Transportation

PAT McCRORY
Governor

NICHOLAS J. TENNYSON
Secretary

November 24, 2015

U.S. Army Corps of Engineers
Regulatory Field Office
2407 West 5th Street
Washington, NC 27889

ATTN: Ms. Tracey Wheeler
NCDOT Coordinator

Subject: **Request for a 404 Nationwide 27 Permit for the Construction of Wavebreak Structure and Subsequent Study to Serve as Mitigation to Offset Potential Loss of SAV Habitat During Construction of the Replacement of Bridge No 11 over Oregon Inlet on NC 12 in Dare County. TIP No. B-2500 Phase I, WBS Element 32635.1.3**

Dear Madam:

The North Carolina Department of Transportation requests issuance of the above referenced permit to offset potential impact(s) to Submerged Aquatic Vegetation (SAV) due to the replacement of Bridge 11.

The attached Mitigation Plan proposes a 500-foot long wavebreak structure, engineered to attenuate wave energies and provide a suitable wave climate to promote SAV coverage. The mitigation site is located southwest of Bonner Bridge, on a stable shoal that has supported patchy seagrass cover since at least 2012.

Construction of the structure will occur from barges and equipment will not dredge or be dragged on the sound bottom. Impacts to the sound bottom will be limited to include the driving of piles, and the placement of the structure itself. The proposed, 500-foot long Reefmaker structure is estimated to have a 0.06 ac (2,500 sq. ft.) benthic footprint.

It is anticipated that any SAV impacts during construction will be offset by relocation into the forecast wave shadow of the structure.

Monitoring
Monitoring of the SAV mitigation site will be conducted for a period of up to 5 years following installation of the wavebreak structure, and will include monitoring of wave energy, seagrass, structure/hard surface, and sediment elevation. A detailed monitoring plan is in the Mitigation Plan.

In the event the structure does not perform as intended, after the 5th year of monitoring, or at final close-out, if requested by all of the resource agencies, NCDOT will remove this structure.

Proposed Let Date
Construction of the structure may begin as soon as all permits are received.

Regulatory Approvals
Section 404 Permit: Issuance of a Nationwide Permit 27 is hereby made for the above described activity.

Section 401 Certification: NCDOT hereby requests NCDWR's issue appropriate general Water Quality Certification for the above described activity.

CAMA: Modification of the existing CAMA permit has been requested under separate letter.

A copy of this request and its distribution list will be posted on the NCDOT Website at: https://connect.ncdot.gov/resources/Environmental. If you have any questions or need additional information, contact Michael Turchy at maturchy@ncdot.gov or 919 707-6157.

Sincerely,

for Richard W. Hancock, P.E., Manager
Project Development and Environmental Analysis Unit

cc: NCDOT Permit Application Standard Distribution List

Pre-Construction Notification (PCN) Form

A. Applicant Information

1. Processing

1a. Type(s) of approval sought from the Corps:	☒ **Section 404 Permit** ☐ Section 10 Permit
1b. Specify Nationwide Permit (NWP) number: **27** or General Permit (GP) number:	
1c. Has the NWP or GP number been verified by the Corps?	☐ Yes ☒ **No**
1d. Type(s) of approval sought from the DWQ (check all that apply): ☐ 401 Water Quality Certification – Regular ☐ Non-404 Jurisdictional General Permit ☐ 401 Water Quality Certification – Express ☐ Riparian Buffer Authorization	
1e. Is this notification solely for the record because written approval is not required?	For the record only for DWQ 401 Certification: ☐ **Yes** ☒ No For the record only for Corps Permit: ☐ Yes ☒ **No**
1f. Is payment into a mitigation bank or in-lieu fee program proposed for mitigation of impacts? If so, attach the acceptance letter from mitigation bank or in-lieu fee program.	☐ Yes ☒ **No**
1g. Is the project located in any of NC's twenty coastal counties. If yes, answer 1h below.	☒ **Yes** ☐ No
1h. Is the project located within a NC DCM Area of Environmental Concern (AEC)?	☒ **Yes** ☐ No

2. Project Information

2a. Name of project:	**Wavebreak Structure for the Mitigation of Submerged Aquatic Vegetation (SAV) for B-2500, the Replacement of Bridge No. 11 in Dare County, on NC 12.**
2b. County:	**Dare**
2c. Nearest municipality / town:	**Rodanthe**
2d. Subdivision name:	**n/a**
2e. NCDOT only, T.I.P. or state project no:	**B-2500**

3. Owner Information

3a. Name(s) on Recorded Deed:	**North Carolina Department of Transportation**
3b. Deed Book and Page No.	
3c. Responsible Party (for LLC if applicable):	
3d. Street address:	**1598 Mail Service Center**
3e. City, state, zip:	**Raleigh, NC 27699-1598**
3f. Telephone no.:	**919-707-6157**
3g. Fax no.:	**919-212-5785**
3h. Email address:	**maturchy@ncdot.gov**

4. Applicant Information (if different from owner)	
4a. Applicant is:	☐ Agent ☐ Other, specify:
4b. Name:	
4c. Business name (if applicable):	
4d. Street address:	
4e. City, state, zip:	
4f. Telephone no.:	
4g. Fax no.:	
4h. Email address:	
5. Agent/Consultant Information (if applicable)	
5a. Name:	
5b. Business name (if applicable):	
5c. Street address:	
5d. City, state, zip:	
5e. Telephone no.:	
5f. Fax no.:	
5g. Email address:	

B. Project Information and Prior Project History	
1. Property Identification	
1a. Property identification no. (tax PIN or parcel ID):	**n/a**
1b. Site coordinates (in decimal degrees):	Latitude: **35.75084041** (DD.DDDDDD) Longitude: - **75.58649065** (-DD.DDDDDD)
1c. Property size:	**Approximately 57 acres**
2. Surface Waters	
2a. Name of nearest body of water (stream, river, etc.) to proposed project:	**Pamlico Sound**
2b. Water Quality Classification of nearest receiving water:	**SA HQW**
2c. River basin:	**Pasquotank**
3. Project Description	
3a. Describe the existing conditions on the site and the general land use in the vicinity of the project at the time of this application: **The project area is in Pamlico Sound. It is adjacent to a natural barrier island and estuarine system, with recreation in Pea Island National Wildlife Refuge and Cape Hatteras National Seashore.**	
3b. List the total estimated acreage of all existing wetlands on the property: **This structure is located in open water. No wetlands are located in the study area.**	
3c. List the total estimated linear feet of all existing streams (intermittent and perennial) on the property: **n/a**	
3d. Explain the purpose of the proposed project: **To compensate for potential losses of SAV which may occur with the replacement of Bridge 11, a unique, engineered 500-foot long wavebreak structure has been proposed to attenuate wave energies and provide a suitable wave climate to promote SAV coverage.**	
3e. Describe the overall project in detail, including the type of equipment to be used: **All current permit conditions for B-2500 will be adhered to. Construction will be predominantly off of barges and include the driving of piles into the water bottom substrate. Cranes will be used to lower structure components onto the supporting piles. Construction equiment will not drag or rest on the water bottom.**	
4. Jurisdictional Determinations	
4a. Have jurisdictional wetland or stream determinations by the Corps or State been requested or obtained for this property / project (including all prior phases) in the past? Comments: **A JD has been obtained for the B-2500 property, but not specifically for this area. This area is located in open water.**	☐ Yes ☐ No ☐ Unknown
4b. If the Corps made the jurisdictional determination, what type of determination was made?	☐ Preliminary ☒ **Final**
4c. If yes, who delineated the jurisdictional areas? Name (if known): **Sam Cooper**	Agency/Consultant Company: **CZR Inc.** Other:
4d. If yes, list the dates of the Corps jurisdictional determinations or State determinations and attach documentation. **May 4, 2012, Action ID SAW-2012-00715. The Division of Coastal Management concurred with CAMA mapping on May 30, 2012**	
5. Project History	
5a. Have permits or certifications been requested or obtained for this project (including all prior phases) in the past?	☒ **Yes** ☐ No ☐ Unknown
5b. If yes, explain in detail according to "help file" instructions. **Individual Permit (Action ID: SAW-1993-03077) was issued on 8/14/2013.**	

6. Future Project Plans			
6a. Is this a phased project?	☐ Yes	☐ No	**See Attached Cover Letter**
6b. If yes, explain.			

C. Proposed Impacts Inventory

1. Impacts Summary

1a. Which sections were completed below for your project (check all that apply):

☐ Wetlands ☐ Streams - tributaries ☐ Buffers

☒ **Open Waters** ☐ Pond Construction

2. Wetland Impacts

If there are wetland impacts proposed on the site, then complete this question for each wetland area impacted.

2a. Wetland impact number – Permanent (P) or Temporary (T)	2b. Type of impact	2c. Type of wetland (if known)	2d. Forested	2e. Type of jurisdiction (Corps - 404, 10 DWQ – non-404, other)	2f. Area of impact (acres)
W1 ☐ P ☐ T			☐ Yes ☐ No	☐ Corps ☐ DWQ	
W2 ☐ P ☐ T			☐ Yes ☐ No	☐ Corps ☐ DWQ	
W3 ☐ P ☐ T			☐ Yes ☐ No	☐ Corps ☐ DWQ	
2g. **Total wetland impacts**					

2h. Comments:

3. Stream Impacts

If there are perennial or intermittent stream impacts (including temporary impacts) proposed on the site, then complete this question for all stream sites impacted.

3a. Stream impact number - Permanent (P) or Temporary (T)	3b. Type of impact	3c. Stream name	3d. Perennial (PER) or intermittent (INT)?	3e. Type of jurisdiction (Corps - 404, 10 DWQ – non-404, other)	3f. Average stream width (feet)	3g. Impact length (linear feet)
S1 ☐ P ☐ T			☐ PER ☐ INT	☐ Corps ☐ DWQ		
S2 ☐ P ☐ T			☐ PER ☐ INT	☐ Corps ☐ DWQ		
S3 ☐ P ☐ T			☐ PER ☐ INT	☐ Corps ☐ DWQ		
S4 ☐ P ☐ T			☐ PER ☐ INT	☐ Corps ☐ DWQ		
S5 ☐ P ☐ T			☐ PER ☐ INT	☐ Corps ☐ DWQ		
S6 ☐ P ☐ T			☐ PER ☐ INT	☐ Corps ☐ DWQ		
3h. **Total stream and tributary impacts**						

3i. Comments:

4. Open Water Impacts

If there are proposed impacts to lakes, ponds, estuaries, tributaries, sounds, the Atlantic Ocean, or any other open water of the U.S. then individually list all open water impacts below.

4a. Open water impact number – Permanent (P) or Temporary (T)	4b. Name of waterbody (if applicable)	4c. Type of impact	4d. Waterbody type	4e. Area of impact (acres)
O1 ☒ **P** ☐ T	**Pamlico Sound**	**Fill (insertion of piles to support mitigation wavebreak structure).**	**Open Water**	0.06 ac or (2,500 sq. ft.)
O2 ☐ P ☐ T				
O3 ☐ P ☐ T				
O4 ☐ P ☐ T				
4f. Total open water impacts				0.06 ac or (2,500 sq. ft.)

4g. Comments:

5. Pond or Lake Construction

If pond or lake construction proposed, then complete the chart below.

5a. Pond ID number	5b. Proposed use or purpose of pond	5c. Wetland Impacts (acres)			5d. Stream Impacts (feet)			5e. Upland (acres)
		Flooded	Filled	Excavated	Flooded	Filled	Excavated	Flooded
P1								
P2								
5f. Total								

5g. Comments:	
5h. Is a dam high hazard permit required?	☐ Yes ☐ No If yes, permit ID no:
5i. Expected pond surface area (acres):	
5j. Size of pond watershed (acres):	
5k. Method of construction:	

6. Buffer Impacts (for DWQ)

If project will impact a protected riparian buffer, then complete the chart below. If yes, then individually list all buffer impacts below. If any impacts require mitigation, then you **MUST** fill out Section D of this form.

6a. Project is in which protected basin?	☐ Neuse ☐ Tar-Pamlico ☐ Other: ☐ Catawba ☐ Randleman				
6b. Buffer impact number – Permanent (P) or Temporary (T)	6c. Reason for impact	6d. Stream name	6e. Buffer mitigation required?	6f. Zone 1 impact (square feet)	6g. Zone 2 impact (square feet)
B1 ☐ P ☐ T			☐ Yes ☐ No		
B2 ☐ P ☐ T			☐ Yes ☐ No		
B3 ☐ P ☐ T			☐ Yes ☐ No		
			6h. **Total buffer impacts**		

6i. Comments:

D. Impact Justification and Mitigation

1. Avoidance and Minimization

1a. Specifically describe measures taken to avoid or minimize the proposed impacts in designing project.
The design selected minimizes the benthic footprint of the structure.
It is anticipated that any SAV impacts during construction will be offset by relocation into the forecast wave shadow of the structure.
Construction of the wave break structure will occur predominantly from barges. No structure or equipment will drag on the water bottom..

1b. Specifically describe measures taken to avoid or minimize the proposed impacts through construction techniques.
NCDOT will implement "Guidelines for Avoiding Impacts to the West Indian Manatee, Precautionary Measures for Construction Activities in North Carolina Waters," during work for this project.

In the event the structure does not perform as intended, after the 5th year of monitoring, or at final close-out, if requested by all of the resource agencies, NCDOT will remove this structure.

2. Compensatory Mitigation for Impacts to Waters of the U.S. or Waters of the State

2a. Does the project require Compensatory Mitigation for impacts to Waters of the U.S. or Waters of the State?	☐ Yes ☒ **No**	
2b. If yes, mitigation is required by (check all that apply):	☐ DWQ ☐ Corps	
2c. If yes, which mitigation option will be used for this project?	☐ Mitigation bank ☐ Payment to in-lieu fee program ☐ Permittee Responsible Mitigation	

3. Complete if Using a Mitigation Bank

3a. Name of Mitigation Bank:

3b. Credits Purchased (attach receipt and letter)	Type	Quantity

3c. Comments:	
4. Complete if Making a Payment to In-lieu Fee Program	
4a. Approval letter from in-lieu fee program is attached.	☐ Yes
4b. Stream mitigation requested:	linear feet
4c. If using stream mitigation, stream temperature:	☐ warm ☐ cool ☐cold
4d. Buffer mitigation requested (DWQ only):	square feet
4e. Riparian wetland mitigation requested:	acres
4f. Non-riparian wetland mitigation requested:	acres
4g. Coastal (tidal) wetland mitigation requested:	acres
4h. Comments:	
5. Complete if Using a Permittee Responsible Mitigation Plan	
5a. If using a permittee responsible mitigation plan, provide a description of the proposed mitigation plan.	
6. Buffer Mitigation (State Regulated Riparian Buffer Rules) – required by DWQ	
6a. Will the project result in an impact within a protected riparian buffer that requires buffer mitigation?	☐ Yes ☒ **No**
6b. If yes, then identify the square feet of impact to each zone of the riparian buffer that requires mitigation. Calculate the amount of mitigation required.	

Zone	6c. Reason for impact	6d. Total impact (square feet)	Multiplier	6e. Required mitigation (square feet)
Zone 1			3 (2 for Catawba)	
Zone 2			1.5	
	6f. **Total buffer mitigation required:**			

6g. If buffer mitigation is required, discuss what type of mitigation is proposed (e.g., payment to private mitigation bank, permittee responsible riparian buffer restoration, payment into an approved in-lieu fee fund).
6h. Comments:

E. Stormwater Management and Diffuse Flow Plan (required by DWQ)	
1. Diffuse Flow Plan	
1a. Does the project include or is it adjacent to protected riparian buffers identified within one of the NC Riparian Buffer Protection Rules?	☐ Yes ☒ **No**
1b. If yes, then is a diffuse flow plan included? If no, explain why. Comments:	☐ Yes ☐ No
2. Stormwater Management Plan	
2a. What is the overall percent imperviousness of this project?	**n/a** %
2b. Does this project require a Stormwater Management Plan?	☐ Yes ☒ **No**
2c. If this project DOES NOT require a Stormwater Management Plan, explain why:	
2d. If this project DOES require a Stormwater Management Plan, then provide a brief, narrative description of the plan: **n/a**	
2e. Who will be responsible for the review of the Stormwater Management Plan?	☐ Certified Local Government ☐ DWQ Stormwater Program ☐ DWQ 401 Unit
3. Certified Local Government Stormwater Review	
3a. In which local government's jurisdiction is this project?	**n/a**
3b. Which of the following locally-implemented stormwater management programs apply (check all that apply):	☐ Phase II ☐ NSW ☐ USMP ☐ Water Supply Watershed ☐ Other:
3c. Has the approved Stormwater Management Plan with proof of approval been attached?	☐ Yes ☐ No
4. DWQ Stormwater Program Review	
4a. Which of the following state-implemented stormwater management programs apply (check all that apply):	☐ Coastal counties ☐ HQW ☐ ORW ☐ Session Law 2006-246 ☐ Other: **N/A**
4b. Has the approved Stormwater Management Plan with proof of approval been attached?	☐ Yes ☐ No **n/a**
5. DWQ 401 Unit Stormwater Review	
5a. Does the Stormwater Management Plan meet the appropriate requirements?	☐ Yes ☐ No
5b. Have all of the 401 Unit submittal requirements been met?	☐ Yes ☐ No

F. Supplementary Information		
1. Environmental Documentation (DWQ Requirement)		
1a. Does the project involve an expenditure of public (federal/state/local) funds or the use of public (federal/state) land?	☒ **Yes**	☐ No
1b. If you answered "yes" to the above, does the project require preparation of an environmental document pursuant to the requirements of the National or State (North Carolina) Environmental Policy Act (NEPA/SEPA)?	☒ **Yes**	☐ No
1c. If you answered "yes" to the above, has the document review been finalized by the State Clearing House? (If so, attach a copy of the NEPA or SEPA final approval letter.) Comments: **NEPA FEIS/EA/ROD for TIP B-2500**	☒ **Yes**	☐ No
2. Violations (DWQ Requirement)		
2a. Is the site in violation of DWQ Wetland Rules (15A NCAC 2H .0500), Isolated Wetland Rules (15A NCAC 2H .1300), DWQ Surface Water or Wetland Standards, or Riparian Buffer Rules (15A NCAC 2B .0200)?	☐ Yes	☒ **No**
2b. Is this an after-the-fact permit application?	☐ Yes	☒ **No**
2c. If you answered "yes" to one or both of the above questions, provide an explanation of the violation(s):		
3. Cumulative Impacts (DWQ Requirement)		
3a. Will this project (based on past and reasonably anticipated future impacts) result in additional development, which could impact nearby downstream water quality?	☐ Yes	☒ **No**
3b. If you answered "yes" to the above, submit a qualitative or quantitative cumulative impact analysis in accordance with the most recent DWQ policy. If you answered "no," provide a short narrative description.		
4. Sewage Disposal (DWQ Requirement)		
4a. Clearly detail the ultimate treatment methods and disposition (non-discharge or discharge) of wastewater generated from the proposed project, or available capacity of the subject facility. **Not applicable.**		

5. Endangered Species and Designated Critical Habitat (Corps Requirement)		
5a. Will this project occur in or near an area with federally protected species or habitat?	☒ **Yes**	☐ No
5b. Have you checked with the USFWS concerning Endangered Species Act impacts?	☒ **Yes**	☐ No
5c. If yes, indicate the USFWS Field Office you have contacted.	☒ **Raleigh** ☐ Asheville	
5d. What data sources did you use to determine whether your site would impact Endangered Species or Designated Critical Habitat? **USFWS website and agency consultation; FEIS/ROD**		
6. Essential Fish Habitat (Corps Requirement)		
6a. Will this project occur in or near an area designated as essential fish habitat?	☒ **Yes**	☐ No
6b. What data sources did you use to determine whether your site would impact Essential Fish Habitat? **NMFS county index; FEIS/ROD**		
7. Historic or Prehistoric Cultural Resources (Corps Requirement)		
7a. Will this project occur in or near an area that the state, federal or tribal governments have designated as having historic or cultural preservation status (e.g., National Historic Trust designation or properties significant in North Carolina history and archaeology)?	☒ **Yes**	☐ No
7b. What data sources did you use to determine whether your site would impact historic or archeological resources? **NEPA documentation; FEIS/ROD**		
8. Flood Zone Designation (Corps Requirement)		
8a. Will this project occur in a FEMA-designated 100-year floodplain?	☒ **Yes**	☐ No
8b. If yes, explain how project meets FEMA requirements: **This activity will not result in changes in permanent flood elevations.**		
8c. What source(s) did you use to make the floodplain determination? **approved NEPA documents**		

for Richard W. Hancock, P.E. Applicant/Agent's Printed Name	Applicant/Agent's Signature (Agent's signature is valid only if an authorization letter from the applicant is provided.)	11-24-2015 Date

APPLICATION WITHDRAWN

STIP B-2500

BONNER BRIDGE

PHASE I SAV MITIGATION PLAN

PAMLICO SOUND, OREGON INLET

DARE COUNTY

NORTH CAROLINA

September 2015

Table of Contents

List of Tables

List of Appendices

1.0 INTRODUCTION & BACKGROUND

The Herbert C. Bonner Bridge is reaching the end of its service life and needs to be replaced. The Bonner Bridge provides the only highway connection for Hatteras Island to the mainland in Dare County, North Carolina via NC 12 and US 64 (**Appendix A, Figure 1)**. The Bonner Bridge will be replaced with a new bridge that will provide access to Hatteras Island across Oregon Inlet. The bridge replacement project is known as State Transportation Improvement Project (STIP) B-2500, replace bridge 270011 (Herbert C. Bonner Bridge) over Oregon Inlet, NC Improvements. In 2012 CSA Ocean Sciences, Inc. was contracted by the North Carolina Department of Transportation (NCDOT) to conduct seagrass mitigation to compensate for losses anticipated to occur during the replacement of the Bonner Bridge over Oregon Inlet (Fonseca, 2015). This project is part of a larger long-term effort to determine the best strategy and methodology for seagrass or submerged aquatic vegetation (SAV) restoration and mitigation in North Carolina.

Submerged aquatic vegetation helps stabilize coastal shorelines through rhizome binding of sediment in shallow nearshore regions, suspended sediment trapping, and wave and current attenuation. SAV distribution is driven by water depth, light penetration, nutrient loading, salinity, exposure to waves and currents, biological disturbance and fishing practices, and in particular, vulnerability to extreme storm events. Because SAV have stabilizing effects on the coastlines around the areas they inhabit, substantive changes in the SAV community will strongly shape the physical integrity of the coastline. Also, because SAV provides critically important food and shelter for fisheries, changes in SAV will affect the fisheries of the future (NCCOS, 2012).

Replacement of the Bonner Bridge will permanently impact approximately 2.66 acres of SAV areas for which mitigation will be required. Mitigation measures will include removal of the existing bridge that will unshade 1.38 acres of suitable habitat, and the remaining 1.28 acres will be mitigated near the project area at the SAV mitigation site described in this plan. This 17-acre mitigation site will generate 1.3 acres of lift in SAV cover coupled with an additional 0.3 acres of hard surface habitat suitable for colonization by algae, oysters and other sessile communities.

1.1 PROJECT OBJECTIVE

The objective of this mitigation project is to reduce the amount of wave energy within the project site to allow for a more continuous cover of SAV (specifically the seagrasses *Halodule wrightii* and *Zostera marina*) to expand, providing increased seagrass acreage and associated ecosystem services. These services include water quality improvement, aquatic habitat creation, reduced sediment movement and plant community establishment. The wave break proposed in this mitigation plan will also create new linkages between intertidal and aquatic environments.

1.2 EXISTING CONDITIONS

The mitigation site (Site S2) is located immediately west of the existing Bonner Bridge (**Appendix A, Figure 2**), and was selected as the preferred site following an April 28, 2015 field verification. It is located on a stable shoal that has supported patchy seagrass cover since at least 1998. During the April 28, 2015 field verification, a point-intercept survey was conducted at sites S2, S2A and S4 to determine the beginning and end point of seagrass along each transect and ultimately the SAV percent cover. Site S2 demonstrated a modest seasonal fluctuation in seagrass cover, increasing 15 percent since the previous survey conducted in 2012, but only to 26 percent cumulative cover (**Table 1**). Site S2A was rejected because of an emerging clay lens observed in the potential planting area (SAV does not grow well in clay). Site S2 was selected

over Site S4 because of the potential for more change in seagrass cover with gap closure among the existing patches.

Table 1. Seagrass and elevation survey results

Site	Percent Cover (2015)	Percent Cover (2012)	Average Patch Size (2015) (ft^2)	Seafloor Elevation (ht. above MSL in ft)
Site S2	26	11	26.9	-1.48
Site S2A	3	7	31.2	-2.66
Site S4	54	53	84.6	-2.89

The proposed site will be staked and signed to demarcate the proposed structure location during the public notice period; additional signage will be posted at Oregon Inlet Fishing Center.

2.0 PROPOSED MITIGATION PLAN

This project is intended for mitigation for SAV impacts associated with Phase I of B-2500, the Bonner Bridge replacement project. A unique and proven engineered structure is proposed to attenuate wave energies and provide a suitable wave climate to promote SAV coverage. The wavebreak will be a permanent, 'living' structure.

The proposed structure is a 500-foot long wavebreak. The length was determined by iteratively adjusting the wall length and running wave and seagrass forecasting models (see below) on each successive wall length until an increase in seagrass cover meeting the mitigation acreage of 1.28 acres was achieved.

The nearest portion of the structure is approximately 900 feet east of the closest existing tidal channel and approximately 2,200 feet from the deepest portions of that channel. Given this distance and the observed stability of the shoal over time (Google Earth imagery; 2004, 2006, 2008, 2009, 2011, 2014 and recent NCDOT high resolution imagery 2012, 2015), this distance is judged to be adequate to avoid any influence of the channel.

The proposed design involves installing a continuous series of innovative wave attenuation structures, termed "EcoSystem Units", by Reefmaker (http://www.reefmaker.com/marine-ecosystems). Each wave attenuator "unit" is comprised of a stack of concrete molded trays set with natural rock material such as granite. These systems are designed to fully attenuate wave energy while still allowing for the exchange of water and the passage of organisms through and around the structure's individual components. Moreover, they are designed for use in high energy wave environments and to survive the passage of large storms such as hurricanes. The proposed structures are comprised of individual units that are four feet tall and approximately five feet wide (**Appendix B, Exhibits 1, 2, and 3)**. The benefits of this system include its ability to decrease the wave energy in the target location and to increase hard surface area serving as epibiota habitat while reducing the benthic footprint compared to other techniques.

The Reefmaker systems have a much smaller benthic footprint (25 square feet per unit) to reach the desired height and have less impact upon installation than a traditional rock wavebreak. A traditional rock wavebreak of similar size with 2:1 slopes would have a 10,000 square foot benthic footprint. The proposed, 500-foot long Reefmaker structure, is estimated to have a 2,500 square foot benthic footprint. The design of the Reefmaker "EcoSystem Units" also provides considerable surface area for oyster settlement and other biofauna (**Table 2**). Based on preliminary design it is anticipated that approximately two units will be submerged below the normal high water level.

Table 2. 500-foot Reefmaker structure surface area calculations

Wave Attenuator Units (vertical)	Surface Areas (sq. ft (ac))	Total Pilings/Units
2	11,413 (0.26)	101
2.5	14,696 (0.34)	101
3	17,978 (0.41)	101

The design and location of the wavebreak was developed by forecasting the wave conditions (Malhotra and Fonseca, 2007) and the associated change in seagrass cover that was expected to occur with the presence of the structure. The relationship of wave energy to predicted percent seagrass cover of the seafloor (Fonseca and Bell, 1998; re-fit with a yet more conservative regression model) was utilized to predict the percent seagrass cover of the seafloor with and without the wavebreak structure present. Change in seagrass cover by creation of the 500-foot wavebreak was based on the area of wave energy reduction ranging from 10 to 20 percent of ambient/normal wave energy. This range was judged to provide a conservative estimate of wave energy reduction over which to forecast seagrass cover while ensuring the target area (1.28 acres) would be met. **Figure 3 (Appendix A)** shows the forecast for wave energy reduction to 10 percent of the ambient/normal wave energy, creating a wave shadow of approximately 57.3 acres. The forecast increase in seagrass acreage for the 10 percent assessment in this shadow area is approximately 0.91 acres. **Figure 4 (Appendix A)** shows the forecast for wave energy reduction to 20 percent of the ambient/normal wave energy, creating a wave shadow of approximately 17.3 acres. The forecast increase in seagrass acreage for the 20 percent assessment in this shadow area is approximately 1.65 acres. The midpoint of the forecast change in seagrass cover in this 10 to 20 percent range of wave energy reduction is a net addition of 1.3 acres.

Construction of the wavebreak structure will impact some existing seagrass patches. These seagrass patches will be relocated to gaps among patches on the lee side of the wavebreak structure to potentially accelerate the anticipated gap closure among the seagrass patches. The effect of the relocation will be tracked as part of the monitoring survey. Specifically, prior to installation of the wavebreak, a point-intercept survey will be conducted within the footprint of the wall and construction access corridor (e.g., construction barge). Three parallel lines running the entire length of the structure and corridor will be surveyed by this method and the percent cover of seagrass computed to document the amount of seagrass moved. The performance of the relocated seagrass will be monitored separately from other surveys, but will employ the same methods.

In addition, the SAV environment within the vicinity of the existing Bonner Bridge will improve upon the bridge's removal in that shading to these habitats will be eliminated. The SAV habitat within the existing bridge location and the area of new bridge construction will be monitored as outlined in Section 4.0.

3.0 CONSTRUCTION IMPLEMENTATION AND METHODOLOGY

The construction of the Bonner Bridge seagrass mitigation wavebreak structure involves the following construction phases:

Phase 1 – Reefmaker Casting

- Setting up the casting molds
- Pouring concrete and creating the Reefmaker units at the land base staging site **(Figure 5 [Appendix A])** - 301 Harbor Road Wanchese, N.C. 27981)
- Concrete pouring and setting activities will remain in upland staging area

Phase 2 – Material Transport

- Materials including pilings, Reefmakers and hardware will be loaded onto the shallow draft barges and transferred to the site location from the land based staging area (**Table 3**)

Table 3. Types of vessels used during construction to minimize bottom disturbance

Vessel	Number of Each Vessel Type	Size (Ft.)	Draft (In.)	Specialized Equipment
Landing Craft Barge	1	42 X 13	8.0	• 360°sonar • Internal Bilge • Drill Hole • Lifting Device
Shallow Draft Barge	2	20 X 40	12.0	• Manual Positioning
Shallow Draft Barge	1	24 X 45	12.0	• Customized Mini Excavator with 42’ Extension Arm
Skiff	3	22 X 10	8.0	• Custom Jack Plates • Marine Tug Push Knee
Standard Jetfloat Platform	1	4 X 4	1.0 – 6.0	• Expandable Units

Phase 3 – Structure Installation

The 24 X 45 shallow draft barge with a 42-foot custom mini excavator will be used in conjunction with specialized 8.0-inch spuds to minimize benthic impacts (**Photos 1 and 2**). A separate expandable standard jetfloat platform will be erected and attached to the working shallow draft barge. Pilings will be jetted and vibrated to depths of 20 to 30 feet. The units will be systematically assembled using the mini excavator 42-foot arm. The Reefmaker unit hardware will be installed following placement. Due to the dynamics of Oregon Inlet, potential entanglement of aquatic species and issues concerning worker safety, turbidity curtains will not be used during construction.

Photo 1. Shallow Draft Barge

Photo 2. Customized Mini Excavator

NCDOT will install and maintain any signal lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, on authorized facilities. NCDOT will submit a *Private Aids to Navigation Application* to the U.S. Coast Guard. The construction schedule is dependent on receipt of permits, procurement of contractors, and appropriate weather conditions.

SAV and Benthic Habitat minimization and avoidance measures

During material transport and construction extra caution will be taken not to disturb the bottom habitat. A specialized landing craft barge will be used during transport and construction phases to assist with supplies and emergency response (**Photo 3**). The barge will be equipped with 360° sonar and an internal bilge system that will be used to monitor water level depths to avoid any impact to existing SAV during construction.

Photo 3. Landing Craft Barge

Threatened and Endangered Species Protection

During construction all precautions will be taken and activities monitored not to impact Threatened and Endangered Species. Threatened and Endangered Species Protection measures are addressed in the original CAMA permit additional conditions sections 35 and 36. These conditions specify:

> 35) In accordance with commitments made by the permittee, the discretionary measures for the piping plover and three species of sea turtles that are described in the permit application that include the terms and conditions outlined in the July 10, 2008 United States Fish and Wildlife Service (USFWS) Biological and Conference Opinions shall be implemented.
>
> 36) In accordance with commitments made by the permittee, all conditions outlined in the USFWS Guidelines for Avoiding the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters shall be implemented.

4.0 MONITORING

Various aspects of the proposed project will be monitored solely for purposes of identifying contributing factors affecting success of the SAV establishment, coalescence of existing patches, and overall persistence. These variables will be monitored through statistically robust design and sampling and documented in order to advance the science and improve the future of SAV mitigation success in North Carolina.

SAV Mitigation Site Monitoring

Mitigation site monitoring will be conducted for up to five years after installation of the wavebreak structure. The methodology for SAV restoration monitoring includes the following:

- *Wave Energy:* Pressure sensors will be deployed 25 meters in front of and 25 meters behind the wavebreak to validate wave simulation models. Sensors are cylindrical (approximately two inches in diameter by 10 inches long) and will be mounted horizontally on the seafloor approximately six inches above the substrate on an embedded (into the seafloor) solid base. These sensors will record wave characteristics. They will be set to record bursts of pressure data every 30 minutes at a sampling rate of 4 Hz for 128 seconds. These data will also provide water level and tide documentation. During times of onsite seagrass surveys, these sensors will be systematically but temporarily relocated across the site to provide a spatially articulated assessment of wave energy distribution with regard to prevailing conditions. These wave energy maps of the area around each wavebreak will be used to inform the seagrass survey and determine the onsite relationships between wave energy distribution and seagrass coverage response.

- *Seagrass:* Gap closure among seagrass patches and change in seagrass cover will be evaluated across wave energy regimes (to include at least 57 acres). Four wave energy regimes (treatments) will be defined by a required re-analysis of the wave energy distribution of the final wavebreak design and validation. The wave energy regimes will represent ambient (reference; < 10 percent forecast reduction), low reduction (10 to 33 percent forecast reduction), moderate reduction (34 to 66 percent forecast reduction) and high wave energy reduction (> 66 percent forecast reduction). The percent reduction regimes will be defined from a cumulative frequency analysis of the area covered by the

modeling effort where greater than 10 percent energy reduction was forecast to occur as the result of the wavebreak structure.

The effect of biological disturbance on seagrass, specifically gap closure will also be tested. Two bioturbation exclusion treatments will be utilized, one with and one without exclusionary wire mesh (removed after patch coalescence has occurred). Large gap (four to six inch) metal mesh will be laid flush on the seafloor and anchored with approximately one to two-foot long J-shaped rebar stakes. Seagrass shoots would extend through the large gaps allowing their continued growth and expansion (vis a vis "TERF" method http://seagrant.mit.edu/eelgrass/background/transplanting.html; F. Short, UNH). Flush deployment on the seafloor plus anchoring is performed to prevent entanglement by sea life, such as diving birds.

Randomly selected seagrass patches will constitute the individual (replicate) test units. To choose individual test units, a location will be randomly chosen in each forecast wave energy treatment area. The nearest seagrass patch to that location meeting two criteria will be selected as a test unit. The individual seagrass patch must first approximately match the average site patch size (+/- 1 standard deviation). The seagrass patch must also be separated from the next nearest patch by a minimum of the site average gap distance. Ten patches will be selected per wave energy treatment; five will be protected with wire mesh and five will be un-protected. The statistical approach for this experiment on the effect of waves and biological disturbance on patch expansion is a repeated measures two-way analysis of variance with wave energy and patch protection as main effects. The survey will end when patch coalescence begins; at this point the mesh and stakes will be removed and disposed of appropriately.

- *Structure/Hard Surface:* Epibiota on the structure will be monitored through the establishment of randomly-placed, permanent quadrats, stratified by either side of the wavebreak (exposed versus sheltered side) and by elevation on the structure (near seafloor, mid-tide, high-tide) for a total of six monitoring strata. Ten quadrats would be assigned per strata for a total of 60 quadrats. Epibiotic coverage will be evaluated annually using a repeated measures design. The quantification will be determined based on the epibiota that recruit, but is anticipated to include percent cover by community type visually identified to the lowest practicable taxonomy.

- *Sediment Elevation:* Digital elevation models will be created encompassing the full forecast extent of wave attenuation out to and including adjacent reference areas un-affected by the wavebreak to relate seagrass response not only to changes in wave climate but also to quantify any changes in sediment elevation. Sediment accumulation or loss can strongly affect seagrass coverage and thus is needed to provide explanatory capacity for seagrass performance. Because the wavebreak structure will be installed on a flat sand surface, little change in seafloor elevation is anticipated around the structure as the result of changes in wave energy. Wave refraction should be limited (i.e., no change in seafloor elevations) and effects should be limited primarily to wave diffraction. Any changes arising from the structure are anticipated to be minor and immediately adjacent to the wavebreak itself. The wavebreak is also installed at the seafloor surface to prevent sand scour under the structure.

The information obtained through the monitoring of this project will substantially increase the state of seagrass mitigation science by both quantifying the relationship between seagrass cover and

wave energy and by understanding the difference in the expansion rate of patches among armored and unarmored patches. Improving the quantification of wave and seagrass landscape cover will specifically inform future seagrass mitigation efforts using wave attenuation approaches. Similarly, understanding the relative impact of bioturbation versus waves on maintenance of seagrass landscapes will inform future mitigation efforts as to the degree (if any) of bioturbation exclusion needed to effect persistent coverage. Both aspects (waves and bioturbation) address important information gaps for North Carolina (and elsewhere) regarding the relative influence of waves and bioturbation on seagrass patchiness and have high intrinsic value.

Temporary SAV Impact Monitoring

NCDOT will provide an annual update on the SAV areas temporarily impacted by the bridge construction. This annual update will consist of photographs and a written report on the progress of the temporarily impacted areas in re-attaining their pre-project abundance. Within three years after project completion, NCDOT will hold an agency field meeting with DCM to assess if the SAV areas temporarily impacted by this project have re-attained pre-project abundance (distribution or coverage).

Existing Bridge SAV Habitat Monitoring

In addition to the proposed mitigation site, the aquatic area in the vicinity of the existing Bonner Bridge will be monitored upon removal of the bridge to assess whether and/or to what extent the effects of removing shade will be to SAV and their habitat.

5.0 REMEDIATION AND LONG-TERM MANAGEMENT

The wavebreak will be inspected for damage annually during the five year monitoring period. If monitoring data indicate that damage to the structure is having a negative effect on SAV coverage, then a remediation plan will be developed in coordination with DCM. In addition, the annual inspection will verify that the required signage and markings are present and visible.

6.0 MITIGATION SUMMARY

The implementation of this plan is proposed as mitigation for approximately 2.66 acres of impact from the B-2500 Bonner Bridge replacement project to existing SAV by creating and affecting the local marine environment in the vicinity of the bridge, as an attempt to make it more conducive to the establishment and enhancement of SAV. Table 4 includes a summary of the proposed mitigation and the estimated acreages of each component.

Table 4. Mitigation summary

Unshaded Area From Existing Bridge (ac)	SAV Increase (Uplift) Due to Wave Attenuation of 10 to 20% (ac)	Hard Surface Habitat Area (sq. ft (ac))	Wavebreak Shadow (ac)	Increase in Seagrass (lift in ac)
1.38	0.91 - 1.65	11,413 (0.3)	17 to 57	1.3

7.0 REFERENCES

Fonseca, Mark and Susan S. Bell. 1998. "Influence of Physical Setting on Seagrass Landscapes near Beaufort, North Carolina, USA." Marine Ecology-Progress Series. 171: 109-121.

Fonseca. 2015. Memo on 9 June, 2015 from Mark Fonseca to Kathy Herring at NCDOT RE: Bonner Bridge Seagrass Mitigation Project (State Project 32635.1.3; TIP B-2500) Task B (Site Verification) Letter Report.

Google Earth Imagery, 2004, 2006, 2008, 2009, 2011, 2014

Malhotra, A. and M.S. Fonseca. 2007. WEMo (Wave Exposure Model): Formulation, Procedures and Validation. NOAA Technical Memorandum NOS NCCOS #65. 28 pp. http://www.ccfhr.noaa.gov/docs/NOS_NCCOS_65.pdf

NCCOS. 2012. Habitats of coastal North Carolina.

NCDOT. 2012. High Resolution Aerial Photography.

NCDOT. 2015. High Resolution Aerial Photography.

NCDWQ 401 Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act with ADDITIONAL CONDITIONS for the Proposed Replacement of the Herbert C. Bonner Bridge over Oregon Inlet in Dare County, Federal Aid Project No. BRNHF-0012(48), TIP B-2500 (Phase I). NCDWQ Project No. 20120629. September 7, 2012.

Appendices

APPLICATION WITHDRAWN

Appendix A: Figures

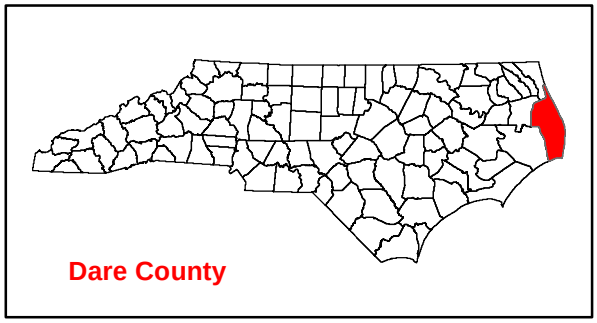
Figure 1. Project Vicinity

Figure 2. Project Location

Figure 3. Percent Change in Seagrass Cover for Representative Wave Energy Difference of 10% or Greater

Figure 4: Percent Change in Seagrass Cover for Representative Wave Energy Difference of 20% or Greater

Figure 5: Project Construction and Staging



SEPI ENGINEERING & CONSTRUCTION

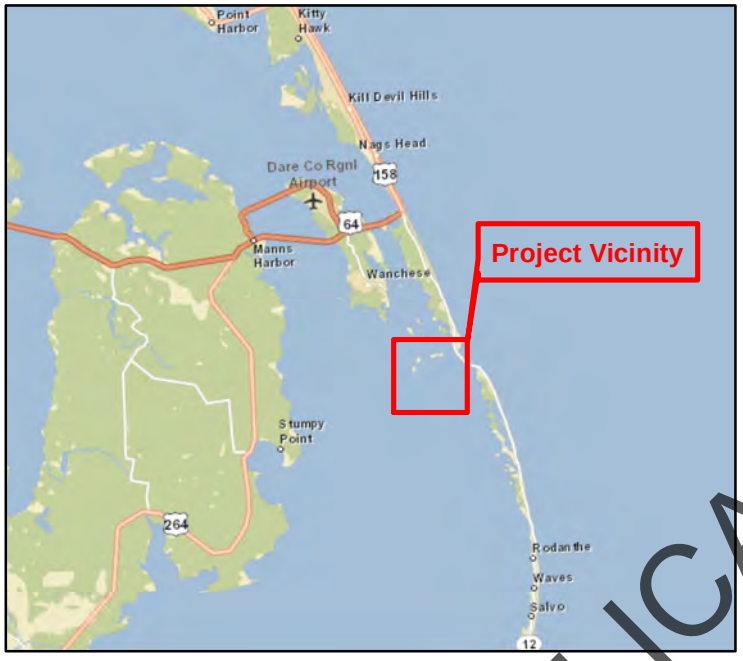


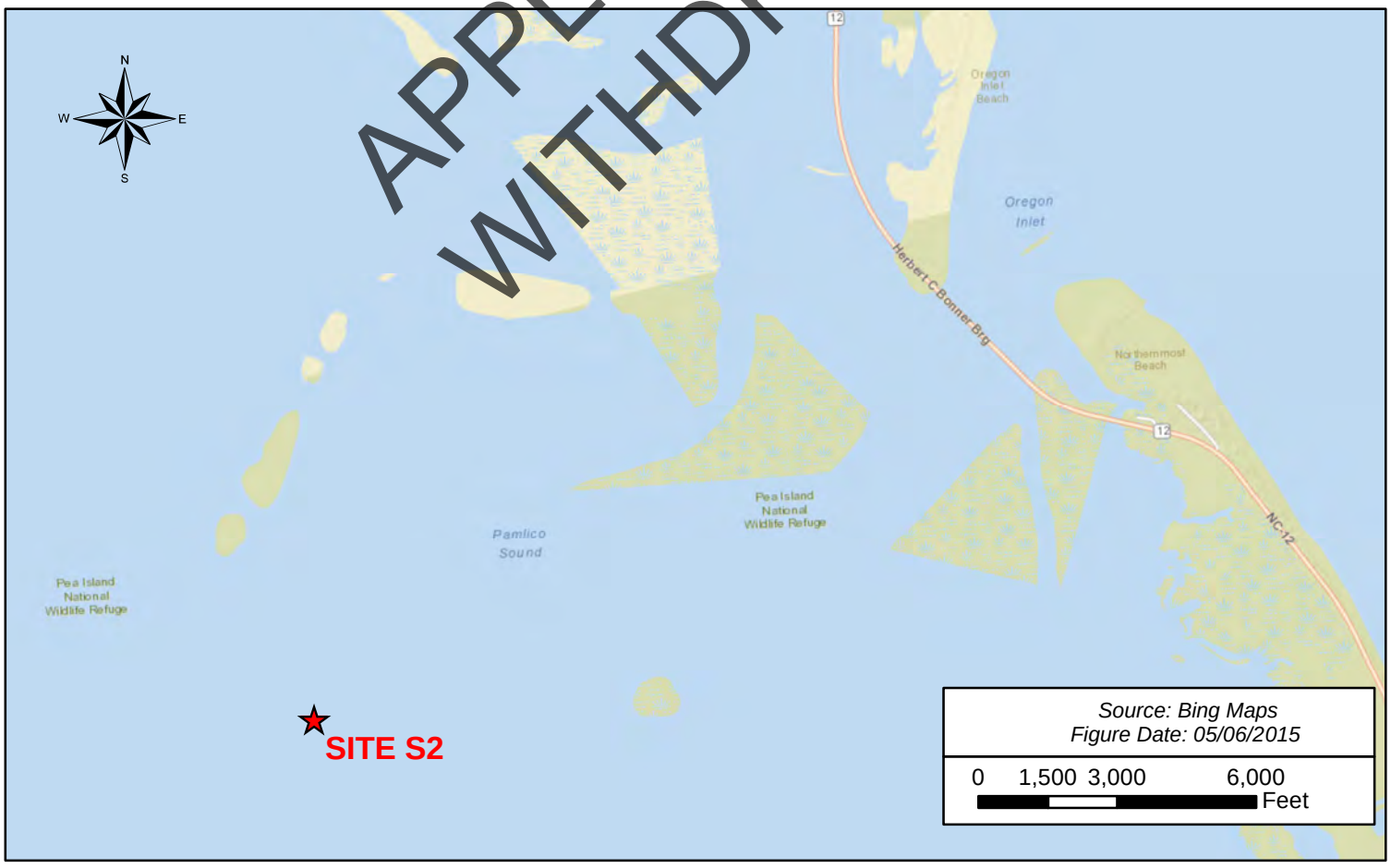
Figure 1:

Project Vicinity

STIP B-2500 BONNER BRIDGE
SAV MITIGATION PLAN

DARE COUNTY - NORTH CAROLINA

SEPTEMBER 2015



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Sources:
ESRI Base Mapping, September 2015

1 inch = 4,000 feet

GRAPHIC SCALE

0 2,000 4,000 8,000 Feet

Figure 2: Project Location

STIP B-2500 BONNER BRIDGE
SAV MITIGATION PLAN

SEPI ENGINEERING & CONSTRUCTION

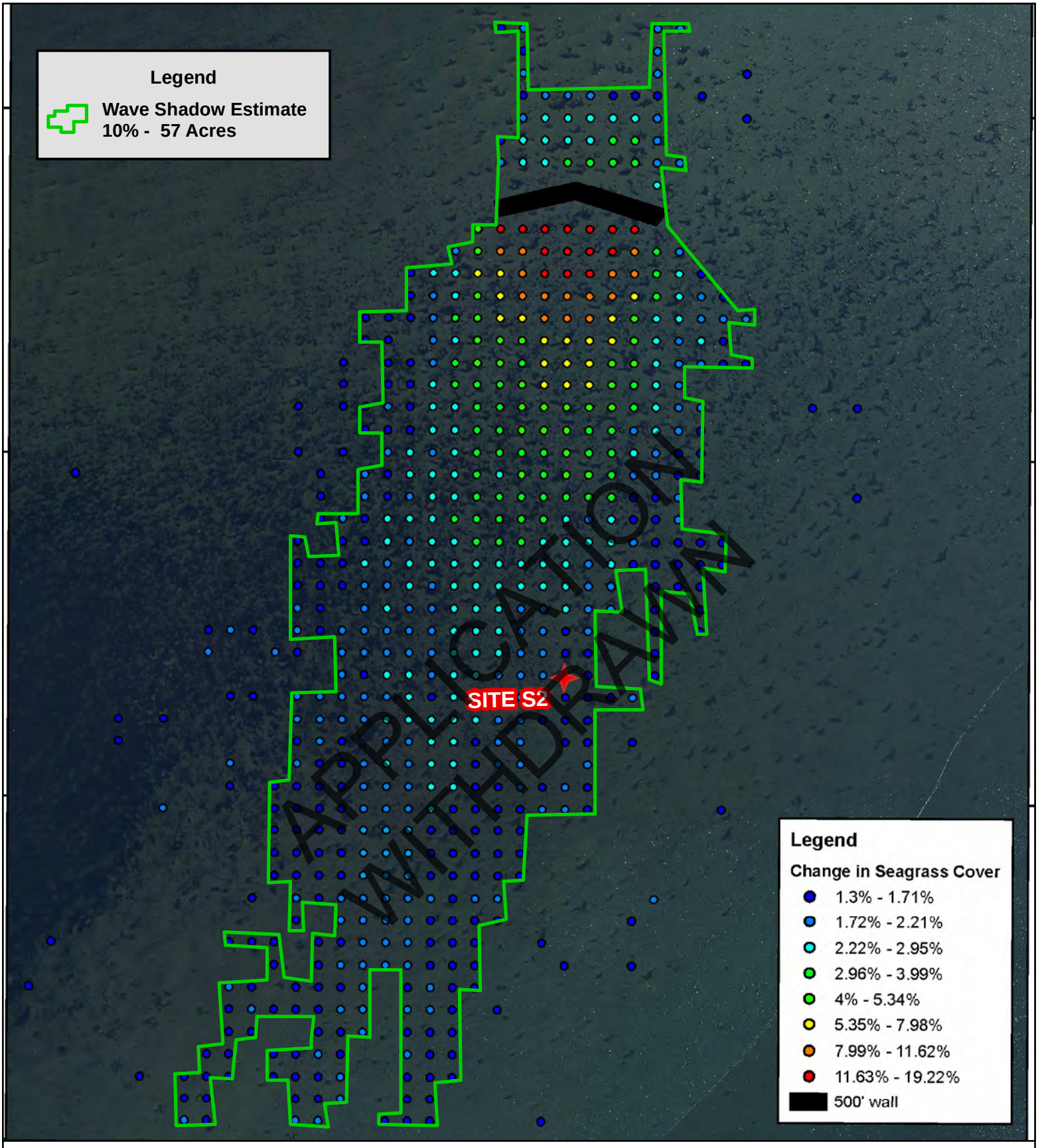


Figure 3: Percent Change in Seagrass Cover for Representative Wave Energy Difference of 10% or Greater

STIP B-2500 BONNER BRIDGE
SAV MITIGATION PLAN

CSA Ocean Sciences Inc.

1 inch = 390 feet

0 195 390 780 Feet

SEPI ENGINEERING & CONSTRUCTION

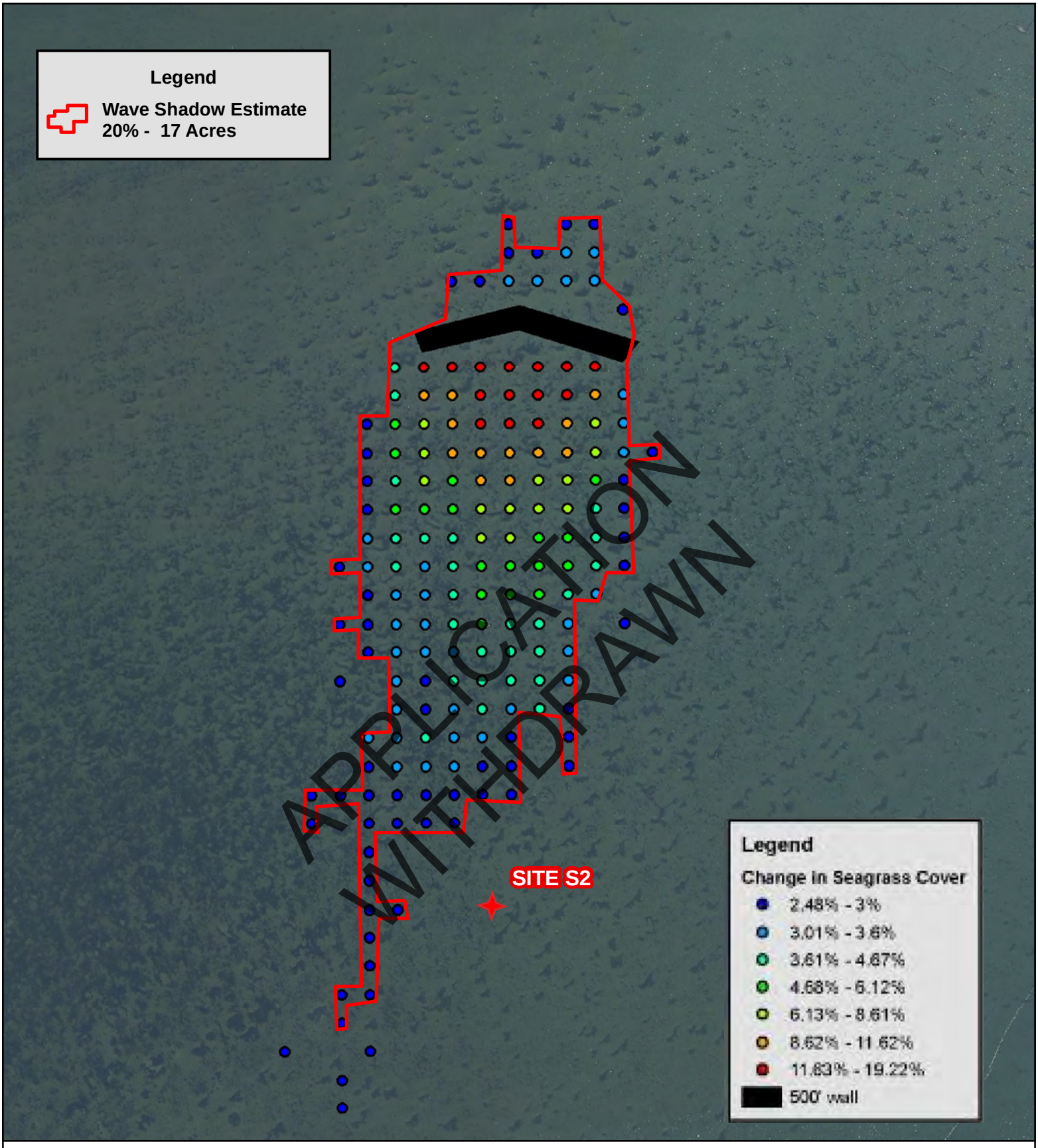


Figure 4: Percent Change in Seagrass Cover for Representative Wave Energy Difference of 20% or Greater

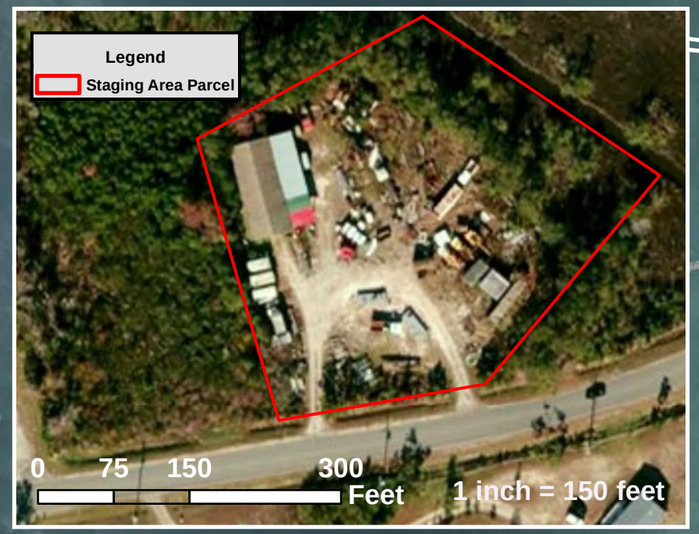
STIP B-2500 BONNER BRIDGE
SAV MITIGATION PLAN

CSA Ocean Sciences Inc.

1 inch = 325 feet

0 162.5 325 650 Feet

SEPI ENGINEERING & CONSTRUCTION



STAGING AREA

APPLICATION WITHDRAWN

SITE S2

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Sources:
Aerial and Topographic Mapping

1 inch = 4,000 feet

GRAPHIC SCALE

0 2,000 4,000 8,000
Feet

Figure 5: Project Construction and Staging

STIP B-2500 BONNER BRIDGE
SAV MITIGATION PLAN

SEPI ENGINEERING & CONSTRUCTION

Appendix B: Exhibits

Exhibit 1. Reefmaker “Ecosystem” Units Design – Front Elevation View

Exhibit 2. Reefmaker “Ecosystem” Units Design – Profile View

Exhibit 3. Reefmaker “Ecosystem” Units Design – Plan View

Exhibit 1. Reefmaker "Ecosytem" Units Design - Front Elevation View

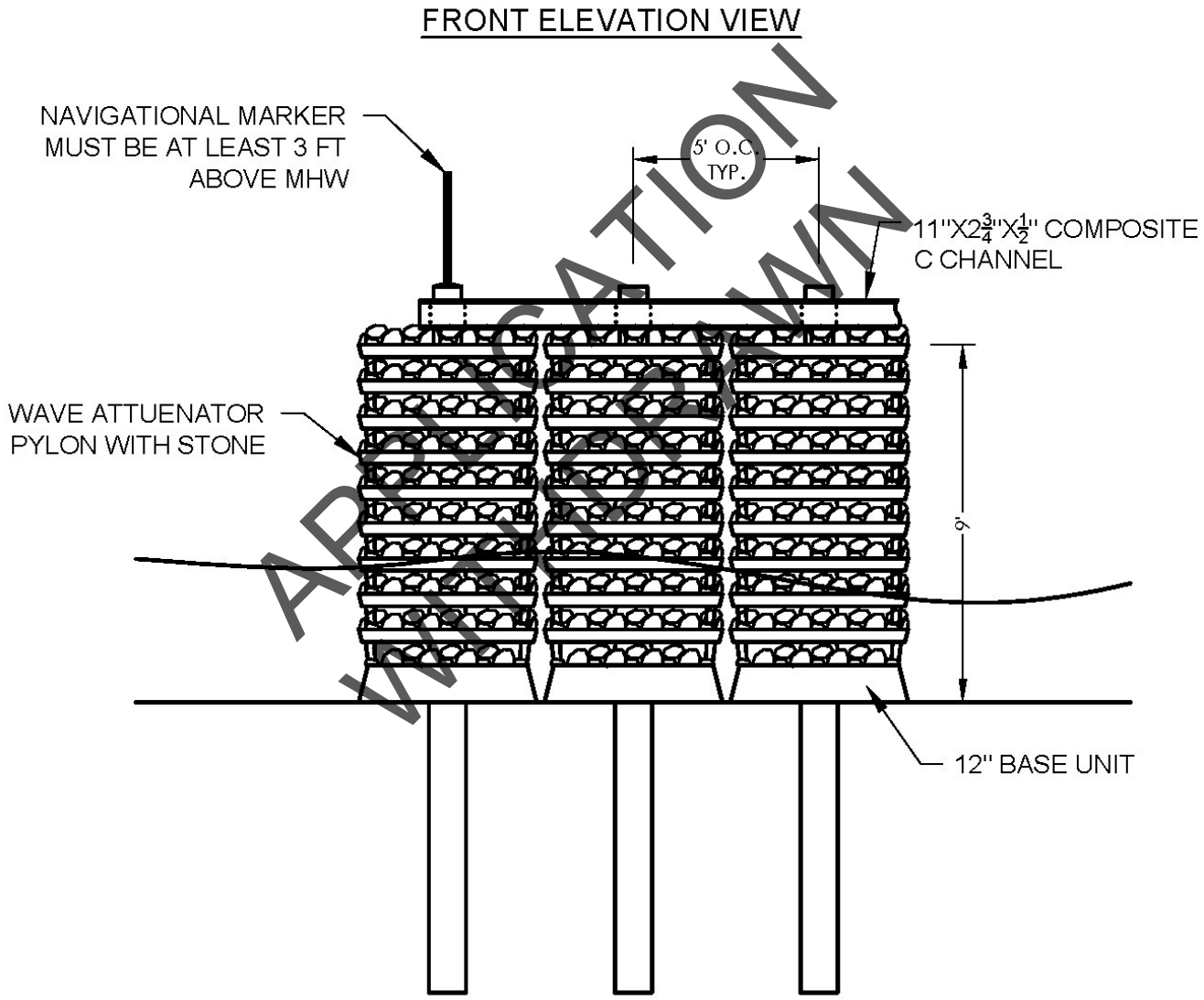

Exhibit 2. Reefmaker "Ecosystem" Units Design - Profile View

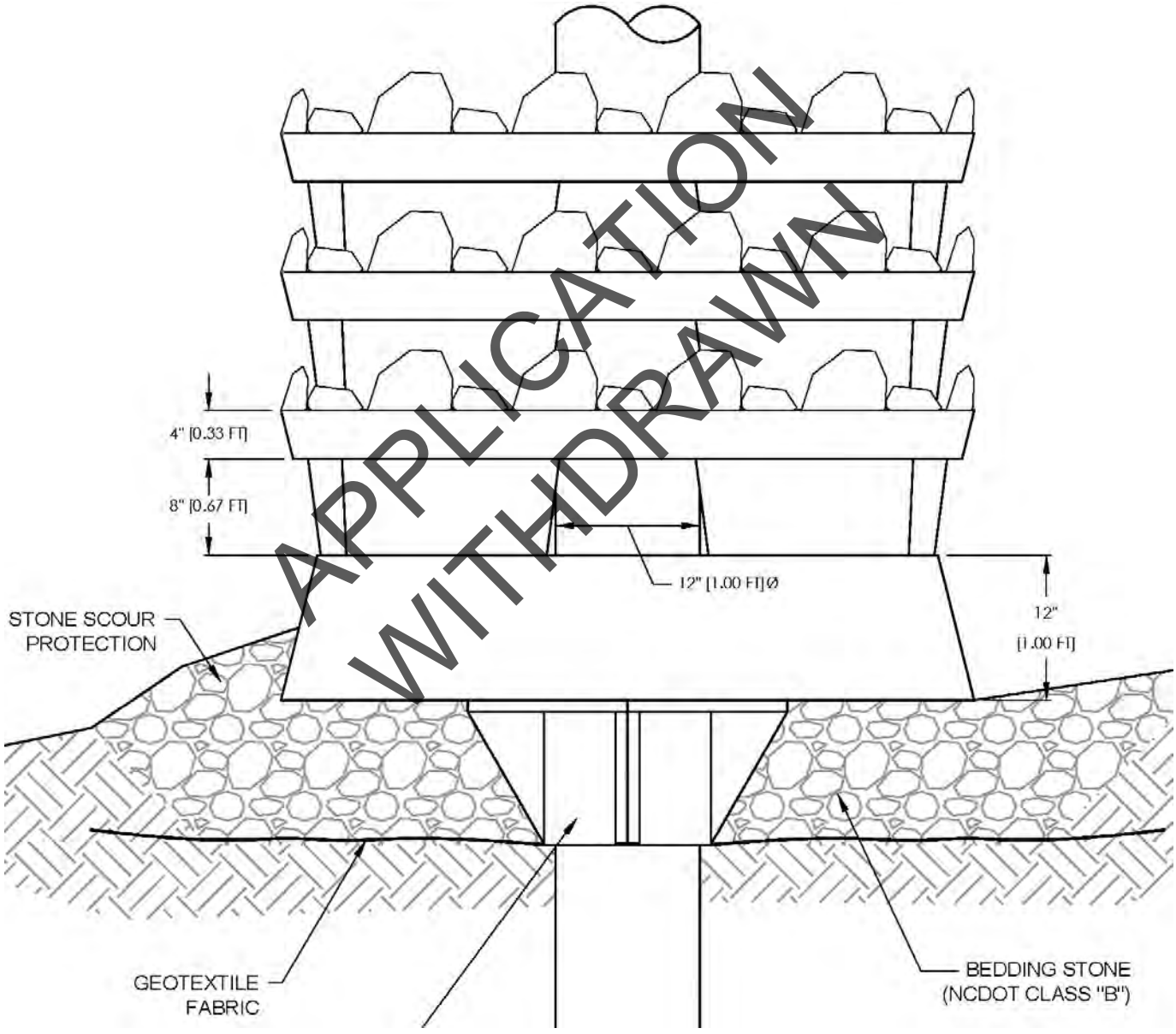

Exhibit 3. Reefmaker "Ecosystem" Units Design - Plan View