:10 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
1,700	100	8:30:20 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
1,600	100	8:30:30 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
1,500	100	8:30:40 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
1,400	100	8:30:50 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
1,300	100	8:31:00 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
1,200	100	8:31:10 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
1,100	100	8:31:20 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
1,000	100	8:31:30 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
900	100	8:31:40 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
800	100	8:31:50 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
700	100	8:32:00 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
600	100	8:32:10 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
500	100	8:32:20 AM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377

Constant-Head Borehole Permeameter Test						Analytical Method: Glover Solution				
Project Name.....: Neighborhood Stormwater Study		Project No.....: K5225061		Terminology and Solution (R. E. Glover Solution)*						
Boring No.....: HA2-1		Proj. Location...: Duck, NC		Ksat _B : (Coefficient of Permeability) @ Base Tmp. T _B (°C) 14						
Investigators.....: T. Kellogg		Date.....: 1/13/22		Q: Rate of flow of water from the borehole						
Boring Depth.....: 1.3 ft (m, cm, ft, in)		WCU Base Ht. h: 15.0 cm		H: Constant height of water in the borehole						
Boring Diameter...: 8.3 cm		WCU Susp. Ht. S: 5.1 cm		r: Radius of the cylindrical borehole						
Boring Radius r....: 4.15 cm		Const. Wtr. Ht. H: 20.1 cm		V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T _B						
Soil/Water Temp. T: 14 °C		H/r **: 4.8		Ksat = Q[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁵ + r/H]/(2πH ²) [Basic Glover Solu.]						
Dyn. Visc. @ T °C.: 0.001170 kg/m-s		Dyn. Visc. @ T _B °C.: 0.001170 kg/m-s		Ksat _B = QV[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁵ + r/H]/(2πH ²) [Tmp. Correction]						
VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time		Flow Rate Q (ml/min)	----- Ksat _B Equivalent Values -----				
			(hr:min:sec)	(min)		(cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
1,900		10:30:00 AM								
1,800	100	10:30:14 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
1,700	100	10:30:28 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
1,600	100	10:30:42 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
1,500	100	10:30:56 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
1,400	100	10:31:10 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
1,300	100	10:31:24 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
1,200	100	10:31:38 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
1,100	100	10:31:52 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
1,000	100	10:32:06 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
900	100	10:32:20 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
800	100	10:32:34 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
700	100	10:32:48 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
600	100	10:33:02 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
500	100	10:33:16 AM	0:00:14	0.23	428.57	0.248	4.13E-03	356.559	5.849	11.698
Natural Moisture.....:	6.4	Consistency.....: Loose		Field-Estimated Ksat:		0.248	4.13E-03	356.559	5.849	11.698
USDA Txt./USCS Class:	SP	Water Table Depth....: 3.0 ft		Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.						
Struct./% Pass. #200..:	0	Init. Saturation Time.: 10:00:00 AM								

*Glover, R. E. 1953. Flow from a test-hole located above groundwater level, pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger, ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. **H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

Constant-Head Borehole Permeameter Test						Analytical Method: Glover Solution					
Project Name.....: Neighborhood Stormwater Study		Project No.....: K5225061		Terminology and Solution (R. E. Glover Solution)*							
Boring No.....: HA3-1		Proj. Location...: Duck, NC		Ksat _B : (Coefficient of Permeability) @ Base Tmp. T _B (°C) 15							
Investigators.....: J. Meads		Date.....: 1/25/22		Q: Rate of flow of water from the borehole							
Boring Depth.....: 1.7 (m, cm, ft, in)		WCU Base Ht. h: 15.0 cm		H: Constant height of water in the borehole							
Boring Diameter...: 8.3 cm		WCU Susp. Ht. S: 5.1 cm		r: Radius of the cylindrical borehole							
Boring Radius r...: 4.15 cm		Const. Wtr. Ht. H: 20.1 cm		V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T _B							
Soil/Water Temp. T: 15 °C		H/r **: 4.8		Ksat = Q[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁻⁵ + r/H]/(2πH ²) [Basic Glover Solu.]							
Dyn. Visc. @ T °C.: 0.001139 kg/m-s		Dyn. Visc. @ T _B °C.: 0.001139 kg/m-s		Ksat _B = QV[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁻⁵ + r/H]/(2πH ²) [Tmp. Correction]							
VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time		Flow Rate Q (ml/min)	----- Ksat _B Equivalent Values -----					
			(hr:min:sec)	(min)		(cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)	
1,900		10:45:00 AM									
1,800	100	10:45:11 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
1,700	100	10:45:22 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
1,600	100	10:45:33 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
1,500	100	10:45:44 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
1,400	100	10:45:55 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
1,300	100	10:46:06 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
1,200	100	10:46:17 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
1,100	100	10:46:28 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
1,000	100	10:46:39 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
900	100	10:46:50 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
800	100	10:47:01 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
700	100	10:47:12 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
600	100	10:47:23 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	
500	100	10:47:34 AM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889	

Constant-Head Borehole Permeameter Test					Analytical Method: Glover Solution					
Project Name.....: Neighborhood Stormwater Study		Project No.....: K5225061		Terminology and Solution (R. E. Glover Solution)*						
Boring No.....: HA4-1		Proj. Location...: Duck, NC		Ksat _B : (Coefficient of Permeability) @ Base Tmp. T _B (°C) 14						
Investigators.....: T. Kellogg		Date.....: 1/13/22		Q: Rate of flow of water from the borehole						
Boring Depth.....: 1.5 ft (m, cm, ft, in)		WCU Base Ht. h: 15.0 cm		H: Constant height of water in the borehole						
Boring Diameter...: 8.3 cm		WCU Susp. Ht. S: 5.1 cm		r: Radius of the cylindrical borehole						
Boring Radius r....: 4.15 cm		Const. Wtr. Ht. H: 20.1 cm		V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T _B						
Soil/Water Temp. T: 14 °C		H/r **: 4.8		Ksat = Q[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁻⁵ + r/H]/(2πH ²) [Basic Glover Solu.]						
Dyn. Visc. @ T °C.: 0.001170 kg/m·s		Dyn. Visc. @ T _B °C.: 0.001170 kg/m·s		Ksat _B = QV[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁻⁵ + r/H]/(2πH ²) [Tmp. Correction]						
VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time		Flow Rate Q (ml/min)	----- Ksat _B Equivalent Values -----				
			(hr:min:sec)	(min)		(cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
1,900		12:30:00 PM								
1,800	100	12:30:11 PM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889
1,700	100	12:30:22 PM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889
1,600	100	12:30:34 PM	0:00:12	0.20	500.00	0.289	4.81E-03	415.986	6.824	13.648
1,500	100	12:30:45 PM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889
1,400	100	12:30:57 PM	0:00:12	0.20	500.00	0.289	4.81E-03	415.986	6.824	13.648
1,300	100	12:31:08 PM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889
1,200	100	12:31:18 PM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
1,100	100	12:31:29 PM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889
1,000	100	12:31:39 PM	0:00:10	0.17	600.00	0.347	5.78E-03	499.183	8.189	16.377
900	100	12:31:50 PM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889
800	100	12:32:01 PM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889
700	100	12:32:12 PM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889
600	100	12:32:23 PM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889
500	100	12:32:34 PM	0:00:11	0.18	545.45	0.315	5.25E-03	453.803	7.444	14.889
Natural Moisture.....: 4.7		Consistency.....: Loose		Field-Estimated Ksat:		0.316	5.26E-03	454.883	7.462	14.924
USDA Txt./USCS Class: SP		Water Table Depth....: 3.8 ft		Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.						
Struct./% Pass. #200.: 0.3		Init. Saturation Time.: 12:00:00 PM								
*Glover, R. E. 1953. Flow from a test-hole located above groundwater level, pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger, ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. **H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13										

Constant-Head Borehole Permeameter Test						Analytical Method: Glover Solution					
Project Name.....: Neighborhood Stormwater Study		Project No.....: K5225061		Terminology and Solution (R. E. Glover Solution)*							
Boring No.....: HA5-1		Proj. Location...: Duck, NC		Ksat _B : (Coefficient of Permeability) @ Base Tmp. T _B (°C) 14							
Investigators.....: T. Kellogg		Date.....: 1/13/22		Q: Rate of flow of water from the borehole							
Boring Depth.....: 1.5 ft (m, cm, ft, in)		WCU Base Ht. h: 15.0 cm		H: Constant height of water in the borehole							
Boring Diameter...: 8.3 cm		WCU Susp. Ht. S: 5.1 cm		r: Radius of the cylindrical borehole							
Boring Radius r...: 4.15 cm		Const. Wtr. Ht. H: 20.1 cm		V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T _B							
Soil/Water Temp. T: 14 °C		H/r **: 4.8		Ksat = Q[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁵ + r/H]/(2πH ²) [Basic Glover Solu.]							
Dyn. Visc. @ T °C.: 0.001170 kg/m·s		Dyn. Visc. @ T _B °C.: 0.001170 kg/m·s		Ksat _B = QV[sinh ⁻¹ (H/r) - (r ² /H ² +1) ⁵ + r/H]/(2πH ²) [Tmp. Correction]							
VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time		Flow Rate Q (ml/min)	----- Ksat _B Equivalent Values -----					
			(hr:min:sec)	(min)		(cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)	
1,900		2:00:00 PM									
1,800	100	2:00:06 PM	0:00:06	0.10	1,000.00	0.578	9.63E-03	831.972	13.648	27.296	
1,700	100	2:00:12 PM	0:00:06	0.10	1,000.00	0.578	9.63E-03	831.972	13.648	27.296	
1,600	100	2:00:18 PM	0:00:06	0.10	1,000.00	0.578	9.63E-03	831.972	13.648	27.296	
1,500	100	2:00:24 PM	0:00:06	0.10	1,000.00	0.578	9.63E-03	831.972	13.648	27.296	
1,400	100	2:00:31 PM	0:00:07	0.12	857.14	0.495	8.25E-03	713.119	11.698	23.396	
1,300	100	2:00:37 PM	0:00:06	0.10	1,000.00	0.578	9.63E-03	831.972	13.648	27.296	
1,200	100	2:00:44 PM	0:00:07	0.12	857.14	0.495	8.25E-03	713.119	11.698	23.396	
1,100	100	2:00:50 PM	0:00:06	0.10	1,000.00	0.578	9.63E-03	831.972	13.648	27.296	
1,000	100	2:00:56 PM	0:00:06	0.10	1,000.00	0.578	9.63E-03	831.972	13.648	27.296	
900	100	2:01:02 PM	0:00:06	0.10	1,000.00	0.578	9.63E-03	831.972	13.648	27.296	
800	100	2:01:08 PM	0:00:06	0.10	1,000.00	0.578	9.63E-03	831.972	13.648	27.296	
700	100	2:01:14 PM	0:00:06	0.10	1,000.00	0.578	9.63E-03	831.972	13.648	27.296	
600	100	2:01:21 PM	0:00:07	0.12	857.14	0.495	8.25E-03	713.119	11.698	23.396	
500	100	2:01:28 PM	0:00:07	0.12	857.14	0.495	8.25E-03	713.119	11.698	23.396	
Natural Moisture.....: 4.2		Consistency.....: Loose		Field-Estimated Ksat:		0.554	9.24E-03	798.014	13.091	26.182	
USDA Txt./USCS Class: SP		Water Table Depth....: 3.6 ft		Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.							
Struct./% Pass. #200.: 0.9		Init. Saturation Time.: 1:30:00 PM									
*Glover, R. E. 1953. Flow from a test-hole located above groundwater level, pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger, ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. **H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13											

Appendix H – Current Zoning Ordinance Information

§ 156.030 RS-1 SINGLE-FAMILY RESIDENTIAL CONVENTIONAL DISTRICT.

The following regulations shall apply to the RS-1 Single-Family Residential District:

(A) *Intent.* The RS-1 District is established to provide for the low-density development of single-family detached dwellings in an environment that promotes orderly neighborhoods, characterized by low vehicular traffic flows, abundant open space and limited impact of development on the natural environment and adjacent land uses.

(B) *Permitted uses.* The following uses shall be permitted by right:

- (1) Detached single-family dwellings, not to include mobile homes;
- (2) Customary accessory buildings, including swimming pools and tennis courts;
- (3) Town owned or leased facilities;
- (4) Minor home occupations;
- (5) Plant nurseries and greenhouses;
- (6) Fine craft and folk art production; and
- (7) Accessory dwelling units, subject to the provisions of § 156.140.

(C) *Special uses.* The following special uses are permitted subject to the requirements of this chapter and additional regulations and requirements as may be imposed by the Town Council as provided in §§ 156.155 *et seq.*:

(1) Public and private utility facilities must provide a vegetated buffer strip at least 10 feet in width where the facility abuts a residential lot or use;

(2) Major home occupations;

(3) Private clubs, including boat launching areas, tennis courts, community centers, libraries, picnic areas, beach clubs and concessions integral to them and provided that no sign other than a directional sign is allowed;

(4) Pole-mounted yard and area lighting; provided that the yard or area lighting must be shielded to prevent the direct rays of the light from extending beyond the property lines of the lot on which it is located. Installation of low-voltage ground-mounted lights less than 24 inches in height above the ground are exempt from this special use permit requirement;

(5) Small child care homes as defined in § 156.002 above and subject to the authorization provisions of § 156.057 below;

(6) Churches and other associated church facilities including fellowship halls, sanctuaries, parsonages, church schools, parking areas and offices; and

(7) Bed and breakfast homes may be permitted subject to the requirements of this chapter and provided that the following minimum conditions are met:

(a) No more than 3 guest rooms shall be available for rental to guests. Guest rooms shall be constructed as part of the primary residential structure and not separate or detached from the principal structure. Any other bedrooms or bedroom equivalents in the structure shall be limited to use by the owner;

(b) The bed and breakfast home shall be owner occupied and shall not employ more than the equivalent of 1 full-time employee who is not a resident of the home;

(c) No separate kitchen facilities shall be provided for the guests' use. Microwaves and refrigerators shall not be located in guest rooms. Food service at the bed and breakfast home shall be limited to guests and not open to the public as a restaurant, catering service or take-out food service;

(d) The bed and breakfast home shall be located on a lot with its entire frontage along a state numbered highway. This shall not include roads included in the state's secondary maintenance system and designated with a SR number;

(e) A bed and breakfast home shall be located on an individual lot or a subdivision lot with no deed restriction or subdivision covenant that prohibits commercial activity;

(f) Parking: 1 space for each guest room available for rental plus the requirements of §§ 156.070 through 156.096 for single-family structures. These spaces should be individually designated for bed and breakfast guests and aligned so that the spaces are horizontally adjacent and will not necessitate vertical double spacing;

(g) Signage: a single sign may be permitted consistent with the standards outlined in § 156.130; and

(h) No retail activities other than food and beverage sales incidental to the operation of the bed and breakfast home shall be allowed on the premises;

(8) Transit stops;

(9) Agricultural buildings;

(10) Commercial animal production;

(11) Commercial crop production (indoor or outdoor); and

(12) Livestock shelters and stables.

(D) Dimensional requirements.

(1) Minimum lot size:

(a) Single-family lots served by a private well and an on-site septic tank/drain field system: 20,000 square feet of area;

(b) Single-family lots served by a central water supply and an on-site septic tank/drain field system: 15,000 square feet of area; and

(c) Single-family lots served by a central water supply and a central wastewater disposal system: 15,000 square feet of area.

(2) Minimum lot width: 75 feet, measured at the building setback line.

(3) Minimum front yard: 25 feet.

(4) Minimum side yard: 10 feet. An additional 10-foot side yard adjacent to the street is required for a corner lot.

(5) Minimum rear yard: 25 feet.

(6) Maximum allowable lot coverage by principal use and all accessory structures: 30%. Lot coverage may be increased to 35% provided that stormwater improvements meeting the following criteria are provided on the development site:

(a) Stormwater runoff from the built-upon area of the site must be directed into an approved stormwater management system designed to accommodate the volume of runoff generated by a 1.5-inch design storm.

(b) The stormwater management system shall be designed in accordance with the standards, methodology, and procedures prescribed in the state *Stormwater Best Management Practices Manual (NCDENR BMP Manual)*.

(c) Project designs shall utilize low-impact development principles and best management practices as the primary method for the treatment of stormwater.

(d) Stormwater plans shall be prepared by a state licensed professional engineer. Prior to the issuance of a certificate of completion for the project, a state licensed professional engineer shall certify that the proposed improvements have been constructed in accordance with the project design.

(7) Height limitation: 35 feet.

(Ord. 04-22, passed 11-3-2004, § 17; Am. Ord. 14-02, passed 6-4-2014; Am. Ord. 16-04, passed 7-6-2016; Am. Ord. 16-07, passed 11-2-2016; Am. Ord. 16-08, passed 2-1-2017; Am. Ord. 17-04, passed 6-7-2017; Am. Ord. 21-01, passed 6-2-2021)

§ 156.031 RS-2 SINGLE-FAMILY RESIDENTIAL CONVENTIONAL DISTRICT.

The following regulations shall apply to the RS-2 Single-Family Residential District:

(A) *Intent.* The RS-2 District is established to provide for the low-density development of single-family detached dwellings in an environment that promotes orderly neighborhoods, characterized by low vehicular traffic flows, abundant open space and limited impact of development on the natural environment and adjacent land uses.

(B) *Permitted uses.* The following uses shall be permitted by right:

- (1) Detached single-family dwellings, not to include mobile homes;
- (2) Customary accessory buildings, including swimming pools and tennis courts;
- (3) Town owned or leased facilities;
- (4) Minor home occupations;
- (5) Plant nurseries and greenhouses;
- (6) Fine craft and folk art production; and
- (7) Accessory dwelling units, subject to the provisions of § 156.140.

(C) *Special uses.* The following special uses are permitted subject to the requirements of this chapter and additional regulations and requirements as may be imposed by the Town Council as provided in §§ 156.155 *et seq.*:

- (1) Public and private utility facilities (must provide a vegetated buffer strip at least 10 feet in width where the facility abuts a residential lot or use);
- (2) Major home occupations;
- (3) Private clubs, including boat launching areas, tennis courts, community centers, libraries, picnic areas, beach clubs and concessions integral to them;

(4) Pole-mounted yard and area lighting; provided that the yard or area lighting must be shielded to prevent the direct rays of the light from extending beyond the property lines of the lot on which it is located. Installation of low-voltage ground-mounted lights less than 24 inches in height above the ground are exempt from this special use permit requirement;

(5) Small child care homes as defined in § 156.002 above and subject to the authorization provisions of § 156.057 below;

(6) Churches and other associated church facilities including fellowship halls, sanctuaries, parsonages, church schools, parking areas and offices;

(7) Transit stops;

(8) Agricultural buildings;

(9) Commercial animal production;

(10) Commercial crop production (indoor or outdoor); and

(11) Livestock shelters and stables.

(D) Dimensional requirements.

(1) Minimum lot size:

(a) Single-family lots served by a private well and an on-site septic tank/drain field system: 20,000 square feet of area;

(b) Single-family lots served by a central water supply and an on-site septic tank/drain field system: 15,000 square feet of area; and

(c) Single-family lots served by a central water supply and a central wastewater disposal system: 15,000 square feet of area.

(2) Minimum lot width: 75 feet, measured at the building setback line.

(3) Minimum front yard: 25 feet.

(4) Minimum side yard: 10 feet. An additional 10-foot side yard adjacent to the street is required for a corner lot.

(5) Minimum rear yard: 20 feet.

(6) Maximum allowable lot coverage by principal use and all accessory structures: 30%. Lot coverage may be increased to 35% provided that stormwater improvements meeting the following criteria are provided on the development site:

(a) Stormwater runoff from the built-upon area of the site must be directed into an approved stormwater management system designed to accommodate the volume of runoff generated by a 1.5" design storm.

(b) The stormwater management system shall be designed in accordance with the standards, methodology, and procedures prescribed in the state *Stormwater Best Management Practices Manual (NCDENR BMP Manual)*.

(c) Project designs shall utilize low-impact development principles and best management practices as the primary method for the treatment of stormwater.

(d) Stormwater plans shall be prepared by a state licensed professional engineer. Prior to the issuance of a certificate of completion for the project, a state licensed professional engineer shall certify that the proposed improvements have been constructed in accordance with the project design.

(7) Height limitation: 52 feet.

(Ord. 04-22, passed 11-3-2004, § 18; Am. Ord. 03-16, passed 11-5-2003; Am. Ord. 14-02, passed 6-4-2014; Am. Ord. 16-04, passed 7-6-2016; Am. Ord. 16-07, passed 11-2-2016; Am. Ord. 16-08, passed 2-1-2017; Am. Ord. 17-04, passed 6-7-2017; Am. Ord. 21-01, passed 6-2-2021)

§ 156.032 R-2 MEDIUM DENSITY RESIDENTIAL CONVENTIONAL DISTRICT.

The following regulations shall apply to the R-2 Medium Density Residential District.

(A) Intent.

(1) The R-2 District is intended to encourage the development of moderate density residential neighborhoods, with a mix of permanent and short-term seasonal residents, and to serve as a transition zone between the low-density area and more intensely developed areas.

(2) The maximum density shall not exceed 6 dwelling units per acre.

(B) Permitted uses. The following uses shall be permitted by right:

(1) Detached single-family dwellings;

(2) Duplexes, with each unit subject to the dimensional requirements for single-family dwellings in the district, except for the side yards required at any common walls;

- (3) Customary accessory buildings, including private swimming pools;
- (4) Mobile homes, Class A;
- (5) Town owned or leased facilities;
- (6) Minor home occupations;
- (7) Plant nurseries and greenhouses;
- (8) Fine craft and folk art production; and
- (9) Accessory dwelling units, subject to the provisions of § 156.140.

(C) *Special uses.* The following special uses are permitted, subject to the requirements of this district and additional regulations and requirements imposed by the Town Council as provided in §§ 156.150 *et seq.*:

- (1) Churches and cemeteries;
- (2) Fire stations, schools and other public buildings;
- (3) Major home occupations;
- (4) Private clubs, including boat launching areas, golf courses, tennis courts, community centers, libraries, picnic areas, beach clubs and concessions integral thereto; provided, that there is no open commercial activity;
- (5) Public and private utility facilities;
- (6) Townhouse developments, under the provisions of §§ 156.054 with a maximum density of 6 dwelling units per acre;
- (7) Public or private parks and playgrounds;
- (8) Small child care homes as defined in § 156.002 above, and subject to the authorization provisions of §§ 156.057 and 156.155;
- (9) Small, medium and large child care centers as defined in § 156.002 above, only as an accessory use of an existing or proposed church, school or other public building;
- (10) Public and private utility facilities must provide a vegetated buffer strip at least 10 feet in width that provides year round screening to adjacent properties where the facility abuts a residential lot or use;
- (11) Pole-mounted yard and area lighting; provided, that the yard or area lighting must be shielded to prevent the direct rays of the light from extending beyond the property lines of the lot on which it is located. Installation of low-voltage ground-mounted lights less than 24 inches in height above the ground are exempt from this special use permit requirement;
- (12) Transit stops;
- (13) Agricultural buildings;
- (14) Commercial animal production;
- (15) Commercial crop production (indoor or outdoor); and
- (16) Livestock shelters and stables.

(D) *Dimensional requirements.*

(1) Minimum lot size:

- (a) Single-family lots served by a private well and an on-site septic tank/drain field system: 20,000 square feet of area;
- (b) Single-family lots served by a central water supply and an on-site septic tank/drain field system: 15,000 square feet of area;
- (c) Single-family lots served by a central water supply and a central wastewater disposal system: 15,000 square feet of area; and
- (d) Duplex: 25,000 square feet; except, that if served by an approved public or community sewage disposal system, lot size may be reduced to 15,000 square feet.

(2) Minimum lot width: 75 feet, measured at the building setback line.

(3) Minimum front yard: 25 feet.

(4) Minimum side yard: 10 feet. An additional 10-foot side yard adjacent to the street is required for a corner lot.

(5) Minimum rear yard: 20% of lot depth, but the yard need not exceed 20 feet.

(6) Maximum allowable lot coverage by principal use and all accessory structures: 30%. Lot coverage may be increased to 35% provided that stormwater improvements meeting the following criteria are provided on the development site:

(a) Stormwater runoff from the built-upon area of the site must be directed into an approved stormwater management system designed to accommodate the volume of runoff generated by a 1.5" design storm.

(b) The stormwater management system shall be designed in accordance with the standards, methodology, and procedures prescribed in the state *Stormwater Best Management Practices Manual (NCDENR BMP Manual)*.

(c) Project designs shall utilize low-impact development principles and best management practices as the primary method for the treatment of stormwater.

(d) Stormwater plans shall be prepared by a state licensed professional engineer. Prior to the issuance of a certificate of completion for the project, a state licensed professional engineer shall certify that the proposed improvements have been constructed in accordance with the project design.

(7) Height limitation: 35 feet.

(Ord. 04-22, passed 11-3-2004, § 19; Am. Ord. 14-02, passed 6-4-2014; Am. Ord. 16-04, passed 7-6-2016; Am. Ord. 16-07, passed 11-2-2016; Am. Ord. 16-08, passed 2-1-2017; Am. Ord. 17-04, passed 6-7-2017; Am. Ord. 21-01, passed 6-2-2021)

§ 156.037 OCEAN AND SOUND OVERLAY DISTRICT.

(A) *Definition.* The Ocean and Sound Overlay District shall consist of all waters abutting the town on the Atlantic Ocean and Currituck Sound that are within 1,000 feet of the town's shoreline, plus the adjacent CAMA Areas of Environmental Concern.

(B) *Intent.* The Ocean and Sound Overlay District is established to provide for the appropriate use of the ocean and sound waters that adjoin the town, including any island areas therein, as well as the Areas of Environmental Concern as established by the Coastal Area Management Act (CAMA) appurtenant thereto, to ensure the continued aesthetic, environmental, and recreational value that these waters provide to the town, its residents, visitors and the surrounding area. The Ocean and Sound Overlay District regulations are in addition to all other town ordinances that regulate, for example, the use of personal watercraft and driving on the beach, and that prohibit specified commercial activities in public trust areas. Nothing contained within this section shall be deemed, however, to prohibit or regulate commercial fishing and navigation. Whenever practical, the town encourages property owners to use natural design and materials when considering shoreline stabilization projects.

(C) *Permitted uses.*

(1) Swimming, boating, sailing, fishing, hunting, wading, crabbing, clamming, and other active and passive noncommercial recreational activities.

(2) Water-dependent commercial recreation activities, provided that the base of the activity is located in a zoning district that permits such activity or such base is located outside the planning and development regulation jurisdiction of the town and further provided that such activity meets all other relevant town ordinances.

(3) On all land abutting the ocean and sound waters, uses permitted shall be those established in the underlying zoning district, subject to all other relevant town ordinances as well as CAMA and other relevant state and federal agency permitting requirements.

(4) Piers and docks, provided such facilities are permitted by CAMA, U.S. Army Corps of Engineers or U.S. Coast Guard, whichever is applicable, and provided further that the activity associated with the pier or dock is also permitted by the zoning district where the pier or dock is anchored.

(5) Future recreational activities or uses (those not introduced on the waters of the town as of May 1, 2002) may be allowed as a special use, subject to procedures described in § 156.155. The purpose of the special use permit is to provide for appropriate review of new activities prior to their introduction and allow for conditions to ensure activities that are compatible with the character of the district.

(6) The following improvements when associated with the installation of a living shoreline or marsh restoration project in Currituck Sound. Such projects must obtain approval from all applicable state and federal agencies.

- (a) Sills;
- (b) Groins;
- (c) Riprap;
- (d) Fill/addition of wetland soils to be planted with marsh vegetation.

(D) *Prohibited activities.*

(1) No permitted beach push or dune restoration activity may take place in the public trust area on weekends or holidays.

(2) No filling of wetland areas shall occur within the Ocean and Sound Overlay District.

(3) No parasail landing and takeoff or seaplane landing and takeoff or similar activities may take place within the Ocean and Sound Overlay District.

(4) No water skiing or tubing and similar recreational towing activities may take place within the Ocean and Sound Overlay District.

(5) The use or placement of sandbags for the purpose of temporary erosion control as outlined in the North Carolina Administrative Code (15A NCAC 07H .0308) and the North Carolina General Statutes (§ 113A-115.1).

(6) All other uses not expressly permitted are hereby prohibited.

(Ord. 07-08, passed 6-6-2007; Am. Ord. 10-14, passed 1-5-2011; Am. Ord. 17-04, passed 6-7-2017; Am. Ord. 17-15, passed 1-3-2018; Am. Ord. 21-01, passed 6-2-2021) Penalty, see § 156.999

§ 156.040 PERMITTED AND PROHIBITED USE TABLE.

(A) The following Permitted/Prohibited Use Table lists use classifications, categories, and types and indicates whether each is allowed with an administrative permit, is allowed with a special use permit, or is prohibited.

(B) *Conventional zoning district descriptions.* The use table lists allowable and prohibited uses for each zoning district in the Town of Duck. A general description outlining the intent of each district is provided below.

(1) *Conservation Public Recreation (C-PR).* The C-PR District is established to provide restricted usage of property located in areas conducive to and appropriate for recreational facilities, public and private utilities, town uses and conservation areas.

(2) *Single-Family Residential (RS-1).* The RS-1 District is established to provide for the low-density development of single-family detached dwellings in an environment that promotes orderly neighborhoods, characterized by low vehicular traffic flows, abundant open space and limited impact of development on the natural environment and adjacent land uses.

(3) *Single-Family Residential (RS-2).* The RS-2 District is established to provide for the low-density development of single-family detached dwellings in an environment that promotes orderly neighborhoods, characterized by low vehicular traffic flows, abundant open space and limited impact of development on the natural environment and adjacent land uses.

(4) *Medium Density Residential (R-2).* The R-2 District is intended to encourage the development of moderate density residential neighborhoods, with a mix of permanent and short-term seasonal residents, and to serve as a transition zone between the low-density area and more intensely developed areas.

(5) *Neighborhood Commercial (C-1).* The C-1 District is established primarily to encourage the concentration of commercial facilities in clusters and to provide readily accessible shopping facilities for permanent and seasonal residents.

(6) *General Commercial (C-2).* The C-2 District is established to provide for the proper grouping and development of commercial facilities to serve permanent residents and the general public.

(7) *Special (S-1).* The S-1 Special District is established as a transitional area to allow broad flexibility of services and uses while establishing certain density limitations, setbacks, parking requirements and other general requirements.

(8) *Village Commercial (V-C).* The V-C District is established to provide limited commercial areas to serve existing or developing residential neighborhoods in the town. The intent of this district is to provide the goods and services needed by permanent and seasonal visitors in concentrated locations on state maintained highways.

(9) *Ocean and Sound Overlay (OSO).* The Ocean and Sound Overlay District is established to provide for the appropriate use of the ocean and sound waters that adjoin the town, including any island areas therein, as well as the Areas of Environmental Concern as established by the Coastal Area Management Act (CAMA) appurtenant thereto, to ensure the continued aesthetic, environmental, and recreational value that these waters provide to the town, its residents, visitors and the surrounding area.

(C) *Organization of uses.* The use table organizes allowable uses by use classifications, use categories, and use types, together providing a systematic basis for identifying and consolidating or distinguishing unidentified land uses to determine whether a particular land use is allowable in a particular zoning district and in addressing future land uses.

(1) *Use classifications.* Use classifications identify broad general classification of uses and include residential uses, institutional uses, agricultural uses, commercial uses, and industrial uses. Use classifications are further broken down into a series of general use categories and more specific use types.

(2) *Use categories.* Use categories describe the major sub-groups of the respective use classifications and are based on common functional, product, or physical characteristics, such as the type and amount of activity, the type of customers or residents, how goods or services are sold or delivered, and site conditions. For example, the residential use classification is divided into the household living and group living use categories. Use categories are further broken down into a series of individual use types.

(3) *Use types.* The specific use types are included in the respective use category. They identify the specific principal uses that are considered to fall within characteristics identified in the use category. For example, duplex dwellings, live/work dwellings, manufactured homes, single-family detached dwellings, and townhouse dwellings are use types in the household living use category.

(D) *Prioritization.* Certain use categories and use types are addressed specifically in the zoning ordinance and/or permitted/prohibited use table.

(1) The allowance for any specifically listed use type in the permitted/prohibited use table takes precedence over requirements for a broader use category.

(2) Likewise, the allowance for any use category in the permitted/prohibited use table takes precedence over a broader use classification.

(E) *Permit types.*

(1) *Permitted uses.* A "P" in a cell of the use table indicates that the corresponding use classification, category or type is permitted in the corresponding zoning district. Permitted uses are subject to compliance with all use-specific standards and applicable development regulations of the zoning ordinance.

(2) *Uses requiring a special use permit.* An "S" in a cell of the use table indicates that the corresponding use classification, category or type is permitted in the corresponding zoning district, subject to approval of a special use permit for the proposed use. Uses requiring a special use permit are subject to compliance with all use-specific standards and applicable development regulations of the zoning ordinance, as well as the special use approval process and criteria found in § 156.155 of the zoning ordinance.

(3) *Prohibited uses.* An "X" in a cell of the use table indicates that the corresponding use classification, category or type is prohibited in the corresponding zoning district

(F) *Classification of unlisted uses.* The Zoning Administrator shall determine whether or not an unlisted use is substantially similar to an already defined use category or use type. Unlisted uses which are found to be dissimilar to an already defined use category or use type are prohibited. The Zoning Administrator shall use the following factors as a guideline when classifying a new or unlisted use to determine if such use is classified in a manner consistent with other similar uses in the applicable zoning district.

- (1) Consistency with the stated intent of the zoning district;
- (2) Consistency with the adopted vision statement and Comprehensive & Land Use Plan;
- (3) Density of development (number of units, square footage, etc.);
- (4) Intensity of use;
- (5) Type of activity associated with the use;
- (6) Number of customers and length of stay;
- (7) Generation of pedestrian and vehicular traffic;
- (8) Potential impacts such as noise, light, odor, etc.; and
- (9) Public safety.

Type of use	Zoning District									Additional Standards
	C-PR	RS-1	RS-2	R-2	C-1	C-2	S-1	V-C	OSO	
Type of use	Zoning District									Additional Standards
	C-PR	RS-1	RS-2	R-2	C-1	C-2	S-1	V-C	OSO	
AGRICULTURAL										
Agricultural buildings	S	S	S	S	S	S	P	S	X	
Commercial animal production	S	S	S	S	S	S	P	S	X	
Commercial crop production (indoor or outdoor)	S	S	S	S	S	S	P	S	X	
Plant nurseries and greenhouses	P	P	P	P	P	P	P	P	X	
Livestock shelters and stables	S	S	S	S	S	S	P	S	X	
Other agricultural uses	X	X	X	X	X	X	P	X	X	
RESIDENTIAL										
Household Living										
Accessory apartments	X	X	X	X	P	P	P	P	X	§ 156.033(B)(11)
Accessory dwelling units	X	P	P	P	X	X	P	X	X	§ 156.140
Customary Accessory Structures	X	P	P	P	X	X	P	X	X	
Duplexes	X	X	X	P	P	X	P	X	X	
Mobile/manufactured homes	X	X	X	P	X	X	P	X	X	

Multi-family residences	X	X	X	X	X	X	P	X	X	
Single-family residences	X	P	P	P	X	X	P	X	X	
Townhouses	X	X	X	P	X	X	P	X	X	§ 156.032(C)(6)
<i>Group Living</i>										
Bed and breakfast homes	X	S	X	X	X	X	X	X	X	§ 156.030(C)(7)
Bed and breakfast inns	X	X	X	X	X	X	P	X	X	
Convents and monasteries	X	X	X	X	X	X	X	X	X	
Dormitories and residence halls	X	X	X	X	X	X	X	X	X	
Fraternity and sorority houses	X	X	X	X	X	X	X	X	X	
Halfway houses	X	X	X	X	X	X	X	X	X	
Other residential uses	X	X	X	X	X	X	P	X	X	
COMMERCIAL										
<i>Entertainment/Recreational Facilities</i>										
Boat launching/rental facilities	X	X	X	X	S	X	P	S	X	
Campgrounds	X	X	X	X	X	X	X	X	X	
Electronic gaming operations	X	X	X	X	X	P	P	X	X	§ 156.034(B)(10)
Night clubs	X	X	X	X	X	X	X	X	X	
Theaters	X	X	X	X	X	S	P	X	X	
Other entertainment/ recreational facilities	X	X	X	X	X	X	X	X	X	
<i>Offices</i>										
General offices	X	X	X	X	P	P	P	P	X	
Laboratories	X	X	X	X	X	X	X	X	X	
Medical offices	X	X	X	X	P	P	P	P	X	
Rental property management and maintenance offices	X	X	X	X	S	S	P	S	X	§ 156.036(C)(11)
<i>Retail Sales</i>										
Drug paraphernalia sales	X	X	X	X	X	X	X	X	X	
Eating establishments and restaurants	X	X	X	X	S	S	P	S	X	§ 156.129
Formula businesses	X	X	X	X	S	S	S	S	X	§ 156.061
Gasoline pumps and sales	X	X	X	X	S	X	P	S	X	§ 156.033(C)(1)
Group developments	X	X	X	S	S	S	P	S	X	§ 156.059
Microbreweries/ microdistilleries	X	X	X	X	S	S	P	S	X	
Motor vehicle sales, service and rental establishments	X	X	X	X	X	X	X	X	X	
Outdoor display, storage and sale - general merchandise	X	X	X	X	P	P	P	P	X	§ 156.131(B)

Outdoor goods - temporary displays, storage and sales	X	X	X	X	P	P	P	P	X	§ 156.131(A) and (E)
Pawn shops	X	X	X	X	X	X	X	X	X	
Produce stands/holiday goods (temporary)	X	X	X	X	P	P	P	P	X	§ 156.131(C)
Retail sales	X	X	X	X	P	P	P	P	X	
Smoke and vapor shops	X	X	X	X	X	X	X	X	X	
SERVICES										
Alcohol and drug detoxification, rehabilitation and treatment facilities	X	X	X	X	X	X	X	X	X	
Bail bond services	X	X	X	X	X	X	X	X	X	
Childcare center (small)	X	X	X	S	P	P	P	X	X	§ 156.002; § 156.032(C)(9)
Childcare center (medium)	X	X	X	S	P	P	P	X	X	§ 156.002; § 156.032(C)(9)
Childcare center (large)	X	X	X	S	P	P	P	X	X	§ 156.002; § 156.032(C)(9)
Childcare homes (small)	X	S	S	S	P	P	P	X	X	§ 156.057
Home occupations (minor)	X	P	P	P	P	X	P	P	X	§ 156.136(B)
Home occupations (major)	X	S	S	S	P	X	P	P	X	§ 156.136(A)
Hotel resort	X	X	X	X	X	S	P	X	X	
Kennels	X	X	X	X	X	X	X	X	X	
Motor vehicle body and paint establishments	X	X	X	X	X	X	X	X	X	
Motor vehicle washing establishments	X	X	X	X	X	X	X	X	X	
Personal service establishments	X	X	X	X	P	P	P	P	X	
Radio and television stations	X	X	X	X	X	X	X	X	X	
Recreational facilities (commercial)	X	X	X	X	X	S	P	X	X	
Resident businesses	X	X	X	X	P	X	P	X	X	§ 156.002
Sexually oriented businesses	X	X	X	X	X	X	X	X	X	§ 156.006
Shooting ranges	X	X	X	X	X	X	X	X	X	
Tattoo, body piercing and body art establishments	X	X	X	X	X	X	X	X	X	
Other services	X	X	X	X	X	X	P	X	X	
INDUSTRIAL										
<i>Energy facilities</i>										
Satellite dish farms	X	X	X	X	X	X	X	X	X	
Solar energy farms	X	X	X	X	X	X	X	X	X	
Solar energy systems (accessory)	P	P	P	P	P	P	P	P	X	§ 156.139

Wind energy facilities (commercial)	X	X	X	X	X	X	X	X	X	§ 156.138
Wind energy facilities (supplementary)	P	P	P	P	P	P	P	P	X	§ 156.138
Other energy facilities	X	X	X	X	X	X	P	X	X	
<i>Manufacturing, processing and assembly facilities</i>										
Asphalt and concrete plants	X	X	X	X	X	X	X	X	X	
Assembly or packaging of articles	X	X	X	X	X	X	X	X	X	
Beverage manufacturing, bottling and processing facilities	X	X	X	X	X	X	X	X	X	
Brick and masonry facilities	X	X	X	X	X	X	X	X	X	
Electrical equipment assembly	X	X	X	X	X	X	X	X	X	
Fine craft and folk art production	P	P	P	P	P	P	P	P	X	
Foundries	X	X	X	X	X	X	X	X	X	
Manufacturing, processing, assembly and other industrial facilities	X	X	X	X	X	X	X	X	X	
Metal products facilities (fabrication and assembly)	X	X	X	X	X	X	X	X	X	
Recycling materials collection and processing	X	X	X	X	X	X	X	X	X	
Resource extraction facilities	X	X	X	X	X	X	X	X	X	
Stone cutting, shaping and finishing facilities	X	X	X	X	X	X	X	X	X	
Waste recovery facilities	X	X	X	X	X	X	X	X	X	
Other manufacturing, processing and assembly facilities	X	X	X	X	X	X	P	X	X	
<i>Warehousing</i>										
Warehousing and storage facilities	X	X	X	X	X	X	X	X	X	
Junk yards, scrap yards, and salvage facilities	X	X	X	X	X	X	X	X	X	
Landfills, and solid waste disposal facilities	X	X	X	X	X	X	X	X	X	
Outdoor storage of construction equipment and materials	X	X	X	X	X	X	X	X	X	
Outdoor storage in crates, trailers and storage units	X	X	X	X	X	X	X	X	X	§ 156.131(D)
Outdoor storage of vehicles, equipment and other goods	X	X	X	X	X	X	X	X	X	
Other warehousing/storage facilities	X	X	X	X	X	X	P	X	X	
<i>Transportation</i>										

Aircraft hangars (commercial)	X	X	X	X	X	X	X	X	X	
Airports, airfields and heliports	X	X	X	X	X	X	X	X	X	
Bus, truck and transportation terminals, yards and parking lots	X	X	X	X	X	X	X	X	X	
Distribution centers, parcel delivery centers and delivery warehouses	X	X	X	X	X	X	X	X	X	
Taxi and pedicab storage and dispatch	X	X	X	X	X	X	X	X	X	
Transit stops	S	S	S	S	S	S	S	S	X	
Other transportation related facilities	X	X	X	X	X	X	P	X	X	

PUBLIC/INSTITUTIONAL*Public Institutions*

Post offices	X	X	X	X	S	X	P	S	X	
Schools	S	X	X	S	X	P	P	P	X	
Fire stations	S	P	P	S	P	P	P	P	X	
Jails and prisons	X	X	X	X	X	X	X	X	X	
Mental hospitals	X	X	X	X	X	X	X	X	X	
Police stations	S	P	P	S	P	P	P	P	X	
Town uses and facilities	P	P	P	S	P	P	P	P	P	
United States government uses and facilities	P	P	P	P	P	P	P	P	P	
Other public institutions	X	X	X	X	X	X	P	X	X	

Religious Institutions

Accessory church schools	X	S	S	S	X	P	P	P	X	
Cemeteries	X	X	X	S	X	X	P	X	X	
Churches and religious institutions	X	S	S	S	S	S	P	S	X	
Crematoriums (human or animal)	X	X	X	X	X	X	X	X	X	
Customary accessory church facilities	X	S	S	S	X	X	P	S	X	§ 156.036(C)(8)

RECREATIONAL

Conservation and open spaces	P	P	P	P	P	P	P	P	P	
Beach and sound accesses	P	P	P	P	P	P	P	P	P	
Passive recreation facilities	P	P	P	P	P	P	P	P	P	
Public parks and playgrounds (includes associated parking)	P	P	P	P	P	P	P	P	P	
Public clubs and recreational areas	S	P	P	S	P	P	P	P	S	
Private clubs, community centers and recreational	X	S	S	S	S	S	P	X	X	§ 156.030(C)(3); § 156.032(C)(4)

facilities										
Other recreational facilities	X	X	X	X	X	X	P	X	X	
WIRELESS TELECOMMUNICATION SYSTEMS										
Existing WTS - eligible facilities request	P	P	P	P	P	P	P	P	X	§ 156.058
Existing WTS - substantial modification	X	X	S	X	S	S	S	S	X	§ 156.058
Free-standing telecommunications tower	X	X	X	X	S	S	S	S	X	§ 156.058
Antenna attached to building or structure	X	X	X	X	S	S	S	S	X	§ 156.058

(Ord. 16-04, passed 7-6-2016; Am. Ord. 16-07, passed 11-2-2016; Am. Ord. 16-08, passed 2-1-2017; Am. Ord. 21-01, passed 6-2-2021; Am. Ord. 22-05, passed 8-3-2022)

AN ORDINANCE CLARIFYING LOT COVERAGE ALLOWANCES FOR RESIDENTIAL PROPERTIES IN THE TOWN OF DUCK, NORTH CAROLINA

Ordinance 22-07

WHEREAS, the Duck Town Council has found it to be in the Town's interest to grant an additional 5% allowance toward the maximum lot coverage in instances where a residential property owner provides appropriate stormwater management measures to limit impacts to adjoining properties and roadways; and

WHEREAS, these amendments are intended to provide engineers with clear, consistent standards for stormwater plans and calculations under which residential properties can be granted an allowance of up to 35% maximum lot coverage; and

WHEREAS, the Duck Planning Board thoroughly reviewed these standards and voted to recommend approval of this ordinance at its public meeting on July 13, 2022; and

WHEREAS, the Duck Town Council found these amendments to be consistent with the goals and objectives of the Town of Duck Comprehensive & CAMA Land Use Plan.

NOW THEREFORE BE IT ORDAINED by the Town Council for the Town of Duck, North Carolina:

PART I. Subsections 156.030(D)(6), 156.031(D)(6), and 156.032(D)(6) of the Duck Town Code shall be amended to read as follows:

“(6) Maximum allowable lot coverage by principal use and all accessory structures: 30%. Lot coverage may be increased to 35% provided that stormwater management improvements meeting the following criteria are provided on the development site:

- (a) Stormwater runoff from the built-upon area of the site must be directed into an approved stormwater management system designed to accommodate the volume of runoff generated by 1.5 inches of rainfall over a two-hour period (1.5” design storm).
- (b) The stormwater management system shall be designed in accordance with the standards, methodology, and procedures prescribed in the state Stormwater Best Management Practices Manual (NCDENR BMP Manual).
- (c) Storage capacity (interstitial storage) within existing soils and/or fill material shall not be counted towards the volume requirement for the stormwater management design.
- (d) The designed stormwater management system may include any of the following low-impact development principles and best management practices as the primary method for the treatment of stormwater:
 1. Landscaped swales
 2. Infiltration basins
 3. Bioretention or rain gardens
 4. Rainwater harvesting to include cisterns and/or rain barrels
 5. Subsurface drainage systems
 6. Other methods approved by the Zoning Administrator

(e) The bottoms of stormwater swales and basins should maintain twelve inches (12") above the seasonal high-water table to avoid long periods of standing water due to elevated water tables. The seasonal high water table elevation must be verified by a soil inspection by a licensed soil scientist or may be verified by a Dare County Health Department Wastewater Site Evaluation.

(f) The stormwater management systems shall adhere to all setbacks, separations, and standards required by the North Carolina on-site wastewater regulations and building code. In no instance shall open drainage systems be located beneath a building.

(g) Rainwater harvesting, rain barrels or cisterns must include plans for the ultimate disposal of the collected rainwater (pump to irrigation, slow release through drip tubing etc.). Open systems must include plans to prevent mosquito breeding.


(h) The stormwater management plan must clearly delineate water sheds or drainage areas within the subject property. This should include a roof plan depicting roof runoff and the method to collect or direct the volume from each portion of the roof area towards the stormwater management system. In some situations, the plan may require a detailed topographic survey and a detailed grading plan.

(i) Stormwater plans must be prepared by a state licensed professional engineer or surveyor, and shall include volumetric calculations. Prior to the issuance of a certificate of completion for the project, a state licensed professional engineer, or surveyor shall certify that the proposed improvements have been constructed in accordance with the project design."

PART II. This ordinance shall be effective upon its adoption.


Don Kingston, Mayor

ATTEST:


Lori Ackerman, Town Clerk

Date adopted: September 7, 2022

Motion to adopt by: Monica Thibodeau

Vote: 5 AYES 0 NAYS



§ 156.124 STRUCTURES WITHIN THE PRIMARY AND FRONTAL DUNES.

(A) *Purpose.* It is the purpose of this section to develop regulatory standards which will assist with the preservation of a continuous dune system within the town, acknowledging the protective and aesthetic values that this feature provides. Regulations are hereby established to limit structures within the dune system that are known to weaken its structural integrity. Further, construction standards are established for dune walkover structures to minimize their impact on the dune, recognizing that these structures provide a safe and responsible mechanism to access the ocean beach.

(B) *Definitions.*

DUNE SYSTEM, FRONTAL DUNE. The first mound of sand located landward of the beach having sufficient vegetation, height, continuity, and configuration to offer protective value.

DUNE SYSTEM, PRIMARY DUNE. The first mounds of sand located landward of the beach having an elevation equal to the mean flood level for the area plus 6 feet. The primary dune extends landward to the lowest elevation in the depression behind the same mound of sand.

DUNE WALKOVER STRUCTURE. A raised walkway constructed for the purpose of providing access to the beach from points landward of the dune system.

ESCARPMENT. The vertical drop or steep slope in the beach profile separating 2 comparatively level or more gentle sloping surfaces caused from high tide or storm tide erosion.

FIRST LINE OF STABLE NATURAL VEGETATION. This line represents the boundary between the normal dry sand beach, which is subject to constant flux due to waves, tides, storms and wind, and the more stable upland areas. The vegetation line is generally located at or immediately oceanward of the seaward toe of the frontal dune or erosion escarpment. The Division of Coastal Management or Local Permit Officer shall determine the location of the stable and natural vegetation line, based on visual observations of plant composition and density. If the vegetation has been planted, it may be considered stable when the majority of the plant stems are from continuous rhizomes, rather than planted individual rooted sets. The vegetation may be considered natural when the majority of the plants are mature and additional species native to the region have been recruited, providing stem and rhizome densities that are similar to adjacent areas that are naturally occurring. In areas where there is no stable natural vegetation present, this line may be established by interpolation between the nearest adjacent stable natural vegetation by on-ground observations or by aerial photographic interpretation.

POST-AND-RAIL STRUCTURE. A single top rail mounted on imbedded posts. To minimize the impact of the structure, a **POST-AND-RAIL STRUCTURE** shall not include additional structural or decorative elements such as cross-bracing, other horizontal railing, or balusters. For structural support, posts must be embedded at least 4 feet in the ground. The rails shall have a span no less than 6 feet and no greater than 10 feet.

POST-AND-ROPE STRUCTURE. A structure consisting of a single strand of rope strung between imbedded posts typically serving to guide people to a certain location traversing a dune. The span between posts shall be no less than 6 feet and no greater than 10 feet.

STATIC VEGETATION LINE. In areas within boundaries of a large-scale beach fill project, the first line of stable natural vegetation that existed prior to the onset of project construction shall be defined as the **STATIC VEGETATION LINE**. The "onset of project construction" shall be defined as the date sediment placement begins. A **STATIC VEGETATION LINE** shall be established in coordination with the N.C. Division of Coastal Management using on-ground observation and surveys of existing conditions for all areas of the oceanfront that undergo a large-scale beach fill project. Once a static vegetation line is established, this line shall be used as the reference point for measuring oceanfront

setbacks in all locations where it is landward of the first line of stable natural vegetation. In all locations where the first line of stable natural vegetation is landward of the static vegetation line, the first line of stable natural vegetation shall be used as the reference point for measuring oceanfront setbacks.

TOE OF SLOPE. That point between the beach and the dune system where the uniform line of slope from the ocean toward the barrier dune begins an abrupt change upward and becomes the slope of the barrier dune.

(C) *Regulatory standards.*

(1) *Dune walkover structures.* Dune walkover structures shall be constructed to entail negligible alteration of the dune. The following construction standards shall apply:

(a) Dune walkover structures for residential use shall be no wider than 4 feet and shall be constructed on raised posts or pilings embedded no less than 4 feet and no greater than 5 feet below grade. Walkover structures for commercial or public use may be constructed up to 6 feet in width and shall utilize piling embedment criteria consistent with the North Carolina Building Code.

(b) The underside of the dune walkover structure across the frontal or primary dune shall be a minimum of 18 inches and a maximum of 30 inches above grade.

(c) Dune walkover structures shall be located such that the first step down to the beach is placed no farther seaward than the beginning of the downward slope of the dune.

(d) Dune walkover structures shall be constructed so that the staircase turns parallel to the dune if there is more than a 12-foot-vertical rise in the staircase required to provide access to the surface of the beach. The requirement to turn the stairs shall not apply in instances where it would preclude the placement of the stairs entirely within the subject property.

(e) Within the beach nourishment project area, dune walkover structures must be constructed to meet the following standards:

1. A dune walkover structure on the western side of the dune may consist of a hardened structure (ramp/stairway), beach access matting, or any material consistent with the standards of this chapter.

2. A dune walkover extending over the top of a dune or on the eastern side of a dune may include the installation of beach access matting.

3. A dune walkover may include the installation of a single post-and-rail structure over the top and on the eastern side of the dune. A second post-and-rail structure will be permitted at a common dune walkover owned and maintained by a neighborhood association or similar entity. The post-and-rail structure(s) may extend down the eastern side of the dune from the top of the dune to the toe of the dune.

4. A dune walkover may include the installation of post-and-rope structures over the top and on the eastern side of a dune. The post-and-rope structures may extend down the eastern side of the dune from the top of the dune to the toe of the dune.

5. If erosion, migration of the dune, or other forces cause any portion of a post-and rail or post-and-rope structure to extend eastward of the toe of the dune or expose the supporting posts, that section of the structure must be removed by the owner.

6. Any portion of a post-and-rail or post-and-rope structure within the area of a beach renourishment or dune maintenance project must be removed by the owner upon notice from the town prior to initiation of the project.

(f) Where a lawful dune walkover structure exists on July 5, 2017 within the beach nourishment project area that could not be built under the terms of division (e) above, the structure may be continued so long as it remains lawful, subject to the following provisions.

1. The non-conforming dune walkover structure may not be enlarged or altered in a way which increases its non-conformity, but any structure or portion thereof may be altered to decrease its non-conformity.

2. Should the non-conforming portion of a dune walkover structure be destroyed by any means to an extent of more than 50% of its replacement cost at the time of destruction, it shall not be reconstructed, except in conformity with the provisions of this chapter.

3. If located at an elevation higher than the top of the dune, an extension of the non-conforming dune walkover structure, not exceeding 5 feet in length, may be added to lower the walkover structure to the elevation at the top of the dune.

(2) *Setbacks established for dune protection.*

(a) Development shall be regulated in accordance with the setback criteria established by the Coastal Area Management Act (CAMA) as defined in 15A NCAC 07H .0306.

(b) Accessory structures that are exempt from the CAMA setback criteria shall not be located within 30 feet of the first line of stable natural vegetation or static vegetation line. This shall include decks, gazebos, pools and any other structure which meets the exception criteria establish by the Coastal Area Management Act (CAMA) in 15A NCAC 07H.0309. This setback shall not apply to dune walkover structures as defined in this section. Additionally, one dune deck per lot may be allowed no closer than 15 feet to the first line of stable natural vegetation or static vegetation line provided that the dune deck does not exceed 8 feet measured in any dimension, including the area that is combined with or adjacent to any dune walkover structure that may be present, and also provided that the dune deck is no higher than 30 inches above grade. In cases where the first line of stable natural vegetation is not evident on the subject property, this line shall be determined by interpolating a straight line between nearest identifiable first line of stable natural vegetation on the adjacent properties directly to the north and south of the subject property (this clause does not apply to properties subject to the static vegetation line).

(c) Existing structures which do not meet the setback criteria established by this section shall be regulated in accordance with the standards applicable to nonconforming structures established in § 156.073. For the purposes of determining replacement cost, the value of each accessory structure shall be considered individually and shall not be combined with the value of any other structure.

(d) Pools within the **OCEAN HAZARD SETBACK** (as defined by 15A NCAC 07H.0306) shall be constructed such that the top of the pool structure is flush with the adjacent grade and shall not be supported on a piling foundation. In addition, pools within the **OCEAN ERODIBLE AREA** (as defined by CAMA in 15A NCAC 07H.0304) and where the pre-disturbance grade elevation is below the regulatory flood protection elevation shall be constructed such that the top of the pool structure is flush with the adjacent grade and shall not be supported on a piling foundation.

(3) Nothing in this section shall preclude the removal of any structure which violates § 156.063, Encroachment of Structures on the Ocean Beach.

(Ord. 13-04, passed 7-17-2013; Am. Ord. 17-05, passed 7-5-2017; Am. Ord. 17-06, passed 7-5-2017; Am. Ord. 19-10, passed 2-5-2020; Am. Ord. 21-01, passed 6-2-2021; Am. Ord. 21-03, passed 6-2-2021)

§ 156.125 WATER SUPPLY AND SEWAGE DISPOSAL.

(A) *Plans to accompany permit applications; plan approval prerequisite to excavation or construction.* Each application for a building permit, a special use permit or a certificate of occupancy

shall be accompanied with plans of the proposed methods of water supply and sewage disposal, in a form acceptable to the appropriate authorizing agency. No excavation or construction for any building or use of land shall be commenced until subsequent approval is noted on the plan of the proposed development and a building permit issued.

(B) *Authorized methods and required approvals.* Any application shall specify the methods to be used and shall describe any special conditions to be met. These methods and the approvals required include the following:

(1) Connection to public sewerage or water systems operated by a municipality, sanitary district or other governmental agency. Connection approval by an authorized officer of the systems;

(2) Connection to community sewerage or water systems operated by a responsible person other than a governmental agency. Connection approval by an authorized officer of the systems; and

(3) Installation of other than public or community sewerage systems. Design approval by the Dare County Health Department.

(C) *System approval.* The sewerage and water systems to which connections are to be made shall be authorized as follows:

(1) *Water supply:*

(a) Individual supply approval by the Dare County Health Department;

(b) For 10 to 25 dwelling units, approval by the State Board of Health; and

(c) For 25 or more dwelling units, approval by the State Board of Health and the State Utilities Commission.

(2) *Sewage collection and treatment:*

(a) For a septic tank, approval by the Dare County Health Department;

(b) For a sewerage system serving facilities regulated by the State Board of Health (i.e. institutions, restaurants, motels and the like), approval by the County Health Department; and

(c) For a sewerage system serving all other uses (i.e., industry, commerce, communities and the like), approval by the State Department of Water and Air Resources, when applicable;

(d) *Additional requirements for certain systems.* The person operating a community water system for 25 or more customers or a sewerage system for which a rate is charged shall hold a Certificate of Public Convenience and Necessity from the State Utilities Commission, and there shall be recorded with a plat of the property the written affidavit of a registered engineer, engaged in the independent practice of civil engineering, that water and sewer mains and laterals comply with pertinent standards of the State Board of Health, and that the mains and laterals are installed according to the standards and approved in writing by the State Board of Health, and a bond, trust instrument or other form of written assurance, satisfactory to the Town Council, assuring the continuous proper maintenance and operation of the sewerage and water systems.

(e) *Pump and haul.* Notwithstanding §§ 156.125(C)(2)(a), (b), (c), and (d) above, pump and haul tank systems are prohibited except when used as a temporary emergency measure while the existing sewage collection and treatment system is being repaired, and the repair period shall not exceed 14 days.

(Ord. 04-21, passed 10-6-2004, § 43.1; Am. Ord. 07-17, passed 12-5-2007; Am. Ord. 21-01, passed 6-2-2021)

§ 156.126 STANDARDS FOR THE SCALE OF RESIDENTIAL DEVELOPMENT.

(A) *Intent.* The purpose of establishing this section is to set forth a comprehensive set of regulations designed to maintain and enhance the scale and character of residential development in the Town of Duck. These standards are intended to ensure that future residential development is compatible with existing developed neighborhoods to protect the interests of both permanent residents and seasonal visitors occupying these structures in the furtherance of public safety and welfare.

(B) *Definitions.*

(1) Large residence means a single-family or two-family dwelling that exceeds the maximum total of heated square feet for a standard residence outlined on the table in § 156.126(C).

(2) Heated square feet or heated square footage for large residences includes any enclosed living space that is present in the principal structure and accessory structures located on the same lot.

(C) *Maximum size of residences.* The maximum size calculation includes any enclosed living space that is present in the principal and accessory structures located on the same property, as shown on the following table:

Lot Size (s.f.)	Maximum Size - Standard	Maximum Size - Large	Septic Capacity (gpd)
9,999 or less	3,500 s.f.	3,500 s.f.	600
10,000 - 14,999	4,000 s.f.	4,000 s.f.	720
15,000 - 19,999	5,000 s.f.	5,000 s.f.	840
20,000 - 24,999	5,500 s.f.	7,000 s.f.	960
25,000 - 29,999	6,500 s.f.	8,000 s.f.	1,080
30,000 or greater	7,000 s.f.	9,000 s.f.	1,080

(D) Large residences, as defined in § 156.126(B), are subject to the following requirements:

(1) *Lot area.* The minimum lot area for establishment of a large residence is 20,000 square feet.

(2) *Building setbacks.*

(a) Large residences are subject to minimum building setbacks greater than the standard setbacks for the zoning district in which the property is located. The following table summarizes the building setbacks for large residences.

(b) *Note.* Increased minimum building setbacks apply only to the principal structure. Accessory structures are subject to the standard minimum setback requirements for the zoning district in which the property is located.

MINIMUM BUILDING SETBACKS FOR LARGE RESIDENCES			
Lot Size (s.f.)	Front Yard	Rear Yard	Side Yard
15,000-19,999	25	25	12
20,000-24,999	30	30	15
25,000 or greater	30	30	20

(3) *Landscaping/canopy coverage requirements.*

(a) Properties containing a large residence must preserve and maintain a minimum of 10% of the lot's total area with existing natural vegetation. Areas designated for the preservation of existing vegetation shall contain significant examples of native vegetation.

(b) In addition, such property must provide for the planting or retention of trees on the site to provide minimum vegetative lot coverage of 20% of the lot's total area minus the footprint of the building. Such vegetation shall be installed or retained according to the standards outlined in § 156.137(G) of the Town Code.

(c) The above landscaping requirements may be altered by the Zoning Administrator due to unique and unusual physical conditions or characteristics of the property, including the reduction of landscaping requirements for oceanfront properties and other lots containing significant dune features that will be preserved in equal proportion.

(d) The property owner shall be responsible for maintaining the landscaped areas required by this section, including the replacement of dead and missing vegetation.

(4) *Building facades.* To limit the massive appearance of larger residences, no section of any building facade shall extend more than 30 feet without architectural features or significant architectural elements to break up the massing of the facade.

(Ord. 04-21, passed 10-6-2004, § 43.2; Am. Ord. 04-29, passed 12-1-2004; Am. Ord. 05-08, passed 6-1-2005; Am. Ord. 15-12, passed 9-2-2015; Am. Ord. 18-06, passed 12-5-2018; Am. Ord. 18-07, passed 1-16-2019; Am. Ord. 21-01, passed 6-2-2021)

§ 156.127 SAND DUNE PROVISIONS.

(A) Sand dunes and their existing contours shall not be damaged, destroyed, removed or changed except as specifically exempted below:

(1) The area required for the construction and installation of septic or wastewater improvements as authorized by the Dare County Health Department or North Carolina Department of Environmental Health;

(2) Activities in conjunction with a town building permit; and

(3) Other land disturbing activities in conjunction with subdivision development or other residential or commercial development as authorized by the Town Planning Department, the Town Planning Board or the Town Council.

(B) (1) For activities exempted under divisions (A)(1), (2) and/or (3), the following standards shall apply:

(a) A site plan prepared by a North Carolina licensed engineer or North Carolina licensed surveyor shall be submitted depicting the existing grades and proposed grades after the proposed land clearing activity, including any stabilization plans;

(b) A horizontal/vertical slope not to exceed 4 feet to 1 foot shall be maintained unless the dune-disturbing activity is intended to provide elevations that are consistent with abutting properties. Graded slopes must be vegetated or otherwise stabilized within 30 working days of completion of the work;

(c) Other proposals for sand dune disturbing activities not specifically exempted in division (A) above may be submitted for review as special uses subject to Planning Board review and Town Council approval; and

(d) Unauthorized dune-disturbing activities shall be considered a violation of this chapter and shall be subject to penalties prescribed in § 156.999. Mitigation plans prepared by a North Carolina

licensed engineer or North Carolina licensed surveyor shall be required for any unauthorized dune-disturbing activity.

(2) These standards do not apply to those sand dunes that are protected by the North Carolina Coastal Area Management Act and subject to those state regulations.

(Ord. 04-21, passed 10-6-2004, § 43.3; Am. Ord. 21-01, passed 6-2-2021)

§ 156.128 LAND DISTURBING ACTIVITIES.

(A) Mandatory standards for land disturbance activities.

(1) The provisions of this section shall apply to any land disturbance activity regardless of the size of the disturbed area. A land disturbance permit is required as provided in division (B)(1) below.

(2) Land disturbing activities, excluding necessary clearing and grubbing shall not be permitted within 5 feet from any property line with the exception of drainage and storm water improvements and underground utilities. Landscaping and fences located within this area are permitted as long as they do not impede the flow of storm water. Land disturbances on front (street) property lines for driveways shall be limited to culvert, drainage, and driveway improvements and shall comply with all provisions of this chapter.

(3) Fill is not allowed within 5 feet of any side or rear property line except to directly match a higher adjacent grade at the property line. Fill is not allowed within 5 feet of the front (street) property line except to directly match the grade at the street and to accommodate driveway improvements as approved by the Zoning Administrator or Town Council.

(4) Except as provided in § 156.128(A)(3) above, a lot shall not be filled/graded higher than the adjacent grades or nearer than 5 feet to any property line in any of the following circumstances:

(a) When the Dare County Health Department determines that fill is necessary for a septic system to function properly, the fill area shall be limited to the septic system and drainfield areas and the maximum fill shall not exceed 24 inches. Copies of the septic permit, once issued by the Health Department, shall be submitted to the Planning Department verifying the amount of fill material needed and the location of the septic improvements as authorized by the Health Department. Fill material used in conjunction with the installation of septic improvements shall be graded and sloped to avoid runoff on adjacent properties, rights-of-way, waterways and easements.

(b) An additional 12 inches of fill above the septic system and drainfield fill (if septic and drainfield fill has been required by the Health Department) may be allowed for the house pad to ensure adequate flow from the building to the septic system.

(c) When fill is required to raise the lot elevation to the base flood elevation. If more than 36 inches of fill material is necessary to raise a lot to base flood elevation, the applicant for a land disturbance permit shall submit a drainage plan prepared by a North Carolina licensed surveyor, North Carolina licensed engineer, North Carolina licensed landscape architect, or North Carolina licensed soil scientist depicting how stormwater on the site will be managed to avoid runoff on adjoining properties, rights-of-way, waterways and easements shall also be submitted at the time building permits are requested. The plan shall depict the existing and proposed elevations at all property lines around the perimeter of the site and internal to the site where improvements, including septic improvements, are proposed. The grading and shaping plan shall depict the areas on the site where fill material will be placed and the limits of the fill material in relation to the property lines. The grading and shaping of the fill material shall be completed so that no fill material is located within 5 feet of any property line. Fill material shall be graded to avoid runoff on adjoining properties, rights-of-way, waterways and easements. If drainage improvements and/or stormwater measures such as infiltration basins, swales or ditches are used to address stormwater runoff, the improvements may be placed within this 5-foot area. Design details on guttering and downspout systems, if utilized, shall be

provided in the plan. This grading and shaping plan shall be submitted a minimum of 5 days before building permits are requested for construction on the site to allow review by the planning staff. An on-site visit with the planning staff may be requested as part of the review process. Verification of the completion of the drainage plans as proposed shall be submitted before the certificate of occupancy is released by the Duck Building Inspector.

(d) When permitted by special use granted by the Town Council in accordance with the procedures established in § 156.155. For all special use requests to fill lots in excess of 36 inches, the drainage plan submission requirements described in division (A)(4)(c) above shall also apply.

(e) All fill shall be established at a slope not to exceed 3 feet horizontal run for every 1-foot vertical rise. The toe of the slope shall meet the 5-foot setback requirement from all property lines.

(f) No fill of any kind shall be allowed within 5 feet of any property line except as associated with a driveway, bulkhead or other permitted setback encroachments.

(g) Driveways shall taper back to existing grade no less than 5 feet from the front property line and shall be designed to the extent reasonable to prevent the direct flow of stormwater runoff to streets or adjacent properties.

(h) Stormwater retention areas may be located up to property lines provided no fill therefor is located within 2 feet of the property lines.

(i) Guttering and rooftop rainwater collection systems shall not flow directly onto driveways, impervious surfaces, or adjacent properties.

(5) A permanent ground cover, sufficient to prevent erosion, must be established on all fill slopes as follows:

(a) Prior to issuance of the certificate of occupancy for construction projects; or

(b) For projects where land disturbance activity has ceased for more than 6 months, whichever occurs first.

(6) Bulkheads or retaining walls shall not be allowed as a method to stabilize or contain fill, except bulkheads established for shoreline protection and as otherwise permitted by special use permit granted by the Town Council. Retaining walls used to stabilize or contain existing natural grade when a driveway or walkway is cut into a lot at an elevation lower than existing natural grade may be approved by the Planning Director.

(7) Any lot requiring a land disturbance permit shall install erosion and sediment control measures to prevent sediment from leaving the site. The erosion and sediment control measures shall be implemented on the site prior to the commencement of land disturbing activities and shall be continuously maintained during the land disturbance phase of development.

(8) In cases of substantial natural grade differences between adjoining lots of the subject property, the Town Council may grant, by special use permit, deviations from the standards contained herein. The applicant shall submit a certified, engineered storm water plan with the applicant's application for a special use permit. The storm water plan shall verify that the proposed development will not create flooding or nuisance conditions on the lower adjacent lots. In no case shall the rear and side yard no fill zones be encroached upon with fill.

(9) A fill permit issued by the North Carolina Division of Water Quality shall be required to fill any 401 wetlands.

(10) A fill permit issued by the United States Army Corp of Engineers shall be required to fill any 404 wetlands.

(11) Fill materials shall be of substantially similar composition to the soils present on the lot being filled and shall not include debris or be finished with soils or materials that will adversely affect the absorption of storm water.

(12) Residential lots may be graded, subject to the requirements of this section, to create a level area for a single-family detached dwelling and its accessory structures and driveway/parking areas. Fill material that is either brought to the lot or re-graded on the lot under the footprint of the principal dwelling unit is subject to the following limitations. For the purposes of this subchapter, the building footprint shall be considered the plan view of the heated area of the principal dwelling unit. Pre-disturbance elevations shall be taken at the four corners of building footprint. In cases where the building footprint is irregular and has more than four sides, pre-disturbance elevations shall be taken using the four building corners closest to the four corners of the smallest square or rectangle that could be drawn to encompass the footprint.

(a) No ground elevation anywhere on the lot, including beneath the final house footprint location, may be increased by more than 3 feet or 36 inches above the pre-disturbance ground elevations without submission and approval by the Town Council of a stormwater management plan, except as provided in division (b) below.

(b) Lot depressions that are interior to the lot a minimum of 5 feet from all lot lines may be filled, either by grading materials from other locations on the lot or by bringing in like-kind material, no higher than to the level of the directly adjacent pre-disturbance grade completely surrounding the depression. The post-fill condition shall be considered as the pre-disturbance ground elevations of such depressions in permitting leveling and calculating building height.

(c) Where fill/grading is not necessary to raise a house to base flood elevation, there shall be a maximum allowance of 3 feet of rise in ground elevation from the lowest pre-disturbance ground elevation beneath the footprint of the house as a leveling factor. Any filled/graded rise in ground elevation greater than 3 feet at any location under the footprint of the dwelling unit that is not necessary to raise a dwelling to base flood elevation shall be calculated as part of the height of the dwelling unit, per the definition of building height.

(B) *Land disturbance permit required.*

(1) A land disturbance permit shall be required for filling and/or grading a lot; any lot clearance, filling or grading activity prior to issuance of a building permit; any installation of gravel or pavers or accessory structures and similar site features whether or not subject to building permit requirements; and any removal or installation of site features such as septic systems, wells and drainage systems that disturb the land.

(2) (a) The land disturbance permit application shall be filed with the Planning Director or his or her designee. The following information shall be submitted as part of the permit application:

1. Adjacent property grades;
2. Approximate depth of seasonal high water table;
3. Existing elevations sufficient to determine the drainage patterns on site and on adjoining sites;
4. Locations and elevations of the adjoining street pavement, shoulder, ditches, drainage systems, upstream and downstream driveway culverts;
5. Proposed elevations of the top of bank and toe of slope and limits for fill necessary to construct the dwelling, including driveway access;
6. For all grading/filling activities up to 36 inches of fill material, a survey depicting the existing and proposed ground elevations shall be submitted at the time building permits are requested. The

survey shall also depict the areas on the site where fill material will be placed and the limits of the fill material in relation to the property lines. Fill material shall be graded to avoid runoff on adjoining properties, rights-of-way, waterways and easements. Fill material shall not be located within 5 feet of any property line;

7. A topographic plan (shown in 1-foot intervals) shall be required for all development where changes in the natural grade of the property greater than 36 inches in height is proposed or has taken place in the past year. The plan shall indicate the location and elevation changes above or below natural grade and contain the following certificate:

I, _____, owner/agent do hereby certify that I will develop the property in accordance with the approved plans which will be constructed or maintained so that surface waters from the development are not unreasonably collected and channeled onto lower adjacent properties at locations or at volumes as to cause substantial damage to the lower adjacent properties. In addition, the property will be constructed or maintained so that it will not unreasonably impede the natural flow of water from higher adjacent properties across the development, thereby unreasonably causing substantial damage to such higher adjacent properties. On the site plan entitled _____, storm water drainage improvements shall be installed according to these plans and specifications and approved by the Town of Duck. The Town of Duck assumes no responsibility for the design, maintenance or the guaranteed performance of the storm water drainage improvements.

Date: _____

Owner/Agent

Registered Land Surveyor/Civil Engineer

Date

8. Location of existing and proposed improvements including features such as driveways and gravel parking areas, structures, patios, walkways and septic systems.

(b) *Plan copies.* Two copies of the land disturbance permit plans shall be filed with the permit application for administrative review. Seven copies of plans shall be submitted as part of a special use request.

(3) Prior to issuance of the land disturbance permit, an on-site inspection of the project site may be scheduled by the Planning Director or his or her designee to evaluate the pre-disturbed conditions of the site and review and discuss the proposed land disturbance activity.

(4) For all grading/filling activities requiring a special use under the terms of this chapter, the use shall be approved prior to issuance of the land disturbance permit.

(5) After issuance of the land disturbance permit, an on-site inspection shall be conducted by the Planning Director or his or her designee to ensure adequate erosion control measures and project activities are in compliance with this chapter. When the Planning Director or his or her designee determines that erosion and sedimentation will likely continue, despite installation and maintenance of protective practices, the person conducting the land disturbance activity will be required to undertake additional protective measures as are required to meet permit requirements.

(6) For the purpose of this section, the following definitions shall apply unless the context clearly indicates or requires a different meaning.

ADJACENT GRADE. The highest grade measured within 30 feet from the subject property lines into the adjoining lots. For filling activities to match the grade at the adjacent property line, the grade shall be shown on a recent survey as described herein at the lot corners and along the lot lines as necessary to determine the elevation of the directly **ADJACENT GRADE**.

FILL. Any material placed or graded on a lot where the material has the effect of increasing the elevation of any portion of the lot.

(7) Any development that requires a CAMA major development permit or a sedimentation and erosion control plan shall be subject to the state storm water runoff policies promulgated in 15 N.C.A.C. 2H § .1000, unless exempted by those regulations. The town may not issue a zoning or special use permit and may not grant final plat approval for subdivisions with respect to any development that would cause land disturbing activity requiring prior approval of an Erosion and Sedimentation Control Plan by the North Carolina Sedimentation Control Commission under G.S. § 113A-57(4) (Mandatory Standards for Land Disturbing Activity) unless the Commission has certified to the town, either that:

(a) An erosion and sedimentation control plan has been submitted to and approved by the Commission; or

(b) The Commission has examined the preliminary plans for the development and it reasonably appears that an erosion and sedimentation control plan can be approved upon submission by the developer of more detailed construction or design drawings. However, in this case, construction of the development may not begin (and no building permits may be issued) until the Commission approves the erosion and sedimentation control plan.

(C) *Special uses for fill/grading activities.*

(1) All proposals to add fill on a lot in excess of 36 inches shall require approval of a special use application by the Town Council in accordance with the procedures established in § 156.155.

(2) The Town Council may grant a special use only after determining that the application meets the following criteria:

(a) The site for the proposed fill is otherwise adequate in size, shape and other characteristics to accommodate the proposed project;

(b) The applicant has demonstrated that the requirements of this chapter are unreasonable or impractical due to the necessity for the fill, lot shape, topographical features, location of mature vegetation, or location and characteristics of existing improvements on the lot;

(c) The amount of fill proposed is the minimum necessary to accommodate the proposed project, especially for soundfront properties;

(d) The proposed fill will not negatively impact adjacent properties or the surrounding area, especially for soundfront properties;

(e) The special use will be consistent with any applicable goals, policies and objectives specified in the town's adopted CAMA Comprehensive & Land Use Plan and vision statement. This review includes the town's evaluation of the proposal's consistency with its adopted CAMA Comprehensive & Land Use Plan, which may be more flexible or more stringent than interpretations by others; and

(f) The applicant has submitted a drainage plan consistent with the requirements described in § 156.128(A)(4)(c).

(Ord. 05-06, passed 5-4-2005; Am. Ord. 07-13, passed 10-3-2007; Am. Ord. 07-18, passed 12-5-2007; Am. Ord. 08-04, passed 10-1-2008; Am. Ord. 09-07, passed 8-5-2009; Am. Ord. 14-02, passed 6-4-2014; Am. Ord. 15-03, passed 3-4-2015; Am. Ord. 17-03, passed 6-7-2017; Am. Ord. 21-01, passed 6-2-2021)

§ 156.131 OUTDOOR STORAGE, DISPLAY AND SALE OF GOODS.

Temporary and permanent outdoor display, storage and sale of produce goods, holiday goods, outdoor-related goods and general merchandise is permitted under the limited conditions described in divisions (A) through (E) below, provided that the sale of those goods is a permitted use in the applicable zoning district. All other outdoor display, storage and sale of goods is prohibited, except as otherwise permitted by the town code.

(A) Operational standards for the temporary outdoor display, storage and sale of outdoor-related goods not contained within a permanent structure.

(1) Outdoor-related goods shall include, but are not limited to, goods that are customarily used outside, including outdoor furniture, sporting goods for outdoor sports activities, plants, flowers, fertilizers, mulch, sod, gardening tools, lawn equipment, storage sheds, grills, snow blowers and firewood, as determined by the Zoning Administrator.

(2) Outdoor display, storage and/or sale of outdoor-related goods shall be sold in connection with an established retail business on the same lot and shall be permitted without specified duration.

(3) The proposed display, storage and/or sale area shall not impede vehicular or pedestrian traffic and parking.

(4) The designated display, storage and/or sale area shall not be located in required landscape or visual buffer areas.

(5) If applicable, building, electrical, fire prevention code and hazardous use permits shall be obtained.

(B) Operational standards for the temporary outdoor display, storage and sale of general merchandise.

(1) General merchandise that is displayed and offered for sale outdoors shall include goods that are customarily sold in connection with an established retail business on the same lot. Examples of displays that may be permitted include sidewalk sales and tent sales.

(2) The outdoor display, storage and sale of general merchandise/goods shall be permitted for a period not to exceed 3 days 4 times per year.

(3) The proposed display, storage and sale area shall not impede vehicular or pedestrian traffic and required parking (unless replaced with substitute spaces on or off-site, subject to Zoning Administrator approval).

(4) The designated display, storage and sale area shall not be located within required landscape or visual buffer areas.

(5) If applicable, building, electrical, fire prevention code and hazardous use permits shall be obtained.

(6) Limited outdoor display of general merchandise on covered porches and deck areas immediately adjacent to established retail businesses shall be permitted, subject to other ordinance limitations or any conditions of development or use approval actions, provided the display does not impede pedestrian traffic or handicapped access and provided the merchandise is displayed only when the business is open. After business hours, the merchandise is to be taken indoors. Any display devices such as tables or crates must be either taken indoors when the business associated therewith is closed or appropriately secured to the building or ground.

(C) Operational standards for the temporary outdoor display, storage and sale of produce goods and holiday goods sold at independent stands.

(1) Produce goods shall include fruits and vegetables and other similar goods, subject to approval of the Zoning Administrator.

(2) Holiday goods shall include, but are not limited to, Christmas trees and pumpkins, as determined by the Zoning Administrator.

(3) The outdoor display, storage and/or sale of produce goods and/or holiday goods shall be permitted for a period not to exceed 30 consecutive days 4 times per year.

(4) A temporary occupancy permit for outdoor storage shall be obtained prior to the commencement of any outdoor display, storage and/or sale of goods, except for outdoor storage facilities appurtenant to retail facilities with approved permanent outdoor storage facilities, governed by division (E) below.

(5) Prior to the issuance of any temporary occupancy permit for outdoor storage, a plan shall be submitted to the Zoning Administrator that designates the display, storage and sale area to be used. The plan shall include the property owner's written permission and shall indicate compliance with setbacks and parking requirements. In addition, the plan shall illustrate the location of any proposed signage, structures and/or stands.

(6) The proposed display, storage and/or sale area shall not impede vehicular or pedestrian traffic and parking.

(7) The designated display, storage and/or sale area shall not be located within required landscape areas.

(8) A refundable cleanup fee in accordance with the adopted fee schedule of the town shall be deposited prior to the issuance of a temporary nonresidential use permit for outdoor storage, display or sales. Any structures, stands and accessory materials shall be removed and the property cleaned up within 3 days of the temporary occupancy permit termination date in order for the deposit to be refunded.

(9) If applicable, building, electrical, fire prevention code and hazardous use permits shall be obtained.

(10) No temporary occupancy permit shall be issued until the applicant provides a signed statement indicating his or her knowledge of and intention to comply with business license and peddlers permit requirements.

(11) The requirements for fees and permits are not applicable to displays that are incidental to the main retail business operating at the site.

(D) *Operational standards for the temporary outdoor storage of crates, trailers and similar storage units.* Temporary outdoor storage in crates, trailers and similar storage units for the purpose of storing supplies or excess inventory to be sold in connection with an established business is not permitted.

(E) *Operational standards for the permanent outdoor display, storage and sale of outdoor-related goods contained within a permanent structure.*

(1) Outdoor-related goods shall include, but are not limited to, goods that are customarily used outside, including outdoor furniture, sporting goods for outdoor sports activities, plants, flowers, fertilizers, mulch, sod, gardening tools, lawn equipment, storage sheds, grills, snow blowers and firewood, but do not include the display of motor vehicles.

(2) The designated outdoor display, storage and/or sale area shall comply with parking requirements and setback regulations.

(3) The designated outdoor display, storage and/or sale area shall not be located within required landscape areas.

(4) A site layout plan shall be submitted to the Planning Board for approval prior to construction of any structure designed for permanent outdoor display, storage and sale of outdoor-related goods.

(5) In zoning districts with architectural review standards, all structures, stands, screening and accessory materials associated with the permanent outdoor display and storage of outdoor-related goods shall be subject to architectural review. The requirement for architectural review shall not apply to display fixtures that are appropriately screened from public view.

(6) If applicable, building, electrical, fire prevention code and hazardous use permits shall be obtained.

(F) *Exemptions.* Town-sponsored events such as outdoor festivals are subject to review and approval of the Town Manager and are exempt from the permitting requirements and limitations of this section.

(Ord. 04-21, passed 10-6-2004, § 44.1)

§ 156.134 PROHIBITED USE OF MAJOR RECREATIONAL EQUIPMENT PARKED OR STORED.

For the purpose of this chapter, **MAJOR RECREATIONAL EQUIPMENT** is defined as including boats and boat trailers, pickup campers or coaches, designed to be mounted on automotive vehicles, motorized dwellings, tent trailers and the like, and cases or boxes used for transporting recreational equipment whether occupied by that equipment or not. Major recreational equipment parked or stored on residential premises shall not be used on the premises for living, sleeping or housekeeping purposes.

(Ord. 04-21, passed 10-6-2004, § 47)

§ 156.135 ACCESS TO N.C. HIGHWAY 12.

Due to the limited amount of land available within the zoned areas of the town for major thoroughfare rights-of-way and the traffic hazard involved in frequent entrances and exits from a major thoroughfare, it is the intent of this chapter to keep driveways and street intersections along N.C. Highway 12 to the minimum possible. In any district established by this chapter where a lot abutting N.C. Highway 12 also abuts any other dedicated public right-of-way or platted private street or road in a community of which the lot is a part, the right-of-way or private street or road shall be used for access rather than N.C. Highway 12.

(Ord. 04-21, passed 10-6-2004, § 48)

§ 156.136 MAJOR AND MINOR HOME OCCUPATIONS.

(A) Major home occupations are subject to the following operational standards:

(1) The use shall be conducted entirely within a dwelling unit which is the bona fide primary residence of the professional person and in which he or she does in fact reside during nonbusiness hours;

(2) The use shall comprise no more than 25% of the gross floor area of the principal dwelling, excluding attached garages;

(3) The professional person shall engage no more than 2 employees in the occupation on the premises;

(4) There shall be no display of goods, tools, equipment, commercial vehicles or advertising other than a single sign subject to the standards outlined in § 156.130; and

(5) No person shall conduct a home occupation without obtaining the appropriate business, service or occupational license required by law. All home occupations shall comply with applicable state, federal and local regulations.

(B) Minor home occupations are subject to the following operational standards:

- (1) No person other than a member of the family residing on the premises shall be engaged in the occupation or business on the premises;
- (2) There shall be no visible evidence (including signs of any size) of the minor home occupation in the outside appearance of the premises;
- (3) The minor home occupation shall generate no greater volume of traffic than would normally be expected from a single-family residence, subject to the additional operational standards for home businesses and student instruction and consistent with the residential character of the neighborhood;
- (4) The business or commercial use shall not generate any need for off-street parking spaces;
- (5) No equipment shall be used other than that normally used for domestic, hobby, household or small office purposes in a single-family residence;
- (6) The street address of a home occupation business shall not be advertised to the general public in newspaper, radio or television advertisements. This provision shall not be construed to prohibit address listing in telephone directories, on business cards, or in communication with customers, suppliers or professional colleagues, nor shall it prohibit referrals to individual consultants from corporate internet sites by customer inquiry;
- (7) No person shall conduct a home occupation without obtaining any appropriate business, service or occupational license required by law. All home occupations shall comply with applicable state, federal and local regulations;
- (8) The receipt or delivery of merchandise, goods or supplies for use in a home occupation shall be limited to the United States mail, similar parcel delivery service, or private vehicles with a gross vehicle weight rating of 10,000 pounds or less;
- (9) No stock in trade shall be displayed or offered for public retail sale on the premises; however goods may be stored for sale subject to the additional limitations for minor home occupations (businesses such as cosmetic and plasticware or housewares party sales). The storage of hazardous materials shall be prohibited;
- (10) It shall be understood that sales and delivery of products are primarily away from the residence or by mail. Sales of goods on the premises shall be limited to goods ordered previously by established customers by mail, telephone, internet or at a sales meeting; and
- (11) No more than 25% of the floor area of the principal dwelling unit shall be used to conduct the home occupation and store stock in trade subject to applicable federal, state and local regulations;

(Ord. 04-21, passed 10-6-2004, § 2; Am. Ord. 17-04, passed 6-7-2017)

§ 156.137 TREE AND VEGETATION PRESERVATION AND PLANNING.

(A) Purpose.

- (1) The purpose of this section is to preserve, protect, and replace trees and vegetation within the town because such plantings:
 - (a) Are an important public resource;
 - (b) Preserve and enhance the town's physical and aesthetic environment, especially its natural and unique atmosphere;
 - (c) Enhance the air quality by filtering air pollutants;
 - (d) Reduce topsoil erosion by the holding effect of their roots;
 - (e) Reduce storm water runoff;

- (f) Provide a buffer and screen against noise pollution;
- (g) Reduce energy consumption by acting as a wind break and producing shade;
- (h) Preserve and enhance nesting areas for birds and other wildlife which, in turn, assist in the control of insects;
- (i) Protect and enhance property values;
- (j) Protect and enhance the quality of life and the general welfare of the town; and
- (k) Improve the compatibility of uses by providing privacy and enhancing the aesthetic transition between uses.

(2) For the purpose of this section, **TREE** is defined as a self-supporting, woody plant, together with its root system, having a well-defined stem or trunk or a multi-stemmed trunk system, a more or less well-defined crown, and a mature height of at least 8 feet. **TREE** does not include trees in containers or nursery stock trees kept or maintained for resale. **VEGETATION** is herein defined as perennial bushes and shrubs or ornamental or other grasses meeting minimum size requirements at planting.

(3) *Multi-trunk trees.*

(a) For the purposes of this section, **MULTI-TRUNK TREES** are defined as trees that have more than 1 trunk growing from a single root mass or trees that split into multiple stems below breast height (4 1/2 feet above ground).

(b) The diameter at breast height of multi-trunk trees shall be measured according to the following formula from the U.S. Forest Service National Core Field Guide: the dbh for a multi-trunk tree is calculated by taking the square root of the sum of squared dbhs of all trunks. The following example shows how this formula is intended to be applied:

Example: multi-trunk tree with four 10-inch trunks

1. Find square of each trunk. $10 \times 10 = 100$
2. Add squared numbers together. $100 + 100 + 100 + 100 = 400$
3. Calculate square root of total. Square root of 400 = 20
4. This multi-stem tree would be measured as a 20 inch dbh tree.

(c) Preserving some trunks of a multi-trunk tree is preferable to removal of the entire tree. The Director is authorized to allow the pruning or removal of an individual trunk to accommodate reasonable development of a property.

(B) *Clear cutting.* On a vacant, undeveloped parcel, removal of any tree greater than 6 inches in diameter at breast height is prohibited except after receiving an approved development site plan and issued building permit, an approved tree management plan and any required tree removal permit.

(C) *Tree removal permit.*

(1) *Permit required.* No person shall remove or destroy any tree which is 24 inches or greater diameter at breast height on any lot without first obtaining a tree removal permit from the Zoning Administrator in accordance with the procedures set forth in this section. Further, no person shall remove or destroy any tree located in the common open space of any development without first obtaining a tree removal permit.

(2) *Issuance of permit.* Tree removal permits shall be issued only after the Zoning Administrator has received the required tree management plan and a completed application for such permit which

has been signed by the property owner. In determining whether to grant or deny a permit, the Zoning Administrator shall consider:

- (a) The effect of the proposed tree removal upon the stabilization of soil;
- (b) The intended use of the property and feasible alternatives which would preserve existing trees;
- (c) The existing topography, proposed changes in the topography and proposed landscaping;
- (d) The hardship imposed or the reasonable use denied to the applicant as a result of permit denial;
- (e) Historical value of the trees;
- (f) Good horticultural and forestry practices;
- (g) The effect of the proposed tree removal on the deadening and absorption of sound;
- (h) The likelihood that the proposed action will adversely affect the control of flooding or soil erosion;
- (i) The impact of such action on surrounding property or persons;
- (j) The consistency of the proposed action with the purpose of this section.

(3) (a) A permit shall expire and become null and void if work authorized is not commenced within 6 months from the date of the permit or if such work when commenced is suspended or abandoned at any time for a period of 6 months;

(b) If work has commenced and the permit becomes null and void or expires because of lack of progress or abandonment, a new permit for the proposed tree removal activity shall be obtained before proceeding with further work.

(4) Removal of any size tree where the tree trunk is within 10 feet of a structure shall be allowed without a permit.

(D) *Tree emergency exception.*

(1) A tree emergency shall be deemed to exist when:

(a) A tree has become an imminent danger or hazard to persons or property as a result of fire, motor vehicle accident, or natural occurrence such as lightning, windstorm, ice storm, flood, or other similar event; or

(b) A tree must be removed in order to perform emergency repair or replacement of public or private water, sewer, electric, gas, or telecommunications utilities.

(2) In the case of a tree emergency, the Director is hereby authorized to:

- (a) Issue a tree removal permit without an application;
- (b) Waive the requirement for a tree removal permit set forth in this section; or
- (c) Waive any of the other regulations of this section.

(3) Notwithstanding any other regulations, a person otherwise required to obtain a tree removal permit may take any reasonable action necessary to avoid or eliminate the immediate danger or hazard, or conduct emergency repair or replacement of the public or private utility. The person taking such action shall file an application for a tree removal permit within 72 hours after a tree is removed in a tree emergency.

(4) In these instances, documentation of the need for the emergency tree removal must be provided. Such documentation can include (as applicable):

- (a) Documentation from a certified arborist;
- (b) Police report;
- (c) Photographs; and/or

(d) Other information documenting the condition of the tree and circumstances surrounding its removal.

(E) *Vegetation management plan required for new development and substantial redevelopment.* Any addition to the footprint of a structure, increases in lot coverage, changes to driveway and parking areas, or total renovation cost greater than or equal to 50% of the assessed value of the principal structure and for tree removal permits as required in division (C)(1).

(1) Any applicant proposing to remove or destroy existing trees or vegetation in conjunction with any land development activity, including the moving of buildings, shall submit a vegetation management plan containing such of the following information as deemed necessary by the Director:

- (a) The location, size and species of all trees which are at least 6 inches diameter at breast height, indicating which are to be preserved, which are to be removed, and a description of the condition of trees or vegetation that are to be preserved;
- (b) Specifications for the removal of trees and protection of trees during construction;
- (c) Proposed grade changes or other potentially injurious work adjacent to trees or vegetation designated for preservation with specifications for maintaining ground drainage and aeration around such trees;
- (d) The location, size and species of all vegetation to be planted;
- (e) An estimate of the vegetation canopy coverage to be provided as required in division (G) via retention or new planting; and
- (f) Such other information that the Director deems essential.

(2) Any applicant proposing to remove or destroy multiple existing trees or substantial vegetation on a developed lot not in conjunction with a land development activity shall ensure that the total vegetation cover on the property is equal to or greater than the minimum requirement through retention of existing vegetation or planting of new vegetation to meet ordinance requirements.

(3) Although not required, any person or firm subject to the requirements of this chapter is encouraged to seek professional assistance from a certified arborist, landscape architect, or similar professional.

(F) *Acts harmful to trees.*

(1) No person shall abuse, mutilate or otherwise damage any tree or vegetation located on public property, or any tree or vegetation protected by this section, including those located in the public right-of-way along street frontages within subdivisions. However, nothing in this section shall be construed to prevent reasonable and proper trimming of trees or vegetation located on public property by authorized persons in accordance with accepted horticultural practices.

(2) No person shall attach any sign, notice, placard, electrical wire or other injurious device to any tree, nor shall any person cause any substance harmful to trees to come in contact with them, or prevent water and oxygen from reaching their roots.

(G) *Canopy cover required.*

(1) New development and substantial redevelopment as defined in § 156.137(E) on any property shall provide for the planting or retention of trees (or approved substitute vegetation in the "Town of Duck Vegetation Planting Guidelines") on the site to provide for a minimum vegetative lot coverage as follows:

(a) Ten percent for a lot within any commercial zoning district;

(b) Fifteen percent for a residential lot; and

(c) Required vegetative lot coverage will be calculated based on the total lot area minus the footprint of the principal building.

(2) To meet the minimum requirements of this division, vegetative lot coverage shall be calculated using the following methods:

(a) Vegetation that is newly planted to meet vegetative lot coverage requirements shall include only vegetation on an approved list of local vegetation, as provided in the "Town of Duck Vegetation Planting Guidelines," or other trees, bushes, shrubs, or grasses as approved by the Zoning Administrator upon submission of a landscape plan with assessment of local hardiness and calculation of canopy. All vegetation planted to meet these requirements shall be a minimum size as specified in the "Town of Duck Vegetation Planting Guidelines" and shall be planted as described in the technical standards included within the guidelines. Palm trees and tropical vegetation cannot be counted to meet vegetative lot coverage requirements. The plant list contained in the "Town of Duck Vegetation Planting Guidelines" defines the plant species that are included within each category. If the canopy coverage is accomplished by installation, canopy credit shall be provided based on the categories listed below:

1. Large trees, provide a 400 square foot canopy credit.

2. Small trees, provide a 200 square foot canopy credit.

3. Mulched bushes or shrubs (18-24 inches minimum height at planting or a 3 gallon size) provide a 40 square foot canopy credit.

4. Ornamental grasses (18-24 inches minimum height at planting or of a 3-gallon size) provide a 20 square foot canopy credit. Credit for smaller coastal grasses and forbs, such as American Beach Grass, will be provided at 100 sprigs or plants for every 100 square feet of lot area. Credit will not be provided for retention of existing vegetation in oceanfront areas within the CAMA small structure setback.

(b) Existing vegetation that is retained to meet vegetative lot coverage requirements may be calculated based on the methods described in division (a) above based on the allowable square footage as shown for large and small trees, shrubs, and grasses. Areas of significant, mature vegetation that will remain undisturbed may also be calculated on a square foot basis by determining the area within the perimeter surrounding the vegetation to be retained. Existing vegetation to be retained need not be on the approved list of local vegetation as provided in the "Town of Duck Vegetation Planting Guidelines," provided it is a native or locally adaptive plant species.

(c) For trees to be eligible for any tree canopy cover credit, the required amount of open soil surface must be present and protected around the tree. The area of vegetative canopy cover for which credit is given shall always remain in vegetative cover and there shall be no other use of the area other than for vegetation growth or passive recreation except as otherwise provided herein. Developed properties shall be required to maintain the minimum vegetative canopy described above and must provide for replacement of or vegetations that are removed, per division (E)(2).

(H) *Vegetation protection during and post development.*

(1) During development or razing activity, the builder shall install effective dripline protection around all vegetation preservation areas, and shall further install tree wells, retaining walls, construction fencing, or other structures necessary to protect individual trees designated for preservation. The protective measures shall be specified on the vegetation management plan and shall be designed and installed in a manner consistent with good horticultural practices and subject to the approval of the site plan approving agent.

(2) If vegetation is not listed for removal on the tree removal permit but is destroyed or receives major damage due to construction activities, it must be replaced with vegetation sufficient to reach the required vegetation canopy, subject to review and approval of the Zoning Administrator.

(3) Trees conserved and planted to meet vegetation canopy requirements shall be actively protected during development activity and passively protected throughout their life in accordance with requirements for protected trees set forth below:

(a) *Prohibited activities.* During lot clearing, grading, building, and all construction activities, the following activities and conditions, and any other activities and conditions harmful to a tree's roots, trunk, or crown, within the vegetation protection zone are prohibited:

1. Vehicle or equipment traffic, parking, or storage, except as provided for in limited activities below;
2. Materials or supplies storage;
3. Placement of temporary or permanent structures;
4. Equipment maintenance or washout;
5. Wounding of trunk;
6. Wounding or breakage of scaffold limbs or branches greater than 6 inches in diameter; and
7. Fires; excessive heat from equipment exhaust pipes.

(b) *Limited activities.* During lot clearing, grading, building, and all construction activities, the following activities and conditions within the vegetation protection zone are limited to 1 side of the tree in the outer half of the dripline, but in no case closer than 2 1/2 feet to the trunk of a planted tree and 10 feet to the trunk of a conserved tree:

1. Site or lot clearing or grubbing;
2. Soil excavation;
3. Soil cuts;
4. Soil fill;
5. Grading;
6. Trenching;
7. Tilling;
8. Edging;
9. Soil compaction;
10. Top dressing with soil greater than 2 inches in depth; and
11. Paving.

(l) *Preservation of special trees.*

(1) The Town Council may, by ordinance, designate any tree as a heritage, memorial, or designated specimen tree. A heritage tree means any tree which the Town Council has designated by ordinance to have notable historic or cultural interest. A memorial tree means any tree which the Town Council has designated by ordinance to be a special commemorating memorial. A designated specimen tree means any tree which the Town Council has designated by ordinance to be notable by virtue of its outstanding size and quality for its particular species. No designated tree shall be removed, damaged or disturbed in any way unless the Town Council finds that:

(a) There is an overriding need for public improvements;

(b) A severe hardship exists in developing a site; or

(c) The tree dies, becomes irreversibly diseased or irreversibly damaged by natural causes. In permitting such action, the Town Council may require that the tree be relocated on-site or to another site designated by the town, or be replaced with a similar tree or trees to approximate the canopy lost.

(2) The provisions of this section shall not apply to:

(a) Work conducted on federal, state, or local government owned property;

(b) Emergency work to protect life, limb or property; and

(c) Routine installation, maintenance and repair of utilities.

(J) *Violations and penalties.*

(1) It shall be a violation for any person to remove a tree without having first obtained a tree removal permit, if so required under the provisions of §§ 156.115 and 156.137 of the Town Code. It shall be a violation for a property owner to employ, authorize or direct any third person or entity to remove a tree without having first obtained a tree removal permit, if so required under the provisions of this section.

(2) A separate violation shall be deemed to have occurred for each tree removed without a tree removal permit in violation of the provisions of this section.

(3) Each violation of the tree removal permit requirements of this section shall subject the offender to a civil penalty in the amount of \$1,000.

(4) Removal of a tree greater than 6 inches in diameter at breast height on any vacant, undeveloped parcel without the necessary permits and approvals as defined above in § 156.137(B), shall subject the offender to a civil penalty according to the following procedure.

(a) If the number and type of removed trees and/or vegetation can be determined, the civil penalty shall be assessed as follows:

1. Unauthorized removal of large trees as defined by the "Town of Duck Vegetation Planting Guidelines" shall subject the offender to a civil penalty in the amount of \$400 per tree.

2. Unauthorized removal of small trees as defined by the "Town of Duck Vegetation Planting Guidelines" shall subject the offender to a civil penalty in the amount of \$200 per tree.

3. Unauthorized removal of shrubs as defined by the "Town of Duck Vegetation Planting Guidelines" shall subject the offender to a civil penalty in the amount of \$40 per shrub.

(b) If the number and type of removed trees and/or vegetation cannot be determined, a civil penalty can be determined based on the square footage of disturbed area and/or area of canopy coverage removed. The penalty shall be equal to \$1 for every 1 square foot of canopy coverage removed. In no instance shall the civil penalty exceed \$5,000.

(5) Unauthorized removal of trees and vegetation shall also subject the offender to mitigation requirements as specified herein.

(a) When dealing with violations of clear-cutting standards under § 156.137(B) or canopy coverage standards in § 156.137(G), the required canopy coverage of replacement trees shall be no less than the canopy coverage which has been determined to have been removed for the assessment of the required civil penalty. The mitigation requirements shall be calculated using the formula to determine canopy coverage as defined above in § 156.137(G). Replacement trees and vegetation, to the extent that it can be determined, shall of a similar type to that which has been removed.

(b) When dealing with tree removal violations of § 156.137(C), the diameter at breast height measurement of the trunk shall be used to determine the number of replacement trees. Trees of similar type must be planted such that the total caliper inches of trees planted is no less than the dbh of the tree(s) removed. In cases where the size of an individual tree(s) cannot be determined, the canopy coverage of replacement trees and vegetation shall be no less than the canopy coverage which has been determined to have been removed for the assessment of the required civil penalty.

(c) The size of such replacement trees at the time of installation shall be a minimum of 3 inches in caliper and 10 feet in height. Each tree must be planted at least 30 feet from any other tree.

(6) If in the determination of the Zoning Administrator, the site cannot reasonably accommodate the required numbers of replacement trees, then only the amount of trees which can be accommodated on the site will be replaced and the remainder of replacement trees and vegetation shall be mitigated through a payment in lieu of providing on-site trees. This payment shall be made to the Town of Duck to be used for tree and vegetation planting and maintenance in public spaces. The amount of the payment shall be in accordance with the costs for purchase, delivery, and planting of the required replacement trees and vegetation.

(K) *Conflicting provisions.*

(1) Where provisions of this zoning chapter dictate conflicting landscaping or screening requirements, the more stringent requirements shall prevail.

(2) Except under the following conditions, no certificate of occupancy or other final approval shall be issued until the relocation or replacement of trees and/or vegetation, as required by the tree removal or vegetation management plan, has been completed and the final approval has been given by the Zoning Administrator. To address temporary adverse conditions during the current planting season, at any time prior to the issuance of the certificate of occupancy the property owner may request to defer installation of vegetation for a period not to exceed 90 days beyond the date of the certificate of occupancy. This request will be accompanied by the following:

(a) A cash deposit, an irrevocable letter of credit, or other financial surety shall be provided to the town to be held until the planting is completed. The amount shall be equal to \$1 for every 1 square foot of canopy coverage required to be installed to satisfy the canopy coverage requirements as specified in the approved vegetation management plan.

(b) A signed memorandum of understanding between the property owner or authorized agent and the town specifying the timeframe for installation of all vegetation and the penalties for failing to abide by the terms of the agreement. This agreement shall also include terms for refunding the cash deposit upon verification of compliance with terms of the vegetation management plan or tree removal permit.

(L) *Special use permits.* The Town Council may, upon application of the property owner, grant special use permits modifying the requirements of this section in accordance with the procedures and limitations established for special use permits in § 156.155. Special use permits shall be granted only if the applicant has clearly demonstrated a situation of extreme topography, unusual lot shape or extraordinary circumstance. In addition, the requested special use permit shall only be granted if the

Town Council finds that the proposed development will not be inconsistent with the Comprehensive & Land Use Plan and the purpose of this section, and otherwise will not result in inadequate on-site amenity or any condition which will adversely affect nearby property. Requests for special use permits may be granted in whole, in modified form with conditions or denied by the Town Council after consideration of the requisites presented in this section.

(M) *Irrigation.* Vegetation that is well-adapted to the local environment does not generally require irrigation. Irrigation systems are not required; however, all irrigation systems installed subsequent to this section must meet the requirements of this section. If irrigation systems are used, the preferred source for their water is from individual or community wells rather than from the county water supply. For irrigation systems which use county water, the installation shall include rain sensors so that unnecessary watering does not occur and thereby add to the local high ground water table. No components of an individually owned private irrigation system shall be installed in any right-of-way. Water from sprinkler heads of an irrigation system shall be appropriately directed to retain the flow of water on the site for which it has been installed and to avoid run-off to adjacent properties and rights-of-way.

(Ord. 07-05, passed 6-6-2007; Am. Ord. 08-01, passed 3-5-2008; Am. Ord. 10-03, passed 3-3-2010; Am. Ord. 15-06, passed 6-3-2015; Am. Ord. 21-01, passed 6-2-2021) Penalty, see § 156.999

§ 156.138 WIND ENERGY FACILITIES.

(A) *Purpose.* To allow for the installation of wind energy facilities that are appropriate within the Town of Duck as a supplemental means of on-site electric power generation, while recognizing the public safety as well as the land use and community compatibility issues that are associated with the structural components of these facilities. This shall be achieved by establishing standards to protect community and neighborhood aesthetics, public safety, and to limit adverse impacts to adjacent property owners.

(B) *Types of wind energy facilities permitted by zoning district.* Supplementary Wind Energy Facilities, as defined in § 156.002, shall be permitted in all zoning districts within the town. Commercial Wind Energy Facilities are considered to be incompatible with development in the Town of Duck and are hereby prohibited.

(C) *Use guidelines and dimensional requirements.*

(1) *Height.* Wind turbine structures shall not exceed the 5 feet above the maximum height limitation established within each zoning district.

(2) *Setbacks.*

(a) Freestanding wind turbines shall be set back a distance of least 1.1 times the total height of the wind energy facility from:

1. The lot lines of the lot where the wind energy facility is located.

2. The first line of stable natural vegetation of the Atlantic Ocean beach. In no instance shall the wind energy facility be located within the small structure setback established by the North Carolina Coastal Area Management Authority (CAMA).

3. The normal water line of the Currituck Sound. In no instance shall the wind energy facility be located within 30 feet of the normal water line of the Currituck Sound.

(b) Roof-mounted wind turbines and other accessory components of wind energy facilities shall be required to adhere to the minimum yard requirements for principal structures established in each zoning district.

(3) *Noise.*

(a) The maximum audible sound resulting from all wind energy facilities located on the same lot shall be 55 decibels (dBA) or 5 decibels (dBA) above the existing ambient noise level, whichever is greater, measured at the closest adjacent property line. The maximum audible sound shall be the sound pressure level that is exceeded for more than 10% of the measurement duration. This standard shall not apply to short-term events such as utility outages and/or severe wind storms.

(b) When the town receives a complaint of noise generated from a wind energy facility, the town shall perform a preliminary test using a decibel meter to determine if the noise from the wind energy facility exceeds the established level for maximum audible sound as defined in this section. If the result of the preliminary test supports that the maximum audible sound level has been exceeded to a material extent, then the owner of the wind energy facility shall be required to perform a detailed acoustic sound measurement of the wind energy facility. This measurement shall be conducted in accordance with industry standards for performing acoustic testing of small wind energy facilities which may include, but shall not be limited to, the procedures set forth in the American Wind Energy Association Publication "AWEA Small Wind Turbine Performance and Safety Standard, Standard AWEA 9.1 - 2009."

(c) If the results of this measurement indicate that a violation exists and that the violation will persist without corrective action, then the owner shall discontinue use of the wind energy facility until appropriate measures can be taken to retrofit the structure or mitigate the noise at the affected property lines. If the noise from the wind energy facility cannot be brought into compliance with the noise requirements established by this section, the owner shall be required to decommission the wind energy facility.

(4) *Aesthetics.*

(a) *Tower.* If a tower is part of a wind energy facility, it shall be a self-supporting tubular tower (monopole) tower.

(b) *Exterior finish.* Each wind energy facility shall maintain a non-reflective finish neutral in color to reduce reflection and glare and to otherwise reduce visual obtrusiveness.

(c) *Signage and lighting.* Signage on a wind energy facility is only permitted consistent with the standards outlined in § 156.130. No lighting on the wind energy facility shall be permitted unless required by FAA regulations.

(d) *Communications antenna.* No communications antenna or arrangement of wires unrelated to the wind energy facility shall be installed or connected to the wind energy facility.

(D) *Structural requirements.*

(1) All wind energy facilities shall be designed and certified by a North Carolina licensed professional engineer that the wind energy facility meets the design requirements established by the current North Carolina State Building Code, including the ability to withstand the force exerted by a 130-mph, 3-second wind gust.

(2) If the lowest point of a rotor blade or other movable part is located closer than 12 feet to the ground, an adequate barrier shall be placed around the base of the wind turbine tower to prevent injury.

(3) The installation and design of all wind energy facilities shall comply with any applicable industry standards including standards for performance and safety as established by the American Wind Energy Association and the Small Wind Coordinating Council, and all electrical and mechanical components shall conform to relevant local, state and national codes.

(4) Wind energy facilities shall meet all applicable FAA regulations.

(5) All wind energy facilities shall be equipped with a disconnection means compliant with Article 705 of the National Electric Code.

(E) *Decommissioning.*

(1) A wind energy facility that is out of service and not functioning shall be repaired by the owner or removed. If the town determines that a wind energy facility has not been operational for a continuous 90-day period, the Zoning Administrator shall give written notice by certified mail to the owner of the facility. The owner shall be given 45 days from receipt of the notice to respond in writing and provide information that explains the reason(s) that the system has been out-of-service and the corrective action that will be taken to put the system back in service. The response shall also include a timetable for completion of repairs.

(2) If the town determines that the corrective measures and/or the proposed time for repairs is unreasonable, the Zoning Administrator shall give written notice by certified mail to the owner or occupant of the property on which the wind energy facility is located to remove the system within 90 days of receipt of the notice. The owner or occupant of the property on which the facility is located shall be solely responsible for safe removal of the facility, and all costs to remove the facility shall be borne solely by such owner or occupant.

(3) Upon failure to comply with a notice of removal within the time specified, the town shall cause removal of the wind energy facility, and any expense incurred shall be paid by the owner of the property upon which the wind energy facility was erected or maintained.

(F) *Wind energy permitting requirements.*

(1) No person shall erect any wind energy facility without first obtaining a permit from the Department of Community Development in accordance with the procedures set forth in this section.

(2) All permit applications for wind energy facilities shall include the following:

(a) Site plan depicting the proposed location of all components of the wind energy facility as well as existing structures located on the subject property with dimensions showing compliance with minimum yard requirements;

(b) Construction drawings of the wind energy facility depicting the design of the turbine structure, tower, base and footings, sealed by a licensed North Carolina Professional Engineer certifying that the drawings conform to all structural requirements established by law;

(c) Wind energy facility specifications including the total rated capacity;

(d) Measurements of ambient noise conditions of the subject property taken during daytime and nighttime hours as well as the maximum sound pressure levels from the proposed wind energy facility;

(e) Construction plan;

(f) Operation and maintenance plans and specifications;

(g) Shutdown procedures;

(h) Evidence of at least \$500,000 of general liability insurance coverage;

(i) Any county, state and federal permits required by law or regulation; and

(j) Other relevant information as may be reasonably requested to ensure compliance with the requirements of this section.

(Ord. 10-06, passed 5-5-2010; Am. Ord. 17-04, passed 6-7-2017; Am. Ord. 21-01, passed 6-2-2021)

§ 156.139 SOLAR ENERGY SYSTEMS.

(A) *Purpose.* To allow for the installation within the town of solar energy systems as defined in § 156.002, while recognizing the public safety as well as the land use and community compatibility issues that are associated with the structural components of these facilities. This shall be achieved by establishing standards to protect community and neighborhood aesthetics, public safety, and to limit adverse impacts of such systems on adjacent property owners.

(B) *Types of solar energy systems permitted by zoning district.* Solar energy systems, as defined in § 156.002, shall be permitted in all zoning districts within the town as an accessory use to any principal use structure.

(C) *Use guidelines and dimensional requirements.*

(1) *Height.*

(a) Roof-mounted solar energy systems:

1. Solar panels should generally relate to the slope of the roof surface to which they are attached. However, to account for the seasonal variation in solar angle and the necessity to tilt solar panels to achieve maximum efficiency of the solar energy system, the following provisions shall apply:

a. Solar panels mounted to a roof with a pitch of greater than 4 in 12 shall not be raised more than 3 feet above the plane of the finished roof surface to which they are attached.

b. Solar panels mounted to a roof with a pitch of less than 4 in 12 shall not be raised more than 5 feet above the plane of the finished roof surface to which they are attached.

2. Solar panels shall in no instance exceed the height limit of the zoning district in which they are located.

(b) The height of any ground mounted solar energy system including any mounts shall not exceed 10 feet when oriented at maximum tilt.

(2) *Location and placement.*

(a) Ground-mounted solar energy systems shall be located in the rear and side yards only and in no instance shall be located forward of the front plane of the principal structure. In the rear and side yards, solar energy systems must meet the required setbacks for the principal structure. In the case of a corner lot, solar energy systems shall not be located forward of the side plane of the principal structure abutting the side street.

(b) Ground-mounted solar photovoltaic systems shall be enclosed within a fence that is reasonably adequate to prevent access to the solar energy system or any ancillary equipment as required by the National Electrical Code.

(c) Roof-mounted solar energy systems shall in no instance extend beyond the edge of the roof to which they are attached.

(3) *Lot coverage.* Ground mounted solar energy systems shall not be counted as lot coverage; however, no more than 5% of total lot area may be covered with a solar energy system.

(D) *Structural/installation requirements.*

(1) All structural components supporting roof mounted solar energy systems shall be evaluated by a North Carolina Licensed Professional Engineer to ensure that the loads imposed by the solar energy system meet the design requirements established by the current North Carolina State Building Code, including the ability to withstand the force exerted by a 130-mph, 3-second wind gust.

(2) The installation and design of all solar energy systems shall comply with any applicable industry standards including standards for performance and safety and all electrical and mechanical

components shall conform to relevant local, state and national codes. All components of a solar energy system must be listed and labeled by a nationally recognized testing laboratory.

(E) *Permitting requirements.*

(1) No person shall erect any solar energy system without first obtaining a permit from the Director of Community Development in accordance with the procedures set forth in this section.

(2) All permit applications for solar energy systems shall include the following:

(a) Site plan depicting the proposed location of all components of the solar energy system as well as existing structures located on the subject property with dimensions showing compliance with minimum yard requirements;

(b) For utility interactive solar photovoltaic systems: a copy of the approved interconnection agreement with the local utility;

(c) Construction drawings of any roof mounted solar energy system depicting the design of the supporting structure, sealed by a North Carolina Licensed Professional Engineer certifying that the drawings conform to all structural requirements established by law;

(d) For solar photovoltaic systems, manufacturers specifications for all system components and an electrical diagram depicting the layout and interconnectivity of all electrical components;

(e) Construction plan;

(f) Operation and maintenance plans and specifications;

(g) Any county, state and federal permits required by law or regulation; and

(h) Other relevant information as may be reasonably requested to ensure compliance with the requirements of this section.

(Ord. 10-10, passed 1-5-2011; Am. Ord. 21-01, passed 6-2-2021)

§ 156.140 ACCESSORY DWELLING UNITS.

(A) *Purpose.* The purpose of these provisions for all accessory dwelling units is to allow the efficient use of existing housing stock, parcels of land, and community infrastructure, and to increase the number and variety of residential units while respecting the scale and character of existing neighborhoods.

(B) *General provisions.* Accessory dwelling units are allowed as permitted uses in the Single-Family Residential (RS-1), Single-Family Residential (RS-2), and Medium Density Residential (R-2) zoning districts, subject to the following standards.

(1) An accessory dwelling unit can only be located on a property containing one single-family detached residence. The property may contain other accessory structures and uses as permitted in this section.

(2) Only one accessory dwelling unit is permitted on a lot.

(3) *Building code.* An accessory dwelling unit must be properly permitted, inspected, and comply with all applicable standards of the N.C. Building Code.

(4) *Septic.* The owner must obtain a permit from the Dare County Environmental Health Department that the existing septic system can accommodate or be improved to accommodate the establishment of an accessory dwelling unit.

(C) *Development standards.*

(1) An accessory dwelling unit will count toward the maximum size of residential development and septic capacity permitted for a property. The development of a property cannot exceed the maximum standards for the size of residential development and septic capacity outlined in § 156.126.

(2) *Size of unit.* The size of an accessory dwelling unit must comply with all of the applicable following standards.

(a) A detached accessory dwelling unit or addition to the principal dwelling accommodating an accessory dwelling unit cannot be larger than 800 square feet of heated space.

(b) An attached accessory dwelling unit cannot be larger than the square footage of the principal dwelling footprint.

(3) *Height.* A detached accessory dwelling unit cannot exceed 27 feet in height or the height of the principal dwelling on the property, whichever is lower. An attached accessory dwelling unit cannot exceed the height of the principal dwelling on the property.

(4) *Setbacks.* An accessory dwelling unit must comply with all applicable minimum building setback requirements.

(5) *Parking.* An accessory dwelling unit must comply with the following parking requirements.

(a) If the establishment of an accessory dwelling unit increases the maximum occupancy permitted on the wastewater permit issued by the Dare County Health Department, then necessary improvements must be completed for the property to maintain compliance with minimum parking standards.

(b) Parking space(s) serving the accessory dwelling unit must have access unobstructed by parking spaces for principal dwelling unit.

(6) *Access.* Access and parking for an accessory dwelling unit must occur via the same driveway as the principal dwelling unit. A separate driveway is not permitted.

(Ord. 16-07, passed 11-2-2016; Am. Ord. 18-08, passed 2-6-2019; Am. Ord. 21-01, passed 6-2-2021)



TOWN OF DUCK VEGETATION PLANTING GUIDELINES

Canopy Requirements

Fifteen percent (15%) of residential sites or ten percent (10%) of commercial sites (area that is minus the footprint of the principal dwelling or commercial buildings) must have vegetative canopy cover either by preservation or by installation. If preservation is used, vegetation must have a protective device around the drip-line of the tree which prohibits construction activity, storage or parking in this area except as permitted by the tree and vegetation ordinance. These preservation methods must be indicated and detailed on the vegetation management plan. If the canopy cover is accomplished by installation, the following tree categories can be used.

A) Large trees listed below, installed at 6'-8' in height, provide a 400 square foot canopy credit.

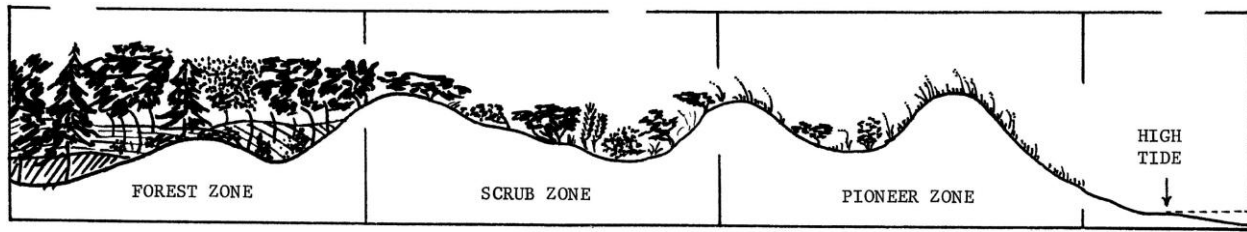
B) Small trees, listed below, installed at 6'-8' in height, provide a 200 square foot canopy credit.

Undesirable trees cannot be counted to meet the canopy requirements. Palm trees and tropical vegetation (other than the dwarf palmetto listed below) cannot be counted to meet the canopy requirements. Applicants may request substitution of other types of vegetation subject to the review procedures of the vegetation ordinance.

Vegetation in the form of small trees, bushes or shrubs may be substituted for large trees at a conversion rate of two small canopy trees or ten mulched shrubs (18-24 inches minimum height at planting or of a 3 gallon size) for one large canopy tree. Ornamental grasses may be substituted for large trees at a conversion rate of twenty plants (18-24 inches minimum height at planting or of a 3 gallon size) for one large canopy tree. Credit for smaller coastal grasses and forbs, such as American Beach Grass, will be calculated at 100 sprigs or plants for every 100 square feet. Credit will not be provided for retention of existing vegetation in oceanfront areas within the CAMA small structure setback.

The table below provides a list of the acceptable trees and other plant species that may be used when planting to meet the vegetative canopy requirements. The table is organized into categories of large and small trees, shrubs and bushes, ornamental grasses, and other grasses and forbs. Additionally, the table categorizes the plant species into the barrier island vegetative zones (see diagram) for which they are best adapted. This information is provided for reference purposes only. The Town of Duck makes no guarantee as to the heartiness or performance of listed plants in these areas; there are many other factors that will affect their survival.

Barrier Island Cross Section with Generalized Vegetative Zones



Excerpt from Seacoast Plants of the Carolinas – For Conservation and Beautification, UNC Sea Grant Program, February 1973

<u>Pine and hardwood or “forest” zone located on the leeward side of the island usually behind a dune ridge which provides protection from salt and wind;</u>	<u>Middle “scrub” zone usually starts behind the protection of the frontal dunes</u>	<u>“grass” or “pioneer” zone closest to the ocean with the most direct exposure to salt and wind</u>
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Not listed in the above diagram is the salt marsh zone which is typically located along the sound shoreline between the high and low tide line.

**AN ORDINANCE UPDATING FLOOD DAMAGE PREVENTION STANDARDS
IN THE TOWN OF DUCK, NORTH CAROLINA**

Ordinance 20-01

WHEREAS, the Federal Emergency Management Agency (FEMA) has notified the Town of Duck that revised Flood Insurance Rate Map (FIRM) panels will become effective on June 19, 2020; and

WHEREAS, by the effective date of the FIRM, the Town of Duck is required, as a condition of continued eligibility in the National Flood Insurance Program (NFIP), to adopt floodplain management regulations that meet the standards of NFIP regulations; and

WHEREAS, it is the purpose of this ordinance to promote public health, safety, and general welfare and to minimize public and private losses due to flooding by restricting or controlling development that potentially increases danger or damage to persons, structures, or properties; and

WHEREAS, the Duck Planning Board thoroughly reviewed these standards and voted unanimously to recommend approval of this ordinance at its public meeting on February 12, 2020; and

WHEREAS, the Duck Town Council found these amendments to the Flood Damage Prevention Ordinance to be consistent with the recommendations of the Town of Duck CAMA Land Use Plan.

NOW THEREFORE BE IT ORDAINED by the Town Council for the Town of Duck, North Carolina:

PART I. The existing Chapter 150, *Flood Damage Prevention*, of the Duck Town Code shall be replaced in its entirety by the following standards:

CHAPTER 150: FLOOD DAMAGE PREVENTION

GENERAL PROVISIONS

150.01 STATUTORY AUTHORIZATION.

The Legislature of the State of North Carolina has in Part 6, Article 21 of Chapter 143; Article 6 of Chapter 153A; Article 8 of Chapter 160A; and Article 7, 9, and 11 of Chapter 160D (Effective January 1, 2021) of the North Carolina General Statutes, delegated to local governmental units the authority to adopt regulations designed to promote the public health, safety, and general welfare.

Therefore, the Town Council for the Town of Duck, North Carolina, does ordain as follows:

150.02 FINDINGS OF FACT.

- (A) The flood prone areas within the jurisdiction of the Town of Duck are subject to periodic inundation which results in loss of life, property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures of flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety, and general welfare.
- (B) These flood losses are caused by the cumulative effect of sea level rise, increased frequency and intensity of rainfall, obstructions in floodplains causing increases in flood heights and velocities, and occupancy in flood prone areas of uses vulnerable to floods or other hazards.

150.03 STATEMENT OF PURPOSE.

It is the purpose of this ordinance to promote public health, safety, and general welfare and to minimize public and private losses due to flood conditions within flood prone areas by provisions designed to:

- (A) Restrict or prohibit uses that are dangerous to health, safety, and property due to water or erosion hazards or that result in damaging increases in erosion, flood heights or velocities;
- (B) Require that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage;
- (C) Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of floodwaters;
- (D) Control filling, grading, dredging, and all other development that may increase erosion or flood damage; and
- (E) Prevent or regulate the construction of flood barriers that will unnaturally divert floodwaters or which may increase flood hazards to other lands.

150.04 OBJECTIVES.

The objectives of this ordinance are to:

- (A) Protect human life, safety, and health;
- (B) Minimize expenditure of public money for costly flood control projects;
- (C) Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- (D) Minimize prolonged business losses and interruptions;
- (E) Minimize damage to public facilities and utilities (i.e. water and gas mains, electric, telephone, cable and sewer lines, streets, and bridges) that are located in flood prone areas;
- (F) Minimize damage to private and public property due to flooding;

- (G) Make flood insurance available to the community through the National Flood Insurance Program;
- (H) Maintain the natural and beneficial functions of floodplains;
- (I) Help maintain a stable tax base by providing for the sound use and development of flood prone areas; and
- (J) Ensure that potential buyers are aware that property is in a Special Flood Hazard Area or area subject to potential flooding;
- (K) Mitigate flood risks in all areas of the Town of Duck by implementing local elevation standards for all Special Flood Hazard Areas and Shaded X and X zones.

150.05 DEFINITIONS.

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this ordinance it's most reasonable application.

"Accessory Structure (Appurtenant Structure)" means a structure located on the same parcel of property as the principal structure and the use of which is incidental to the use of the principal structure. Garages, carports and storage sheds are common urban accessory structures. Pole barns, hay sheds and the like qualify as accessory structures on farms and may or may not be located on the same parcel as the farm dwelling or shop building. For the purposes of this chapter only, accessory structures are considered structures used for parking and storage only.

"Addition (to an existing building)" means an extension or increase in the floor area or height of a building or structure.

"Appeal" means a request for a review of the Floodplain Administrator's interpretation of any provision of this ordinance.

"Area of Shallow Flooding" means a designated Zone AO or AH on a community's Flood Insurance Rate Map (FIRM) with base flood depths determined to be from one (1) to three (3) feet. These areas are located where a clearly defined channel does not exist, where the path of flooding is unpredictable and indeterminate, and where velocity flow may be evident.

"Area of Special Flood Hazard" see "Special Flood Hazard Area (SFHA)".

"Attendant Utility" means any utility that accompanies a structure, including, but not limited to ductwork, electrical, mechanical, plumbing, and heating & cooling.

"Base Flood" means the flood having a one (1) percent chance of being equaled or exceeded in any given year.

"Base Flood Elevation (BFE)" means a determination of the water surface elevations of the base flood as published in the Flood Insurance Study. When the BFE has not been provided in a "Special Flood Hazard

Area”, it may be obtained from engineering studies available from a Federal, State, or other source using FEMA approved engineering methodologies. This elevation, when combined with the “Freeboard”, establishes the “Regulatory Flood Protection Elevation”.

“Basement” means any area of the building having its floor subgrade (below ground level) on all sides.

“Breakaway wall. A wall that is not part of the structural support of the building and is intended through its design and construction to collapse under specific lateral loading forces without causing damage to the elevated portion of the building or the supporting foundation system.

“Building” see “Structure”.

“Chemical Storage Facility” means a building, portion of a building, or exterior area adjacent to a building used for the storage of any chemical or chemically reactive products.

“Coastal Area Management Act (CAMA)” means North Carolina’s Coastal Area Management Act, this act, along with the Dredge and Fill Law and the Federal Coastal Zone Management Act, is managed through North Carolina Department of Environmental Quality (NCDEQ) Division of Coastal Management (DCM).

“Coastal Barrier Resources System (CBRS)” consists of undeveloped portions of coastal and adjoining areas established by the Coastal Barrier Resources Act (CoBRA) of 1982, the Coastal Barrier Improvement Act (CBIA) of 1990, and subsequent revisions, and includes areas owned by Federal or State governments or private conservation organizations identified as Otherwise Protected Areas (OPA).

“Coastal High Hazard Area (CHHA)” means a Special Flood Hazard Area extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. The area is designated on a FIRM, or other adopted flood map as determined in Section 150.07 of this ordinance, as Zone VE, or any property containing a structure or proposed structure abutting the Atlantic Ocean to a maximum limit of the Ocean Erodeable Area (OEA) as defined by the CAMA.

“Design Flood”: See “Regulatory Flood Protection Elevation.”

“Development” means any man-made change to improved or unimproved real estate, including, but not limited to, buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials.

“Development Activity” means any activity defined as Development which will necessitate a Floodplain Development Permit. This includes buildings, structures, and non-structural items, including (but not limited to) fill, bulkheads, piers, pools, docks, landings, ramps, and erosion control/stabilization measures.

“Digital Flood Insurance Rate Map (DFIRM)” means the digital official map of a community, issued by the Federal Emergency Management Agency (FEMA), on which both the Special Flood Hazard Areas and the risk premium zones applicable to the community are delineated.

“Disposal” means, as defined in NCGS 130A-290(a)(6), the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste into or on any land or water so that the solid waste or any constituent part of the solid waste may enter the environment or be emitted into the air or discharged into

any waters, including groundwaters.

“Elevated Building” means a non-basement building which has its lowest elevated floor raised above ground level by foundation walls, shear walls, posts, piers, pilings, or columns.

“Encroachment” means the advance or infringement of uses, fill, excavation, buildings, structures or development into a special flood hazard area, which may impede or alter the flow capacity of a floodplain.

“Existing building and existing structure” means any building and/or structure for which the “start of construction” commenced before the community entered the NFIP, dated October 6, 1978.

“Existing Manufactured Home Park or Manufactured Home Subdivision” means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) was completed before September 3, 2003, the effective date of the initial floodplain management regulations adopted by the Town of Duck.

“Flood” or **“Flooding”** means a general and temporary condition of partial or complete inundation of normally dry land areas from:

- (1) The overflow of inland or tidal waters; and/or
- (2) The unusual and rapid accumulation or runoff of surface waters from any source.

“Flood Insurance” means the insurance coverage provided under the National Flood Insurance Program.

“Flood Insurance Rate Map (FIRM)” means an official map of a community, issued by the FEMA, on which both the Special Flood Hazard Areas and the risk premium zones applicable to the community are delineated. (see also DFIRM)

“Flood Insurance Study (FIS)” means an examination, evaluation, and determination of flood hazards, corresponding water surface elevations (if appropriate), flood hazard risk zones, and other flood data in a community issued by the FEMA. The Flood Insurance Study report includes Flood Insurance Rate Maps (FIRMs) and Flood Boundary and Floodway Maps (FBFMs), if published.

“Flood Prone Area” see “Floodplain”

“Flood Zone” means a geographical area shown on a Flood Hazard Boundary Map or Flood Insurance Rate Map that reflects the severity or type of flooding in the area.

“Floodplain” means any land area susceptible to being inundated by water from any source.

“Floodplain Administrator” is the individual appointed to administer and enforce the floodplain management regulations. The Floodplain Administrator may assign duties of the position to a designee.

“Floodplain Development Permit” means any type of permit that is required in conformance with the provisions of this ordinance, prior to the commencement of any development activity.

“Floodplain Management” means the operation of an overall program of corrective and preventive measures for reducing flood damage and preserving and enhancing, where possible, natural resources in

the floodplain, including, but not limited to, emergency preparedness plans, flood control works, floodplain management regulations, and open space plans.

“Floodplain Management Regulations” means this ordinance and other zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances, and other applications of police power. This term describes federal, state or local regulations, in any combination thereof, which provide standards for preventing and reducing flood loss and damage.

“Floodproofing” means any combination of structural and nonstructural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitation facilities, structures, and their contents.

“Flood-resistant material” means any building product [material, component or system] capable of withstanding direct and prolonged contact (minimum 72 hours) with floodwaters without sustaining damage that requires more than low-cost cosmetic repair. Any material that is water-soluble or is not resistant to alkali or acid in water, including normal adhesives for above-grade use, is not flood-resistant. Pressure-treated lumber or naturally decay-resistant lumbars are acceptable flooring materials. Sheet-type flooring coverings that restrict evaporation from below and materials that are impervious, but dimensionally unstable are not acceptable. Materials that absorb or retain water excessively after submergence are not flood-resistant. Please refer to Technical Bulletin 2, *Flood Damage-Resistant Materials Requirements*, and available from the FEMA. Class 4 and 5 materials, referenced therein, are acceptable flood-resistant materials.

“Freeboard” means the height added to the BFE to account for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, blockage of bridge or culvert openings, storm surge or precipitation exceeding the base flood, and the hydrological effect of urbanization of the watershed. The BFE plus the freeboard establishes the “Regulatory Flood Protection Elevation”.

“Free and Clear of Obstruction” means the required space below the lowest floor of an elevated structure located in a CHHA that is open and is designed to allow floodwaters to flow freely beneath the structure, experiencing only minimal resistance from supporting structural elements such that floodwaters transfer only minimal lateral forces to the foundation system. For the purposes of this chapter, the space below the structure that is unobstructed as described herein shall be a minimum vertical distance of 2 feet, measured from the highest adjacent grade below the structure to the bottom of the lowest horizontal structural member of the lowest floor. Non-bearing solid breakaway walls, open lattice panels and insect screening are not considered obstructions that will impede the free flow of floodwaters and may be allowed below the lowest floor of the structure.

“Functionally Dependent Facility” means a facility which cannot be used for its intended purpose unless it is located in close proximity to water, limited to a docking or port facility necessary for the loading and unloading of cargo or passengers, shipbuilding, or ship repair. The term does not include long-term storage, manufacture, sales, or service facilities.

“Hazardous Waste Management Facility” means, as defined in NCGS 130A, Article 9, a facility for the collection, storage, processing, treatment, recycling, recovery, or disposal of hazardous waste.

“Highest Adjacent Grade (HAG)” means the highest natural elevation of the ground surface, prior to construction, immediately next to the proposed walls of the structure.

“Historic Structure” means any structure that is:

- (1) Listed individually in the National Register of Historic Places (a listing maintained by the US Department of Interior) or preliminarily determined by the Secretary of Interior as meeting the requirements for individual listing on the National Register;
- (2) Certified or preliminarily determined by the Secretary of Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
- (3) Individually listed on a local inventory of historic landmarks in communities with a “Certified Local Government (CLG) Program”; or
- (4) Certified as contributing to the historical significance of a historic district designated by a community with a “Certified Local Government (CLG) Program.”

Certified Local Government (CLG) Programs are approved by the US Department of the Interior in cooperation with the North Carolina Department of Cultural Resources through the State Historic Preservation Officer as having met the requirements of the National Historic Preservation Act of 1966 as amended in 1980.

“Letter of Map Change (LOMC)” means an official determination issued by FEMA that amends or revises an effective Flood Insurance Rate Map or Flood Insurance Study. Letters of Map Change include:

- (1) Letter of Map Amendment (LOMA): An official amendment, by letter, to an effective National Flood Insurance Program map. A LOMA is based on technical data showing that a property had been inadvertently mapped as being in the floodplain but is actually on natural high ground above the base flood elevation. A LOMA amends the current effective Flood Insurance Rate Map and establishes that a specific property, portion of a property, or structure is not located in a special flood hazard area.
- (2) Letter of Map Revision (LOMR): A revision based on technical data that may show changes to flood zones, flood elevations, special flood hazard area boundaries and floodway delineations, and other planimetric features.
- (3) Letter of Map Revision Based on Fill (LOMR-F): A determination that a structure or parcel of land has been elevated by fill above the BFE and is, therefore, no longer located within the special flood hazard area. In order to qualify for this determination, the fill must have been permitted and placed in accordance with the community’s floodplain management regulations.
- (4) Conditional Letter of Map Revision (CLOMR): A formal review and comment as to whether a proposed project complies with the minimum NFIP requirements for such projects with respect to delineation of special flood hazard areas. A CLOMR does not revise the effective Flood Insurance Rate Map or Flood Insurance Study; upon submission and approval of certified as-built documentation, a Letter of Map Revision may be issued by FEMA to revise the effective FIRM.

“Light Duty Truck” means any motor vehicle rated at 8,500 pounds Gross Vehicular Weight Rating or less which has a vehicular curb weight of 6,000 pounds or less and which has a basic vehicle frontal area of 45 square feet or less as defined in 40 CFR 86.082-2 and is:

- (1) Designed primarily for purposes of transportation of property or is a derivation of such a vehicle, or
- (2) Designed primarily for transportation of persons and has a capacity of more than 12 persons; or

- (3) Available with special features enabling off-street or off-highway operation and use.

“Local Elevation Standard” means a locally adopted elevation level used as the Regulatory Flood Protection Elevation (RFPE) or in conjunction with the BFE and freeboard standard to mitigate flood hazards in the AE, AO, VE, Shaded X and X zones as depicted on the FIRMs for Dare County.

“Lowest Adjacent Grade (LAG)” means the lowest elevation of the ground, sidewalk or patio slab immediately next to the building, or deck support, after completion of the building.

“Lowest Floor” means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access, or limited storage in an area other than a basement area is not considered a building's lowest floor, provided that such an enclosure is not built so as to render the structure in violation of the applicable design flood requirements of this ordinance.

“Manufactured Home” means a structure, transportable in one or more sections, which is built on a permanent chassis and designed to be used with or without a permanent foundation when connected to the required utilities. The term “manufactured home” does not include a “recreational vehicle”.

“Manufactured Home Park or Subdivision” means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

“Map Repository” means the location of the official flood hazard data to be applied for floodplain management. It is a central location in which flood data is stored and managed; in North Carolina, FEMA has recognized that the application of digital flood hazard data products carries the same authority as hard copy products. Therefore, the NCEM’s Floodplain Mapping Program websites house current and historical flood hazard data. For effective flood hazard data, the NC FRIS website (<http://FRIS.NC.GOV/FRIS>) is the map repository, and for historical flood hazard data the FloodNC website (<http://FLOODNC.GOV/NCFLOOD>) is the map repository.

“Market Value” means the building value, not including the land value and that of any accessory structures or other improvements on the lot. Market value may be established by independent certified appraisal; replacement cost depreciated for age of building and quality of construction (Actual Cash Value); or adjusted tax assessed values.

“New Construction” means structures for which the “start of construction” commenced on or after the effective date of the initial floodplain management regulations and includes any subsequent improvements to such structures.

“Non-Conversion Agreement” means a document stating that the owner will not convert or alter what has been constructed and approved. Violation of the agreement is considered a violation of the ordinance and, therefore, subject to the same enforcement procedures and penalties. The agreement must be filed in the Dare County Register of Deeds. The agreement must show the clerk’s or recorder’s stamps and/or notations that the filing has been completed.

“Ocean Erodible Area” This is the area where there exists a substantial possibility of excessive erosion and significant shoreline fluctuation. The oceanward boundary of this area is the mean low water line. The landward extent of this area is the distance landward from the first line of stable and natural vegetation as defined in 15A NCAC 07H .0305(a)(5) to the recession line established by multiplying the long-term

annual erosion rate times 90; provided that, where there has been no long-term erosion or the rate is less than two feet per year, this distance shall be set at 120 feet landward from the first line of stable natural vegetation. For the purposes of this Rule, the erosion rates are the long-term average based on available historical data. The current long-term average erosion rate data for each segment of the North Carolina coast is depicted on maps entitled "2011 Long-Term Average Annual Shoreline Rate Update" and approved by the Coastal Resources Commission on May 5, 2011 (except as such rates may be varied in individual contested cases or in declaratory or interpretive rulings). In all cases, the rate of shoreline change shall be no less than two feet of erosion per year. The maps are available without cost from any Local Permit Officer or the Division of Coastal Management on the internet at <http://www.nccoastalmanagement.net>

"Otherwise Protected Area (OPA)" see "Coastal Barrier Resources System (CBRS)".

"Post-FIRM" means construction or other development for which the "start of construction" occurred on or after October 6, 1978, the effective date of the initial Flood Insurance Rate Map.

"Pre-FIRM" means construction or other development for which the "start of construction" occurred before October 6, 1978, the effective date of the initial Flood Insurance Rate Map.

"Primary Frontal Dune (PFD)" means a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

This definition applies only to this chapter for floodplain management purposes and varies from the definition used by the N.C. Division of Coastal Management in the CAMA.

"Principally Above Ground" means that at least 51% of the actual cash value of the structure is above ground.

"Public Safety" and/or "Nuisance" means anything which is injurious to the safety or health of an entire community or neighborhood, or any considerable number of persons, or unlawfully obstructs the free passage or use, in the customary manner, of any navigable lake, or river, bay, stream, canal, or basin.

"Recreational Vehicle (RV)" means a vehicle, which is:

- (1) Built on a single chassis;
- (2) 400 square feet or less when measured at the largest horizontal projection;
- (3) Designed to be self-propelled or permanently towable by a light duty truck;
- (4) Designed primarily not for use as a permanent dwelling, but as temporary living quarters for recreational, camping, travel, or seasonal use, and
- (5) Is fully licensed and ready for highway use.

For the purpose of this chapter, "Tiny Homes/Houses" and Park Models that do not meet the items listed above are not considered Recreational Vehicles and should meet the standards of and be permitted as Residential Structures.

"Reference Level"

- (1) For structures within the Special Flood Hazard Areas designated as Zones AE and AO the reference level is the bottom of the lowest floor or the bottom of the lowest attendant utility including ductwork, whichever is lower, with only flood resistant materials located below the

reference level.

- (2) For structures within Coastal High Hazard Areas, the reference level is the bottom of the lowest horizontal structural member of the lowest floor or the bottom of the lowest attendant utility including ductwork, whichever is lower.
- (3) For structures within Zones Shaded X or X, the reference level is the bottom of the lowest floor or the bottom of the lowest attendant utility including ductwork whichever is lower with only flood resistant materials located below the reference level.

“Regulatory Flood Protection Elevation” In Special Flood Hazard Areas means the “Base Flood Elevation” plus the “Freeboard” OR the “Local Elevation Standard”, whichever is greater, for those areas where base flood elevations have been determined on the FIRM; the base flood depth above the highest adjacent grade or “Local Elevation Standard”, whichever is greater, for those areas identified as AO zones of the FIRM, or the “Local Elevation Standard” for those areas identified as Shaded X or X zones on the FIRM.

For the Town of Duck, the RFPE is applied as follows:

- (1) In CHHA zones, the RFPE is the Base Flood Elevation as designated on the effective FIRM plus 2 feet of freeboard.
- (2) In AE zones, the RFPE is the Base Flood Elevation as designated on the effective FIRM plus 3 feet of freeboard OR an elevation to or above 10 feet NAVD 1988, whichever is greater.
- (3) In AO zones, the RFPE is the designated base flood depth on the effective FIRM above the highest natural adjacent grade OR an elevation to or above 10 feet NAVD 1988, whichever is greater.
- (4) In Shaded X and X zones, the RFPE is 10 feet NAVD 1988 OR the natural grade elevation if the natural grade is greater than 10 feet NAVD 1988.

“Remedy a Violation” means to bring the structure or other development into compliance with state and community floodplain management regulations, or, if this is not possible, to reduce the impacts of its noncompliance. Ways that impacts may be reduced include protecting the structure or other affected development from flood damages, implementing the enforcement provisions of the ordinance or otherwise deterring future similar violations, or reducing federal financial exposure with regard to the structure or other development.

“Salvage Yard” means any non-residential property used for the storage, collection, and/or recycling of any type of equipment, and including but not limited to vehicles, appliances and related machinery.

“Sand Dunes” means naturally occurring accumulations of sand in ridges or mounds landward of the beach.

“Secondary Structure” means a structure that features habitable conditioned space above the RFPE located on the same parcel as a primary use structure. A secondary structure is not an accessory structure as defined in this section. When applying the standards of this chapter, a secondary structure is subject to the same standards as a primary use structure.

“Shaded X Zone” means areas of moderate flood hazard shown on the FIRM and are the areas between the limits of the base flood and the 0.2% annual chance for flood. Also commonly referred to as the 500-year flood.

“Shear Wall” means walls used for structural support but not structurally joined or enclosed at the end (except by breakaway walls). Shear walls are parallel or nearly parallel to the flow of the water.

Solid Waste Disposal Facility” means any facility involved in the disposal of solid waste, as defined in NCGS 130A-290(a)(35).

“Solid Waste Disposal Site” means, as defined in NCGS 130A-290(a)(36), any place at which solid wastes are disposed of by incineration, sanitary landfill, or any other method.

“Special Flood Hazard Area (SFHA)” means the land in the floodplain subject to a one percent (1%) or greater chance of being flooded in any given year, as determined in Section 150.07 of this ordinance.

“Start of Construction” (definition applies only to this chapter)

- (1) Start of Construction includes substantial improvement and means the date the building permit was issued provided the actual start of construction, repair, reconstruction, rehabilitation, addition placement, or other improvement was within 180 days of the permit date.
- (2) The actual Start of Construction means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation.
- (3) Permanent construction does not include land preparation, such as clearing, grading, and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure.
- (4) For a substantial improvement, the actual Start of Construction means the first alteration of any wall, ceiling, floor, or other structural part of the building, whether or not that alteration affects the external dimensions of the building.

“Structure” means a walled and roofed building, a manufactured home, or a gas, liquid, or liquefied gas storage tank that is principally above ground.

“Substantial Damage” means damage of any origin sustained by a structure during any one-year period whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. See definition of “substantial improvement”.

“Substantial Improvement” means any combination of repairs, reconstruction, rehabilitation, addition, or other improvement of a structure, taking place during any one-year period for which the cost equals or exceeds 50 percent of the market value of the structure before the “start of construction” of the improvement. This term includes structures which have incurred “substantial damage”, regardless of the actual repair work performed. The term does not, however, include either:

- (1) Any correction of existing violations of state or community health, sanitary, or safety code specifications which have been identified by the community code enforcement official and which are the minimum necessary to assure safe living conditions; or
- (2) Any alteration of a historic structure, provided that the alteration will not preclude the structure's continued designation as a historic structure and the alteration is approved by variance issued pursuant to Section 150.19 of this ordinance.

“Technical Bulletin and Technical Fact Sheet” means a FEMA publication that provides guidance concerning the building performance standards of the NFIP, which are contained in Title 44 of the U.S. Code of Federal Regulations at Section 60.3. The bulletins and fact sheets are intended for use primarily by State and local officials responsible for interpreting and enforcing NFIP regulations and by members of the development community, such as design professionals and builders. New bulletins, as well as updates of existing bulletins, are issued periodically as needed. The bulletins do not create regulations; rather they provide specific guidance for complying with the minimum requirements of existing NFIP regulations.

It should be noted that Technical Bulletins and Technical Fact Sheets provide guidance on the minimum requirements of the NFIP regulations. State or community requirements that exceed those of the NFIP take precedence. Design professionals should contact the community officials to determine whether more restrictive State or local regulations apply to the building or site in question. All applicable standards of the State or local building code must also be met for any building in a flood hazard area.

“Temperature Controlled” means having the temperature regulated by a heating and/or cooling system, built-in or appliance.

“Unshaded X Zone” means the areas of minimal flood hazard shown on the FIRM which are areas outside of the Special Flood Hazards Areas and higher than the elevation of the 0.2% annual flood chance.

“Variance” is a grant of relief from the requirements of this ordinance.

“Violation” means the failure of a structure or other development to be fully compliant with the community's floodplain management regulations. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance with the standards of this chapter is presumed to be in violation until such time as that documentation is provided.

“Water Surface Elevation (WSE)” means the height, in relation to NAVD 1988, of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

“Watercourse” means a lake, river, creek, stream, wash, channel or other topographic feature on or over which waters flow at least periodically. Watercourse includes specifically designated areas in which substantial flood damage may occur.

150.06 LANDS TO WHICH THIS ORDINANCE APPLIES.

This ordinance shall apply to all areas within the jurisdiction of the Town of Duck.

150.07 BASIS FOR ESTABLISHING THE SPECIAL FLOOD HAZARD AREAS.

The SFHAs are those identified under the Cooperating Technical State (CTS) agreement between the State of North Carolina and FEMA in its FIS dated June 19, 2020 shown on the FIS for Dare County and associated DFIRM panels, including any digital data developed as part of the FIS, which are adopted by reference and declared a part of this ordinance, and all revisions thereto after January 1, 2021. Future revisions to the FIS and DFIRM panels that do not change flood hazard data within the jurisdictional authority of the Town of Duck are also adopted by reference and declared a part of this ordinance.

Subsequent Letter of Map Revisions (LOMRs) and/or Physical Map Revisions (PMRs) shall be adopted within three months.

150.08 ESTABLISHMENT OF A LOCAL ELEVATION STANDARD FOR SHADED X AND X ZONES.

A locally adopted elevation standards shall apply to any Shaded X or X zone as identified on the effective DFIRMs for Dare County. These areas may be vulnerable to flooding from storm surge, wind-driven tides, and excessive rainfall associated with storm systems. Many of these areas have flooded during past storm events and continue to remain at risk to flooding. Therefore, an elevation standard and other floodplain development standards have been determined by the Town of Duck to be appropriate for these Shaded X and X zones as defined in Section 150.05. All development activities in any Shaded X or X zone shall conform to the provisions set forth in this Chapter.

150.09 ESTABLISHMENT OF FLOODPLAIN DEVELOPMENT PERMIT.

A Floodplain Development Permit shall be required in conformance with the provisions of this ordinance prior to the commencement of any development activities in accordance with the provisions of this ordinance.

150.10 COMPLIANCE.

No structure or land shall hereafter be located, extended, converted, altered, or developed in any way without full compliance with the terms of this ordinance and other applicable regulations.

150.11 ABROGATION AND GREATER RESTRICTIONS.

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and another conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

150.12 INTERPRETATION.

In the interpretation and application of this ordinance, all provisions shall be:

- (A) Considered as minimum requirements;
- (B) Liberally construed in favor of the governing body; and
- (C) Deemed neither to limit nor repeal any other powers granted under State statutes.

150.13 WARNING AND DISCLAIMER OF LIABILITY.

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering consideration. Larger floods can and will occur. Actual flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside

the SFHAs or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of the Town of Duck or by any officer or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

150.14 PENALTIES FOR VIOLATION.

In addition to the penalty provisions set forth in N.C.G.S. § 143-215.58, any person violating the provisions of this chapter shall be subject to a civil penalty in the amount of \$100.00 per violation. Each day such violation continues shall be considered a separate offense. The person cited for the violation must pay the civil penalty within five (5) days of being cited for the violation. In the event that the person cited for the violation does not pay the civil penalty within the prescribed time, the town may bring a civil action to recover the penalty and associated court costs. Nothing herein contained shall prevent the Town of Duck from taking such other lawful action as is necessary to prevent or remedy any violation.

ADMINISTRATION

150.15 DESIGNATION OF FLOODPLAIN ADMINISTRATOR.

The Director of Community Development, hereinafter referred to as the "Floodplain Administrator", or their designee, is hereby appointed to administer and implement the provisions of this ordinance. In instances where the Floodplain Administrator receives assistance from others to complete tasks to administer and implement this ordinance, the Floodplain Administrator shall be responsible for the coordination and community's overall compliance with the National Flood Insurance Program and the provisions of this ordinance.

150.16 FLOODPLAIN DEVELOPMENT APPLICATION, PERMIT AND CERTIFICATION REQUIREMENTS.

- (A) *Application Requirements.* Application for a Floodplain Development Permit shall be made to the Floodplain Administrator prior to any development activities. The following items shall be presented to the Floodplain Administrator to apply for a floodplain development permit:
- (1) A site plan drawn to scale which shall include, but shall not be limited to, the following specific details of the proposed floodplain development:
 - (a) The nature, location, dimensions, and elevations of the area of development/disturbance; existing and proposed structures, utility systems, grading/pavement areas, fill materials, storage areas, drainage facilities, and other development;
 - (b) The boundary of the SFHA, Shaded X or X Zone as delineated on the FIRM or other flood map as determined in Section 150.07, or a statement that the entire lot is within the SFHA;
 - (c) Flood zone(s) designation of the proposed development area as determined on the FIRM or other flood map as determined in Section 150.07;

- (d) The BFE and/or RFPE where provided as set forth in Sections 150.07 or 150.17;
 - (e) The old and new location of any watercourse that will be altered or relocated as a result of proposed development;
 - (f) The boundary and designation date of the Coastal Barrier Resource System (CBRS) area or Otherwise Protected Areas (OPA), if applicable; and
 - (g) The certification of the site plan by a registered land surveyor or professional engineer.
- (2) Proposed elevation, and method thereof, of all development including but not limited to:
- (a) Elevation in relation to NAVD 1988 of the proposed reference level (including basement) of all structures;
 - (b) Elevation in relation to NAVD 1988 to which any non-residential structure in Zones A, AE, AH, AO, A99, Shaded X or X will be floodproofed; and
 - (c) Elevation in relation to NAVD 1988 to which any proposed utility systems will be elevated or floodproofed.
- (3) If floodproofing, a Floodproofing Certificate (FEMA Form 086-0-34) with supporting data, an operational plan, and an inspection and maintenance plan that include, but are not limited to, installation, exercise, and maintenance of floodproofing measures.
- (4) A Foundation Plan, drawn to scale, which shall include details of the proposed foundation system to ensure all provisions of this ordinance are met. These details include but are not limited to:
- (a) The proposed method of elevation, if applicable (i.e., fill, solid foundation perimeter wall, solid backfilled foundation, open foundation on columns/posts/piers/piles/shear walls); and
 - (b) Openings to facilitate automatic equalization of hydrostatic flood forces on walls in accordance with Section 150.21(D)(3) when solid foundation perimeter walls are used in Zones A, AE, AH, AO, A99, Shaded X or X.
 - (c) The following, in CHHA, in accordance with the provisions of Section 150.21(D)(4) and Section 150.22:
 - 1. V-Zone Certification with accompanying plans and specifications verifying the engineered structure and any breakaway wall designs; In addition, prior to the Certificate of Compliance/Occupancy issuance, a registered professional engineer or architect shall certify the finished construction is compliant with the design, specifications and plans for VE Zone construction.
 - 2. Plans for open wood latticework or insect screening, if applicable; and

3. Plans for non-structural fill, if applicable. If non-structural fill is proposed, it must be demonstrated through coastal engineering analysis that the proposed fill would not result in any increase in the BFE or otherwise cause adverse impacts by wave ramping and deflection on to the subject structure or adjacent properties.

- (5) Usage details of any enclosed areas below the lowest floor.
- (6) Plans and/or details for the protection of public utilities and facilities such as sewer, gas, electrical, and water systems to be located and constructed to minimize flood damage.
- (7) Certification that all other Local, State and Federal permits required prior to floodplain development permit issuance have been received.
- (8) Documentation for placement of Recreational Vehicles and/or Temporary Structures, when applicable, to ensure that the provisions of Subsections 150.21 (F) and (G) of this ordinance are met.
- (9) In Shaded X and X zones, a survey prepared by a licensed North Carolina surveyor may be used to demonstrate the natural grades of the parcel relative to the RFPE of 10 feet.

(B) *Permit Requirements.* The Floodplain Development Permit shall include, but is not limited to:

- (1) A complete description of all the development to be permitted under the floodplain development permit (e.g. house, garage, pool, septic, bulkhead, cabana, pier, bridge, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials, etc.).
- (2) The flood zone determination for the proposed development in accordance with available data specified in Section 150.07.
- (3) The Regulatory Flood Protection Elevation required for the reference level and all attendant utilities.
- (4) The Regulatory Flood Protection Elevation required for the protection of all public utilities.
- (5) All certification submittal requirements with timelines.
- (6) The flood openings requirements, if in Zones A, AE, AH, AO, A99, Shaded X or X Zone.
- (7) Identify uses of enclosures below the RFPE and a statement that they are limited to the following uses: parking, building access and limited storage only.
- (8) A statement, if in CHHA, that there will be no alteration of sand dunes which would increase potential flood damage.
- (9) A statement, if in CHHA, that there will be no fill used for structural support.
- (10) A statement, that all materials below RFPE will be flood resistant materials.

(C) *Certification Requirements.*

(1) *Elevation Certificates for AE, AO, VE, Shaded X and X Zones.*

- (a) An Elevation Certificate (FEMA Form 086-0-33) for the proposed development must be submitted as part of the permit application materials. It shall be the duty of the permit holder to submit to the Floodplain Administrator a certification of the elevation of the reference level, in relation to NAVD 1988. The Floodplain Administrator or designee shall review the certificate data submitted. Deficiencies with the elevation certificate detected by such review shall be corrected by the permit holder prior to the start of construction. Failure to submit the certification or failure to make required corrections shall be cause to deny a floodplain development permit.
- (b) With the understanding that lesser documentation leads to a greater assumption of risk by the permit holder and property owner, the permit holder has the following options for submission of an under-construction documentation:
 - 1. The Town of Duck encourages submission of an under-construction elevation certificate to the Floodplain Administrator at the time a rough-in inspection is scheduled with the Town of Duck Building Inspector; or
 - 2. In lieu of an elevation certificate, the permit holder may submit alternative documentation from a registered land surveyor or professional engineer regarding the elevation of the reference level in relation to mean sea level; or
 - 3. The permit holder may opt not to submit an under-construction elevation certificate or alternative documentation from a registered land surveyor or professional engineer prior to the rough-in inspection.

If submitted, the Floodplain Administrator shall review the elevation certificate or other documentation and report any deficiencies to the permit holder immediately and such deficiencies shall be corrected immediately prior to further work being permitted to proceed.

- (c) A final Finished Construction Elevation Certificate (FEMA Form 086-0-33) is required after construction is completed and prior to Certificate of Compliance/Occupancy issuance. It shall be the duty of the permit holder to submit to the Floodplain Administrator a certification of final as-built construction of the elevation of the reference level and all attendant utilities. The Floodplain Administrator shall review the certificate data submitted. Deficiencies detected by such review shall be corrected by the permit holder immediately and prior to Certificate of Compliance/Occupancy issuance. In some instances, another certification may be required to certify corrected as-built construction. Failure to submit the certification or failure to make required corrections shall be cause to withhold the issuance of a Certificate of Compliance/Occupancy. The Finished Construction Elevation Certificate certifier shall provide at least 2 photographs showing the front and rear of the building taken within 90 days from the date of certification. The photographs must be taken with views confirming the building description and diagram number provided in Section A. To the extent possible, these photographs should show the entire building including foundation. If the building has split-level or multi-level areas,

provide at least 2 additional photographs showing side views of the building. In addition, when applicable, provide a photograph of the foundation showing a representative example of the flood openings or vents. All photographs must be in color and measure at least 3" x 3". Digital photographs are acceptable.

- (d) In Shaded X and X zones, the proposed and under construction elevation certificates are not needed if a current survey of the parcel is submitted that demonstrates the natural grade of the structure footprint is above the RFPE of 10 feet. A finished construction elevation certificate is required at the completion of the project.

(2) *Floodproofing Certificate.*

- (a) If non-residential floodproofing is used to meet the Regulatory Flood Protection Elevation requirements, a Floodproofing Certificate (FEMA Form 086-0-34), with supporting data, an operational plan, and an inspection and maintenance plan are required prior to the actual start of any new construction. It shall be the duty of the permit holder to submit to the Floodplain Administrator a certification of the floodproofed design elevation of the reference level and all attendant utilities, in relation to NAVD 1988. Floodproofing certification shall be prepared by or under the direct supervision of a professional engineer or architect and certified by same. The Floodplain Administrator shall review the certificate data, the operational plan, and the inspection and maintenance plan. Deficiencies detected by such review shall be corrected by the applicant prior to permit approval. Failure to submit the certification or failure to make required corrections shall be cause to deny a Floodplain Development Permit. Failure to construct in accordance with the certified design shall be cause to withhold the issuance of a Certificate of Compliance/Occupancy.
 - (b) A final Finished Construction Floodproofing Certificate (FEMA Form 086-0-34), with supporting data, an operational plan, and an inspection and maintenance plan are required prior to the issuance of a Certificate of Compliance/Occupancy. It shall be the duty of the permit holder to submit to the Floodplain Administrator a certification of the floodproofed design elevation of the reference level and all attendant utilities, in relation to NAVD 1988. Floodproofing certificate shall be prepared by or under the direct supervision of a professional engineer or architect and certified by same. The Floodplain Administrator shall review the certificate data, the operational plan, and the inspection and maintenance plan. Deficiencies detected by such review shall be corrected by the applicant prior to Certificate of Occupancy. Failure to submit the certification or failure to make required corrections shall be cause to deny a Floodplain Development Permit. Failure to construct in accordance with the certified design shall be cause to deny a Certificate of Compliance/Occupancy.
- (3) *Elevation of chassis.* If a manufactured home is placed within Zones A, AE, AH, AO, A99, Shaded X or X and the elevation of the chassis is more than 36 inches in height above grade, an engineered foundation certification is required in accordance with the provisions of Subsection 150.21(C)(2).
- (4) *Alterations and relocations.* If a watercourse is to be altered or relocated, a description of the extent of watercourse alteration or relocation; a professional engineer's certified report on the effects of the proposed project on the flood-carrying capacity of the watercourse and the effects

to properties located both upstream and downstream; and a map showing the location of the proposed watercourse alteration or relocation shall all be submitted by the permit applicant prior to issuance of a floodplain development permit.

- (5) *Certification Exemptions.* The following structures, if located within Zones A, AE, AH, AO, A99, Shaded X or X are exempt from the elevation/floodproofing certification requirements specified in items (a) and (b) of this subsection:
 - (a) Recreational Vehicles meeting requirements of Section 150.21(F); and
 - (b) Temporary Structures meeting requirements of Section 150.21(G).
- (6) *V-Zone/CHHA Certification.* A V-Zone/CHHA Certification with accompanying design plans and specifications is required prior to issuance of a Floodplain Development permit within CHHA. It shall be the duty of the permit applicant to submit to the Floodplain Administrator said certification to ensure the design standards of this ordinance are met. A registered professional engineer or architect shall develop or review the structural design, plans, and specifications for construction and certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of this ordinance. This certification is not a substitute for an Elevation Certificate.
- (7) *Non-Conversion Agreement.* A non-conversion agreement shall be required for all new construction and substantial improvements which feature an enclosure area below the RFPE and with walls greater than 4 feet in height that may be converted after occupancy of the structure. This signed, completed non-conversion agreement shall be completed by the property owner of record (if different than the permit holder) and shall be recorded in the Dare County Register of Deeds. A copy of the recorded agreement shall be provided to the Town of Duck Building Inspector prior to the issuance of the certificate of occupancy. Failure to submit the certification shall be cause to withhold the issuance of a certificate of occupancy.
- (8) *Release of Restrictive Covenant.* If a property which is bound by a non-conversion agreement is modified to remove enclosed areas below RFPE, then the owner may request release of restrictive covenant after staff inspection and submittal of confirming documentation.
- (9) *Acknowledgement Form.* Acknowledgement forms shall be signed and completed by property owners or authorized agent at the time permits are issued by the Town of Duck Building Inspector. This acknowledgement form indicates the specific flood zone designation for the subject property; outlines the construction standards for elevation of the structure to the regulatory flood elevation and explains the use restrictions associated with the property.

(D) Determinations for existing buildings and structures.

For applications for building permits to improve buildings and structures, including alterations, movement, relocation, enlargement, replacement, repair, change of occupancy, additions, rehabilitations, renovations, substantial improvements, repairs of substantial damage, and any other improvement of or work on such buildings and structures, the Floodplain Administrator, in coordination with the Building Official, shall:

- (1) Estimate the market value, or require the applicant to obtain an appraisal of the market value

prepared by a qualified independent appraiser, of the building or structure before the start of construction of the proposed work; in the case of repair, the market value of the building or structure shall be the market value before the damage occurred and before any repairs are made;

- (2) Compare the cost to perform the improvement, the cost to repair a damaged building to its pre-damaged condition, or the combined costs of improvements and repairs, if applicable, to the market value of the building or structure;
- (3) Determine and document whether the proposed work constitutes substantial improvement or repair of substantial damage; and
- (4) Notify the applicant if it is determined that the work constitutes substantial improvement or repair of substantial damage and that compliance with the flood resistant construction requirements of the NC Building Code and this ordinance is required.

150.17 DUTIES AND RESPONSIBILITIES OF THE FLOODPLAIN ADMINISTRATOR

The Floodplain Administrator shall perform, but not be limited to, the following duties:

- (A) Review all floodplain development applications and issue permits for all proposed development to assure that the requirements of this ordinance have been satisfied.
- (B) Review all proposed development to assure that all necessary local, state and federal permits have been received, including Section 404 of the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1334.
- (C) Notify adjacent communities and the North Carolina Department of Public Safety, Division of Emergency Management, State Coordinator for the National Flood Insurance Program prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Emergency Management Agency (FEMA).
- (D) Assure that maintenance is provided within the altered or relocated portion of said watercourse so that the flood-carrying capacity is maintained.
- (E) Obtain actual elevation (in relation to NAVD 1988) of the reference level (including basement) and all attendant utilities of all new and substantially improved structures, in accordance with the provisions of Section 150.16(C).
- (F) Obtain actual elevation (in relation to NAVD 1988) to which all new and substantially improved structures and utilities have been floodproofed, in accordance with the provisions of Section 150.16(C).
- (G) Obtain actual elevation (in relation to NAVD 1988) of all public utilities in accordance with the provisions of Section 150.16(C).
- (H) When floodproofing is utilized for a particular structure, obtain certifications from a registered professional engineer or architect in accordance with the provisions of Sections 150.16(C) and

150.21(B).

- (I) Where interpretation is needed as to the exact location of boundaries of the SFHAs, Shaded X or X zones, floodways, or non-encroachment areas (for example, where there appears to be a conflict between a mapped boundary and actual field conditions), make the necessary interpretation. The person contesting the location of the boundary shall be given a reasonable opportunity to appeal the interpretation as provided in this article.
- (J) When BFE data has not been provided in accordance with the provisions of Section 150.07, obtain, review, and reasonably utilize any BFE data in order to administer the provisions of this ordinance.
- (K) Permanently maintain all records that pertain to the administration of this ordinance and make these records available for public inspection, recognizing that such information may be subject to the Privacy Act of 1974, as amended.
- (L) Make on-site inspections of work in progress. As the work pursuant to a floodplain development permit progresses, the Floodplain Administrator shall make as many inspections of the work as may be necessary to ensure that the work is being done according to the provisions of the local ordinance and the terms of the permit. In exercising this power, the Floodplain Administrator has a right, upon presentation of proper credentials, to enter on any premises within the jurisdiction of the community at any reasonable hour for the purposes of inspection or other enforcement action.
- (M) Issue stop-work orders as required. Whenever a building or part thereof is being constructed, reconstructed, altered, or repaired in violation of this ordinance, the Floodplain Administrator may order the work to be immediately stopped. The stop-work order shall be in writing and directed to the person doing or in charge of the work. The stop-work order shall state the specific work to be stopped, the specific reason(s) for the stoppage, and the condition(s) under which the work may be resumed. Violation of a stop-work order constitutes a misdemeanor.
- (N) Revoke floodplain development permits as required. The Floodplain Administrator may revoke and require the return of the floodplain development permit by notifying the permit holder in writing stating the reason(s) for the revocation. Permits shall be revoked for any substantial departure from the approved application, plans, and specifications; for refusal or failure to comply with the requirements of State or local laws; or for false statements or misrepresentations made in securing the permit. Any floodplain development permit mistakenly issued in violation of an applicable State or local law may also be revoked.
- (O) Make periodic inspections throughout the Special Flood Hazard Areas within the jurisdiction of the community. The Floodplain Administrator and each member of his or her inspections department shall have a right, upon presentation of proper credentials, to enter on any premises within the territorial jurisdiction of the department at any reasonable hour for the purposes of inspection or other enforcement action.
- (P) Follow through with corrective procedures of Section 150.18.
- (Q) Review, provide input, and make recommendations for variance requests.
- (R) Maintain a current map repository to include, but not limited to, historical and effective FIS Report, historical and effective FIRM and other official flood maps and studies adopted in accordance with

the provisions of Section 150.07, including any revisions thereto, including Letters of Map Change issued by FEMA.

- (S) Coordinate revisions to FIS reports and FIRMs, including Letters of Map Revision Based on Fill (LOMR-Fs) and Letters of Map Revision (LOMRs).

150.18 CORRECTIVE PROCEDURES

- (A) *Violations to be Corrected:* When the Floodplain Administrator finds violations of applicable state and local laws; it shall be his or her duty to notify the owner or occupant of the building of the violation. The owner or occupant shall immediately remedy each of the violations of law cited in such notification.
- (B) *Actions in Event of Failure to Take Corrective Action:* If the owner of a building or property shall fail to take prompt corrective action, the Floodplain Administrator shall give the owner written notice, by certified or registered mail to the owner's last known address or by personal service, stating:
 - (1) That the building or property is in violation of the floodplain management regulations;
 - (2) That a hearing will be held before the Floodplain Administrator at a designated place and time, not later than ten (10) days after the date of the notice, at which time the owner shall be entitled to be heard in person or by counsel and to present arguments and evidence pertaining to the matter; and
 - (3) That following the hearing, the Floodplain Administrator may issue an order to alter, vacate, or demolish the building; or to remove fill as applicable.
- (C) *Order to Take Corrective Action:* If, upon a hearing held pursuant to the notice prescribed above, the Floodplain Administrator shall find that the building or development is in violation of the Flood Damage Prevention Ordinance, he or she shall issue an order in writing to the owner, requiring the owner to remedy the violation within a specified time period, not less than sixty (60) calendar days, nor more than 180 days. Where the Floodplain Administrator finds that there is imminent danger to life or other property, he or she may order that corrective action be taken in such lesser period as may be feasible.
- (D) *Appeal:* Any owner who has received an order to take corrective action may appeal the order to the local elected governing body by giving notice of appeal in writing to the Floodplain Administrator and the clerk within ten (10) days following issuance of the final order. In the absence of an appeal, the order of the Floodplain Administrator shall be final. The local governing body shall hear an appeal within a reasonable time and may affirm, modify and affirm, or revoke the order.
- (E) *Failure to Comply with Order:* If the owner of a building or property fails to comply with an order to take corrective action for which no appeal has been made or fails to comply with an order of the governing body following an appeal, the owner shall be guilty of a Class 1 misdemeanor pursuant to NC G.S. § 143-215.58 and shall be punished at the discretion of the court subject to the penalties outlined in Section 150.14.

150.19 VARIANCE PROCEDURES

- (A) The Town of Duck Board of Adjustment as established by the Town of Duck, hereinafter referred to as the “appeal board”, shall hear and decide requests for variances from the requirements of this ordinance.
- (B) Any person aggrieved by the decision of the appeal board may appeal such decision to the Court, as provided in Chapter 7A of the North Carolina General Statutes.
- (C) Variances may be issued for:
 - (1) The repair or rehabilitation of historic structures upon the determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and that the variance is the minimum necessary to preserve the historic character and design of the structure;
 - (2) Functionally dependent facilities if determined to meet the definition as stated in Section 150.05 of this ordinance, provided provisions of Subsections 150.19(I)(2) and (I)(4) have been satisfied, and such facilities are protected by methods that minimize flood damages during the base flood and create no additional threats to public safety; or
 - (3) Any other type of development provided it meets the requirements of this Section.
- (D) In reviewing variances, the appeal board shall consider all technical evaluations, all relevant factors, all standards specified in other sections of this ordinance, and:
 - (1) The danger that materials may be swept onto other lands to the injury of others;
 - (2) The danger to life and property due to flooding or erosion damage;
 - (3) The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
 - (4) The importance of the services provided by the proposed facility to the community;
 - (5) The necessity to the facility of a waterfront location as defined under Section 150.05 of this ordinance as a functionally dependent facility, where applicable;
 - (6) The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use;
 - (7) The compatibility of the proposed use with existing and anticipated development;
 - (8) The relationship of the proposed use to the comprehensive plan and floodplain management program for that area;
 - (9) The safety of access to the property in times of flood for ordinary and emergency vehicles;

- (10) The expected heights, velocity, duration, rate of rise, and sediment transport of the floodwaters and the effects of wave action, if applicable, expected at the site; and
 - (11) The costs of providing governmental services during and after flood conditions including maintenance and repair of public utilities and facilities such as sewer, gas, electrical and water systems, and streets and bridges.
- (E) A written report addressing each of the above factors shall be submitted with the application for a variance.
- (F) Upon consideration of the factors listed above and the purposes of this ordinance, the appeal board may attach such conditions to the granting of variances as it deems necessary to further the purposes and objectives of this ordinance.
- (G) Any applicant to whom a variance is granted shall be given written notice specifying the difference between the RFPE and the elevation to which the structure is to be built and that such construction below the RFPE increases risks to life and property, and that the issuance of a variance to construct a structure below the RFPE may result in increased premium rates for flood insurance up to \$25 per \$100 of insurance coverage. Such notification shall be maintained with a record of all variance actions, including justification for their issuance.
- (H) The Floodplain Administrator shall maintain the records of all appeal actions and report any variances to the FEMA and the State of North Carolina upon request.
- (I) Conditions for Variances:
- (1) Variances shall not be issued when the variance will make the structure in violation of other federal, state, or local laws, regulations, or ordinances.
 - (2) Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.
 - (3) Variances shall only be issued prior to development permit approval.
 - (4) Variances shall only be issued upon:
 - (a) A showing of good and sufficient cause;
 - (b) A determination that failure to grant the variance would result in exceptional hardship; and
 - (c) A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, or extraordinary public expense, create nuisance, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances.
- (J) A variance may be issued for solid waste disposal facilities or sites, hazardous waste management facilities, salvage yards, and chemical storage facilities that are located at elevations below the RFPE in the SFHA and Shaded X and X zones provided all of the following conditions are met:

- (1) The use serves a critical need in the community.
- (2) No feasible location exists for the use at elevations at or above the RFPE in the SFHA and Shaded X and X zones.
- (3) The reference level of any structure is elevated or floodproofed to at least the RFPE.
- (4) The use complies with all other applicable federal, state and local laws.
- (5) The Town of Duck has notified the Secretary of the North Carolina Department of Public Safety of its intention to grant a variance at least thirty (30) calendar days prior to granting the variance.

PROVISIONS FOR FLOOD HAZARD REDUCTION

150.20 GENERAL STANDARDS

The following provisions are required:

- (A) All new construction and substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse, and lateral movement of the structure.
- (B) All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage in accordance with the FEMA Technical Bulletin 2, *Flood Damage-Resistant Materials Requirements*.
- (C) All new construction and substantial improvements shall be constructed by methods and practices that minimize flood damages.
- (D) All new electrical, heating, ventilation, plumbing, air conditioning equipment, and other service equipment shall be located at or above the RFPE or designed and installed to prevent water from entering or accumulating within the components during the occurrence of the base flood. These include, but are not limited to, HVAC equipment, water softener units, bath/kitchen fixtures, ductwork, electric/gas meter panels/boxes, utility/cable boxes, water heaters, and electric outlets/switches.
 - (1) Replacements that are part of a substantial improvement, electrical, heating, ventilation, plumbing, air conditioning equipment, and other service equipment shall also meet the above provisions.
 - (2) Replacements that are for maintenance and not part of a substantial improvement, may be installed at the original location provided the addition and/or improvements only comply with the standards for new construction consistent with the code and requirements for the original structure.
- (E) All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of floodwaters into the system.

- (F) New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters into the systems and discharges from the systems into flood waters.
- (G) On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.
- (H) New solid waste disposal facilities and sites, hazardous waste management facilities, salvage yards, and chemical storage facilities shall not be permitted, except by variance as specified in Section 150.19(J). A structure or tank for chemical or fuel storage incidental to an allowed use or to the operation of a water treatment plant or wastewater treatment facility may be located in a SFHA only if the structure or tank is either elevated or floodproofed to at least the RFPE and certified in accordance with the provisions of Section 150.16(C).
- (I) All subdivision proposals and other development proposals shall be consistent with the need to minimize flood damage.
- (J) All subdivision proposals and other development proposals shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage.
- (K) All subdivision proposals and other development proposals shall have adequate drainage provided to reduce exposure to flood hazards.
- (L) All subdivision proposals and other development proposals shall have received all necessary permits from those governmental agencies for which approval is required by federal or state law, including Section 404 of the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1334.
- (M) When a structure is partially located in a SFHA, the entire structure shall meet the requirements for new construction and substantial improvements.
- (N) When a structure is located in multiple flood hazard zones or in a flood hazard risk zone with multiple base flood elevations, the provisions for the more restrictive flood hazard risk zone and the highest RFPE shall apply.

150.21 SPECIFIC STANDARDS

In addition to the provisions of Section 150.20, the following provisions are required:

- (A) ***Residential Construction.*** New construction and substantial improvement of any residential structure (including manufactured homes) shall have the reference level, including basement, elevated no lower than the Regulatory Flood Protection Elevation, as defined in Section 150.05 of this ordinance.
- (B) ***Non-Residential Construction.*** New construction and substantial improvement of any commercial, industrial, or other non-residential structure shall have the reference level, including basement, elevated no lower than the RFPE, as defined in Section 150.05. Structures located in Zones A, AE, AH, AO, A99 Shaded X and X may be floodproofed to the RFPE in lieu of elevation provided that all areas of the structure, together with attendant utility and sanitary facilities, below the RFPE are watertight with walls substantially impermeable to the passage of water, using structural components

having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. For AO Zones, the floodproofing elevation shall be in accordance with Section 150.23. A registered professional engineer or architect shall certify that the floodproofing standards of this subsection are satisfied. Such certification shall be provided to the Floodplain Administrator as set forth in Section 150.16(C), along with the operational plan and the inspection and maintenance plan.

(C) *Manufactured Homes.*

- (1) New and replacement manufactured homes shall be elevated so that the reference level of the manufactured home is no lower than the RFPE, as defined in Section 150.05.
- (2) Manufactured homes shall be securely anchored to an adequately anchored foundation to resist flotation, collapse, and lateral movement, either by certified engineered foundation system, or in accordance with the most current edition of the State of North Carolina Regulations for Manufactured Homes adopted by the Commissioner of Insurance pursuant to NCGS 143-143.15. Additionally, when the elevation would be met by an elevation of the chassis thirty-six (36) inches or less above the grade at the site, the chassis shall be supported by reinforced piers or engineered foundation. When the elevation of the chassis is above thirty-six (36) inches in height, an engineering certification is required.
- (3) All enclosures or skirting below the lowest floor shall meet the requirements of Section 150.21(D).
- (4) An evacuation plan must be developed for evacuation of all residents of all new, substantially improved or substantially damaged manufactured home parks or subdivisions located within flood prone areas. This plan shall be filed with and approved by the Floodplain Administrator and the local Emergency Management Coordinator.

(D) *Elevated Buildings.* Fully enclosed area, of new construction and substantially improved structures, which is below the lowest floor or below the lowest horizontal structural member in VE zones:

- (1) Shall not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door) or limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator). The interior portion of such enclosed area shall not be finished or partitioned into separate rooms, except to enclose storage areas;
- (2) Shall be constructed entirely of flood resistant materials at least to the Regulatory Flood Protection Elevation; and
- (3) Shall include, in Zones A, AE, AH, AO, A99, Shaded X and X, flood openings to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings must either be certified by a professional engineer or architect or meet or exceed the following minimum design criteria:
 - (a) A minimum of two flood openings on different sides of each enclosed area subject to flooding;

- (b) The total net area of all flood openings must be at least one (1) square inch for each square foot of enclosed area subject to flooding or a minimum of one engineered inch for each square foot of enclosed area for an engineered opening;
 - (c) If a building has more than one enclosed area, each enclosed area must have flood openings to allow floodwaters to automatically enter and exit consistent with Subsection 150.21(D)(3)(a) above;
 - (d) The bottom of all required flood openings shall be no higher than one (1) foot above the higher of the interior or exterior adjacent grade;
 - (e) Flood openings may be equipped with screens, louvers, or other coverings or devices, provided they permit the automatic flow of floodwaters in both directions; and
 - (f) Enclosures made of flexible skirting are not considered enclosures for regulatory purposes, and, therefore, do not require flood openings. Masonry or wood underpinning, regardless of structural status, is considered an enclosure and requires flood openings as outlined above.
- (4) In CHHA shall either be free of obstruction or constructed with breakaway walls, open wood latticework or insect screening, provided they are not part of the structural support of the building and are designed so as to breakaway, under abnormally high tides or wave action without causing damage to the elevated portion of the building or supporting foundation system or otherwise jeopardizing the structural integrity of the building. The following design specifications shall be met:
- (a) Material shall consist of open wood or plastic lattice or insect screening; or
 - (b) Breakaway walls shall contain the required amount and size of flood vents consistent with Subsections 150.21(D)(3)(a) and (b) and meet the following design specifications:
 - 1. Design safe loading resistance shall be not less than 10 nor more than 20 pounds per square foot; or
 - 2. Breakaway walls that exceed a design safe loading resistance of 20 pounds per square foot (either by design or when so required by State or local codes) shall be certified by a registered professional engineer or architect that the breakaway wall will collapse from a water load less than that which would occur during the base flood event, and the elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement, or other structural damage due to the effects of wind and water loads acting simultaneously on all building components (structural and non-structural). The water loading values used shall be those associated with the base flood. The wind loading values used shall be those required by the North Carolina State Building Code.
- (5) Property owners shall be required to execute and record a non-conversion agreement prior to issuance of a building permit declaring that the area below the lowest floor shall not be improved, finished or otherwise converted to habitable space. This agreement shall be recorded with the Dare County Register of Deeds and shall transfer with the property in

perpetuity. The Town of Duck will have the right to inspect the enclosed area. Such inspection should be coordinated with the property owner.

- (6) Release of restrictive covenant. If a property which is bound by a non-conversion agreement is modified to remove enclosed areas below RFPE, then the owner may request release of restrictive covenant after staff inspection and submittal of confirming documentation.

(E) *Additions/Improvements/Conversions.*

Standards in All Flood Zones (AE, AO, VE, Shaded X, and X):

- (1) Additions and/or improvements to pre-FIRM structures when the addition and/or improvements in combination with any interior modifications to the existing structure are:
 - (a) Not a substantial improvement, the addition and/or improvements must be designed to minimize flood damages and must not be any more non-conforming than the existing structure.
 - (b) A substantial improvement, with modifications/rehabilitations/improvements to the existing structure or the common wall is structurally modified more than installing a doorway, both the existing structure and the addition must comply with the standards for new construction.
- (2) Additions to pre-FIRM or post-FIRM structures that are a substantial improvement with no modifications/rehabilitations/improvements to the existing structure other than a standard door in the common wall, shall require only the addition to comply with the standards for new construction.
- (3) Additions and/or improvements to post-FIRM structures when the addition and/or improvements in combination with any interior modifications to the existing structure are:
 - (a) Not a substantial improvement, the addition and/or improvements only must comply with the standards for new construction consistent with the code and requirements for the original structure.
 - (b) A substantial improvement, both the existing structure and the addition and/or improvements must comply with the standards for new construction.
- (4) A substantial improvement must comply with the standards for new construction. For each building or structure, the 1-year period begins on the date of the first improvement or repair of that building or structure subsequent to the effective date of this ordinance. If the structure has sustained substantial damage, any repairs are considered substantial improvement regardless of the actual repair work performed. The requirement does not, however, include either:
 - (a) Any project for improvement of a building required to correct existing health, sanitary or safety code violations identified by the code enforcement official and that are the minimum necessary to assume safe living conditions.
 - (b) Any alteration of a historic structure provided that the alteration will not preclude the structure's continued designation as a historic structure.

- (5) Areas in existing structures may be converted to conditioned, temperature-controlled space provided the use is limited to parking, storage and access. Property Owner will be required to record a non-conversion agreement consistent with Subsection 150.21(D)(5).

Additional Standards in Shaded X and X Zones:

- (6) Remodeling or renovations of existing structures with the reference level located below the current applicable RFPE that do not increase the footprint or temperature-controlled area of the structure may be authorized at the existing reference level or higher. Reconstruction of damage to the structure with no increase in footprint may be authorized at the existing reference level or higher.

(F) *Recreational Vehicles.* Recreational vehicles shall either:

- (1) Meet the following standards for temporary placement:
 - (a) Be on site for fewer than 180 consecutive days; or
 - (b) Be fully licensed and ready for highway use. (A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities, and has no permanently attached additions.)
- (2) Permanent Placement. Recreational vehicles located in the Town of Duck that do not meet the limitations of Temporary Placement shall meet all the requirements for new construction.

(G) *Temporary Non-Residential Structures.* Prior to the issuance of a floodplain development permit for a temporary structure, the applicant must submit to the Floodplain Administrator a plan for the removal of such structure(s) in the event of a hurricane, flash flood or other type of flood warning notification. The following information shall be submitted in writing to the Floodplain Administrator for review and written approval:

- (1) A specified time period for which the temporary use will be permitted. Time specified may not exceed three (3) months, renewable up to one (1) year;
- (2) The name, address, and phone number of the individual responsible for the removal of the temporary structure;
- (3) The time frame prior to the event at which a structure will be removed (i.e., minimum of 72 hours before landfall of a hurricane or immediately upon flood warning notification);
- (4) A copy of the contract or other suitable instrument with the entity responsible for physical removal of the structure; and
- (5) Designation, accompanied by documentation, of a location outside the Special Flood Hazard Area, to which the temporary structure will be moved.

(H) *Accessory Structures.* The following criteria shall be met:

- (1) Accessory structures shall not be used for human habitation (including working, sleeping,

living, cooking or restroom areas)

- (2) Accessory structures may have conditioned, temperature-controlled space provided the use is limited to parking or storage. The property owner will be required to record a non-conversion agreement consistent with Subsection 150.21(D)(5). Electrical, heating, ventilation, plumbing, air conditioning, and other service equipment associated with an accessory structure shall be located at or above the RFPE.
- (3) Accessory structures shall be designed to have low flood damage potential;
- (4) Accessory structures shall be constructed and placed on the building site so as to offer the minimum resistance to the flow of floodwaters;
- (5) Accessory structures shall be firmly anchored in accordance with the provisions of Section 150.20(A);
- (6) Accessory structures, regardless of the size or cost, shall not be placed below elevated buildings in the CHHA;
- (7) All service facilities such as electrical shall be installed in accordance with the provisions of Section 150.20(D); and
- (8) Flood openings to facilitate automatic equalization of hydrostatic flood forces shall be provided below Regulatory Flood Protection Elevation in conformance with the provisions of Subsection 150.21(D)(3). The Floodplain Administrator shall certify installation of required flood openings in compliance with these provisions.
- (9) Secondary structures located on the same parcel in addition to a principal use structure which feature conditioned, temperature-controlled areas elevated above the regulatory flood protection elevation shall be constructed consistent with Sections 150.20 and 150.21.

(I) *Tanks.* Gas and liquid storage tanks shall meet the following criteria:

- (1) *Underground Tanks.* Underground tanks in flood hazard areas shall be anchored to prevent flotation, collapse or lateral movement resulting from hydrodynamic and hydrostatic loads during conditions of the design flood, including the effects of buoyancy assuming the tank is empty; or
- (2) *Above-Ground Tanks, Elevated.* Above-ground tanks in flood hazard areas may be elevated to or above the Regulatory Flood Protection Elevation on a supporting structure that is designed to prevent flotation, collapse or lateral movement during conditions of the design flood. Tank-supporting structures shall meet the foundation requirements of the applicable flood hazard area; or
- (3) *Above-Ground Tanks, Not Elevated.* Above ground tanks that do not meet the elevation requirements of Subsections 150.21(B) and (I)(2) shall not be permitted in the CHHA. Above-ground tanks in flood hazard areas may be located below the regulatory flood protection elevation provided the tanks are designed, constructed, installed, and anchored to resist all flood-related and other loads, including the effects of buoyancy and lateral movement, during

conditions of the design flood and without release of contents in the floodwaters or infiltration by floodwaters into the tanks. Tanks shall be designed, constructed, installed, and anchored to resist the potential buoyant and other flood forces acting on an empty tank during design flood conditions.

- (4) *Tank Inlets and Vents.* Tank inlets, fill openings, outlets and vents shall be located at or above the regulatory flood protection elevation or fitted with covers designed to prevent lateral movement, the inflow of floodwater or outflow of the contents of the tanks during conditions of the design flood.

150.22 COASTAL HIGH HAZARD AREA

Coastal High Hazard Areas are SFHAs established in Section 150.07. These areas have special flood hazards associated with high velocity waters from storm surges or seismic activity and, therefore, all new construction and substantial improvements shall meet the following provisions in addition to the provisions of Sections 150.20 and 150.21:

- (A) All new construction and substantial improvements must be located landward of the reach of mean high tide and comply with all applicable setback standards of the Town's Zoning chapter.
- (B) All new construction and substantial improvements shall be elevated so that the bottom of the lowest horizontal structural member of the lowest floor (excluding pilings or columns) is no lower than the regulatory flood protection elevation. Floodproofing shall not be utilized on any structures in CHHAs to satisfy the regulatory flood protection elevation requirements.
- (C) All new construction and substantial improvements shall have the space below the bottom of the lowest horizontal structural member of the lowest floor either be free of obstruction or constructed with breakaway walls, open wood latticework or insect screening, provided they are not part of the structural support of the building and are designed so as to breakaway, under abnormally high tides or wave action without causing damage to the elevated portion of the building or supporting foundation system or otherwise jeopardizing the structural integrity of the building. The following design specifications shall be met:
 - (1) Material shall consist of open wood or plastic lattice having at least 40 percent of its area open, or
 - (2) Insect screening; or
 - (3) Breakaway walls shall meet the following design specifications:
 - (a) Breakaway walls shall have flood openings that allow for the automatic entry and exit of floodwaters to minimize damage caused by hydrostatic loads, per Subsection 150.21(D)(3); and
 - (b) Design safe loading resistance shall be not less than 10 nor more than 20 pounds per square foot; or
 - (c) Breakaway walls that exceed a design safe loading resistance of 20 pounds per square foot

(either by design or when so required by State or local codes) shall be certified by a registered professional engineer or architect that the breakaway wall will collapse from a water load less than that which would occur during the base flood event, and the elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement, or other structural damage due to the effects of wind and water loads acting simultaneously on all building components (structural and non-structural). The water loading values used shall be those associated with the base flood. The wind loading values used shall be those required by the North Carolina State Building Code.

(D) All new construction and substantial improvements shall be securely anchored to pile or column foundations. All pilings and columns and the structure attached thereto shall be anchored to resist flotation, collapse, and lateral movement due to the effect of wind and water loads acting simultaneously on all building components.

(1) Water loading values used shall be those associated with the base flood.

(2) Wind loading values used shall be those required by the current edition of the North Carolina State Building Code.

(E) For concrete pads, including patios, decks, parking pads, walkways, driveways, pool decks, etc. the following is required:

(1) Shall be structurally independent of the primary structural foundation system of the structure and shall not adversely affect structures through redirection of floodwaters or debris; and

(2) Shall be constructed to breakaway cleanly during design flood conditions, shall be frangible, and shall not produce debris capable of causing damage to any structure. The installation of concrete in small segments (approximately 4 feet x 4 feet) that will easily break up during the base flood event or score concrete in 4 feet x 4 feet maximum segments is acceptable to meet this standard; and

(3) Reinforcing, including welded wire fabric, shall not be used in order to minimize the potential for concreted pads being a source of debris; and

(4) Pad thickness

(a) shall not exceed 4 inches; or

(b) a design professional shall certify that the design and method of construction to be used will be compliant with the applicable criteria of this section.

(F) For swimming pools and spas, the following is required:

(1) They must be designed to withstand all flood-related loads and load combination and

(a) Be elevated so that the lowest horizontal structural member is elevated above the RFPE; or

(b) Be designed and constructed to break away during design flood conditions without producing debris capable of causing damage to any structure; or

(c) Be sited to remain in the ground during design flood conditions without obstructing flow that results in damage to any structure.

(2) Registered design professionals must certify to local officials that a pool or spa beneath or near

a building in a CHHA will not be subject to flotation or displacement that will damage building foundations or elevated portions of the building or any nearby buildings during a coastal flood.

- (3) Pool equipment shall be located above the RFPE whenever practicable. Pool equipment shall not be located beneath an elevated structure.
- (4) Consistency with all applicable standards specified in the Town's Zoning chapter.

(G) For all elevators, vertical platform lifts, chair lifts, etc., the following is required:

- (1) Elevator enclosures must be designed to resist hydrodynamic and hydrostatic forces as well as erosion, scour, and waves.
- (2) Utility equipment in CHHAs must not be mounted on, pass through, or be located along breakaway walls.
- (3) The cab, machine/equipment room, hydraulic pump, hydraulic reservoir, counter weight and roller guides, hoist cable, limit switches, electric hoist motor, electrical junction box, circuit panel, and electrical control panel shall:
 - (a) be elevated to or above the RFPE; or
 - (b) constructed using flood damage-resistant components/materials.
- (4) Elevator shafts/enclosures that extend below the RFPE shall be constructed of reinforced masonry block or reinforced concrete walls and located on the landward side of the building to provide increased protection from flood damage. Drainage must be provided for the elevator pit.
- (5) Flood damage-resistant materials can also be used inside and outside the elevator cab to reduce flood damage. Use only stainless steel doors and door frames below the RFPE. Grouting in of door frames and sills is recommended.
- (6) If an elevator is designed to provide access to areas below the RFPE, it shall be equipped with a float switch system that will activate during a flood and send the elevator cab to a floor above the RFPE.

(H) Accessory structures, regardless of size or cost, shall not be permitted below elevated structures.

(I) *Fill/Grading.*

- (1) Minor grading and the placement of minor quantities of nonstructural fill may be permitted for landscaping and for drainage purposes under and around buildings and for support of parking slabs, pool decks, patios, walkways, and similar site elements.
- (2) The placement of site-compatible, non-structural fill under or around an elevated building is limited to two feet (2'). Fill greater than two feet (2') must include an analysis prepared by a qualified registered design professional demonstrating no harmful diversion of floodwaters or wave runup and wave reflection that would increase damage to adjacent elevated buildings and structures.

- (3) The fill material must be similar and consistent with the natural soils in the area.
- (4) Nonstructural fill with finished slopes that are steeper than five (5) units horizontal to one (1) unit vertical shall be permitted only if an analysis prepared by a qualified registered design professional demonstrates no harmful diversion of floodwaters or wave runup and wave reflection that would increase damage to adjacent elevated buildings and structures.
- (5) Fill and grading activities must be consistent with the applicable standards as specified in the Town's Zoning chapter.
- (J) There shall be no alteration of sand dunes or mangrove stands which would increase potential flood damage.
- (K) No manufactured homes shall be permitted except in an existing manufactured home park or subdivision. A replacement manufactured home may be placed on a lot in an existing manufactured home park or subdivision provided the anchoring and elevation standards of this Section have been satisfied.
- (L) Recreational vehicles may be permitted in CHHAs provided that they meet the Recreational Vehicle criteria of Section 150.21(F).
- (M) A deck that is structurally attached to a building or structure shall have the bottom of the lowest horizontal structural member at or above the RFPE and any supporting members that extend below the RFPE shall comply with the foundation requirements that apply to the building or structure, which shall be designed to accommodate any increased loads resulting from the attached deck. The increased loads must be considered in the design of the primary structure and included in the V-Zone Certification required under Subsection 150.16(C)(6).
- (N) A deck or patio that is located below the RFPE shall be structurally independent from buildings or structures and their foundation systems, and shall be designed and constructed either to remain intact and in place during design flood conditions or to break apart into small pieces to minimize debris during flooding that is capable of causing structural damage to the building or structure or to adjacent buildings and structures.
- (O) In CHHAs, development activities other than buildings and structures shall be permitted only if also authorized by the appropriate state or local authority; if located outside the footprint of, and not structurally attached to, buildings and structures; and if analyses prepared by qualified registered design professionals demonstrate no harmful diversion of floodwaters or wave runup and wave reflection that would increase damage to adjacent buildings and structures. Such other development activities include but are not limited to:
 - (1) Bulkheads, seawalls, retaining walls, revetments, and similar erosion control structures;
 - (2) Solid fences and privacy walls, and fences prone to trapping debris, unless designed and constructed to fail under flood conditions less than the design flood or otherwise function to avoid obstruction of floodwaters.
 - (3) Docks, piers and similar structures.

- (P) No more than four (4) electrical outlets and no more than four (4) electrical switches may be permitted below RFPE unless required by building code.

150.23 STANDARDS FOR AREAS OF SHALLOW FLOODING (ZONE AO)

Located within the SFHAs established in Section 150.07, are areas designated as shallow flooding areas. These areas have special flood hazards associated with base flood depths of one (1) to three (3) feet where a clearly defined channel does not exist and where the path of flooding is unpredictable and indeterminate. In addition to Sections 150.20 and 150.21, all new construction and substantial improvements shall meet the following requirements:

- (A) The reference level shall be elevated at least as high as the designated base flood depth specified on the Flood Insurance Rate Map (FIRM) plus a freeboard of one foot above the highest adjacent grade OR at or above 10 feet NAVD 1988, whichever is greater.
- (B) Non-residential structures may, in lieu of elevation, be floodproofed to the same level as required above in Section 150.23(A) so that the structure, together with attendant utility and sanitary facilities, below that level shall be watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. Certification is required in accordance with Sections 150.16(C)(2) and 150.21(B).
- (C) Adequate drainage paths shall be provided around structures on slopes, to guide floodwaters around and away from proposed structures.

LEGAL STATUS PROVISIONS

150.24 EFFECT ON RIGHTS AND LIABILITIES UNDER THE EXISTING FLOOD DAMAGE PREVENTION ORDINANCE

This ordinance in part comes forward by re-enactment of some of the provisions of the Flood Damage Prevention Ordinance enacted September 3, 2003 as amended, and it is not the intention to repeal but rather to re-enact and continue to enforce without interruption of such existing provisions, so that all rights and liabilities that have accrued thereunder are reserved and may be enforced. The enactment of this ordinance shall not affect any action, suit or proceeding instituted or pending. All provisions of the Flood Damage Prevention Ordinance of the Town of Duck enacted on September 3, 2003, as amended, which are not reenacted herein are repealed.

150.25 EFFECT UPON OUTSTANDING FLOODPLAIN DEVELOPMENT PERMITS

Nothing herein contained shall require any change in the plans, construction, size, or designated use of any development or any part thereof for which a floodplain development permit has been granted by the Floodplain Administrator or his or her authorized agents before the time of passage of this ordinance; provided, however, that when construction is not begun under such outstanding permit within a period of six (6) months subsequent to the date of issuance of the outstanding permit, construction or use shall be in conformity with the provisions of this ordinance.

150.26 SEVERABILITY


If any section, clause, sentence, or phrase of the Ordinance is held to be invalid or unconstitutional by any court of competent jurisdiction, then said holding shall in no way effect the validity of the remaining portions of this Ordinance.

150.27 EFFECTIVE DATE

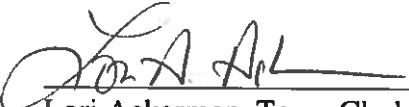
This ordinance shall become effective June 19, 2020.

150.28 ADOPTION CERTIFICATION

I hereby certify that this is a true and correct copy of the Flood Damage Prevention Ordinance as adopted by the Town Council for the Town of Duck, North Carolina.


Don Kingston, Mayor

ATTEST:


Lori Ackerman, Town Clerk

Date adopted: May 20, 2020

Motion to adopt by: Nancy Caviness

Vote: 5 AYES 0 NAYS





TOWN OF DUCK, NORTH CAROLINA

Residential Land Disturbance Permit Policies

Prior to commencing any project that disturbs the earth (other than planting flowers, shrubs, grasses, or trees or making small (less than two feet) landscaping berms, please contact the Town's Planning and Building Department at 252-255-1234 to determine what permits may be required to conduct the project. Homeowners are responsible for obtaining required permits and it is not safe to assume that a contractor hired to do a job will obtain the required permits...please check to be sure!

If you are installing new driveway or parking areas (concrete, asphalt, pavers, or gravel), accessory structures such as sheds and gazebos or accessory uses such as volleyball and basketball courts, patios, decks, paths, bulkheads, conducting filling/grading/clearing operations or removing and replacing septic systems and similar projects such as extensive drainage systems (even those that do not require a building permit), you are likely to need a Land Disturbance Permit to ensure that setbacks and lot coverage requirements are met and environmental issues may be examined, as necessary. Wooden fences that do not retain earth and small landscaping walls (less than two feet high) and minor landscaping projects do not require a land disturbance permit; however, if they are located in FEMA flood zones, they will require a flood development permit and if they are located in a Coastal Management Area of Environmental Concern, they may require a CAMA permit.

Projects that require a Building Permit or a Land Disturbance Permit will also need to have the approval of the Dare County Health Department. This ensures that you are not encroaching on or too close to your septic field or repair areas or that you have adequate septic capacity in the case of new living space. You will submit your plans to the Health Department and they will place a stamp of approval on your survey plat and on your construction documents prior to submission to the Town for a Land Disturbance or Building Permit.

The following information should be submitted as part of the Land Disturbance permit application:

Plan Requirements – All land disturbance permit plans shall be based on a current site survey prepared by a North Carolina licensed Professional Engineer (PE), licensed surveyor or landscape architect and contain architectural and engineering drawings, maps, assumptions, calculations, and narrative statements as needed to adequately describe the proposed development of the property and the measures planned to comply with the requirements of this ordinance. The survey should show the location of existing and proposed improvements including features such as driveways and gravel parking areas, structures, patios, walkways, and septic systems. A land disturbance plan involving filling or grading activities should also include, but not be limited to:

1. Adjacent property grades;
2. Approximate depth of seasonal high water table;
3. Existing elevations sufficient to determine the drainage patterns on site and on adjoining sites;
4. Locations and elevations of the adjoining street pavement, shoulder, ditches, drainage systems, upstream and downstream driveway culverts;
5. Proposed elevations of the top of bank and toe of slope and limits for fill necessary to construct the dwelling, including driveway access;
6. For all grading/filling activities up to 36" of fill material – A survey depicting the existing and proposed ground elevations shall be submitted at the time building permits are requested. The survey shall also depict the areas on the site where fill material will be placed and the limits of the fill material in relation to the property lines. Fill material shall be graded to avoid runoff on adjoining properties, rights of way, waterways and easements.

- (b) Plan copies – Two (2) copies of the land disturbance permit plans shall be filed with the permit application for administrative review.
- (c) Health Department approval
- (d) CAMA approval, if required
- (e) Fees, per the approved fee schedule

Prior to issuance of the land disturbance permit, an on-site inspection of the project site may be scheduled by the Planning Director or his designee to evaluate the pre-disturbed conditions of the site and, review and discuss the proposed land disturbance activity.

Town of Duck Residential Permitting Guidelines
Typical Information Required for a Residential Permit¹



<i>Project Description</i>	<i>Health Department Approval</i>	<i>Building Plans Required²</i>	<i>Building Permit Required</i>	<i>Survey Required w/ Permit Application⁶</i>	<i>Zoning Approval</i>	<i>As-built Survey Required Prior to CO</i>	<i>Vegetation Management Plan</i>	<i>Land Disturbance Permit</i>
Land Disturbance (Not Associated w/ Building Permit)								
Tree Clearing on Vacant Property								Machine Clearing
Grading/Filling								
Driveway/Parking/Impervious Areas				See Note 3		See Note 6		
Septic Repair/Replacement				See Note 4				
Remodel/Addition								
Siding/Roof Coverings			If > \$5,000					
Replacement Windows & Doors		See Note 2						
Replacement Rails or Deckboards			If > \$5,000					
Deck to Porch Conversion; Exact Footprint	Heated Space			See Note 3				
Replacement Pilings or Girders; Exact Footprint		See Note 2		See Note 3				
Replacement Stairs; Exact Footprint				See Note 3				
New Stairs/New Deck				See Note 3		See Note 6		
Fence	Not on Prop. Line			See Note 4				
Bulkhead/Retaining Wall		See Note 2				See Note 6		
Swimming Pool/Spas/Hot Tubs				See Note 3		See Note 6		
Accessory Building			If > 12' dimension	See Note 3		See Note 6		w/o Bldg Permit
HVAC/Plumbing/Electrical/Gas (Fuel Piping)								
Ramps				See Note 3		See Note 6		
Remodel (< 50%) (within existing footprint)				See Note 3				
Addition (< 50% and/or conversion to living space)				See Note 5		See Note 6		
New Construction⁷				See Note 5				

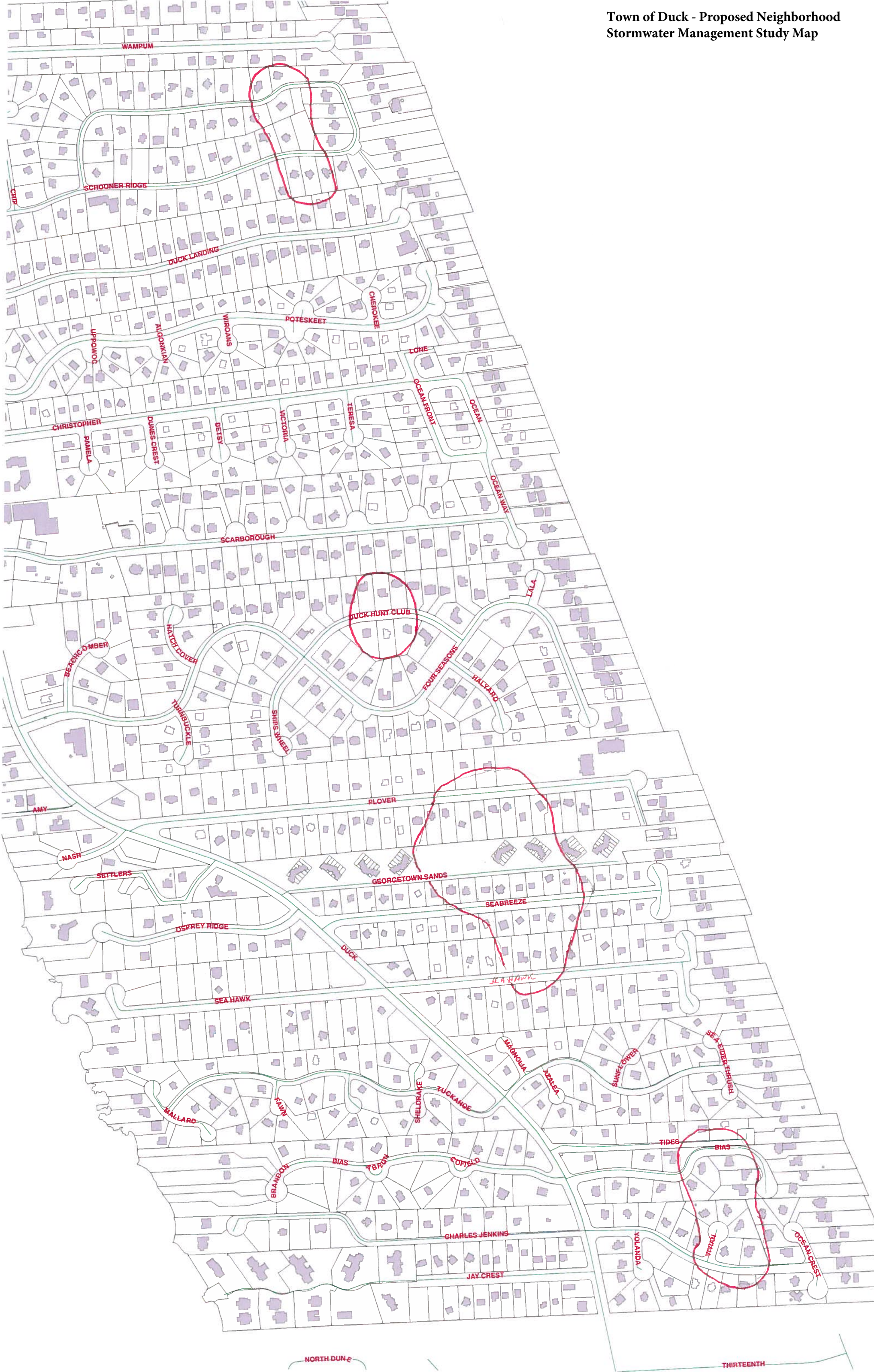
Required
If applicable

- Guidelines are typical requirements. Application requirements will be reviewed on a case-by-case basis; additional information may be required upon review of your application.
- Engineering may be required. All items must meet NC Building Code. Engineer seals must be original on at least 1 set of plans.
- Will accept either a duplicate survey followed by a site visit or an original survey with original surveyor seal. Duplicate surveys must include all improvements constructed on the property.
A prior plan of development that was not actually field verified by a licensed surveyor will not be accepted. If duplicate surveys are not field verifiable, a current survey will be required.
- A legible survey, site plan, or property diagram showing proposed improvements should be acceptable.
- Current survey with proposed improvements sealed by a NC lic. surveyor should be used.
- For certain smaller projects, as-built surveys may not be necessary if setbacks and lot coverage can be verified based on the original site plan and a field inspection.
For example, if an improvement is greater than five feet from a setback line and if more than five percent lot coverage remains, a field inspection should suffice in lieu of an as-built.
Staff reserves the right to request an as-built on a case-by-case basis.
- Improvements to existing structures where the cost of improvements will exceed 50 percent of the value of the structure will be considered new construction for permitting purposes.

For further assistance, please contact the Town of Duck Department of Community Development at 252-255-1234.

Appendix I – References

Town of Duck - Proposed Neighborhood
Stormwater Management Study Map



Town of Duck - Proposed Neighborhood
Stormwater Management Study Map

