



November 27, 2023

Mr. Tyler Stanton
North Carolina Department of Transportation
1020 Birch Ridge Drive Raleigh, NC 27610

Re: **R-2576 - Proposed Mid-Currituck Sound Bridge - Submerged Aquatic Vegetation Survey
2023 Monitoring Report**

Dear Mr. Stanton,

RK&K is pleased to provide you with the 2023 submerged aquatic vegetation (SAV) monitoring report for R-2576 (Mid-Currituck Sound Bridge).

Project Area Description

The proposed bridge project is located over Currituck Sound from Aydlett, NC (west) to just south of Corolla, NC (east). The SAV study area spans open water and is 4.64 miles long and 330 feet wide (Figure 2). Throughout the project study area, water depths range from the shoreline (0 foot) to approximately -11 feet mean lower low water (MLLW). The substrate within the project area consists of sand and muck with no areas of hard bottom noted. In 2020, the project study area was adjusted to the most recent bridge design and study corridor (Figure 4).

Project Methodology

Surveys to determine accurate boundaries of SAV beds and estimated species composition/percent cover consisted of five steps:

- Side-scan sonar to determine SAV location in deeper areas
- UAS-imagery collection to determine SAV location in shallow areas
- UAS-imagery unsupervised iso-classification to delineate SAV
- Manual SAV boundary confirmation via RTK-GNSS
- Random sampling of SAV beds for species composition and percent cover

Pre-fieldwork assessment of SAV bed boundaries utilized geographic information systems (GIS) to interpret color aerial imagery from NC ONEMAP, National Oceanic and Atmospheric Administration (NOAA)¹ GIS SAV data, North Carolina Department of Environmental Quality (NCDEQ)² GIS SAV data, as well as previous UAS-imagery and side-scan sonar data (2015-2021 data sets).

Field data was collected utilizing unmanned aerial system (UAS) technology and side-scan marine imaging sonar from a 23-foot center console vessel. To ensure the geospatial accuracy of seagrass bed margins, sonar data was acquired in conjunction with an RTK-equipped high-resolution GNSS receiver. Field data was then processed within GIS environment to identify potential areas of SAV for ground-truthing purposes.

The ground-truthing process utilized an RTK-equipped high-resolution GNSS receiver and data collection device to locate predetermined and randomly selected SAV areas for assessment. SAV species composition was also established through predetermined and random sample locations. Species information was documented at each sample location for later analysis in ESRI ArcGIS Pro.

¹National Oceanic and Atmospheric Administration. *Estuarine Benthic Cover GIS Data Layer, NC90*.

Estuarine Aquatic Bed, Submersed Rooted Vasculars (SRV), Beaufort Marine Lab. 1998

²North Carolina Department of Environmental Quality. *Submerged Aquatic Vegetation, GIS Data Layer*.
Albemarle-Pamlico National Estuary Partnership (APNEP), Raleigh, NC. 2008

Project Results

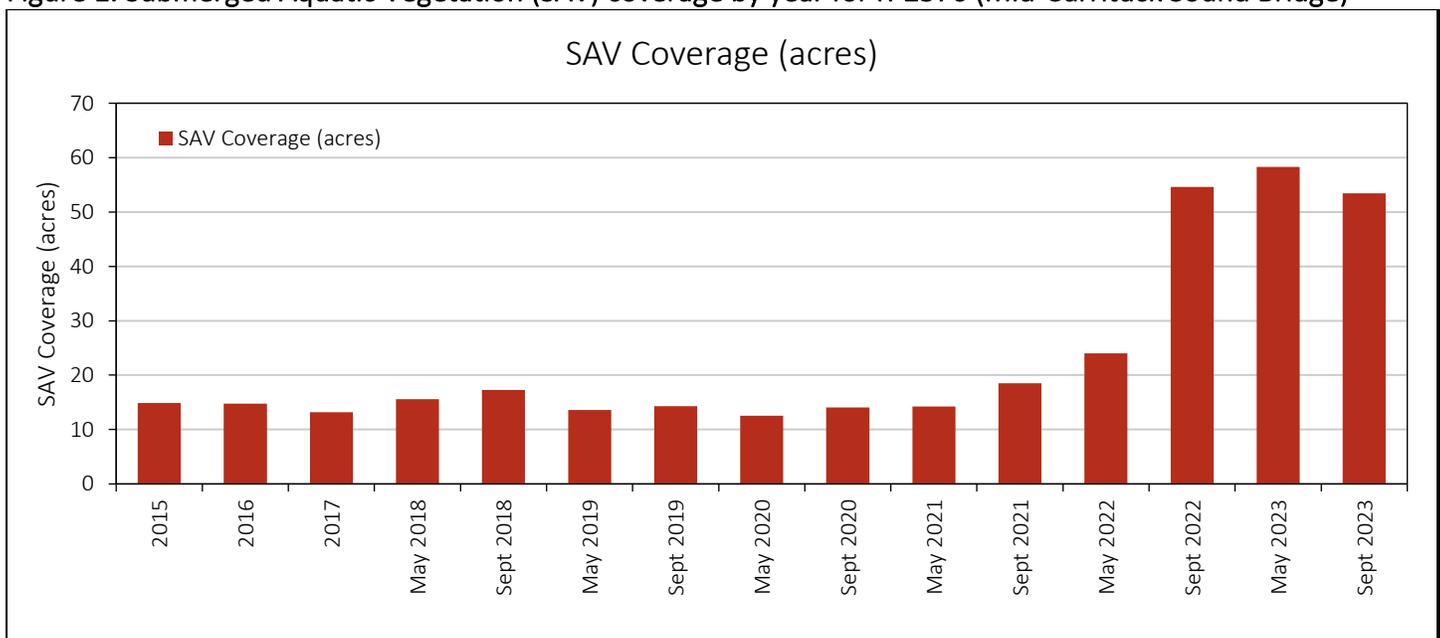
Delineated SAV within the project study area was 58.31 acres in May 2023 and 53.46 acres in September 2023 (Figures 3A-3C). The western terminus of the project area was previously void of SAV. However, since May of 2022, this area has experienced substantial growth (Figure 3C). Across the study area, SAV was observed in water depths down to -7.4 feet, not accounting for daily wind or tide variations. Deeper open waters (> -7.4 feet) were assessed and no SAV was located. Water clarity was measured with a Secchi disk and ranged from 1m to 1.2m in May and 0.4m to 1m in September (Figure 3A-3C). From 2015 to May 2021, SAV coverage has remained relatively constant throughout the study area; however, since the September 2021 survey, a steady increase in SAV coverage has been observed with a substantial increase starting in 2022 (Table 1 and Figure 1). There are likely multiple factors contributing to the increase in SAV. Favorable climate conditions have been observed in recent years, including the absence of large storm events and warmer water temperatures during the winter. These climate influences can create stable conditions and reduce turbidity. When turbidity is reduced, photosynthetically active radiation (PAR) can enhance SAV growth.

Table 1. Submerged Aquatic Vegetation (SAV) coverage by year for R-2576 (Mid-Currituck Sound Bridge)

Year	SAV Coverage (acres)
2015	14.90
2016	14.78
2017	13.17
May 2018	15.59
September 2018	17.26
May 2019	13.59
September 2019	14.32
May 2020	12.57
September 2020	14.06
May 2021	14.22
September 2021	18.50
May 2022	24.01
September 2022	54.59
May 2023	58.31
September 2023*	53.46

*Tropical Storm Ophelia landfall occurred on September 21, 2023. This storm event may have impacted SAV in the area.

Figure 1. Submerged Aquatic Vegetation (SAV) coverage by year for R-2576 (Mid-Currituck Sound Bridge)



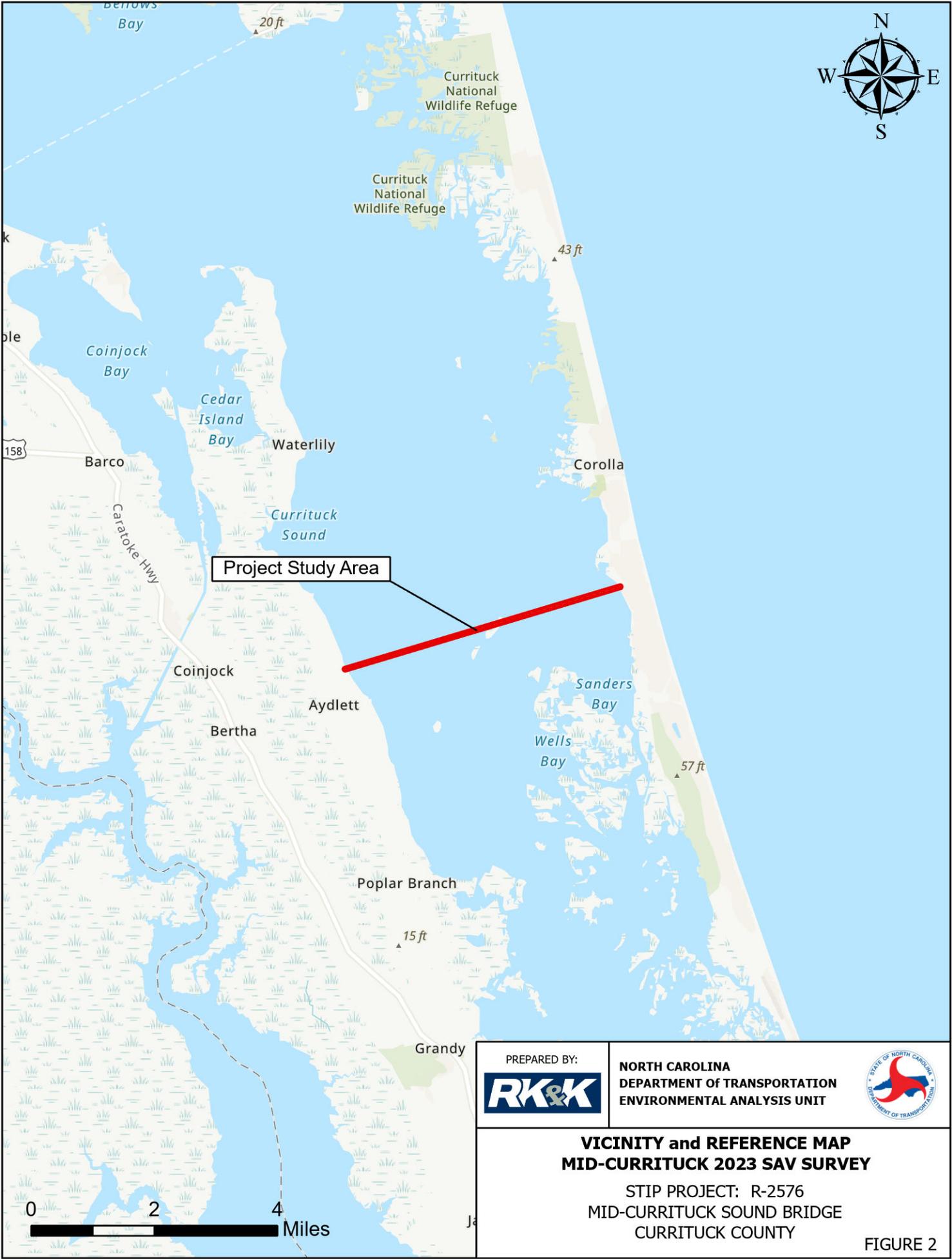
Six species of SAV were identified during the May 2023 assessment: widgeon grass (*Ruppia maritima*), Eurasian watermilfoil (*Myriophyllum spicatum*), tapegrass (*Vallisneria americana*), southern waterlily (*Najas guadalupensis*), perfoliate pondweed (*Potamogeton perfoliatus*), and muskgrass (*Chara spp.*) (Figure 5A). Five species of SAV were identified during the September 2023 assessment: widgeon grass (*Ruppia maritima*), Eurasian watermilfoil (*Myriophyllum spicatum*), tapegrass (*Vallisneria americana*), southern waterlily (*Najas guadalupensis*) and perfoliate pondweed (*Potamogeton perfoliatus*) (Figure 6). Distribution and percent cover of these species is illustrated in Figures 5 - 8. Due to the scarcity (and random distribution) of perfoliate pondweed (*Potamogeton perfoliatus*) and muckgrass (*Chara spp.*) these species are not illustrated in the figures.

Thank you for the opportunity to provide you with these services to the NCDOT. Please let me know if you have any questions.

Sincerely,

Pete Stafford

Pete Stafford, PWS, CMS-UAS



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Project Study Area

0 2 4 Miles

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NORTH CAROLINA
 DEPARTMENT OF TRANSPORTATION
 ENVIRONMENTAL ANALYSIS UNIT



VICINITY and REFERENCE MAP
MID-CURRITUCK 2023 SAV SURVEY

STIP PROJECT: R-2576
 MID-CURRITUCK SOUND BRIDGE
 CURRITUCK COUNTY

FIGURE 2

Legend

- ◆ Secchi Disk
- ▭ Project Study Area
- ▨ May 2023 SAV Delineation (58.31 Ac.)
- September 2023 SAV Delineation (53.46 Ac.)

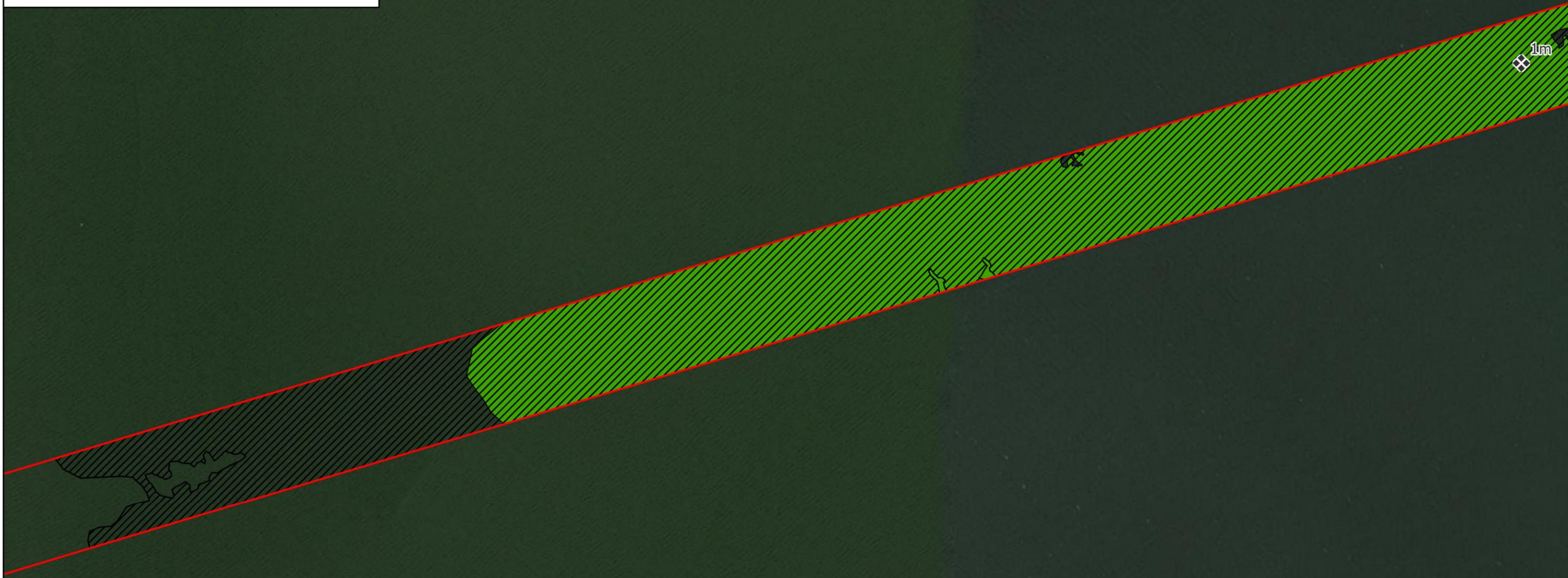


Scale: 1 in. : 300 ft.

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT 
EASTERN 2023 SAV COVERAGE MID-CURRITUCK 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 3A	

Legend

- ◆ Secchi Disk
- ▭ Project Study Area
- ▨ May 2023 SAV Delineation (58.31 Ac.)
- September 2023 SAV Delineation (53.46 Ac.)



Scale: 1 in. : 300 ft.

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EASTERN 2023 SAV COVERAGE MID-CURRITUCK 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 3B	

Legend

- ◆ Secchi Disk
- ▭ Project Study Area
- ▨ May 2023 SAV Delineation (58.31 Ac.)
- September 2023 SAV Delineation (53.46 Ac.)



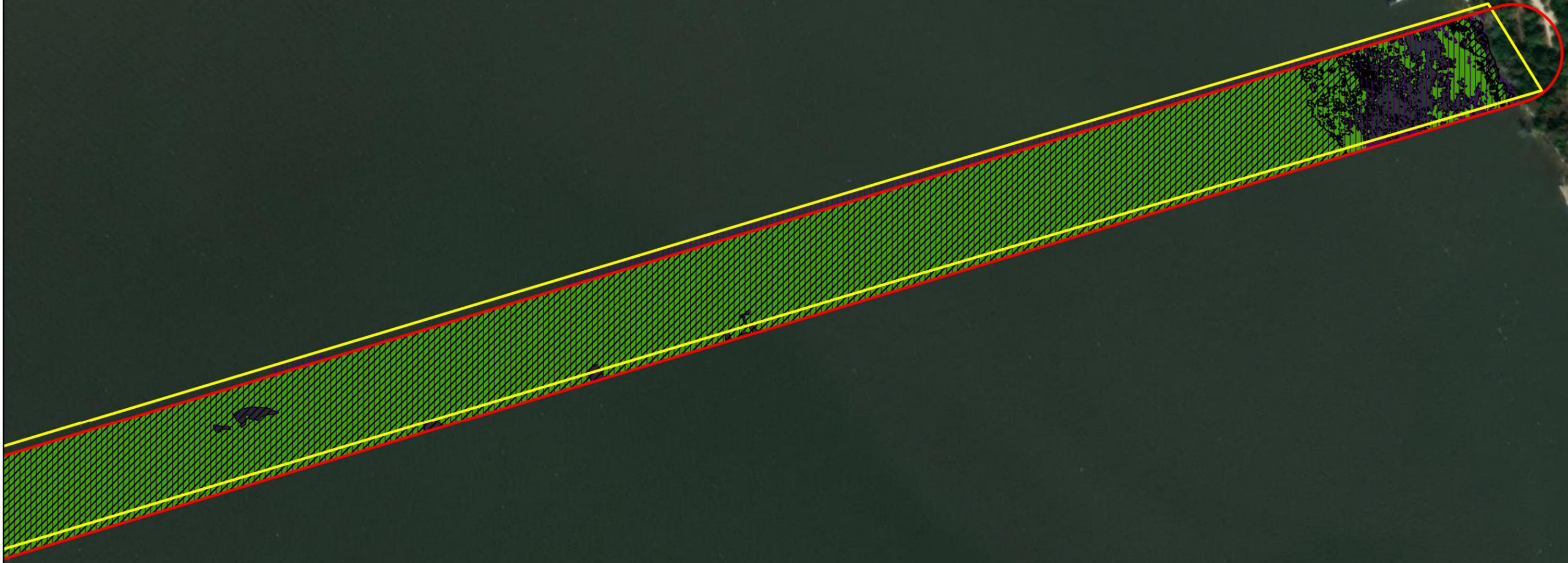
0 150 300
US Feet

Scale: 1 in. : 150 ft.

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT
WESTERN 2023 SAV COVERAGE MID-CURRITUCK 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 3C	

Legend

-  Project Study Area
-  Previous Study Area
-  May 2023 SAV Delineation (58.31 Ac.)
-  September 2023 SAV Delineation (53.46 Ac.)
-  SAV for Previous Years Combined (65.37 Ac.)

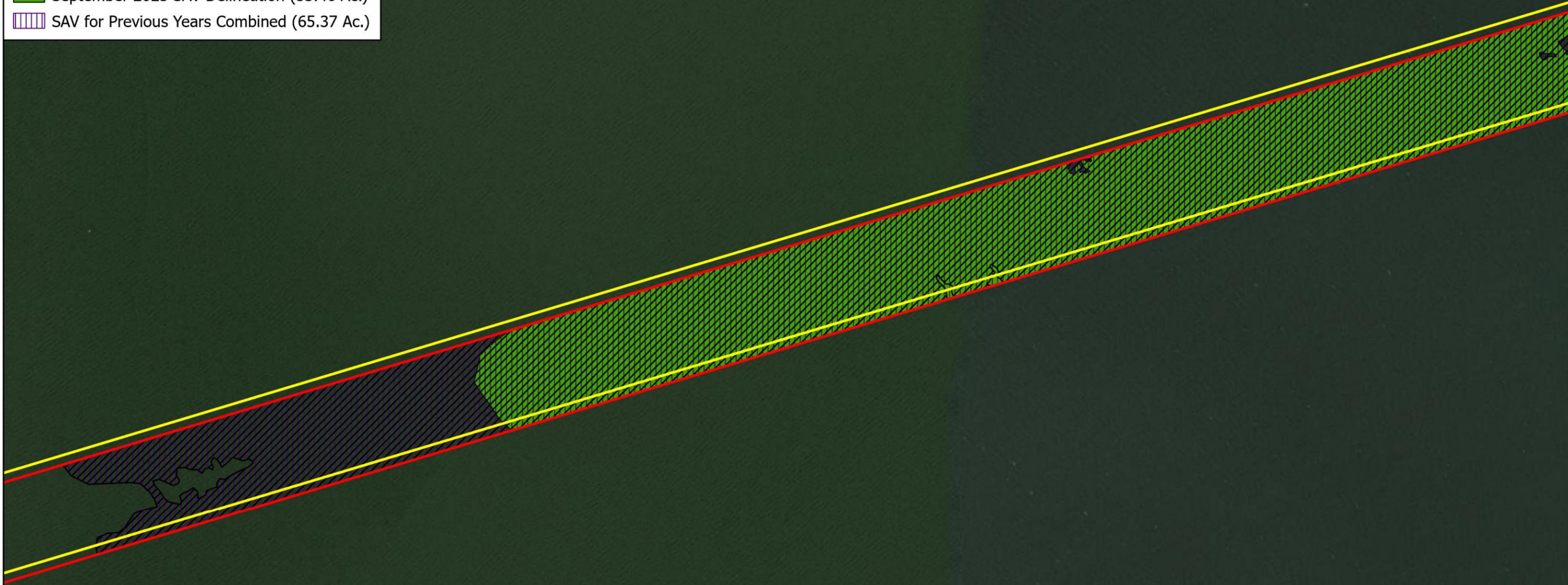


Scale: 1 in. : 300 ft.

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT 
EASTERN DATA COMPARISON (2015-2023) MID-CURRITUCK 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 4A	

Legend

-  Project Study Area
-  Previous Study Area
-  May 2023 SAV Delineation (58.31 Ac.)
-  September 2023 SAV Delineation (53.46 Ac.)
-  SAV for Previous Years Combined (65.37 Ac.)

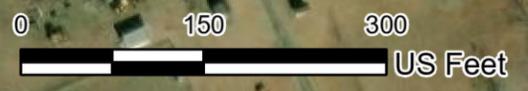


Scale: 1 in. : 300 ft.

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT 
EASTERN DATA COMPARISON (2015-2023) MID-CURRITUCK 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 4B	

Legend

-  Project Study Area
-  Previous Study Area
-  May 2023 SAV Delineation (58.31 Ac.)
-  September 2023 SAV Delineation (53.46 Ac.)
-  SAV for Previous Years Combined (65.37 Ac.)



Scale: 1 in. : 150 ft.

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT	
WESTERN DATA COMPARISON (2015-2023) MID-CURRITUCK 2023 SAV SURVEY		
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY		
		FIGURE 4C

Legend

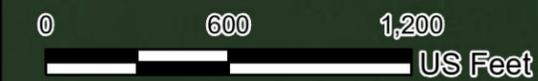
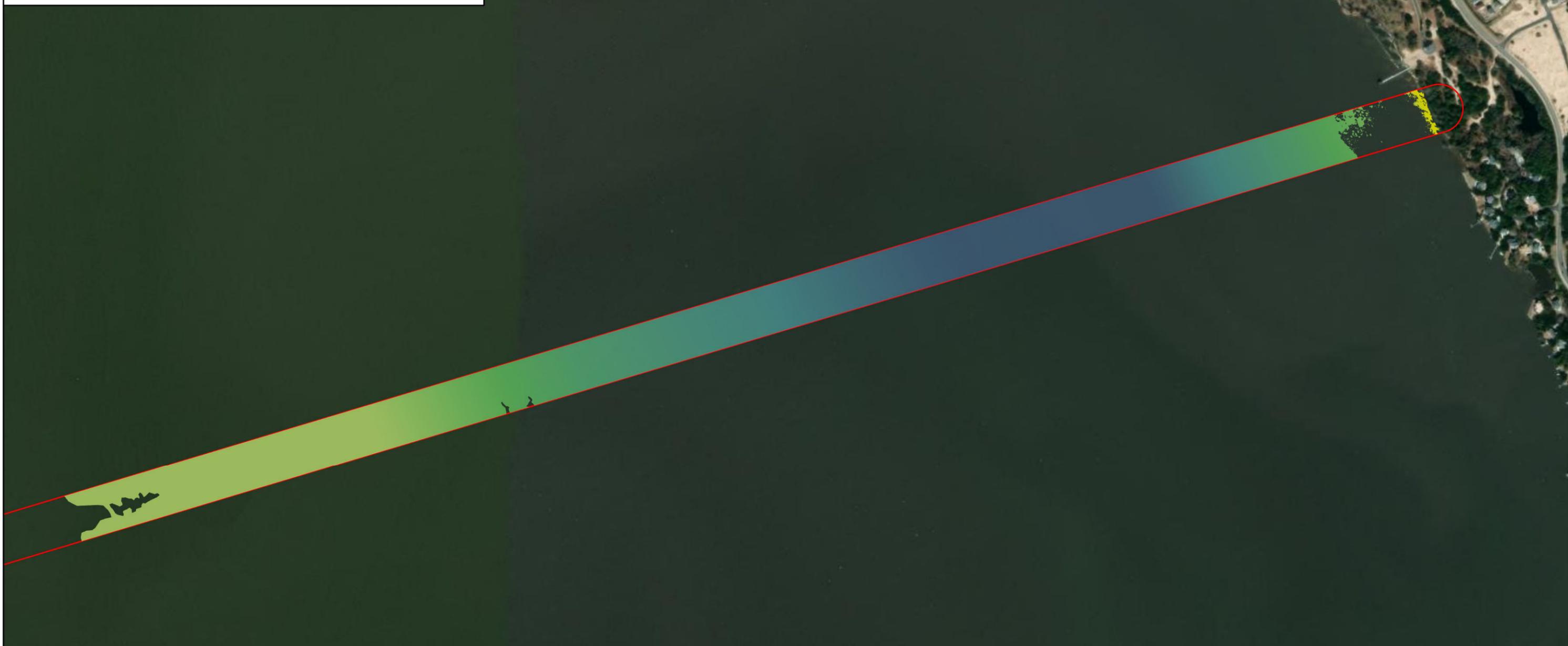
 Project Study Area

May 2023 Species Composition

 Vallisneria americana (VA) and Myriophyllum spicatum (MS)

 VA, MS, and Ruppia maritima (RM)

 VA, MS, RM, and Najas guadalupensis



Scale: 1 in. : 600 ft.

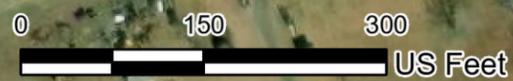
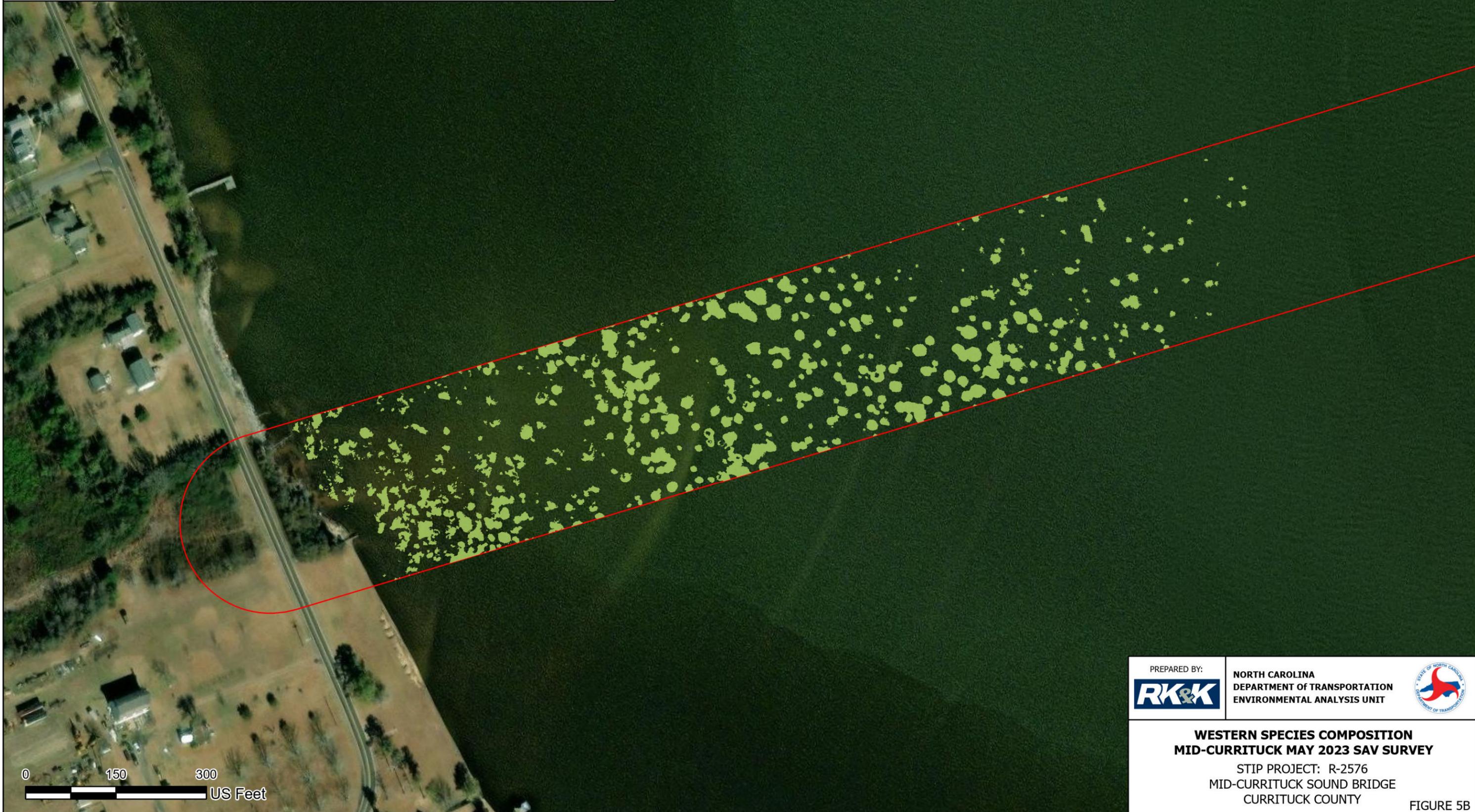
PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT 
EASTERN SPECIES COMPOSITION MID-CURRITUCK MAY 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 5A	

Legend

 Project Study Area

Species

 *Vallisneria americana* (VA), *Myriophyllum spicatum* (MS), and *Ruppia maritima* (RM)



Scale: 1 in. : 150 ft.

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WESTERN SPECIES COMPOSITION MID-CURRITUCK MAY 2023 SAV SURVEY		
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY		
		FIGURE 5B

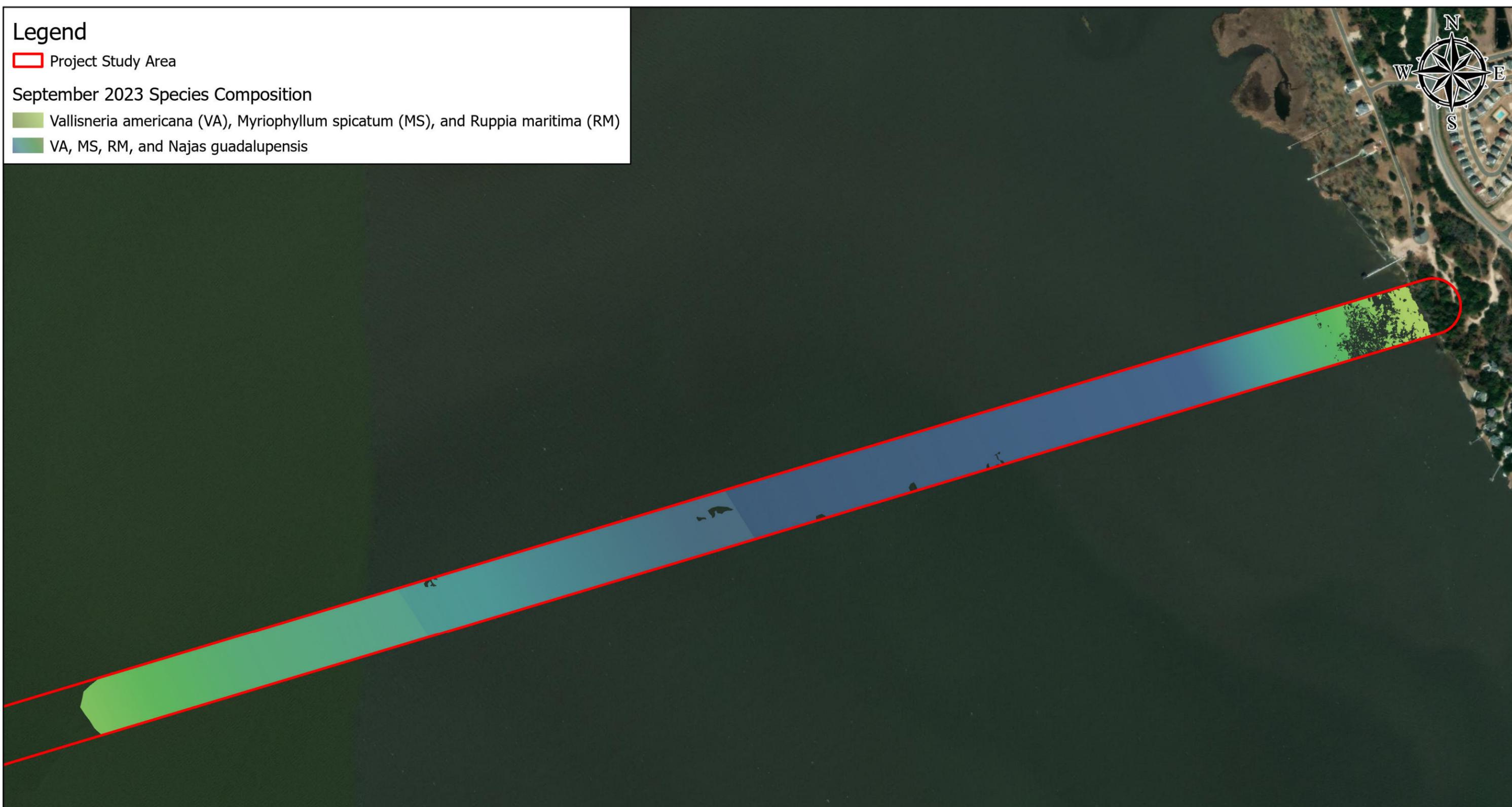
Legend

 Project Study Area

September 2023 Species Composition

 Vallisneria americana (VA), Myriophyllum spicatum (MS), and Ruppia maritima (RM)

 VA, MS, RM, and Najas guadalupensis



Scale: 1 in. : 500 ft.

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EASTERN SPECIES COMPOSITION MID-CURRITUCK SEPTEMBER 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 6A	

Legend

 Project Study Area

September 2023 Species Composition

 Vallisneria americana (VA), Myriophyllum spicatum (MS), and Ruppia maritima (RM)



0 150 300
US Feet

Scale: 1 in. : 150 ft.

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WESTERN SPECIES COMPOSITION MID-CURRITUCK SEPTEMBER 2023 SAV SURVEY		
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY		
		FIGURE 6B

Legend

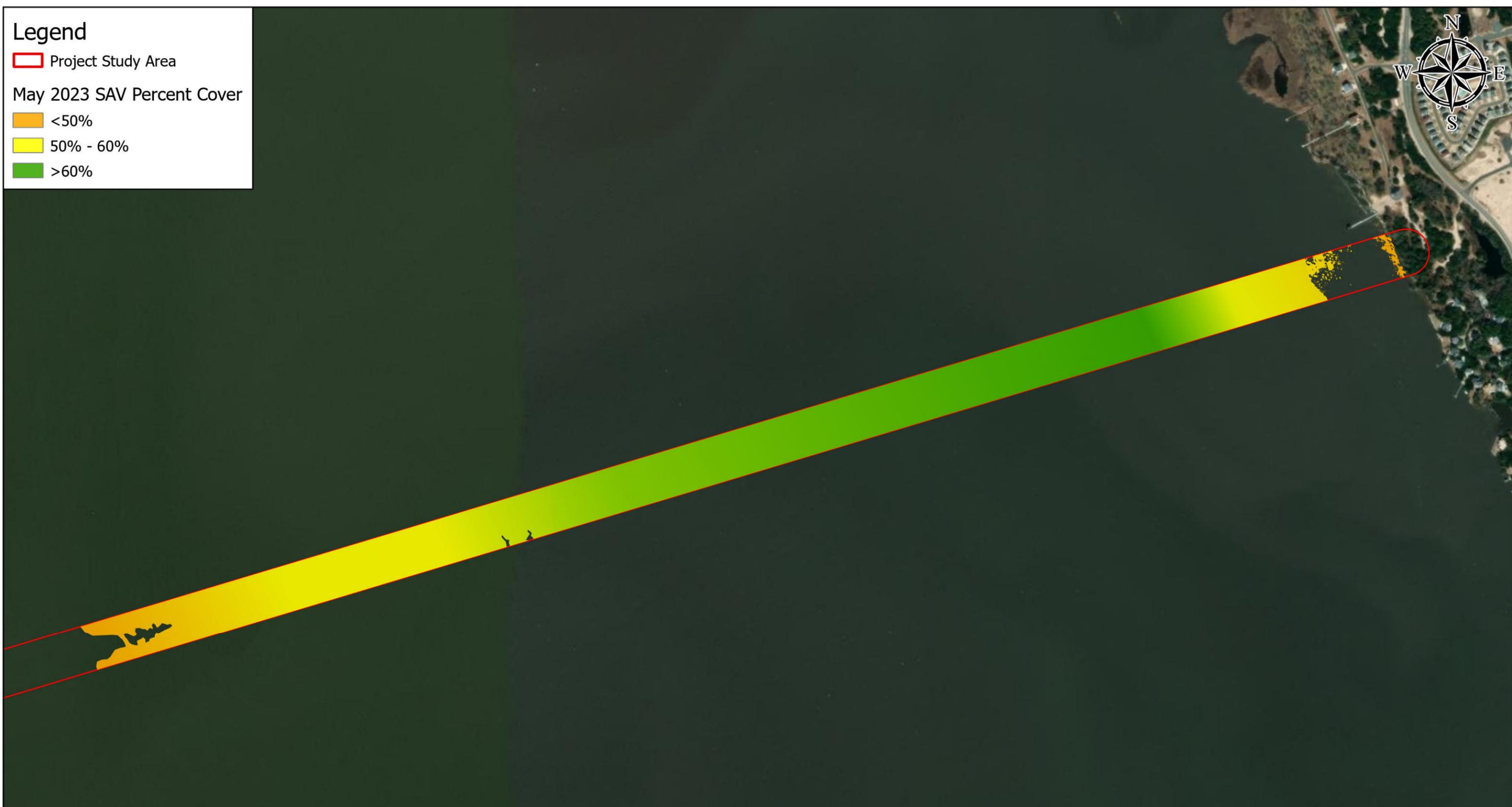
 Project Study Area

May 2023 SAV Percent Cover

 <50%

 50% - 60%

 >60%



Scale: 1 in. : 600ft.

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EASTERN ESTIMATED PERCENT COVER MID-CURRITUCK MAY 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 7A	

Legend

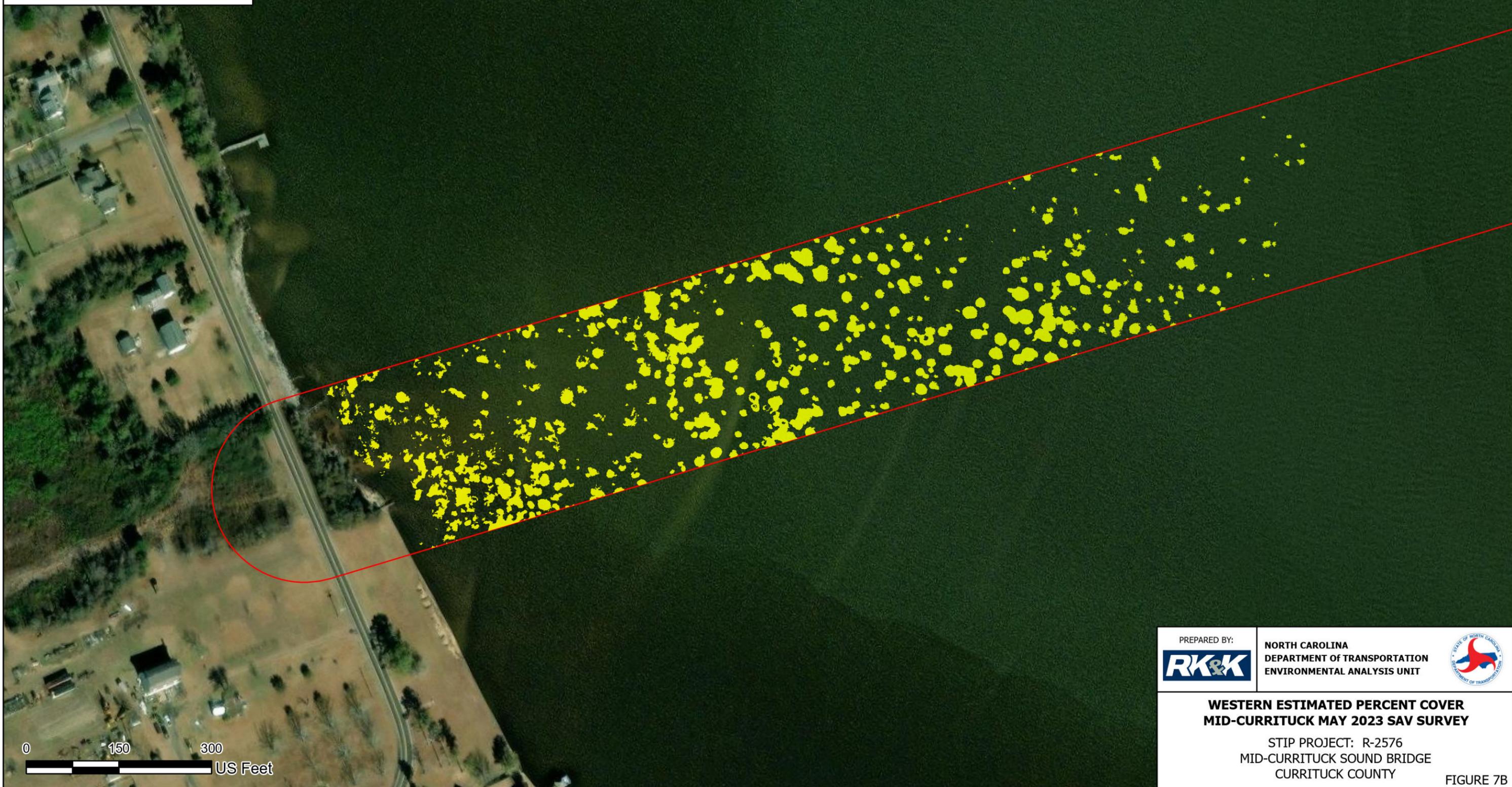
 Project Study Area

May 2023 SAV Percent Cover

 <50%

 50% - 60%

 >60%



0 150 300
US Feet

Scale: 1 in. : 150ft.

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT 
WESTERN ESTIMATED PERCENT COVER MID-CURRITUCK MAY 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 7B	

Legend

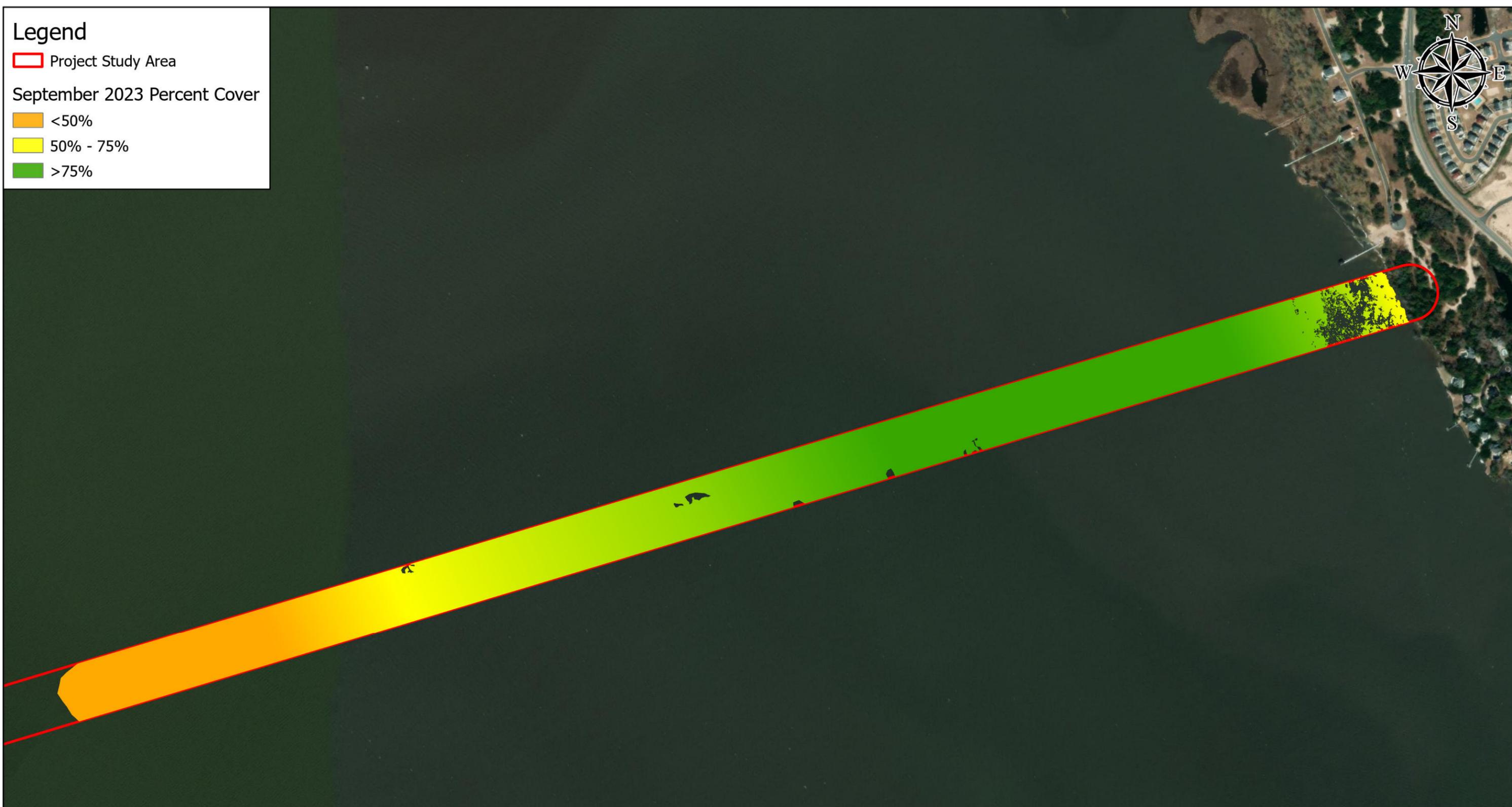
 Project Study Area

September 2023 Percent Cover

 <50%

 50% - 75%

 >75%



Scale: 1 in. : 500ft.

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT 
EASTERN ESTIMATED PERCENT COVER MID-CURRITUCK SEPTEMBER 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 8A	

Legend

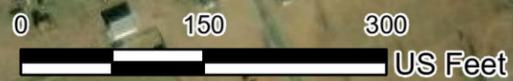
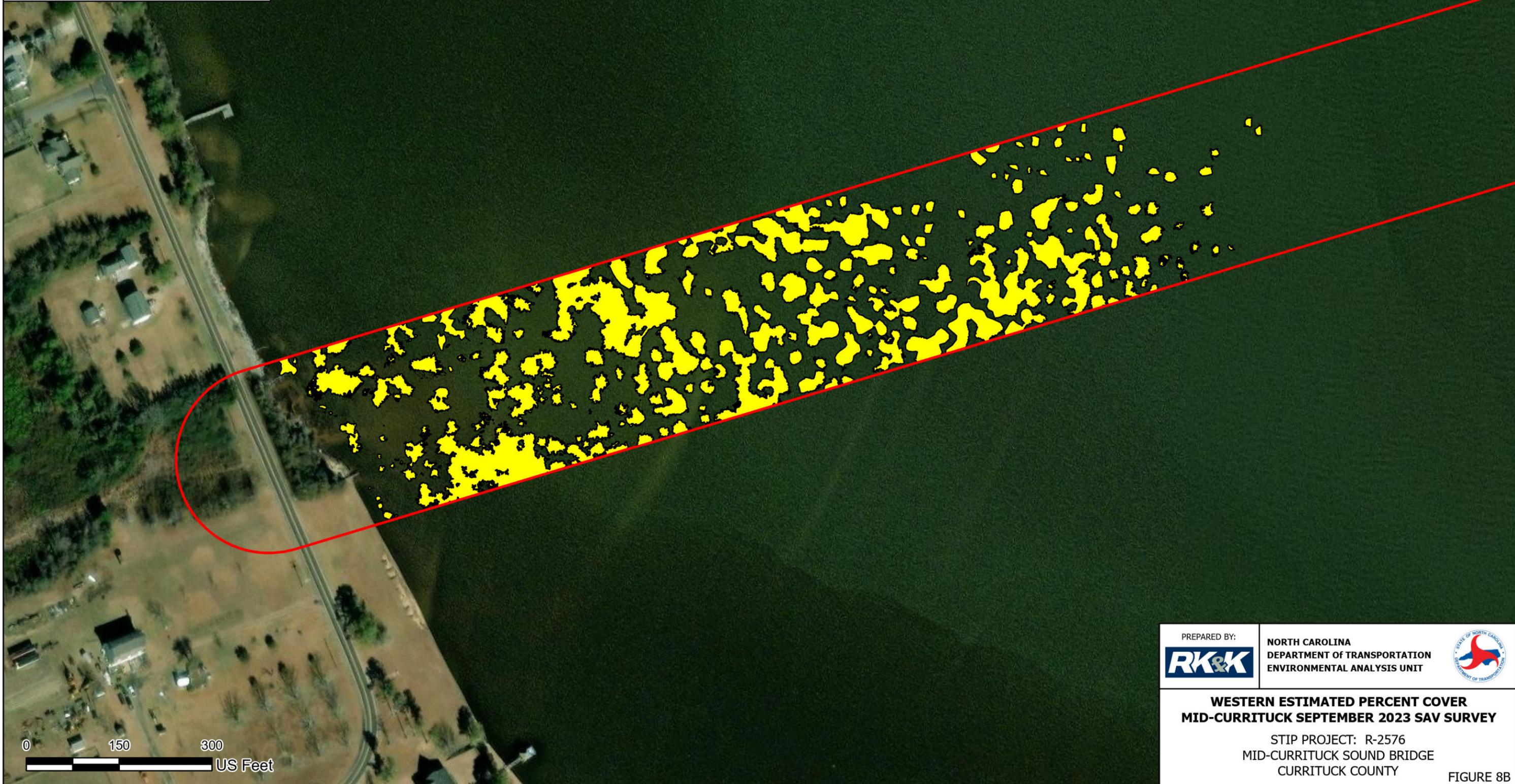
 Project Study Area

September 2023 Percent Cover

 <50%

 50% - 75%

 >75%

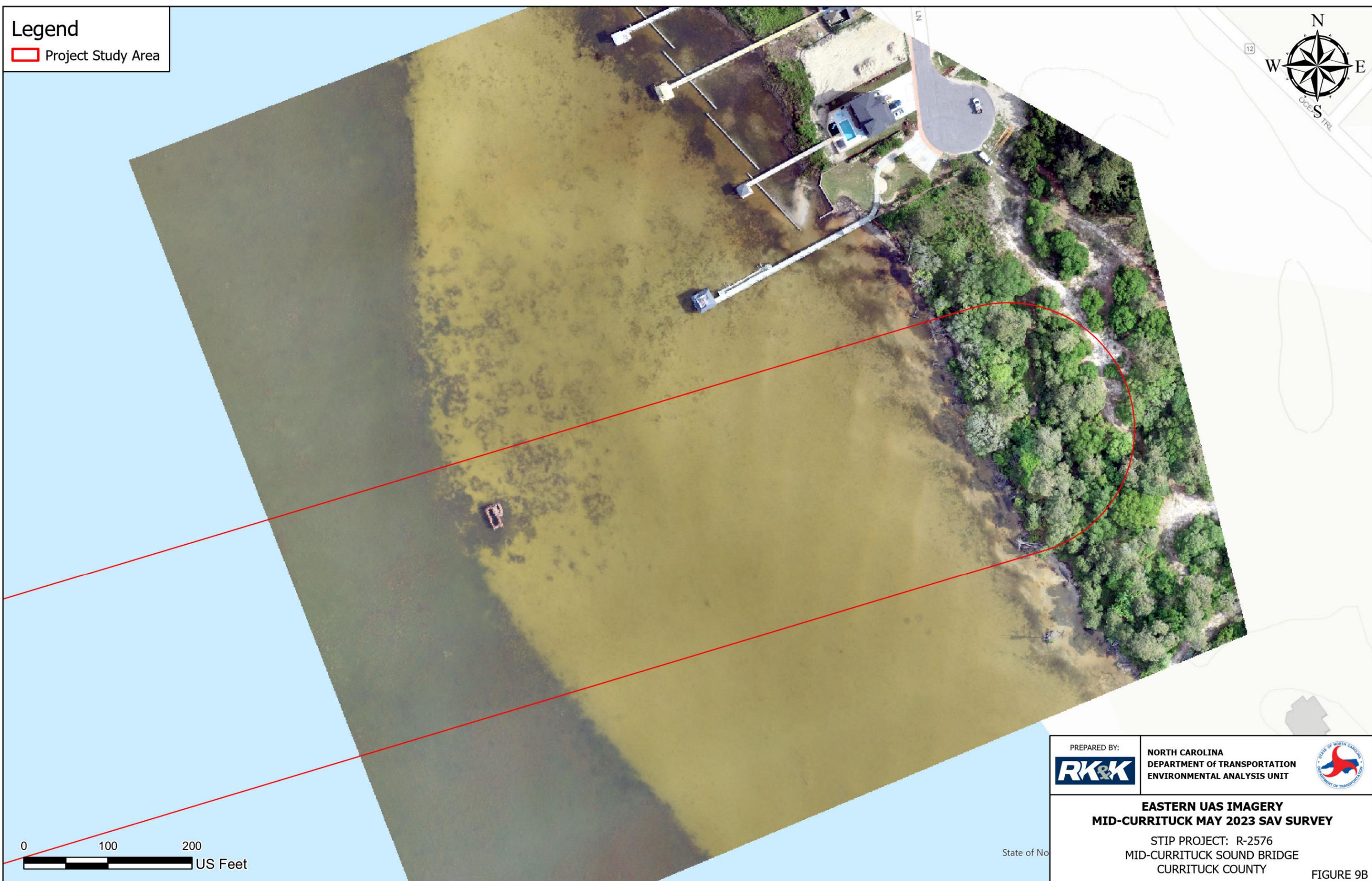


Scale: 1 in. : 150ft.

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT 
WESTERN ESTIMATED PERCENT COVER MID-CURRITUCK SEPTEMBER 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
FIGURE 8B	

Legend

 Project Study Area

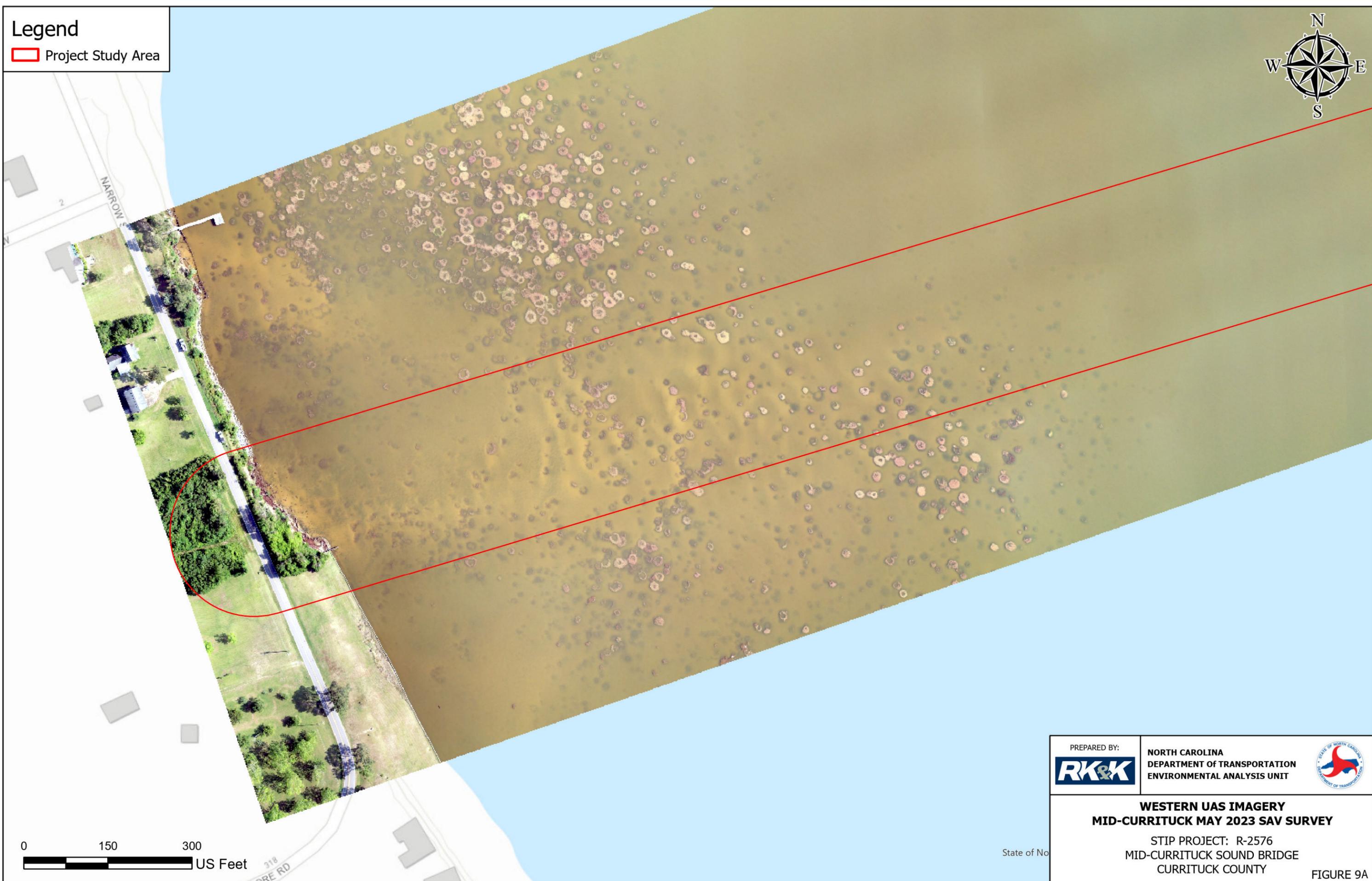
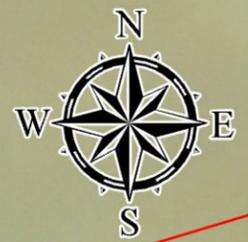


Scale: 1 in. : 200ft

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT 
EASTERN UAS IMAGERY MID-CURRITUCK MAY 2023 SAV SURVEY	
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY	
State of No	FIGURE 9B

Legend

Project Study Area



0 150 300 US Feet

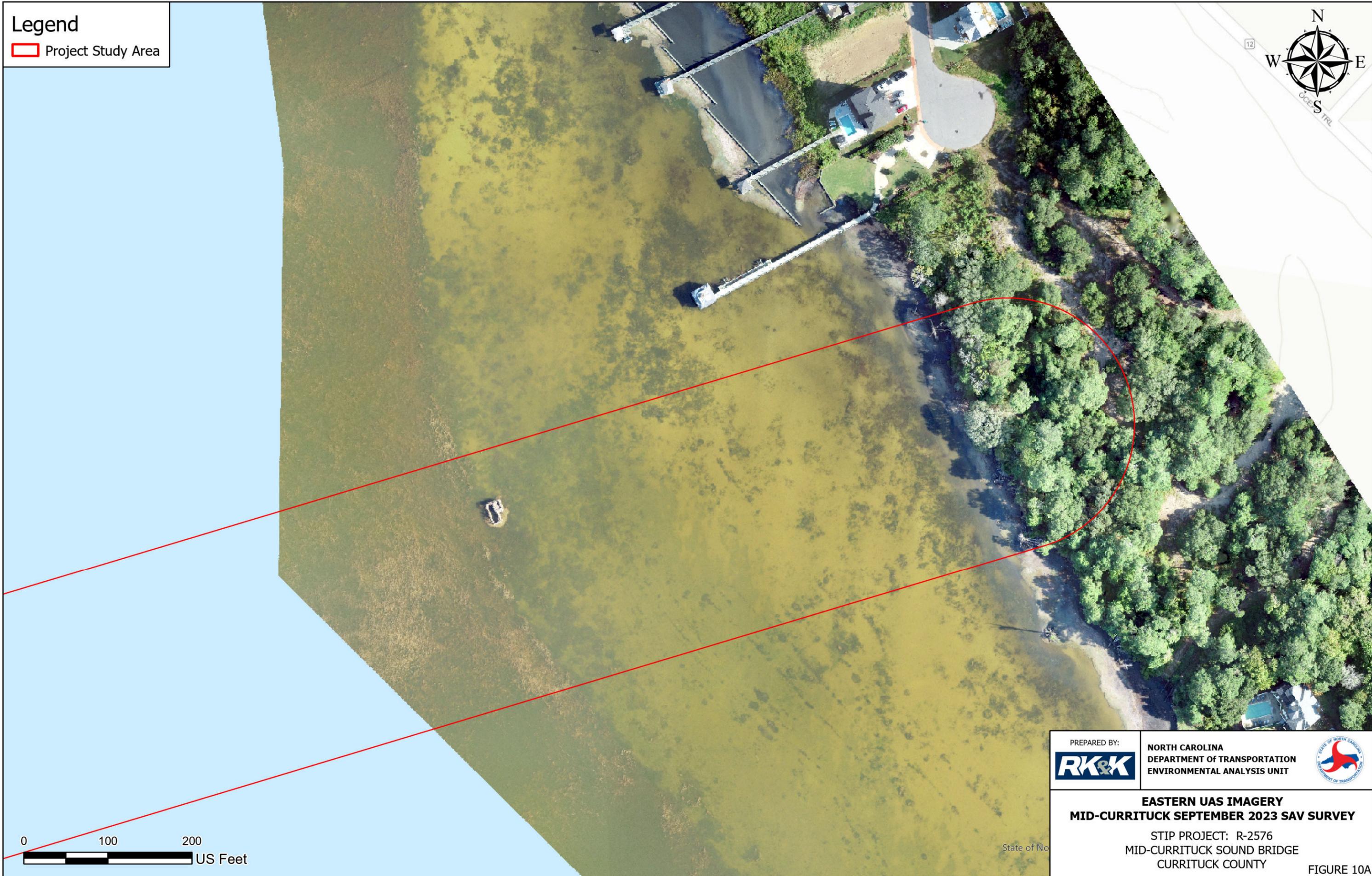
Scale: 1 in. : 150ft

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT	
<p align="center"> WESTERN UAS IMAGERY MID-CURRITUCK MAY 2023 SAV SURVEY STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY </p>		

FIGURE 9A

Legend

 Project Study Area



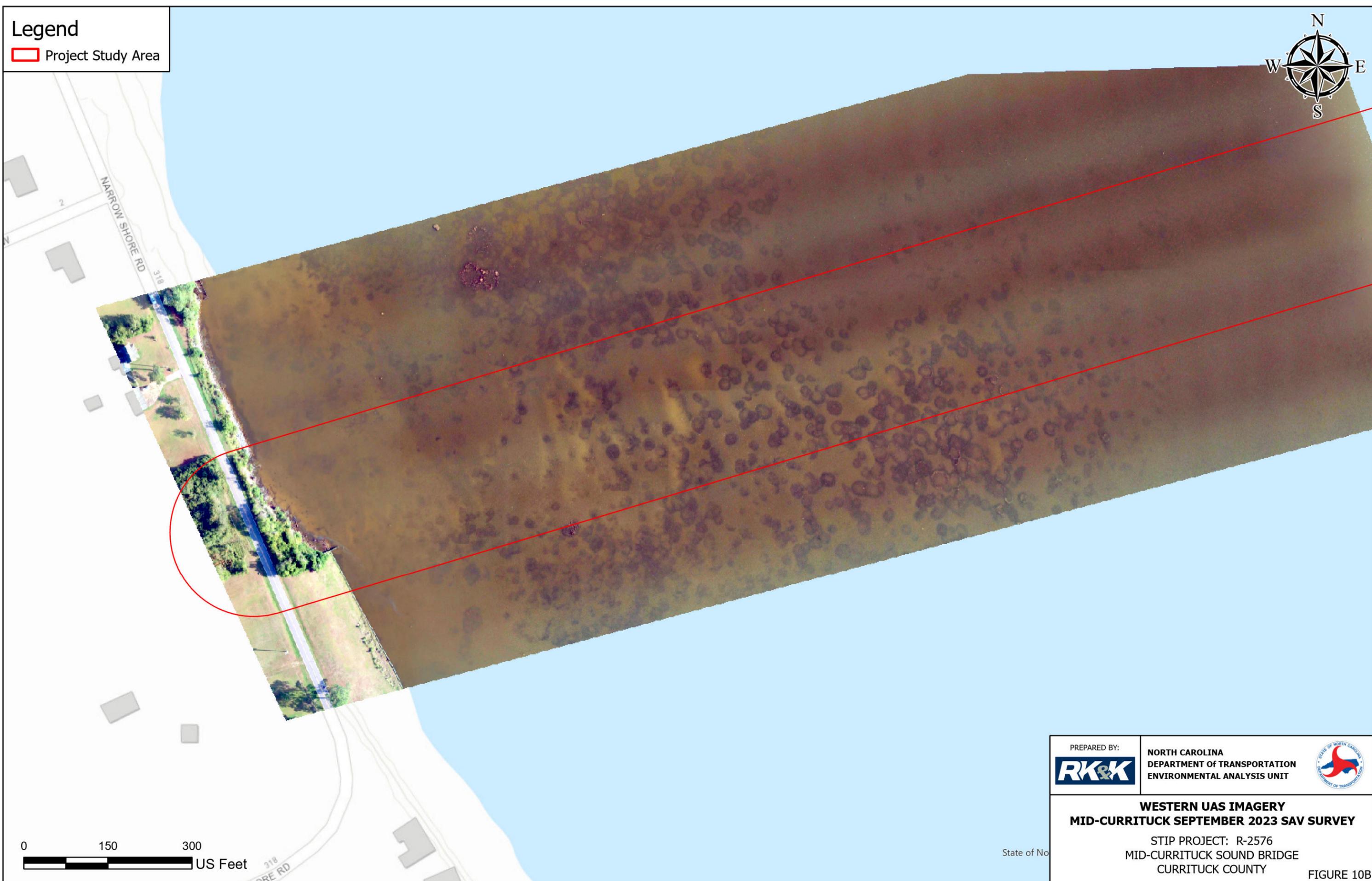
0 100 200
US Feet

Scale: 1 in. : 200ft

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT 
EASTERN UAS IMAGERY MID-CURRITUCK SEPTEMBER 2023 SAV SURVEY STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY FIGURE 10A	

Legend

 Project Study Area



0 150 300
US Feet

Scale: 1 in. : 150ft

PREPARED BY: 	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION ENVIRONMENTAL ANALYSIS UNIT	
WESTERN UAS IMAGERY MID-CURRITUCK SEPTEMBER 2023 SAV SURVEY		
STIP PROJECT: R-2576 MID-CURRITUCK SOUND BRIDGE CURRITUCK COUNTY		
		FIGURE 10B

State of No