

Chesapeake BAY CROSSING STUDY
TIER 2 NEPA

NATURAL ENVIRONMENT TECHNICAL REPORT

JANUARY 2026

Maryland Transportation Authority
MDTA

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TABLE OF CONTENTS

1 INTRODUCTION 1-1
2 BACKGROUND 2-1
2.1 The Tiered NEPA Process 2-2
2.2 Study Limits 2-2
2.3 Purpose and Need 2-2
3 ALTERNATIVES 3-1
3.1 Alternative A: No-Build 3-2
3.2 Alternative B: 6-8-6 North 3-2
3.3 Alternative C: 6-8-6 South 3-2
3.4 Alternative D: 8-8-8 North 3-4
3.5 Alternative E: 8-8-8 South 3-4
3.6 Alternative F: 8-10-8 North 3-4
3.7 Alternative G: 8-10-8 South 3-4
3.8 Other Components of the Build Alternatives 3-5
4 GEOLOGY AND TOPOGRAPHY 4-1
4.1 Regulatory Context and Methodology 4-1
4.2 Affected Environment 4-1
4.3 Environmental Consequences 4-7
4.4 Avoidance, Minimization, and Further Mitigation Strategies 4-8
5 SOILS AND FARMLAND SOILS 5-1
5.1 Regulatory Context and Methodology 5-1
5.2 Affected Environment 5-2
5.3 Environmental Consequences 5-8
5.4 Avoidance, Minimization, and Further Mitigation Strategies 5-11
6 GROUNDWATER AND WASTEWATER 6-1
6.1 Regulatory Context and Methodology 6-1
6.2 Affected Environment 6-2
6.3 Environmental Consequences 6-13
6.4 Avoidance, Minimization, and Further Mitigation Strategies 6-14
7 FLOODPLAINS 7-1
7.1 Regulatory Context and Methodology 7-1
7.2 Affected Environment 7-2
7.3 Environmental Consequences 7-5
7.4 Avoidance, Minimization, and Further Mitigation of Encroachments 7-9
8 SURFACE WATER RESOURCES 8-1
8.1 Watersheds 8-1

8.2 Water Quality 8-9
8.3 Wild and Scenic Rivers 8-24
9 WATERS OF THE U.S., INCLUDING WETLANDS 9-1
9.1 Regulated Wetlands and Waterways 9-1
9.2 Chesapeake Bay 9-20
9.3 Maintained Navigational Channels and Civil Works Projects 9-33
10 COASTAL ZONE 10-1
10.1 Regulatory Context and Methodology 10-1
10.2 Affected Environment 10-2
10.3 Environmental Consequences 10-2
10.4 Avoidance, Minimization, and Further Mitigation Strategies 10-5
11 COASTAL BARRIER RESOURCES 11-1
11.1 Regulatory Context and Methodology 11-1
11.2 Affected Environment 11-1
11.3 Environmental Consequences 11-2
11.4 Avoidance, Minimization, and Further Mitigation Strategies 11-2
12 CHESAPEAKE BAY CRITICAL AREA 12-1
12.1 Regulatory Context and Methodology 12-1
12.2 Affected Environment 12-2
12.3 Environmental Consequences 12-8
12.4 Avoidance, Minimization, and Further Mitigation Strategies 12-10
13 AQUATIC HABITAT AND BIOTA 13-1
13.1 Nontidal and Tidal Aquatic Habitat 13-1
13.2 Benthic Macroinvertebrates 13-10
13.3 Submerged Aquatic Vegetation 13-14
13.4 Oyster Beds 13-18
13.5 Essential Fish Habitat 13-22
13.6 Fish 13-24
13.7 Blue Crabs and Horseshoe Crabs 13-32
13.8 Waterfowl Staging and Concentration Areas 13-35
13.9 Colonial Waterbird Nesting Areas 13-38
13.10 Marine Mammals 13-39
13.11 Avoidance, Minimization, and Further Mitigation Strategies 13-46
14 TERRESTRIAL HABITAT AND BIOTA 14-1
14.1 Terrestrial Habitat 14-1
14.2 Terrestrial Biota 14-10
15 RARE, THREATENED, AND ENDANGERED SPECIES 15-1
15.1 Regulatory Context and Methodology 15-1

15.2 Affected Environment 15-2
15.3 Environmental Consequences 15-5
15.4 Avoidance, Minimization, and Further Mitigation Measures 15-12
16 UNIQUE AND SENSITIVE AREAS 16-1
16.1 Regulatory Context and Methodology 16-1
16.2 Affected Environment 16-2
16.3 Environmental Consequences 16-2
16.4 Avoidance, Minimization, and Further Mitigation Strategies 16-7
17 REFERENCES 17-1
17.1 Federal Regulations and Executive Orders 17-1
17.2 State Regulations 17-2
17.3 Literature Cited and References 17-3

LIST OF FIGURES

Figure 2-1: Chesapeake Bay Watershed 2-1
Figure 3-1: Alternatives Summary 3-3
Figure 4-1: Geologic Formations 4-3
Figure 4-2: Topography – Anne Arundel County 4-5
Figure 4-3: Topography – Queen Anne's County 4-6
Figure 5-1: Farmland Soils – Anne Arundel County 5-6
Figure 5-2: Farmland Soils – Queen Anne's County 5-7
Figure 6-1: Aquifers 6-4
Figure 6-2: Groundwater Wells Representing Aquifers that Underlie the Resource Review Area 6-6
Figure 6-3: Wastewater Resources 6-12
Figure 7-1: FEMA Floodplain – Anne Arundel County 7-3
Figure 7-2: FEMA Floodplain – Queen Anne's County 7-4
Figure 8-1: Watersheds 8-3
Figure 8-2: Water Quality Monitoring Sites 8-15
Figure 9-1: Chesapeake Bay Bathymetry 9-24
Figure 9-2: Geologic Section and Chesapeake Bay Bottom Material 9-26
Figure 9-3: Navigation Channels 9-34
Figure 12-1: Critical Areas – Anne Arundel County 12-4
Figure 12-2: Critical Areas – Queen Anne's County 12-5
Figure 12-3: FIDS Habitat – Anne Arundel County 12-6
Figure 12-4: FIDS Habitat – Queen Anne's County 12-7
Figure 13-1: Tidal Benthic Habitat Based on Chesapeake Bay Bottom Survey Data 13-6
Figure 13-2: Submerged Aquatic Vegetation 13-17
Figure 13-3: Oyster Beds/Habitat 13-21
Figure 13-5: Horseshoe Crab Habitat 13-34
Figure 13-6: Waterfowl Staging and Concentration Areas and Colonial Waterbird Nesting Areas 13-37
Figure 13-7: Level B Harassment Zone of Influence from Vibratory Pile Driving for High Frequency Cetaceans 13-43
Figure 13-8: GARFO Marine Mammal Disturbance Isopleths for Pile Driving Associated with the Proposed Eastbound Bridge 13-44
Figure 14-1: Forest – Anne Arundel County 14-4

Figure 14-2: Forest Cover – Queen Anne's County 14-5
Figure 16-1: GI Corridors and Hubs 16-4
Figure 16-2: SSPRAs 16-5

LIST OF TABLES

Table 4-1: Geologic Deposits within the Resource Review Area 4-2
Table 4-2: Steep Slope Impacts (acres) 4-7
Table 4-3 SUP Steep Slope Impacts (acres) 4-7
Table 5-1: Soils within the Resource Review Area 5-3
Table 5-2: Soil Types within the Resource Review Area 5-5
Table 5-3: Hydric Soil Impacts (acres) 5-8
Table 5-4: SUP Hydric Soil Impacts (acres) 5-8
Table 5-5: Farmland Soil Impacts (acres) 5-9
Table 5-6: SUP Farmland Soil Impacts (acres) 5-9
Table 6-1: USGS Groundwater Wells Representing Aquifers that Underlie the Resource Review Area 6-7
Table 6-2: Common Highway Runoff Contaminants and Associated USEPA Drinking Water Standards 6-8
Table 6-3: Groundwater Quality Data for Selected Pollutants 6-10
Table 7-1: FEMA 100-Year Floodplain Encroachments (acres) 7-5
Table 7-2: SUP FEMA 100-Year Floodplain Encroachments (acres) 7-6
Table 8-1: Overall Watershed Characteristics Summary 8-4
Table 8-2: 303(d) Impairment Listings for Completed TMDLs and Category 5 8-4
Table 8-3: Acreage of 12 Digit Watersheds within the Resource Review Area 8-6
Table 8-4: Impacts to 12-Digit Watersheds (acres) 8-7
Table 8-5: SUP Impacts to 12-Digit Watersheds (acres) 8-7
Table 8-6: Increase in Impervious Surfaces (acres) 8-9
Table 8-7: SUP Increase in Impervious Surfaces (acres) 8-9
Table 8-8: COMAR Use Class Water Quality Criteria 8-12
Table 8-9: COMAR Criteria and Federal Freshwater Water Quality Recommendations 8-13
Table 8-10: Fecal Coliform Criteria for Areas Designated as Use II Shellfish Harvest Waters 8-14
Table 8-11: Summary of AABWPR In Situ Data for Lower Severn River 8-16
Table 8-12: Percentage of Dissolved Oxygen Records that Fall Below COMAR Criteria for the Northwest Lower Chesapeake Bay 8-18
Table 8-13: Percentage of Dissolved Oxygen Records that Fall Below COMAR Criteria for the Annapolis Shore 8-18
Table 8-14: Percentage of Dissolved Oxygen Records that Fall Below COMAR Criteria for the Kent Island True Bay 8-19
Table 8-15: COMAR Water Quality Parameters within 12-digit Watersheds in the Vicinity of the Resource Review Area 8-20
Table 8-16: Salinity and Conductivity within 12-digit Watersheds in the Vicinity of the Resource Review Area 8-21
Table 9-1: Wetland Plant Indicator Status 9-3
Table 9-2: Wetland Classification/Resource Definitions 9-5
Table 9-3: Wetland and Waterways within Limits of Field Delineation 9-6
Table 9-4: Tidal and Nontidal Wetland Impact Summary (acres) 9-11
Table 9-5: SUP Tidal and Nontidal Wetland Impact Summary (acres) 9-12
Table 9-6: Wetland and Waterway Impacts per 12-Digit Watershed 9-13
Table 9-7: SUP Wetland and Waterway Impacts per 12-Digit Watershed 9-14
Table 9-8: Nontidal Wetland Buffer Impact Summary (acres) 9-14
Table 9-9: Waterway Impact Summary 9-15
Table 9-10: SUP Waterway Impact Summary 9-15
Table 9-11: Culverted Waterway Impact Summary 9-16

Table 9-12: SUP Culverted Waterway Impact Summary....9-16
Table 9-13: Approximate Number of Waterway Crossings....9-17
Table 9-14: Wetland Mitigation Ratios....9-19
Table 9-15: Chesapeake Bay Tidal Water Impacts (acres) from New Bridge Construction and Old Bridge Pier Removal....9-27
Table 9-16: SUP Chesapeake Bay Tidal Water Impacts (acres) from New Bridge Construction and Old Bridge Pier Removal....9-27
Table 9-17: Chesapeake Bay Substrate Impacts from Dredging....9-29
Table 9-18: Local Channels Within the Resource Review Area....9-36
Table 9-19: Navigation Channels Affected by Build Alternatives....9-36
Table 10-1: Coastal Zone Resource Impacts (acres)....10-2
Table 10-2: SUP Coastal Zone Resource Impacts (acres)....10-3
Table 12-1: Chesapeake Bay Critical Area....12-3
Table 12-2: Impacts to Critical Area Land Use (acres)....12-9
Table 12-3 SUP Impacts to Critical Area Land Use (acres)....12-10
Table 13-1: AABWPR Aquatic Habitat Scoring Criteria....13-2
Table 13-2: MBSS Aquatic Habitat Scoring Criteria....13-2
Table 13-3: AABWPR Aquatic Habitat Scores within Resource Review Area....13-3
Table 13-4: Acreage of Bottom Substrate within the Resource Review Area[1] for MD 12-digit Watersheds....13-4
Table 13-5: Potential Impacts to Aquatic Habitat and Biota....13-7
Table 13-6: Aquatic Habitat Impacts....13-9
Table 13-7: SUP Aquatic Habitat Impacts....13-9
Table 13-8: MBSS Benthic IBI Scores and Narrative Ratings....13-11
Table 13-9: Chesapeake Bay-IBI Scores and Narrative Ratings....13-11
Table 13-10: Chesapeake Bay Benthic IBI Scores in the Vicinity of the Resource Review Area....13-13
Table 13-11: SAV Species Documented within the Resource Review Area from 2019-2023....13-16
Table 13-12: EFH Designations Within the Resource Review Area....13-23
Table 13-13: MBSS Fish IBI Scores and Narrative Ratings....13-25
Table 13-14: AABWPR Fish IBI Scores within Resource Review Area....13-26
Table 13-15: Fish Species Documented in Magothy River South Shore Watershed....13-27
Table 13-16: Fish Species Documented Within 5 Miles of the Bay Bridge....13-27
Table 13-17: Diadromous Fish Species in the Resource Review Area[1]....13-29
Table 13-19 : Calculation of Expected Dolphin Density in the Proposed Action Area....13-40
Table 13-20: GARFO Tool Summary: Response of High-Frequency Cetaceans to Impact and Vibratory Hammer Operation....13-45
Table 13-21: Maximum Distances (Isopleths) and Level A and B ZOIs....13-46
Table 13-22: Estimated Dolphin Exposures in a 24-Hour Period from Pile Driving (two trestle piles [36" steel pipes], one main support pile [36" drilled shaft] and one pier protection pile [19.6" sheet pile])....13-46
Table 14-1: Tree Species Identified....14-6
Table 14-2: Invasive Plant Species....14-7
Table 14-3: Forest Impacts....14-8
Table 14-4: SUP Forest Impacts....14-9
Table 14-5: Terrestrial Mammal Species Potentially Occurring Within the Resource Review Area....14-12
Table 14-6: Amphibian and Reptile Species Documented Within the Resource Review Area....14-13
Table 14-7: BCC and SGCN Bird Species Likely Breeding Within the Review Area By Habitat....14-14
Table 15-1: USFWS Federally Listed and Proposed Species....15-2
Table 15-2: NOAA Fisheries Federally Listed Species....15-3
Table 15-3: Marine Mammals....15-4
Table 15-4: State-Listed Species....15-5
Table 16-1: Impacts to Green Infrastructure Hubs and Corridors (acres)....16-3
Table 16-2: SUP Impacts to Green Infrastructure Hubs and Corridors (acres)....16-3

Table 16-3: SSPRAs within each Build Alternative (acres) 16-6
Table 16-4: SSPRAs within SUP Area Associated with each Build Alternative (acres) 16-6

APPENDICES

Appendix A: Web Soil Survey Report
Appendix B: Natural Resource Map Set (Northern Alignments)
Appendix C: Natural Resource Map Set (Southern Alignments)
Appendix D: WHPA Response Letters from MDE
Appendix E: Wetland and Waterway Delineation Report
Appendix F: Hydrodynamic Modeling Report
Appendix G: Shoreline Change Assessment Report
Appendix H: Chesapeake Bay Map Set (Northern Alignments)
Appendix I: Chesapeake Bay Map Set (Southern Alignments)
Appendix J: Bird Species Documented in the Resource Review Area
Appendix K: Telemetry Data and NOAA EFH Mapper Results
Appendix L: MDNR Environmental Review Program Letter
Appendix M: MDNR WHS Review Letter
Appendix N: USFWS IPaC Official Species List
Appendix O: NOAA Section 7 ESA Mapper Results
Appendix P: Essential Fish Habitat Assessment
Appendix Q: Biological Assessment, Northern Long-Eared and Tricolored Bat
Appendix R: Biological Assessment, Atlantic and Shortnose Sturgeon and Sea Turtles

ABBREVIATIONS AND ACRONYMS

AABWPR	Anne Arundel County Bureau of Watershed Protection and Restoration
ACFHP	Atlantic Coastal Fish Habitat Partnership
ARDS	Alternatives Retained for Detailed Study
ASMFC	Atlantic States Marine Fisheries Commission
BA	Biological Assessment
BEACH	Bolstering Ecosystems Against Coastal Harm
BMPs	Best Management Practices
BPW	Maryland Board of Public Works
CB3MH	Upper Chesapeake Bay Watershed
CB4MH	Middle Central Chesapeake Bay Watershed
CBBMP	Chesapeake Bay Benthic Monitoring Program
CBP	Chesapeake Bay Program
CBRA	Coastal Barrier Resources Act
CBRS	Coastal Barrier Resources System
CEQ	Council on Environmental Quality
CFPP	Chesapeake Fish Passage Prioritization database
CFR	Code of Federal Regulations
ChesMMAP	Chesapeake Bay Multispecies Monitoring and Assessment Program
COMAR	Code of Maryland Regulations
CREP	Conservation Reserve Enhancement Program
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
DBH	Diameter at Breast Height
DO	Dissolved Oxygen
E1	Tidal Waterway
E2	Intertidal Waterway
E2EM	Estuarine Emergent
E2FO	Estuarine Forested
E2SS	Estuarine Scrub/Shrub
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ERP	Environmental Review Program
ESA	Endangered Species Act
ESC	Erosion and Sediment Control
ESD	Environmental Site Design
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIDS	Forest Interior Dwelling Species
FIRM	Flood Insurance Rate Map
FPPA	Farmland Protection Policy Act

GI	Green Infrastructure
GIS	Geographic Information System
GPS	Global Positioning System
HAPC	Habitat Areas of Particular Concern
IBI	Index of Biotic Integrity
IDA	Intensely Developed Areas
ILF	In-Lieu-Fee Program
IPaC	Information for Planning and Consultation
KNSG	Kent Narrows, Stevensville, Grasonville
LDA	Limited Development Area
LOD	Limits of Disturbance
MAL	Minimum Allowable Limit
MARA	Maryland Amphibian and Reptile Atlas
MBSS	Maryland Biological Stream Survey
MBTA	Migratory Bird Treaty Act
MD	Maryland
MD-DC BBA3	Maryland & DC Breeding Bird Atlas 3
MDE	Maryland Department of the Environment
MDEM	Maryland Department of Emergency Management
MDNR	Maryland Department of Natural Resources
MDOT	Maryland Department of Transportation
MDTA	Maryland Transportation Authority
MEP	Maximum Extent Practicable
MES	Maryland Environmental Service
MGD	Million Gallons per Day
MGS	Maryland Geological Survey
MLLW	Mean Low Lower Water
MMPA	Marine Mammal Protection Act
MPA	Maryland Port Administration
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer System
MSA	Magnuson-Stevens Fishery Conservation and Management Act
n.d.	no date
NAACC	North Atlantic Aquatic Connectivity database
NEPA	National Environmental Policy Act
NETR	Natural Environment Technical Report
NFIP	National Flood Insurance Program
NLEB	Northern long-eared bat
NOAA	National Oceanic Atmospheric Administration
NOB	Natural Oyster Bar
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NTU	Nephelometric Turbidity Unit
NWI	National Wetlands Inventory
NWQMC	National Water Quality Monitoring Council
OBL	Obligate Wetland
OPA	Otherwise Protected Area

OSDS	Onsite Sewage Disposal System
OSHA	Occupational Safety and Health Administration
PBO	Programmatic Biological Opinion
PCB	Polychlorinated Biphenyls
PEM	Palustrine Emergent
PFO	Palustrine Forested
ppt	Parts per thousand
PSS	Palustrine Scrub/Shrub
PTSU	Part-Time Shoulder Use
PUB	Palustrine Unconsolidated Bottom
R2	Nontidal Perennial Waterway
R4	Nontidal Intermittent Waterway
RBP	Rapid Bioassessment Protocol
RCA	Resource Conservation Areas
ROD	Record of Decision
ROW	Right-of-Way
RTE	Rare, Threatened, and Endangered
SAV	Submerged Aquatic Vegetation
SDWA	Safe Drinking Water Act
SGCN	Species of Greatest Conservation Need
SHA	State Highway Administration
SSA	Sole Source Aquifer
SSPRA	Sensitive Species Project Review Area
SU	System Units
SUP	Shared Use Path
SWAP	State Wildlife Action Plan
SWM	Stormwater Management
TCB	Tri-colored Bat
TDM	Transportation Demand Management
TEA	Targeted Ecological Area
TMDL	Total Maximum Daily Load
TOYR	Time of Year Restriction
TPZ	Tree Protection Zone
TSM	Transportation System Management
TSS	Total Suspended Solids
TWOW	Tidal Wetland Open Water
UMCES	University of Maryland Center for Environmental Science
UPL	Obligate Upland
USACE	U.S. Army Corps of Engineers
U.S.	United States
U.S.C.	U.S. Code
USCB	U.S. Census Bureau
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

VIMS	Virginia Institute of Marine Science
WHPA	Wellhead Protection Area
WHS	Wildlife and Heritage Service
WOTUS	Waters of the United States
WRF	Water Reclamation Facility
WSSC	Wetlands of Special State Concern
WTP	Wastewater Treatment Plant
ZSFP	Zone of Safe Fish Passage

1 INTRODUCTION

The Chesapeake Bay Crossing Study (Bay Crossing Study) is a two-tiered engineering and environmental study being advanced by the Maryland Transportation Authority (MDTA) in coordination with the Federal Highway Administration (FHWA). The Bay Crossing Study is addressing existing and future transportation issues at the William Preston Lane, Jr. Memorial Bridge (Bay Bridge) and its approaches along U.S. 50/301. Each tier of the Bay Crossing Study involves development of an Environmental Impact Statement (EIS), in compliance with the National Environmental Policy Act (NEPA), to describe potential significant environmental effects and inform the evaluation of alternatives. Tier 1 of the Bay Crossing Study (Tier 1 Study) was completed in April 2022. At that time, the FHWA issued a Final EIS/Record of Decision (FEIS/ROD) identifying Corridor 7, the corridor that includes the Bay Bridge and its approaches, as the Selected Corridor Alternative for further evaluation. Tier 2 of the Bay Crossing Study (Tier 2 Study) was launched in June 2022 to focus on a project-level (site-specific) analysis within the Tier 1 Selected Corridor Alternative (Corridor 7). Study limits for the Tier 2 Study analysis are defined in **Section 2.2**. The Tier 2 NEPA process was initiated formally with publication of a Notice of Intent (NOI) to prepare an EIS in the Federal Register on November 15, 2024.

The purpose of this Natural Environment Technical Report is to identify and describe the presence of natural resources, summarize the existing conditions, and provide a comparison of the potential impacts to these resources for the different alternatives. Information in this report, described below, will support discussions presented in the EIS. Within the 2-mile-wide Tier 1 Selected Corridor Alternative, resource-specific review areas were established to best characterize the resource being evaluated for potential impacts from the build alternatives. Each resource review area extends for a specific width along the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split and to the extent needed to properly characterize the resources, identify potential resource issues and constraints, and calculate impacts from the build alternatives. For example, some broad-scale resources, such as groundwater and wastewater, used a 2,000-foot-wide resource review area (1,000 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split) to address potential impacts on resources (e.g., groundwater wells). Other resources, such as soils and farmland soils, used a narrower 1,000-foot-wide resource review area of 500 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split, more appropriate for addressing the potential impacts on resources (e.g., conversion of farmland soils).

2 BACKGROUND

The Chesapeake Bay is one of Maryland's most important natural, economic, and cultural resources and the largest estuary in the United States. The 64,000-square-mile watershed that flows into the Chesapeake Bay (**Figure 2-1**) spans six states and the District of Columbia and includes 150 major rivers and over 100,000 tributaries. The Chesapeake Bay has historically shaped the region's identity, culture, and traditions.

The Bay Bridge is a two-span structure that crosses the Chesapeake Bay from Anne Arundel County on the Western Shore to Queen Anne's County on the Eastern Shore. The original span opened in 1952, and the second span opened in 1973. Today, the two-lane original span typically carries eastbound traffic, and the three-lane second span typically carries westbound traffic. However, lanes on the bridge can be reversed to accommodate periods of heavy traffic. The approaches along U.S. 50/301 on each shore have six lanes (three lanes for each travel direction). The Bay Bridge has become one of Maryland's most iconic and recognizable landmarks, used by millions of Maryland residents and other travelers every year.

Figure 2-1: Chesapeake Bay Watershed



2.1 The Tiered NEPA Process

To study possible solutions that could address transportation issues, specifically as they relate to congestion, the MDTA and the FHWA are conducting the Bay Crossing Study as a tiered NEPA study. The tiered approach to NEPA has allowed the MDTA and the FHWA to focus on broader, planning-level decisions related to the preferred location of a potential new bay crossing in the Tier 1 Study EIS. In the subsequent Tier 2 Study EIS, the MDTA and FHWA analyzed more specific, project-level alternatives and potential impacts.

The Tier 1 Study evaluated 14 possible alternative corridor locations over a broad geographic area that spanned nearly 100 miles of the Chesapeake Bay between Harford and Cecil counties to the north and St. Mary's and Somerset counties to the south. The Tier 1 Study identified Corridor 7 as the Selected Corridor Alternative, which is a two-mile-wide and approximately 22-mile-long corridor that follows existing U.S. 50/301 and includes the location of the existing Bay Bridge.

The Tier 2 Study involves a project-level (site-specific) alternatives analysis within the Tier 1 Selected Corridor Alternative (Corridor 7). The focus of the Tier 2 Study is to identify the environmental impacts associated with alternatives to address the Tier 2 Study's Purpose and Need. This technical report supports the evaluation presented in the EIS.

2.2 Study Limits

The MDTA analyzed the traffic volumes along Corridor 7 and its interchanges to determine appropriate study limits for the Tier 2 Study. The Tier 2 western study limit has been identified as the MD 2/MD 450 interchange just east of the Severn River Bridge, and the Tier 2 eastern study limit has been identified as the U.S. 50/301 split.

2.3 Purpose and Need

The purpose of the Tier 2 Study is to address existing and future transportation capacity needs and access across the Chesapeake Bay and at the Chesapeake Bay Bridge approaches along the U.S. 50/301 corridor. The Tier 2 Study is evaluating measures to reduce congestion; improve travel times and reliability, mobility, and roadway deficiencies; and accommodate maintenance activities and navigation, while minimizing impacts to local communities and the environment. Five needs have been identified:

- **Adequate Capacity and Reliable Travel Times** – Capacity of the Bay Bridge and its approaches on U.S. 50/301 are not sufficient to accommodate existing and anticipated traffic demand, resulting in traffic congestion on the Bay Bridge and adjacent roadway network.

- **Mobility** – Congestion at the Bay Bridge and its approaches and subsequent spillover effects on local roadways limit the movement of people, goods, and services across the Chesapeake Bay and in adjacent communities.

- **Roadway Deficiencies** – The bridge does not meet current design standards for design or traffic operations because of the existing narrow lane widths, lack of shoulders, and other factors.

- **Existing and Future Maintenance Needs** – Due to the age and design life of the existing Bay Bridge, substantial maintenance of the facility will be needed, leading to lane closures that make incident management more difficult and cause increased traffic and congestion delays.

- **Navigation** – The existing Bay Bridge is a key constraint for the height of ships that travel the Chesapeake Bay, including to the Port of Baltimore.

The MDTA has also identified two study objectives:

- **Environmental Responsibility** – Project alternatives will be developed to avoid and minimize impacts to communities and sensitive environmental resources.

- **Cost and Financial Responsibility** – Cost and financial responsibility will be a factor when analyzing and evaluating potential solutions, with regard to the means of paying for the development, operation, and maintenance of all proposed facilities.

3 ALTERNATIVES

The MDTA identified the Alternatives Retained for Detailed Study (ARDS), which are the NEPA range of reasonable alternatives for evaluation in the Tier 2 Study EIS. The ARDS include the No-Build Alternative and six build alternatives **(Figure 3-1)**. Each build alternative includes removing the existing eastbound and westbound Bay Bridge spans and replacing them with two new bridge spans constructed near the location of the existing Bay Bridge. The ARDS are differentiated by the number of lanes provided across the new bridge and on the approaches as well as the bridge location, and consist of:

- **Alternative A - No-Build**: retains the existing Bay Bridge, the U.S. 50/301 alignment, and the existing number of lanes: 6 lanes along U.S. 50/301 on the Western Shore, 5 lanes across the Chesapeake Bay on the existing Bay Bridge, and 6 lanes along U.S. 50/301 on the Eastern Shore;

- **Alternative B - 6-8-6 North**: 6 lanes along U.S. 50/301 on the Western Shore, 8 lanes across the Chesapeake Bay on a new bridge with one span to the north of the existing spans and one span in-between the existing spans, and 6 lanes along U.S. 50/301 on the Eastern Shore;

- **Alternative C - 6-8-6 South**: 6 lanes along U.S. 50/301 on the Western Shore, 8 lanes across the Chesapeake Bay on a new bridge with one span to the south of the existing spans and one span in-between the existing spans, and 6 lanes along U.S. 50/301 on the Eastern Shore;

- **Alternative D - 8-8-8 North**: 8 lanes along U.S. 50/301 on the Western Shore, 8 lanes across the Chesapeake Bay on a new bridge with one span to the north of the existing spans and one span in-between the existing spans, and 8 lanes along U.S. 50/301 on the Eastern Shore;

- **Alternative E - 8-8-8 South**: 8 lanes along U.S. 50/301 on the Western Shore, 8 lanes across the Chesapeake Bay on a new bridge with one span to the south of the existing spans and one span in-between the existing spans, and 8 lanes along U.S. 50/301 on the Eastern Shore;

- **Alternative F - 8-10-8 North**: 8 lanes along U.S. 50/301 on the Western Shore, 10 lanes across the Chesapeake Bay on a new bridge with one span to the north of the existing spans and one span in-between the existing spans, and 8 lanes along U.S. 50/301 on the Eastern Shore; and

- **Alternative G - 8-10-8 South**: 8 lanes along U.S. 50/301 on the Western Shore, 10 lanes across the Chesapeake Bay on a new bridge with one span to the south of the existing spans and one span in-between the existing spans, and 8 lanes along U.S. 50/301 on the Eastern Shore.

Each of the ARDS will also include an optional pedestrian / bicycle shared use path, tolling, transit-related improvements, Transportation Systems Management (TSM)/Transportation Demand Management (TDM), stormwater management, utilities, and truck weigh and inspection stations. These common items, in addition to the improvements associated with each build alternative, informed the development of the limit of disturbance (LOD) for each build alternative. Additional detail on the ARDS can be found in the Tier 2 Study Draft EIS.

3.1 Alternative A: No-Build

Alternative A (6-5-6), the No-Build Alternative, would retain the existing Bay Bridge, the U.S. 50/301 alignment, and the existing number of lanes. This alternative would retain six lanes on the approaches on the Eastern and Western Shores and five lanes on the two-span Bay Bridge. The No-Build Alternative will include regular maintenance of the Bay Bridge and U.S. 50/301, but no capital improvements other than currently planned and programmed projects.

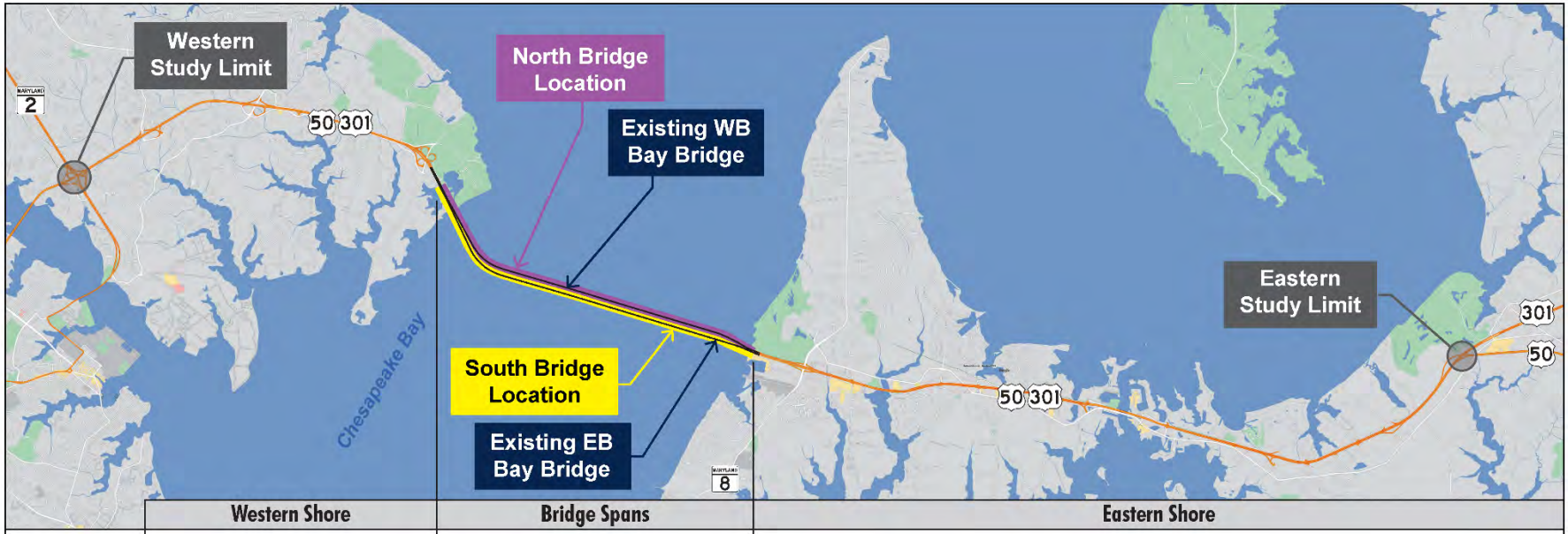
3.2 Alternative B: 6-8-6 North

Alternative B (6-8-6 North) would replace the existing Bay Bridge spans with two new bridge spans and would consist of six lanes along U.S. 50/301 on the Western Shore (three per direction), eight lanes on a new bridge (four per direction), and six lanes along U.S. 50/301 on the Eastern Shore (three per direction). The two new bridge spans would consist of one span to the north and one span in between the location of the existing bridge spans. The approach roadways would remain on the existing roadway alignment, except where necessary to connect to the new bridge spans. Thus, with Alternative B, the five existing bridge lanes would be increased to eight bridge lanes; however, the number of lanes on the Western Shore and Eastern Shore would not change and would remain at six total travel lanes beyond the immediate tie-ins to the new bridge spans.

3.3 Alternative C: 6-8-6 South

Alternative C (6-8-6 South) would replace the existing Bay Bridge spans with two new bridge spans and would consist of six lanes along U.S. 50/301 on the Western Shore (three per direction), eight lanes on a new bridge (four per direction), and six lanes along U.S. 50/301 on the Eastern Shore (three per direction). The two new bridge spans would include one span to the south and one span in between the location of the existing bridge spans. The approach roadways would remain on the existing roadway alignment, except where necessary to connect to the new bridge spans. Thus, with Alternative C, the five existing bridge lanes would be increased to eight bridge lanes; however, the number of lanes on the Western Shore and Eastern Shore would not change and would remain at six total travel lanes beyond the immediate tie-ins to the new bridge spans.

Figure 3-1: Alternatives Summary



	Western Shore	Bridge Spans	Eastern Shore
Alternative A: No-Build	6 Lanes	5 Lanes	6 Lanes
Alternative B	6 Lanes	8 Lanes NORTH	6 Lanes
Alternative C	6 Lanes	8 Lanes SOUTH	6 Lanes
Alternative D	8 Lanes	8 Lanes NORTH	8 Lanes
Alternative E	8 Lanes	8 Lanes SOUTH	8 Lanes
Alternative F	8 Lanes	10 Lanes NORTH	8 Lanes
Alternative G	8 Lanes	10 Lanes SOUTH	8 Lanes

3.4 Alternative D: 8-8-8 North

Alternative D (8-8-8 North) would replace the existing Bay Bridge spans with two new bridge spans and would consist of eight lanes along U.S. 50/301 on the Western Shore (four per direction), eight lanes on a new bridge (four per direction), and eight lanes along U.S. 50/301 on the Eastern Shore (four per direction). The two new bridge spans would include one span to the north and one span in between the location of the existing bridge spans. Alternative D would increase the number of lanes along the U.S. 50/301 approaches to eight lanes from the MD 2/MD 450 interchange on the Western Shore to the U.S. 50/301 split on the Eastern Shore and would generally remain on the existing roadway alignment except where necessary to connect to the new bridge spans. Thus, with Alternative D, the five existing bridge lanes would be increased to eight bridge lanes and the number of lanes on the Western Shore and Eastern Shore would increase from six total travel lanes to eight total travel lanes.

3.5 Alternative E: 8-8-8 South

Alternative E (8-8-8 South) would replace the existing Bay Bridge spans with two new bridge spans and would consist of eight lanes along U.S. 50/301 on the Western Shore (four per direction), eight lanes on a new bridge (four per direction), and eight lanes along U.S. 50/301 on the Eastern Shore (four per direction). The two new bridge spans would include one span to the south and one span in between the location of the existing bridge spans. Alternative E would increase the number of lanes along the U.S. 50/301 roadway approaches to eight lanes from the MD 2/MD 450 interchange on the Western Shore to the U.S. 50/301 split on the Eastern Shore and would generally remain on the existing roadway alignment except where necessary to connect to the new bridge spans. Thus, with Alternative E, the five existing bridge lanes would be increased to eight bridge lanes and the number of lanes on the Western Shore and Eastern Shore would increase from six total travel lanes to eight total travel lanes.

3.6 Alternative F: 8-10-8 North

Alternative F (8-10-8 North) would replace the existing Bay Bridge spans with two new bridge spans and would consist of eight lanes along U.S. 50/301 on the Western Shore (four per direction), ten lanes on a new bridge (five per direction), and eight lanes along U.S. 50/301 on the Eastern Shore (four per direction). The two new bridge spans would include one span to the north and one span in between the location of the existing bridge spans. Alternative F would increase the number of lanes along the U.S. 50/301 approach roadway to eight lanes from the MD 2/MD 450 interchange on the Western Shore to the U.S. 50/301 split on the Eastern Shore and would generally remain on the existing roadway alignment except where necessary to connect to the new bridge spans. Thus, with Alternative F, the five existing bridge lanes would be increased to ten bridge lanes and the number of lanes on the Western Shore and Eastern Shore would increase from six total travel lanes to eight total travel lanes.

3.7 Alternative G: 8-10-8 South

Alternative G (8-10-8 South) would replace the existing Bay Bridge spans with two new bridge spans and would consist of eight lanes along U.S. 50/301 on the Western Shore (four per direction), ten lanes on a new bridge (five per direction), and eight lanes along U.S. 50/301 on the Eastern Shore (four per direction). The two new bridge spans would include one span to the south and one span in between the location of the existing bridge spans. Alternative G would increase the number of lanes along the U.S. 50/301 approach roadway to eight lanes from the MD 2/MD 450 interchange on the Western Shore to the U.S. 50/301 split on the Eastern Shore and would generally remain on

the existing roadway alignment except where necessary to connect to the new bridge spans. Thus, with Alternative G, the five existing bridge lanes would be increased to ten bridge lanes and the number of lanes on the Western Shore and Eastern Shore would increase from six total travel lanes to eight total travel lanes.

3.8 Other Components of the Build Alternatives

3.8.1 Optional Pedestrian / Bicycle Shared Use Path

All proposed build alternatives include the option for the safe inclusion of a pedestrian/bicycle shared use path (SUP) along a new bridge. The MDTA has identified connections to existing and proposed trails and recreational facilities on the Eastern Shore and Western Shore.

3.8.2 Tolling

The MDTA owns and operates the Bay Bridge and uses tolls from its eight facilities to maintain and operate all their facilities. The Bay Bridge will continue to be a tolled facility and the MDTA will continue to manage it and the toll to address the current and future traffic and the associated congestion.

3.8.3 Transit-related Improvements

Transit-related improvements would be made through a financial commitment from the MDTA that would focus on providing a one-time investment for local transit agencies near the Bay Bridge. The same commitment would be made for all alternatives and would not be used to differentiate between alternatives.

All transit-related opportunities would be determined in the future, closer to the time of construction. The MDTA would coordinate with the Maryland Transit Administration (MTA), local governments, and local transit agencies to help determine the opportunities. However, these agencies would determine the transit-related improvements that would be most beneficial for them at that time and they would be separate and distinct projects from the Bay Crossing.

3.8.4 TSM TDM Considerations

Two TSM/TDM improvements were considered with the retained build alternatives for potential implementation: congestion pricing and part-time shoulder use (PTSU) lanes.

The Bay Bridge will continue to be a tolled facility. If a build alternative is selected, congestion pricing could be used in the future to provide flexibility for toll management strategies that the MDTA could use to further reduce congestion and achieve transportation goals.

The shoulders on the bridge would be full width (12 feet wide) to accommodate future maintenance needs and incident management; therefore, they would also be wide enough to accommodate a PTSU lane. Although the build alternatives have been developed to accommodate PTSU, the operation of PTSU lanes is not being included as part of the alternatives. Future implementation of PTSU is not precluded.

3.8.5 Stormwater Management (SWM)

A planning-level, conceptual SWM analysis was completed that identified the stormwater needs and potential treatment locations throughout the study area for each build alternative.

3.8.6 Utilities

The study area along U.S. 50/301 contains public utilities including: potable water, sanitary sewer, natural gas, electric power/distribution, communications, and cable television. The build alternatives would impact some of these utilities that are in close proximity to U.S. 50/301, and the impacts to these utilities and associated replacements have been included in the build alternatives.

3.8.7 Truck Weigh and Inspection Station

There are two existing Truck Weigh and Inspection Stations (TWIS) along U.S. 50/301 between Oceanic Drive and the Bay Bridge, one in each direction. As part of the build alternatives, these facilities would be upgraded and relocated where necessary.

3.8.8 Limits of Disturbance (LOD)

The LOD is the proposed boundary that would include all construction, erosion and sediment control (ESC), SWM, and right-of-way offsets. The LODs for the alternatives were developed from the proposed horizontal and vertical geometry, typical sections, roadside design, and proposed interchange modifications. For Alternatives B and C, the number of lanes on the Western Shore and Eastern Shore would not change and would remain at six total travel lanes beyond the immediate tie-ins to the new bridge spans. This would mean the limits of roadway improvements associated with Alternatives B and C would end at the immediate tie-ins to the new bridge spans, compared with the limits of roadway improvements for Alternatives D through G, which would end at the study limits (MD 2/MD 450 and the U.S. 50/301 Split). Due to the shorter distance of proposed roadway modifications associated with Alternatives B and C, the LODs associated with these two build alternatives are smaller than the LODs associated with the other build alternatives.

4 GEOLOGY AND TOPOGRAPHY

The resource review area for geology and topography extends 500 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split. Geologic resources are naturally occurring features that formed during evolution of the Earth, including fossilized flora and fauna (i.e., paleontological resources), fossil fuels, mineral resources, and rock formations that may provide value to the human or physical environment. Unique geological features are any distinctive or rare physical feature of the Earth's surface, or of the rocks exposed at the surface, which are formed by a geologic process. Geologic hazards, such as earthquakes, sinkholes, and landslides, are natural occurrences that may result in a threat to the human or physical environment. Topography refers to the shape and features of the Earth's crust.

4.1 Regulatory Context and Methodology

The MDTA reviewed information available from the U.S. Geological Survey (USGS), Maryland Department of Natural Resources (MDNR) Maryland Geological Survey (MGS), and Maryland's geographic information systems online database (MD iMAP Data Catalog), which provides data from several agencies, including the Maryland Department of the Environment (MDE), MDNR, and the Maryland Environmental Service (MES). The MDTA also utilized existing reports prepared for similar transportation studies (Baltimore-Washington Super Conducting Maglev Project, Harry Nice Bridge Replacement Project, and the Hampton Roads Crossing Study) to aid in a qualitative analysis based on publicly available desktop information concerning the geologic and topographic setting. Potential geologic hazards (seismic hazards, karst topography, and landslide prone soils) were evaluated to understand potential conditions and associated risks related to construction activities. The MDE *2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control* defines steep slopes as those with gradients of 20 percent or more. The MDTA used Anne Arundel County and Queen Anne's County Geographic Information System (GIS) contour data to run a preliminary analysis of steep slopes within the resource review area. The following regulatory requirements could be relevant if certain geologic resources or hazards are identified during project planning and throughout final design and later during construction, if applicable:

- Occupational Safety and Health Act (29 United States Code [U.S.C.] § 651 et seq.);
- Safe Drinking Water Act of 1974 (42 U.S.C. § 300f et seq.);
- Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. § 1201 et seq.); and
- Paleontological Resources Preservation Act (16 U.S.C. § 470aaa et seq.)

4.2 Affected Environment

4.2.1 Geology

The resource review area falls entirely within the Atlantic Coastal Plain Physiographic Province, located over ten miles southeast of the Fall Zone,[1] which separates it from the Piedmont Plateau Physiographic Province. A physiographic province is a geographic area in which the geology (including lithology[2] and structure) and climate history have resulted in landforms that are distinctly different from adjacent areas. The Atlantic Coastal Plain represents the easternmost contact with

[1] The Atlantic Coastal Plain Province is underlain by a wedge of unconsolidated sediments including gravel, sand, silt, and clay, which overlaps the rocks of the eastern Piedmont along an irregular line of contact known as the Fall Zone.
[2] Lithology is the study of the general physical characteristics of rocks.

crystalline bedrock to the shorelines of major estuaries or the Atlantic Ocean. The Coastal Plain is characterized as relatively flat with loosely arranged sediments of gravel, silt, and clay. In Maryland, the Chesapeake Bay bisects the Coastal Plain, and the sediment layers become thicker, moving east from the Baltimore region, across the Eastern Shore, towards the Atlantic Ocean.

Table 4-1 describes the geologic formations in the resource review area, which consists solely of the Lowland Deposits Formation in Queen Anne's County and is split largely between the Aquia Formation and the Monmouth Formation in Anne Arundel County (**Figure 4-1**). For information regarding bathymetry of the Chesapeake Bay and Chesapeake Bay sediments, see **Section 9.2, Chesapeake Bay**.

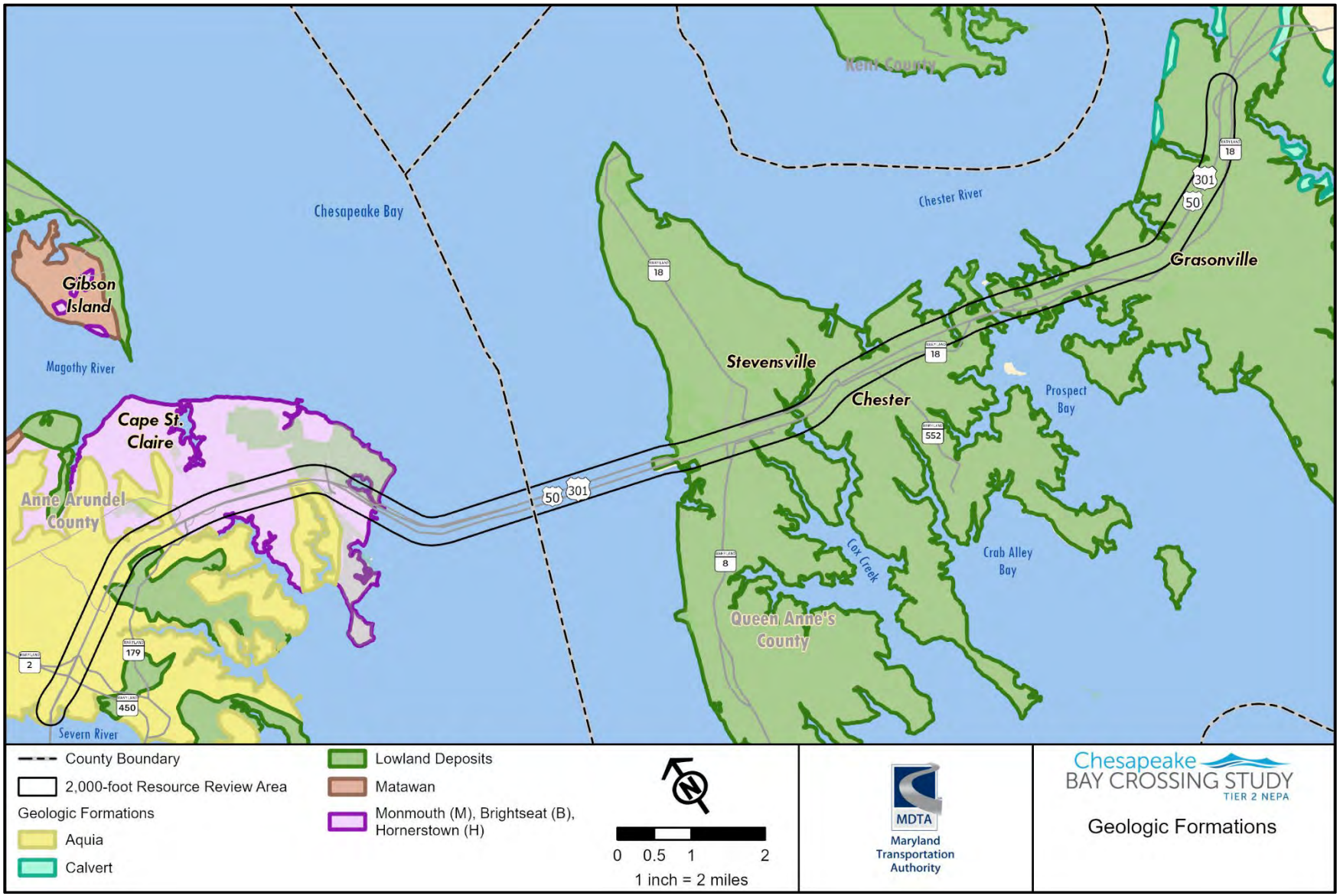
Table 4-1: Geologic Deposits within the Resource Review Area

Deposit	Description
Lowland Deposits	• Primarily silt, clay, and sand • Bay and river shore deposits made during higher water levels • Deposited as sea level of Atlantic Ocean and Chesapeake Bay varied • Limited use for aggregate (sand and gravel)
Monmouth Formation (Monmouth, Brightseat, Hornerstown)	• Primarily sand (Monmouth and Brightseat) and glauconite sand (Hornerstown) • Monmouth - Marine deposition on continental shelf, probably in shallow water; Brightseat and Hornerstown - shallow marine • Sediments eroded eastward from Appalachians toward Atlantic Ocean
Aquia Formation	• Primarily sand with clay • Shallow marine, near shore • Sediments eroded eastward from Appalachians toward Atlantic Ocean • Sand layers are aquifers

The following geologic hazards and resources were evaluated for their potential to occur within the resource review area:

- **Seismicity** – The frequency and severity of earthquakes. Seismic hazards are typically associated with a geologic fault or fracture and areas requiring bridges may be especially susceptible to potential damage. The resource review area is in an area of the U.S. with a low probability of seismic activity. The USGS identifies the eastern U.S. as a "Stable Continental Region" because of its location in the center of a tectonic plate. According to the MGS, strong earthquakes are unusual in Maryland, although the state occasionally experiences perceptible earthquakes. In 2011, a 5.8-magnitude earthquake occurred 35 miles north of Richmond, Virginia and registered as a 2.2-magnitude earthquake in Anne Arundel County. In 2010, a 3.6-magnitude earthquake occurred in Montgomery County. The latest earthquake occurred in Maryland on November 11, 2017, classified as a 1.5-magnitude earthquake (MGS, 2024). Therefore, the probability of seismic activity within the resource review area is low. Construction would be required to adhere to the American Association of State Highway and Transportation Official "Standard Specifications for Highway Bridges." Because of this, the MDTA has not evaluated earthquake risk further, as all appropriate design criteria per state and federal standards would be required.

Figure 4-1: Geologic Formations



- **Karst Topography** – Dissolution of a soluble layer or layers of bedrock. These areas are susceptible to sinkholes, groundwater contamination, and erosion. According to the MGS, in Maryland, karst areas occur in Baltimore, Carroll, Washington, and Frederick counties, with less extensive areas in Allegany County (MGS, 2024). Since karst topography does not occur within the resource review area, the MDTA has not evaluated this resource further.

- **Landslide Prone Soils** – The susceptibility for rock or landslides (debris, mudflows, or rock fall). In areas that contain landslide-prone soils construction requires engineering/design considerations to minimize hazards to workers during construction and the future utilization of the corridor. According to information available on the USGS U.S. Landslide Inventory (USGS, 2023a), there are only a few recorded recent landslide events near Washington, D.C. and Baltimore with a designated level of confidence "probable landslide in the area." According to the Federal Emergency Management Agency (FEMA) Landslide Risk Map (FEMA, 2023), the resource review area is within a "Relatively Moderate Landslide Incidence Area" in Anne Arundel County and a "Relatively Low Incidence Area" in Queen Anne's County. Within the resource review area, the USGS identifies clay layers of the Arundel Formation (from deposits of the Potomac Group and Marlboro Clay) that act as the confining unit between aquifers and are known to cause stability issues and create pockets of moderate landslide risk (Pomeroy, 1988). According to the Maryland Department of Emergency Management (MDEM), landslides are rare in Maryland, but small ones can happen in the mountainous areas in Western Maryland (MDEM, 2024). Due to the relatively gently rolling topography within the resource review area, the MDTA considered there to be a low risk from landslides and has not evaluated this hazard further.

- **Mines** – A review of the USGS Mineral Resources Online Spatial Data shows no mines or mine features are present within the resource review area (Horton and San Juan, 2021). Further, there are no mining locations identified as "past producers" present within 4 miles of the resource review area (Mineral Resources Data System [MRDS], 2023). Therefore, the MDTA has not evaluated mines further.

- **Paleontological Resources** – Soils in Queen Anne's and Anne Arundel counties originate from three types of geologic deposits: the Monmouth Formation, Aquia Formation, and Lowland Deposits Formation. The closest known paleontological resources were documented several miles from the resource review area in the Potomac Formation to the north and west (Kranz, 1989). Therefore, the MDTA has not evaluated this resource further.

4.2.2 Topography

Anne Arundel County is characterized as having a mostly flat or gently rolling topography, with the greatest distinction in terrain along waterways that cut through areas of higher elevation. Steeper terrain, although rarely evident within the resource review area immediately along U.S. 50/301, occurs in the vicinity of Mill Creek. According to published elevation mapping (USGS, 2025a), the lowest point within Anne Arundel County is near the location of the Bay Bridge at 0 feet elevation, and elevation ranges from between approximately 40 feet to 110 feet within the resource review area (**Figure 4-2**). The same mapping identifies Queen Anne's County elevation at 20 feet or less throughout the entirety of the resource review area (see **Figure 4-3**). Queen Anne's County topography is characterized as largely level, to gently rolling and close to sea level, bound in large part by water. Additional details illustrating the geologic conditions within the Chesapeake Bay are provided in **Section 9.2, Chesapeake Bay**.

Figure 4-2: Topography – Anne Arundel County



Figure 4-3: Topography – Queen Anne's County



4.3 Environmental Consequences

The MDTA evaluated the potential for the addition or modification of roads and bridges to affect geology and topography.

4.3.1 No-Build Alternative

The No-Build Alternative, Alternative A, would have no impact to geology and topography.

4.3.2 Build Alternatives

Construction of any of the build alternatives is not anticipated to impact geologic resources. However, permanent topographical changes would occur from grading or filling the landscape to provide structural stability for the proposed new roadway and bridge spans associated with the build alternatives. It is anticipated that alternatives impacting steep slopes would result in greater topographical changes than those that do not impact steep slopes. **Table 4-2** shows the steep slope areas affected by the build alternatives.

Table 4-3 shows the steep slope areas affected by a SUP option associated with each of the build alternatives.

Table 4-2: Steep Slope Impacts (acres)

County	No-Build	Build Alternative					
		B	C	D	E	F	G
Anne Arundel County	0	10.8	10.1	49.5	48.8	49.6	48.9
Queen Anne's County	0	17.1	15.5	62.5	60.9	63.5	61.8
Total	**0**	**27.9**	**25.6**	**112.0**	**109.7**	**113.1**	**110.7**

Table 4-3 SUP Steep Slope Impacts (acres)

County	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
Anne Arundel County	0	0.4	0.4	0.4	0.4	0.4	0.4
Queen Anne's County	0	0.5	0.2	0.5	0.2	0.3	0.1
Total	**0**	**0.9**	**0.6**	**0.9**	**0.6**	**0.7**	**0.5**

Steep slopes may directly influence both the volume and velocity of surface runoff, which can increase the potential for erosion. Alternatives B and C would have minimal changes to existing topography, as existing U.S. 50/301 would not be widened. Alternatives D, E, F, and G would have comparable impacts, as these alternatives all include roadway widening to eight lanes, with the northern alignments (Alternatives D and F) having approximately one acre of additional impact in areas of steep slopes. This additional impact to areas of steep slopes is located at both the eastern and western shorelines along the Chesapeake Bay, north of the Bay Bridge westbound span. At Sandy Point State Park on the western shoreline, there is a man-made rip rap peninsula that separates the beach from the entrance to Mezick Pond, which is illustrated with slopes greater than 20 percent in the GIS analysis. On the eastern shoreline, the additional steep slopes are

identified along the peninsula where the eastbound and westbound spans connect to the shoreline.

The addition of an SUP option with any of the build alternatives would result in between 0.5 acres and 0.9 acres of additional impact to steep slopes, with the northern alternatives, Alternatives B, D, and F having slightly more impact than the southern alternatives.

Topographical changes could also result to the substrate of the Chesapeake Bay because of anticipated dredging operations. These impacts are described in more detail in **Section 9.2, Chesapeake Bay**.

4.4 Avoidance, Minimization, and Further Mitigation Strategies

The MDTA would approach design and development with the goal of minimizing and mitigating construction impacts to topography by using Best Management Practices (BMPs) and construction techniques specifically identified in the Erosion and Sediment Control (ESC) Plan and geotechnical investigation reports. The grading plan would include measures to prevent erosion in highly susceptible areas, such as steep slopes, and would be prepared and implemented in accordance with MDE regulations.

Although the resource review area is considered to have a low potential for seismic hazards, there have been earthquakes in Maryland. The MDTA would consider seismic risk, safety factors, and potential mitigation measures should an event occur that affects the structures and/or surrounding infrastructure and population. At this time, the need for blasting during construction has not been identified. Future studies would also consider the possibility for construction of the structures to result in any micro-seismic activity, and the MDTA would evaluate the need for, and specific type of micro-seismic monitoring needed.

5 SOILS AND FARMLAND SOILS

The resource review area for soils, including farmland soils, extends 500 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split. This section identifies soil types, potential soil hazards, and soils designated as Prime and Unique Farmlands or Farmlands of Statewide or Local Importance within the resource review area.

5.1 Regulatory Context and Methodology

The MDTA conducted an analysis of soil resources based on publicly available desktop information, including published/online reports and maps from the Natural Resources Conservation Service (NRCS), the USGS (USGS, 2025a), and the U.S. Census Bureau (USCB; USCB, 2020). The MDTA overlaid the LODs onto the existing soils mapping and documented the presence of hydric soils, a potential soil hazard, which may be encountered by the build alternatives.

Using the U.S. Department of Agriculture (USDA) NRCS Web Soil Survey (USDA/NRCS, 2024), the MDTA identified soil associations within the resource review area, including areas containing farmland soils.

USDA/NRCS uses a farmland classification system to designate soils as Prime Farmland Soils, Unique Farmland Soils, Farmland Soils of Statewide Importance, or Farmland Soils of Local Importance.

- Prime farmland soils include land with "the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed and other agricultural crops and that is available for these uses."
- Unique farmland soils include "land other than prime farmland that is used for production of specific high-value food and fiber crops."
- Farmland soils of statewide or local importance are land that is identified by state or local agencies, respectively, as "being important to produce food, feed, fiber, forage, and/or oilseed crops in the corresponding state or local community" (USDA/NRCS, 2024).

The Farmland Protection Policy Act (FPPA) of 1981 was created "to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland soils to non-agricultural uses" and is regulated by the NRCS. All farmland soils identified with areas that are prime, unique, or of statewide or local importance are subject to the FPPA. Land protected under the FPPA does not have to currently be in use for agriculture – it can be forest land, pastureland, cropland, or other land. According to federal regulations implementing the FPPA, farmland does not include land already in or committed to urban development, including lands identified as urbanized areas on the 2020 Census urban area-based reference map, and lands within existing transportation right-of-way (ROW). The MDTA reviewed recent aerial imagery from 2023/2024 to identify potential active farmland activities observed within the resource review area.

Once the Preferred Alternative is identified, the MDTA will prepare the NRCS-CPA-106 (*Farmland Conversion Impact Rating for Corridor Type Projects*) form for submission to the local NRCS field office. The form identifies the relative value of farmland soils and ranks it across a series of criteria that account for the site in a larger context, such as whether there are farming support

services or urban areas in the greater landscape. The ranked relative value of the farmland soils is added to the sitewide context, and the overall value of the farmland soil is assigned a score by the NRCS on a scale of 0 to 260. If the results identify scores below 160, no additional action is required under the FPPA. If scores are 160 or above, federal agencies will give increasingly higher levels of consideration for protection.

5.2 Affected Environment

Within the resource review area, soils are primarily silt loam to sandy loam, with hydric soils and occasional swamp areas occurring within some of the lowland areas. Descriptions of general soil associations within the soils resource review area were compiled from county soil surveys and are described below.

Anne Arundel County (USDA/NRCS, 1973)

- Sassafrass-Croom-Chillum Association: Gently sloping to steep, well-drained, loamy soils; compact, gravelly subsoil in places.
- Evesboro-Rumford-Sassafras association: Gently sloping to moderately steep, excessively drained and well-drained, sandy and loamy soils.
- Monmouth-Collington association: Nearly level to moderately steep, well-drained, sandy and loamy soils that developed in sediments containing glauconite.
- Elkton-Othello-Mattapex association: Level to sloping, poorly drained and moderately well-drained, loamy soils.
- Marr-Westphalia-Sassafras association: Gently sloping to steep, dominantly severely eroded, well-drained, loamy soils that contain much fine sand.

Queen Anne's County (USDA/NRCS, 2002)

- Honga-Bestpitch association: Nearly level, very poorly drained soils that formed in organic deposits overlying mineral sediments.
- Ingleside-Pineyneck-Unicorn association: Nearly level to steep, well-drained and moderately well-drained soils that formed in stratified sediments.
- Longmarsh-Zekiah association: Nearly level, very poorly drained and poorly drained soils that formed in recent alluvial sediments.
- Matapeake-Mattapex-Nassawango association: Nearly level to moderately sloping, well-drained and moderately well-drained soils that formed in silty sediments.
- Whitemarsh-Hurlock-Carmichael association: Nearly level, poorly drained soils that formed in silty and loamy sediments.

The NRCS Web Soil Survey tool was used to generate a list of soils within the resource review area (NRCS, 2024).

Table 5-1 summarizes the soils present within the resource review area, including Prime Farmland Soils and Soils of Statewide Importance, as well as hydric soils.

Table 5-1: Soils within the Resource Review Area

Soil Map Unit Symbol	Soil Map Unit Name/Description	Acreage within Resource Review Area	Percentage of Resource Review Area	Hydric Soil (Yes/No)
Anne Arundel County				
AsC	Annapolis fine sandy loam, 5 to 10% slopes*	8	0.3%	N
AsE	Annapolis fine sandy loam, 15 to 25% slopes	26	1%	N
AuD	Annapolis-Urban land complex, 5 to 15% slopes	4	0.2%	N
CoB	Collington-Wist complex, 2 to 5% slopes**	5	0.2%	N
CoC	Collington-Wist complex, 5 to 10% slopes*	24	1%	N
CpB	Collington-Wist-Urban land complex, 0 to 5% slopes	1	0%	N
CpD	Collington-Wist-Urban land complex, 5 to 15% slopes	0	0%	N
CRD	Collington and Annapolis soils, 10 to 15% slopes	8	0.3%	N
CSE	Collington, Wist, and Westphalia soils, 15 to 25% slopes	9	0.4%	N
CSF	Collington, Wist, and Westphalia soils, 25 to 40% slopes	15	0.6%	N
CxA	Cumberstone-Mattapex complex, 0 to 2% slopes*	61	3%	N
CxB	Cumberstone-Mattapex complex, 2 to 5% slopes*	47	2%	N
CxC	Cumberstone-Mattapex complex, 5 to 10% slopes*	7	0.3%	N
DcA	Deale-Shadyoak complex, 0 to 2% slopes*	6	0.3%	N
DxC	Downer-Phalanx complex, 5 to 10% slopes*	4	0.2%	N
DxD	Downer-Phalanx complex, 10 to 15% slopes	1	0.0%	N
MtaB	Mattapex silt loam, 2 to 5% slopes, northern coastal plain**	10	0.4%	N
MtC	Mattapex silt loam, 5 to 10% slopes*	4	0.2%	N
MxB	Mattapex-Butlertown complex, 2 to 5% slopes**	14	0.6%	N
MyB	Mattapex-Butlertown-Urban land complex, 0 to 5% slopes	17	0.7%	N
MZA	Mispillion and Transquaking soils, 0 to 1% slopes, tidally flooded	18	0.7%	Y
SaB	Sassafras fine sandy loam, 2 to 5% slopes**	6	0.2%	N
SME	Sassafras and Croom soils, 15 to 25% slopes	19	0.8%	N
SMF	Sassafras and Croom soils, 25 to 40% slopes	1	0.1%	N
SnB	Sassafras-Urban land complex, 0 to 5% slopes	2	0.1%	N
SoA	Shadyoak-Elkton complex, 0 to 2% slopes	16	0.7%	Y
UxB	Udorthents, loamy, sulfidic substratum, 0 to 5% slopes	213	9%	N
UxD	Udorthents, loamy, sulfidic substratum, 5 to 15% slopes	137	6%	N
Uz	Urban land	8	0.3%	N
W	Water	259	11%	N
WBA	Widewater and Issue soils, 0 to 2% slopes, frequently flooded	31	1%	N
WdaB	Woodstown sandy loam, 2 to 5% slopes, Northern Coastal Plain**	8	0.3%	N
Queen Anne's County				
Bp	Bestpitch peat, very frequently flooded, tidal	31	1%	Y
CaA	Carmichael loam, 0 to 2% slopes*	31	1%	Y
CoA	Corsica mucky loam, 0 to 2% slopes*	15	0.6%	Y
HnA	Hammonton sandy loam, 0 to 2% slopes**	69	3%	N
HnB	Hammonton sandy loam, 2 to 5% slopes**	9	1%	N

Soil Map Unit Symbol	Soil Map Unit Name/Description	Acreage within Resource Review Area	Percentage of Resource Review Area	Hydric Soil (Yes/No)
Ho	Honga peat, very frequently flooded, tidal	104	4%	Y
HvA	Hurlock sandy loam, 0 to 2% slopes*	154	6%	Y
IgB	Ingleside sandy loam, 2 to 5% slopes**	38	2%	N
LO	Longmarsh and Indiantown soils, frequently flooded	14	0.6%	Y
MqA	Mattapex-Butlertown silt loams, 0 to 2% slopes**	90	4%	N
MqB	Mattapex-Butlertown silt loams, 2 to 5% slopes**	34	1%	N
NsB	Nassawango silt loam, 2 to 5% slopes**	16	0.7%	N
OtA	Othello silt loams, 0 to 2% slopes, Mid-Atlantic Coastal Plain*	172	7%	Y
PiA	Pineyneck silt loam, 0 to 2% slopes**	21	0.8%	N
PiB	Pineyneck silt loam, 2 to 5% slopes**	96	4%	N
UbB	Udorthents, borrow area, 0 to 5% slopes	2	0.1%	N
UoB	Unicorn silt loam, 2 to 5% slopes**	12	0.5%	N
UpB	Urban land	139	6%	N
UsB	Unicorn-Sassafras loams, 2 to 5% slopes**	9	0.4%	N
UsC	Unicorn-Sassafras loams, 5 to 10% slopes*	5	0.2%	N
W	Water	327	13%	N
WhA	Whitemarsh silt loam, 0 to 2% slopes	68	3%	Y

** Farmland soil of statewide importance*
*** Prime farmland soil*
Acreages rounded to nearest whole number; percentages rounded to nearest whole number if >1%.
Source: NRCS, 2024

Soil map units and detailed soil series descriptions are included in the Web Soil Survey report (NRCS, 2024) included in **Appendix A**. Within the resource review area, Anne Arundel County has few hydric soils (less than 2 percent of soils are hydric), while Queen Anne's County has about 23 percent hydric soils. Prime Farmland Soils and Farmland Soils of Statewide Importance occur in the resource review area; however, Unique Farmland Soils or Farmland Soils of Local Importance were not identified. Most of the NRCS-mapped soils within the resource review area were ultimately excluded from consideration as farmland soils under the FPPA because they are within census-designated urban areas. **Table 5-2** lists the farmland soil classifications present within the resource review area by county.

Table 5-2: Soil Types within the Resource Review Area

Description	Acreage			
	Anne Arundel County	Percentage of Resource Review Area	Queen Anne's County	Percentage of Resource Review Area
Prime Farmland Soil	44	2%	395	17%
Farmland Soil of Statewide Importance	161	8%	376	15%
Non-Farmland Soil	144	6%	216	9%
Urban Land or Water	640	26%	467	6%
Totals*	**989**	**42%**	**1,454**	**47%**

Acreages and percentages rounded to nearest whole number
** Total percentages equal 89% of resource review area because 11% of resource review area is comprised of roadways.*
Source: NRCS, 2024

Figure 5-1 and **Figure 5-2** show the soils designated as Prime Farmland Soils and Farmland Soils of Statewide Importance, and census-designated urban areas within the soil resource review area for each county.

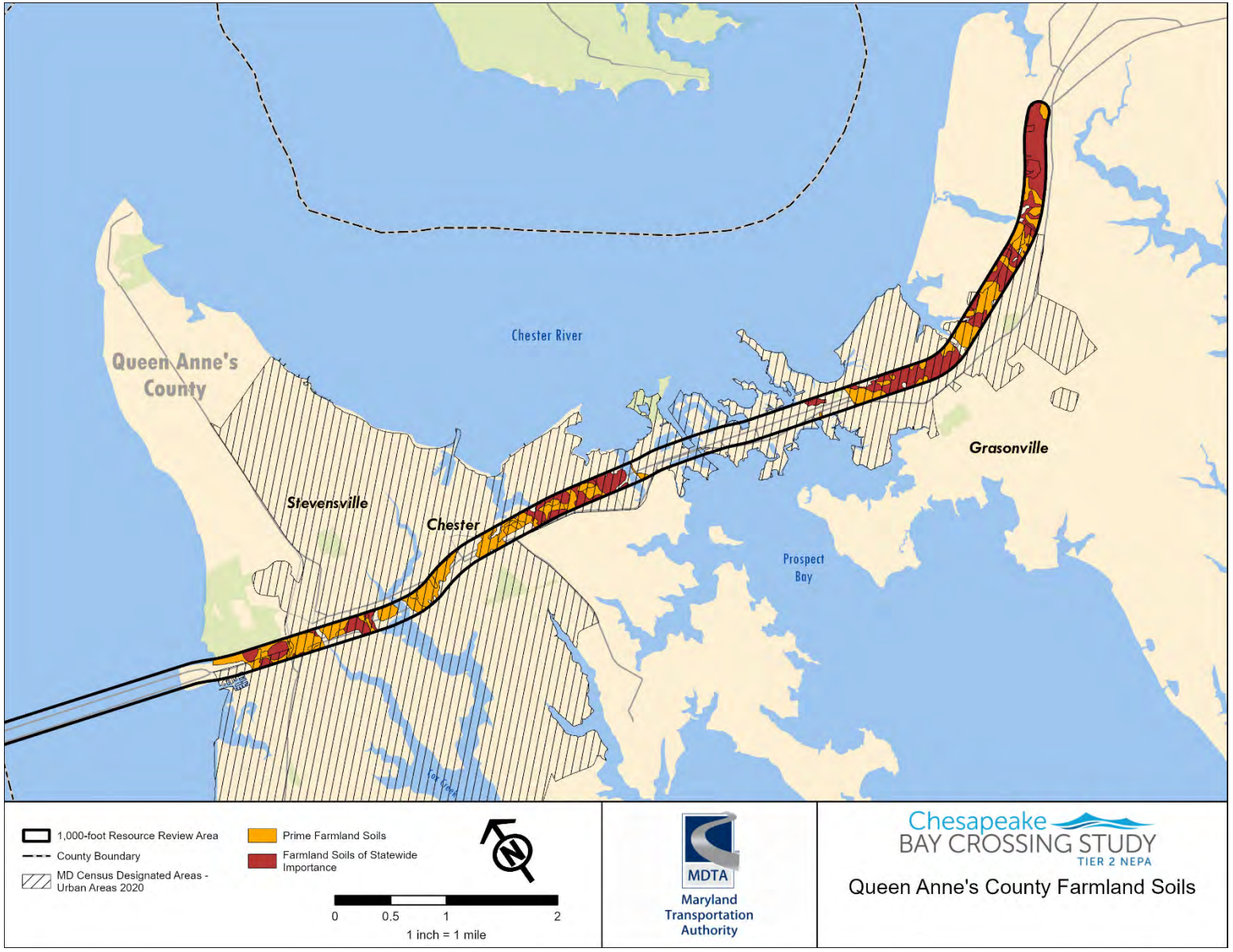
Within the resource review area of Anne Arundel County, no Prime Farmland Soils were identified, although a very minor area of Farmland Soils of Statewide Importance is located outside of urban designated areas. These soils are located just east of Meredith Creek/Colbert Road and south of U.S. 50/301. Within the resource review area of Queen Anne's County, Prime Farmland Soils and Farmland Soils of Statewide Importance located outside of urban designated areas were identified in three places: between the Bay Bridge and Romancoke Road, north of U.S. 50/301; east of Hissey Road and north of U.S. 50/301; and east of Nesbit Road throughout the remainder of the resource review area limits to the east.

Based on a review of 2023/2024 aerial imagery, an estimated seven potential agricultural fields (one in Anne Arundel County and six in Queen Anne's County) and one pasture (in Anne Arundel County) were observed within the resource review area. Only one of these areas identified in Queen Anne's County coincides with identified Prime Farmland Soil outside of census-designated urban areas, and no active farming operations were observed outside of census-designated urban areas in Anne Arundel County. Farm operations are addressed in the *Chesapeake Bay Crossing Study Socioeconomic and Land Use Technical Report*.

Figure 5-1: Farmland Soils – Anne Arundel County



Figure 5-2: Farmland Soils – Queen Anne's County



5.3 Environmental Consequences

The MDTA has evaluated potential impacts to soils and the presence of hydric soils and farmland soils located within the resource review area.

5.3.1 No-Build Alternative

The No-Build Alternative would have no impact to soils, including farmland soils and hydric soils.

5.3.2 Build Alternatives

5.3.2.1 Soils

The primary impact to soils from all build alternatives would be soil displacement due to construction activities. Construction activities would include cut/cover, excavation, filling, cutting, pile driving, vegetation clearing, and the development of impervious surfaces and physical elements. Soils may also be compacted from heavy equipment over non-paved areas during construction, which can reduce infiltration rates and exacerbate surface water runoff.

Table 5-3 provides the acreage of hydric soils that would be impacted by the build alternatives. **Table 5-4** provides the additional acreage of hydric soils that would be impacted by a SUP option associated with each of the build alternatives.

Table 5-3: Hydric Soil Impacts (acres)

No-Build	Build Alternative					
	B	C	D	E	F	G
0	4.4	4.5	25.5	25.6	28.0	28.1

Table 5-4: SUP Hydric Soil Impacts (acres)

No-Build	Associated Build Alternative					
	B	C	D	E	F	G
0	0.3	0.4	0.3	0.4	0.3	0.4

Because hydric soils tend to be less stable than drier non-hydric soils, the load-bearing strength of these soils may need to be increased if they are proposed to support structures or roadway construction. Alternatives D, E, F, and G would impact the greatest acreage of hydric soils due to the longer length of the build alternatives in Queen Anne's County, where these hydric soils are more prevalent. The presence of hydric soils is often correlated to potential wetland resources (Refer to **Section 9, Waters of the U.S, Including Wetlands** for the identification of wetland resources within the resource review area.) The addition of a SUP option with any of the build alternatives would result in between 0.3 acres and 0.4 acres of additional impacts to hydric soils.

5.3.2.2 Farmland Soils

Table 5-5 shows permanent impacts to Prime Farmland Soils and Farmland Soils of Statewide Importance beyond the limits of census-designated urban areas and existing transportation right-of-way for each build alternative. **Table 5-6** shows permanent impacts to Prime Farmland Soils and Farmland Soils of Statewide Importance beyond the limits of census-designated urban areas and existing transportation right-of-way associated with a SUP for each build alternative.

Farmland soils are shown on the natural resource map sets for the northern alignments (**Appendix B**) and southern alignments (**Appendix C**).

Table 5-5: Farmland Soil Impacts (acres)

Soil Type	No-Build	Build Alternative					
		B	C	D	E	F	G
Farmland Soils of Statewide Importance							
Anne Arundel County	0	8.9	8.9	8.9	8.9	8.9	8.9
Queen Anne's County	0	7.6	7.6	43.1	43.1	43.3	43.3
Total	**0**	**16.5**	**16.5**	**52.0**	**52.0**	**52.2**	**52.2**
Prime Farmland Soils							
Anne Arundel County	0	0	0	0	0	0	0
Queen Anne's County	0	3.9	3.9	17.2	17.2	19.4	19.4
Total	**0**	**3.9**	**3.9**	**17.2**	**17.2**	**19.4**	**19.4**

Table 5-6: SUP Farmland Soil Impacts (acres)

Soil Type	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
Farmland Soils of Statewide Importance							
Anne Arundel County	0	0	0	0	0	0	0
Queen Anne's County	0	0.3	0.3	0.3	0.3	0.3	0.3
Total	**0**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
Prime Farmland Soils							
Anne Arundel County	0	0	0	0	0	0	0
Queen Anne's County	0	0.9	0.6	0.9	0.6	0.7	0.4
Total	**0**	**0.9**	**0.6**	**0.9**	**0.6**	**0.7**	**0.4**

Alternatives B and C have the least impact on farmland soils, converting 3.9 acres of Prime Farmland Soils in Queen Anne's County and 16.5 acres of Farmland Soils of Statewide Importance in both counties to transportation use. Alternatives D, E, F, and G result in impacts to 69.2 to 71.6 acres of farmland soil, respectively, from the conversion of Farmland Soils of Statewide Importance to a transportation use in both counties, and the conversion of Prime Farmland Soils to a transportation use in Queen Anne's County. The SUP option would result in an additional 0.3 acres of impact to Farmland Soils of Statewide Importance and between 0.4 acres and 0.9 acres of additional impact to Prime Farmland soils. The SUP associated with Alternative G has the lowest impact to Prime Farmland soils while the SUP for Alternatives B and D has the greatest additional impact.

Under the FPPA, the conversion of farmland soils located outside of urban areas (regardless of whether they are actively farmed) to a non-agricultural use, such as transportation, constitutes a direct impact. Direct conversion occurs within the LOD, regardless of the duration of the work/feature (e.g., temporary laydown area or construction of permanent roadway) and results in the land no longer being usable for agriculture.

Indirect conversion occurs where an action results in restricted access to farmland (stream crossings and build alternative crossings are not considered to provide access; local roads are considered to provide access). Restricted access in urban areas does not constitute indirect conversion because soils in urban areas are not considered farmland under the FPPA.

All build alternatives have the potential to result in a direct conversion of Farmland Soils of Statewide Importance to transportation use east of Meredith Creek and south of U.S. 50/301 in Anne Arundel County, and in three areas of Prime Farmland Soils and Farmland Soils of Statewide Importance located outside of urban designated areas in Queen Anne's County. None of these areas are observed to have active farming activities; therefore, impacts to soils in these areas would not constitute an indirect conversion of farmland soils.

Although small areas of active farming were observed within the resource review area, no active farmland is currently identified within the limits of any of the build alternatives. Upon identification of the Preferred Alternative, the potential for active farmland operations to be affected would be reevaluated. It is anticipated that this only has the potential to occur in Queen Anne's County, and from Alternatives D, E, F and G, as they each require adjacent right-of-way in areas that are less developed and could be actively farmed. Queen Anne's County has a higher prevalence of adjacent open and agricultural fields and low-lying landscape than Anne Arundel County. Additional details regarding land use and potential active farmland are included in the *Chesapeake Bay Crossing Study Socioeconomic and Land Use Technical Report*.

Once the Preferred Alternative has been identified, the MDTA will prepare the NRCS-CPA-106 worksheet (*Farmland Conversion Impact Rating for Corridor Type Projects*), obtain NRCS input on Land Evaluation Information, and apply the corridor assessment criteria. The 10 criteria included in Part VI of the worksheet are listed below:

1. Area in Nonurban Use: Determined using Census Bureau GIS data for the LOD. Percentage in Nonurban Use scored according to the NRCS-CPA-106 guidance.
2. Perimeter in Nonurban Use: Determined using Census Bureau GIS data for the LOD. Percentage in nonurban use scored according to the NRCS-CPA-106 worksheet.
3. Percent of Corridor Being Farmed: Determined by field ground-truthing. Percentage of corridor being farmed scored according to the NRCS-CPA-106 guidance.
4. Protection Provided by State and Local Government: Determined by NRCS-provided state and local government farmland protection easement data.
5. Size of present farm unit compared to average.
6. Creation of Nonfarmable Farmland: The acreage of indirect farmland conversion is scored according to the NRCS-CPA-106 worksheet guidance.

7. Availability of Farm Support Services: Farm support services are generally available in Anne Arundel and Queen Anne's Counties.
8. On-Farm Investments.
9. Effects of Conversion on Farm Support Services.
10. Compatibility with Existing Agricultural Use.

5.4 Avoidance, Minimization, and Further Mitigation Strategies

The MDTA would approach design and development with the goal of avoiding and minimizing impacts to soils and farmland soils. The need for geotechnical investigations to identify specific soil characteristics that could affect constructability and/or methods of construction would be determined during final design. The MDTA will prepare an Erosion and Sediment Control (ESC) Plan during final design and ensure that appropriate Best Management Practices (BMPs) are in place during construction to minimize impacts on soils, especially in the areas of highly erodible soils in Anne Arundel County. The ESC Plan would be prepared in accordance with MDE guidelines. Successful implementation of appropriate BMPs would help ensure compliance with state and federal requirements, and that short-term and long-term soil impacts are maintained at acceptable levels. These measures could include consideration of the following elements during design and planning and later throughout construction:

- During the design phase, utilize 2:1 slopes whenever possible to minimize the overall area of disturbance and footprint of the roadway.
- Install and monitor erosion-prevention measures, such as silt fences and water breaks, sedimentation basins, filter fences, sediment berms, interceptor ditches, straw bales, riprap, swales, and/or other sediment control structures; and re-spreading stockpiled topsoil.
- Minimize the footprint of bare soils on site during construction.
- Seed and revegetate areas temporarily cleared of vegetation, and use native seed mixes and plants, whenever possible.
- Retain vegetation.
- Install and maintain soil-stabilizing vegetation, mulch, or man-made materials to provide soil stabilization on disturbed areas.
- Minimize soil compaction by restricting vehicle travel, avoiding working on wet soils, and restoring soil conditions when necessary.
- Conduct regular inspections of ESC measures, seeded/vegetated areas, and monitor for damage/unstable conditions so that identified issues can be repaired immediately.
- Soils removed may require testing prior to disposal. During construction, contractors would follow the U.S. Environmental Protection Agency (USEPA) guidelines to remove, test, and dispose of soils, including those that may be suspected of contamination. Testing ensures that soils can be safely placed into the environment at approved locations. Prior to construction, the MDTA would prepare a Construction Management Plan, which includes a Waste Management Plan. The Waste Management Plan would address

sampling analysis, characterization, handling, storing, transporting, and disposing of hazardous waste and construction and demolition waste generated during construction and operation activities.

Mitigation measures for areas of direct conversion of farmland soils to a transportation use may be difficult to implement, as the roadway design within both Anne Arundel and Queen Anne's counties is constrained by the necessity to tie into existing roadways. However, the goal of mitigation would be to reduce impacts to farmland soils.

Additional discussion of minimizing and mitigating impacts to soils can be found in **Section 4, Geology and Topography.**

6 GROUNDWATER AND WASTEWATER

The resource review area for groundwater and wastewater resources extends 1,000 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split.

Groundwater resources, including wells and aquifers, consist of water beneath the ground surface in the soil or pore spaces and the fractures of rock formations. An aquifer is a water-bearing rock or sediment formation that readily transmits a usable quantity of water to wells and springs. After entering an aquifer, water moves slowly toward lower-lying places and eventually is discharged from the aquifer from springs, seeps into streams, or is withdrawn from the ground by wells.

Wastewater is water used by homes, businesses, and industries that must be treated before it is released back into the environment. It includes substances such as human waste, food scraps, oils, soaps, and chemicals. In homes, this includes water from sinks, showers, bathtubs, toilets, washing machines, and dishwashers. Businesses and industries also contribute water used in industrial processes. Wastewater also includes storm runoff from roads, parking lots, and rooftops. If wastewater is not properly treated, the environment and human health can be negatively impacted. These impacts can include harm to fish and wildlife populations, oxygen depletion, beach closures and other restrictions on recreational water use, restrictions on fish and shellfish harvesting, and contamination of drinking water. Primary treatment of wastewater removes about 60 percent of suspended solids and aerates the wastewater to return oxygen; secondary treatment removes more than 90 percent of suspended solids (USGS, 2023b).

6.1 Regulatory Context and Methodology

Congress enacted the Safe Drinking Water Act (SDWA) in 1974 (Public Law 93-523, 42 U.S.C. 300 et. seq), amended and reauthorized in 1986 and 1996. It is the main federal law that ensures the quality of Americans' drinking water and authorizes the USEPA to set national standards for drinking water to protect against health effects from exposure to naturally occurring and man-made contaminants. These drinking water standards only apply to public water systems, and the EPA works with states, localities, and water suppliers who apply these standards (EPA, 2024a).

Wellhead protection is a strategy designed to protect public drinking water supplies by managing the land surface around a well where activities might affect the quality of the water. The SDWA Amendments of 1986 require each state to develop Wellhead Protection Programs. The USEPA approved Maryland's Wellhead Protection Program in June of 1991. Maryland's program provides technical assistance, information, and funding to local governments to help them protect their water supplies by defining a Wellhead Protection Area (WHPA) around a drinking water well where contaminants could enter and pollute the well. The MDE's Water Supply Program assists landowners in defining the WHPAs (MDE, 2024a).

The Sole Source Aquifer (SSA) program, authorized by Section 1424(e) of the SDWA, enables the USEPA to designate an aquifer as a sole source of drinking water and establish a review area. The USEPA defines an SSA as one where: 1) the aquifer supplies at least 50 percent of the drinking water for its service area; and 2) there are no reasonably available alternative drinking water sources should the aquifer become contaminated. The USEPA has the authority to review proposed projects that both receive federal funding and are located within the resource review area (area overlying the SSA) (EPA, 2024a).

The MDE has the responsibility of controlling the impacts of groundwater withdrawal in Maryland through the Water Appropriations and Use Permit process (Code of Maryland Regulations [COMAR] 26.17.06 and 26.17.07). Through the permit review process, the MDE Water Supply Program works to ensure that groundwater withdrawals do not exceed the sustained yield of the state's aquifers. The permitting process also ensures that public drinking water systems obtain the best possible source of water for quality and sustainability.

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into Waters of the United States (WOTUS) and regulating quality standards for surface waters. The CWA primarily regulates pollutant discharges to surface waters and may only indirectly affect groundwater. The CWA requires a National Pollutant Discharge Elimination System (NPDES) permit for the discharge of pollutants through a point source to surface water or groundwater. Pollutants include any type of municipal, industrial, and agricultural waste such as dredged soil, solid waste, incinerator residue, sewage, sewage sludge, garbage, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste. A point source is any discernible, confined, and discrete conveyance, such as a pipe, ditch, channel, tunnel, conduit, discrete fissure, or container. The NPDES permit program is authorized to state governments by the USEPA to perform many permitting, administrative, and enforcement aspects of the program. The MDE issues state NPDES permits under provisions and conditions of COMAR 26.08.01. In Maryland, private septic systems are regulated by the MDE. Septic systems must be designed and constructed according to specific criteria, including minimum tank capacities based on the number of bedrooms in a residence. Public septic systems in Maryland are also regulated by the MDE, which provides technical assistance and direction to county health departments and local approving authorities for the implementation of programs related to onsite sewage disposal systems (OSDS) and individual wells. The MDE ensures compliance with COMAR and provides guidance on the design, installation, operation, and maintenance of these systems.

The MDTA gathered publicly available information on groundwater and wastewater resources, including GIS data from the Anne Arundel County Department of Public Works, Queen Anne's County Department of Public Works, MDE Water Supply Program, MGS, USGS, and USEPA. The MDTA evaluated existing conditions, overlaid existing resources on the 2,000-foot-wide resource review area mapping, and assessed the potential for impacts to groundwater and wastewater resources. Potential impacts to groundwater were determined based on the proximity of public drinking water sources and aquifers to the resource review area. Potential impacts to OSDS were determined by reviewing publicly available information, where available, for wastewater resources, including GIS data from the Anne Arundel County Department of Public Works. Available information for Queen Anne's County was more limited.

6.2 Affected Environment

6.2.1 Groundwater

Groundwater is water that is held underground in the soil or pores and crevices in rock. Groundwater characteristics can be directly correlated with the surrounding natural environment such as forests, wetlands, and waterways, as well as the surrounding human environment. Most aquifers in the Coastal Plain are overlain by low permeability clay layers (forming confined or artesian aquifers), which prevent surface contaminants from reaching the aquifers (MGS, 2023). Much of the public water supply in southern Maryland and most of the Delmarva Peninsula,

including the Eastern Shore, comes from confined aquifers. The primary confined aquifers in Maryland from shallowest to deepest include: Manokin, Piney Point, Aquia, Magothy, Patapsco, and Patuxent (USGS, 2017). No sole source aquifers were identified in Anne Arundel or Queen Anne's counties (EPA, 2024b), where the resource review area is located.

In the Coastal Plain physiographic province, groundwater flows through pore spaces between sand and gravel particles – known as intergranular flow. Wells in the Coastal Plain commonly have moderate to very high yields. Groundwater levels are not affected significantly by short-term variations in climate (droughts and wet periods) but typically do respond readily to increased groundwater withdrawals (MGS, 2023).

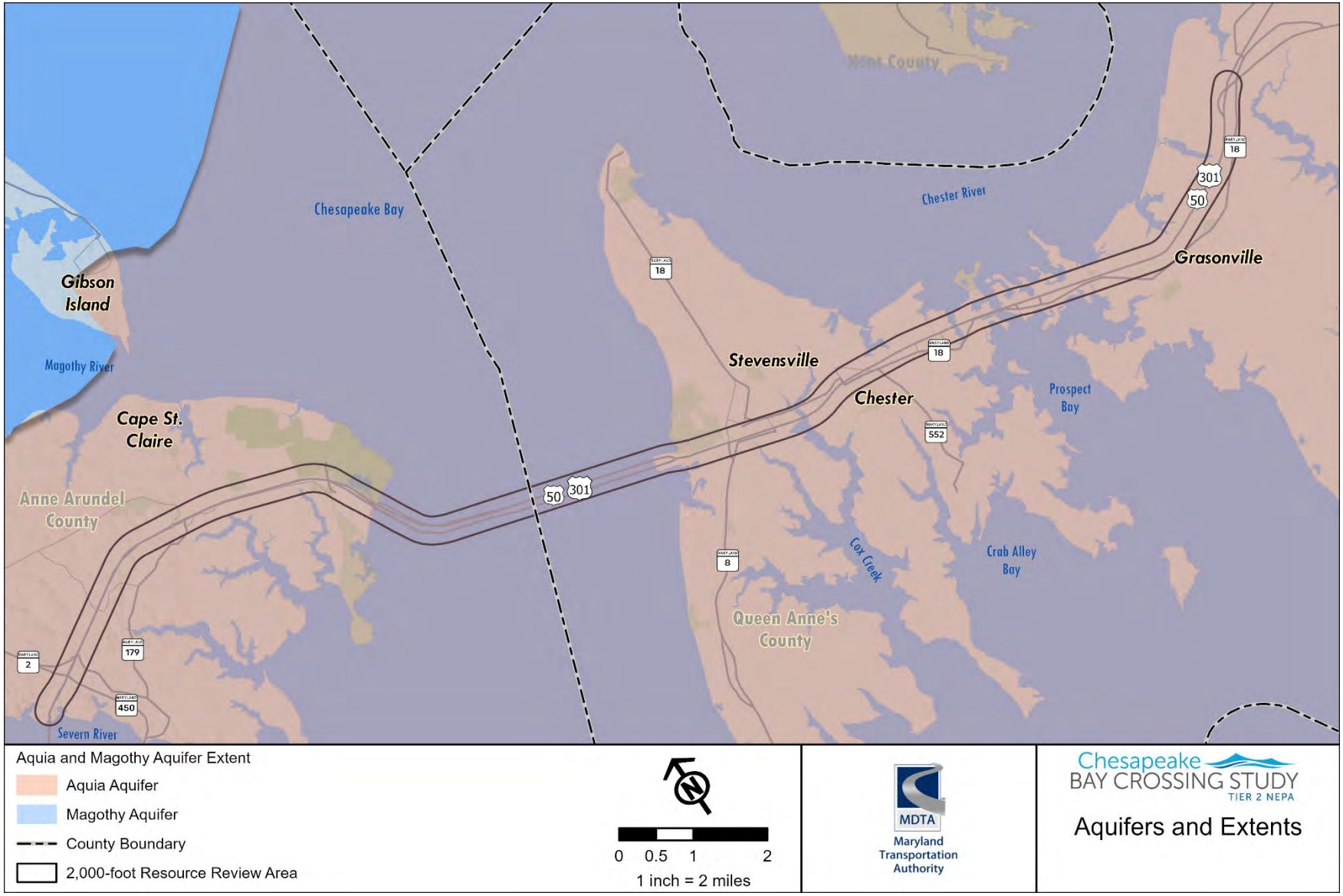
Groundwater recharge zones occur beneath the surface of the ground within a zone of saturation, whether flowing through known and definite channels or percolating through underground geologic formations, and regardless of whether they are the result of natural or artificial recharge.

Within the resource review area, Anne Arundel County relies almost entirely on groundwater from the Magothy and Aquia aquifers for both its municipal water supply and as the water source for private wells serving individual homes (Anne Arundel County, 2021). Groundwater from the Magothy and Aquia aquifers is also the main source for municipal, industrial and private water supplies in Queen Anne's County. This is due to the availability of groundwater of good to moderate quality and the lack of suitable surface impoundment sites (Queen Anne's County, 2011).

- Magothy aquifer: Current water levels within the aquifer range from 4 feet above sea level west of Annapolis to 24 feet below sea level in Broadneck. Overall, water levels show a relatively flat trend with seasonal fluctuation due to water use over the last 10 years.
- Aquia aquifer: The water level within the aquifer in Southern Anne Arundel County at the Deale Athletic Field was 32 feet below sea level. While fluctuating seasonally by as much as approximately 5 feet due to local pumpage, the overall water level trend since about 2006 has been relatively flat.

Figure 6-1 depicts the aquifer outcrop area for the Magothy Aquifer, or the area where the aquifer formation is exposed at the ground surface, which serves as the primary recharge zone for the aquifer. Note that the Magothy Aquifer extends underground to the southeast of where its outcropping is shown on **Figure 6-1** and underlies the area where the Aquia Aquifer is shown in the figure on the Western Shore of the Chesapeake Bay and extending into Queen Anne's County, Talbot County, and Dorchester County on the eastern shore of the Chesapeake Bay.

Figure 6-1: Aquifers



According to the USGS National Water Information System mapper, there are 19 active groundwater wells representing aquifers within and near the resource review area (**Figure 6-2**). Three wells are located within the 2000-foot resource review area. Because groundwater is a regional resource and not directly indicative of surface conditions immediately above a given location in the aquifer, 16 additional wells near the resource review area have also been included. All 19 wells help to characterize the groundwater within the resource review area. **Table 6-1** provides details on the 19 active wells, including a range of depths to the ground water level. Within the wells in the resource review area, the depth to groundwater ranges from approximately 11 to 50 feet below ground level, and within the wells adjacent to the resource review area, the depth to groundwater ranges from approximately <1 to 240 feet below ground level. Local variations in the depth to groundwater and localized flow directions are expected due to urbanization and redevelopment activities that have occurred within the resource review area (USGS, 2020).

Figure 6-2: Groundwater Wells Representing Aquifers that Underlie the Resource Review Area

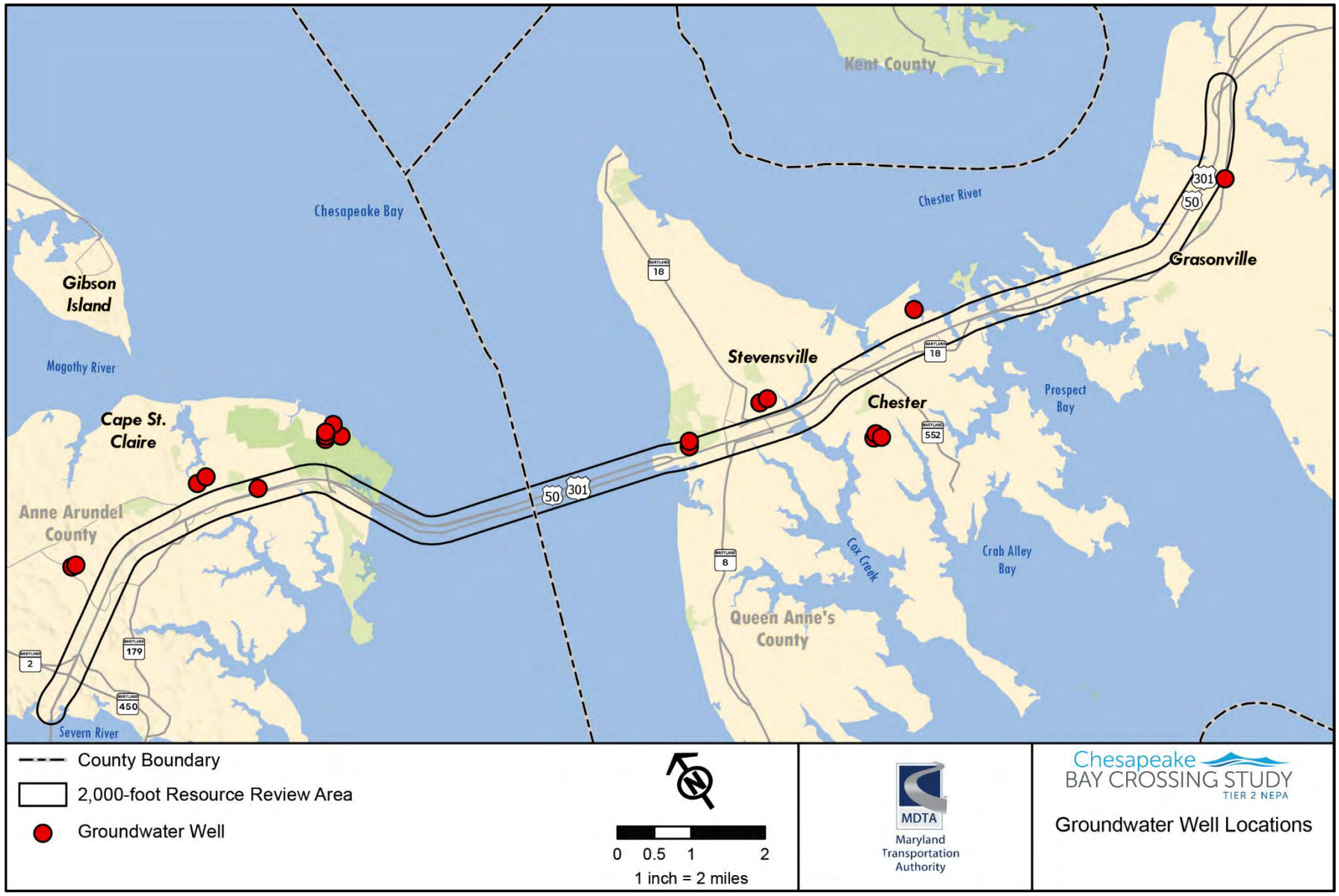


Table 6-1: USGS Groundwater Wells Representing Aquifers that Underlie the Resource Review Area

USGS Code	Well Name	Latitude	Longitude	National Aquifer	Local Aquifer	Depth to water level* (Feet)
390154076282801	AA Cf 166	39°01'53.61	76°28'28.08	Not Reported	Patuxent Formation	154 - 240
390154076282802	AA Cf 167	39°01'53.56"	76°28'27.77	Not Reported	Lower Patapsco Aquifer in the Patapsco Formation	144 - 195
390149076261703	AA Cf 128	39°01'49"	76°26'17"	Northern Atlantic Coastal Plain aquifer system	Upper Patapsco Aquifer in the Patapsco Formation	36 - 41
390149076261702	AA Cf 122	39°01'50.2"	76°26'14.6"	Northern Atlantic Coastal Plain aquifer system	Aquia Aquifer	17 - 20
390121076253301	AA Cf 152Δ	39°01'21.28"	76°25'34.53"	Northern Atlantic Coastal Plain aquifer system	Magothy Aquifer	45 - 50
390123076241602 Location has 3 sites	AA Cg 23	39°01'23"	76°24'16"	Northern Atlantic Coastal Plain aquifer system	Lower Patapsco Aquifer in the Patapsco Formation	43 - 58
390123076241102	AA Cg 7	39°01'23"	76°24'11"	Northern Atlantic Coastal Plain aquifer system	Magothy Aquifer	35 - 50
390127076240301	AA Cg 25	39°01'27	76°24'03	Northern Atlantic Coastal Plain aquifer system	Aquia Aquifer	14 – 16
385852076195202 Location has 2 sites	QA Eb 157Δ	38°58'52"	76°19'52"	Northern Atlantic Coastal Plain aquifer system	Aquia Aquifer	11 -12
385850076183601	QA Eb 167	38°58'50"	76°18'36"	Northern Atlantic Coastal Plain aquifer system	Upper Patapsco Aquifer in the Patapsco Formation	34 - 37
385850076183501	QA Eb 182	38°58'50"	76°18'33"	Northern Atlantic Coastal Plain aquifer system	Lower Patapsco Aquifer in the Patapsco Formation	46 - 69

USGS Code	Well Name	Latitude	Longitude	National Aquifer	Local Aquifer	Depth to water level* (Feet)
385751076171602 Location has 3 sites	QA Eb 112	38°57'51"	76°17'16"	Northern Atlantic Coastal Plain aquifer system	Lower Patapsco Aquifer in the Patapsco Formation	43 - 52
385843076155302	QA Eb 155†	38°58'43"	76°15'53"	Northern Atlantic Coastal Plain aquifer system	Aquia Aquifer	8 - 11
385756076105301	QA Ec 1	38°57'56.6"	76°10'52.1"	Northern Atlantic Coastal Plain aquifer system	Kent Island Formation	<1 - 8

† Well includes water quality data within the last twenty years.
* Depth to water level fluctuates over time. Values shown represent the minimum and maximum depth to water level in feet below land surface, since 2015.
Δ Well located within the resource review area.

Groundwater contaminants can come from a variety of sources. Common highway runoff contaminants that impact both surface and groundwater are listed in **Table 6-2** (Kobringer and Geinopolos, 1984; Barrett et al., 1995). The existing areas of impervious surfaces on and alongside U.S. 50/301 are most likely to be exposed to various contaminants, such as chlorides from road salt/deicing operations, fuel spills from accidents that flow off the road surface, and fluids leaking from vehicles/motorized equipment, etc., which can contaminate groundwater. In addition, potential contaminants are generated by the various properties located along existing U.S. 50/301, such as gas stations, auto repair facilities, car washing facilities, older drycleaning facilities, and equipment laydown yards.

The USEPA's National Primary Drinking Water Standards regulate the allowable amounts of these listed compounds within drinking water due to concerns over human and environmental health (EPA, 2009). The Secondary Drinking Water Standards recommend acceptable levels of compounds that can cause cosmetic effects or aesthetic effects to drinking water, such as poor taste or smell (EPA, 2009). This designation is listed in the table where applicable, as well as the origin of these pollutants within the scope of highway activities.

Table 6-2: Common Highway Runoff Contaminants and Associated USEPA Drinking Water Standards

Contaminant	Primary Source on Roadways	Primary or Secondary Pollutant*	USEPA Maximum Contaminant Limit (MCL)*	Units
Arsenic	Fossil fuel combustion	Primary	10	ug/L
Cadmium	Exhaust, tire wear	Primary	5	ug/L
Chromium	Wear of engine parts, brake lining wear	Primary	100	ug/L
Lead	Exhaust, tire wear, fossil fuels	Primary	15	ug/L

Contaminant	Primary Source on Roadways	Primary or Secondary Pollutant*	USEPA Maximum Contaminant Limit (MCL)*	Units
Nitrate (measured as Nitrogen)	Roadside fertilizer	Primary	10,000	ug/L
Nitrite (measured as Nitrogen)	Roadside fertilizer	Primary	1,000	ug/L
Turbidity	Sediment runoff, pavement wear, highway maintenance	Primary	1	NTU
Copper	Vehicle fluids and fuel	Primary/Secondary	1,300/1,000	ug/L
Total Dissolved Solids	Includes salts from roadway deicing.	Secondary	500,000	ug/L
Iron	Auto body rust, metal roadway components (bridges, guardrails, etc.), wear of engine parts	Secondary	300	ug/L
Manganese	Wear of engine parts	Secondary	50	ug/L
Zinc	Tire wear, motor oils	Secondary	5,000	ug/L
Sulfate	Pavement, fuel, deicing salts	Secondary	250,000	ug/L
Nickel	Fossil fuels, metal plating, brake wear, asphalt paving	N/A	N/A	
Ammonia	Roadside fertilizer	N/A	N/A	
Phosphorus	Roadside fertilizer	N/A	N/A	

*N/A = No USEPA Primary or Secondary Drinking Water Standard, but still a known constituent of highway runoff with potential environmental effects.

Source: Kobringer and Geinopolos,1984; Barrett et al., 1995; USEPA, 2009.

Recent (within the past 20-years) groundwater quality data is only available for one of the 19 USGS groundwater wells located within and near the resource review area, detailed in **Table 6-1**, Well QA Eb 155. Water quality data for the other wells was either collected prior to 2005 and/or did not contain data for the applicable common highway contaminants included in **Table 6-2.** Groundwater quality data for Well QA Eb 155 is presented in **Table 6-3**.

Table 6-3: Groundwater Quality Data for Selected Pollutants

Well Name	QA Eb 155
pH	8.06
Nitrate (ug/L as N)	Not Detected
Nitrite (ug/L as N)	Not Detected
Total Dissolved Solids (ug/L)	**926,689**
Iron (ug/L)	61.6
Manganese (ug/L)	12.7
Sulfate (ug/L)	66,400
Ortho-phosphate (ug/L as P)	60

Groundwater quality data measurements were collected from 07/01/2005 – 09/28/13
Bold values indicate a concentration higher than the established USEPA Maximum Contaminant Limit (Table 6-2: Common Highway Runoff Contaminants and Associated USEPA Drinking Water Standards).
Source: USGS, 2016

Groundwater quality data was reviewed for Well QA Eb 155 to provide a snapshot of existing conditions relative to the pollutants listed in **Table 6-2**. Data from Well QA Eb 155 may or may not be indicative of the overall resource review area, but is the only publicly available data, and indicates total dissolved solids are above Secondary Drinking Water Standards. These elevated values could indicate impacts from road salting operations, the existing geology, or a combination of both geologic components and human activities in the surrounding area. All other pollutants measured at this well were within the USEPA Primary and/or Secondary Drinking Water Standards limits.

The MDTA received information from the MDE to identify existing WHPAs in the vicinity of the resource review area. Factors such as flow rate, direction, and groundwater levels, as well as existing sources of nearby contamination, can all affect the selection of a WHPA and how it is anticipated to function. The MDE has determined that no WHPAs exist within the resource review area (see **Appendix D**).

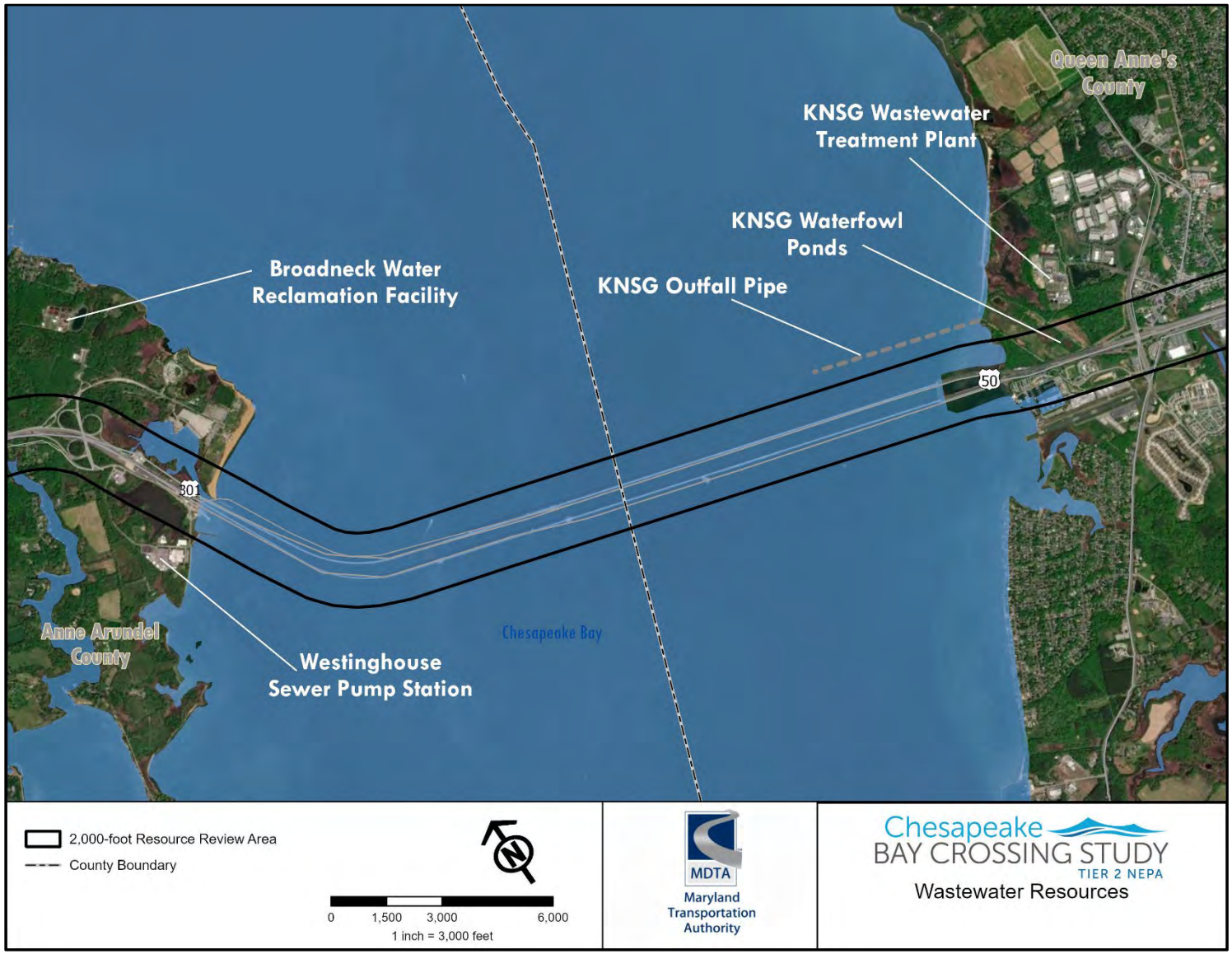
6.2.2 Wastewater

Wastewater resources include water treatment facilities and outfalls, sewer force mains, gravity and low-pressure sewer lines, pump stations, and private septic systems. While some information related to private and public septic systems was available for Anne Arundel County, which has more private septic systems than public sewer, this information was not available for Queen Anne's County. Queen Anne's County has private septic systems near the Chesapeake Bay and transfers to public sewer with a force main about 2 miles west of the Bay Bridge, where private septic systems are not as common. There are two water treatment facilities that serve the resource review area, the Broadneck Water Reclamation Facility (WRF) in Anne Arundel County and the Kent Narrows, Stevensville, Grasonville (KNSG) Wastewater Treatment Plant (WTP) in Queen Anne's County.

Anne Arundel County's Broadneck WRF is located just north of Sandy Point State Park and has a treatment capacity of approximately 6 million gallons per day (MGD). This capacity allows the facility to effectively manage and treat wastewater from the surrounding communities, ensuring that the treated water meets environmental standards before being released back into local water bodies.

Queen Anne's County KNSG WTP has a capacity of 3.3 MGD. The KNSG outfall is located just north of the Bay Bridge (where it makes landfall in Queen Anne's County) and extends 0.75 miles west into the Chesapeake Bay at depths ranging from 1 foot to 28 feet. Adjacent to the KNSG WTP are two outfall areas, identified as Waterfowl Ponds 1 and 2. Permit 21-DP-2885 was issued on April 1, 2023, to discharge treated wastewater to these ponds. The permit allows Ponds 1 and 2 (each about 2.5 acres in size) to receive 700,000 gallons of treated sewage effluent from the KNSG WTP, mostly from September 1st to April 1st in any given year. The monthly average discharge may not exceed 0.7 MGD. The soil at the site of the ponds is classified as slowly permeable Woodstown soil series. Sewage confined in the ponds may leak into the shallow aquifer and laterally move to the Chesapeake Bay. No wells are located between the ponds and the Chesapeake Bay and the MDE determined there would be no impact to wells from the ponds. The ponds are not currently in use because of insufficient overflow from the weir but provide extra capacity if needed. Wastewater is currently treated at the KNSG WTP and additional treatment from the waterfowl ponds is not expected (MDE, 2023). **Figure 6-3** shows wastewater resources within the resource review area.

Figure 6-3: Wastewater Resources



6.3 Environmental Consequences

The MDTA has evaluated the potential impacts to groundwater and wastewater from the proposed build alternatives.

6.3.1 No-Build Alternative

The No-Build Alternative would have no impact to groundwater or wastewater resources.

6.3.2 Build Alternatives

A qualitative analysis was conducted of anticipated impacts to groundwater resources and wastewater.

6.3.2.1 Groundwater

The relatively shallow depth of construction activities associated with all the build alternatives would not likely be deep enough to impact any municipal/public water systems, although temporary disruptions to public water service may occur as the contractor would need to reconfigure/reconnect any lines that may need to be moved due to construction activities. The roadway construction is not likely to be deep enough to affect wells. Existing private wells are set back far enough from the roadway alignment that they would not be impacted by the build alternatives. WHPAs are not located within or near the resource review area and no impacts to WHPAs are anticipated.

Each of the build alternatives could impact the quantity and quality of groundwater recharge that enters the Magothy and Aquia aquifers due to the increase in impervious surfaces that redirects potential groundwater recharge to surface water bodies. Impacts to surface waters and general water quality and the amount of impervious surface increase estimated for each build alternative are discussed in detail in **Section 8 Surface Water Resources.**

Impacts associated with the use of the road after construction include potential for contamination of groundwater by runoff from new impervious roadway surfaces. The proposed roadway widening would accommodate more traffic, which would increase contaminants that could then be conveyed to the groundwater via new impervious surfaces. Potential contaminants to surface waters, which can then leach into the groundwater system, include heavy metals, deicing compounds, organic pollutants, and hazardous chemical spills. Alternatives D, E, F, and G would result in substantially more impervious surface than Alternatives B and C due to the extended length and width of roadway improvements, as well as the larger proposed bridge surface. Alternatives F and G would result in the greatest amount of new impervious surface. The optional SUP would increase new impervious area, with the optional SUP under Alternatives C and E adding slightly more impervious area than the other build alternatives. See **Tables 8-6** and **8-7** in **Section 8 Surface Water Resources**.

Deicing compounds that are used during the winter for highway safety maintenance can also eventually make their way into groundwater, affecting water quality. Runoff containing road salts, among other things, can cause elevated conductivity in surface waters, especially during the spring, and can leach into the sediment and contaminate groundwater. Elevated total dissolved solids were noted for Well QA Eb155, the only well with available water quality data in the review area. These elevated values could indicate impacts from road salting operations, the existing

geology, or a combination of both geologic components and human activities in the surrounding area.

During construction of the build alternatives, releases of hazardous materials into the environment have a potential to affect surface water quality as well as groundwater quality, if the release were to occur on impervious surfaces or in proximity to a groundwater well or body of water. Additional information regarding potential areas of concern that have been identified within the resource review area is presented in the *Chesapeake Bay Crossing Study Initial Site Assessment Technical Report* which addresses hazardous materials.

Construction of the build alternatives could reduce infiltration into the shallow portions of aquifers, reducing or redirecting available hydrology. It is anticipated that localized changes in hydrology could occur. However, these impacts are not expected to change the overall sub-watershed or watershed hydrology. The effects of a widened roadway on deep groundwater reserves are similar to the overall effects of suburban development. Differences in potential quantity impacts between the build alternatives are related to the overall footprint on the landscape, with Alternatives F and G having the largest footprint and Alternatives B and C having the smallest footprint. Addition of the optional SUP would increase the overall footprint of the build alternatives to a similar degree, with the SUP for Alternatives C and E resulting in a slightly larger footprint than the SUP for the other build alternatives.

6.3.2.2 Wastewater

The build alternatives are not expected to impact wastewater facilities. One site with an active groundwater discharge permit, the KNSG Waterfowl Ponds, is located 0.25 miles northeast of where the Bay Bridge makes landfall on the east side of the Chesapeake Bay. The ponds are not currently in use because of insufficient overflow from the weir. The ponds are located within the resource review area but outside the build alternatives.

6.4 Avoidance, Minimization, and Further Mitigation Strategies

6.4.1 Groundwater

Construction of any of the build alternatives would result in an increase in the amount of impervious surface area, removal of vegetation, risk of accidental release due to vehicular transport, and alteration of the surrounding environment. The MDTA would approach design and development with the goal of avoiding and minimizing impacts to groundwater resources by optimizing opportunities to incorporate Environmental Site Design (ESD) to meet (and exceed, where feasible) groundwater protection requirements along the roadway and the Bay Bridge.

To mitigate potential impacts to groundwater, the MDTA would adhere to the developed ESD and required BMPs, ESC, and stormwater management (SWM) practices to treat runoff from new impervious surfaces, manage stormwater quality and quantity, and implement MDE recommendations on managing stormwater in a way that mimics natural infiltration. BMPs are designed to help attenuate and infiltrate runoff, filter pollutants, and trap sediments. Such measures reduce potential impacts to groundwater due to additional impervious surfaces in the watersheds. The MDTA would coordinate with the MDE to develop a SWM plan that incorporates groundwater recharge, as appropriate per state requirements.

In the case of petroleum or chemical transports, any spills would likely concentrate in roadside ditches. Because the ditches would be vegetated, much of the liquid would be bound and detained within the vegetation and soil with relatively little contamination reaching the sand filters and ponds. Because spills are acute isolated events, as opposed to chronic long-term events, the MDTA would use its existing operational procedures to work with the MDE to contain and remediate areas that are contaminated should an emergency occur.

The effects of road salt may be mitigated by using alternative anti-icing techniques, such as pre-application of brine. The MDTA would use the appropriate BMPs included in the Maryland Salt Management Plan.

MDTA would submit an application to MDE for a Water Appropriations and Use Permit for non-agricultural withdrawal of water for construction activities (making concrete, concrete curing, dust control, hydroseeding, and construction dewatering). The source of the water supply and how much water will be pumped will be determined during final design and permitting.

6.4.2 Wastewater

Impacts to OSDS from the build alternatives could be mitigated by upgrading the conventional septic systems that are impacted by either connecting the dwelling to a public sewer connection or installing nitrogen removing Best Available Technology.

The MDTA would coordinate with the MDE Water Supply Program, part of the Water and Science Administration, appropriate local governments, water suppliers, and other agencies to further assess the potential for impacts and develop appropriate measures to avoid or minimize impacts, as needed. During final design, the MDTA would develop a Waste Management Plan and Spill Prevention Plan that addresses measures to avoid and minimize, and mitigate, if necessary, a potential threat of contamination.

7 FLOODPLAINS

The resource review area for floodplains extends 500 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split. Floodplains are those areas of land susceptible to flooding and thus subject to regulatory oversight and management by a specific governmental jurisdiction. These areas are typically delineated based on hydrological characteristics and regulations are enforced to guide responsible land use practices, mitigate flood risks, and protect both the human and natural environments.

Maryland distinguishes between tidal and nontidal floodplains. Tidal floodplains are areas adjacent to tidal waters that are subject to periodic flooding due to tidal action. Tidal floodplains exist along the Chesapeake Bay. Nontidal floodplains are areas along nontidal waterways, such as rivers and streams, where flooding is primarily driven by precipitation, stormwater runoff, and river discharge. The FEMA 100-year floodplain is an area where there is a 1 percent chance of flooding in any given year; the 500-year floodplain is an area where there is a 0.2 percent chance of flooding in any given year.

7.1 Regulatory Context and Methodology

The 100-year floodplain is also known as the base floodplain and is the area that has a 1% or greater chance of flooding in any given year. FEMA issues Flood Insurance Rate Maps (FIRM) to identify the regulatory 100-year floodplain and floodways for the National Flood Insurance Program (NFIP).

FHWA regulations prescribe “policies and procedures for the location and hydraulic design of highway encroachments on floodplains” to avoid and minimize potential floodplain encroachment from federal highway projects (23 CFR 650 Subpart A). A Location Hydraulic Study is required by 23 CFR 650.111 for all actions within the base (i.e., 100-year) floodplain. Location studies must include evaluation and discussion of the practicability of alternatives to any significant encroachments or any support of incompatible floodplain development. A project-related floodplain impact is considered a significant encroachment under 23 CFR 650 Subpart A if the encroachment results in “a significant potential for interruption or termination of a transportation facility which is needed for emergency vehicles or provides a community's only evacuation route; a significant risk, or a significant adverse impact on natural and beneficial floodplain values.”

COMAR 26.17.04, Construction in Nontidal Waters and Floodplains, provides MDE with the authority to regulate FEMA-designated 100-year floodplains associated with nontidal waters. Work within 100-year floodplains requires authorization via MDE’s Wetlands and Waterways Protection Program wetland/waterway impact permitting process and/or a Waterway Construction Permit. The MDE requires engineering and hydrologic and hydraulic (H&H) analyses for bridges, culverts, and other construction activities that could affect the course, current, or cross-section of nontidal streams and waterbodies, including the 100-year floodplain of those systems. Permit compliance for activities within a jurisdictional floodplain mandates that development may not increase flooding or create a dangerous situation during flooding on downstream properties. More specifically, projects cannot increase the risk of flooding to properties not owned by the project applicant (COMAR 26.17.04.11.B(6)). The regulation stipulates no specific amount of increase, however, through policy, MDE has applied a maximum 0.1-foot increase criteria when detailed hydraulic modeling has been performed.

Although the MDE and the U.S. Army Corps of Engineers (USACE) do not regulate the tidal floodplain specifically through the wetland and waterway permitting process, measures to address these tidal areas are managed and governed through Maryland's Tidal Wetlands Act and Critical Area Law. The MDE, the State's Chesapeake Bay Critical Area Program administered through MDNR, and local county Critical Area Programs impose regulations on development in tidal wetlands and within the surrounding Chesapeake Bay Critical Area. These regulations collectively ensure that tidal floodplain impacts are managed to protect public safety, property, and natural resources.

Generally, the FEMA 500-year floodplain is not regulated by 23 CFR 650 Subpart A, MDE, or by Queen Anne's or Anne Arundel counties. However, critical facilities (hospitals, sewer treatment plants, etc.) are often subject to more stringent standards. According to Maryland's Model Floodplain Management Ordinance, if a critical facility is located within a Special Flood Hazard Area, it must be protected to at least the 500-year flood level.

For this analysis, FIRMs were used to identify the jurisdictional 100-year floodplain within the resource review area. Maryland iMap GIS was used to calculate acreages and identify properties that could be affected by a rise in flood elevation due to road widening and construction of a new bridge.

To evaluate changes within the Bay and along its nearby shoreline, MDTA developed a hydrodynamics model (see **Appendix F**) to examine the effects of additional structures (e.g., piers or islands) on circulation in and around a new bridge, and a shoreline change assessment (see **Appendix G**) to evaluate changes to the shoreline, which would also change the extent of the tidal floodplain. These analyses will not only help identify potential impacts within the Chesapeake Bay and its shoreline but help to inform the design of a new bridge configuration, spans, and orientation. The hydrodynamic modeling and Shoreline Assessment are discussed further in **Section 9.2, Waters of the U.S. Including Wetlands, Chesapeake Bay**.

7.2 Affected Environment

There are no FEMA regulatory floodways with the review area. The FEMA FIRMs identify approximately 380 acres of FEMA-mapped 100-year floodplain (**Figure 7-1** and **Figure 7-2**), which constitutes approximately 15 percent of the floodplain resource review area. In Anne Arundel County, the floodplain resource review area crosses the nontidal floodplains associated with Mill Creek, Whitehall Creek, Meredith Creek, and tidal floodplain adjacent to the Chesapeake Bay and within Mezick Pond and Westinghouse Bay.

Large areas of nontidal and tidal floodplain are located in Queen Anne's County and include those associated with the shoreline of the Chesapeake Bay, Thompson Creek, Cox Creek, Macum Creek, Piney Creek, Kent Narrows, and Chester River tributaries such as Muddy Creek, Jackson Creek, Winchester Creek, and Walsey Creek along the northern side of the floodplain resource area, and the Wye River along the southern side at the far eastern study limit. The existing U.S. 50/301 roadway is generally elevated above the 100-year floodplain in all but a few small areas, the largest of which are Mill Creek on the Western Shore and Winchester Creek on the Eastern Shore, where both floodplains cross over the roadway.

Figure 7-1: FEMA Floodplain – Anne Arundel County

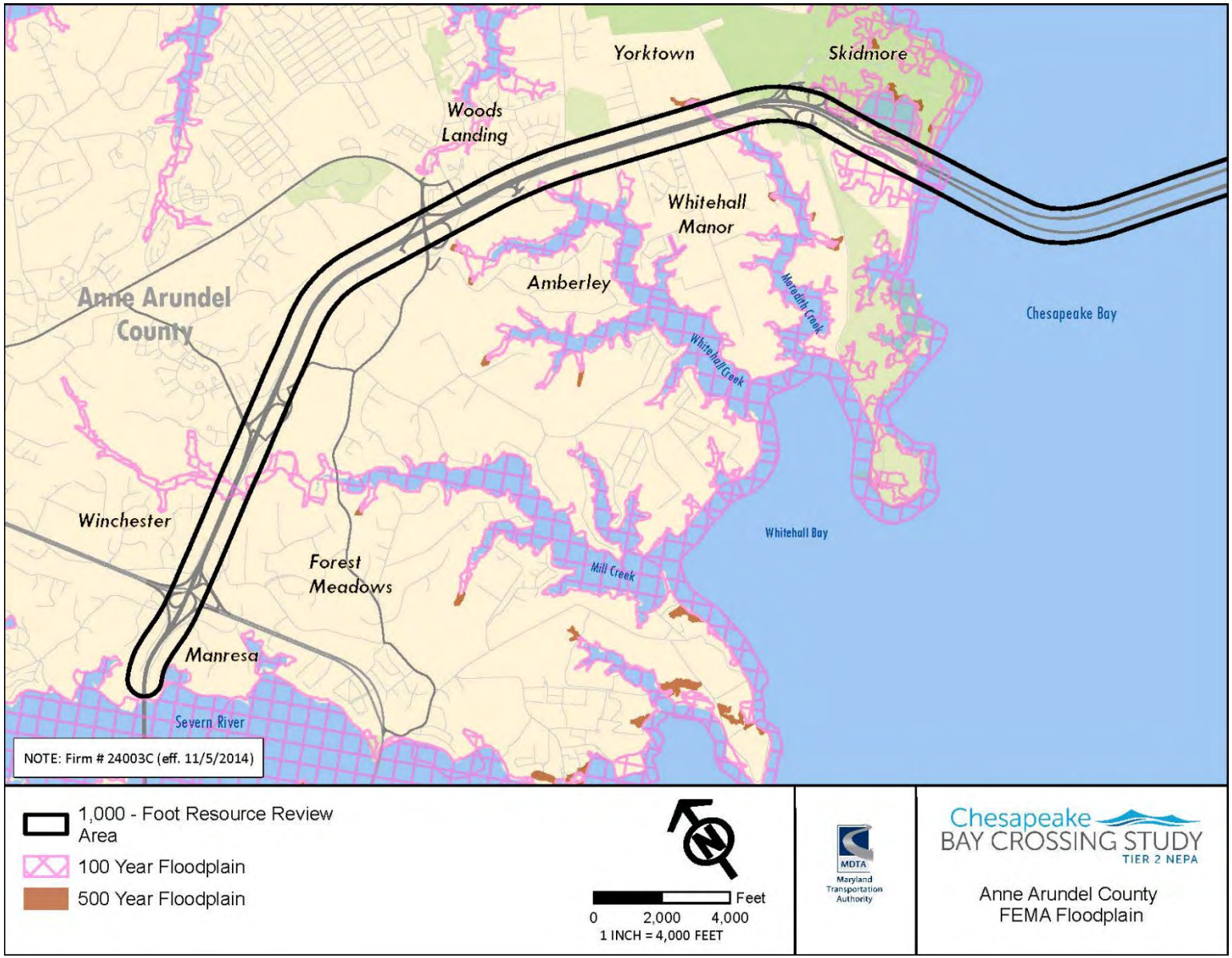
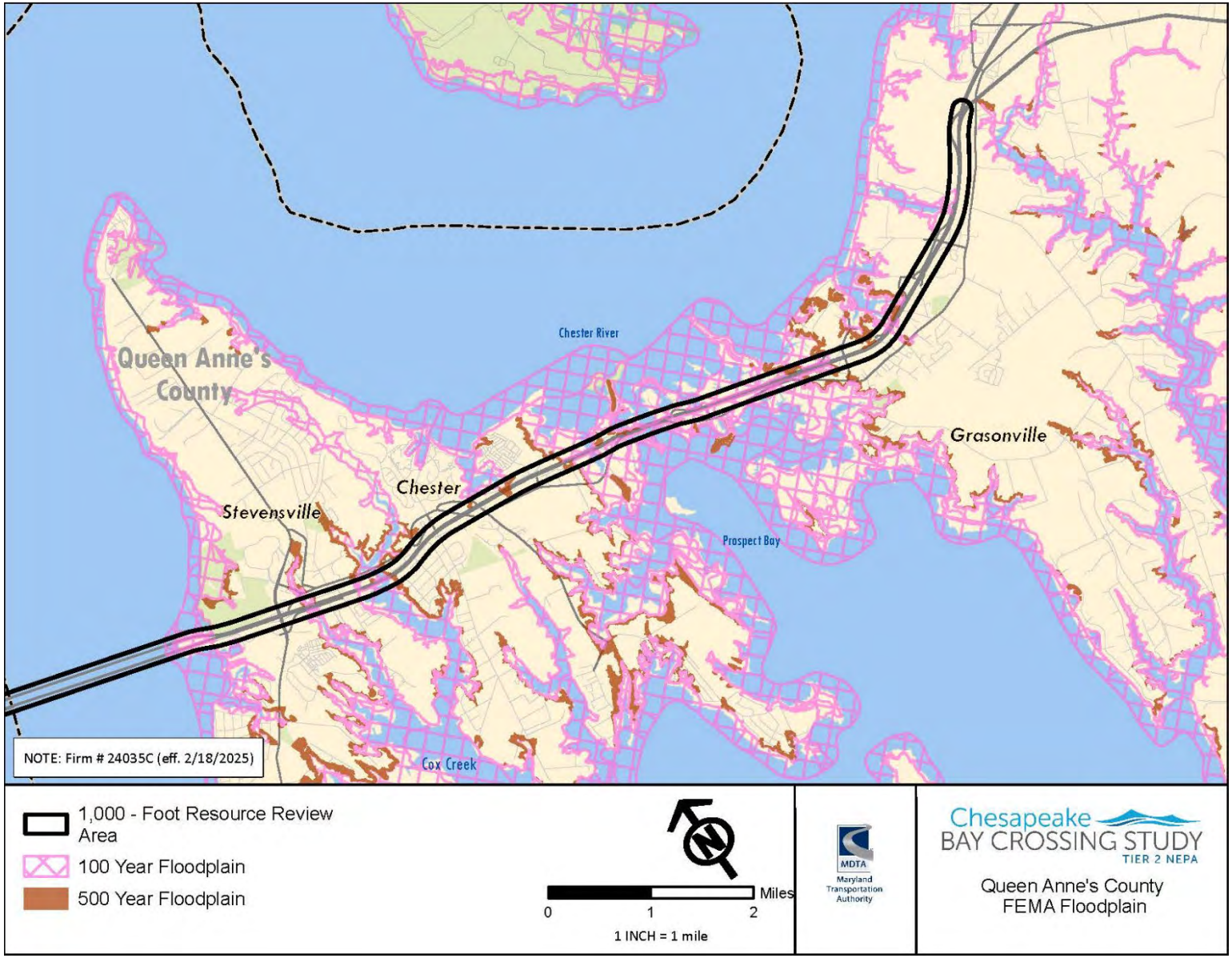


Figure 7-2: FEMA Floodplain – Queen Anne's County



7.3 Environmental Consequences

The MDTA has evaluated the potential impacts to FEMA floodplains from the build alternatives. In accordance with 23 CFR 650 Subpart A, a location hydraulic study was performed to determine if the build alternatives would result in a floodplain encroachment and the risks associated with any encroachments.

7.3.1 No-Build Alternative

The No-Build Alternative would have no impact to floodplains.

7.3.2 Build Alternatives

FEMA 100-Year Floodplain Encroachments

The proposed build alternatives were evaluated with respect to potential impacts to the FEMA 100-year floodplain boundaries for each waterway (**Table 7-1**). **Table** 7-2 shows the additional potential floodplain impacts associated with the SUP option for each of the build alternatives. The 100-year floodplains are shown on the natural resource map sets for the northern alignments (**Appendix B**) and southern alignments (**Appendix C**). Due to floodplain locations relative to existing U.S. 50/301, and the Tier 2 Study's purpose in evaluating a crossing of the Chesapeake Bay, a large tidal waterway, all build alternatives would result in unavoidable impacts to 100-year floodplains and constitute a floodplain encroachment. Encroachments are any action within the 100-year floodplain. Encroachments include temporary and permanent effects. Permanent encroachments are anticipated from fill for roadway widening and culvert extensions to carry flows beneath the widened roadway. Temporary encroachments would include construction related activities, such as vegetation clearing, sediment and erosion control, and space for construction activities. Temporary and permanent encroachments will be broken out during final design and permitting.

Table 7-1: FEMA 100-Year Floodplain Encroachments (acres)

Floodplain	No-Build	Build Alternative					
		B	C	D	E	F	G
Mill Creek	0	0.0	0.0	1.9	1.9	1.9	1.9
Whitehall Creek	0	0.0	0.0	0.0	0.0	0.0	0.0
Meredith Creek	0	0.4	0.4	0.4	0.4	0.5	0.5
Mezick Pond	0	2.0	0.7	2.0	0.7	2.0	0.7
Chesapeake Bay	0	29.1	33.4	29.1	33.4	29.1	33.4
Thompson Creek	0	0.3	0.3	0.3	0.3	0.3	0.3
Cox Creek	0	1.9	1.9	1.9	1.9	2.6	2.6
Macum Creek	0	0.0	0.0	0.3	0.3	0.3	0.3
Piney Creek	0	0.0	0.0	3.7	3.7	3.7	3.7
Kent Narrows & Chester River Tribs.	0	0.0	0.0	6.8	6.8	6.8	6.8
Winchester Creek	0	0.0	0.0	2.1	2.1	2.1	2.1
Walsey Creek	0	0.0	0.0	8.4	8.4	8.4	8.4
Total Floodplain*	**0**	**33.5**	**35.6**	**57.0**	**59.0**	**59.1**	**60.7**

** Due to rounding, totals may not equal the sum of all individual floodplain impacts.*

Table 7-2: SUP FEMA 100-Year Floodplain Encroachments (acres)

Floodplain	No-Build	Build Alternative					
		B	C	D	E	F	G
Mill Creek	0	0.0	0.0	0.0	0.0	0.0	0.0
Whitehall Creek	0	0.0	0.0	0.0	0.0	0.0	0.0
Meredith Creek	0	0.0	0.0	0.0	0.0	0.0	0.0
Mezick Pond	0	0.9	0.9	0.9	0.9	1.1	0.9
Chesapeake Bay	0	0.7	0.5	0.7	0.5	0.9	0.5
Thompson Creek	0	0.0	0.0	0.0	0.0	0.0	0.0
Cox Creek	0	0.0	0.0	0.0	0.0	0.0	0.0
Macum Creek	0	0.0	0.0	0.0	0.0	0.0	0.0
Piney Creek	0	0.0	0.0	0.0	0.0	0.0	0.0
Kent Narrows & Chester River Tribs.	0	0.0	0.0	0.0	0.0	0.0	0.0
Winchester Creek	0	0.0	0.0	0.0	0.0	0.0	0.0
Walsey Creek	0	0.0	0.0	0.0	0.0	0.0	0.0
Total Floodplain	**0**	**1.6**	**1.4**	**1.6**	**1.4**	**1.9**	**1.4**

** Due to rounding, totals may not equal the sum of all individual floodplain impacts.*

All build alternatives would result in longitudinal encroachments, at various locations where culverts are extended. Fill would be placed in the floodplain to support road widening for additional lanes, and where the proposed bridge structure meets the Chesapeake Bay shorelines. Alternatives B and C have the lowest potential for floodplain encroachments because these alternatives do not extend as far to the east and west as the other build alternatives. Alternatives B and C only cross the mapped 100-year floodplain at the eastern and western approaches to the Chesapeake Bay, as well as areas of mapped floodplain associated with Meredith Creek and Mezick Pond in Anne Arundel County and Thompson Creek and Cox Creek in Queen Anne's County. The most substantial floodplain encroachments for Alternatives B and C would be to the floodplain of the Chesapeake Bay itself, primarily on the Eastern Shore where additional fill would be required to build additional or widened causeways connecting the bridge structure to existing grades. The existing U.S. 50/301 roadway is above the 100-year flood elevation for all floodplains within the resource review area. The widened sections of roadway would be designed to meet or, in the case of the new bridge spans, exceed the height of the existing elevations of the roadway above the floodplain.

Alternatives D, E, F, and G have much greater potential for floodplain encroachments because they extend further to the east and west. They cross the same floodplains as Alternatives B and C, but also cross additional mapped floodplain areas associated with Mill Creek in Anne Arundel County and Macum Creek, Piney Creek, Kent Narrows, Walsey Creek, and Winchester Creek, in Queen Anne's County. Existing U.S. 50/301 is above the 100-year flood elevation in all but two of the floodplains crossed by Alternatives D, E, F, and G. Mill Creek on the Western Shore and Winchester Creek on the Eastern Shore are shown by the FIRM as crossing above the roadway rather than entirely within the culvert beneath the road. Additional culvert capacity would be evaluated to reduce potential flood flows across the roadway in later phases of design. The U.S. 50/301 bridge over Kent Narrows is also shown as being within the floodplain by the FIRM; however, the 100-year flood elevation of 5 feet is well below the bridge deck height of 65 feet.

Alternatives D, E, F, and G would have similar encroachments on floodplains, but Alternative G would have the largest encroachment. Similar to Alternatives B and C, the largest encroachments would be within the Chesapeake Bay floodplain for Alternatives D, E, F, and G due to the new or expanded causeways on the Eastern Shore.

Practicability of Alternatives to Encroachments

Floodplain encroachments are unavoidable with the implementation of any of the build alternatives. The build alternatives would widen an existing roadway that already crosses the 100-year floodplain at the locations discussed above. Bridging these floodplains to avoid all floodplain impacts would not be practicable, as it would require rebuilding the entire existing roadway at each floodplain, and in some cases on the Eastern Shore, bridges would still require encroachments for bridge piers as the floodplains abut the existing roadway for thousands of feet in some locations. However, Alternatives B or C would result in fewer unavoidable floodplain encroachments. The MDTA will continue to minimize and mitigate encroachments in later phases of design as discussed in **Section 7.4**.

Floodplain Encroachment Risks

Risks associated with floodplain encroachments anticipated under any of the build alternatives would include:

- reduced floodplain capacity and retention time;
- increased flooding in surrounding areas;
- increased risk of loss of life and property;
- disruption of a critical transportation and emergency evacuation route; and
- loss of beneficial floodplain values.

Some beneficial floodplain values that could be lost include flood moderation, plant and animal habitat, water quality maintenance, groundwater recharge in nontidal floodplains, natural beauty, and recreation. Many of these impacts and risks already exist along the study corridor due to the location of the project and past floodplain encroachments from the existing U.S. 50/301 corridor. For instance, currently, if a major flood event were to close either of the existing approaches to the Bay Bridge, this would disrupt the only crossing of the Chesapeake Bay for many miles, cutting off a critical travel route and a major emergency evacuation route for much of the Eastern Shore. However, such a closure would not be substantially more likely due to any of the build alternatives.

Additional floodplain encroachments from a build alternative have the potential to add to the existing risk within the U.S. 50/301 corridor. The potential for additional risks would be greatest under Alternatives D, E, F, and G due to the additional floodplains impacted. These alternatives also include encroachments on the only floodplains that cross over (rather than under) existing U.S. 50/301 within the study limits, further increasing the potential and area for hazardous conditions from roadway flooding. Alternatives B and C would result in the least additional risk.

All construction occurring within the FEMA designated floodplains must comply with FEMA-approved local floodplain construction requirements. These requirements consider structural

evaluations, fill levels, and grading elevations. Detailed analysis of potential project related changes to hydraulic function and elevation of floodplains would be determined using hydraulic and hydrologic (H&H) floodplain modeling as part of the engineering process for each structure in final design. If the hydraulic analysis associated with a Selected Alternative determines that floodplain effects would cause an increase in the 100-year flood elevation, the following conditions would apply in accordance with Maryland waterway construction regulations:

- An increase of less than 0.1-foot is considered negligible and does not require mitigation.
- The MDTA must modify the design to decrease the 100-year flood to within 0.1 foot, or would need to purchase the additional area of property that studies show are susceptible to a greater than 0.1-foot increase in flood levels.

Additional measures to analyze and minimize or further mitigate the risks of potential floodplain encroachments are discussed in **Section 7.4.**

Natural and Beneficial Floodplain Values

Natural and beneficial floodplain values would be impacted by all build alternatives. Encroachments for road widening and culvert extensions necessary to implement the build alternatives would result in permanent loss of vegetation, and floodplain capacity in floodplain areas. This loss of vegetated floodplain would reduce the floodplain's ability to naturally moderate flood flows, capture sediment and pollutants to maintain water quality, and provide wildlife habitat and natural areas that may provide natural beauty for human enjoyment. Encroachments to the nontidal floodplains on the Western Shore could also reduce floodplain areas providing groundwater recharge. Temporary impacts from construction activities would include short-term loss of vegetation and habitat and potential for compaction of floodplain soils and loss of capacity from sedimentation. Alternatives D, E, F, and G would result in the greatest potential impact to beneficial floodplain values due to their higher acreage of floodplain impacts. Alternatives B and C would result in the least potential impact to beneficial floodplain values.

Support of Incompatible Floodplain Development and Significant Encroachments

None of the build alternatives support probable incompatible floodplain development.

Hydraulic and Hydrologic Analysis

Analysis of potential project related changes to hydraulic function and elevation of floodplains would be determined using hydraulic and hydrologic (H&H) floodplain modeling as part of the engineering process for culverts, bridges, and other structures in later phases of design. In general, construction of roadway improvements across drainageways and in floodplains could lead to increases in floodplain elevation and size, which would be addressed by adjusting or augmenting culvert and stormwater structures to ensure that no property damage or impacts to other natural resources outside of direct effects from fill result. Detailed analysis and design solutions will be required to accommodate increased flood volumes to eliminate impacts to adjacent properties. Roadway expansion and extended culverts may increase the size of existing floodplain encroachments but would not result in new significant encroachments into the floodplain as defined in 23 CFR §650.105(q).

7.4 Avoidance, Minimization, and Further Mitigation of Encroachments

Encroachments, including longitudinal encroachments, within floodplains from the build alternatives are unavoidable due to the widening of existing U.S. 50/301 that already crosses floodplains, including the Chesapeake Bay. The MDTA will incorporate minimization and mitigation strategies for potential floodplain encroachments in accordance with 23 CFR 650 Subpart A, thus reducing impacts to beneficial floodplain values and overall risks. Preliminary designs have reduced encroachments on floodplains where practicable using steeper slopes, retaining walls, and other measures to reduce the alternatives' LOD in areas of sensitive resources, including floodplains. The MDTA has preliminarily identified locations for quantitative SWM to attenuate peak discharge increases to minimize downstream impacts to existing culverts and floodplains. If H&H studies find that an encroachment would change the flood elevation, mitigation or other actions would be required in accordance with floodplain regulations, including submittal of a Conditional Letter of Map Revision (CLOMR) and subsequent Letter of Map Revision (LOMR) if elevations are determined to increase by greater than 0.1 foot.

Further impact minimization would be achieved by incorporating BMPs as identified in COMAR 26.17.01 for ESD and COMAR 26.17.02 for SWM. Most of the acreage of potential encroachment is along the edge of floodplains rather than across the main channel flow of the associated waterway, and in many cases the encroachments would be primarily temporary, from construction, rather than permanent fill. To minimize floodwater impacts associated with construction, drainage structures would be designed to maintain current flow regimes per COMAR 26.17.04.

H&H studies would be conducted at nontidal floodplain and waterway crossings, and drainage structures would be designed to maintain current flow regimes per COMAR 26.17.04. Hydrodynamic modeling would be conducted to evaluate current and future flow patterns, tidal movements, and water level fluctuations at the proposed Bay Bridge for the Preferred Alternative. Analysis of current and future tidal floodplain elevations where widening is proposed along existing U.S. 50/301 will also be analyzed during final design to ensure a Selected Alternative is resilient to tidal fluctuations.

Longer bridge spans could be used to reduce piers within the Bay and fill within the floodplain. Hydrologic and hydraulic studies completed during final design to evaluate any changes to flood elevations would be included as part of the MDE Nontidal Wetlands and Waterways Construction permitting process. Bridge and culvert openings would be assessed to identify the minimum hydraulic openings required to pass the design flood flows. If it is determined during final design that a property within a Special Flood Hazard Area, or the effective base flood elevation would be affected, additional coordination would be required with FEMA through a Conditional Letter of Map Revision to determine if proposed actions would meet the minimum floodplain management criteria of the NFIP.

Measures to Restore and Preserve Floodplain Values

Minimizing areas of bare soil, revegetation and seeding temporary disturbances, and avoiding compaction of soils during construction would help to minimize the loss of floodplain function and beneficial values. Temporary impacts to wetlands within floodplains would be restored in accordance with MDE tidal and nontidal wetland regulations which require restoration of wetland and floodplain elevations, and vegetation. The MDTA would avoid placement of temporary staging and stockpile areas within floodplains. The MDTA will continue avoidance and minimization efforts in final design and coordinate with MDE to determine the encroachments on regulated floodplains and potential mitigation measures.

8 SURFACE WATER RESOURCES

Surface water resources include watersheds, streams and rivers, as well as the Chesapeake Bay. The Chesapeake Bay is further addressed in **Section 9, Waters of the U.S., Including Wetlands** and in **Section 12, Chesapeake Bay Critical Area**.

8.1 Watersheds

A watershed is a land area that channels precipitation to creeks, streams, and rivers, and eventually to outflow points such as reservoirs, bays, and the ocean. The resource review area for watersheds extends 1 mile on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split.

8.1.1 Regulatory Context and Methodology

EO 13508, *Chesapeake Bay Protection and Restoration*, was issued on May 12, 2009, and included goals for the Chesapeake Bay watershed to restore clean water by reducing nitrogen, phosphorus, sediment, and other pollutants; recovering habitat by restoring a network of land and water habitats to support priority species and other public benefits; sustaining fish and wildlife; and conserving land and increasing public access. The EO also establishes additional responsibilities for federal agencies to ensure their actions align with the goals of addressing water quality issues in the Chesapeake Bay watershed. After issuance of EO 13508, the USEPA established the Chesapeake Bay Total Maximum Daily Load (TMDL) requirements on December 29, 2010, which necessitate quantitative nutrient reductions by each contributing jurisdiction.

In compliance with CWA Sections 303(d), 305(b), and 314 and the SDWA, states develop a prioritized list of waterbodies that currently do not meet water quality standards. The Section 303(d) prioritized list includes waterbodies and watersheds that exhibit levels of impairment that require further investigation or restoration. The MDE uses monitoring data to compare existing stream conditions to water quality standards and determine which streams should be listed as impaired. Parameters monitored include temperature, dissolved oxygen (DO), pH, fecal coliform, *Escherichia coli* (*E. coli*), enterococci, total phosphorus, chlorophyll a, and benthic macroinvertebrates, as well as metals and toxins in the water column, sediments, and fish tissues. The waterbodies on this list may be subject to a TMDL of these constituents under Section 303(d) of the CWA. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Waterbodies can also be listed under Category 5 on the 303(d) list for impairment, which indicates that the waterbody is impaired, does not meet the water quality standard, and that a TMDL is required.

The SHA controls most of the land-based portion of the U.S. 50/301 roadway and right-of-way within the resource review area and received an NPDES Municipal Separate Storm Sewer System (MS4) Phase I permit originally issued in 2015 and modified in 2019. The Phase I permit requires that SHA use restoration practices to treat 20 percent of existing SHA impervious surfaces and address stormwater Wasteload Allocations established under approved TMDLs. The permit serves to control storm drain system pollution discharges in designated areas, including Anne Arundel County. The MDTA is covered under the MS4 Phase II permit that includes the Chesapeake Bay TMDL restoration goal of 20 percent impervious area treatment for legacy pavement based on impervious surface area treatment. The MDTA has met this goal.

MDE's Searchable Integrated Report Database (Combined 303[d]/305[b] List) was used to compile information on 303(d) listings for waterbodies and watersheds that occur within the resource review area. Information on completed TMDLs (Category 4a), Category 5 impairment listings, and salt chloride impairments (Category 5s) were compiled for each watershed crossed by the resource review area. Total acreage of impact to MD 12-digit watersheds was determined in GIS by overlaying the build alternative LODs with the 12-digit watershed boundaries.

8.1.2 Affected Environment

The resource review area spans three major state-designated 6-digit watersheds: West Chesapeake Bay, Chesapeake Bay Proper, and the Chester River. Within each of these major watersheds, the resource review area crosses numerous smaller 8-digit and smaller, 12-digit watersheds, which are shown in **Figure 8-1**.

Table 8-1 presents a summary of watershed characteristics, including designated stream use classes, for watersheds that fall within the resource review area. Designated stream use classes are further defined in **Section 8.2 Water Quality**.

The West Chesapeake Bay watershed spans from Gibson Island to the mouth of the Patuxent River, extending landward to the west. The Chesapeake Bay Proper watershed consists solely of the Chesapeake Bay mainstem itself, lacking any landforms or tidal tributaries. The Chester River watershed extends from the mouth of the Eastern Bay to Easton, Maryland and up the Chester River to the Maryland-Delaware state line.

Each of the MD 8-digit watersheds crossed by the resource review area have been placed on the 303(d) impaired waters list. The Lower Chesapeake Bay, Severn River, Magothy River, Kent Island Bay, Eastern Bay, Kent Narrows, Wye River, and Lower Chester River watersheds have all been listed as impaired due to poor water quality. TMDLs have been completed for many of the pollutants, though some listings are Category 5 and will require a TMDL in the future. Pollutants such as fecal coliform, PCBs in fish tissue, elevated levels of phosphorus and nitrogen, total suspended solids (TSS), and unknown pollutants (based on benthic Indices of Biotic Integrity or IBIs) have been observed within the resource review area. Specific Category 4a and 5 impairment listings are summarized in the following subsections and listed in **Table 8-2**.

Figure 8-1: Watersheds

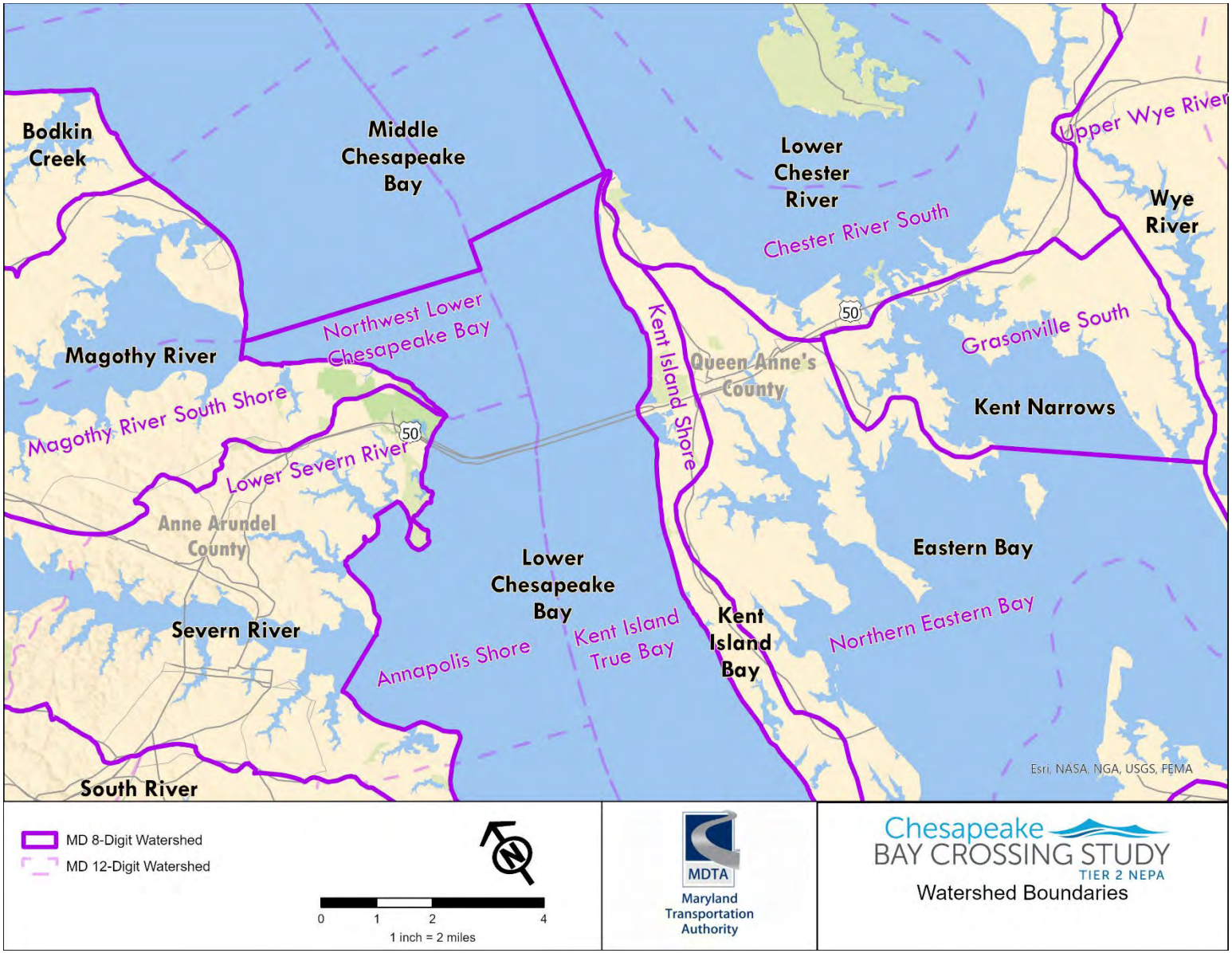


Table 8-1: Overall Watershed Characteristics Summary

MD State-Designated Watershed			Watershed Drainage Area (acres)	Impervious Surface Percent[1]	Designated Streams Use Class
6-digit Name (Number)	8-digit Name (Number)	12-digit Name (Number)			
West Chesapeake Bay (021310)	Severn River (02131002)	Lower Severn River (021310020997)	21,242	21%	I; II
	Magothy River (02131001)	Magothy River South Shore (021310011003)	10,484	14%	I; II
Chesapeake Bay Proper (021399)	Lower Chesapeake Bay (02139998)	Northwest Lower Chesapeake Bay (021399981091)	4,301	--	II
		Annapolis Shore (021399981093)	11,610	--	II
		Kent Island True Bay (021399981092)	23,367	--	II
Chester River (021305)	Kent Island Bay (02130511)	Kent Island Shore (021305110428)	5,754	15%	I; II
	Eastern Bay (02130501)	Northern Eastern Bay (021305010429)	35,258	4%	I; II
	Kent Narrows (02130504)	Grasonville South (021305040431)	12,647	5%	I; II
	Wye River (02130503)	Upper Wye River (021305030433)	9,716	5%	I; II
	Lower Chester River (02130505)	Chester River South (021305050390)	29,607	4%	I; II

[1] *Impervious surface was not determined for 12-digit watersheds that are comprised entirely of tidal open water. Impervious surface calculations are for the entire watershed, which may include areas upstream and downstream of the resource review area*

Use Class I: Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life
Use Class II: Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting
Sources: USGS, 2024; MDE, 2008; MDE, 2019a

Table 8-2: 303(d) Impairment Listings for Completed TMDLs and Category 5

MD State-Designated Watershed		Completed TMDL (Category 4a)	TMDL Potentially Needed (Category 5)
6-digit Name (Number)	8-digit Name (Number)		
West Chesapeake Bay (021310)	Severn River (02131002)	PCBs (tidal segments); TSS (tidal segments); nitrogen (tidal segments); phosphorus (tidal segments); fecal coliform (tidal segments)	Unknown pollutants based on benthic IBIs (tidal segments); unknown pollutants based on fish and benthic IBIs (1st to 4th order streams)
	Magothy River (02131001)	PCBs in fish tissue (tidal segments); TSS (tidal segments); nitrogen (tidal segments); phosphorus (tidal segments); fecal coliform (tidal segments)	Unknown pollutants based on fish and benthic IBIs (tidal segments); chloride (1st through 4th order streams)

MD State-Designated Watershed		Completed TMDL (Category 4a)	TMDL Potentially Needed (Category 5)
6-digit Name (Number)	8-digit Name (Number)		
Chesapeake Bay Proper (021399)	Lower Chesapeake Bay (02139998)	TSS (tidal segments); nitrogen (tidal segments); phosphorus (tidal segments)	Unknown pollutants based on benthic IBIs (tidal segments)
Chester River (021305)	Kent Island Bay (02130511)	TSS (tidal segments); nitrogen (tidal segments); phosphorus (tidal segments)	Unknown pollutants based on benthic IBIs (tidal segments); fecal coliform (tidal segments)
	Eastern Bay (02130501)	TSS (tidal segments); nitrogen (tidal segments); phosphorus (tidal segments)	Unknown pollutants based on benthic IBIs (tidal segments); fecal coliform (tidal segments)
	Kent Narrows (02130504)	TSS (tidal segments); nitrogen (tidal segments); phosphorus (tidal segments); fecal coliform (tidal segments)	Unknown pollutants based on benthic IBIs (tidal segments)
	Wye River (02130503)	TSS (tidal segments); nitrogen (tidal segments); phosphorus (tidal segments); fecal coliform (tidal segments)	Unknown pollutants based on benthic IBIs (tidal segments)
	Lower Chester River (02130505)	TSS (tidal segments); nitrogen (tidal segments); phosphorus (tidal segments); fecal coliform (tidal segments)	Unknown pollutants based on benthic IBIs (tidal segments); PCB (tidal segments)

8.1.2.1 West Chesapeake Bay

As part of the West Chesapeake Bay 6-digit watershed, the Magothy River MD 8-digit watershed currently has completed TMDLs (Category 4a) for PCBs in fish tissue, TSS, nitrogen, phosphorus, and fecal coliform in tidal segments. The Magothy River watershed also has Category 5 impairment listings for unknown pollutants based on benthic IBIs in tidal segments and chloride impairments in 1st through 4th order streams (Category 5s) (MDE, 2024b).

The Magothy River watershed also has an SHA TMDL for PCBs approved by USEPA on March 16, 2015. The Magothy River is included in the list of waterbodies for which the Chesapeake Bay tidal influence is the single major source of elevated PCBs. For watersheds where tidal influence is largely the pollutant source, the SHA is proposing no action. Modeling demonstrates that the Chesapeake Bay tidal influence is the source of 98.7 percent of PCBs in the Magothy River, but additional sources of PCBs include atmospheric deposition, non-regulated watershed runoff, contaminated sites, and NPDES regulated stormwater (MDE, 2015).

The Severn River 8-digit watershed, also in the West Chesapeake Bay MD 6-digit watershed, has completed TMDLs (Category 4a) for elevated PCBs, TSS, nitrogen, phosphorus, and fecal coliform in tidal segments. The Severn River watershed also has Category 5 impairment listings for unknown pollutants based on benthic IBIs in tidal segments and unknown pollutants based on fish and benthic IBIs in 1st to 4th order streams (MDE, 2024b).

8.1.2.2 Chesapeake Bay Proper

As part of the Chesapeake Bay Proper 6-digit watershed, the Lower Chesapeake Bay MD 8-digit watershed currently has completed TMDLs (Category 4a) for TSS, nitrogen, and phosphorus in tidal segments, and a Category 5 impairment listing for unknown pollutants based on benthic IBIs in tidal segments (MDE, 2024b).

8.1.2.3 Chester River

Within the Chester River 6-digit watershed, the Kent Island Bay, Eastern Bay, Kent Narrows, Wye River, and Lower Chester River 8-digit watersheds all have approved TMDLs (Category 4a) for TSS, nitrogen, and phosphorus in tidal segments. These watersheds also all have Category 5 impairment listings for unknown pollutants based on benthic IBIs in tidal segments. The Kent Narrows, Wye River, and Lower Chester River watersheds all have approved TMDLs for fecal coliform in tidal segments. The Kent Island Bay and Eastern Bay watersheds have a Category 5 listing for fecal coliform in tidal segments. The Lower Chester River has an additional Category 5 listing for PCBs in tidal segments (MDE, 2024b).

Table 8-3 shows the acreage of 12-digit watersheds within the resource review area.

Table 8-3: Acreage of 12 Digit Watersheds within the Resource Review Area

12-Digit Watershed	Acres
Lower Severn River	8,052
Magothy River South Shore	1,758
Northwest Lower Chesapeake Bay*	472
Annapolis Shore*	2,106
Kent Island True Bay*	2,649
Kent Island Shore	1,177
Northern Eastern Bay	2,756
Grasonville South	2,926
Upper Wye River	990
Chester River South	5,101

**Watersheds only within the Chesapeake Bay open water*
Sources: USGS, 2024; MDE, 2008; MDE, 2019a

8.1.3 Environmental Consequences

The addition or modification of roads and bridges can adversely impact watersheds by altering existing natural or constructed flow patterns. Altering these existing flow patterns can change the overall size and makeup of the watershed and can have a negative effect on natural resources as well as outfalls within the watershed.

8.1.3.1 No-Build Alternative

The No-Build Alternative would have no impact to watersheds.

8.1.3.2 Build Alternatives

Each of the build alternatives crosses several watersheds within the resource review area. As shown on **Figure 8-1**, three 12-digit watershed boundaries are located within the limits of the

Chesapeake Bay, however the Northwest Lower Chesapeake Bay watershed is not within any of the build alternatives and therefore not included in the impacts discussion. **Table 8-4** identifies the total amount of 12-digit watershed acreage associated with each of the build alternatives and provides a comparative analysis of potential impacts. The Annapolis Shore watershed and Kent Island True Bay watershed are combined in the table to represent the acreage of impacts within the Chesapeake Bay. Estimated impacts to the Chesapeake Bay substrate and water column are addressed in detail in **Section 9, Waters of the U.S. Including Wetlands**. Impacts shown in **Table 8-4** represent areas that will include permanent and temporary piers, dredge areas, and pier demolition within the Chesapeake Bay. **Table 8-5** represents impacts associated with the SUP option for each build alternative. The current level of project design does not differentiate between permanent and temporary impacts. Impacts will be broken out in later phases of design. These impacts do not represent the larger area of open water that would account for vessel movement, navigational markers, and stationary barges.

The greatest impacts within a watershed will occur from Alternatives F and G, due to their larger overall LODs, extending both east and west several miles beyond Alternatives B and C, and including the largest of proposed bridges over the Chesapeake Bay. The watersheds with the greatest acreage within the LODs include the Lower Severn River and the Chester River South. The addition of a SUP option with any of the build alternatives would result in between 6.8 acres and 7.7 acres of additional impacts within watersheds.

Table 8-4: Impacts to 12-Digit Watersheds (acres)

12-Digit Watershed	No-Build	Build Alternative					
		B	C	D	E	F	G
Lower Severn River	0	126.5	123.7	311.0	308.2	313.6	310.1
Magothy River South Shore	0	0	0	5.9	5.9	5.9	5.9
Watersheds within Chesapeake Bay*	0	124.5	123.9	124.5	123.9	127.2	126.7
Kent Island Shore	0	48.5	52.2	48.5	52.2	57.6	61.2
Northern Eastern Bay	0	52.3	52.3	81.8	81.8	88.5	88.5
Grasonville South	0	0	0	31.5	31.5	31.5	31.5
Upper Wye River	0	0	0	32.1	32.1	32.1	32.1
Chester River South	0	0	0	223.7	223.7	223.7	223.7
Totals**	**0**	**351.6**	**351.9**	**858.5**	**858.8**	**879.6**	**879.2**

** Annapolis Shore and Kent Island True Bay watersheds*
*** Totals may not match sum of breakout values due to rounding.*

Table 8-5: SUP Impacts to 12-Digit Watersheds (acres)

12-Digit Watershed	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
Lower Severn River	0	2.0	2.0	2.0	2.0	2.0	2.1
Magothy River South Shore	0	0	0	0	0	0	0
Watersheds within Chesapeake Bay*	0	3.7	3.7	3.7	3.7	3.7	4.0

12-Digit Watershed	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
Kent Island Shore	0	2.5	1.5	2.5	1.5	2.2	1.1
Northern Eastern Bay	0	0	0	0	0	0	0
Grasonville South	0	0	0	0	0	0	0
Upper Wye River	0	0	0	0	0	0	0
Chester River South	0	0	0	0	0	0	0
Totals**	**0**	**8.0**	**7.1**	**8.0**	**7.1**	**7.7**	**7.1**

** Annapolis Shore and Kent Island True Bay watersheds*
***Totals may not match sum of breakout values due to rounding.*

All build alternatives have the potential to affect watersheds, due to the increase in impervious surfaces, whether on land or from bridges spanning over water. Increased impervious surface would impact drainage and flow and additional contaminants could potentially be introduced to surface waters and groundwater from the additional traffic supported by the wider roadway. The addition of contaminants to surface waters could potentially increase water impairment and affect the TMDLs of these waterways. The MDTA will ensure that all SWM and ESC requirements are met or exceeded to limit the potential for additional contaminants to be introduced to waterways. **Table 8-6** shows the increase in impervious surfaces for each of the build alternatives and **Table 8-7** shows increased impervious surfaces for the SUP option associated with each build alternative. The greatest increase in impervious surfaces will occur with Alternatives F and G due to the proposed number of lanes along U.S. 50/301 that require a longer roadway length and width. Alternatives D, E, F, and G have a greater potential for increased stormwater runoff that could make its way to downstream waters, due to a greater increase in impervious surfaces than Alternatives B and C. The addition of a SUP option with any of the build alternatives would result in between 11.6 acres and 12.1 acres of additional increase in impervious surface.

Transportation construction activities typically include the addition of impervious surface and the removal of vegetated surfaces or the conversion of a vegetated surface (such as a wooded area converted to grass). These construction activities can increase overland flows within the watershed, causing erosion and an increase in sediment and pollutant transport. Additional construction activities would include new and/or modified culverts and SWM features. Modifying the existing culverts or outfalls could change existing flow patterns within the watershed, consequently diverting flow away from some areas and directing it to others. Decreasing flow to an area within a watershed could have detrimental effects on natural resources that rely on a continuously wet environment. Increased flow to an area such as near bridge supports could result in scour. Bridge decks and roadways can also become sources of pollutants, which can be carried into waterways by stormwater runoff. These changes may lead to the destabilization of stream channels within the watershed, failure of outfalls, and loss of natural resources and aquatic habitat. However, the MDTA will take steps necessary to avoid, minimize, and where needed, mitigate for such outcomes.

Table 8-6: Increase in Impervious Surfaces (acres)

No-Build	Build Alternative					
	B	C	D	E	F	G
0	96.7	95.7	161.8	160.8	185.5	184.3

Table 8-7: SUP Increase in Impervious Surfaces (acres)

No-Build	Associated Build Alternative					
	B	C	D	E	F	G
0	11.6	12.1	11.6	12.1	11.6	11.6

8.1.4 Avoidance, Minimization, and Further Mitigation Strategies

The MDTA would approach design and construction with the goal of minimizing impacts within watersheds and providing ESD measures to control stormwater from within and surrounding the construction limits, with SWM techniques in compliance with MDE requirements. The design would incorporate SWM systems to help control runoff and reduce peak flows in accordance with COMAR 26.17.02. The design would also aim to maintain existing flow patterns and mitigate any increase in impervious surface, and where practicable, utilize existing infrastructure to limit these changes to flow patterns within the watershed. Strict ESC measures would be required during construction to minimize soil eroding beyond work limits, and to prevent sedimentation downstream. Approved ESC plans would be implemented in accordance with COMAR 26.17.02.

Impacts to the Chesapeake Bay Proper watershed during construction could be minimized and further mitigated through specified in-water construction BMPs, routine water quality monitoring, and potential species/habitat/substrate monitoring and sampling. Additional specific avoidance, minimization, and further mitigation measures to protect and maintain the health and function of watersheds within the resource review area include those identified in other sections throughout this document, including **Section 7, Floodplains**, **Section 8, Surface Water Resources**, **Section 9, Waters of the U.S., Including Wetlands**, **Section 12, Chesapeake Bay Critical Area**, **Section 13, Aquatic Habitat and Biota**, and **Section 14, Terrestrial Habitat and Biota.**

8.2 Water Quality

The resource review area for water quality generally extends 1,000 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split. However, the resource review area was expanded to two miles on either side of the centerline for areas of the Chesapeake Bay and Eastern Shore that drain to the resource review area, as available data was more limited within the 2,000-foot-wide resource review area and these tidal areas are largely connected. Water quality is a measure of the suitability of water for a particular use based on selected physical, chemical, and biological characteristics. Water pollution occurs when harmful substances, often chemicals or microorganisms, contaminate a stream, river, lake, ocean, aquifer, or other body of water, degrading water quality and rendering it toxic to humans or the environment.

8.2.1 Regulatory Context and Methodology

Sections 401 and 402 of the federal CWA regulate water quality and the introduction of contaminants to waterbodies (33 USC 1341 and 1342). Water quality criteria are based on

scientifically derived relationships among water constituents and biological conditions. Water quality standards have been established to protect public health and welfare, and to protect and enhance the quality of the water for aquatic life. When criteria are met, water quality will generally protect the designated use of the waterbody (40 CFR 131.3). MDE is the regulatory agency responsible for ensuring adherence to water quality standards in Maryland. During final design, a Section 401 Water Quality Certification from MDE will be required for the project, supporting how anticipated discharges will comply with federally mandated water quality standards.

Under COMAR 26.08.02, Maryland has adopted state water quality standards to enhance and protect water resources and meet the requirements of the federal CWA. The water quality standards designate uses for the waters of the state and set criteria to protect and maintain water quality for these "designated uses."

EO 13508, *Chesapeake Bay Protection and Restoration*, was issued May 12, 2009, and included goals for the Chesapeake Bay watershed to restore clean water, recovering habitat, sustaining fish and wildlife, conserving land, and increasing public access. The federal order also establishes additional responsibilities for federal agencies to ensure their actions align with the goals of addressing water quality issues in the Chesapeake Bay watershed. After issuance of EO 13508, the USEPA established the Chesapeake Bay TMDL requirements on December 29, 2010, which necessitate quantitative nutrient reductions by each contributing jurisdiction.

The MDE has also designated certain surface waters of the state as Tier II (High Quality) waters, based on monitoring data documenting water quality conditions that exceeded the minimum standard necessary to meet designated uses. In accordance with federal regulations (40 CFR 131.12), additional antidegradation protections apply to ensure that these high-quality waters are maintained (COMAR 26.08.02.04-1).

Maryland has several laws, regulations and programs aimed at safeguarding surface waters and stream channel geomorphology to preserve water quality, reduce erosion, and protect aquatic habitats. Key regulatory measures include:

- **Maryland ESC Law** – Requires developers to implement ESC plans for construction sites to minimize sedimentation and disturbance to natural stream channels. Governed by the MDE, it mandates BMPs to stabilize soils and reduce runoff.
- **Stormwater Management Act of 2007** – Promotes the use of ESD to mimic natural hydrology. Requires SWM plans that reduce peak flow and maintain natural geomorphology of streams by encouraging infiltration and slowing runoff.
- **Nontidal Wetlands Protection Act** – Protects wetlands adjacent to stream channels, which play a crucial role in stabilizing stream geomorphology and filtering pollutants. Includes buffer zones and restrictions on activities that might disrupt the hydrological and sediment balance of streams.

Surface waters in Maryland are assigned a use class (COMAR 26.08.02), a set of designated uses that define an intended human and aquatic life objective, use, or goal for a water body. The determination of designated use includes consideration of existing conditions and potential uses, which may be made possible by anticipated improvements in water quality. Because certain periods of the year are considered crucial for the growth and propagation of aquatic species, each

use class designation incorporates a timing restriction or stream closure period identifying when instream activities are not permitted. Streams within the resource review area are classified as Use Class I and Use Class II. Use I waterways within the resource review area are nontidal and eventually transition or drain into tidal Use II waters. These Use Classes are described as:

- Use Class I – Water Contact Recreation, Protection of Nontidal Warm Water Aquatic Life.
- Use Class II – Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting.

The Chesapeake Bay (designated as Use Class II) is also assigned a series of designated subcategories that reflect the various habitats associated with the Chesapeake Bay and the water resource communities inhabiting them. The designated use categories listed below describe what is protected and the general locations of associated habitat:

- **Migratory Fish and Spawning Nurseries** – Migratory fish, including striped bass, perch, shad, herring, and sturgeon, are protected during the winter/spring spawning and nursery season. The habitat consists of tidal freshwater to low salinity habitats primarily found in the upper mainstem of the Chesapeake Bay and the upper reaches of the Chesapeake Bay's tidal rivers and creeks.
- **Shallow Water** – Underwater grasses and the fish and crab species that depend on this shallow water habitat. The habitat consists of shallow waters near shorelines.
- **Open Water Fish and Shellfish** – Water quality in surface water habitats to protect sportfish and bait fish. The habitat includes tidal creeks, rivers, embayments, and the mainstem of the Chesapeake Bay.
- **Deep Water Fish and Shellfish** – Water quality in deep water to protect bottom-feeding fish, crabs, oysters, and the bay anchovy. The habitat includes the deeper transitional water column and bottom habitats between the well-mixed surface waters and the very deep channels during the summer months.
- **Deep Channel Seasonal Refuge** – Bottom sediment-dwelling worms and small clams that act as a food source for bottom-feeding fish and crabs in the very deep channels in summer. The habitat includes overwintering blue crab habitat, which occurs seasonally.

Water quality standards based on the use classes of streams and waterbodies are listed in COMAR 26.08.02.01-.03–Water Quality and are shown in **Table 8-8**. The MDTA analyzed existing water quality data collected at monitoring locations and compared the data to these standards to determine whether streams and waterbodies meet state criteria. There is limited monitoring data available within the resource review area, therefore consideration of monitoring data collected in locations beyond the resource review area has been included if the location would have the potential to provide flow and/or drain to waters within the resource review area.

Water quality data was gathered from MDE, MDNR's *Eyes on the Bay* program, Anne Arundel County Bureau of Watershed Protection and Restoration (AABWPR), and other monitoring programs accessed through the Chesapeake Bay Program (CBP). Queen Anne's County does not collect water quality data. In addition, MDE Shellfish Data, Beaches Data, and Point Data were gathered from the National Water Quality Monitoring Council (NWQMC) database and in situ data were obtained from MDNR's Chesapeake Bay Benthic Monitoring Program (CBBMP).

These agencies and monitoring groups use a broad range of data to assess overall watershed health and condition, including data on chemical water quality. Many of these agencies and monitoring groups also collect data on biotic communities and aquatic habitat. Data collected on aquatic habitat conditions and fish and benthic macroinvertebrate communities are often used to summarize existing water quality conditions based on an overall narrative rating (e.g., Very Poor, Poor, Fair, Good), using established methodologies. These methodologies and rating criteria are detailed in **Section 13, Aquatic Habitat and Biota**.

The MDTA has utilized water quality data from in-situ multi-probe sampling and chemical grab sampling collected through the above referenced sources to represent existing conditions of streams and rivers within and surrounding the resource review area. In-situ data is defined as data collected with field measurement techniques such as water quality meters, while chemical grab sampling is defined as sampling where water samples were collected in the field and transported to a laboratory for detailed analysis. The MDNR also conducts long-term continuous water quality monitoring through the *Eyes on the Bay* program, which uses continuous data loggers that are deployed at set locations throughout the Chesapeake Bay.

Table 8-8: COMAR Use Class Water Quality Criteria

Parameter	Use I	Use II
Temperature	Maximum of 90°F (32°C) or ambient surface water temperature, whichever is greater	
pH	6.5 to 8.5	
Dissolved Oxygen	Minimum of 5 mg/L	• Seasonal and Migratory Fish Spawning and Nursery Use: o 7-day mean ≥ 6 mg/L from February 1 through May 31; o instantaneous minimum ≥ 5 mg/L from February 1 through May 31; o open-water fish and shellfish use standards apply from June 1 to January 31 • Seasonal Shallow-Water Submerged Aquatic Vegetation Use: Open-water fish and shellfish use standards apply year-round • Open-Water Fish and Shellfish Use: o 30-day mean ≥ 5 mg/L o 7-day mean ≥ 4 mg/L o instantaneous minimum ≥ 3.2 mg/L[1] • Seasonal Deep-Water Fish and Shellfish Use: o June 1 through September 30 ▪ 30-day mean ≥ 3 mg/L ▪ 1-day mean ≥ 2.3 mg/L ▪ instantaneous minimum ≥ 1.7 mg/L o Open-water fish and shellfish use standards apply from October 1 to May 31 • Seasonal Deep-Channel Refuge Use: o June 1 through September 30 ▪ instantaneous minimum ≥ 1 mg/L o Open-water fish and shellfish use standards apply from October 1 to May 31
Turbidity	Maximum of 150 Nephelometric Turbidity Units (NTU) and maximum monthly average of 50 NTU	
Enterococci (fresh or marine) culturable	Geometric mean over 90 days shall not exceed 35 Most Probable Number (MPN)/100 mL and 10% of samples taken over 90 days shall not exceed 130 MPN/100 mL	

[1] *At temperatures considered stressful to the endangered shortnose sturgeon (>29°C), dissolved oxygen concentrations ≥ an instantaneous minimum of 4.3 mg/L will protect survival of this listed sturgeon species.*

Parameter	Use I	Use II

Source: Maryland COMAR regulation 26.08.02.03

Some of the sampled water quality parameters in the available data sets have associated state and federal standards for the protection of aquatic life. It should be noted that the water quality criteria listed here are not comprehensive and are provided for comparison of existing conditions based on available data. Additional state and federal water quality criteria and recommendations exist for organic and inorganic parameters (e.g., metals) not discussed here, as data for those parameters were not publicly available within the resource review area. The USEPA established aggregate reference condition values for freshwater (nontidal) systems, based on ecoregions, for total nitrogen and total phosphorus (EPA, 2000). These reference condition values were developed to be used by state agencies as guidelines for developing criteria and have no standalone regulatory importance. Ranges for other parameters indicative of anthropogenic stress were determined for the state by the Maryland Biological Stream Survey (MBSS) for nontidal streams. These benchmarks developed by MBSS are only used as a management guideline and do not carry the same weight as the regulatory standards set by the state and federal governments. These parameters include ammonia, nitrate, nitrate, nitrite, phosphorus, and sulfate. These benchmark levels, as well as the state and federal standards and recommendations, are presented in **Table 8-9**.

Excess levels of metals and nutrients listed in **Table 8-9** have negative effects on fish and macroinvertebrate communities. According to the USEPA, acute effects are those that show up in 0 to 7 days, while chronic effects can take years or lifetimes to be seen. Each of the following parameters was determined to have negative effects by the USEPA "Gold Book" of water quality criteria (EPA, 1986).

Table 8-9: COMAR Criteria and Federal Freshwater Water Quality Recommendations

Parameter Tested	Maryland		USEPA Recommendations	
	Acute	Chronic	Acute	Chronic
Ammonia (mg/L)	>0.03*		None	
Chloride (mg/L)	None		860	230
Copper (µg/L)	13	9	13	9
Lead (mg/L)	0.065	0.0025	0.065	0.0025
Zinc (µg/L)	120	120	120	120
Biochemical Oxygen Demand (mg/L)	None		8.41	
Total Suspended Solids (mg/L)	**None**		**None**	
Nitrate Nitrogen (mg/L)	>1*		0.89	
Nitrite Nitrogen (mg/L)	>0.0025*		0.01	
Nitrogen (Total) (mg/L)	>1.5*		0.69	
Phosphorus (Total) (mg/L)	>0.025*		0.037	
Orthophosphate (mg/L)	>0.008*		None	
Enterococcus (MPN/100mL)	35		None	

* *Threshold level used by MBSS as an indication of anthropogenic stress.*

Sources: Maryland COMAR regulation 26.08.02; USEPA, 2000; and MBSS 2000-2004 Volume II Ecological Assessment of Streams Sampled in 2001

High levels of bacteria may result in a public health hazard and make the consumption of shellfish from those areas unsafe. The COMAR criteria for fecal coliform bacteria in Use II shellfish harvesting areas are listed in **Table 8-10**.

Table 8-10: Fecal Coliform Criteria for Areas Designated as Use II Shellfish Harvest Waters

Classification*	Criteria
Approved	14 MPN/100mL
Restricted	88 MPN/100 mL
Point Source	260 MPN/100mL
Other Areas	260 MPN/100mL
Prohibited	Exceeds values required for restricted classification or is located adjacent to a sewage treatment facility outfall or known pollution source.

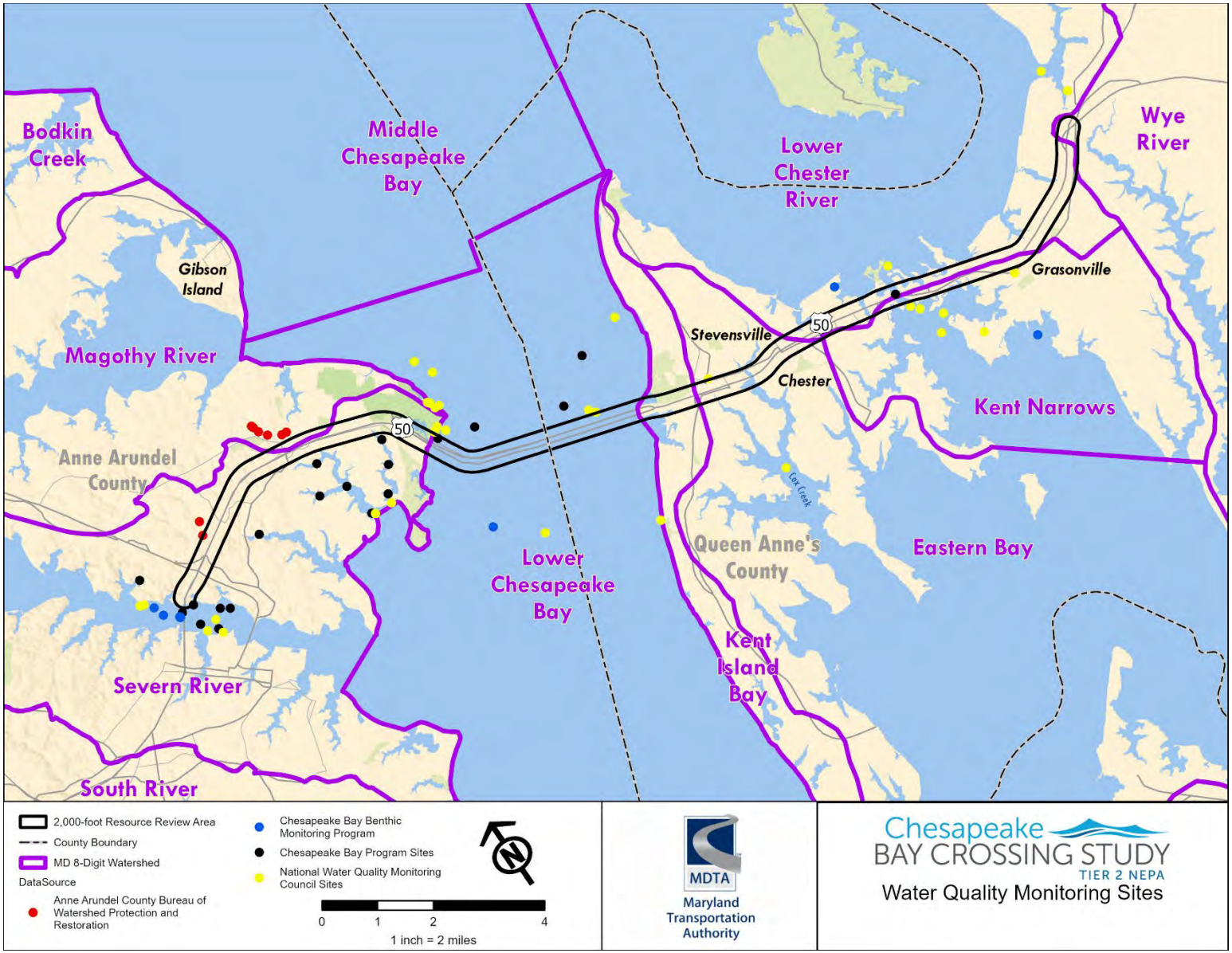
* *Includes Shellfish Harvesting classifications present in the resource review area and not all possible classifications.*

Source: Maryland COMAR regulation 26.08.02.03

8.2.2 Affected Environment

Nontidal and tidal waterways have different state and federally regulated water quality criteria. They also have guidelines that are not regulated criteria, intended to identify stress levels for aquatic biota. Therefore, existing water quality monitoring information has been organized by data collected for nontidal waterways and data collected for tidal waterways. Monitoring locations utilized for these analyses are illustrated in **Figure 8-2.**

Figure 8-2: Water Quality Monitoring Sites



Existing nontidal and tidal water quality data collected within and surrounding the resource review area indicates many stream sampling locations well within compliance of current state and federal criteria and acceptable ranges of predicted stressors to aquatic biota. However, there are also areas identified to exceed regulated criteria, including DO, but largely for pH and bacteria, including *Enterococcus* and fecal coliform. Nontidal tributaries in Anne Arundel County fall outside of acceptable ranges for total phosphorus, ammonia nitrogen, and nitrite. These monitoring results exist both upstream and downstream of the proposed build alternatives limits. According to MDE, there are no Tier II High Quality waters located within the resource review area, therefore, additional antidegradation protections per COMAR 26.08.02.04-1 would not apply.

8.2.2.1 Nontidal

Nontidal grab sample and in situ water quality data in the vicinity of the resource review area are discussed relative to the MD 12-digit watershed below. In Anne Arundel County, limited in situ data were available, collected by AABWPR at two locations in the Lower Severn River MD 12-digit watershed (**Table 8-11**). Both sites are located along Mill Creek, just upstream of U.S. 50/301, one on the Mill Creek mainstem (R2-10-08) at the approximate boundary of the resource review area, and one on an unnamed tributary to Mill Creek (R2-10-06) just north of the resource review area. Data from both locations met COMAR criteria for DO, temperature, and turbidity. The monitoring site on the mainstem had a record that fell below the COMAR standard for pH of 6.5 System Units.

Table 8-11: Summary of AABWPR In Situ Data for Lower Severn River

Site ID	Sampling Year	Dissolved Oxygen (mg/L)	pH (System Units)*	Turbidity (NTU)	Temperature (°C)	Specific Conductance (µS/cm)**
R2-10-08	2013	8.13	6.28	11.20	4.60	109.2
R2-10-06	2013	12.43	6.74	7.05	6.50	137.9

** Bolded values are not within COMAR Use I water quality standards.*
*** microSiemens per centimeter.*

Additional data collected by AABWPR is available at seven locations in the Magothy River South Shore MD 12-digit watershed, all located on Cat Branch, to the north of U.S. 50/301. Data from all seven sites meets COMAR criteria for DO, temperature, and turbidity, and two sites do not meet COMAR standards for pH. Additionally, all sites met COMAR standards for total copper, total zinc, and turbidity. Although the project crosses through the Magothy River 6-digit watershed and the Magothy River South Shore 12-digit watershed, immediately adjacent to and paralleling a section of U.S. 50/301, these sampling locations, as well as the Magothy River and tributaries, are located just beyond the limits of the resource review area. These sampling locations are located within a waterway that does not drain to the south within the resource review area. These locations drain to the north/northeast. It should be noted that in situ data was collected at one point in time and may not be representative of conditions throughout the year or across years.

In Queen Anne's County, the most recent chemical grab sample data available from the NWQMC database for one nontidal location on Thompson Creek in the Northern Eastern Bay MD 12-digit watershed, identified that approximately 23 percent of *Enterococcus* records from 2013 to 2022 exceeded the nontidal COMAR criterion of 35 MPN/100 mL. *Enterococcus* is a lactic acid bacterium, tolerant of a wide range of environmental conditions such as extreme temperatures

and high levels of pH and sodium chloride. This sampling site is located near the northernmost boundary of the resource review north of U.S. 50/31 and Thompson Creek is located within the resource review area.

Recent chemical grab sample data was available from the NWQMC database for two nontidal locations on different unnamed tributaries to Eastern Bay in the Grasonville South MD 12-digit watershed. These are beyond the resource review area, but in proximity to it. It is anticipated that the waters within resource review area would yield similar results at the time of sampling. Approximately 46 percent of all *Enterococcus* records at these sites exceeded the nontidal COMAR criterion of 35 MPN/100 mL.

8.2.2.2 Tidal

Tidal grab sample and in situ water quality data in the vicinity of the resource review area are discussed relative to the MD 12-digit watershed below. No recent water quality data were available for the Kent Island Shore and Upper Wye River MD 12-digit watersheds. Detailed data from each dataset on COMAR water quality parameters and salinity and conductivity are presented in **Table 8-15** and **Table 8-16**. Water quality ranges and values exceeding criteria are discussed by 12-digit watershed below. Error! Reference source not found. **Table 8-12** through **Table 8-14** represent DO criteria per tidal water designated subcategories as identified in **Section 8.2.1**, and specifically for the three 12-digit watersheds that comprise the Chesapeake Bay within the resource review area. Data for these tables provides an aggregate of sampling records. Data summarization for each watershed includes multiple sites and/or sampling events, depending on available data compiled from multiple data sources. These conditions may not reflect the full range of water quality conditions depending on the spatial and temporal coverage of available data.

Data available within the Northwest Lower Chesapeake Bay and Annapolis Shore 12-digit watersheds have sampling locations north of and beyond the resource review area, however, these locations are along the shoreline of the Chesapeake Bay and flow directly into the resource review area. DO data for this area reflects existing turbidity and shoreline erosion conditions, since DO and turbidity are inversely related, and provides base conditions for the area where the bridge would be constructed.

In the Northwest Lower Chesapeake Bay MD 12-digit watershed, recent chemical grab data were available for three monitoring locations from the NWQMC database, which indicated approximately 5 percent of pH records, 14 percent of all *Enterococcus* records, and 8 percent of fecal coliform records not meeting COMAR criteria. Values for pH ranged from 6.1 to 9.0, which violated both the low and high COMAR criteria of 6.5 and 8.5, respectively. In general, DO values met COMAR criteria for the various designated habitats and seasons, with records infrequently falling below specific criteria. The full range of DO values observed across all seasons and habitat types can be found in **Table 8-15**. Salinity ranged from 1.9 to 16 ppt, depending on the sampling event (**Table 8-16**Error! Reference source not found.).

Table 8-12: Percentage of Dissolved Oxygen Records that Fall Below COMAR Criteria for the Northwest Lower Chesapeake Bay

Designated Habitat	COMAR Criteria	Percentage of Records that Fall Below Criteria
Seasonal and Migratory Fish Spawning and Nursery Use	Instantaneous minimum ≥ 5 mg/L from February 1 through May 31	0
	Open-water fish and shellfish use standards apply from June 1 to January 31 (≥ 3.2 mg/L)	3
Seasonal Shallow-Water Submerged Aquatic Vegetation Use	Open-water fish and shellfish use standards apply year-round (≥ 3.2 mg/L)	2
Open-Water Fish and Shellfish Use (year-round)	Instantaneous minimum ≥ 3.2 mg/L	2
Seasonal Deep-Water Fish and Shellfish Use	Instantaneous minimum ≥ 1.7 mg/L from June 1 to September 30	0
	Open-water fish and shellfish use standards apply from October 1 to May 31 (≥ 3.2 mg/L)	0
Seasonal Deep-Channel Refuge Use	Instantaneous minimum ≥ 1 mg/L from June 1 to September 30	0
	Open-water fish and shellfish use standards apply from October 1 to May 31 (≥ 3.2 mg/L)	0

Sampling data in the Annapolis Shore MD 12-digit watershed was collected just north of the Bay Bridge landside connection with Anne Arundel County. In situ and grab sample water quality data for two locations in this area were gathered from the CBP DataHub, where approximately 10 percent of surface pH records exceeded the COMAR criterion of 8.5, with a maximum recorded value of 9.1. All surface DO readings met COMAR criteria for the various designated habitats and seasons, and between 7 percent and 29 percent of bottom DO readings fell below COMAR criteria, depending on the designated habitat and season (**Table 8-13**). The full range of DO values observed across all seasons and habitat types can be found in **Table 8-15**. Chemical grab sample data was available for one monitoring location from the NWQMC database, indicating approximately 8 percent of all fecal coliform records exceeded the most stringent COMAR criterion for shellfish harvesting areas (i.e., ≤14 MPN/100 mL). Recent in-situ water quality data for one location, available from MDNR's CBBMP, revealed that there were no exceedances of water quality criteria, however, this location is well south of the resource review area and flowing away from the Bay Bridge. Salinity ranged from 0.61 to 18.48 ppt, depending on the sampling event, location, and depth (**Table 8-16**Error! Reference source not found.).

Table 8-13: Percentage of Dissolved Oxygen Records that Fall Below COMAR Criteria for the Annapolis Shore

Designated Habitat	COMAR Criteria	Percentage of Records that Fall Below Criteria	
		Surface	Bottom
Seasonal and Migratory Fish Spawning and Nursery Use	Instantaneous minimum ≥ 5 mg/L from February 1 through May 31	0	21
	Open-water fish and shellfish use standards apply from June 1 to January 31 (≥ 3.2 mg/L)	0	29

Designated Habitat	COMAR Criteria	Percentage of Records that Fall Below Criteria	
		Surface	Bottom
Seasonal Shallow-Water Submerged Aquatic Vegetation Use	Open-water fish and shellfish use standards apply year-round (≥ 3.2 mg/L)	0	26
Open-Water Fish and Shellfish Use (year-round)	Instantaneous minimum ≥ 3.2 mg/L	0	26
Seasonal Deep-Water Fish and Shellfish Use	Instantaneous minimum ≥ 1.7 mg/L from June 1 to September 30	0	15
	Open-water fish and shellfish use standards apply from October 1 to May 31 (≥ 3.2 mg/L)	0	12
Seasonal Deep-Channel Refuge Use	Instantaneous minimum ≥ 1 mg/L from June 1 to September 30	0	7
	Open-water fish and shellfish use standards apply from October 1 to May 31 (≥ 3.2 mg/L)	0	12

Recent chemical grab sample data from one location in the Northern Eastern Bay MD 12-digit watershed, located downstream of the build alternatives, were available from the NWQMC database. Approximately 30 percent of all fecal coliform records exceed the most stringent COMAR criterion for shellfish harvesting areas (i.e., ≤14 MPN/100 mL).

Additional in situ and grab sample water quality data was retrieved from five sampling sites in the Kent Island True Bay MD 12-digit watershed, within the Chesapeake Bay, just north of the Bay Bridge. Data from two sites in the CBP DataHub and three sites in the NWQMC dataset indicated that approximately 9 percent of in situ surface records for pH and less than 1 percent of bottom records exceeded the upper COMAR criterion of 8.5. All surface DO readings met COMAR criteria for the various designated habitats and seasons. Bottom DO readings frequently fell below COMAR criteria, with 12 percent to 51 percent of readings not meeting COMAR criteria, depending on the designated habitat and season (**Table 8-14**). Approximately 1 percent of all fecal coliform records exceeded the most stringent COMAR criterion for shellfish harvesting areas (i.e., ≤14 MPN/100 mL). Salinity ranged from 0.50 to 22.32 ppt, depending on the sampling event, location, and depth (**Table 8-16**Error! Reference source not found.).

Table 8-14: Percentage of Dissolved Oxygen Records that Fall Below COMAR Criteria for the Kent Island True Bay

Designated Habitat	COMAR Criteria	Percentage of Records that Fall Below Criteria	
		Surface	Bottom
Seasonal and Migratory Fish Spawning and Nursery Use	Instantaneous minimum ≥ 5 mg/L from February 1 through May 31	0	27
	Open-water fish and shellfish use standards apply from June 1 to January 31 (≥ 3.2 mg/L)	0	47
Seasonal Shallow-Water Submerged Aquatic Vegetation Use:	Open-water fish and shellfish use standards apply year-round (≥ 3.2 mg/L)	0	39

Designated Habitat	COMAR Criteria	Percentage of Records that Fall Below Criteria	
		Surface	Bottom
Open-Water Fish and Shellfish Use (year-round)	Instantaneous minimum ≥ 3.2 mg/L	0	39
Seasonal Deep-Water Fish and Shellfish Use:	Instantaneous minimum ≥ 1.7 mg/L from June 1 to September 30	0	51
	Open-water fish and shellfish use standards apply from October 1 to May 31 (≥ 3.2 mg/L)	0	12
Seasonal Deep-Channel Refuge Use:	Instantaneous minimum ≥ 1 mg/L from June 1 to September 30	0	47
	Open-water fish and shellfish use standards apply from October 1 to May 31 (≥ 3.2 mg/L)	0	12

Within the vicinity of the resource review area in the Grasonville South MD 12-digit watershed, the NWQMC database has chemical grab sample records for five stations. For these stations, approximately 3 percent of all pH records and 46 percent of all *Enterococcus* records did not meet COMAR criteria, and 18 percent of tidal fecal coliform records exceeded the most stringent COMAR criterion for shellfish harvesting areas (i.e., ≤14 MPN/100 mL). These sampling sites are all located downstream of the build alternatives. Salinity ranged from 3.9 to 15.1 ppt, depending on the sampling event, location, and depth (**Table 8-16**Error! Reference source not found.).

In situ water quality data in the Chester River South MD 12-digit watershed was available from the NWQMC and CBBMP datasets just north of the resource review area, and from the CBP DataHub located almost directly at the Kent Narrows bridge. No in situ parameters exceeded COMAR water quality standards. Recent chemical grab data were available for one monitoring location from the CBP DataHub and for two monitoring locations from the NWQMC database. In the NWQMC dataset, approximately 3 percent of all pH records did not meet COMAR criteria and 18 percent of fecal coliform records exceeded the most stringent COMAR criterion for shellfish harvesting areas (i.e., ≤14 MPN/100 mL). Full ranges of water quality parameter values are presented in **Table 8-15**. Salinity ranged from 1.93 to 15.75 ppt, depending on the sampling event, location, and depth (**Table 8-16**Error! Reference source not found.).

Table 8-15: COMAR Water Quality Parameters within 12-digit Watersheds in the Vicinity of the Resource Review Area

Watershed	Source	Number of Sites	Year	Depth (m)	Parameter				
					Temperature (°C)	pH	DO (mg/L)*	Enterococcus (MPN/100mL)	Fecal Coliform (MPN)
Northwest Lower Chesapeake Bay	NWQMC	1 - 3	2013 - 2019	---	2.6 - 28.5	**6.1 - 9.0**	**2.6** - 14.2	10 – **160** (2014-2022)	1 - **93**
Annapolis Shore	CBBMP	1	2018	0.5 / 9	26.30 / 26.37	7.8 / 7.2	6.35 / **4.20** (ppm)	---	---
	CBP	2 / 1	2013 - 2023	0.5 / 4	3.7 - 30.9 / 1 - 28.3	7.1 - **9.1** / 7.1 - 8.4	**4.6** - 15.1 / **0.28** - 12.6	---	---

	NWQMC	1	2013 - 2019	---	---	---	---	---	1 - **23**
Northern Eastern Bay	NWQMC	1	2013 - 2019	---	---	---	---	10 - **2,010** (2013 - 2022)	1 - **1,100**
Kent Island True Bay	CBP	2	2013 - 2023	0.5 / 6	1.3 - 29.6 / 0 - 28	6.9 - **9.6** / 6.8 - **8.7**	5.1 - 17.8 / **0.09** - 12.7	---	---
	NWQMC	1 - 3	2013 - 2019	---	1.2 - 29	7.4 - **8.8**	**4.1** - 14.5	10 - **1,450** (2013 - 2022)	1 – **23**
Grasonville South	NWQMC	1 - 4	2013 – 2019	---	-5.0 - 29.7	7.0 - **9.0**	5.0 - 16.1	10 - **2,010** (2013 - 2022)	1 - **2,400**
Chester River South	CBBMP	1	2019	0.6	23.94	7.06	5.08	---	---
	CBP	1	2013 - 2023	0.3	-0.3 - 29.0	---	5.0 - 15.7	---	---
	NWQMC	1 - 2	2013 - 2019	---	-0.5 - 28.9	6.8 - **9.0**	4.9 - 16.3	---	1 - **240**

*In dilute aqueous solutions, 1 mg/L is approximately equivalent to 1 ppm.

Notes:

*1. **Bold** values indicate that they exceed/are below COMAR criteria during the listed time period.*

2. Data collected at two depths is shown in the same cell separated by a "/," corresponding to the two depths reported in the Depth column.

3. Not all parameters or sites were monitored in each year within the year range.

4 A range of sites is presented to note that not all parameters were assessed at all sites for certain watersheds and datasets.

Table 8-16: Salinity and Conductivity within 12-digit Watersheds in the Vicinity of the Resource Review Area

Watershed	Source	Number of Sites	Year	Depth (m)	Parameter	
					Salinity (ppt)*	Conductivity (UMHO/cm)
Northwest Lower Chesapeake Bay	NWQMC	2	2013 - 2019	---	1.9 - 16	---
Annapolis Shore	CBBMP	1	2018	0.5 / 9	3.26 / 5.83 (PSU)	5,972 / 10,340
	CBP	2 / 1	2013 - 2023	0.5 / 4	0.61 - 16.43 / 3.38 - 18.48	3,100 - 27,000 / 6,640 - 30,000
Kent Island True Bay	CBP	2	2013 - 2023	0.5 / 6	0.5 - 16.56 / 4.75 - 22.32	3,120 - 27,200 / 8,940 - 35,500
	NWQMC	1	2013 - 2019	---	2.8 - 15.2	---
Grasonville South	NWQMC	2	2013 - 2019	---	3.9 - 15.1	---
Chester River South	NWQMC	1	2013 - 2019	---	3.4 - 14.0	---
	CBP	1	2013 - 2023	0.3	1.93 - 15.75	12,400 - 21,400
	CBBMP	1	2019	0.6	11.22	18,911

*1 PSU is approximately equivalent to 1 ppt.

Notes:

1. Data collected at two depths is shown in the same cell separated by a "/", corresponding to the two depths reported in the Depth column.

Watershed	Source	Number of Sites	Year	Depth (m)	Parameter	
					Salinity (ppt)*	Conductivity (UMHO/cm)

2. Not all parameters of sites were monitored in each year within the range.

8.2.3 Environmental Consequences

Impacts to water quality can refer to the chemical, physical, and biological characteristics of surface waters, assessed against standards for their intended use. Water quality is essential for human health and supporting aquatic life.

8.2.3.1 No-Build Alternative

The No-Build Alternative would have no impact to water quality.

8.2.3.2 Build Alternatives

Despite stormwater BMPs and strict ESC measures, construction of any build alternative has the potential to affect downstream water quality conditions and exacerbate exceedances of regulated criteria. Water quality criteria must be met to maintain the designated use of certain waterways within the watershed.

Alternatives B and C would have the least potential for impacts to water quality within the Chesapeake Bay and its tributaries, with tributaries of only four main waterways, Mezick Pond and its connection to the Chesapeake Bay, affected by these alternatives. It is anticipated that Alternatives D, E, F, and G would have greater water quality impacts than Alternatives B and C, with each of these alternatives affecting at least eight additional major waterways. Alternatives F and G include the largest proposed bridge size and the greatest new impervious surface coverage over the Chesapeake Bay. Therefore, these alternatives have the greatest potential for impacts to water quality through short-term effects associated with construction and long-term effects associated with the increase of impervious areas.

Despite the use of BMPs and ESC measures, short-term construction effects still have the potential to increase turbidity due to erosion and sediment disturbance. An overabundance of sediment or pollution from construction activities could impact water quality, resulting in exceedance of regulatory standards, and affect the designated use for the channel. Turbidity could also decrease the photic zone, which is the top layer of a water body that receives sunlight, and a vital area for marine life and ecosystems. It can reduce sunlight penetration, hinder photosynthesis, and increase water temperatures, all of which can lead to lower DO levels. Low DO can also result from industrial point sources of nutrients and agricultural and urban nutrient runoff throughout the entire watershed. DO conditions in the Chesapeake Bay vary seasonally due to natural processes such as stratification. As illustrated in **Section 8.2.2**, the Chesapeake Bay appears to meet standards for DO at the surface water levels, and in many locations to some extent does not meet DO criteria at the Bay bottom.

Grading operations associated with any build alternative could expose large areas of soil that are highly susceptible to erosion from rain or wind. During construction, land cover typically is reduced to grass or impervious surface. Even if areas are planted per the BMPs, it takes time for the roots to stabilize the soil and the possibility for erosion remains. These construction activities can lead to sediment entering stream channels, destabilizing the channel and damaging aquatic

habitat. An increase in sediment in channels can also reduce channel capacity, which could lead to flooding.

The additional roadway surface of the build alternatives would contribute additional contaminants that could then be conveyed to the surface waters via new impervious surfaces. These contaminants can make their way through stormwater runoff into roadside culverts or through bridge deck drainage systems, and into adjacent waterways. Long-term effects from stormwater runoff have the potential to increase the level of contaminants entering surface waters. Roadway runoff contains many natural and anthropogenic constituents. Sources of roadway runoff constituents include local and regional atmospheric deposition, wind-blown soils and vegetation, vehicular sources (including tire wear, lubricants, brake linings, exhaust gasses, antifreeze, and windshield fluids), right-of-way sources (including road-surface wear, corrosion of metal structures, right-of-way soils and plantings, and breakdown of roadway elements and drainage systems), litter and debris from passengers and cargo, winter maintenance materials, and runoff from adjacent land covers. Many of these sources generate particulates, which can be measured as total suspended solids or suspended sediment concentrations. Many roadway-runoff constituents are part of these particulates or are carried by these particulates. These constituents include nutrients, metals, and organic compounds, which may be particulate bound or in what is commonly described as the dissolved phase. Highway runoff itself is not always toxic but toxins can accumulate in sediment deposits from highway drainage, which indicates the potential effectiveness of commonly used BMPs that remove sediment (Buckler and Granato 1999). Runoff from all land covers also commonly carries bacteria from natural and human sources.

Winter maintenance materials include application of particulates for traction and deicing chemicals for melting ice and snow. Deicing chemicals commonly are comprised of calcium-, potassium-, and sodium-chloride salts. These constituents can increase conductivity, chloride, and salinity levels of receiving waters, particularly non-tidal waterways. Because of the inherently higher salinity, conductivity, and chloride levels of the tidal waterways in the resource review area, additional impacts from de-icing chemicals would be less severe.

Bridge and culvert expansion over waterways may also result in changes in water temperatures, which could affect aquatic habitat, wetlands, and vegetation acting as filters to protect water quality.

8.2.4 Avoidance, Minimization, and Further Mitigation Strategies

If a build alternative is selected, a Section 401 Water Quality Certification (WQC) would be required from MDE indicating that anticipated discharges from the project will comply with federally mandated water quality standards; any limitation, standard, or other requirement under the CWA; federal, state, or Tribal laws or regulations implementing the CWA; and state or Tribal water quality related requirements. In support of the water quality certification requirements, avoidance and minimization measures would be further evaluated during final design. SWM would be developed in compliance with all applicable MDE regulations and guidance and designed in accordance with MDE's 2000 Maryland Stormwater Design Manual (MDE, 2009) and MDE's SWM Act of 2007. The 2007 SWM Act requires establishing a comprehensive approach to SWM through implementation of Environmental Site Design (ESD) to the maximum extent practicable and only using structural practices where absolutely necessary. The MDTA would implement strict ESC measures and SWM techniques, to reduce waterway and water quality impacts. These techniques would reduce impacts related to sediment and contaminants, which

could otherwise result in increased turbidity, decreased DO, and varying water quality impacts to surface waters. The MDTA will also develop a Stormwater Pollution Prevention Plan (SWPPP) to ensure that rainwater and stormwater runoff does not intercept potentially harmful chemicals, hazardous materials, sanitary and other wastes, wash waters, and any other potential pollutants that may be found at a construction site. SWM systems would be designed to help control runoff, reduce peak flows, and filter sediment and pollutants from the runoff before entering a downstream system. These SWM systems would aim to eliminate any impacts to or improve the performance of meeting TMDL goals.

The MDTA would coordinate with the regulatory agencies to develop a water quality monitoring program during final design. Development and implementation of a water quality monitoring plan prior to construction would provide real-time comparable data to support consistent management and attainment of water quality standards. Additional minimization and further mitigation strategies that result in sustaining and/or promoting improved water quality are also discussed in **Section 9, Waters of the U.S., Including Wetlands**.

8.3 Wild and Scenic Rivers

Consistent with the resource review for streams and rivers, the wild and scenic rivers resource review area also extends 1,000 feet on either side of the U.S. 50/301 centerline from the eastern shoreline of the Severn River to the U.S. 50/301 split. These rivers, or sections of rivers and tributaries, are preserved in their free-flowing condition and are not dammed or otherwise impeded.

8.3.1 Regulatory Context and Methodology

The federal Wild and Scenic Rivers system was created to protect "rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values." The system is administered by the Bureau of Land Management, National Park Service (NPS), U.S. Forest Service, and U.S. Fish and Wildlife Service (USFWS). "Rivers included in the National System at the request of a governor and designated by the Secretary of the Interior (under Section 2 (a)(ii) of the Act) are administered by their respective state(s), with the NPS or another of the three lead agencies making determinations under Section 7 of the Act" (USDOI, 2023).

The Maryland Scenic and Wild Rivers Act of 1968 established the Maryland Scenic and Wild Rivers System to preserve and protect the natural values and enhance the water quality of rivers, or segments of rivers, which possess outstanding scenic, geologic, ecologic, historic, recreational, agricultural, fish, wildlife, cultural, and other similar resource values (MDNR, 2023a). A Scenic River is a "free-flowing river whose shoreline and related land are predominantly forested, agricultural, grassland, marshland, or swampland with a minimum of development for at least two miles of the river length." A Wild River is a "free-flowing river whose shoreline and related land are undeveloped, inaccessible except by trail, or predominantly primitive in a natural state for at least four miles of the river length" (Maryland Code, Natural Resources § 8-402). Each unit of state and local government is required to take whatever action is necessary to protect and enhance the qualities of a designated river. Potential effects to scenic and wild rivers are reviewed and coordinated by MDNR in collaboration with the relevant Scenic and Wild River Advisory Board.

The MDTA accessed online information from the National Wild and Scenic River System website and the MDNR Scenic and Wild Rivers Program to determine if any federally designated Wild and Scenic Rivers or state-designated Scenic and Wild Rivers are located within the resource review area (MDNR, 2018a; MDNR, n.d.b.).

8.3.2 Affected Environment

There are no federally designated Wild or Scenic Rivers in Maryland. The Severn River, located on the western end of the resource review area, is a state-designated Scenic and Wild River (Severn River Association, 2024). The Severn River Commission was created in 1984 by the Anne Arundel County Council and the Annapolis City Council to advise these organizations on policies to enhance and protect the natural, historic, and scenic quality of the Severn River watershed (Severn River Commission, 2024).

The Severn River is a tidal tributary of the Chesapeake Bay, extending from Annapolis northwestward about 10 miles. Upstream, Severn Run provides the main source of fresh water to the tidal Severn River. More than a dozen tidal creeks join the Severn River throughout its length, allowing sheltered anchorage for recreational boats. The depth in the middle of the Severn River is typically about 20 to 25 feet, with depths to about 10 feet in the adjoining creeks. This depth prevents large ships from entering Annapolis and was one of the factors that fostered the growth of Baltimore at the beginning of the 19th century. The Severn River's intermediate salinity limits the biological organisms that can live in it, as it is too salty for most freshwater fish and too fresh for most marine organisms. However, some animals are adapted to this level of estuarine salinity, including blue crabs, oysters, white perch, eels, and a variety of other fish as well as invertebrates. The Severn River's water quality has been a concern, and like much of the Chesapeake Bay, during the summer, levels of DO diminish with depth, so that many fish avoid the low oxygen "hypoxic" waters that occur about half-way between the surface and the bottom (The Severn Riverkeeper, 2024).

8.3.3 Environmental Consequences

8.3.3.1 No-Build Alternative

The No-Build Alternative would have no impact to the Severn River.

8.3.3.2 Build Alternatives

No impacts to the Severn River or viewshed changes surrounding the vast majority of the river are anticipated from any of the build alternatives because the LODs end at the MD 2/MD 450 interchange, just east of the Severn River Bridge. However, the existing Chesapeake Bay Bridge is visible from the mouth of Severn River where it meets the Bay, and any new bridge could also be seen from this location.

A new bridge would be generally consistent with the existing views, but a new bridge could vary somewhat visually from the existing bridge due to the larger structure required to accommodate increased vertical clearance and additional travel lanes. Temporary visual impacts during construction would include visible construction equipment and activity over a number of years. None of these potential impacts is expected to substantially impact the overall scenic nature of the river. The MDTA will continue to coordinate with MDNR and the Severn River Commission throughout the design process to ensure any impacts to vistas from the mouth of the Severn River are minimized to the extent practicable.

8.3.4 Avoidance, Minimization, and Further Mitigation Strategies

Substantial impacts to Wild and Scenic Rivers are not anticipated with any of the build alternatives. Potential minimization of visual impacts from the mouth of the Severn River will be coordinated with MDNR and the Severn River Commission. Further information on the visual impacts from the build alternatives and potential mitigation measures can be found in the *Chesapeake Bay Crossing Study Socioeconomic and Land Use Technical Report.*

9 WATERS OF THE U.S., INCLUDING WETLANDS

This section evaluates the existing WOTUS including wetlands and state jurisdictional wetlands and waterways within the resource review area and expands upon specific surface waters crossed by the resource review area, as discussed in **Section 8 Surface Water Resources**. Waterways and wetlands were initially mapped based on a desktop analysis of a resource review area that extends 1,000 feet on either side of the U.S. 50/301 centerline from the eastern shoreline of the Severn River to the U.S. 50/301 split. Following the desktop analysis, waterways and wetlands were delineated in the field within roughly 300 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split.

9.1 Regulated Wetlands and Waterways

9.1.1 Regulatory Context and Methodology

Jurisdictional waterways and wetlands, or WOTUS, are federally regulated by the USACE and USEPA under Section 404 of the CWA, and Section 10 of the Rivers and Harbors Act. USACE and USEPA regulate the discharge of dredged or fill material into WOTUS. Under Section 404(b)(1) Guidelines of the CWA, non-fill related impacts to WOTUS that result in permanent loss of wetland functions or services are also considered by USACE, including wetland conversion from one type to another and hydrologic loss due to nearby direct impacts.

At the state level, waterways and wetlands are regulated as Waters of the State by MDE under the Nontidal Wetlands Protection Act (Md. Code Ann. Environment § 5-9) and the Tidal Wetlands Act (Md. Code Ann. Natural Resources § 16-101). Impacts to tidal wetlands require a tidal license issued by the Maryland Board of Public Works (BPW). It should be noted that Maryland regulates the following resources that the USACE does not: nonadjacent wetlands; and a 25-foot nontidal wetland buffer.

MDE also regulates certain designated high-quality wetlands called Wetlands of Special State Concern (WSSC). A WSSC is one with unique ecological value, often in which rare, threatened, or endangered (RTE) species or a unique habitat may be present. MDE regulates activities in WSSCs, including a 100-foot buffer, to protect these wetlands from the impacts of development.

Additional waterways and wetlands regulations include:

- Final rule on the “Revised Definition of ‘Waters of the United States’”; Conforming (88 Federal Register 61964, published September 08, 2023 and effective March 20, 2023);
- EO 11990, Protection of Wetlands (42 Federal Register 26961, May 24, 1977);
- USDOT Order 5660.1A, Preservation of the Nation’s Wetlands;
- COMAR Title 26; Subtitle 23 Nontidal Wetlands, Subtitle 24 Tidal Wetlands, Subtitle 17 Section 04 Construction on Nontidal Waters and Floodplains; and Subtitle 23, Section 6, Wetlands of Special State Concern;
- MDE Nontidal Wetlands Protection Act and Program and the Tidal Wetlands Act and Program; and
- Anne Arundel County Office of Planning and Zoning Protections and Minimum Mitigation Conditions for Nontidal Wetlands (OPZ-20-06).

During final design, a Joint Federal/State Application for the Alteration of Any Floodplain, Waterway, Tidal or Nontidal Wetland in Maryland would be required for submittal to MDE and USACE. The project would be considered a major project requiring an Individual Permit, which requires several documents, including contiguous property owner notifications, detailed impact drawings, cross-section and profile project plan sheets, detailed sequence of construction and BMPs, planned mitigation, and additional agency correspondence. Public Notice would be required during the permitting process, and a Public Hearing may also be required by USACE and MDE.

9.1.1.1 Published Data Review

An initial desktop review of published GIS databases was conducted to gather information to aid in identification of waterways and wetlands within the resource review area. An overview of the type of data considered includes:

- USDA NRCS – hydric soils (USDA/NRCS, 2018; 2002; 1973);
- USFWS – nontidal and tidal waterways and wetlands (USFWS, 1993; 1977-2024);
- MDNR – nontidal waterways and wetlands, including WSSCs, and tidal wetlands (MDNR, 1972; MERLIN);
- USGS – rivers, streams, and lakes (USGS, 2025a);
- MDE – designated use classes for Maryland's surface waters (MDE, 2019a);
- Anne Arundel County and Queen Anne's County databases – parcel data (Anne Arundel County, 2023; Queen Anne's County, n.d.);
- FEMA – 100-year floodplains (FEMA, 2023);
- USGS and County databases (including Light Detection and Ranging) – topography, geology, and vegetation (USGS, 2025a; MD iMAP, 2018); and
- SHA – right-of-way boundaries, existing NPDES-mapped conveyances, and SWM facilities (ArcGIS Online for Maryland, 2020, 2022).

9.1.1.2 Field Delineations

The study limits for the waterways and wetlands field delineation included approximately 250 to 300 feet north and south of the existing U.S. 50/301 centerline, between the eastern shoreline of the Severn River and the U.S. 50/301 split. The field study limits were widened to encompass existing roadway interchanges, or areas identified as in need of additional study because potential roadway improvements may extend past the field delineation boundary. Resources described in this section include only those delineated within the field study limits and may therefore be impacted by the build alternatives.

The field delineations were conducted in accordance with the USACE Wetlands Delineation Manual (USACE, 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual, *Atlantic and Gulf Coastal Plain Region, Version 2.0* (USACE, 2010), which describe the three-parameter approach to delineating typical wetlands (hydrophytic vegetation, hydric soils, and wetland hydrology). Resource boundaries were located in the field using Trimble™ and Catalyst sub-meter accuracy global positioning system (GPS) equipment, or equivalent. The boundary between tidal and nontidal wetlands was determined based on topography, vegetation changes, wrack lines, and other field indicators of tidal influence. Tidal wetland boundaries, including determination of State versus private wetlands will be refined for permitting in final design. Not all properties within the field study limits could be physically

accessed, therefore, approximate resource locations are shown in the resource mapping for those locations in the *Wetland Delineation Report* (**Appendix E**).

A modified approach to soils identification was conducted for all private property locations, where "invasive" soil samples could not be taken. Only published soil survey information was used to delineate wetland boundaries in these locations; therefore, the delineation was largely based on hydrology and vegetation parameters, while the soils parameter was based on mapped hydric soil locations and anticipated soil conditions. Field soil sampling using an auger or shovel to examine the soil profile was conducted within the SHA and the MDTA right-of-way. For collected soil samples, the *Field Indicators of Hydric Soils in the United States Version 8.2*, (USDA/NRCS, 2018) was used to determine the presence of hydric soil indicators.

For all potential wetlands within the field study limits, the *National Wetland Plant List* (USACE, 2020) was used to determine the wetland indicator status of plants identified (**Table 9-1**). In general, for inaccessible properties where resources were deemed likely present, published resource data were used in conjunction with field observations to identify approximate resource boundaries. Routine Wetland Data Forms were completed to record information for each wetland and associated upland determination data points collected in the field. To assist in later calculation of mitigation requirements using the Maryland Stream Mitigation Framework, additional stream functional data were collected during the field delineation and recorded on stream point data sheets for all intermittent and perennial systems. This information is included in **Appendix E**. In accordance with the September 2023 changes to the federal definition of WOTUS, boundaries of ephemeral systems were not delineated or flagged in the field. Boundaries of relatively permanent waterways, including intermittent and perennial streams, are illustrated in **Appendix E** report attachments.

Table 9-1: Wetland Plant Indicator Status

Indicator Category	Indicator Abbreviation	Description
Obligate Wetland	OBL	Almost always occur in wetlands (estimated probability >99%) under natural conditions
Facultative Wetland	FACW	Usually occur in wetlands (estimated probability 67% - 99%), but occasionally found in non-wetlands (estimated probability 1% - 33%)
Facultative	FAC	Equally likely to occur in wetlands (estimated probably 34% - 66%) or non-wetlands
Facultative Upland	FACU	Usually occur in non-wetlands (estimated probability 67% - 99%), but occasionally found in wetlands (estimated probability 1% - 33%)
Obligate Upland	UPL	Almost always occur in non-wetlands (estimated probability >99%) under natural conditions

Each field-delineated resource was classified in accordance with the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979), commonly referred to as the Cowardin Classification System. A comprehensive resource table with descriptions of resources, photographs, data sheets, approximate size of the resource within the field study limits, and a wetland functions and values assessment for all wetlands measuring more than 0.5 acre within the field study limits are included in **Appendix E**. Functions and values were evaluated in

accordance with the *Highway Methodology Workbook Supplement: Wetland Functions and Values, a Descriptive Approach* (USACE, 1999).

Wetland Mapping was prepared using waterway and wetland boundaries delineated during the 2023 field investigations. This field data replaces published information in areas of overlap, and published data is used to represent extensions of these systems beyond the field study limits. A 25-foot wetland buffer has been identified for field delineated nontidal wetland systems. The buffers were developed to exclude areas of existing pavement or other impervious surfaces. Additionally, nontidal wetland buffers often overlap, therefore, an identified wetland buffer may not be solely representative of one wetland, but rather of multiple adjacent wetland systems. Wetland buffers may cross over and include small waterways but do not extend across waterways with substantially defined banks. There are no documented State WSSC and associated 100-foot nontidal wetland buffers within the study limits; therefore, all nontidal wetland buffers are assumed to be 25-feet in accordance with MDE regulations. However, MDE may require an expanded 100-foot nontidal wetland buffer where certain conditions are present such as steep slopes and/or highly erodible soils. These determinations will be made during final design when detailed coordination with MDE will occur during field reviews and resource permitting. MDE does not regulate a buffer area for tidal wetlands.

9.1.2 Affected Environment

9.1.2.1 Published Data Review

The USFWS National Wetland Inventory (NWI) and MDNR-published mapping identify a variety of tidal and nontidal wetland systems within the resource review area in both Anne Arundel County and Queen Anne's County.

In Anne Arundel County, wetlands are largely associated with four main waterways: Severn River, Mill Creek, Whitehall Creek, and Meredith Creek. The upstream segments of these waterways are nontidal, freshwater systems. The stream geomorphology in this region is characterized by generally rolling topography and streams that may have moderate to steep slopes, steep valley walls, and bottom materials dominated by sands and gravel.

Each of these waterways drains south to the Chesapeake Bay, south of or immediately adjacent to the Bay Bridge. The 1972 Tidal Wetland Boundary Maps (MDNR, 1972) indicate that wetlands and ponds within the field study limits, located along the eastern shoreline of the Severn River, have a tidal influence. Wetlands associated with Mill Creek and Whitehall Creek are not located within tidal limits; these are identified as nontidal waterways with adjacent palustrine (freshwater) nontidal systems and do not have a tidal classification until south of the field study limits. Largely, all mapped systems associated with Meredith Creek within the field study limits are within tidal limits, classified as estuarine and marine subtidal waterways and both subtidal and intertidal wetlands. Estuarine ponds are located on either side of U.S. 50/301 just prior to the Bay Bridge. In Anne Arundel County, mapped waterways and wetlands associated with the Little Magothy River, draining north of U.S. 50/301, do not fall within the field study limits.

Mapped wetlands in Queen Anne's County are associated with the following mostly tidal classified estuarine and marine systems: Thompson Creek, Cox Creek, Macum Creek, Piney Creek, Kent Narrows, Prospect Bay (including Marshy Creek), Chester River (including Muddy Creek, Jackson Creek, Winchester Creek, and Walsey Creek), and the Wye River. Excluding Thompson Creek, Walsey Creek, and Wye River, these waterways are designated Use II. Use II waterways

prevalent in these areas are tidal, brackish and saltwater systems. The stream geomorphology in this region is characterized as very flat topography that is drained by low-gradient streams. The sediments that dominate the channel bottom of Delmarva streams are typically smaller in size than the coarse gravels found in streams located west of the Chesapeake Bay. Thompson Creek is a Use I waterway north of U.S. 50/301 and transitions to Use II just south of U.S. 50/301. Walsey Creek and the Wye River have upstream sections within the resource review area that are also Use I. Queenstown Creek, a tributary to the Chester River, is located just north of the field study limits and mapped wetlands associated with this waterway are not located within or drain into the field study limits. The 1972 Tidal Wetland Boundary largely abuts U.S. 50/301 either to the north or south or on both sides of the roadway in most waterway locations. Palustrine nontidal wetlands are located beyond tidal boundaries.

Nontidal WSSCs are "the best examples of Maryland's nontidal wetland habitats" and are provided additional protections under Maryland wetland regulations. One (1) WSSC is located north of U.S. 50/301, west of Route 2 and along Chase Creek. This WSSC is outside the resource review area and the field study limits.

Table 9-2 provides a high-level definition of terminology and classifications used within this section.

Table 9-2: Wetland Classification/Resource Definitions

Classification	Definition*
System	
Palustrine	A palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5 parts per thousand (ppt). It also includes wetlands lacking such vegetation but with all the following four characteristics: 1. Area less than 20 acres; 2. Active wave-formed or bedrock shoreline features lacking; 3. Water depth in the deepest part of the basin less than 6.6 feet at low water; and 4. Salinity due to ocean-derived salts is less than 0.5 ppt.
Estuarine	An estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may periodically increase above that of the open ocean due to evaporation.
Riverine	A riverine system includes all wetlands and deepwater habitats contained within a channel with two exceptions: 1. Wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses or lichens, and 2. Habitats with water containing ocean-derived salts more than 0.5 ppt.
Subsystem	
Tidal	Waters with low gradient and water velocity fluctuate under tidal influence.
Nontidal	Waters without tidal influence.
Subtidal	Wetlands or waters with a substrate continuously submerged.
Intertidal	Wetlands or waters with substrates exposed and flooded by tides.
Perennial	Flowing year round and most of the water comes from smaller upstream waters or groundwater while runoff from rainfall or other precipitation is supplemental.
Intermittent	Flowing during certain times of the year when smaller upstream waters are flowing and when groundwater provides enough water for stream flow. During dry periods, there may not be flowing water.

**Source: Cowardin et al., 1979*

9.1.2.2 Field Delineations

Detailed descriptions of wetland and waterway classifications and characteristics for resources located within the field study limits are included in the *Wetland Delineation Report*, **Appendix E** and a high-level summary of these areas is provided below. The location of each field-delineated resource within the field study limits, supplemented with published resource information to show extension of these systems beyond the field study limits, where relevant, is illustrated on the wetland mapping attachment to the *Wetland Delineation Report*.

A summary of systems delineated within the field study limits is presented in **Table 9-3**.

Table 9-3: Wetland and Waterways within Limits of Field Delineation

Resource	Classification	Number of Systems
Wetland	Palustrine Emergent (PEM)	36
	Palustrine Scrub/Shrub (PSS)	6
	Palustrine Forested (PFO)	58
	Palustrine Unconsolidated Bottom (PUB)	9
	Estuarine Emergent (E2EM)	31
	Estuarine Scrub/Shrub or Forested (E2SS or E2FO)	4
Total # of Wetland Systems		**144**
Waterway	Nontidal Perennial (R2)	16
	Nontidal Intermittent** (R4)	23
	Tidal (E1)	19
Total # of Waterways		**58**

*Determination of wetland connections or isolation will be made during permitting.
**Intermittent streams identified meet the definition of relatively permanent waters of the U.S. (88 Federal Register 61964).

The 8-digit Severn River Watershed makes up most of the field study limits within Anne Arundel County. A portion of the field study limits within Anne Arundel County is within the Magothy River Watershed, located to the north of U.S. 50/301, between Cape St. Claire Road and Yorktown Road; however, NWI mapping and the field delineation did not reveal any wetlands or streams within the field study limits of this watershed. Therefore, all resources identified and described within Anne Arundel County are located within the Severn River Watershed. The following narrative provides details focused on field delineated wetlands and waterways, organized from west to east through the study limits and largely associated with the main waterway into which identified resources drain, correlating this discussion with **Section 8.2, Streams and Rivers.**

Severn River

The eastern shoreline of the Severn River, a Use II perennial waterway, functions as the western limits of the resource review area. Manresa Pond Tributary is confluent with the Severn River, developing within the field study limits near the intersection of U.S. 50/301 and MD 2. This lower perennial nontidal tributary is fed through several smaller intermittent streams, connecting within and underneath the adjacent roadway infrastructure. Several PEM and PFO wetlands are located abutting and surrounding this stream, with an additional inline pond classified as a PUB but functioning as a SWM facility.

Mill Creek

East of the Severn River, Mill Creek is a Use I perennial waterway classified as nontidal within the field study limits and, per the 1972 Tidal Wetland Boundary, is classified as tidal waters south of the field study limits. The mainstem of Mill Creek, north of U.S. 50/301, is impounded and approximately 300 feet wide and bound on each side by PFO wetlands. The waterway is piped under U.S. 50/301 to an approximate 12-foot-wide open channel, which is fed by a nontidal perennial tributary from the west, and both nontidal perennial and intermittent tributaries from the east. Nontidal PFO wetlands are located along the tributaries. Mill Creek, south of U.S. 50/301, has been greatly altered from its original channel patterns and connections due to commercial development. This fragmentation results in tributaries and forested wetlands scattered between commercial properties.

Whitehall Creek

Whitehall Creek is a Use I perennial nontidal tributary meandering through a large portion of the Anne Arundel County field study limits, east of Mill Creek and west of Meredith Creek, bisecting U.S. 50/301 several times and traversing almost three linear miles along the roadway. This tributary and its several intermittent and perennial channels extend from just east of Old Mill Bottom Road, west through the interchanges at St. Margaret's Road and an extensive SHA mitigation site, and east as far as Jenkins Lane. Nearly the entire expanse of Whitehall Creek and its tributaries within the resource review area are surrounded by nontidal wetlands; most extensively PFO but also scattered locations of PEM and PSS wetlands. All wetlands and tributaries of Whitehall Creek within the field study limits are indicative of nontidal systems.

A notable location within this section of the resource review area is the large SHA mitigation site located within the interchanges with St. Margarets Road on the south side of U.S. 50/301. Historic and published data indicate this area was traversed by the mainstem of Whitehall Creek. SHA created a series of grass swales with check dams and a wet pond with riprap outlet ditch. Whitehall Creek has become impounded in the interchange area west of St. Margarets Road and is surrounded by PEM and PSS wetlands. The waterway mainstem is piped under U.S. 50/301 to the eastern interchange area where a large PFO with scattered PEM wetlands and a PUB system is present. This interchange complex is almost entirely filled with wetland and waterway resources.

Meredith Creek/ Mezick Pond/Westinghouse Bay

Meredith Creek headwaters are classified as Use I nontidal intermittent streams, which have a groundwater connection and receive hydrology from surrounding nontidal wetlands. South of State Park Road, a sizable portion of the field study limits consists of open water systems and wetlands. West of U.S. 50/301 and east of Meredith Creek, hydrology to and from wetlands and streams is split between flowing west towards Meredith Creek and Moss Pond and eventually to the Chesapeake Bay and flowing south towards a large manmade area called Westinghouse Bay on the MDTA property, which immediately borders the Chesapeake Bay but does not have a hydrologic connection. East of U.S. 50/301, most surface flow is directed toward Mezick Pond and flanking wetlands, which are located within Sandy Point State Park, with hydrology directly connecting to the Chesapeake Bay. This area is largely influenced by the tides and floodplain, and therefore a mostly tidal estuarine system exists.

Chesapeake Bay

The Chesapeake Bay is classified as a Use II tidal waterway. North of the bridge, the Bay is within the Upper Chesapeake Bay segment (CB3MH), and south of the bridge, the Bay is within the Middle Central Chesapeake Bay segment (CB4MH). The Chesapeake Bay is a mesohaline system (represented as the MH within the segment identifier above), which means its waters have a low to medium saline content, or are brackish waters, and are typically defined as having salinity between 5 and 18 parts per thousand (ppt) (Park, 2012).

The western shoreline of the Chesapeake Bay forms the field study limits in Anne Arundel County. Here the shoreline is largely hardened with revetment and retaining walls along the MDTA property and private properties. A cove-like area identified as Moss Pond, with a largely forested natural shoreline, is located south of the Bay Bridge. Sandy Point State Park beach area is located north of the Bay Bridge.

The field study limits in Queen Anne's County begins just west of the landward connection of the Bay Bridge travel lanes and the eastern shoreline of the Chesapeake Bay. A large estuarine ponded area, connected to the Chesapeake Bay by two culverts/pipes, is located between the eastbound and westbound travel lanes just prior to the bridge connection landside. The shoreline south of the bridge has a small, relatively unvegetated beach area and portions of hardened shoreline bordering a marina and private businesses. The landscape in this area and east (south of U.S. 50/301) has been continually changed over the last 25 years, due to development within and surrounding the marina and the Bay Bridge Airport. Shoreline north of the bridge is partially structured and has a small unvegetated beach area.

Thompson Creek and Cox Creek

Within the Eastern Bay Watershed, major waterways draining from the north to the south include Thompson Creek, a Use I perennial waterway, and Cox Creek, a Use II perennial tidal waterway. Thompson Creek south of U.S. 50/301, although still classified within the field study limits as a Use I system by MDE, is tidally influenced, and is bordered on either side by estuarine emergent wetlands. Cox Creek is a tidal system both north and south of U.S. 50/301. This system is approximately 575 feet wide north of U.S. 50/301 and 1,650 feet wide south of the roadway. Although the FEMA 100-year floodplain is associated with this waterway both north and south U.S. 50/301, there are no wetlands identified to the north. Large areas of estuarine common reed (*Phragmites australis*) wetland are located along the western bank, on the south side of U.S. 50/301.

Macum Creek and Piney Creek

The Lower Chester River Watershed is located largely north of U.S. 50/301, only extending just south of the roadway around the headwaters of Piney Creek and paralleling MD 18. Two main tributaries of the Chester River, Macum Creek and Piney Creek, are within this watershed. Macum Creek is a Use II tidal waterway located only north of U.S. 50/301 and north of Piney Creek Road. A FEMA 100-year floodplain surrounds two tributaries of this creek, both with tidal estuarine fringe wetlands on either side of the channel. Immediately east of Macum Creek is an impounded nontidal perennial open water system, with no clear connection to the Chester River. This waterway meanders in and out of the field study limits and connects under White's Heritage Lane to a nontidal open water system. Piney Creek is a Use II tidal waterway located east of this area and beginning south as far as Route 18 and draining north. Large estuarine common reed wetlands and PFO wetlands are associated with Piney Creek.

Kent Narrows

The Kent Narrows flows under U.S. 50/301, connecting the Chester River in the Lower Chester River Watershed to the north and Prospect Bay in the Kent Narrows Watershed to the south. This waterway has a mostly hardened shoreline within the field study limits, with substantial development and piers/docks along the water's edge. The watersheds of these waterways are split largely parallel along U.S. 50/301 until influenced by Winchester Creek to the east.

Muddy Creek and Marshy Creek

Muddy Creek, a Use II tributary to the Chester River is located north of U.S. 50/301 and Marshy Creek, a Use II tributary to Prospect Bay is south of U.S. 50/301. Estuarine wetlands are located on both sides of the roadway and span almost the entirety of this area within the field study limits and beyond. There is a boardwalk paralleling the north side of U.S. 50/301, spanning over tidal areas of Muddy Creek.

Jackson Creek and Winchester Creek

Continuing east, the two main waterways that the field study limits drain to are Jackson Creek and Winchester Creek, both tidal tributaries to the Chester River. Jackson Creek is classified as a Use I waterway, with its headwaters just north of U.S. 50/301, however it was identified during field delineations as tidal. Within the field study limits the channel is manmade and surrounded by tidal common reed emergent wetland until it connects with the larger mainstem of Jackson Creek, beyond the field study limits. Winchester Creek, a Use II tidal waterway, flows north to the Chester River, with headwaters both north and south of U.S. 50/301. All wetlands associated within these waterways delineated within the field study limits are dominated by common reed.

Walsey Creek and Wye River

Walsey Creek is a tributary of the Chester River, located north of U.S. 50/301 and classified as a Use I nontidal waterway with nontidal common reed and PFO fringe wetlands surrounding the waterway within the field study limits. Extending beyond the field study limits it receives tidal influence and is surrounded by tidal emergent wetland. Moving east, much of U.S. 50/301 is bordered on both sides by nontidal palustrine wetlands, including PFO and PEM systems. Some are large expanses of well-established forest, largely west of the U.S. 50 westbound ramp onto U.S. 50/301. Additional systems located between MD 18 and eastbound U.S. 50/301 in largely disturbed landscape are a mix of scattered PFO wetlands and several linear PEM wetlands that have formed in open-canopy areas.

An unnamed tributary, headwaters of the Wye River, extends to the southeast corner of the intersection of MD 18 and U.S. 50, just west of a shopping outlet mall. Surface waters here have been classified as intermittent, surrounded on either side by PFO wetlands. Additional linear drainage feature PFO and PEM wetlands are located near both the north and south entrances to the outlets.

9.1.2.3 Wetland Function and Value Assessment

Wetland functions are defined as "self-sustaining properties of a wetland ecosystem that exist in the absence of society," meaning that functions therefore "relate to the ecological significance of wetland properties without regard to subjective human values." Wetland values are "benefits that derive from either one or more functions and the physical characteristics associated with a wetland" (USACE, 1999).

A function and value assessment form was completed for delineated wetlands comprising a half-acre or greater within the field study limits. Within the field study limits, 62 wetlands 0.5 acres or larger were identified. The functions and values most associated with wetlands within the field study limits include flood flow alteration; sediment, toxicant, and pathogen retention; nutrient removal/retention transformation; and wildlife habitat. The slow movement of water through many of these wetlands allows water flow retention and ability of suspended particles moving in the adjacent waterways to settle out, which improves water quality. Approximately 45 percent of field-delineated wetlands were noted to have a high-water table and approximately 33 percent exhibited saturation to the surface. These factors contribute directly to these most frequently identified functions and values.

Functions and values including recreation, uniqueness/heritage, and visual quality/aesthetics were the least commonly identified in the assessment. No wetlands were identified as having an educational/scientific value, likely due to busy roadways and inadequate safe access for people to view and hold an "outdoor classroom." Additionally, more than half of the wetlands delineated contain common reed as a dominant species, with approximately 82 percent of those wetlands having an absolute percent cover of common reed at 50 percent or higher, which reduces species diversity. Common reed is a non-native, invasive wetland grass, and is typically considered a noxious weed in Maryland. Because it is so easily spread by wind and water, the high-water table and suitable hydric soil conditions contribute to its re-establishment and prevalence. Additional information on common reed and other invasive species in the resource review area is provided in **Section 14, Terrestrial Habitat and Biota**.

9.1.3 Environmental Consequences

Potential impacts to wetlands and waterways associated with the No-Build Alternative and the build alternatives have been evaluated. The evaluation considers those impacts that may only be short-term and largely associated with construction, and long-term or permanent impacts associated with new pavement or structures.

9.1.3.1 No-Build Alternative

The No-Build Alternative would have no impacts to waterways or wetlands.

9.1.3.2 Build Alternatives

This section provides both a qualitative and quantitative analysis of impacts from the build alternatives. The following types of disturbances to wetlands and waterways are anticipated and could result in temporary and permanent impacts:

- Complete or partial fill of a wetland system and disconnection and/or fill within a wetland or waterway because of placement of permanent structures such as bridge piers or abutments, culverts, or new roadway embankments. These impacts would be permanent.
- Complete or partial fill of a wetland system because of required grading for proposed roadway. Although the area may not result in new impervious surface, if the resource receives fill, the impacts would be permanent.
- Loss of natural stream channel habitat and potential for loss or reduction of aquatic organism passage from extension of existing culverts. These impacts would be permanent.

- Conversion of wetland type (e.g., removal of vegetation from a PFO wetland resulting in conversion to a PEM wetland). This would result in a permanent loss of forested wetland habitat; however, no net loss of overall wetland acreage would result. These impacts could be considered as both permanent and temporary impacts, depending on state or federal regulations.
- Grading or construction activities where the impacted area is returned to existing contours and reseeded, would be considered a temporary impact.
- Placement of wetland matting, fords, or structures spanning over wetlands or waterways for the purpose of construction access would be considered a temporary impact.
- Placement of temporary access structures within a waterway (e.g., trestles, causeway) and mooring anchors used to stage equipment and materials on vessels or barges within open water areas. These would be considered temporary impacts. Temporary impact structures that remain in place longer than a year would be considered permanent impacts.
- Relocation of waterways or creation/expansion of permanent culverts or bridges over waterway systems. These impacts could result in either permanent impact for the area of fill (e.g., new permanent structure/riprap) within the waterway, or temporary impact for construction activities, and may depend on state or federal regulations.
- Removal, excavation, or dredging of river bottom or additional in-water actions such as pile driving, and instream diversion measures such as cofferdams or pump-arounds. This would be considered a temporary impact.
- Placement of bridge pier protective barriers (fender rings) that shield the bridge supports from damage caused by vessel collisions. The fender piles reaching the Bay bottom, and area of the fender ring at the water's surface, would be considered permanent impact.

Wetland and waterway boundaries are illustrated on natural resource map sets for the northern alignments (**Appendix B**) and southern alignments (**Appendix C**). Impact calculations include the total acreage of wetland, acreage of 25-foot nontidal wetland buffer, and acreage and linear feet of waterway that falls within the LOD of each build alternative. Both temporary and permanent impacts were considered. **Table 9-4** illustrates impacts to all nontidal and tidal wetlands. **Table 9-5** illustrates impacts to all nontidal and tidal wetlands associated with the SUP option for each build alternative.

Table 9-4: Tidal and Nontidal Wetland Impact Summary (acres)

Resource Classification	No-Build	Build Alternative					
		B	C	D	E	F	G
PEM	0	0.7	0.9	1.2	1.4	1.2	1.4
PSS	0	<0.1	<0.1	0.9	0.9	0.9	0.9
PFO	0	3.3	3.3	6.5	6.5	6.6	6.6
PUB	0	0	0	0.4	0.4	0.4	0.4
Nontidal Wetland Total*	**0**	**3.9**	**4.2**	**8.8**	**9.1**	**9.0**	**9.2**
E2EM	0	2.0	1.4	2.7	2.1	3.0	2.3
E2SS/E2FO	0	0.1	0.1	0.1	0.1	0.1	0.1

Resource Classification	No-Build	Build Alternative					
		B	C	D	E	F	G
Tidal Wetland Total*	**0**	**2.1**	**1.5**	**2.7**	**2.1**	**3.1**	**2.3**
TOTAL*	**0**	**6.0**	**5.6**	**11.5**	**11.1**	**12.0**	**11.5**

** Totals may not match sum of breakout values due to rounding.*

Table 9-5: SUP Tidal and Nontidal Wetland Impact Summary (acres)

Resource Classification	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
PEM	0	0	0	0	0	0	0
PSS	0	0	0	0	0	0	0
PFO	0	0	0	0	0	0	0
PUB	0	0	0	0	0	0	0
Nontidal Wetland Total*	**0**	0	0	0	0	0	0
E2EM	0	0.7	0.7	0.7	0.7	0.8	0.7
E2SS/E2FO	0	0	0	0	0	0	0
Tidal Wetland Total*	**0**	**0.7**	**0.7**	**0.7**	**0.7**	**0.8**	**0.7**
TOTAL*	**0**	**0.7**	**0.7**	**0.7**	**0.7**	**0.8**	**0.7**

** Totals may not match sum of breakout values due to rounding.*

Alternatives D, E, F, and G would have approximately double the impact to both nontidal and tidal wetlands than Alternatives B and C, largely because of the extended length of these alternatives. Consistent throughout every build alternative are impacts located in Anne Arundel County within roadside nontidal wetland ditches and systems within the interchanges of Oceanic Drive and U.S. 50/301. These are situated near the headwaters of Meredith Creek and drain south/southeast towards Mezick Pond and Westinghouse Bay. The greatest impact to tidal wetlands is in Queen Anne's County, to emergent systems immediately adjacent to U.S. 50/301 that would be affected by roadway widening associated with Alternatives D, E, F and G. The addition of a SUP option with any of the build alternatives would result in between 0.7 acres and 0.8 acres of additional impacts to tidal wetlands, and no additional impacts to nontidal wetlands.

The following locations present the greatest differences in wetland impacts, dependent upon the build alternative. These areas are illustrated on natural resource map sets for the northern alignments (**Appendix B**) and southern alignments (**Appendix C**), with the relevant map set page numbers noted for each reference below.

Alternatives D, E, F, and G would result in almost just over a one half-acre of emergent tidal wetland impact surrounding Muddy Creek, north of U.S. 50/301. These emergent systems are dominated by invasive common reed. Refer to Appendix B and C map pages 28-30.

- Alternatives C, E, and G (southern alignments) would avoid direct impacts to the tidal emergent wetlands surrounding Mezick Pond in Anne Arundel County, just west of the Chesapeake Bay, north of U.S. 50/301. Alternatives B, D, and F (northern alignments) would require substantial fill necessary to construct a new roadway approach to the Bay Bridge and result in just under one half-acre of direct impact to these tidal emergent wetlands. Refer to Appendix B and C map pages 10-11.
- The greatest difference in nontidal wetland impacts between build alternatives is associated with Whitehall Creek in Anne Arundel County. Alternatives B and C do not extend as far west to impact the mainstem of Whitehall Creek and surrounding wetlands

and would therefore avoid direct impacts. Alternatives D, E, F, and G propose roadway widening through this area and would impact an approximate 3.8 acres of wetlands, consisting of largely PFO wetland surrounding the mainstem and tributaries, both north and south of U.S. 50/301, and require stream relocations in a few areas. Refer to **Appendix B** and **C** map pages 3-5.

- Whitehall Creek extends east by pipe/culvert through the intersection of U.S. 50/301 with Busch's Frontage Road and St. Margaret's Road, at the location of previously noted SHA mitigation areas. Almost the entirety of land within these interchanges, south of U.S. 50/301, is nontidal wetland and waterway, and totals almost 8 acres with existing SWM controls located within several of these systems. With further design and avoidance developed for this area the anticipated impacts to these systems is approximately 1 acre. Refer to **Appendix B** and **C** map page 5.
- Impacts to nontidal PEM and PSS wetlands are comparable for Alternatives B and C, totaling just over 1 acre of impact, and comparable between Alternatives D, E, F, and G, ranging from 2.5 to 3.6 acres. The most measurable impacts to nontidal wetlands are to PFO systems from Alternatives D, E, F, and G, which have more than three times the impact to these systems than Alternatives B and C.

Table 9-6 illustrates the total acreage of tidal and nontidal wetland, and the linear feet of tidal and nontidal waterway impacts within each of the 12-digit watersheds that fall within the LOD of each build alternative. **Table 9-7**Error! Reference source not found. illustrates the total acreage of tidal and nontidal wetland, and the linear feet of tidal and nontidal waterway impacts within each of the 12-digit watersheds associated with the SUP option for each build alternative. The watersheds that are only within the Chesapeake Bay (Annapolis Shore and Kent Island True Bay) are not represented in the table.

As shown in Error! Reference source not found.**Table 9-6,** there would be no impacts to wetlands or waterways within the Magothy River South Shore 12-digit watershed from any of the build alternatives. All wetland and waterway impacts within Anne Arundel County are within the Lower Severn River watershed. Alternatives B and C have similar watershed impacts, and Alternatives D, E, F, and G have similar watershed impacts. All watersheds impacted by a build alternative have a record of impaired waters. Alternatives D, E, F, and G, however, have the greatest potential for changes in flow patterns and hydrology and more dynamic changes are anticipated within the Lower Severn River watershed. This is a result of the increase of impervious surface and anticipated stream relocations that would be necessary, specifically to tributaries of Whitehall Creek. The addition of a SUP option with the build alternatives would only result in additional impacts to the Lower Severn River watershed for all alternatives, and to the Kent Island Shore watershed for Alternatives C, E, and G.

Table 9-6: Wetland and Waterway Impacts per 12-Digit Watershed

12-Digit Watershed		No-Build	Build Alternative					
			B	C	D	E	F	G
Lower Severn River	Wetland (Ac)	0	4.1	3.6	8.2	7.8	8.5	7.9
	Waterway (LF)	0	710	670	3,490	3,450	3,560	3,520
Magothy River South Shore	Wetland (Ac)	0	0	0	0	0	0	0
	Waterway (LF)	0	0	0	0	0	0	0
Kent Island Shore	Wetland (Ac)	0	1.6	1.7	1.6	1.7	1.7	1.7

12-Digit Watershed		No-Build	Build Alternative					
			B	C	D	E	F	G
	Waterway (LF)	0	0	0	0	0	0	0
Northern Eastern Bay	Wetland (Ac)	0	0.4	0.4	0.4	0.4	0.6	0.6
	Waterway (LF)	0	280	280	280	280	330	330
Grasonville South	Wetland (Ac)	0	0	0	0.3	0.3	0.3	0.3
	Waterway (LF)	0	0	0	0	0	0	0
Upper Wye River	Wetland (Ac)	0	0	0	0.3	0.3	0.3	0.3
	Waterway (LF)	0	0	0	30	30	30	30
Chester River South	Wetland (Ac)	0	0	0	0.9	0.9	0.9	0.9
	Waterway (LF)	0	0	0	590	590	590	590

UDAc = acre; LF = linear feet

Table 9-7: SUP Wetland and Waterway Impacts per 12-Digit Watershed

12-Digit Watershed		No-Build	Associated Build Alternative					
			B	C	D	E	F	G
Lower Severn River	Wetland (Ac)	0	0.7	0.7	0.7	0.7	0.8	0.7
	Waterway (LF)	0	20	30	20	30	0	50
Magothy River South Shore	Wetland (Ac)	0	0	0	0	0	0	0
	Waterway (LF)	0	0	0	0	0	0	0
Kent Island Shore	Wetland (Ac)	0	0	0.1	0	0.1	0	0.1
	Waterway (LF)	0	0	0	0	0	0	0
Northern Eastern Bay	Wetland (Ac)	0	0	0	0	0	0	0
	Waterway (LF)	0	0	0	0	0	0	0
Grasonville South	Wetland (Ac)	0	0	0	0	0	0	0
	Waterway (LF)	0	0	0	0	0	0	0
Upper Wye River	Wetland (Ac)	0	0	0	0	0	0	0
	Waterway (LF)	0	0	0	0	0	0	0
Chester River South	Wetland (Ac)	0	0	0	0	0	0	0
	Waterway (LF)	0	0	0	0	0	0	0

Table 9-8 provides a summary of MDE-regulated 25-foot nontidal wetland buffer impacts. Alternatives D, E, F, and G have approximately double the acreage of wetland buffer impact associated with Alternatives B and C. Most of the wetland buffer impacts associated with any build alternative are located within the existing right-of-way for U.S. 50/301 and intersecting roadways. These are typically mowed during routine maintenance. The characteristics of the wetland buffers affect their ability to protect wetlands. Although any naturally vegetated buffer aids in protecting adjacent wetlands, mowed grass is not as effective as dense vegetated cover. Many of the wetland buffers within the resource review area provide little protection from direct human disturbance and provide little to no wildlife habitat. The addition of a SUP option with any of the build alternatives would not result in additional wetland buffer impacts.

Table 9-8: Nontidal Wetland Buffer Impact Summary (acres)

No-Build	Build Alternative					
	B	C	D	E	F	G
0	9.4	10.0	17.2	17.8	17.5	17.9

Section 8.2 identified up to 14 named waterways that could be impacted, dependent upon the build alternative. There are numerous additional unnamed tributaries to these waterways that are also present and may be impacted. **Table 9-9** identifies the cumulative total of temporary and permanent effects to tidal and nontidal waterways associated with each build alternative. **Table 9-10** identifies the cumulative total of temporary and permanent effects to tidal and nontidal waterways associated with the SUP option for each build alternative. A breakdown of temporary and permanent impacts will be determined during final design. The impacts presented below have been divided into intermittent and perennial nontidal waterways, and tidal waterways.

Table 9-9: Waterway Impact Summary

Resource Classification	No-Build	Build Alternative					
		B	C	D	E	F	G
Nontidal Perennial (R2)	0	0.1 Ac / 290 LF	0.1 Ac / 290 LF	0.8 Ac / 2,740 LF	0.8 Ac / 2,740 LF	0.8 Ac / 2,740 LF	0.8 Ac / 2,740 LF
Nontidal Intermittent (R4)	0	0.1 Ac / 410 LF	0.1 Ac / 380 LF	0.1 Ac / 790 LF	0.1 Ac / 760 LF	0.1 Ac / 870 LF	0.1 Ac / 820 LF
Nontidal Waterway TOTAL**	**0**	**0.1 Ac / 700 LF**	**0.1 Ac / 670 LF**	**0.9 Ac / 3,520 LF**	**0.9 Ac / 3,490 LF**	**0.9 Ac / 3,600 LF**	**0.9 Ac / 3,550 LF**
Tidal Waterway (E1) TOTAL*,**	**0**	**1.1 Ac / 290 LF**	**1.0 Ac / 290 LF**	**4.9 Ac / 860 LF**	**4.7 Ac / 860 LF**	**5.4 Ac / 900 LF**	**5.3 Ac / 900 LF**

Ac = acres, LF = linear feet
**Impacts do not include the Chesapeake Bay. See Section 9.2.3 for discussion of impacts to the Bay.*
*** Totals may not match sum of breakout values due to rounding.*

Table 9-10: SUP Waterway Impact Summary

Resource Classification	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
Nontidal Perennial (R2)	0	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF
Nontidal Intermittent (R4)	0	<0.1 Ac / 20 LF	<0.1 Ac / 30 LF	<0.1 Ac / 20 LF	<0.1 Ac / 30 LF	0 Ac / 0 LF	<0.1 Ac / 50 LF
Nontidal Waterway TOTAL**	**0**	<0.1 Ac / 20 LF	<0.1 Ac / 30 LF	<0.1 Ac / 20 LF	<0.1 Ac / 30 LF	0 Ac / 0 LF	<0.1 Ac / 50 LF
Tidal Waterway (E1) TOTAL*,**	**0**	<0.1 Ac / 0 LF	<0.1 Ac / 0 LF	<0.1 Ac / 0 LF	<0.1 Ac / 0 LF	<0.1 Ac / 0 LF	<0.1 Ac / 0 LF

Ac = acres, LF = linear feet
**Impacts do not include the Chesapeake Bay. See Section 9.1.3 for discussion of impact to the Bay.*
*** Totals may not match sum of breakout values due to rounding.*

In general, linear footage of impacts to nontidal and tidal waterways is similar between Alternatives D, E, F, and G, with Alternative F having the greatest impact. Similarly, Alternatives B and C have nearly equivalent nontidal and tidal waterway impacts, which are much lower than the other build alternatives. Acreages of tidal waterway impacts differ due to the variation in width of the waterways. Many are systems of substantial width, paralleling both north and south of U.S. 50/301, such as Cox Creek, Piney Creek, and Kent Narrows. Therefore, a wider area of the tidal channel would be impacted by Alternatives D, E, F, and G, which have a wider footprint and span more tidal waterways than Alternatives B and C. However, each alternative would result in few linear feet of waterway impact.

Alternatives B and C have approximately one third of the linear footage of proposed tidal waterway impact, and five-times less nontidal waterway impact compared to Alternatives D, E, F, and G, as these two alternatives will only impact three main waterways, Meredith Creek, Thompson Creek, and Cox Creek, and the Mezick Pond connection to the Chesapeake Bay. The addition of a SUP option with any of the build alternatives would result in less than 0.1 acres of nontidal and tidal waterway impacts across all build alternatives.

Many waterways throughout the resource review area are culverted through pipes under U.S. 50/301 and other roadways. Waterways connected through pipes are regulated by MDE, therefore, calculations of impacts to piped waters are required. The location and size of some piped waterways were received through SHA databases. Other piped waterway sizes are unknown. For those pipes of unknown size, a width of 18-inches was assumed. **Table 9-11** provides a summary of potential impact to these piped waterways due to each build alternative. **Table 9-12** provides a summary of potential impacts to piped waterways due to the SUP option associated with each build alternative. These resources have not been further classified as tidal or nontidal.

Table 9-11: Culverted Waterway Impact Summary

Resource Classification	No-Build	Build Alternative					
		B	C	D	E	F	G
Culverted Waterway of Known Size	0	0.1 Ac / 1,010 LF	0.1 Ac / 1,010 LF	0.3 Ac / 2,210 LF	0.3 Ac / 2,210 LF	0.3 Ac / 2,210 LF	0.3 Ac / 2,210 LF
Culverted Waterway of Unknown Size	0	0.1 Ac / 390 LF	0.1 Ac / 320 LF	0.1 Ac / 1,280 LF	0.1 Ac / 1,210 LF	0.1 Ac / 1,280 LF	0.1 Ac / 1,210 LF

Ac = acres, LF = linear feet

Table 9-12: SUP Culverted Waterway Impact Summary

Resource Classification	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
Culverted Waterway of Known Size	0	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF
Culverted Waterway of Unknown Size	0	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF	0 Ac / 0 LF

Ac = acres, LF = linear feet

It is assumed that **Table 9-11** and **Table 9-12** present an overestimate of impacts that would result from a build alternative. Full sections of roadway and existing pipes are not proposed for removal. Most waterways currently culverted and piped under the roadway have the potential to only require pipe extensions and/or segment replacements, and reconstructed headwalls, as appropriate. The MDE would determine whether impacts to piped waterways are considered temporary or permanent, dependent upon proposed activities. For example, the construction or extension of culverts to maintain hydrologic connections in locations of proposed widened roadway may require fill within the defined banks of the channel and the loss of natural substrate and habitat of that system. The MDE anticipates this would be a permanent impact with a direct effect to channel function. An area of piped waterway that may require replacing or relining and not result in a loss of natural channel is likely to be considered a temporary impact. Mitigation for

impacts to piped waterways is not anticipated. The addition of a SUP option with any of the build alternatives would not result in additional impacts to culverted waterways.

Another important consideration for evaluating the impacts to waterways is related to the number of times the same waterway (i.e., mainstem and/or tributaries) may be crossed by a build alternative. Multiple crossings of the same waterway create the opportunity for added pollution, spills, erosion, and sedimentation within the waterway.

Table 9-13 illustrates the anticipated number of times each build alternative crosses and/or overlaps a delineated waterway. Impacts below do not include the Chesapeake Bay.

Table 9-13: Approximate Number of Waterway Crossings

Waterway	No-Build	Build Alternative					
		B	C	D	E	F	G
Mill Creek	0	0	0	2	2	2	2
Whitehall Creek*	0	0	0	20	20	20	0
Meredith Creek	0	4	4	4	4	4	4
Mezick Pond	0	1	1	1	1	1	1
Westinghouse Bay	0	0	0	0	0	0	0
Thompson Creek	0	2	2	2	2	2	2
Cox Creek	0	3	3	3	3	3	3
Macum Creek	0	0	0	4	4	4	4
Piney Creek	0	0	0	2	2	2	2
Kent Narrows**	0	0	0	2	2	2	2
Muddy Creek	0	0	0	1	1	1	1
Marshy Creek	0	0	0	0	0	0	0
Jackson Creek	0	0	0	1	1	1	1
Winchester Creek	0	0	0	2	2	2	2
Walsey Creek	0	0	0	2	2	2	2
Wye River	0	0	0	4	4	4	4

**Whitehall Creek is provided as a range for the number of stream crossings, as several stream segments will require relocation, and other areas may only result in culvert extensions.*

***Kent Narrows represents the north and south extensions of the bridge and would require new piers in the river.*

Most clearly illustrated in the table is the potential for Alternatives D, E, and F to have an elevated effect on Whitehall Creek and its tributaries. The stream flows largely parallel to U.S. 50/301, crossing under the U.S. 50/301 mainline roadway and interchange ramps multiple times. These proposed build alternatives overlap the waterway several times and would result in many culvert extensions and/or modifications and new headwalls. Relocation of the natural channel due to new roadway fill, embankments, or construction of adjacent noise walls, would be required for three or more portions of Whitehall Creek. Since the waterway is parallel to the roadway, impacts do not result in a less impactful crossing perpendicular to the channel, enabling greater avoidance of the resource.

All build alternatives would result in multiple crossings of Meredith Creek and its tributaries, with the potential for at least three locations of the channel to include culvert extensions/modifications.

The addition of a SUP option with any of the build alternatives would not result in additional waterway crossings, other than one crossing of a small tributary to Mezick Pond for Alternatives C, E, and G, where the alternatives parallel Mezick Pond along U.S. 50/301.

Estimated impacts to the Chesapeake Bay have been evaluated separately in **Section 9.2**.

9.1.4 Avoidance, Minimization, and Further Mitigation Strategies

Use of MDE's *Best Management Practices for Working in Nontidal Wetlands, Wetland Buffers, Waterways, and 100-Year Floodplains* (MDE, n.d.d.), NOAA Fisheries/FHWA Best Management Practices Manual for Transportation Activities in the Greater Atlantic Region, and other recommended tidal resource BMPs would provide guidelines for all proposed actions that cannot avoid resource impacts. Resource impact minimization measures could include:

- Minimize the LOD through alignment adjustments and utilizing 2:1 slopes.
- Avoid stockpiling excess fill, construction material, and debris in wetlands, wetland buffers, waterways, or floodplains.
- Place construction materials to avoid adversely affecting surface or subsurface water flow between resources.
- Prevent use of contaminated excavation material as backfill.
- Repair and/or maintain any serviceable structures to avoid further permanent resource loss.
- Restore resources and adjacent areas temporarily impacted by construction activities to pre-existing conditions/topography.
- Utilize temporary stream crossings to allow construction equipment to cross from bank to bank without instream disturbance.
- Use MDE-approved seed mixes for temporary seeding of wetland and wetland buffer locations.
- Adhere to instream work prohibition periods (time-of-year restrictions [TOYRs]), see additional detail in **Section 8.2, Rivers and Streams**.
- Strictly adhere to SWM controls to avoid runoff from impervious surfaces and construction areas.
- Use same-day stabilization measures.
- Use cofferdams or equivalent instream protections to create a watertight enclosure for instream work, while still allowing water to flow freely within the rest of the channel.
- Use construction matting or equivalent protections for crossing wetlands and wetland buffers that will not have permanent impacts.

During final design, existing U.S. 50/301 roadway culverts will be evaluated in accordance with SHA's Highway Drainage Manual (MD SHA, September 2023) to determine if culverts are to be augmented with additional flow capacity or replaced. Where new culverts are warranted,

bottomless or natural channel bottom designs will be included to the extent practicable, and all new culverts will be constructed so that the placement of riprap does not impede movement of aquatic species. If existing culverts do not meet current aquatic life passage standards and are being extended rather than replaced, then opportunities for improving aquatic life passage are limited; however, the MDTA will work to maintain or improve aquatic life passage where practicable. Tidal bridge and culvert extensions or replacements will take tidal flows into account to ensure maintenance of existing and estimated future tidal regimes to avoid impacts to aquatic organism passage and tidal flushing.

Wetland mitigation can include creation, restoration, enhancement, or in rare cases, preservation of tidal or nontidal wetlands, to compensate for tidal or nontidal wetland loss due to regulated activities. During final design, federal and state agencies would require compensatory mitigation for all unavoidable adverse impacts to all wetlands and waterways from a build alternatives. The type and amount of compensation would be coordinated directly with the regulatory agencies as well as supporting resource agencies. Compensation would focus on qualitative measures, such as a replacement of direct loss of a wetland or waterway function, as well as those quantitative impacts identified for specified acreages of wetland and waterway loss and/or construction activities. Mitigation would adhere to the USACE mitigation hierarchy, as described in the 2008 mitigation rule (33 CFR 332.4(c)), and the NOAA Tidal Mitigation Policy for Trust Resources (NOAA, 2022); the order of preference would be mitigation banking, in-lieu fee, and then permittee-responsible mitigation. Hierarchy preference may be influenced by availability of mitigation banks that serve the study area, as well as availability of approved in-lieu fee programs. It is anticipated that coordination with the MDE and the USACE would be required to address impacts to wetland that are currently part of existing mitigation (i.e., area within the St. Margarets interchange).

Permanent impacts to nontidal wetlands would be mitigated based on acreage, with replacement ratios identified by the USACE and/or MDE. **Table 9-14** illustrates the typical mitigation ratios the agencies apply depending upon the classification of wetland impacted, and the type of mitigation proposed. During final design, impacted wetlands may need to be assessed using the Maryland Wetland Assessment Methodology (MDWAM) to evaluate wetland functional losses and inform mitigation requirements. The MDTA would consider potential measures for nontidal wetland mitigation, including purchase of available credits from an approved mitigation bank having a service area overlapping with the area of impacts, payment into the MDE In-Lieu-Fee (ILF) Program, or completing permittee-responsible mitigation. The MDE's order of preference for tidal wetland mitigation is: a) restoration; b) in-kind creation; c) out-of-kind creation; d) enhancement of existing tidal wetlands; and e) payment into the Tidal Wetlands Compensation Fund. Coordination with the MDE and the USACE would be conducted throughout the process.

Table 9-14: Wetland Mitigation Ratios

Wetland Type and Proposed Mitigation Method	Mitigation Replacement Ratio
Nontidal Wetlands	
PEM	1:1
PSS to PEM conversion	1:1
PFO to PEM or PSS conversion	1:1
PSS and PFO	2:1

Tidal Wetlands Restoration or In-Kind Creation	
Open water tidal wetlands	1:1
Emergent tidal wetlands	2:1
Forested or scrub-shrub tidal wetlands	2:1
Wetlands with identified rare, threatened, or endangered species (RTE) or species in need of conservation	3:1
SAV and Natural Oyster Bars	3:1
Tidal Wetlands Enhancement or Out-of-Kind Creation	
Open water tidal wetlands	2:1
Emergent, scrub shrub, or forested tidal wetlands	4:1
Wetlands with identified RTE species or species in need of conservation	6:1
Submerged Aquatic Vegetations (SAV) and Natural Oyster Bars	6:1

In 2023, the USACE developed the *Maryland Stream Mitigation Framework Version 1 Final* (USACE Baltimore District Regulatory Branch, 2023) to aid in quantifying unavoidable stream impacts and determining compensatory mitigation requirements. The process allows the ability to forecast stream credit mitigation requirements or stream credits generated by various activities where unavoidable impacts to streams occur. The Framework provides a user manual and a Calculator Workbook that would be utilized to determine final impacts to streams, assess stream quality, assess stream buffer quality, and ultimately quantify required mitigation.

Currently, there are no approved wetland or stream mitigation banks and/or ILF Program sites that have a service area within the resource review area. However, mitigation banking opportunities may arise during final design and/or permitting, and the MDTA would continue to coordinate with the MDE and the USACE to evaluate this potential compensatory mitigation option. For permittee-responsible mitigation, the MDTA would first look to restore, enhance, or create nontidal and tidal wetlands within the resource review area.

Additional mitigation opportunities may also include:

- Nature-based shoreline stabilization;
- SAV restoration/enhancement;
- Oyster reef seeding, funding, and/or oyster reef creation;
- Fish reef enhancement and/or creation;
- Common reed eradication;
- Fish passage restoration; and/or
- Stream restoration

9.2 Chesapeake Bay

This section addresses the existing condition and proposed impacts to the Chesapeake Bay, primarily in terms of the potential for construction of a build alternative to affect bottom sediments. Additional information is provided regarding potential impacts within the tidal open waters of the Chesapeake Bay. The resource review area for the Chesapeake Bay extends 1,000 feet on either side of the U.S. 50/301 centerline within the Chesapeake Bay from shore to shore along the existing Bay Bridge.

9.2.1 Regulatory Context and Methodology

Regulatory context for impacts to tidal waters has been presented in **Section 8, Surface Waters** and **Section 9, Waters of the U.S., Including Wetlands**. The following lists previously noted regulatory context for tidal waters, with a focus on including additional federal and state laws that define and regulate activities anticipated to cause impacts to the Chesapeake Bay substrate.

Federal

- CWA – Section 404 – Permits for Dredged or Fill Material (33 USC 1344) regulates the discharge of dredged and fill material into WOTUS, including wetlands.
- CWA – Section 403 – Ocean Discharge Criteria (33 USC 1343).
- CWA – Section 402 – National Pollutant Discharge Elimination System (33 USC 1342).
- CWA – Section 401 – State and Tribal Certification of Water Quality (33 USC 1341).
- Rivers & Harbors Act of 1899 – Section 10 (33 USC 403) establishes a program to regulate activities affecting navigation in U.S. waters, including wetlands.
- 40 CFR 232.2 defines regulated discharges of dredged or fill material including material (e.g., rock, sand, dirt) placed in waters of the U.S. which has the effect of replacing any portion of waters of the U.S. with dry land or changing the bottom elevation of any portion of waters of the U.S.
- Coastal Zone Management Act (CZMA), Section 307 Federal Consistency Requirements.
- Marine Protection, Research, and Sanctuaries Act (16 USC 1431 and 33 USC 1401) prohibits transportation of material from the United States for the purpose of ocean dumping without a permit from USACE following USEPA guidelines.
- Magnuson Stevens Fishery Conservation and Management Act, Section 305(b)(4)(B).

Maryland

- The Dredged Material Management Act of 2001 specifically regulates dredging and dredged material disposal and placement.
- Tidal Wetlands Act. Environment Article, Annotated Code of Maryland, Title 16; COMAR 26.24 requires permits for filling or dredging in private tidal wetlands from MDE or for state-owned wetlands from the Board of Public Works.
- State Tidal Wetlands Licensing Procedures; Environmental Article Title 16; COMAR 23.02.04.

As illustrated in **Section 9.1, Regulated Wetlands and Waterways**, impacts to tidal waters, including the Chesapeake Bay and its substrate, will require permitting through Section 404 of the CWA. The Section 404(b)(1) Guidelines of the CWA require the selection of the Least Environmentally Damaging Practical Alternative (LEDPA). During project permitting, MDTA will be required to identify areas of proposed dredging of the Chesapeake Bay substrate, and therefore the need to present existing conditions and proposed impacts to this resource. MDTA has prepared preliminary computations and illustrations identifying anticipated dredging sections required within the Chesapeake Bay. Existing channel profiles from Google Earth, as-built bridge

plans, and preliminary drawings were used to determine the preliminary dredging quantities anticipated during construction. Dredging may be combined with construction of causeways and/or trestles to provide access for construction. A final decision on which method to be used will be made during the detailed bridge design phase.

The MDTA used comparisons between existing and proposed build alternative design conditions to assess the impacts of each build alternative on the Chesapeake Bay bottom. A hydrodynamics model was developed to assess potential changes in substrate elevation and bottom contours due to sedimentation from erosion or settlement of suspended sediment, current patterns, water circulation, water fluctuation, wind and wave action, and salinity (see **Appendix F**). This included comparisons of color contour maps that show differences between existing and design conditions over defined time periods. These velocities were compared to critical values related to suspension and deposition of sediment in the vicinity of the structures. The model examined the effects of additional structures (e.g., piers or islands) on circulation within the broader area of the Chesapeake Bay, beyond the resource review area. Hydrodynamic, meteorological, bathymetric, water quality, and shoreline data sets were integrated into the modeling framework. .

A shoreline change assessment was also performed in the vicinity of the resource review area (see **Appendix G**). The assessment was completed to provide an understanding of the existing conditions of the Chesapeake Bay shoreline. The MDTA has developed shoreline change maps relative to a baseline, and summarized the shoreline change rates at regularly spaced (e.g., 100-meter) transects in the vicinity of the resource review area. The hydrodynamic analysis shows increases in currents, which could develop erosion hot spots, or alternatively decreases in currents, which could develop further deposition and shoreline accretion. The analysis of shoreline structures, which can both increase flooding resilience and induce erosion in nearby areas, will play an important part of this analysis. Coastal structures induce changes to wavefields and longshore sediment transport processes (e.g., seawalls that reflect rather than absorb wave energy cause sediment to return in the seaward direction). Consequently, structures can lead to unintended shoreline destabilization by changing local dynamics that influence the equilibrium shoreline shape. These changes can also affect nearby circulation and ecosystem health. To mitigate the impacts, proactive coastal management strategies and adaptation measures can be recommended. For example, nature-based solutions such as beach nourishment, living shorelines, dune restoration, and wetland enhancement can help stabilize the shoreline, reduce erosion, and enhance coastal resilience.

9.2.2 Affected Environment

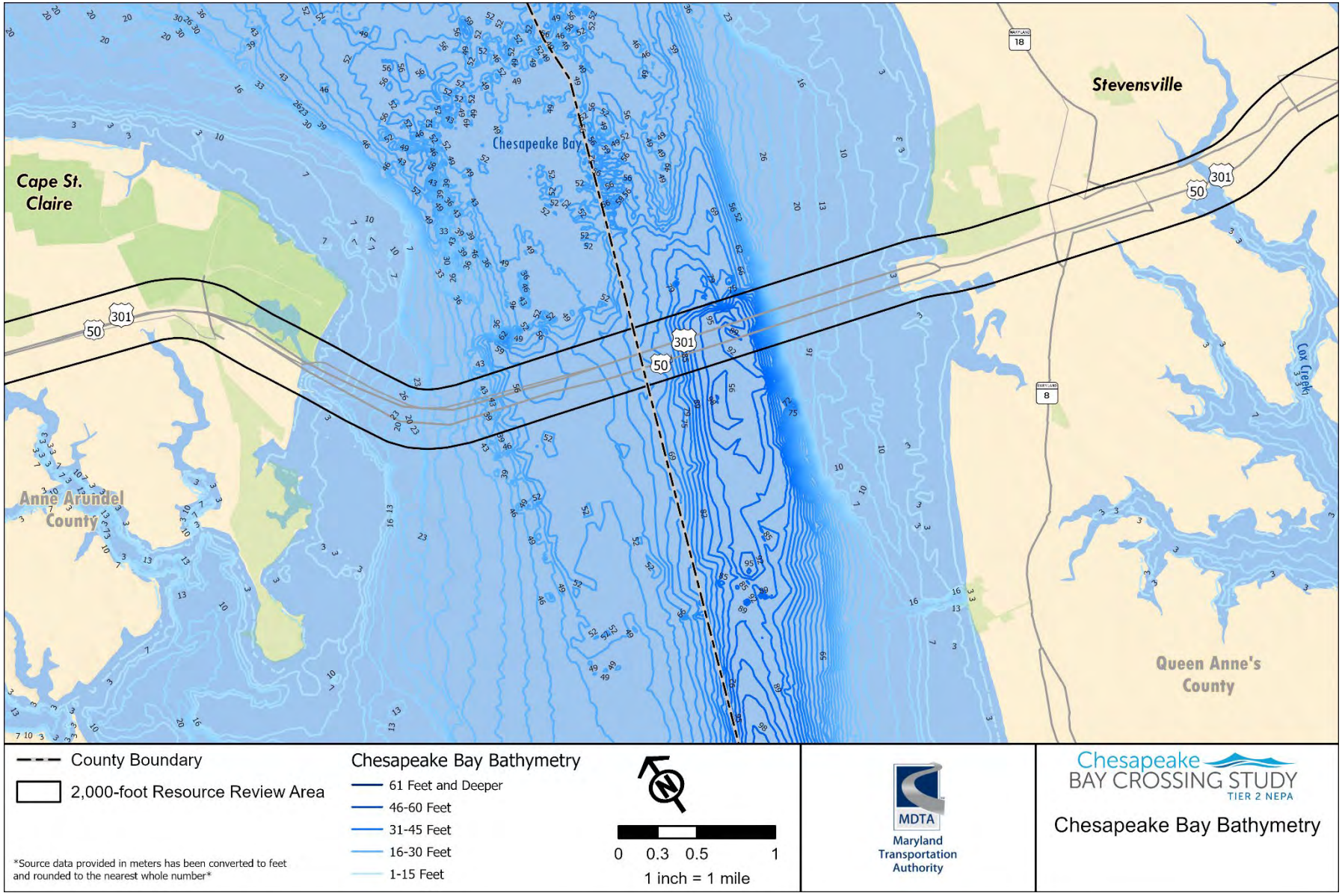
Within the resource review area, as depicted in **Figure 9-1**, the Chesapeake Bay is deepest in the center and east of the county boundary, located within the navigation channel, identified previously as the Chesapeake Bay Bridge Auxiliary channel. As expected, the depth becomes increasingly shallower towards the shorelines. The Chesapeake Bay has an average depth of approximately 40 feet within the resource review area, with the main channel depth approximately 56 feet, and the Chesapeake Bay Bridge Auxiliary channel depth approximately 92 feet. **Figure 9-1** illustrates the bathymetry of the Chesapeake Bay, with close contours indicative of varying steep slopes within the deeper areas. The shallows of the Chesapeake Bay (1 to 3 feet) extend channelward approximately 800 to 950 feet from the western shoreline in Anne Arundel County, and approximately 1,200 to 1,300 feet from the eastern shoreline in Queen Anne's County. Areas with depths from approximately 3 feet to 12 feet generally extend from about 2,100 to 2,200 feet from the western shoreline and 3,900 to 4,700 feet from the eastern shoreline. Based on

bathymetric analysis, it is anticipated that dredging would be required to a depth of 9 feet at mean lower low water (MLLW). Previous agency coordination for other bridge projects that required dredging required mitigation for areas with a water depth of 3 feet or less.

Except in the shallow areas along the Anne Arundel and Queen Anne's shorelines, the Chesapeake Bay is deep enough for barge-mounted construction equipment and material barges to perform work adjacent to the existing Bay Bridge.

Hydrodynamics modeling of existing conditions (see **Appendix F**) demonstrates a spatial variation in current velocity across the study area due to the Chesapeake Bay's bathymetry, coastline morphology, and structures (e.g., existing Bay Bridge). Deeper channels represented by the model bathymetry exhibit stronger tidal currents, while shallower regions and tributary mouths experience reduced velocities. For example, faster currents are found in the constricted parts of the Chesapeake Bay (e.g., between Sandy Point and Kent Island) in the vicinity of the existing Bay Bridge. Peak velocities in the vicinity of the Bay Bridge during a spring tide are relatively consistent along the bridge channel between the piers, with average peak velocities between 0.73 m/s and 0.93 m/s. The maximum velocity of 0.93 m/s is found near the Sandy Point Shoal Light. Other locations within the Chesapeake Bay with above average peak velocities include Howell Point (0.59 m/s) and near Taylor's Island (0.71 m/s).

Figure 9-1: Chesapeake Bay Bathymetry



9.2.2.1 Bay Depths

The shallowest areas within the resource review area are along the Anne Arundel County and Queen Anne's County shorelines. From the Anne Arundel County shoreline north of the Bay Bridge, the water depth is approximately 9 feet deep between approximately 1,400 to 1,600 feet channelward. This area is adjacent to the access channel into Mezick Pond and the Sandy Point State Park marina. The access channel is protected by a 525-foot-long rock groin. From the Anne Arundel County shoreline south of the Bay Bridge, the water depth is approximately 9 feet deep at approximately 2,000 feet channelward. This area is adjacent to the MDTA maintenance yard and dock areas that are used for service vessels.

From the Queen Anne's County shoreline north of the Bay Bridge, the water depth is approximately 9 feet deep between approximately 3,500 to 3,700 feet channelward. This area is adjacent to and north of the peninsula where the Bay Bridge lands and south of the Terrapin Nature Park. From the Queen Anne's County shoreline south of the Bay Bridge, the water depth is approximately 9 feet deep between approximately 3,700 to 4,000 feet channelward. This area is adjacent to the peninsula where the Bay Bridge lands and the Chesapeake Bay Bridge Marina. The channel to access the marina runs southwest away from the Bay Bridge.

9.2.2.2 Bay Bottom Material

The Chesapeake Bay bottom is primarily formed by layers of Magothy, Matawan, and Monmouth formations, which is overlaid by sandy material in the shallow areas and loose silty clay material in the deeper channels. Surficial sand is generally found in the areas that are most affected by wave action and tidal fluctuations. The waves and tide move fine silt, clay, and organic material out of the sand and deposit them in lower energy areas along the bottom (**Figure 9-2)**.

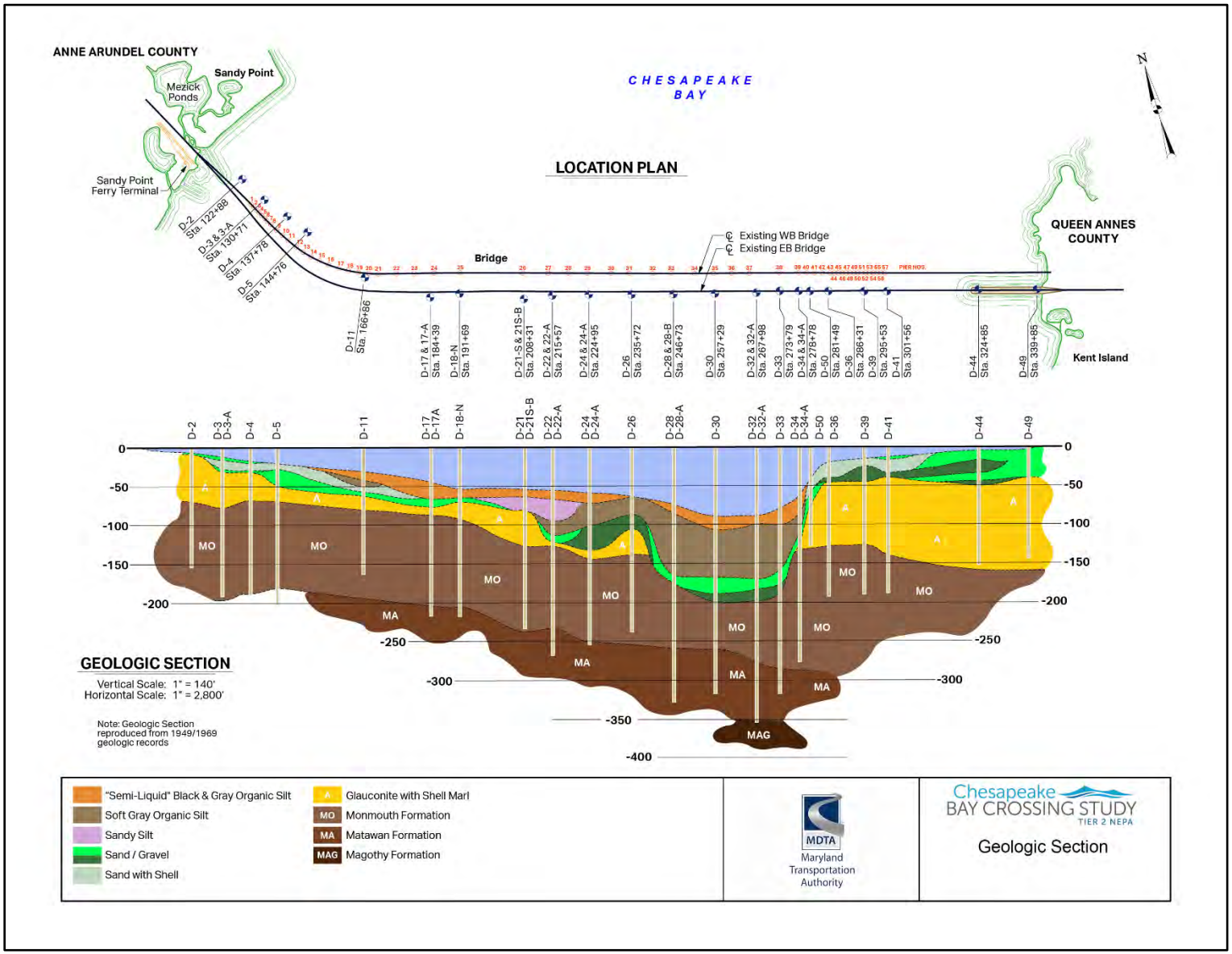
Sand: Surficial sand extends approximately 1,100 feet channelward from the Anne Arundel County shore, which corresponds to approximately a 6-foot water depth. Surficial sand extends approximately 4,200 feet channelward from the Queen Anne's County shore which corresponds to approximately a 12-foot water depth. Both shorelines correspond to bottom slopes that are flat (less than 0.5 percent) and near the surface. Geotechnical borings near the shorelines show the Chesapeake Bay bottom is underlain by sand to 50 feet deep where it begins to increase in clay content.

Cultch: Material (such as oyster shells) that has been laid down on oyster grounds and furnishes points of attachment for oyster spat is found in shallower areas (less than 26 feet deep). Cultch areas are generally inclusions in sandy bottom and may be incorporated into organic/silt mud areas.

Silty Clay: Surficial silty clay covers most of the Chesapeake Bay bottom along the existing resource review area. Silty clay is generally associated with relatively deep waters (deeper than 6 to 12 feet). Geotechnical borings in the mid-bay show organic silt and silty clay layers from 10 to 50 feet thick, before transitioning to clayey sand below.

Chesapeake Bay Bottom Survey data, as well as information on biogenic habitats (e.g., oyster beds and SAV) can be found in **Section 13 Aquatic Habitat and Biota**.

Figure 9-2: Geologic Section and Chesapeake Bay Bottom Material



9.2.3 Environmental Consequences

Estimated impacts to the Chesapeake Bay within the limits of the mean-high water line have been evaluated separately in this section, to address the anticipated construction activities that would result in both temporary and permanent impacts to the tidal open waters and substrate of the Bay. At this early stage of design, quantitative impact calculations include both permanent and temporary effects to the Chesapeake Bay as a total combined impact within each alternative.

9.2.3.1 No-Build Alternative

Alternative A, the No-Build Alternative, would have no impact to the Chesapeake Bay and its substrate.

9.2.3.2 Build Alternatives

This section evaluates the potential temporary and permanent impacts to the Chesapeake Bay open waters and its substrate that may result from a build alternative. **Table 9-15** illustrates the effects of each build alternative that may be required to construct new bridges and demolish existing bridges. **Table 9-16** provides a summary of potential temporary and permanent impacts to the Chesapeake Bay open waters and its substrate that may result due to the SUP option associated with each build alternative. The limits and assumed type of both permanent and temporary impacts to the Chesapeake Bay are illustrated on Chesapeake Bay impacts map sets for the northern alignments (**Appendix H**) and southern alignments (**Appendix I**).

Table 9-15: Chesapeake Bay Tidal Water Impacts (acres) from New Bridge Construction and Old Bridge Pier Removal

No-Build	Build Alternative					
	B	C	D	E	F	G
0	130.7	131.9	130.7	131.9	134.1	135.0

Table 9-16: SUP Chesapeake Bay Tidal Water Impacts (acres) from New Bridge Construction and Old Bridge Pier Removal

No-Build	Associated Build Alternative					
	B	C	D	E	F	G
0	1.9	1.9	1.9	1.9	1.9	2.0

The anticipated impacts from Alternatives B, C, D, and E are similar, as those alternatives all include an eight-lane bridge structure. Alternatives F and G, which propose 10 lanes, would have the largest impacts to tidal waters, supporting the largest bridge piers and bridge protection systems. The addition of the SUP option would require slightly larger piers, resulting in 1.9 acres of additional pier footprint on the Bay substrate for all build alternatives except for the Alternative G SUP option, which would have 2.0 acres of additional impact.

Appendix H and **I** map sets also illustrate the anticipated overall temporary construction action area, which would be similar for all build alternatives. This accounts for sufficient area to allow temporary access within the Bay through whatever means are determined during final design and allow for movement of construction barges carrying equipment and materials within the immediate areas of construction. Staging areas for barges/vessels at locations away from the immediate work zone have not yet been identified.

Temporary impacts from all build alternatives may include geotechnical investigations, dredging, temporary mooring piles or mooring ball anchors to stabilize the barges and vessels at the staging areas, and in-water BMPs (e.g., turbidity curtains, bubble curtain/cans, cofferdams). Temporary impacts also include the removal of existing bridge piers/piles in the river, which totals almost 17 acres.

Impacts associated with all construction and demolition are regulated by MDE and the USACE and will be included in required permit applications. These individual impacts will be defined during final design. Both temporary and permanent impacts have the potential to impact water quality and aquatic species. These impacts are detailed in **Section 8.2, Water Quality**, and **Section 13, Aquatic Habitat and Biota**.

Permanent impacts within the Chesapeake Bay are anticipated to include areas of permanent fill within the substrate from bridge substructure elements including piers, pier protection systems, and pier islands, as well as any impacts that last longer than one year. Placement of these structures would result in a direct impact to the substrate, with the potential to fill benthic habitat. Final design will dictate the size and type of piles or footings proposed for pier construction and impacts would be calculated based on the area of new structure/fill at or below the mudline. Some dredging effects could also be considered permanent impacts, depending on a number of specific factors that would be determined in final design. The nature of the dredging effects would be coordinated with the permitting agencies during final design.

Analysis of modeled velocity magnitude differences between existing and proposed conditions in the hydrodynamics model developed to evaluate impacts on the Bay bottom from the placement of new bridge piers (**Appendix F**) indicates that there would be areas of increases in near-bed velocity primarily within the immediate vicinity of bridge piers. The piers and pier spacing modify near-bed flow velocities, turbulence, and shear stresses, leading to changes in sediment deposition and erosion patterns. These changes to sediment transport and deposition patterns, in turn, impact aquatic habitats such as SAV, oyster reefs, and other benthic organisms that depend on stable substrates and water quality conditions. In general, areas within 500 ft of the piers may experience slight increases in shear stress, promoting sediment resuspension. Resuspension and downstream transport may alter the sediment composition, leading to shifts from coarser to finer substrates or vice versa. Such changes can be a benefit or detriment to different benthic communities, potentially changing habitat suitability and nutrient dynamics for species adapted to the existing sediment type. Modeled changes in flow velocities and sediment transport near the proposed bridge piers are relatively modest, localized impacts to benthic habitat from increased deposition of silty fine sediments are possible soon after the construction of the new bridge piers.

Alternatives F and G, which propose the largest bridge spans, would have the greatest impact on the Chesapeake Bay substrate. The larger bridges would require larger piers for support. Placement of these structures would result in a direct impact to the substrate, with the potential to fill benthic habitat, and their larger presence in the water column would also result in greater changes to flow patterns around the piers.

Based on the findings of the shoreline change assessment (see **Appendix G**), the build alternatives are not expected to substantially exacerbate shoreline currents. Modeled velocities remain below the critical threshold for erosion, suggesting that the bridge structures themselves

will not significantly contribute to shoreline retreat through current-driven processes. While there are some localized increases in current velocity near the northern Anne Arundel shoreline at Sandy Point, these increases are not substantial enough to initiate erosion. The velocities remain below the critical threshold required to mobilize sediment in the near-shore area. Instead, future erosion is anticipated to be primarily driven by wind wave action within the Bay. As water elevations change with time, deeper water will allow wave energy to propagate further landward, increasing the potential for wave-induced erosion along vulnerable shorelines. The bridge piers are not expected to influence these wave dynamics and are therefore not anticipated to substantially affect long-term shoreline change.

Due to existing conditions within the Chesapeake Bay, it is expected that dredging would be necessary to create access channels to support construction and demolition activities. **Table 9-17** identifies the amount of dredging anticipated for each build alternative. No additional dredging is anticipated from the SUP options associated with each build alternative.

Table 9-17: Chesapeake Bay Substrate Impacts from Dredging

Activity	No-Build	Build Alternative					
		B	C	D	E	F	G
Dredging (acres)	0	50.1	50.4	50.1	50.4	49.8	50.1
Dredging (cubic yards)	0	329,900	317,400	329,900	317,400	329,900	317,400

Construction barges and tugboats require sufficient depth and width to maneuver. During construction, multiple vessels, and barges with cranes, supplies, and support equipment would be needed. All build alternatives are estimated to impact between 49.8 and 50.4 acres of Bay substrate due to dredging. The dredge area includes what is needed to build the new bridge spans and remove the existing spans. Because the Chesapeake Bay is a dynamic and fluid system and these impacts are so similar, it is assumed that the surface area of dredging impacts for all build alternatives would be comparable.

Current engineering estimates prepared for the northern alignments (Alternatives B, D, and F) assume a total of approximately 329,900 cubic yards of dredging would be required, approximately 12,500 cubic yards more than the southern alignments (Alternatives C, E, and G). Dredging calculations assume a depth of 9 feet at MLLW and exclude the footprints of the proposed piers. Access and dredging details would be evaluated in future design phases. Alternatives D, E, F, and G may also require dredging at Kent Narrows.

Construction needs for work area access and structure installation would vary for each build alternative. For access in shallow areas, dredging would need be wide enough to facilitate equipment mobility, loading and unloading material barges, and erecting structures. Depending on the consistency of bottom materials, additional area may be needed because the sides of dredged areas must be sloped back to prevent the material from sloughing back into the excavated areas. The bottom materials may need to be sloped as much as 3:1 horizontal to vertical. Additionally, based on the greater expanse of shallow water from the eastern shoreline, it is anticipated that more dredging would be required along the eastern shoreline than the western shoreline.

The potential impacts of dredging for any build alternative would include:

- the generation of suspended solids/turbidity and the resultant degradation of surface water quality and sediment quality;
- a decreased photic zone due to increased turbidity;
- elimination of benthic populations within the dredging zone;
- deposition of dredge-induced suspended sediment on benthic populations downstream of the dredging zone;
- alteration of bottom substrate and depth characteristics of niche habitats in shallow waters potentially displacing species adapted to those habitats;
- fish and sea turtle mortality from dredge equipment;
- disruption of normal foraging or spawning behaviors of fauna;
- gill injury to fish from exposure to local increases in turbidity; and/or
- re-suspension of contaminants, and/or release of nutrients resulting in eutrophication of the waters and increase biological oxygen demand and subsequent reduction of dissolved oxygen.

Several of these potential impacts are also identified in **Section 8.2 Water Quality** and **Section 13 Aquatic Habitat and Biota** along with other potential effects to water quality and aquatic habitat and biota.

Dredging may be combined with the construction of temporary trestles or causeways that facilitate the loading and unloading of barges and support vessels. Multiple access points (dredged channels, causeways, or trestles) may be needed depending on the work configuration and specific construction equipment needed. Access and dredging details would be evaluated in final design.

All build alternatives would use similar construction equipment and methods, which would have a direct bearing on the extent of dredging required and thus potential impact to the Chesapeake Bay substrate. The size of vessels and barges used would be determined by the construction operation and material being transported. The size of these vessels and their maximum draft is the critical factor in determining what degree of dredging would be required for the construction of a new bridge.

Dredged material is anticipated to be transported by barge to an approved and permitted dredged material containment facilities (DMCF). Several dredged material placement sites are available. The Maryland Port Administration has developed the Masonville and Cox Creek DMCF. Masonville DMCF has 10.4 million cubic yards (mcy) of capacity on 101 acres located in South Baltimore along the Patapsco River. Cox Creek has 14.7 million cubic yards (mcy) of capacity on 241 acres located in northern Anne Arundel County along the Patapsco River. Port Tobacco at Weanack is a privately owned DMCF on 280 acres in Charles City, VA along the James River. All three DMCF have the ability to accept the anticipated dredged material. The anticipated dredged material can be transported by barge to Masonville, Cox Creek, or Port Tobacco at Weanack for efficient off-loading. The anticipated volume would be between 200 and 250 barge loads over the course of the project. Shorter distances to Masonville and Cox Creek would result in more efficient transport than delivering the material to Port Tobacco at Weanack. The proposed transport routes would run through federally designated navigational channels in the Chesapeake Bay and either the Patapsco River or James River.

Any build alternative that may require fill in tidal waters to extend the Chesapeake Bay shoreline may require dredging to remove unsuitable material from underlying substrate. This would provide a substrate that is stable enough to provide a suitable base for construction and prevent the shoreline extension from subsiding. Additional areas of dredging may also be needed for construction activities in Kent Narrows in Queen Anne's County, and within the entrance from the Chesapeake Bay to Mezick Pond in Anne Arundel County. The need for any additional construction-related dredging will be determined in final design and would be based on geotechnical investigations of bottom substrates necessary for final design and construction.

9.2.4 Avoidance, Minimization, and Further Mitigation Strategies

Impact minimization to waterways both east and west of the Chesapeake Bay are likely to be different than proposed minimization measures for the Chesapeake Bay tidal open waters, and potentially other in-water work proposed for a larger waterway system such as the Kent Narrows. Several minimization measures noted in **Section 9, Waters of the U.S., Including Wetlands**, are relevant to the Chesapeake Bay and larger waterways; however, it is anticipated that the MDTA would further identify opportunities to avoid and minimize impacts to the Chesapeake Bay open waters and substrate during final design and construction. Options for reducing overall structure footprint in the Chesapeake Bay will be evaluated where practicable during final design. Piers will be constructed with consideration of the local hydrodynamics and piers will be aligned to minimize potential impacts to flow. A new bridge will be designed to all applicable bridge design standards, which include consideration of scour and scour protection.

The magnitude of the environmental consequences from dredging and disposal of dredged material would correlate to the duration, volume, and size of area dredged. This is a large project; however, dredging associated with the build alternatives could occur in stages over the course of many years as permits may be approved in phases, resulting in design and construction being spaced over several years. This could minimize short-term high-volume impacts. This would also affect the volume of dredged material and thus the amount that needs to be managed at any given point in time. The time of year and time spent performing dredging operations may need to be considered, as prolonged dredging would result in disturbance to natural resources and the adjacent water column over a longer period dependent upon the nature of the bottom substrate, tidal fluctuations, and estuarine dynamics.

The MDTA would approach design and development with the goal of minimizing and further mitigating impacts to the Chesapeake Bay substrate to the greatest extent practicable. Dredging would be permitted as impacts to tidal open water through the USACE Section 404 permit and the Maryland BPW Tidal License requirements. Potential time-of-year restrictions for various species protections are discussed in **Section 13, Aquatic Habitat and Biota** and **Section 15, Rare, Threatened, and Endangered Species**. Time-of-year restrictions apply under the Maryland Tidal Wetlands license for Natural Oyster Bars (NOB) and SAV. Dredging is prohibited:

- Within 500 yards of an SAV bed - April 15 through October 15.
- Within 500 yards of an NOB using mechanical dredging - December 16 through March 14 and June 1 through September 30.
- Within 500 yards of an NOB using hydraulic dredging - June 1 through September 30.
- Within the boundaries of an NOB - December 16 through March 14 and June 1 through September 30.

MDTA has minimized potential dredging impacts by committing to using only mechanical dredging, rather than hydraulic dredging, which has the potential for greater impacts to aquatic habitats and species. Operational BMPs can be employed to further reduce impacts to the Chesapeake Bay bottom, which in turn would help protect water quality. The MDTA would prepare a Dredge Material Management Plan, which would include final methods proposed, minimization measures specific to dredging operations, and detailed information regarding the transport and disposal of dredged materials to an approved disposal site. Additional considerations for multiple construction methods and/or construction materials that may aid in impact minimization could include:

- Use of turbidity curtains;
- Utilize pre-cast concrete piles to reduce underwater noise;
- Utilize vibratory hammers in place of impact hammers when possible;
- Minimize the use of vibratory hammers to reduce underwater noise intensity and duration;
- Use of bubble curtains, when practical, for driving piles to reduce underwater noise;
- Use of waterline pile cap/pier footings to avoid dredging to construct footings below the mudline;
- Use of pre-cast concrete footings to reduce risk of concrete contaminating Bay water;
- Employ soft start at the beginning of daily pile driving operations and after breaks of greater than 30 minutes to minimize fish injury; and/or
- Creating an on-site concrete batch plant to minimize material transportation.

Detailed coordination with the regulatory and resource agencies would dictate and inform additional minimization measures, methods for dredging and specific plans for the disposal of the dredged material, construction, and demolition within the Chesapeake Bay. Compensatory mitigation would be required for impacts to the Chesapeake Bay substrate due to dredging. New work dredging in shallow water areas ($\leq$ 3 feet at mean low water), as well as for any dredging impacts to natural oyster bars (NOB) or SAV would require mitigation. There are several mitigation options that could be considered that would mitigate for impacts to the Chesapeake Bay bottom which are included in **Section 9, Waters of the U.S., Including Wetlands**. SAV and oysters are discussed in **Section 13, Aquatic Habitat and Biota**. There may also be opportunities for beneficial reuse of appropriate dredged material that would be considered and coordinated with regulatory and resource agencies in final design and permitting. The potential to restore bottom contours through natural sedimentation or adaptive management at deeper depths as well as potential for beneficial reuse of dredge material would be explored and discussed with the resource agencies during final design.

9.3 Maintained Navigational Channels and Civil Works Projects

The resource review area for maintained navigational channels and USACE Civil Works projects extends 1 mile on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split. The USACE Civil Works Program (Section 408) constructs, operates, and maintains more than 290 miles of Federal navigation channels within the Chesapeake Bay and associated waterways that are essential for the movement of commercial cargo and are marked on official navigation charts to guide vessels. This work includes dredging, employing cutting-edge technology to conduct underwater surveys, and applying its fleet of debris removal vessels to clear federal channels of floating hazards in the Baltimore Harbor and Potomac and Anacostia rivers (USACE, 2023a). The Civil Works Program covers the channels in the Chesapeake Bay that facilitate access to the Baltimore Harbor from the Atlantic Ocean (**Figure 9-3**).

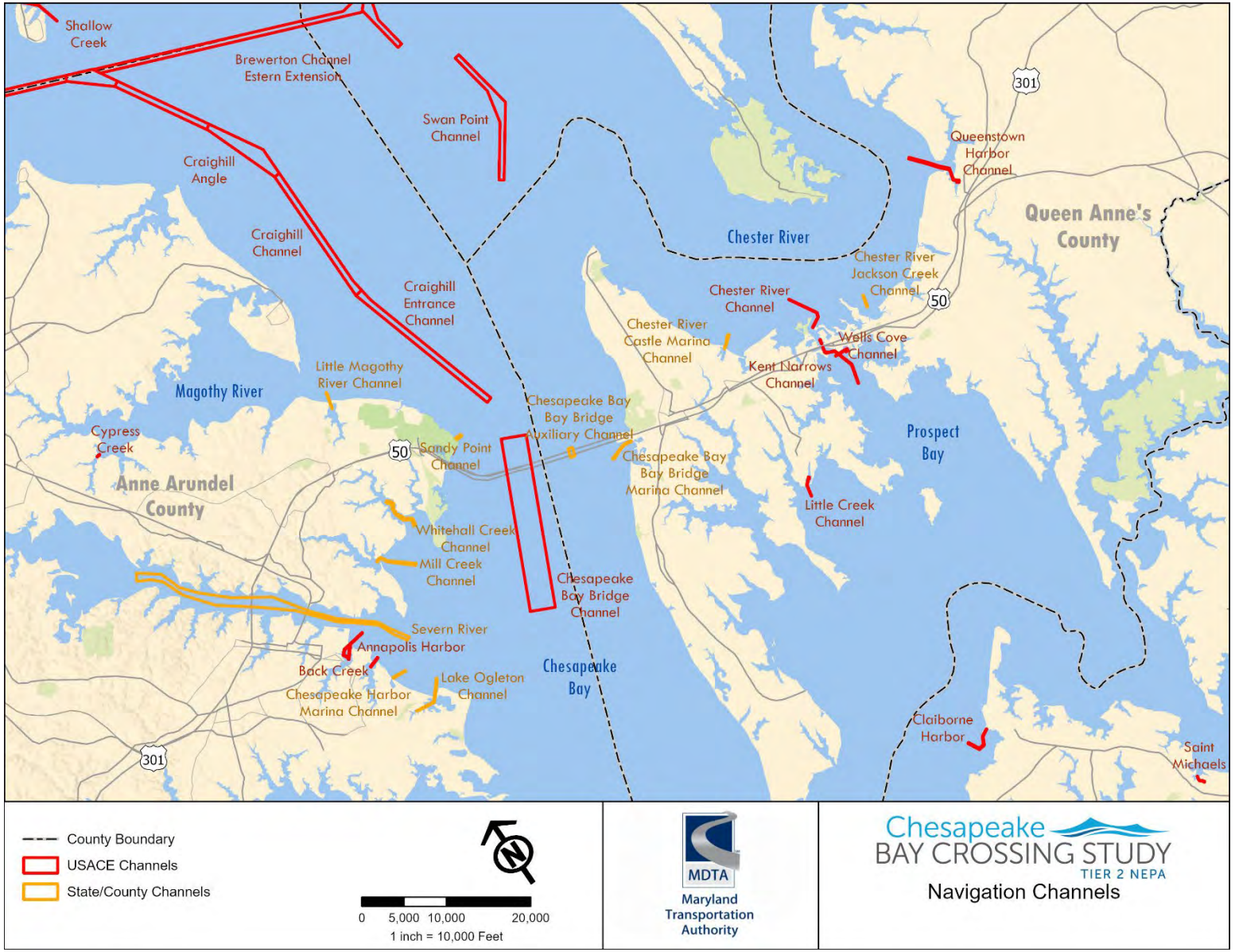
9.3.1 Regulatory Context and Methodology

Section 9 of the Rivers and Harbors Appropriation Act (33 U.S.C. 401) prohibits the construction of any bridge, causeway, dam, or dike over or in any port, roadstead, haven, harbor, canal, navigable river, or other navigable WOTUS without approval of the U.S. Coast Guard (USCG) and the USACE.

Section 10 of the Rivers and Harbors Appropriation Act (33 U.S.C. 403) prohibits the obstruction or alteration of navigable WOTUS without a permit from the USACE.

Section 14 of the Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. 408) prohibits changes to authorized USACE Civil Works projects without verification by the USACE Civil Works (Section 408) Program that the action will not be injurious to the public interest and will not impair the usefulness of the project.

Figure 9-3: Navigation Channels



The MDTA coordinated with the USACE Baltimore District Civil Works program to identify Section 408 resources in and around the resource review area. USACE provided GIS data sets of the Civil Works projects and the latest hydrographic surveys (USACE, 2023b), which have been incorporated into the resource review area base mapping. National Oceanic and Atmospheric Administration (NOAA) Navigational Charts (NOAA, 2023) and USACE Federal Navigation Channel Maps (USACE, 2023c) have been referenced into the data set.

9.3.2 Affected Environment

Navigable waters with marked channels are located throughout the resource review area. Many of the channels are federally maintained and facilitate intrastate, interstate, and international navigation. Other channels are designated as state or county channels or are privately maintained channels. The existing Section 408 (USACE Civil Works) projects within the resource review area are the federal navigation channels in the Chesapeake Bay, Kent Narrows, and Chester River, which are detailed below. Important local channels that are not federally maintained are also discussed.

Chesapeake Bay Bridge Channel: The Chesapeake Bay Bridge channel is federally maintained and facilitates navigation under the Bay Bridge. It connects to other Civil Works projects to the north and south that connect Baltimore Harbor to the Atlantic Ocean. The channel extends from approximately 3,200 feet north of the Bay Bridge to approximately 16,800 feet south of the Bay Bridge and has an authorized maintained depth of 50 feet, an authorized maintained width of 3,000 feet, an operational width approaching the bridge of approximately 1,000 feet, and vertical clearance of 182 feet.

Kent Narrows Channel: The Kent Narrows channel is federally maintained and begins approximately 2,300 feet north of the existing Bay Bridge and continues south to Prospect Bay. The channel has a maintained depth of 7 feet and width of 75 feet. The U.S. 50/301 bridge is a fixed span with a vertical clearance of 65 feet. The Kent Narrows channel is crossed by the MD 18 bascule span with a vertical clearance of 18 feet when closed. An overhead utility line crosses the channel south of MD 18 and has a vertical clearance of 85 feet.

Wells Cove Channel: The Wells Cove channel is federally maintained and connects to the Kent Narrows channel from within Prospect Bay. The channel is approximately 1,600 feet long and 75 feet wide.

Chester River Channel: The Chester River channel is federally maintained and begins approximately 8,600 feet north of the existing Bay Bridge and continues north connecting Kent Narrows to the Chester River. The channel has a maintained depth of 7 feet and width of 75 feet.

Severn River Channel: The Severn River channel is not federally maintained but facilitates access to the Chesapeake Bay for local recreational and commercial vessels. The Severn River Channel crosses under the U.S. 50/301 Bridge and has an approximate depth of 20 feet and vertical clearance of 80 feet.

Chesapeake Bay Auxiliary Channel: The Chesapeake Bay Auxiliary channel is not federally maintained, but functions as an alternate that can be used for vessels that have less than a 58-foot vertical clearance. This channel runs parallel to, and approximately 6,000 feet off, the Kent Island shoreline.

Local Channels: Many of the non-federal channels (Table 9-18) serve local communities, marinas, and parks and provide water access for small recreation and commercial vessels. Although Mezick Pond is not identified through USACE and NOAA resources, it currently provides local boating access for recreation.

Table 9-18: Local Channels Within the Resource Review Area

Waterway	County	Longitude	Latitude
Sandy Point Channel	Anne Arundel	76°23'35.24"W	39° 0'46.54"N
Chesapeake Bay Bridge Marina	Queen Anne's	76°20'14.85"W	38°58'49.04"N
Chester River Jackson Creek	Queen Anne's	76°13'17.88"W	38°58'6.13"N

An additional Section 408 Civil Works project beyond the resource review area includes the Craighill Entrance Channel. This channel is federally maintained and begins approximately 8,400 feet north of the existing Bay Bridge and continues north through the Craighill Channel, Craighill Angle, Upper Range, and the Cutoff Angle to the point where it joins with the Brewerton Channel into the Baltimore Harbor. The channel has a maintained depth of 50 feet and width of 700 feet. The Queenstown Harbor channel is another federally maintained channel and begins approximately 1,400 feet north of U.S. 50/301 in Queenstown Harbor and continues north connecting to the Chester River. The channel has a maintained depth of 7 feet and width of 75 feet.

9.3.3 Environmental Consequences

Potential impacts to navigation and USACE Civil Works projects associated with the No-Build Alternative and the build alternatives have been evaluated. The evaluation considers impacts that may only be short-term and are largely associated with construction, and whether any permanent impacts would result. This section will also present the anticipated local, state, and federal permitting requirements for impacts to navigation and Civil Works projects.

9.3.3.1 No-Build Alternative

The No-Build Alternative would have no impacts to navigation or Civil Works projects.

9.3.3.2 Build Alternatives

All build alternatives would require work in navigational channels and USACE Civil Works projects. Encroaching on the navigational channels may restrict large vessel navigation and result in rerouted shipping or dredging for alternative access. The channels where a relatively continuous construction presence is anticipated include the Chesapeake Bay Bridge federal channel and Chesapeake Bay Bridge Auxiliary channel. No permanent impacts would result from any build alternative, with all construction impacts occurring temporarily and dependent upon the type of work occurring. The optional SUP would not add additional crossings to any navigational channels.

Table 9-19: Navigation Channels Affected by Build Alternatives

Navigation Channels	No-Build	Build Alternative					
		B	C	D	E	F	G
Chesapeake Bay Bridge Channel	---	X	X	X	X	X	X
Kent Narrows Channel	---	---	---	X	X	X	X

Navigation Channels	No-Build	Build Alternative					
		B	C	D	E	F	G
Wells Cove Channel	---	---	---	---	---	---	---
Severn River Channel	-	---	---	---	---	---	---
Chester River Channel	---	---	---	X	X	X	X
Chesapeake Auxiliary Channel	---	X	X	X	X	X	X
Local Navigation Channels							
Sandy Point Channel	---	---	---	---	---	---	---
Chesapeake Bay Bridge Marina Channel	---	---	X	---	X	---	X
Mezick Pond Channel	---	X	X	X	X	X	X

X Denotes that the waterway is crossed by the alternative;
--- Denotes that the waterway is not crossed by the alternative

Chesapeake Bay Bridge Channel: This navigation channel cannot be avoided. At some point during project construction for the new Bay Bridge and/or demolition of the existing bridge, all build alternatives would impact this navigation channel. It is anticipated that the greatest temporary impacts would result from Alternatives F and G due to the larger structure proposed and longer duration of active construction compared to the other alternatives.

Kent Narrows Channel: This channel would only be impacted by Alternatives D, E, F, and G. These alternatives include widening the existing Kent Narrows Bridge requiring the use of large equipment within the channel. This channel would likely require temporary closings during construction, as there would not be sufficient safe passage for navigation.

Wells Cove Channel and the Severn River Channel: These channels would not be impacted by any build alternative.

Chester River Channel: It is anticipated that this channel would be utilized by construction vessels/barges carrying equipment and materials for access to work occurring within the Kent Narrows. Therefore, this channel would only be impacted by Alternatives D, E, F, and G.

Chesapeake Bay Auxiliary Channel: It is anticipated that this alternate navigation channel would be impacted by all build alternatives, however, only for brief time periods as construction vessels/barges traverse through the LOD.

Local Channels: The Sandy Point Channel would not be impacted by any build alternative. It is anticipated that the Chesapeake Bay Bridge Marina Channel may have temporary closings during in-water construction directly adjacent to the eastern shoreline of the Chesapeake Bay, as there would not be sufficient safe passage for navigation. It is anticipated that only the southern alignment build alternatives (Alternatives C, E, and G) would impact the Chesapeake Bay Bridge Marina Channel.

Impacts to the entrance of Mezick Pond would include temporary closings during in-water construction directly adjacent to the western shoreline of the Chesapeake Bay for all the build alternatives. The entrance to Mezick Pond would be directly impacted by the northern alignment build alternatives (Alternatives B, D, and F). The westbound span for Alternatives B, D, and F

would require the placement of bridge piers on the south end of Sandy Point Beach, near the existing rock jetty, and the bridge structure would span the mouth of the channel. It is anticipated that this is the only channel that would require construction of a completely new bridge feature along with an analysis of required dimensions, but only if a northern alignment alternative is selected.

Temporary construction trestles built immediately adjacent to the channel for construction equipment and work access; in-channel activities such as dredging, geotechnical soil borings, or pile driving; and loading of barges could also result in potential impacts, affecting maritime traffic. The MDTA would work closely with the USCG to ensure the safety of boaters utilizing federal, state, and local channels. Build alternatives will likely have temporary closures of the Mezick Pond entrance channel. The MDTA would work closely with the DNR to ensure the safety of boaters utilizing Mezick Pond.

Beyond the LODs of the build alternatives, it is anticipated that the Craighill Channels may also be utilized for movement of construction equipment/materials to and from the site. Work that has the potential to alter, occupy, or use a USACE Civil Works project (federal channel) would need a Section 408 permit from the USACE.

9.3.4 Avoidance, Minimization, and Further Mitigation Strategies

The MDTA would maintain close coordination with USACE and USCG to obtain final permits and approvals regarding construction in or near the federal navigation channels and elsewhere in the Chesapeake Bay and navigable tributaries. As part of the USCG Bridge Permit process, a Navigation Impact Report was prepared for the Chesapeake Bay, and a Preliminary Navigational Clearance Determination (PNCD) was received from the USCG on November 28, 2025. It is expected that the conditions and stipulations of the Bridge Permits would help ensure that any construction effects to ongoing navigation are minimized and further mitigated (if required); and that the safety of workers, inspectors, mariners, and recreational boaters remains paramount. Potential conditions of the permits include:

- Coordinating Local Notices to Mariners with the USCG to inform vessel captains of changing construction conditions, including temporary channel closures needed for construction over the channel and restricting access to areas within the construction safety zone outside the navigation channels.

- Establishing safe anchorages for construction vessels outside the navigation channel to avoid interfering with normal navigation patterns when possible, including installation of mooring piles and buoys.

- Establishing vessel speed restrictions within the navigation channel adjacent to the construction safety zone to reduce wake impacts to construction vessels.

- Adhering to the requirements of the U.S. Aids to Navigation System for temporary navigation marking and lighting within the construction safety zone, including establishing the construction zone perimeter with buoys, beacons, and the installation of lights on vessels and obstructions within the construction zone.

Measures to minimize encroachment to navigation channels and to further mitigate for the use of those channels, are anticipated to include the following:

- Regular notices to mariners and the recreational boating community during construction periods.
- Appropriate lighting of barges and construction equipment.
- Placement of construction mooring locations away from navigation channels and the use of deepwater anchorages.
- Development of a Vessel Maintenance of Traffic plan.

10 COASTAL ZONE

The resource review area for coastal zone resources extends 1 mile on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split.

10.1 Regulatory Context and Methodology

The National Coastal Zone Management Program (CZMP) is authorized by the CZMA of 1972, amended by the Coastal Zone Act Reauthorization Amendments of 1990 and is administered by NOAA (15 CFR Part 930). Under the CZMA, direct federal actions, federal licensing or permit projects, and federal assistance activities with reasonably foreseeable coastal effects must be consistent with the enforceable policies of a state's approved CZMP. The process by which a state decides whether a federal action meets its enforceable policies is called federal consistency.

The resource review area falls entirely within Maryland's coastal zone and thus the CZMP. The CZMP is administered by the MDNR, in partnership with the MDE, to ensure federal activities are consistent with Maryland's coastal resource objectives and policies. Therefore, the methodology for evaluating coastal zone resources is summarized in this section and in more detail in the referenced sections of this technical report. The MDTA has evaluated all applicable Core Policies of Maryland's CZMP, which are:

- Quality of Life Policies (addressed in the *Chesapeake Bay Crossing Study Socioeconomic and Land Use Technical Report*, the *Chesapeake Bay Crossing Study Noise Technical Report*, the *Chesapeake Bay Crossing Study Air Quality Technical Report*, and the *Chesapeake Bay Crossing Study Section 4(f) Evaluation Technical Report*).
- Waste and Debris Management (addressed in the *Chesapeake Bay Crossing Study Initial Site Assessment Technical Report*).
- Water Resources Protection and Management (addressed in **Section 8, Surface Water Resources, Section 9, Waters of the U.S., Including Wetlands, and Section 12, Chesapeake Bay Critical Area**).
- Flood Hazards & Community Resilience (addressed in **Section 7, Floodplains, Section 9, Waters of the U.S., Including Wetlands**, the *Chesapeake Bay Crossing Study Socioeconomic and Land Use Technical Report*.

The MDTA has also evaluated all applicable Coastal Resources and Coastal Uses Policies of Maryland's CZMP. The applicable Coastal Resources Policies are:

- The Chesapeake and Atlantic Coastal Bays Critical Area (addressed in **Section 12, Chesapeake Bay Critical Area**).
- Tidal Wetlands (addressed in **Section 9, Waters of the U.S., Including Wetlands**).
- Non-tidal Wetlands (addressed in **Section 9, Waters of the U.S., Including Wetlands**).
- Forests (addressed in **Section 14, Terrestrial Habitat and Biota**).
- Historical and Archaeological Sites (addressed in the *Chesapeake Bay Crossing Study Cultural Resources Technical Report*).

- Living Aquatic Resources (addressed in **Section 13, Aquatic Habitat and Biota,** and **Section 15, Rare, Threatened, and Endangered Species**).

The applicable Coastal Uses Policies are:

- Dredging and Disposal of Dredged Material (addressed in **Section 9, Waters of the U.S., Including Wetlands,** and **Section 13, Aquatic Habitat and Biota**).
- Transportation (addressed through compliance with NEPA).
- Development (addressed in **Section 4, Geology and Topography, Section 5, Soils and Farmland Soils, Section 7, Floodplains, Section 13, Aquatic Habitat and Biota,** and **Section 14, Terrestrial Habitat and Biota**).

10.2 Affected Environment

The entirety of both Anne Arundel and Queen Anne's Counties is within the Coastal Zone. Coastal resources present within the resource review area include land designated within the limits of the Chesapeake Bay Critical Area (see **Section 12, Chesapeake Bay Critical Area**), tidal and nontidal wetlands and waterways (addressed in **Section 9, Waters of the U.S., Including Wetlands**), forest (see **Section 14.1, Terrestrial Habitat**), aquatic resources (see **Section 13, Aquatic Habitat and Biota**), and historical and archaeological sites (see the *Chesapeake Bay Crossing Study Cultural Resources Technical Report*).

10.3 Environmental Consequences

The MDTA has completed a review of effects to Maryland's coastal resources, such as wetlands, waterways, and forests, as well as coastal uses such as navigation, fishing, and agriculture, to determine whether the build alternatives are consistent with the Maryland CZMP enforceable polices. This chapter specifically focuses on the natural resources components of the review and summarizes impacts presented in this document.

10.3.1 No-Build Alternative

The No-Build Alternative would have no impact to the natural resources within the coastal zone.

10.3.2 Build Alternatives

All build alternatives would impact natural resources within the coastal zone. **Table 10-1** provides an overall summary of anticipated impacts to coastal resources from each build alternative. **Table 10-2** provides an overall summary of anticipated impacts to coastal resources from the SUP option associated with each build alternative.

Table 10-1: Coastal Zone Resource Impacts (acres)

Resource	No-Build	Build Alternative					
		B	C	D	E	F	G
Critical Area	0	166.5	164.1	397.7	395.4	402.0	398.8
100-foot Critical Area Buffer	0	19.0	17.7	28.2	26.9	28.8	27.3
Sensitive Species Project Review Area	0	110.0	109.4	119.4	118.8	122.5	121.2
Nontidal Wetlands*	0	3.9	4.2	8.8	9.1	9.0	9.2

Resource	No-Build	Build Alternative					
		B	C	D	E	F	G
Nontidal Waterways* (Acres/Linear Feet)	0	0.1 / 700	0.1 / 670	0.9 / 3,520	0.9 / 3,490	0.9 / 3,600	0.9/ 3,550
Tidal Wetlands*	0	2.1	1.5	2.7	2.1	3.1	2.3
Tidal Waterways* (Acres/Linear Feet)		1.1 / 290	1.0 / 290	4.9 / 860	4.7 / 860	5.4 / 900	5.3 / 900
Forest	0	27.4	27.4	87.2	87.2	88.6	88.6
FIDS Habitat	0	12.1	12.1	33.3	33.3	34.5	34.5
SAV (2019-2023))	0	0.4	0	0.7	0.4	0.9	0.4
Natural Oyster Bar (NOB)	0	9.4	10.2	12.6	13.3	13.8	14.6
Historic Oyster Bottom	0	24.8	24.1	28.7	28.0	29.5	28.9
Oyster Plantings	0	0	0	0	0	0	0
Oyster Sanctuaries	0	0.6	0.6	1.1	1.1	1.6	1.6
Essential Fish Habitat (EFH)**	0	133.2	136.0	137.0	139.8	140.4	143.5
Public Shellfisheries	0	5.6	6.1	8.8	9.3	9.3	9.8
Horseshoe Crab Habitat (linear feet)	0	2,100	290	2,100	290	2,240	290
Waterfowl Staging and Concentration Areas	0	7.1	2.5	7.1	2.5	7.1	2.5
Colonial Waterbird Nesting Areas***	0	Mezick Pond, Bay Bridge Pier Islands					

** Nontidal and tidal wetland and waterway impacts do not include the Chesapeake Bay.*

***Impacts to EFH include the total of all tidal and nontidal waterways plus the overall permanent LOD represented within the Chesapeake Bay.*

****Specific impacts to colonial waterbird nesting areas would be determined through continued coordination with the MNDR and through later design and minimization practices.*

Table 10-2: SUP Coastal Zone Resource Impacts (acres)

Resource	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
Critical Area	0	3.4	2.5	3.4	2.5	3.3	2.6
100-foot Critical Area Buffer	0	1.2	1.0	1.2	1.0	1.2	1.0
Sensitive Species Project Review Area	0	4.3	4.5	4.3	4.5	4.2	4.6
Nontidal Wetlands*	0	0	0	0	0	0	0
Nontidal Waterways* (Acres/Linear Feet)	0	<0.1 / 20	<0.1 / 30.0	<0.1 / 20	<0.1 / 30.0	0 / 0	<0.1 / 50.0
Tidal Wetlands*	0	0.7	0.7	0.7	0.7	0.8	0.7
Tidal Waterways* (Acres/Linear Feet)		<0.1 / 0	<0.1 / 0	<0.1 / 0	<0.1 / 0	<0.1 / 0	<0.1 / 0
Forest	0	0.5	0.2	0.5	0.2	0.5	0.2
FIDS Habitat	0	0.2	0.2	0.2	0.2	0.1	0.1

Resource	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
SAV (2019-2023))	0	0.3	0	0.3	0	0.4	0
Natural Oyster Bar (NOB)	0	0.8	0.9	0.8	0.9	0.8	0.9
Historic Oyster Bottom	0	1.0	1.0	1.0	1.0	1.0	1.1
Oyster Plantings	0	0	0	0	0	0	0
Oyster Sanctuaries	0	0	0	0	0	0	0
Essential Fish Habitat (EFH)**	0	4.0	4.0	4.0	4.0	4.2	4.3
Public Shellfisheries	0	0.5	0.6	0.5	0.6	0.5	0.6
Horseshoe Crab Habitat (linear feet)	0	430	0	430	0	300	0
Waterfowl Staging and Concentration Areas	0	0.1	0	0.1	0	0.1	0
Colonial Waterbird Nesting Areas***	0	Mezick Pond, Bay Bridge Pier Islands					

** Nontidal and tidal wetland and waterway impacts do not include the Chesapeake Bay.*

***Impacts to EFH include the total of all tidal and nontidal waterways plus the overall permanent LOD represented within the Chesapeake Bay.*

****Specific impacts to colonial waterbird nesting areas would be determined through continued coordination with the MNDR and through later design and minimization practices.*

Alternatives B and C would have the least impact overall to the Chesapeake Bay compared to Alternatives D, E, F, and G, due to the smaller relative size of the proposed bridge spans for Alternatives B and C. Also, Alternatives B and C have a shorter length of proposed roadway improvements along U.S. 50/301 compared to the other build alternatives, therefore avoiding direct impacts to additional natural resources within each county. As illustrated in **Table 10-1**, the increased acreage of the impacts for Alternatives D, E, F, and G are most clearly correlated to natural resource impacts associated with land acreage within the Critical Area, linear feet of nontidal waterways, nontidal wetlands, forests and FIDS habitat. Alternatives B and C result in less than half the impacts to these resources when compared to the other build alternatives.

Table 10-1 illustrates a clear difference in impacts between the proposed northern alignments (Alternatives B, D, and F) and the proposed southern alignments (Alternatives C, E, and G). Alternatives B, D, and F would affect more vegetated shoreline areas, while Alternatives C, E, and G would affect shorelines that are more developed and less vegetated. This is illustrated most notably in the difference in impacts to horseshoe crab habitat and waterfowl staging and concentration areas. Alternatives D and F result in the greatest impacts to coastal resources. The addition of a SUP option with any of the build alternatives would result in additional impacts, with the greatest impacts to Critical Area, linear feet of nontidal waterways, forest, SAV, horseshoe crab habitat, and waterfowl staging and concentration areas associated with the northern alternatives. No additional impacts would occur to nontidal wetlands, oyster plantings, or oyster sanctuaries with the addition of a SUP option with any of the build alternatives.

10.4 Avoidance, Minimization, and Further Mitigation Strategies

The MDTA would approach design and development with the goal of minimizing and further mitigating impacts to coastal zones and resources and would optimize opportunities to incorporate ESD to meet (and exceed where feasible) surface and groundwater protection requirements.

The MDTA would continue to coordinate with the regulatory agencies to ensure consistency with the CZMP. A federal consistency determination will be made during final design and after determining construction methods, BMPs, and mitigation compliance. The MDE's CZMP will review actions submitted through the nontidal and tidal wetland and waterway permitting processes to determine if actions are consistent with Maryland's enforceable coastal policies. In accordance with Maryland's Transportation Environmental Regulatory Process (MDOT SHA, 2017), a Coastal Zone Consistency Determination would be prepared to provide details on how the proposed project would comply with all applicable coastal zone core policies and would be consistent, to the maximum extent practicable, with Maryland's CZMP, as required by Section 307 of the Federal CZMA of 1972, as amended.

11 COASTAL BARRIER RESOURCES

This section discusses Coastal Barrier Resources System (CBRS) resources that could either influence project design or be affected by the build alternatives. The resource review area for CBRS resources extends 1,000 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split.

CBRS resources are storm-prone and dynamic coastal barriers and include 3.5 million acres along the eastern U.S. A CBRS unit includes the entire sand-sharing system, including the beach and nearshore area. The sand-sharing system of coastal barriers is normally defined by the 30-foot bathymetric seaward contour. In large coastal embayments the sand-sharing system is defined by the 20-foot bathymetric contour or a line approximately 1 mile seaward of the shoreline, whichever is nearer the coastal barrier.

11.1 Regulatory Context and Methodology

The Coastal Barrier Resources Act (CBRA) of 1982, as amended (16 U.S.C. 3501) established the John H. Chafee CBRS. The USFWS administers the CBRA, which encourages the conservation of storm-prone and dynamic coastal barriers by withdrawing the availability of federal funding and financial assistance within a designated set of units of the CBRS (USFWS, n.d.). The CBRS consists of relatively undeveloped coastal barriers and other areas located in the eastern United States. The CBRS currently includes 585 System Units (SU), which comprise nearly 1.4 million acres of land and associated aquatic habitat. There are also 277 "Otherwise Protected Areas," a category of coastal barriers that are mostly held for conservation or recreation purposes that include an additional 2.1 million acres of land and associated aquatic habitat. The CBRS units are identified and depicted on a series of maps which show the areas protected by the CBRA. The Bolstering Ecosystems Against Coastal Harm (BEACH) Act (Pub. L. 118-117) was enacted on November 25, 2024. This legislation adopted 195 revised maps that affect 454 units of the CBRS across several mid-Atlantic states, including Maryland.

The MDTA gathered publicly available information, including GIS data, for CBRS resources, evaluated existing conditions, overlaid existing resources on resource review area mapping, and assessed the potential for direct and indirect impacts as well as temporary and permanent impacts to CBRS resources.

11.2 Affected Environment

The CBRS contains two types of mapped units – SUs and Otherwise Protected Areas (OPA). OPAs are designated with a “P” at the end of the unit designation. Most new federal expenditures and financial assistance, including federal flood insurance, are prohibited within SUs, while the only federal spending prohibition within OPAs is on federal flood insurance. No mapped CBRS units are located within the resource review area. Two CBRS resources are located to the north of the resource review area (USFWS, 2014a and 2014b). The Stevensville Unit MD-32 is on the eastern shoreline of the Chesapeake Bay about one-half mile north of the Bay Bridge, and the Wesley Church Unit MD-33 is on the western shoreline of the Chester River about 1 mile north of U.S. 50/301 where it crosses Castle Marina Road.

11.3 Environmental Consequences

11.3.1 No-Build Alternative

The No-Build Alternative would have no impact to CBRS resources.

11.3.2 Build Alternatives

The build alternatives would not impact any CBRS resources, as the CBRS resources are outside of and upstream of all build alternatives.

11.4 Avoidance, Minimization, and Further Mitigation Strategies

All build alternatives avoid impacts to CBRS.

12 CHESAPEAKE BAY CRITICAL AREA

The resource review area for the Chesapeake Bay Critical Area (Critical Area) extends 1,000 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split. The Critical Area Program was designed to protect the ecological health and water quality of the Chesapeake Bay and its tributaries by minimizing adverse impacts while promoting responsible land use practices and sustainable development.

12.1 Regulatory Context and Methodology

The Critical Area Program was created by the passage of the Critical Area Act by the Maryland General Assembly in 1984. It is a comprehensive program to protect the natural resources of the Chesapeake Bay and its tidal shorelines. The Act identified the "Critical Areas" in Maryland as all land within 1,000 feet of the mean high-water line of tidal waters or the landward edge of tidal wetlands and all waters of, and lands under, the Chesapeake Bay and its tributaries. Also regulated is a 100-foot buffer, which consists of the first 100 feet landward of tidal waters, tidal wetlands, or tributary streams. For further protection, the 100-foot buffer is expanded for steep slopes, adjacent nontidal wetlands, and hydric or highly erodible soils. All development projects within 1000 feet of tidal waters, including partially or wholly funded state projects, are required to comply with the Chesapeake Bay Critical Area regulations.

Within the Critical Area, three land classifications have been designated:

- Intensely Developed Areas (IDA): This zone typically includes existing developed areas with urban or suburban characteristics. Higher-density development is allowed, and these areas may have pre-existing infrastructure. Regulations in the IDA are generally more lenient compared to other zones, but they still emphasize environmentally sensitive practices to mitigate the impact of human activities on the Chesapeake Bay. New development or redevelopment in the IDA must reduce pollution from stormwater runoff by at least 10 percent below that of existing land use.
- Resource Conservation Area (RCA): The RCA zone focuses on preserving natural resources and habitats. Stricter regulations govern development in this area to minimize disturbance to sensitive ecosystems, control stormwater runoff, and protect water quality. The RCA acts as a buffer, helping to maintain the ecological balance and prevent adverse impacts to the Chesapeake Bay.
- Limited Development Area (LDA): The LDA is an intermediate zone between the IDA and RCA, where controlled development is allowed, but with greater consideration for environmental protection. It encourages responsible land use practices, emphasizing the importance of maintaining a balance between human activities and the preservation of the Chesapeake Bay's critical natural resources.

Rare habitats for both plants and animals are also regulated under the Critical Area Act. The MDNR maintains a digital map layer, accessed via the Maryland iMap Data catalog, called Sensitive Species Project Review Areas (SSPRA), that incorporates various types of areas under the Critical Area criteria including:

- Natural Heritage Areas;

- State and/or Federally Listed Species;
- Other or Locally Significant Habitat Areas;
- Colonial Waterbird Sites;
- Nontidal Wetlands of Special State Concern; and
- Geographic Areas of Particular Concern.

This digital map layer was used to identify SSPRA that occurs within the limits of the Critical Area associated with the build alternatives. **Section 16, Unique and Sensitive Areas** also discusses SSPRA but within the context of the entire resource review area.

12.1.1 Critical Areas and Buffers

Maryland's iMap GIS portal was used to identify the 1,000-foot Critical Area limits within the resource review area and provide a breakdown of existing critical areas by land classification. The 100-foot Critical Area buffer is assigned to the first 100 feet beyond tidal waters, tidal wetlands, and tributary streams, and is expanded beyond 100 feet to include steep slopes and highly erodible soils. The expanded Critical Area buffer is not designated until a project is submitted for authorization. The location of Critical Area land classifications, FIDS habitat and SSPRAs, and the 100-foot Critical Area buffer (derived directly from the limits of the 1972 Tidal Wetland Boundary) are shown on the natural resource map sets for the northern alignments (**Appendix B**) and southern alignments (**Appendix C**).

12.1.2 Forest Interior Dwelling Species Habitat

Forest Interior Dwelling Species (FIDS) are regulated as a protected resource within the Critical Area (COMAR 27.01.09.04). FIDS refers to bird species that require large forest areas to breed successfully and maintain viable populations. This diverse group includes colorful songbirds (e.g., tanagers, warblers, and vireos) that breed in North America and winter in the Caribbean and Central and South America, as well as residents and short-distance migrants (e.g., woodpeckers, hawks, and owls) that rely on the interior or core of mature forests for their habitat requirements. The interior of the forest is less influenced by noise, light penetration, and temperature fluctuations than the forest edge.

FIDS habitat is classified as forests of at least 50 acres in size with 10 or more acres of forest interior habitat, dominated by pole-sized or larger trees (5 inches or more in diameter at breast height [DBH] (measured at 4.5 feet above the ground), with a predominantly closed canopy (Critical Area Commission, 2000). Riparian FIDS habitat is at least 50 acres in size with an average width of 300 feet and associated with a perennial stream. Maryland's iMap GIS portal was used to identify mapped FIDS habitat within the limits of the identified Critical Area boundary. Within the resource review area, areas of forest that appear to meet the FIDS habitat criteria for areal extent, tree size, canopy closure, and/or association with a perennial stream were determined based on modeling, using aerial photography. The FIDS habitat outside the resource review area is unaltered published data. The data was last updated in August 2017.

12.2 Affected Environment

This section quantifies the total acreage of Critical Area within the resource review area, and the total acreage of FIDS habitat within that identified Critical Area. For a discussion of the affected environment, including those within the Critical Area, associated with the other protected

resources, see **Section 10, Coastal Zone**, **Section 13, Aquatic Habitat and Biota**, and **Section 15, Rare, Threatened, and Endangered Species**.

Figure 12-1 and **Figure 12-2** identify the location and distribution of Critical Area within the resource review area. The resource review area contains approximately 3,250 acres of land within the limits of the Critical Area. Most of this is classified as LDA but the resource review area also contains relatively large areas classified as RCA and IDA.

Table 12-1 provides a breakdown of the total area (acres) of IDA, LDA, and RCA identified, and the percentage each comprises of the total resource review area.

Table 12-1: Chesapeake Bay Critical Area

Land Classification	Size within Resource Review Area (acres)	Percentage of Total Resource Review Area
IDA	645	13%
LDA	1,930	39%
RCA	675	14%
Total	**3,250**	**66%**

Source: MD iMap, 2017

Within Anne Arundel County, the Critical Area is primarily associated with the Severn River, Whitehall Creek, Meredith Creek, and the western shoreline of the Chesapeake Bay, and made up largely of LDA and RCA. A large portion of the resource review area in Anne Arundel County is outside the limits of the Critical Area.

Most of the resource review area within Queen Anne's County that spans Kent Island is located within the Critical Area and the majority of IDA identified within the resource review area occurs on Kent Island, due to the high level of existing development. There is also Critical Area along the Wye River and Chester River. In Queen Anne's County, the Critical Area exists at almost every major waterway that crosses through the resource review area.

The resource review area contains approximately 370 acres of potential FIDS habitat (MD iMap Data Catalog, 2017), of which approximately 96 acres are located within the Critical Area (**Figure 12-3** and **Figure 12-4**). The largest concentrations occur within the Anne Arundel County portion of the resource review area, which contains relatively large areas of forest interspersed with residential development. The section of the resource review area that spans Kent Island contains relatively few areas of FIDS habitat due to the high level of development. The eastern portion of the resource review area, just west of Queenstown, also contains a small area of potential FIDS habitat within the Critical Area.

In Anne Arundel County, FIDS habitat functions as part of the riparian buffer for headwater streams for several nontidal and tidal tributaries, both north and south of U.S. 50/301. In Queen Anne's County, the largest expanse of FIDS habitat is located at the easternmost end of the resource review area, near and within the split between U.S. 50/301 and westbound ramp to U.S. 50/301. This area of FIDS habitat coincides with an undeveloped area and several nontidal forested wetlands.

Figure 12-1: Critical Areas – Anne Arundel County

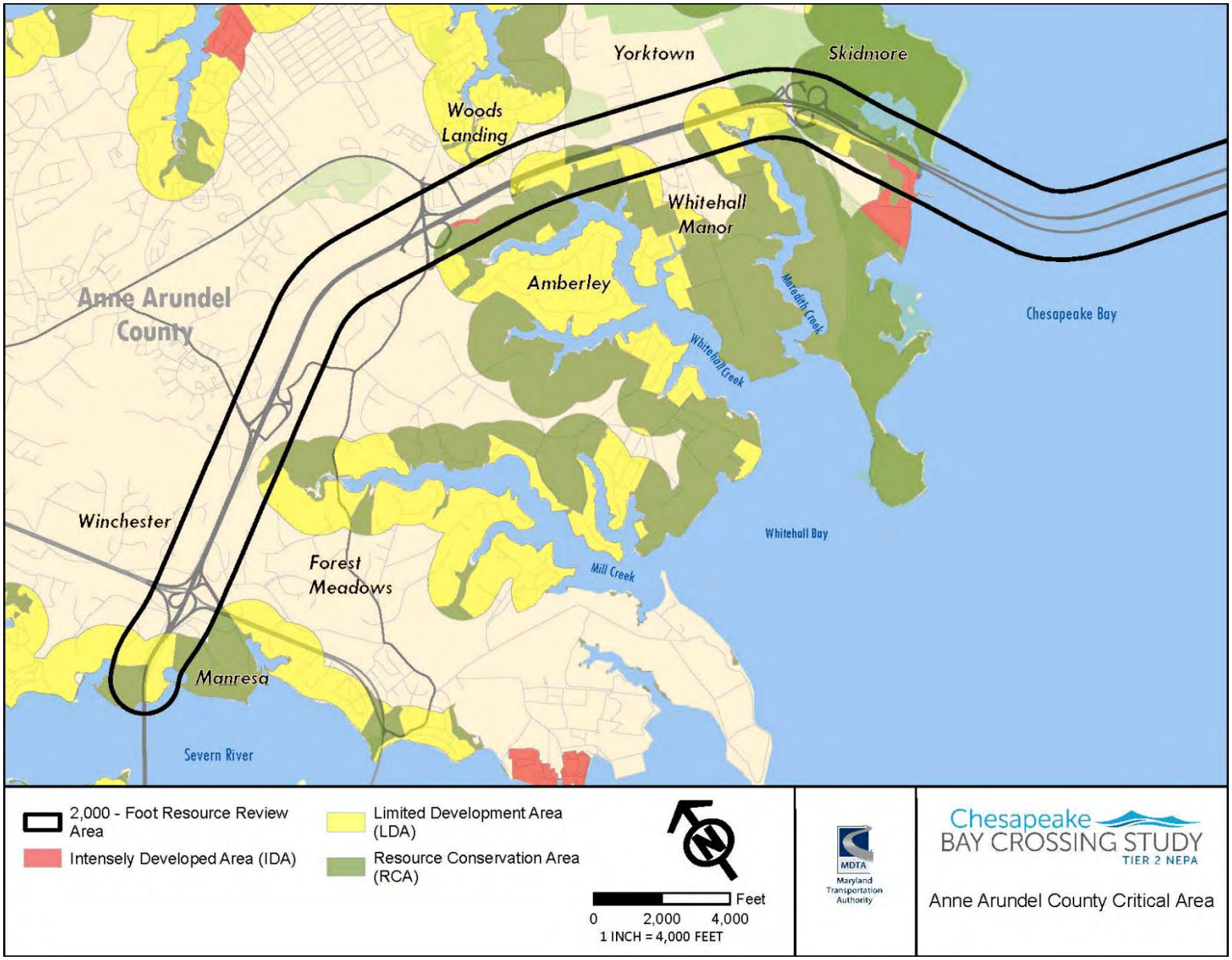


Figure 12-2: Critical Areas – Queen Anne's County

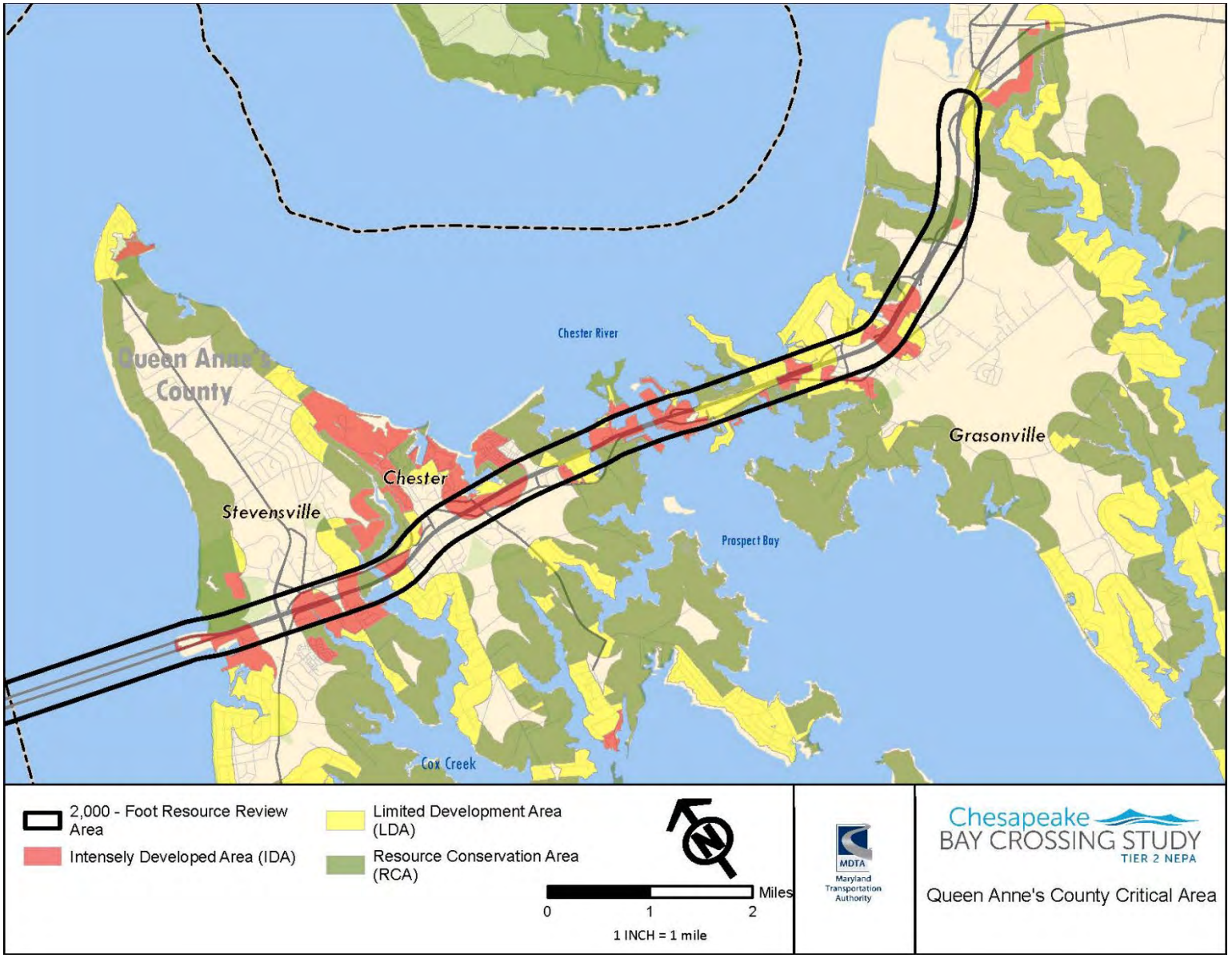


Figure 12-3: FIDS Habitat – Anne Arundel County

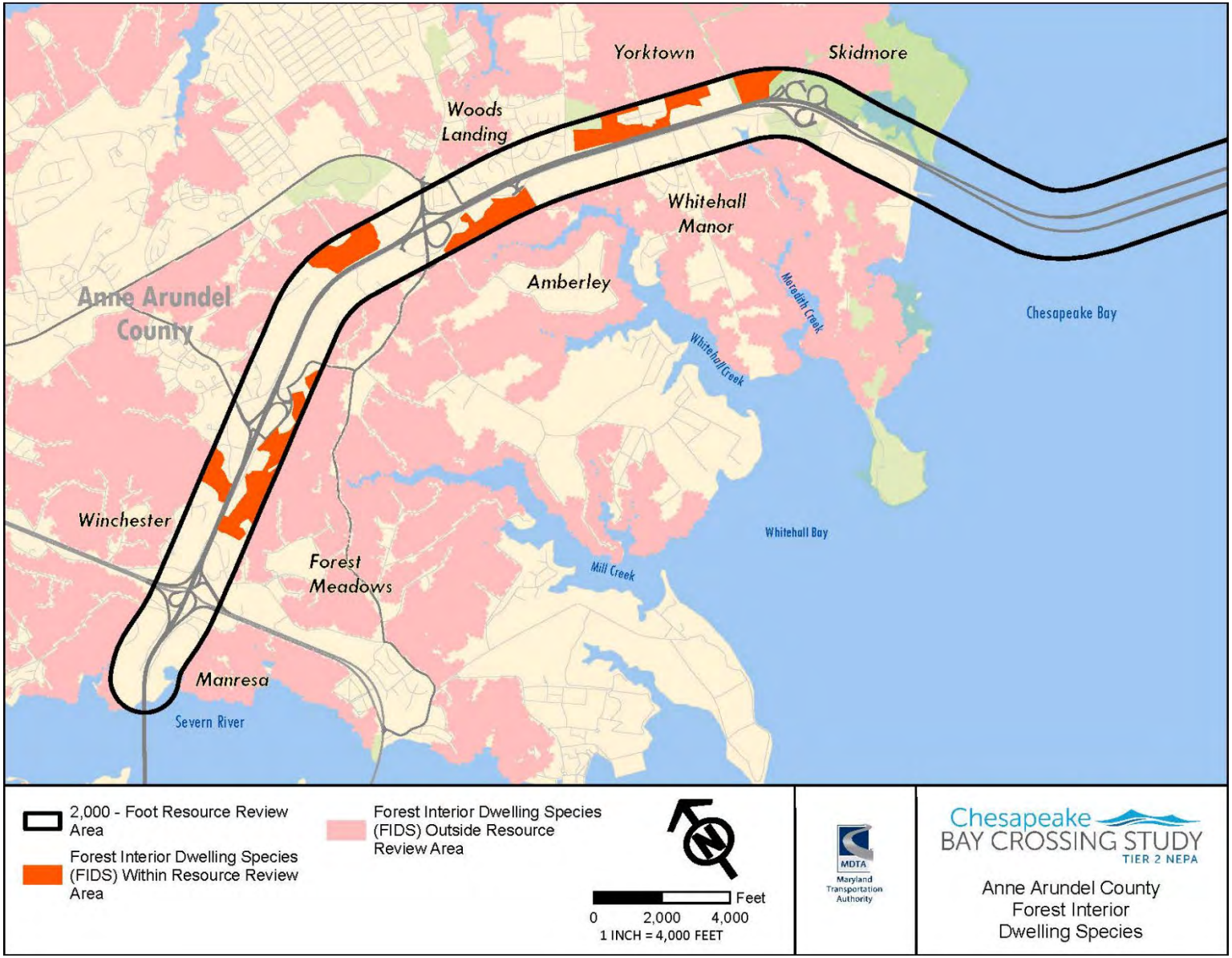
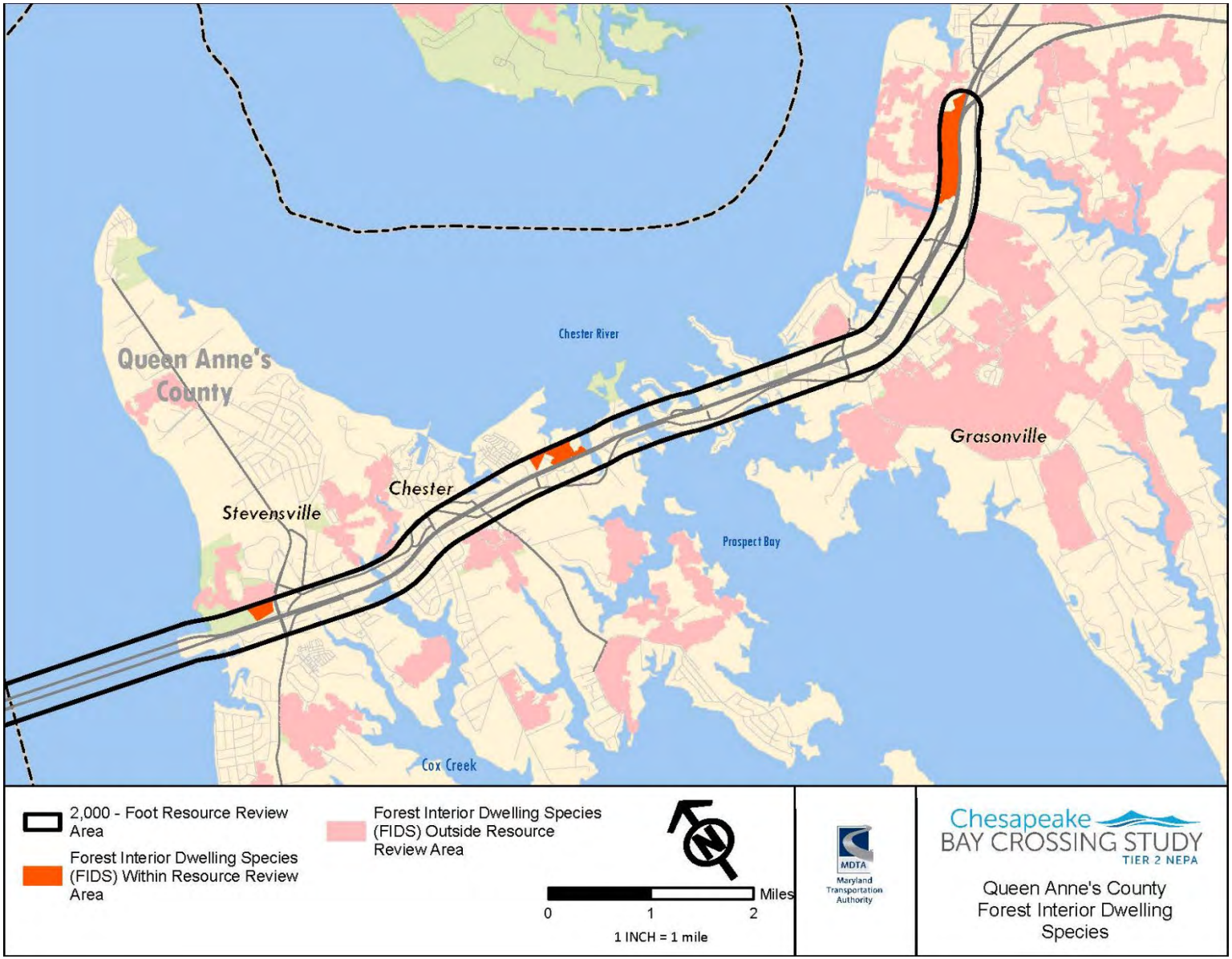


Figure 12-4: FIDS Habitat – Queen Anne's County



12.3 Environmental Consequences

The MDTA has evaluated the impacts of the alternatives to the Critical Area, the 100-foot Critical Area buffer, and to SSPRAs and FIDS habitat within the Critical Area. SSPRA represents a composite area of several categories of sensitive resources under the Critical Area criteria.

12.3.1 No-Build Alternative

The No-Build Alternative would have no impact to Critical Area resources.

12.3.2 Build Alternatives

The build alternatives would result in impacts to aquatic habitats and other sensitive Critical Area resources, which could lead to increased sedimentation and degraded water quality. The addition of impervious surfaces (see **Section 8.1, Watersheds, Table 8-6** and **Table 8-7**) and structural supports could alter natural water flow, potentially leading to increased erosion and changes in shoreline stability. Furthermore, the build alternatives may contribute to pollution from stormwater runoff and potential spills, all of which could harm the Chesapeake Bay's delicate ecosystem. Construction could also lead to displacement of FIDS and SSPRA habitat within the Critical Area.

Table 12-2 provides a comparison of the total amount of Critical Area land that would be impacted by the alternatives, as well as impacts to mapped FIDS habitat and SSPRA identified within the Critical Area.

Table 12-3 provides a comparison of the total amount of Critical Area land that would be impacted by the SUP option associated with each of the build alternatives. Refer to **Section 15 – Rare, Threatened, and Endangered Species** and **Section 16 – Unique and Sensitive Areas** for more information on SSPRA.

Table 12-2: Impacts to Critical Area Land Use (acres)

Critical Area Land Use Classification	No-Build	Build Alternative					
		B	C	D	E	F	G
IDA	0	58.5	59.3	164.3	165.1	166.5	167.2
RCA	0	69.9	66.7	112.8	109.6	113.9	110.0
LDA	0	38.2	38.2	120.7	120.7	121.7	121.7
Total*	**0**	**166.5**	**164.1**	**397.7**	**395.4**	**402.0**	**398.8**
Critical Area 100-foot Buffer	0	19.0	17.7	28.2	26.9	28.8	27.3
Critical Area Expanded Buffer	0	30.4	29.1	54.5	53.2	55.8	53.9
FIDS Habitat	0	10.4	10.4	14.2	14.2	14.5	14.5
SSPRA	0	47.1	45.8	49.1	47.7	50.5	48.5

**Totals may not match sum of breakout values due to rounding.*

Table 12-3 SUP Impacts to Critical Area Land Use (acres)

Critical Area Land Use Classification	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
IDA	0	1.0	0.5	1.0	0.5	0.7	0.3
RCA	0	2.5	2.0	2.5	2.0	2.7	2.3
LDA	0	0	0	0	0	0	0
Total*	**0**	**3.4**	**2.5**	**3.4**	**2.5**	**3.3**	**2.6**
Critical Area 100-foot Buffer	0	1.2	1.0	1.2	1.0	1.2	1.0
Critical Area Expanded Buffer	0	1.7	1.5	1.7	1.5	1.6	1.4
FIDS Habitat	0	0	0	0	0	0	0
SSPRA	0	2.0	2.1	2.0	2.1	2.0	2.1

**Totals may not match sum of breakout values due to rounding.*

Critical Area land use, FIDS habitat, and SSPRAs are shown on the natural resource map sets for the northern alignments (**Appendix B**) and southern alignments (**Appendix C**). Critical Area and FIDS habitat impacts are somewhat similar for Alternatives B and C. The potential for Critical Area and FIDS habitat impacts is highest with Alternatives D, E, F, and G.

Alternatives B and C would impact less than half of the Critical Area, and approximately two-thirds of the Critical Area FIDS habitat than Alternatives D, E, F, and G. Due to their shorter overall length, these build alternatives avoid more substantial FIDS habitat identified along Mill Creek and Whitehall Creek in Anne Arundel County, and the substantial forested area noted near the U.S. 50/301 split in Queen Anne's County. The addition of a SUP option with any of the build alternatives would result in between 2.5 acres and 3.4 acres of additional impacts to Critical Area. The addition of a SUP option with any of the build alternatives would not result in any additional impacts to FIDS habitat.

All build alternatives involve potential impacts to SSPRA within the Critical Area in Anne Arundel County associated with Sandy Point State Park, and in Queen Anne's County within an area on Kent Island near Cox Creek. Alternatives D, E, F, and G also impact areas of SSPRA within the eastern portion of Queen Anne's County. The largest area is located on the north side of U.S. 50/301 between the roadway and the Chesapeake Bay. This area is categorized as an MD Environmental Trust Easement and located within a relatively large, forested tract. The addition of a SUP option with any of the build alternatives would result in between 2.0 and 2.1 acres of additional impacts to SSPRA, with the northern alternatives, Alternatives B, D, and F having slightly less impact than the southern alternatives.

12.4 Avoidance, Minimization, and Further Mitigation Strategies

Final design will include efforts to avoid or minimize impacts on water quality, Critical Areas and buffers, FIDS and FIDS habitat, SSPRAs, and other habitats and riparian buffers. The MDTA would coordinate with MDNR Critical Area Commission and adhere to the requirements established within any impact authorization provided under COMAR 27.01.

The MDTA would prioritize minimization of impacts by reducing the footprint on Critical Area habitats and natural shorelines by using 2:1 slopes and/or retaining walls, where feasible. The proposed build alternatives all partially utilize existing transportation corridors and previously disturbed lands, which minimizes potential FIDS habitat impacts, avoiding habitat fragmentation and largely preserving the integrity of mature forest resources. Additionally, timing construction activities to avoid breeding, nesting, or migration seasons for key species would further protect local wildlife. To manage stormwater runoff, installing green infrastructure BMPs such as bio-retention basins and vegetative buffers along bridge approaches could filter pollutants before they reach the Chesapeake Bay. Regular monitoring during and after construction would ensure compliance with environmental regulations and help identify unforeseen impacts for timely remediation. Public and stakeholder engagement fosters transparency and encourages collaborative solutions, ensuring that development balances infrastructure needs with the protection of Critical Area resources.

Additional minimization strategies that would affect resources within the Critical Area are discussed in **Section 8, Surface Water Resources**, **Section 9, Waters of the U.S., Including Wetlands**, **Section 13, Aquatic Habitat and Biota**, and **Section 14, Terrestrial Habitat and Biota**.

The MDTA would incorporate mitigation strategies to address both short-term and long-term impacts. Restoring damaged habitats, such as replanting impacted vegetation communities or creating new wetlands, can help offset ecological losses. Mitigation would be required for impacts to all forest within the Critical Area at a ratio ranging from 1:1 to 3:1 depending on the percent of forest acreage cleared, designated land use classification, and whether impacts fall within the identified Critical Area Buffer. Outside of the 100-foot Critical Area Buffer, a forest mitigation ratio of 1:1 would apply if a project were to clear less than 20% of the onsite forest cover in the RCA or LDA. A forest mitigation ratio of 1.5:1 would apply for clearing 20-30% of onsite forest cover in areas outside of the 100-foot Critical Area Buffer in the RCA or LDA. Clearing more than 30% of the onsite forest cover in the RCA or LDA outside of the 100-foot Critical Area Buffer may require a variance from the local government, and when permitted, requires a 3:1 mitigation replacement ratio. Trees or vegetation cleared within the 100-foot Critical Area Buffer when a variance has been approved for new development or re-development must be replaced at a 3:1 mitigation ratio, except for Buffer Exemption Area and Shoreline Access, where a 2:1 mitigation ratio is required, and Shore Erosion Control, which requires 1:1 replacement. In IDAs, there are no Critical Area reforestation requirements. During final design, the MDTA will evaluate replacement of affected trees and forest. It is expected that all reforestation and/or afforestation that will be required will not be feasible on site. The MDTA will work with the MDNR Critical Area Commission to identify additional land within the Critical Area outside of the LOD, and within the Critical Area Buffer, as appropriate, to fully address mitigation requirements. Additional coordination with the Anne Arundel County and Queen Anne's County Critical Area Programs may provide further information regarding potential mitigation opportunities within each county. The MDTA would work with MDE to develop ESC/SWM plans to protect resources.

The final design would be required to reduce pollution from stormwater runoff by at least 10 percent below that of existing land use within impact areas associated with the IDA portions of the Critical Area.

13 AQUATIC HABITAT AND BIOTA

The initial resource review area for aquatic habitat and biota extends 1,000 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split. However, the resource review area was expanded up to 2 miles on either side of the centerline for areas of the Chesapeake Bay and Eastern Shore that drain to the resource review area, as available data was more limited within the 2,000-foot wide resource review area and these tidal areas are largely connected.

13.1 Nontidal and Tidal Aquatic Habitat

Aquatic habitat is the water area (oceans, rivers, streams, lakes, and ponds) inhabited by fish, waterfowl and water birds, and other aquatic organisms. It also includes the chemical, physical, and biological components of the water atmosphere, which combine to form this habitat. These components include water debris, temperature, aquatic plants, water level, and water flow. This section is organized to begin with an overview of nontidal and tidal characteristics present within the resource review area and presents an overall review of environmental consequences that could affect aquatic habitat and biota. The remaining sections identify the vast array of habitats and species present within this environment.

13.1.1 Regulatory Context and Methodology

Tidal and nontidal aquatic habitats are protected under state and federal regulations such as the CWA and Rivers and Harbors Act, as well as regulations that apply to various specific habitat types or designations such as waterfowl staging and concentration areas and colonial waterbird nesting areas. All regulations have been noted thus far in previous sections, including **Section 8, Surface Water Resources**, **Section 9, Waters of the U.S., including Wetlands**, and **Section 12, Chesapeake Bay Critical Area**. Tidal and nontidal wetland and waterway impacts identified in **Section 9, Waters of the U.S. Including Wetlands** are included within the environmental consequences for this discussion as representative aquatic habitat. Additional habitat impacts, such as EFH or SAV for example, are not intended to be cumulative. These unique aquatic habitats fall within the identified tidal and nontidal habitat.

13.1.1.1 Nontidal

Several publicly available data sources were used to characterize nontidal aquatic habitat within the resource review area. The Atlantic Coastal Fish Habitat Partnership (ACFHP) developed a species-habitat matrix as a conservation planning tool to evaluate the relative importance of 26 coastal, estuarine, and freshwater habitat types that fall within seven broader habitat categories. The matrix evaluates the importance of various habitat types as shelter, nursery, feeding, or spawning areas for each species during the egg/larval, juvenile/young of year, adult, and spawning adult life stages (ACFHP, 2009). Information from the matrix has been incorporated into various subsections to provide additional context and is also used to evaluate potential impacts to specific habitat types and species.

For nontidal streams, Anne Arundel County aquatic habitat data within the resource review area were available from the AABWPR. Queen Anne's County does not collect aquatic habitat data. The AABWPR assesses aquatic habitat using MBSS methods and the USEPA Rapid Bioassessment Protocol (RBP) for aquatic habitat scoring. The RBP methods rate the quality of 10 habitat parameters for low gradient streams relative to least-impaired reference conditions.

The narrative rating criteria utilized by AABWPR based on RBP aquatic habitat scoring are shown in **Table 13-1**.

The aquatic habitat assessment developed by MBSS and used by AABWPR is based on the USEPA RBP aquatic habitat assessment methodology and modified for use in Maryland streams. This protocol assigns a value and weight to each of six habitat parameters for Coastal Plain systems, to compare to least-impaired reference conditions. The parameter scores are combined into a physical habitat index, set on a scale of 0 to 100, and a narrative ranking is assigned, as shown in **Table 13-2**.

Table 13-1: AABWPR Aquatic Habitat Scoring Criteria

Score	Narrative Rating
151 +	Comparable to Reference
126 – 151	Supporting
100 – 125	Partially Supporting
< 100	Non-supporting

Table 13-2: MBSS Aquatic Habitat Scoring Criteria

Score	Narrative Rating
81 – 100	Minimally Degraded
66 – 80	Partially Degraded
51 – 65	Degraded
0 – 50	Severely Degraded

For the purposes of this study, aquatic habitat data collected within the 10-year period from 2013-2023 were considered representative of existing conditions within the resource review area.

13.1.1.2 Tidal

Several publicly available data sources were used to characterize tidal aquatic habitat within the resource review area. Information from the ACFHP species habitat matrix has been incorporated into this section to provide additional context and is also used to evaluate potential impacts to specific tidal habitat types and species.

MDNR's Chesapeake Bay Bottom Survey GIS data were used to characterize bottom substrates in the tidal portions crossed by the resource review area (MD iMap, 2015). The Chesapeake Bay Bottom Survey geodatabase characterizes bottom type designations determined by MDNR's acoustic bay bottom survey conducted from 1974 to 1983. Because this dataset is up to 30 years old and areas identified as cultch bottom when the survey was conducted may have degraded since the time of the survey, quantitative impacts were not calculated using this data source. This data source does not represent the entirety of benthic habitat in the resource review area, due to depth restrictions of the bottom surveys.

13.1.2 Affected Environment

13.1.2.1 Nontidal

Nontidal aquatic habitats within the resource review area include nontidal stream reaches and ponds. These habitats support a diverse array of biota, including resident and migratory fish, crustaceans such as crayfish, amphibians, including salamanders and frogs, a diverse array of benthic macroinvertebrates, and SAV. Within the resource review area, nontidal aquatic habitat data were available from AABWPR for the Lower Severn River and Magothy River South Shore MD 12-digit watersheds (**Table 13-3**). Refer to **Section 8.4 Water Quality** and **Figure 8-2** for monitoring locations. Within the Lower Severn River, AABWPR assessed aquatic habitat at two sites just upstream of U.S. 50/301 on Mill Creek and an unnamed tributary to Mill Creek. Aquatic habitat for this site was rated as *Partially Supporting* to *Comparable to Reference* based on RBP methods and *Degraded* to *Partially Degraded* based on MBSS methods. AABWPR assessed aquatic habitat at eight different sites within the Magothy River South Shore watershed, all located on Cat Branch to the north of U.S. 50/301. Aquatic habitat was highly variable along Cat Branch, ranging from *Non-supporting* to *Comparable to Reference* based on RBP methods and *Degraded* to *Partially Degraded* based on MBSS methods. Although the proposed build alternatives cross through the Magothy River watershed, immediately adjacent to and paralleling a section of U.S. 50/301, these sampling locations, as well as the Magothy River and tributaries, are located just beyond the limits of the resource review area. Additionally, these locations are within a waterway that does not drain south within the resource review area limits. Therefore, these data are not included in the table.

Recent nontidal aquatic habitat data is not available for the Queen Anne's County watersheds within the resource review area. These watersheds are largely comprised of tidal waterways, with small, nontidal stream reaches in headwater areas. These small, nontidal stream reaches have not been assessed in recent years by state or county nontidal monitoring programs. Nontidal stream health for the watersheds located on Kent Island is rated as "Poor" to "Fair" according to the benthic macroinvertebrate stream health index (Chessie BIBI) developed by the Interstate Commission on the Potomac River Basin (ICPRB) and applied to Chesapeake Bay watersheds (ICPRB, 2025). The stream health rating for these watersheds was determined from historic MBSS benthic macroinvertebrate data that was collected between 2000 and 2017 and the sites closest to the resource review area were assessed from 2002 to 2008. Watershed conditions and stream health may have changed since these assessments.

Table 13-3: AABWPR Aquatic Habitat Scores within Resource Review Area

Watershed (MD 12-digit)	Site	Year[1]	Scoring Method	Habitat Score Range	Narrative Score Range
Lower Severn River (021310020997)	(Mill Creek) R2-10-08	2013	RBP	153	Comparable to Reference
			MBSS	61.8	Degraded
	(Mill Creek) R2-10-06	2013	RBP	120	Partially Supporting
			MBSS	71.54	Partially Degraded

[1]*Sampling may not have been conducted during all years within year ranges.*

Vernal pools are typically associated with aquatic habitat during certain times of the year. These are seasonal, shallow wetlands, characterized by their temporary presence of water that forms a "pool" largely in the winter and spring. They provide a unique habitat for species adapted to these

temporary aquatic environments. Of the 144 total wetlands delineated, 13 were identified as potential vernal pools. One mapped vernal pool was noted in correspondence from MDNR dated January 23, 2024 (**Appendix L**), which identified the location of the vernal pool near the Severn River, outside the study limits. These areas may provide habitat for species of reptiles and amphibians. Wetlands that were noted during wetland delineations to potentially function as vernal pools are identified in the Resource Table in **Appendix E, Wetland Delineation Report**.

13.1.2.2 Tidal

Benthic substrate documented by the Chesapeake Bay Bottom Survey data is shown on **Figure 13-1** and summarized in **Table 13-4**, shown largely in the shallower areas along the Anne Arundel County and Queen Anne's County shorelines, as well as within the Kent Narrows waterway. Bottom substrate is a crucial component of aquatic habitat, as most tidal species rely on specific benthic habitats for foraging, shelter, or reproduction. Within the resource review area, substrates in the Lower Severn River, Annapolis Shore, and Kent Island True Bay MD 12-digit watersheds are dominated by mud and natural oyster rubble. The Northwest Lower Chesapeake Bay MD 12-digit watershed contains natural oyster rubble and sand substrates within the resource review area. The Grasonville South MD 12-digit watershed contains man-made oyster rubble, mud, natural oyster rubble, sand, and sandy mud substrate types within the resource review area. Mud, natural oyster rubble, sand, and sandy-mud substrate is present in the Chester River South MD 12-digit watershed. Finally, the Kent Island Shore MD 12-digit watershed contains only sand substrate, based on MDNR's Chesapeake Bay Bottom Survey data (Smith et al., 2001). **Table 13-4** illustrates the predominance of mud, sand, and natural oyster rubble within the resource review area. These substrates provide a soft bottom habitat supportive of diverse aquatic life, providing habitat for invertebrates as well as other species that rely on foraging and burrowing. Areas of natural oyster rubble can form from oysters settling and growing on hard surfaces, creating a more complex habitat. This can provide additional food and shelter for a variety of invertebrates, other shellfish, and fish species. The existing bridge structure itself also provides important habitat for fish and other biota, acting as a congregation area for fish and aquatic organisms seeking shelter and food. The Chesapeake Bay Bridge is a hotspot for recreational and commercial fishing activities.

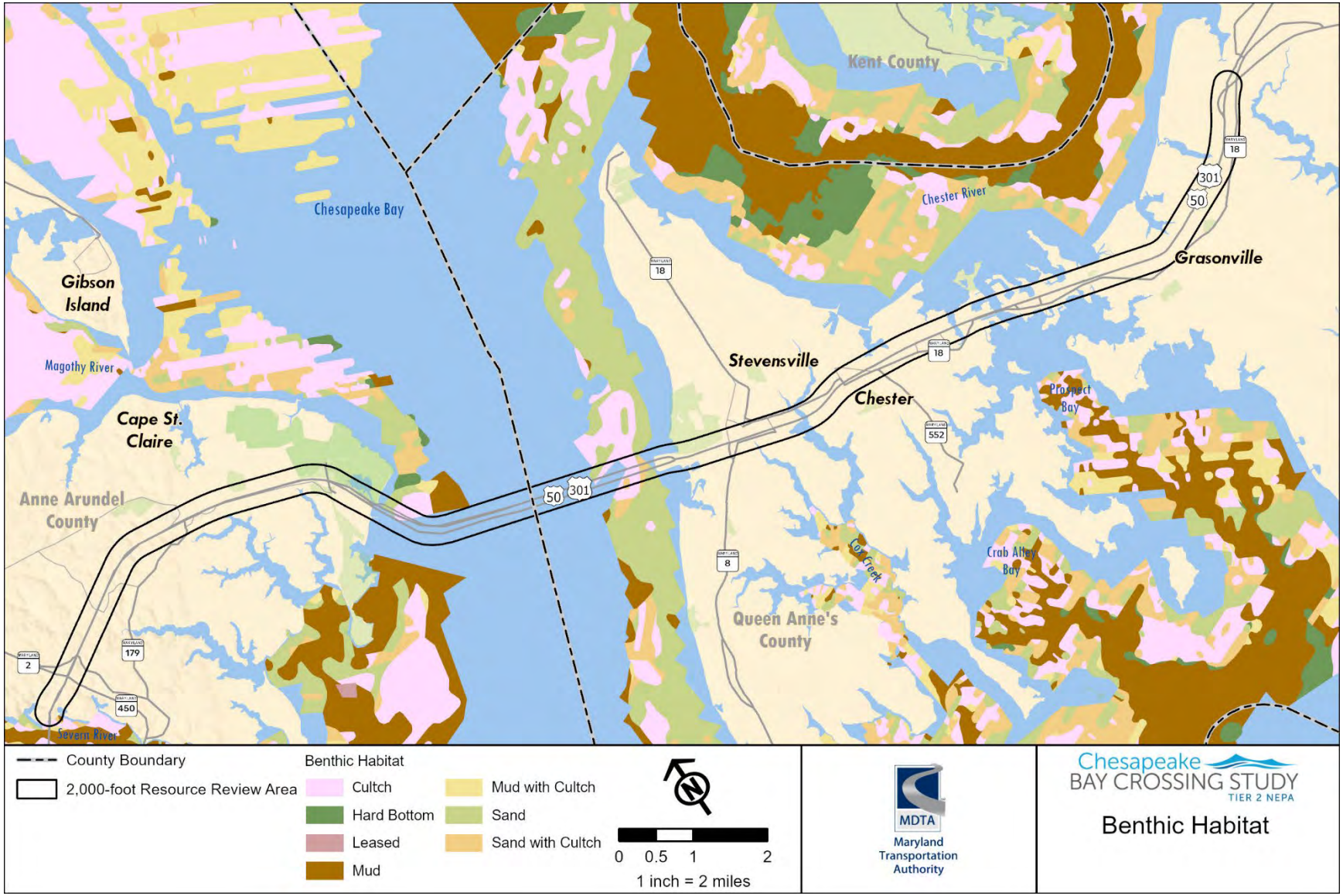
Table 13-4: Acreage of Bottom Substrate within the Resource Review Area[1] for MD 12-digit Watersheds

Habitat Type	Lower Severn River	Annapolis Shore	Northwest Lower Chesapeake Bay	Kent Island True Bay	Kent Island Shore	Grasonville South	Chester River South
Man-Made Oyster Reef	0.68	---	---	---	---	---	---
Man-Made Oyster Rubble	3.31	---	---	---	---	17.02	4.32
Mud	340.43	333.10	---	8.20	---	39.15	44.79
Natural Oyster Rubble	198.62	125.09	88.26	396.49	---	25.12	81.37
Sand	2.03	58.87	46.89	590.97	1.26	6.97	46.47
Sandy Mud	---	---	---	---	---	35.29	56.60
Unclassified	14.07	---	---	---	---	---	3.44
Unspecified Construction Reef	2.54	---	---	---	---	---	---

Habitat Type	Lower Severn River	Annapolis Shore	Northwest Lower Chesapeake Bay	Kent Island True Bay	Kent Island Shore	Grasonville South	Chester River South
Unspecified Rock Reef	10.66	---	---	---	---	---	---

[1] Note that the resource review area for this calculation extended 1-mile on either side of the roadway, as these resources are tidal and largely in the Chesapeake Bay.

Figure 13-1: Tidal Benthic Habitat Based on Chesapeake Bay Bottom Survey Data



13.1.3 Environmental Consequences

13.1.3.1 No-Build Alternative

The No-Build Alternative would have no impact to nontidal and tidal aquatic habitat.

13.1.3.2 Build Alternatives

The build alternatives would impact nontidal and tidal aquatic habitat and biota by removing or altering aquatic habitat during construction and/or degrade habitat and affect biota during operation of a build alternative. Impacts to aquatic habitat correlate to the number and size of bridge piers needed, pier placement, construction techniques, construction access and duration, and the success of implemented ESC and stormwater BMPs. **Table 13-5** provides a detailed summary of how aquatic habitats may be altered and the possible effects on biota. These changes and effects are described in later subsections as appropriate, per identified habitat and/or biota. Additionally, the existing Chesapeake Bay Bridge is an area of significant fishing activity, including recreational shore angling, boating, charter fishing, oystering, and crabbing. These activities may be temporarily disrupted during project construction/demolition of the build alternatives.

Table 13-5: Potential Impacts to Aquatic Habitat and Biota

Change to Aquatic Habitat	Effects on Aquatic Biota
Increased flow volumes	• Alterations in habitat complexity • Changes in availability of food organisms • Reduced prey diversity • Scour-related mortality • Accelerated streambank erosion and/or sedimentation • Increasing bed load movement decreases the permanence of benthic habitats
Decreased base flows	• Crowding and increased competition for foraging sites • Increased vulnerability to predation • Increased fine sediment deposition • More extreme water quality conditions (e.g., higher summer temperatures or contaminant concentrations)
Sedimentation or siltation	• Reduced survival of eggs and young, loss of spawning habitat due to deposition • Reduced macroinvertebrate reproduction from siltation of pools • Reduction in SAV bed area or density
Changes in substrate composition	• Reduced survival of eggs • Reduced aquatic insect production • Reduced species diversity and abundance
Increase in water temperature	• Changes in movement patterns • Increased metabolic activity, increased susceptibility to disease and parasites • Increased mortality of sensitive fish species
Water quality degradation	• Reduced survival of eggs and young • Acute and chronic toxicity to juveniles and adult fish • Loss of sensitive species, including localized extirpation • Increased physiological stress

Change to Aquatic Habitat	Effects on Aquatic Biota
Decreased base flows	• Crowding and increased competition for foraging sites • Increased vulnerability to predation • Increased fine sediment deposition • More extreme water quality conditions (e.g., higher summer temperatures or contaminant concentrations)
Increased underwater noise (pressure waves)	• Injury or direct mortality • Behavior modifications (e.g., avoidance and alteration of movement patterns, including spawning disruption)
Increased shading	• Behavior modifications for aquatic biota • Reduction in photic zone for SAV

The following sections identify the array of aquatic habitat types and biota living within these systems. These include benthic substrates and macroinvertebrates, SAV, oysters, Essential Fish Habitat (EFH), fish, blue crabs and horseshoe crabs, waterfowl staging and concentration areas, colonial waterbird nesting areas, and marine mammals. **Table 13-6** illustrates those aquatic habitats and biota for which quantitative impacts can be calculated or the locations in which those habitats and/or species may be found within the resource review area. **Table 13-7** illustrates the aquatic habitats and biota impacts associated with the SUP option for each build alternative.

Table 13-6: Aquatic Habitat Impacts

Habitat	No-Build	Build Alternative					
		B	C	D	E	F	G
Nontidal and Tidal Wetlands* (Acres)	0	6.0	5.6	11.5	11.1	12.0	11.5
Nontidal and Tidal Waterways* (Acres)	0	1.2	1.1	5.7	5.6	6.3	6.1
5-Year SAV 2019-2023 (Acres)	0	0.4	0	0.7	0.4	0.9	0.4
Past SAV 2000-2018 (Acres)		0.3	0	0.7	0.5	0.9	0.5
Natural Oyster Bar (NOB) (Acres)	0	9.4	10.2	12.6	13.3	13.8	14.6
Historic Oyster Bottom (Acres)	0	24.8	24.1	28.7	28.0	29.5	28.9
Oyster Plantings (Acres)	0	0	0	0	0	0	0
Oyster Sanctuaries (Acres)	0	0.6	0.6	1.1	1.1	1.6	1.6
Public Shellfisheries (Acres)	0	5.6	6.1	8.8	9.3	9.3	9.8
EFH** (Acres)	0	133.2	136.0	137.0	139.8	140.4	143.5
Horseshoe Crab Habitat (Linear Feet)	0	2,100	290	2,100	290	2,240	290
Waterfowl Staging and Concentration Areas (Acres)	0	7.1	2.5	7.1	2.5	7.1	2.5
Colonial Waterbird Nesting Areas (Location)	0	Mezick Pond, Bay Bridge Pier Islands					
Marine Mammals (Location)	0	Chesapeake Bay					

** Nontidal and Tidal wetland and waterway Impacts do not include habitat within the Chesapeake Bay. Chesapeake Bay impacts are discussed in **Section 9.2 Chesapeake Bay.***

*** Impacts within the Chesapeake Bay and other tidal waters reported in **Section 9** do not equal the EFH impact areas reported here, since the EFH impact estimate does not take into account engineering details such as pier/pier protection area.*

Table 13-7: SUP Aquatic Habitat Impacts

Habitat	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
Nontidal and Tidal Wetlands* (Acres)	0	0.7	0.7	0.7	0.7	0.8	0.7
Nontidal and Tidal Waterways* (Acres)	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
5-Year SAV 2019-2023 (Acres)	0	0.3	0	0.3	0	0.4	0
Past SAV 2000-2018 (Acres)		0.3	0	0.3	0	0.5	0

Habitat	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
Natural Oyster Bar (NOB) (Acres)	0	0.8	0.9	0.8	0.9	0.8	0.9
Historic Oyster Bottom (Acres)	0	1.0	1.0	1.0	1.0	1.0	1.1
Oyster Plantings (Acres)	0	0	0	0	0	0	0
Oyster Sanctuaries (Acres)	0	0	0	0	0	0	0
Public Shellfisheries (Acres)	0	0.5	0.6	0.5	0.6	0.5	0.6
EFH** (Acres)	0	4.0	4.0	4.0	4.0	4.2	4.3
Horseshoe Crab Habitat (Linear Feet)	0	430	0	430	0	300	0
Waterfowl Staging and Concentration Areas (Acres)	0	0.1	0	0.1	0	0.1	0
Colonial Waterbird Nesting Areas (Location)	0	Mezick Pond, Bay Bridge Pier Islands					
Marine Mammals (Location)	0	Chesapeake Bay					

** Nontidal and Tidal wetland and waterway Impacts do not include habitat within the Chesapeake Bay. Chesapeake Bay impacts are discussed in **Section 9.2 Chesapeake Bay.***

***Impacts within the Chesapeake Bay and other tidal waters reported in **Section 9** do not equal the EFH impact areas reported here, since the EFH impact estimate does not take into account engineering details such as pier/pier protection area.*

13.2 Benthic Macroinvertebrates

Benthic macroinvertebrates are the bottom dwelling animals and aquatic larval stages of insects. Benthic substrate is the material that forms the bottom of a body of water, like sand, mud, rock, or manufactured materials.

13.2.1 Regulatory Context and Methodology

As required by the CWA (Sections 305b and 303d), MDE uses biological monitoring data to determine impaired waterbodies within Maryland. According to MDE methodologies, Maryland watersheds are assessed using a multi-step process to categorize impaired waters for the Integrated Report (MDE/MDNR, 2014). A site is considered failing if the IBI scores do not meet the minimum allowable limit (MAL) of 2.5 for fish IBIs and 2.65 for benthic IBIs. Failing IBI scores are then compared to scores from reference watersheds and the watershed is categorized as impaired (Category 5) if the scores are significantly different.

For the purposes of this study, benthic macroinvertebrate data collected within the 10-year period from 2013-2023 were considered representative of existing conditions within the resource review area. Monitoring sites falling within or just outside of the resource review area were included to summarize existing conditions.

13.2.1.1 Nontidal

For nontidal streams, benthic macroinvertebrate data within the resource review area were available from AABWPR, which uses MBSS sampling methods and analyses for monitoring benthic macroinvertebrate communities (Stranko et al., 2019). MBSS has developed a benthic IBI that compares the macroinvertebrate community within a given stream to "reference" or ideal macroinvertebrate communities found in the least-impaired streams. For the Coastal Plain physiographic province, the MBSS benthic IBI is based on state-wide reference streams and uses seven community metrics found to characterize macroinvertebrate community health. **Table 13-8** summarizes how MBSS rates each benthic IBI score and how each of these scores and ratings relates to reference conditions.

Table 13-8: MBSS Benthic IBI Scores and Narrative Ratings

Benthic IBI Score	Narrative Rating	Characteristics
4.00 – 5.00	Good	Comparable to reference streams considered to be minimally impacted, biological metrics fall within the upper 50 percent of reference site conditions.
3.00 – 3.99	Fair	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of minimally impacted streams.
2.00 – 2.99	Poor	Significant deviation from reference conditions, indicating some degradation. On average, biological metrics fall below the 10th percentile of reference site values.
1.00 – 1.99	Very Poor	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, most or all metrics fall below the 10th percentile of reference site values.

For the purposes of this study, nontidal benthic macroinvertebrate data collected within the 10-year period from 2013-2023 were considered representative of existing conditions within the resource review area. AABWPR monitoring sites within the resource review area are shown in **Section 8.2, Water Quality** and **Figure 8-2**: Water Quality Monitoring Sites

13.2.1.2 Tidal

For tidal systems in the vicinity of the resource review area, benthic macroinvertebrate data was available from MDNR. MDNR conducts benthic macroinvertebrate monitoring throughout the Maryland portion of the Chesapeake Bay through its CBBMP. The program assesses water quality and benthic community condition throughout the Chesapeake Bay using standardized sampling and analysis methods (Versar, 2022). Benthic macroinvertebrate data is used to calculate the Chesapeake Bay IBI (Bay-IBI), which varies based on salinity regime and bottom substrate (Weisberg et al., 1997; Llansó and Dauer, 2002). The Bay-IBI is calculated by assigning each individual community metric a score based on its value. The combined scores of the metrics are then averaged to determine the overall Bay-IBI score and associated narrative rating for a site. **Table 13-9** summarizes how MDNR rates each Bay-IBI score.

Table 13-9: Chesapeake Bay-IBI Scores and Narrative Ratings

Bay-IBI Score	Narrative Rating
≥ 3.0	Meets Restoration Goals
2.7-2.9	Marginal

Bay-IBI Score	Narrative Rating
2.1-2.6	Degraded
≤ 2.0	Severely Degraded

13.2.2 Affected Environment

13.2.2.1 Nontidal

Within the resource review area, nontidal benthic macroinvertebrate data were available from AABWPR for the Lower Severn River and Magothy River South Shore MD 12-digit watersheds. In 2013, within the Lower Severn River, AABWPR assessed benthic macroinvertebrate communities at one site just upstream of U.S. 50/301 on Mill Creek (sites are illustrated in **Section 8.4, Water Quality**). Benthic macroinvertebrate community health for this site was rated as Poor based on the benthic IBI rating of 2.43. AABWPR assessed benthic macroinvertebrate communities at nine different sites within the Magothy River South Shore watershed, all located on Cat Branch to the north of U.S. 50/301. Benthic macroinvertebrate community health was generally degraded along Cat Branch, ranging from Very Poor to Fair based on benthic IBI ratings. As noted previously, no waterways within the Magothy River will be crossed and its tributaries do not drain toward the resource review area, therefore detailed data results for these locations are not included in the table below.

Recent nontidal benthic macroinvertebrate data was not available for the Queen Anne's County watersheds crossed by the resource review area, as these small, nontidal stream reaches have not been assessed in recent years by state or county nontidal monitoring programs. Nontidal stream health for the subwatersheds located on Kent Island is rated as "Poor" to "Fair" according to the Chessie BIBI (ICPRB, 2025). The stream health rating for these subwatersheds was determined from historic MBSS benthic macroinvertebrate data that was collected between 2000 and 2017 and the sites closest to the resource review area were assessed from 2002 to 2008. Subwatershed conditions and stream health may have changed since these assessments.

13.2.2.2 Tidal

Within the vicinity of the resource review area, MDNR CBBMP tidal benthic macroinvertebrate data was available for the Lower Severn River, Annapolis Shore, Grasonville South, and Chester River South MD 12-digit watersheds (**Table 13-10);** sites are illustrated in **Section 8.4, Water Quality**). Within the Lower Severn River, MDNR assessed benthic macroinvertebrate communities at two random sites and one fixed monitoring location, all located upriver of U.S. 50/301. Benthic macroinvertebrate community health varied from Severely Degraded to Meets Restoration Goals for these sites, based on benthic IBI scores. Benthic macroinvertebrate communities were assessed by MDNR at one random site from within each of the Annapolis Shore, Grasonville South, and Chester River South watersheds. These sites were located north of U.S. 50/301 for Chester River South and south of U.S. 50/301 for Annapolis Shore and Grasonville South. Benthic macroinvertebrate communities for all three watersheds fell in the Degraded range based on benthic IBI scores.

Table 13-10: Chesapeake Bay Benthic IBI Scores in the Vicinity of the Resource Review Area

Watershed (MD 12-digit)	Site	Site Type	Year	Benthic IBI Range	Narrative Score Range
Lower Severn River (021310020997)	204	Fixed	2013 - 2022	1.78 - 4.00	Severely Degraded - Meets Restoration Goals
	26304	Random	2019	3.00	Meets Restoration Goals
	29308	Random	2022	2.00	Severely Degraded
Annapolis Shore (021399981093)	25525	Random	2018	2.60	Degraded
Grasonville South (021305040431)	26525	Random	2019	2.20	Degraded
Chester River South (021305050390)	26413	Random	2019	2.20	Degraded

13.2.3 Environmental Consequences

13.2.3.1 No-Build Alternative

The No-Build Alternative would have no impact to benthic substrate and macroinvertebrates.

13.2.3.2 Build Alternatives

All build alternatives would primarily impact tidal benthic macroinvertebrate communities through dredging, which would result in direct mortality and alter aquatic habitat, as detailed in **Table 13-5**. Benthic habitat would also be lost through increasing impervious land cover, and habitat loss and direct mortality would occur through the placement of fill/structure for piers, pier protection systems, and pier islands. **Table 9-15** illustrates the overall circumference of new structure/fill proposed within the Chesapeake Bay substrate associated with the build alternatives and **Table 9-17** identifies the amount of dredging anticipated per build alternative. Relative impacts to bottom substrate would be similar across the build alternatives, with Alternatives C, E, and G resulting in slightly less dredging impacts than Alternatives B, D, and F. The addition of the SUP option would require slightly larger piers, resulting in 1.9 acres of additional pier footprint on the Bay substrate for all build alternatives except for the Alternative G SUP option which would have 2.0 acres of additional impact. Dredging may also be required within Kent Narrows, which would increase the potential impacts from Alternatives D, E, F, and G. Additionally, temporary and localized increases in turbidity from dredging operations associated with all build alternatives could cause deposition of silt over benthic organisms and destroy benthic food sources. Increased turbidity can also reduce survival of eggs and place physiological stress on aquatic organisms.

All build alternatives would also impact nontidal benthic macroinvertebrate communities by widening the roadway and impacting non-tidal streams. Impacts could range from mortality of benthic macroinvertebrates during construction of culvert extensions and loss of natural habitat from the placement of culvert pipes and other in-stream structures, to more gradual changes in stream conditions. Alternatives D, E, F, and G would have approximately five times more impact to nontidal waterway than Alternatives B and C (**Table 9-9**).

13.3 Submerged Aquatic Vegetation

SAV consists of vascular plants that live submerged in many of Maryland's tidal and nontidal waters. The Chesapeake Bay is home to 26 different species of SAV, including freshwater plants like wild celery, estuarine plants like sago pondweed and redhead grass, and marine species like eelgrass and widgeon grass. The specific habitat needs differ among plant species, with the most important factor being salinity. SAV is an important and sensitive resource within the Chesapeake Bay ecosystem, providing critical food and habitat for aquatic biota. In addition, SAV improves water quality by releasing oxygen into the water column through photosynthesis, reducing wave action and erosional forces near shorelines, capturing and anchoring suspended sediment, and absorbing excess nutrients like phosphorus and nitrogen from the water column (MDNR, 2023b).

13.3.1 Regulatory Context and Methodology

SAV is protected under several federal and state regulations. SAV is regulated federally under Section 404 of the CWA (33 USC 1344) and Section 10 of the Rivers and Harbors Act (33 USC 403). In the Section 404(b)(1) Guidelines, SAV is referred to as vegetated shallows, which are defined under 40 CFR 230.43(a) as "permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation." The definition also includes vegetated shallows that may occur in marine and estuarine systems as well as in freshwater lakes and rivers. SAV is regulated under the vegetated shallows definition as one of several categories of "Special Aquatic Sites", each of which is a subset of WOTUS. SAV is also directly protected under the CZMA (15 CFR 930.11) as a "resource." SAV has been designated as a Habitat Area of Particular Concern (HAPC) for summer flounder by the Mid-Atlantic Fishery Management Council and is a priority habitat for NOAA Fisheries as essential fish habitat under the Magnusson-Stevens Fishery Conservation and Management Act.

The Maryland Tidal Wetlands Act and related COMAR 26.24, protect SAV as a tidal wetland resource regulated by MDE. Impacts to tidal wetlands, including SAV, require a Maryland Tidal Wetlands License. Tidal wetlands are discussed in **Section 9, Waters of the U.S., Including Wetlands**. SAV is also protected under *Natural Resources Article 4 Section 4-213 – Submerged Aquatic Vegetation – Removal or Eradication (§ 4-213)*, which defines SAV as "a vascular or nonvascular hydrophyte, which is rooted or unrooted, that lies entirely beneath the surface of the water, except for flowering parts in some species." Harvesting, cutting, removal, or eradication of SAV in Maryland tidal waters below mean high tide requires approval by MDNR.

Information regarding SAV within the resource review area was obtained from the Virginia Institute of Marine Science (VIMS) SAV monitoring program, which uses multispectral aerial imagery to annually assess the distribution and abundance of SAV in areas including the Chesapeake Bay. Ground surveys are conducted to provide supplementary information, including species data, though not all areas are ground surveyed. This data is then used to develop trends, identify areas of decline and abundance, and to implement strategies of preservation.

The extent of SAV present in the resource review area was determined through an analysis of the existing and historical SAV beds documented by VIMS. The 5-year average extents of SAV were determined using a GIS overlay of the resource review area with the VIMS data from 2019 through 2023. The MDTA analyzed SAV density from year to year, utilizing the annual datasets from VIMS from 2000 to 2022. MDNR considers any area mapped in those 5 years to be habitat that supports SAV, even if SAV is not found there on a given date during the growing season. This analysis revealed historic patterns and trends that enhanced understanding of SAV in the

resource review area. Historical data from 2000 to 2018 were also reviewed to identify areas that could potentially support SAV again in the future, given the right conditions.

13.3.2 Affected Environment

SAV habitat exists north of the eastern terminus for the Bay Bridge, to approximately 1,200 feet north, along the Queen Anne's County shoreline. Records show that SAV has been present in this area in 4 of the last 5 years (2023, 2022, 2021, and 2019) of available data. There are no SAV records south of the eastern terminus of the bridge in Queen Anne's County or for either side of the western terminus of the bridge in Anne Arundel County.

As shown in **Figure 13-2**, SAV has been documented in various portions of the resource review area. The largest concentrations of SAV in the resource review area are in the tidal creeks of Queen Anne's County surrounding Kent Narrows and to the east, such as Winchester Creek, Muddy Creek, and Marshy Creek. These locations are generally in shallow, gentle-current water bodies with silt and sandy bottoms. SAV is also found on the eastern shoreline of the Chesapeake Bay mainstem along Terrapin Park, north of the existing Bay Bridge. Most of the SAV beds within the resource review area in 2023 were identified as dense SAV beds (>70 percent cover). Although some localized variation was observed, SAV bed size in Kent Narrows and to the east increased slightly from 2022 to 2023.

Review of historical mapping revealed that SAV beds were much more abundant from 1971 through the early 2000s than they are currently. SAV beds extended into many calm shallows throughout the resource review area during those years, which suggests that presence and abundance of SAV beds is highly variable from year-to-year with an overall decline over the years. The Chesapeake Bay, like many other temperate estuaries, has exhibited dramatic declines in the abundance of SAV during the last half of the 20th century. Numerous studies suggest that increases in nutrient loading are the primary cause of these declines. In general, SAV populations across the entire Chesapeake Bay have begun rebounding in the last 20 years, following widespread, chronic declines in the late 1960s and 1970s and acute loss in many areas due to Hurricane Agnes in 1972 (Orth, et al., 2017; Naylor, n.d.).

SAV beds have fluctuated in size and density within the vicinity of the resource review area since 2000. During the 2000 SAV survey, no SAV was documented within the resource review area. From the early 2000s through 2018, bed locations and density increased, with the largest concentrations of SAV occurring in the tidal creeks of Queen Anne's County surrounding Kent Narrows and to the east (e.g., Winchester Creek, Muddy Creek, and Marshy Creek), consistent with recent trends. In the early 2000s, extensive SAV beds also occurred in Macum Creek, to the west of Kent Narrows. The extent and density of SAV beds in Macum Creek has fluctuated from 2019 to 2023, with no SAV beds present in 2023. There has been SAV bed presence in the Severn River since the early 2000s, with the highest density of SAV beds generally occurring upriver of the resource review area.

Based on VIMS data from 2019 through 2023, at least 14 species of SAV have been documented in VIMS survey segments (i.e., Chesapeake Bay Program segments) crossed by the resource review area. Species likely to inhabit the resource review area range from freshwater to mesohaline species that can tolerate moderate salinity levels. These species are typically found in the middle and upper reaches of the Chesapeake Bay (see **Table 13-11**). It should be noted that surveys conducted by VIMS occur later in the growing season; therefore, the presence and

density of horned pondweed (*Zannichellia palustris*) beds is often underrepresented as the species senesces during warmer months.

Table 13-11: SAV Species Documented within the Resource Review Area from 2019-2023

Common Name	Scientific Name	Common Name	Scientific Name
Eurasian watermilfoil	*Myriophyllum spicatum*	Common elodea	*Elodea canadensis*
Sago pondweed	*Stuckenia pectinata*	Coontail	*Ceratophyllum demersum*
Redhead grass	*Potamogeton perfoliatus*	Hydrilla	*Hydrilla verticillata*
Curly pondweed	*Potamogeton crispus*	Water stargrass	*Heteranthera dubia*
Slender pondweed	*Potamogeton pusillus*	Southern naiad	*Najas guadalupensis*
Horned pondweed	*Zannichellia palustris*	Naiads	*Najas spp.*
Wild celery	*Vallisneria americana*	Widgeon grass	*Ruppia maritima*
Eelgrass	*Zostera marina*	---	---

Figure 13-2: Submerged Aquatic Vegetation



13.3.3 Environmental Consequences

13.3.3.1 No-Build Alternative

The No-Build Alternative would have no impact on SAV.

13.3.3.2 Build Alternatives

As shown in **Table 13-6,**Table 13-6: Aquatic Habitat Impacts Build Alternative C is the only alternative that is anticipated to avoid impacts to SAV, including SAV beds recorded in the last 5-years (2019-2023) and historic (2000-2018) SAV beds. Based on 5-year data, Alternatives B, E, and G would impact 0.4 acres of impacts and Alternatives D, and F would impact 0.7 acres and 0.9 acres of SAV, respectively. Impacts to historical SAV beds (2000-2018) would be similar to SAV beds mapped in the last 5-years, with impacts ranging from 0.3 acres to 0.9 acres. Alternative F would have the greatest impact to SAV. SAV beds located closest to U.S. 50/301 are found in Piney Creek and Winchester Creek, as well as the eastern shoreline of Queen Anne's County, north of the Bay Bridge. Displacement or water quality impacts may occur to SAV in the headwaters of creeks on the Eastern Shore when these areas are near or adjacent to U.S. 50/301. Bridges associated with build alternatives could also create shading impacts on SAV from the bridge deck, depending on the height of the bridge and the angle and duration of sun exposure. Shading could impact existing SAV beds and limit the establishment of new beds in the future. As the widest alternatives, Alternatives F and G would have the largest shading impacts, reducing the amount of light reaching the photic zone and affecting plants' ability to photosynthesize. Specific shading impacts will be determined in final design. The addition of a SUP option with the southern alternatives, Alternatives C, E, and G would not result in any impacts to SAV. The addition of a SUP option with northern alternatives, B, D, and F would result in between 0.3 acres and 0.4 acres of additional impacts to SAV, including SAV beds recorded in the last 5 years (2019-2023) and historic (2000-2018) SAV beds.

The build alternatives would impact SAV by direct removal during dredging operations. In addition, increased turbidity can lead to indirect losses of SAV through deposition of silt that would bury or impede the growth of SAV by reducing photosynthesis. Additional impacts to SAV through modification of aquatic habitat are detailed in **Table 13-5.** The locations of SAV and their relation to the build alternatives are shown on the natural resource map sets for the northern alignments (**Appendix B**) and southern alignments (**Appendix C**).

13.4 Oyster Beds

The eastern oyster (*Crassostrea virginica*) has represented an important commercial fishery in the Chesapeake Bay and its tributaries since colonial times; however, populations are currently estimated to be at a historically low abundance due to overharvesting, disease, habitat loss, and pollution. Oysters, as filter feeders, have ecological value both related to water quality and as an important habitat and food source for other marine organisms. Eastern oysters, a keystone species, are a critical component of the Chesapeake Bay ecosystem. Oyster habitat is typically brackish or salt water from 8 to 35 feet deep, though shallower habitat can occur, especially in areas of higher salinity (CBP, 2023).

13.4.1 Regulatory Context and Methodology

Due to the historically low oyster population in the Chesapeake Bay, many laws and regulations exist to protect and enhance oyster populations and habitats. Maryland's oyster laws encompass seasonal restrictions to protect key periods of oyster growth and reproduction. These regulations include size limits to ensure the maturity of harvested oysters, and they dictate acceptable harvesting methods like hand-tonging or dredging. Oyster sanctuaries, designated non-harvest zones, aim to foster oyster growth and reproduction without disruption (COMAR 08.02.04.15). Recreational harvesters do not need a license; however, regulations specify the quantity of oysters that can be harvested. Environmental considerations, such as water quality, are integral to these laws to safeguard the overall health of both the oyster population and the ecosystem. These laws and regulations vary year-to-year based on the status of the oyster community and their ecosystem. The MDNR issues a public notice yearly, no later than July 1, which establishes the yearly parameters for Maryland's recreational and commercial oyster fishery (COMAR 08.02.04.02).

Information on the locations and characteristics of oyster beds within the resource review area was obtained from MDNR's iMap GIS layers, which provide locations of significant oyster features, including legally described Natural Oyster Bars (NOBs), designated Oyster Sanctuaries and oyster seeding areas, Public Shellfish Fishery Areas, and historic oyster bars, sites where watermen have engaged in oyster harvesting for centuries (MD iMap, 2023).

13.4.2 Affected Environment

Oyster beds are located throughout the Chesapeake Bay and are shown in **Figure 13-3**. NOBs exist in the shallow areas of the Severn River and from approximately 1,500 feet to 4,500 feet off the Anne Arundel County shoreline towards the main channel, extending north and south of the Chesapeake Bay Bridge. NOBs exist from approximately 4,100 feet to 6,200 feet off the Queen Anne's County shoreline towards the main channel and also extend north and south of the Chesapeake Bay Bridge. Most tidal crossings along Kent Island cross NOBs, including Thompson Creek, Cox Creek, Kent Island Narrows, and Marshy Creek. Historic oyster bottom habitat generally falls in the same areas as NOBs, with differences in specific boundaries. Cultch areas are found in concentrated areas along both the Anne Arundel and Queen Anne's County shorelines. One oyster planting area, Sandy Point South, is located at the edge of the resource review area, south of the Chesapeake Bay Bridge and approximately 3,500 feet from the Anne Arundel County shoreline towards the main channel. Oyster sanctuaries are present where the review area crosses the Severn River, Thompson Creek, Cox Creek, Macum Creek, and Piney Creek. Public Shellfish Fishery Areas overlap NOBs off the Anne Arundel County shoreline towards the main channel and within Kent Island Narrows and adjacent tidal connections.

13.4.3 Environmental Consequences

13.4.3.1 No-Build Alternative

The No-Build Alternative would have no impact to oyster beds, plantings, NOBs, or sanctuaries.

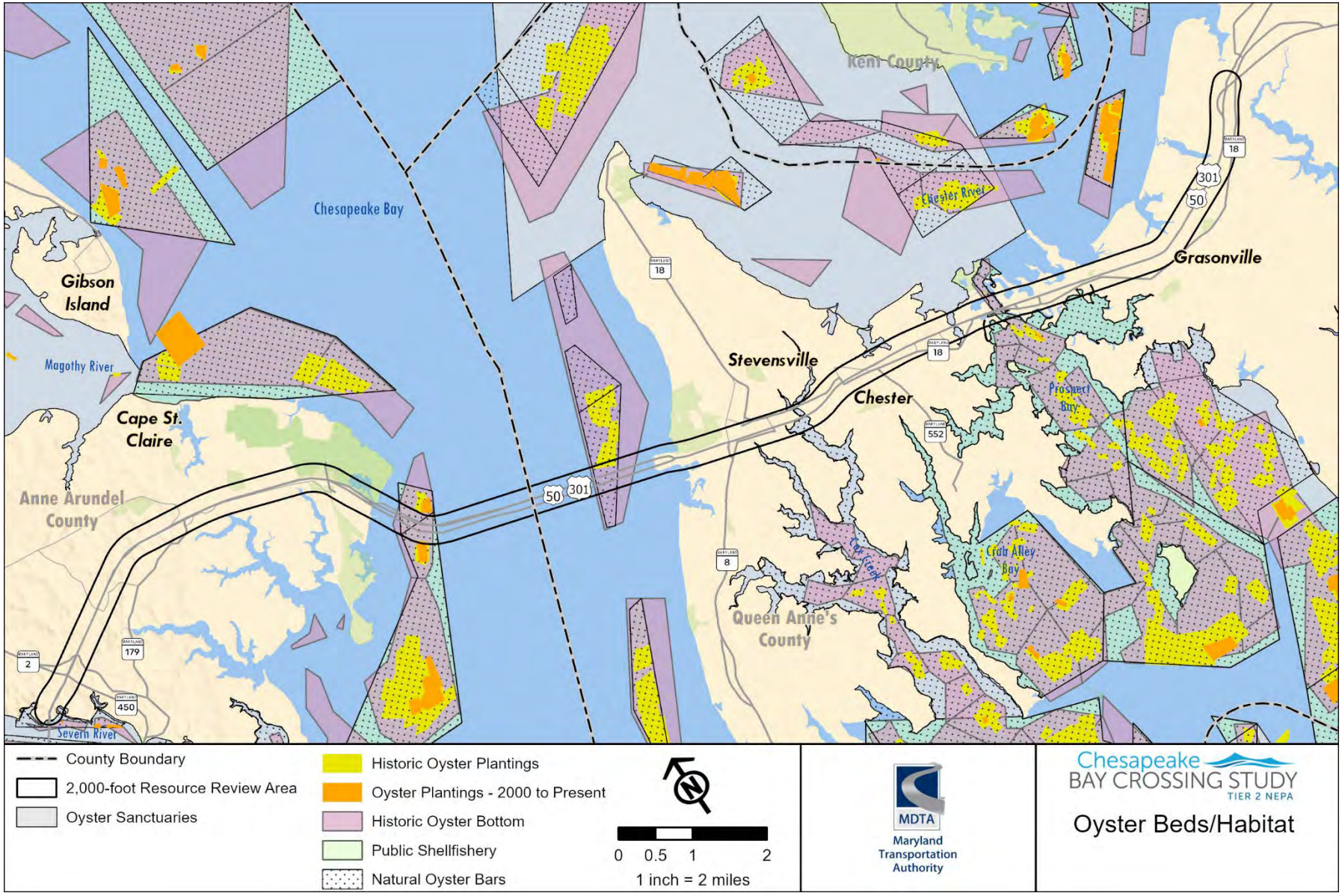
13.4.3.2 Build Alternatives

All build alternatives would have potential impact to NOBs, ranging from 9.4 acres for Build Alternative B to 14.6 acres for Build Alternative G. Greater impacts for Alternatives F and G are directly associated with the wider bridge spans and limits of work within the Chesapeake Bay, and potential impacts within the Kent Narrows. All build alternatives would also impact oyster sanctuaries. These impacts are the least with Alternatives B and C (0.6 acres) and incrementally increase with Alternatives D and E (1.1 acres) and Alternatives F and G (1.6 acres) and are directly associated with Cox Creek. Although none of the build alternatives directly overlap oyster planting areas, both current and historic oyster plantings at Sandy Point South and Broad Creek may be affected as they fall within 500 yards of all build alternatives and associated potential bottom disturbing activities. Historic oyster plantings at Well Cove fall within 500 yards of Alternatives D, E, F, and G, and may also be affected by similar bottom disturbing activities. Public Shellfish Fishery Area (PSFA) impacts range from 5.6 acres with Alternative B to 9.8 acres with Alternative G. The almost doubled impact between these build alternatives is due to the wider 10-lane Bay Bridge with Alternative G, and the PSFA located along the slight bend in the bridge alignment. Alternatives D, E, F, and G would also result in greater impacts because the alternatives extend over the Kent Narrows. Potential oyster impacts would result from the dredging and pile driving construction operations, and the permanent placement of piers and pier protection in the Bay bottom. Additional impacts to oysters through modification of aquatic habitat are detailed in **Table 13-5.**

The addition of a SUP option with any of the build alternatives would result in additional impacts to NOBs, with 0.9 acres of additional impacts from the southern alternatives, Alternatives C, E, and G, and 0.8 acres of additional impacts from the northern alternatives. The addition of a SUP option would also impact PSFAs, with an additional 0.6 acres of impacts from Alternatives C, E, and G, and an additional 0.5 acres of impacts from Alternatives B, D, and F. No additional impacts to oyster sanctuaries would result from the addition of a SUP option with any of the build alternatives.

Despite BMPs and dredging techniques, turbidity resulting from pier placement, dredging, and pile driving operations and associated fills could lead to deposition of silt on oyster beds, destroying or displacing food sources. As filter feeders, oysters are especially affected as they may be unable to feed in silt-laden waters. Dredging operations can directly affect oyster bars by destroying eggs and starving larvae that ingest the sediment.

Figure 13-3: Oyster Beds/Habitat



13.5 Essential Fish Habitat

EFH includes "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH occurs throughout the Chesapeake Bay, and within the resource review area, and includes soft bottom to structured habitats (e.g., oyster reefs), as well as SAV and shellfish beds.

13.5.1 Regulatory Context and Methodology

The 1996 amendments to the MSA strengthened the ability of NOAA Fisheries and the regional Fishery Management Councils to protect and conserve EFH for marine, estuarine, and anadromous finfish, mollusks, and crustaceans. The MSA requires the Councils to describe and identify EFH for managed species, minimize adverse effects to EFH caused by fishing, and identify other actions to encourage the conservation and enhancement of EFH. This includes the identification of HAPCs, which are discrete subsets of EFH that provide extremely important ecological functions or are especially vulnerable to degradation (NOAA Fisheries, 2020). In addition, the MSA provides for the identification and protection of EFH.

Pursuant to Section 305 (b)(2) of the MSA, the FHWA and the MDTA, acting as a non-federal sponsor, have prepared an EFH Assessment (**Appendix P**). FHWA submitted the EFH Assessment and a letter requesting initiation of consultation for EFH to NOAA Fisheries on November 28, 2025. Coordination with NOAA Fisheries for EFH will be ongoing throughout the planning and design process. To evaluate the presence of EFH and HAPC within the resource review area, the NOAA Fisheries online EFH Mapper (NOAA Fisheries, 2021) was used to identify potential federally-managed fish species, their designated EFH, and HAPCs and this list was refined based on species habitat parameters outlined in the fishery management plans (FMP) prepared by the Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission (ASMFC) in coordination with NOAA Fisheries.

13.5.2 Affected Environment

The January 14, 2025 results from the EFH Mapper refined with EFH text descriptions and FMP habitat parameters indicate the presence of EFH for species in **Table 13-12**. The HAPC identified within the resource review area is for summer flounder and applies to SAV habitat and includes “all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH; in locations where native species have been eliminated from an area, then exotic species are included” (MAFMC, 1998) FMP habitat parameters and EFH text description refinement eliminated EFH for red hake and Atlantic herring, since these species and life stages are not likely to occur within the resource review area due to their salinity tolerances. According to the EFH text descriptions (NEFMC, 2017), Atlantic herring and red hake occur in high salinity zones of greater than 25 parts per thousand (ppt) in the Chesapeake Bay, whereas the middle Chesapeake Bay, where the study area is, is considered a mixing zone, with salinities between 0.5 and 25 ppt. **Appendix K** includes the official EFH Mapper results for the resource review area. **Table 13-12** summarizes the EFH designations within the resource review area. See the EFH Assessment (**Appendix P**) for more information regarding federally-managed fish species, EFH, and HAPC.

Table 13-12: EFH Designations Within the Resource Review Area

Species Present	Life Stage(s)	Habitat/Notes
Atlantic butterfish *Peprilus triacanthus*	Eggs, larvae, juvenile, adults	Pelagic estuaries including the Chesapeake Bay, bottom depths between 10-350 meters, upper 200 meters of water column, water temps 40-81.5 °F, salinity above 5ppt.
Black sea bass *Centropristis striata*	Juvenile, adults	Inshore estuaries, water temps >43 °F, structured habitats (natural and man-made), "mixing" salinity zone.
Bluefish *Pomatomus saltatrix*	Juvenile, adults	Major estuaries, "mixing" salinity zone.
Clearnose skate *Raja eglanteria*	Juvenile	High and mixed salinity zones in Chesapeake Bay, shoreline to 40 meters, mud, sand, gravelly/rocky bottom substrate
Scup *Stenotomus chrysops*	Juvenile, adults	Estuaries, "mixing" salinity zone, water temps >45 °F, salinity above 5ppt.
Summer flounder *Paralichthys dentatus*	Larvae, juvenile, adults	Pelagic estuaries, "mixing" salinity zone, nearshore, water temps >37 °F, depths between 30-230 ft.
Windowpane flounder *Scophthalmus aquosus*	Juvenile, adults	Estuaries, sandy substrate, "mixing" salinity zone, maximum depth of 60 meters.

13.5.3 Environmental Consequences

13.5.3.1 No-Build Alternative

The No-Build Alternative would have no impact to EFH.

13.5.3.2 Build Alternatives

All build alternatives would affect EFH within the Chesapeake Bay, as the entire Chesapeake Bay and waterways within the alternatives are considered EFH. All the build alternatives would have similar types of impact to EFH as a result of permanent impacts from the placement of piers on the Chesapeake Bay bottom, and temporary impacts related to construction activities, including pier removal. Shock waves produced by pile-driving for construction and subaqueous demolition via blasting of some of the existing bridge elements are likely to have the largest negative consequences for fish species and their associated habitat. The primary difference between build alternatives is the magnitude of those impacts.

Alternatives B and C include the Bay Crossing and widening of an existing bridge over Cox Creek and would result in 133.2 and 136.0 acres of impact to EFH, respectively. Alternatives D, E, F, and G include the same crossings as Alternatives B and C, but also include crossings over Piney Creek and Kent Narrows, resulting in greater impacts to EFH (approximately 136.8 to 143.4 acres). New construction over waters as opposed to only adjacent to waterways, can increase risk for materials debris, accidental spills directly within the waterway, and/or alter hydrology due to equipment or materials, even if only temporarily. Alternatives D, E, F, and G, therefore, would have a greater potential to impact EFH. Direct impacts to EFH include increased turbidity, stirring up sediment within the water column, which can in turn deplete DO; permanent fills and associated irretrievable loss of EFH; and habitat conversion (e.g., soft bottom habitat to riprap). It should be noted that the current analysis was conducted using NOAA Fisheries EFH Mapper GIS layers refined with habitat parameters reported for each federally-managed fish species in the FMPs, which represent conservative areas where EFH may occur depending on specific requirements for federally-managed fish species and life stages.

The addition of an SUP option with the build alternatives would result in 3.9 to 4.3 additional acres of EFH impact.

Although the exact timing of dredging is unknown, an estimated two thirds of the total dredging will take place in the first and second years of construction to accommodate the eastbound bridge and will be in place for the duration of construction and demolition, which is estimated to take at least 15 years. The remaining one third of dredging will take place at the start of construction of the westbound bridge and is estimated to be in place for 8 years. Mechanical dredging methods will be used. See **Table 9-17** for estimated dredge impacts by alternative and **Section 9.2** for further discussion of dredging.

Dredging for the eastbound bridge is estimated to take up to 14 days to complete and dredging for the westbound bridge is estimated to take up to 7 days to complete. During these approximately 21 days of active dredging in the shallow areas of the Chesapeake Bay, increases in sedimentation and turbidity will likely impact fish behavior and biology throughout the resource review area, as fish avoid shallow waters and respond to increased turbidity. Due to the duration of the placement of dredge material, any pre-existing habitat within the proposed dredging footprint would be considered permanently lost. Within the dredged area, benthic contours would be restored and benthic habitat would begin to re-establish after the construction period. Potential impacts of dredging that would affect all life stages of federally-managed fish species within the resource review area are included in **Section 9.2.3.2**.

The build alternatives will result in adverse effects to summer flounder HAPC (SAV). SAV impacts by alternative are included in **Section 13.3.3.2**.

Impacts to federally-managed fish species from pile driving and blasting are included in **Section 13.6.3**. See the EFH Assessment (**Appendix P**) for more details regarding potential impacts to federally-managed fish species, their designated EFH, and HAPC.

13.6 Fish

13.6.1 Regulatory Context and Methodology

The MSA and the Fish and Wildlife Conservation Act are the primary federal law that governs fisheries resources and management in the United States. The MSA promotes long-term biological and economic sustainability of marine fisheries through preventing overfishing; rebuilding overfished stocks; increasing long-term economic and social benefits; ensuring a safe and sustainable supply of seafood; and protecting habitat that fish need to spawn, breed, feed, and grow to maturity (16 USC §§ 1801).

NOAA Fisheries and MDNR both regulate fish species within the resource review area. As discussed in **Section 15, Rare, Threatened, and Endangered Species**, the MDTA requested information from the MDNR Environmental Review Program (ERP) and MDNR Wildlife and Heritage Service (WHS) regarding the presence of sensitive species and other natural resources within the resource review area. MDNR ERP provided feedback in a response dated January 23, 2024 (**Appendix L**) that included a list of fish species likely to occur within the waterbodies crossed by the preliminary 2-mile-wide study corridor identified in the BCST2 Tier 1 Study, which includes the resource review area. Most of the species noted by MDNR were also documented in the data obtained from AABWPR and other data sources on tidal fisheries. However, some additional species were also noted in the MDNR ERP letter, and it is likely that these additional species were documented outside of physical and temporal boundaries used to collect existing data on aquatic biota for this document. These additional species are noted in the discussions below, and the full lists provided by MDNR are included in their letter in **Appendix L**.

13.6.1.1 Nontidal

For nontidal streams, fish community data was available from AABWPR, which used MBSS methods to conduct fish assessments. MBSS has developed a fish IBI that compares the fish community within a given stream to reference fish communities in the least-impaired streams. This fish IBI is based on the principles of evaluating a community using a suite of comparative metrics. The MBSS fish IBI is calculated by assigning a score to each metric result based on a comparison to the distribution of values at a reference site. All the metric scores are averaged and assigned a total score and narrative rating. For the Coastal Plain physiographic province, the MBSS fish IBI is based on state-wide reference streams and uses six community metrics found to characterize fish community health in Maryland's streams (Stranko et al., 2007; Roth et al., 2000; Southerland et al., 2005).

Table 13-13 summarizes how MBSS rates each fish IBI score and how these scores and narrative ratings relate to reference conditions. For the purposes of this study, nontidal fish data collected within the 10-year period from 2013-2023 were considered representative of existing conditions within the resource review area.

Table 13-13: MBSS Fish IBI Scores and Narrative Ratings

Benthic IBI Score	Narrative Rating	Characteristics
4.00 – 5.00	Good	Comparable to reference streams considered to be minimally impacted, biological metrics fall within the upper 50 percent of reference site conditions.
3.00 – 3.99	Fair	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of minimally impacted streams.
2.00 – 2.99	Poor	Significant deviation from reference conditions, indicating some degradation. On average, biological metrics fall below the 10th percentile of reference site values.
1.00 – 1.99	Very Poor	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, most or all metrics fall below the 10th percentile of reference site values.

13.6.1.2 Tidal

Information on tidal fish communities within the vicinity of the resource review area was compiled from the VIMS Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) online database (VIMS, n.d.). The ChesMMAP survey is used to describe fish assemblages in the Chesapeake Bay. ChesMMAP conducts surveys in four regions within the Chesapeake Bay, with Region A, the northernmost region, covering Maryland's Upper Bay, including the resource review area. The survey uses a bottom trawl and samples late juvenile and adult fishes (Bonzek et al., 2022). A data request was submitted through the VIMS website on January 9, 2024. Data requested included latitude/longitude of stations, total catch numbers, total catch biomass, and individual sex/maturity for all species in Region A from 2013 through 2023. The data was received on January 18, 2024. Data from stations within 5 miles of the Bay Bridge is included in this report. In addition, the NOAA Fisheries Chesapeake Bay Office and partners operate several acoustic telemetry receivers in the Chesapeake Bay, including one just south of the Bay Bridge. Telemetry data on tagged fish movements in the vicinity of the resource review area was obtained from NOAA Fisheries and partners through the Mid-Atlantic Acoustic Telemetry Observation System. NOAA Fisheries provided a summary of telemetry

data in the vicinity of the Chesapeake Bay Bridge and associated figures on October 1, 2025 (**Appendix K**).

Diadromous fish are those that spend part of their lives in freshwater and part in saltwater. Two categories of diadromous fish exist, anadromous and catadromous. Anadromous fish are those that begin their lives in freshwater, migrate to the ocean to mature to adults, and then return to freshwater to reproduce. Catadromous fish are those that begin their lives in saltwater, migrate to freshwater to mature to adults, and then return to saltwater to reproduce. Publicly available data sets were used to characterize diadromous fish presence and movement in the vicinity of the resource review area.

The Chesapeake Fish Passage Prioritization (CFPP) database was reviewed for all watersheds crossed by the resource review area. The CFPP project is a collaboration led by The Nature Conservancy and is comprised of fish blockage data for the greater Chesapeake Bay watershed (Martin, 2019). This database includes historic blockages that have not been recently confirmed, as well as partial blockages and blockages with facilities that allow aquatic life passage. Despite these limitations, the database provides context for the status of fish movement and blockages within each watershed, as well as current and historical presence of anadromous fish species.

In addition to the CFPP database, MDNR's Fish Blockage Locations shapefile (MD iMap, 2017) and the North Atlantic Aquatic Connectivity (NAACC) database were used to supplement fish blockage information in the CFPP database. The NAACC is a network of individuals from academia, conservation organizations, state agencies, and federal agencies focused on improving aquatic organism passage and aquatic connectivity across 13 states, including Maryland. The NAACC houses an online database where road-stream crossing assessment data is stored for crossings that have been assessed by the group. MDNR's anadromous fish layer was also referenced to supplement information from the CFPP project tool. This layer includes information on the presence of yellow perch (*Perca flavescens*), white perch (*Morone americana*), and Clupeidae (MD iMap, 2023).

13.6.2 Affected Environment

13.6.2.1 Nontidal

Within the resource review area, nontidal fish data was available from AABWPR for the Magothy River South Shore MD 12-digit watershed (**Table 13-14**). AABWPR assessed fish communities at four different sites within the Magothy River South Shore watershed, all located on Cat Branch to the north of U.S. 50/301. Fish community health was moderately degraded along Cat Branch, ranging from Poor to Fair based on fish IBI ratings. Across these four sites, 11 fish species were observed, all of which are considered tolerant of degraded conditions or have no tolerance designation (**Table 13-15**).

Detailed information on the Magothy River has not been included within previous sections (such as water quality or aquatic habitat), because the build alternatives do not cross waters of the Magothy River and these tributaries do not drain areas with the alternatives; however, detailed data for fish has been included because fish can migrate to the larger waters of the Magothy and enter the Chesapeake Bay north of the alignments.

Table 13-14: AABWPR Fish IBI Scores within Resource Review Area

Watershed (MD 12-digit)	Site	Year[1]	Fish IBI Range	Narrative Score Range
	08-R3M-03-18	2018	3.00	Fair
	08-R3M-02-18	2018	2.67	Poor

Watershed (MD 12-digit)	Site	Year[1]	Fish IBI Range	Narrative Score Range
Magothy River South Shore (021310011003)	08-R3M-05-18	2018	2.33	Poor
	08-L2M-02-18	2018	2.67	Poor

[1] *Sampling may not have been conducted during all years within year ranges.*

Table 13-15: Fish Species Documented in Magothy River South Shore Watershed

Common Name	Scientific Name
American eel	*Anguilla rostrata*
Banded killifish	*Fundulus diaphanus*
Bluegill	*Lepomis macrochirus*
Brown bullhead	*Ameiurus nebulosus*
Chain pickerel	*Esox niger*
Eastern mosquitofish	*Gambusia holbrooki*
Eastern mudminnow	*Umbra pygmaea*
Golden shiner	*Notemigonus crysoleucas*
Largemouth bass	*Micropterus salmoides*
Mummichog	*Fundulus heteroclitus*
Pumpkinseed	*Lepomis gibbosus*

There was no recent nontidal fish data available for the Eastern Shore watersheds crossed by the resource review area, as these small, nontidal stream reaches have not been assessed in recent years by state or county nontidal monitoring programs. However, MDNR ERP indicated that the following fish species have been previously documented in the Wye River, which falls within the Upper Wye River MD 12-digit watershed: American eel, bluegill, creek chubsucker (*Erimyzon oblongus*), eastern mosquitofish, eastern mudminnow, golden shiner, pumpkinseed, tessellated darter (*Etheostoma olmstedi*), and yellow perch.

13.6.2.2 Tidal

Tidal data from ChesMMAP was received from VIMS on January 18, 2024. Stations sampled from 2013 through 2023 and within 5 miles of the Bay Bridge were reviewed to determine species present. This 5-mile extent of the Chesapeake Bay mainstem on either side of the bridge captures the mouth of the Magothy and Severn Rivers on the western shoreline and north to Love Point on the Eastern Shore. Species documented are included in **Table 13-16**.

Table 13-16: Fish Species Documented Within 5 Miles of the Bay Bridge

Common Name	Scientific Name	Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*	Harvestfish	*Peprilus paru*
American eel	*Anguilla rostrata*	Hogchoker	*Trinectes maculatus*
American shad	*Alosa sapidissima*	Oyster toadfish	*Opsanus tau*
Atlantic croaker	*Micropogonias undulatus*	Rough scad	*Trachurus lathami*
Atlantic menhaden	*Brevoortia tyrannus*	Silver perch	*Bairdiella chrysoura*
Atlantic sturgeon	*Acipenser oxyrinchus*	Spanish mackerel	*Scomberomorus maculatus*
Bay anchovy	*Anchoa mitchilli*	Spot	*Leiostomus xanthurus*
Blue catfish	*Ictalurus furcatus*	Striped anchovy	*Anchoa hepsetus*

Common Name	Scientific Name	Common Name	Scientific Name
Blueback herring	*Alosa aestivalis*	Striped bass	*Morone saxatilis*
Bluefish	*Pomatomus saltatrix*	Summer flounder	*Paralichthys dentatus*
Channel catfish	*Ictalurus punctatus*	Weakfish	*Cynoscion regalis*
Cownose ray	*Rhinoptera bonasus*	White catfish	*Ameiurus catus*
Gizzard shad	*Dorosoma cepedianum*	White perch	*Morone americana*

Source: VIMS ChesMMAP

Data collected from passive acoustic telemetry at the Chesapeake Bay Bridge North array from 2021 through 2024 was provided by NOAA Fisheries. The Chesapeake Bay Bridge North array is located just south of the Bay Bridge and offers valuable insights into fish activity in the area. This data includes detections of 9 different species originating from the Chesapeake Bay, Delaware Bay, Maine, Massachusetts, and Virginia: alewife, American eel, Atlantic sturgeon, blueback herring, cownose ray, gizzard shad, red drum, striped bass, and white perch. The most commonly detected species near the bridge were striped bass, American eel, gizzard shad, cownose ray, and Atlantic sturgeon. Striped bass exhibited consistent detections throughout the year, indicating their year-round presence in the area. In contrast, American eel detections were primarily concentrated at night, with significant seasonal activity in the spring and late fall to early winter. Atlantic sturgeon and cownose ray were detected mainly during the warmer months, while gizzard shad and white perch appeared less frequently. Daily detection patterns showed that striped bass and American eel were more prevalent during cooler periods, whereas migratory species like sturgeon and cownose ray were more commonly observed in the spring and summer. Results indicate that several ecologically and economically important species, including the federally protected Atlantic sturgeon, actively use habitats near the bridge. Supporting figures and correspondence with NOAA Fisheries on this telemetry data can be found in **Appendix K**.

MDNR ERP indicated a diverse range of resident and migratory finfish species inhabiting the tidal portion of the Chesapeake Bay, which have the potential to occur in the vicinity of the resource review area. These species support important commercial and recreational fisheries for striped bass, white perch, Atlantic menhaden, spot, Atlantic croaker, red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), weakfish, largemouth bass, smallmouth bass (*Micropterus dolomieu*), and walleye (*Sander vitreus*). Important forage fish also occur, including Atlantic menhaden and bay anchovy. The Chesapeake Bay Bridge is a hotspot for recreational and commercial fishing activities. The existing bridge structure provides important habitat for recreational and commercial fish species, acting as a congregation area for fish seeking shelter and food.

Based on a review of the CFPP project tool and MDNR's diadromous fish GIS data, the species in **Table 13-17** have been either documented to occur (D), likely to occur (L), or potentially occur (P) within these watersheds. Per MDNR ERP, areas including Mill Creek, Whitehall Creek, Weems Creek and Little Magothy River are habitat for both white perch and yellow perch. It should be noted that the Chesapeake Bay mainstem at the Bay Bridge is a major migratory pathway for fish moving to and from the upper portions of the Chesapeake Bay watershed. Therefore, all diadromous species noted in **Table 13-17** are likely to occur in the mainstem of the Chesapeake Bay at the resource review area.

Table 13-17: Diadromous Fish Species in the Resource Review Area[1]

Common Name	Magothy River South Shore	Lower Severn River	Kent Island Shore	Northern Eastern Bay	Chester River South	Grasonville South	Upper Wye River
Alewife	D	D	D	D	D	P	P
Blueback herring	L	L	--	L	L	--	--
American shad	D	D	D	D	--	--	--
Hickory shad	D	D	D	D	--	--	--
Striped bass	L	D	L	L	D	L	L
White perch	D	D	L	L	L	L	L
Yellow perch	D	D	--	--	--	--	D
American eel	D	D	D	D	D	D	D

[1] Note that the absence of these species in certain watersheds does not mean that they do not occur, rather that they are not specifically noted in the CFPP project tool and MDNR GIS data. The CFPP project tool uses waterbody feature center lines to display this information; therefore, certain species are likely unaccounted for in watersheds including open tidal portions of the Chesapeake Bay.

American eels are found throughout all tidal and nontidal watersheds crossed by the resource review area. Special attention has been given to American eel management in recent years, due to their ecological and economic importance, and their declining numbers. American eels are catadromous, meaning they primarily live in rivers and estuaries but return to the ocean to spawn.

Information regarding fish blockages within the resource review area was obtained from the CFPP database and MDNR Fish Blockage Locations files. Six migration barriers exist within the Magothy River South Shore 12-digit watershed, four in the Lower Severn River 12-digit watershed, and four in the Chester River South 12-digit watershed. These barriers can affect the historical range for the diadromous species that utilize these watersheds.

13.6.3 Environmental Consequences

13.6.3.1 No-Build Alternative

The No-Build Alternative would have no impact to fish.

13.6.3.2 Build Alternatives

Fish species have the potential to be impacted by all build alternatives through direct impacts or alteration of aquatic habitat, as detailed in **Table 13-5**. All build alternatives would require dredging operations, blasting, and pile driving, which are the construction actions most likely to affect fish. Alternatives D, E, F, and G have the greatest potential to impact fish due largely to their encroachment into additional waterways beyond those affected by Alternatives B and C. The addition of the SUP option would require slightly larger piers, resulting in 1.9 acres of additional pier footprint on the Bay substrate for all build alternatives except for the Alternative G SUP option which would have 2.0 acres of additional impact. Disturbance to fish can result from accidental spills in the waterway, increased noise and human presence immediately over and/or surrounding the waterway, and from the potential need for equipment within the waterway to effectively construct a roadway or bridge widening. Alternatives F and G are anticipated to cause the greatest potential impact to fish, as they involve construction of the widest Bay Bridge, with 10 lanes, and therefore would require the most pile driving activities.

As previously described in **Sections 9.2 and 13.5**, dredging is expected to be necessary within the Chesapeake Bay, in the shallower areas along each shoreline. It may also be determined dredging would be required within Kent Narrows, which would increase the potential impacts from Alternatives D, E, F, and G. The effects to benthic habitat and substrate from dredging would directly affect bottom-dwelling species such as the American eel, which often inhabit shallow waters where they burrow or live among rocks.

Dredging and pile driving operations can increase turbidity and create sedimentation. Increased turbidity can deplete DO, lead to decreased fish health, and a reduction in the ability of fish to capture prey due to decreased visibility and deposition of silt on foraging sites. For example, by limiting visibility, turbidity can inhibit the predation success of fish species, as well as directly affect the abundance and distribution of prey species. However, non-larval fish are much more mobile than benthic organisms and can move away from areas of increased turbidity. See **Section 13.5.3** and the EFH Assessment (**Appendix P**) for further discussion of the effects of dredging on EFH and federally-managed fish species.

Pile driving activities cause pressure waves, or underwater sound waves, which can be correlated directly to fish mortality. Pressure waves can kill or seriously injure fish by rupturing their swim bladders. The acoustic effects of pile driving can affect fish hearing, swim bladders, and tissue. Underwater noise can also result in fish behavioral modification, including disruption of fish movements and migrations. The upper Chesapeake Bay is a productive spawning habitat for several anadromous species, including striped bass. Underwater noise in this part of the Bay may result in delay or abandonment of spawning migrations, depending on the duration and severity of the disturbance. According to the National Marine Fisheries Service: Summary of Endangered Species Act Acoustic Thresholds (NOAA Fisheries, 2023), fishes weighing greater than or equal to 2 grams have a peak threshold for onset of physical injury from impulsive sources of 206 dB and a 12-hour cumulative exposure threshold of 187dB. fishes weighing greater than or equal to 2 grams also have a peak threshold of mortality and/or physical injury from underwater explosives of 206 dB and a 12-hour cumulative exposure threshold of 187 dB. Behavior modifications may result from all disturbance at a threshold of 150 dB.

The distance of the effects of noise generated by pile driving is dependent upon the pile size, material, and methods of pile driving. Though specific construction means and methods have not been developed, estimates of noise levels were calculated based on preliminary design assumptions using the NOAA Fisheries Greater Atlantic Regional Fisheries Office (GARFO) Multi-Species Pile Driving Calculator (NMFS 2024). Calculations were completed for the pile types and sizes assumed for the main structure, trestles, and pier protection dolphins based on preliminary design. These assumptions and the corresponding noise analysis will continue to be refined as the Study progresses.

All life stages of federally-managed fish species within the resource review area would be affected by underwater noise, since the current design assumptions indicate that pile driving would likely occur throughout years 1 through 3 of construction of the eastbound bridge and its pier protection, and years 7 through 12 for the westbound bridge and its pier protection, for a total of 9 years of intermittent pile driving. Pile driving is estimated to occur on about 120 days for the eastbound bridge within the 3-year pile driving window, and about 138 days for the westbound bridge within a 6-year window. It is important to understand that although the pile driving time will be protracted, it will not happen on a daily basis and when it occurs, it will not always occur for full days. Exact timing for pile driving has not been determined, but it could possibly take place throughout multiple seasons of the year, with breaks for

time-of-year restrictions to protect aquatic species, for adverse weather conditions, to set-up or break-down equipment, and to conduct other construction activities.

While there will be a 12-hour quiet period implemented each day within the MDTA RPA LOD in which pile driving will not be conducted, extended periods of noise throughout the middle Chesapeake Bay are likely to affect migration and spawning patterns. These effects will likely affect population numbers, as multiple year classes of federally-managed fish and their prey are affected by far-reaching and high-intensity underwater vibration and pressure caused by pile driving. The fact that pile driving for the eastbound and westbound bridges will be separated by at least a 3-year gap will provide federally-managed fish species some time to rebound from adverse effects before entering a new phase of noise impact.

Accurate fish stock counts for the middle Chesapeake Bay are not known at this time, and therefore exact mortality and behavior modification numbers for federally-managed fish species cannot be determined. The MDTA has coordinated with NOAA Fisheries to obtain fisheries telemetry data for the area just south of the Bay Bridge through the Mid-Atlantic Acoustic Telemetry Observation System. However, the fish species documented in the telemetry studies do not have designated EFH within the study area and therefore do not allow for stock counts of the federally managed species with designated EFH. Other recent fish stock count data for the portion of the Chesapeake Bay in the vicinity of the study area is available through the Virginia Institute of Marine Science Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP). However, the only federally managed fish species with designated EFH included in this study were bluefish and summer flounder, and stock assessment data for these species are not publicly available. Therefore, the mortality and behavior modification numbers for Federally managed fish species have not been estimated. Instead, MDTA used a standard habitat-based approach for the EFH assessment.

While details of what would be required with regards to blasting are unknown at this preliminary stage of design, it is assumed that based on the depth and size of some existing piers, blasting would be required to remove select bridge elements. According to current design assumptions, blasting would occur in years 6 and 7 for the eastbound bridge, totaling 9 blast events, and would occur again in years 14 and 15 for the westbound bridge, totaling 7 blasting events. Blasting instances are considered intense, discrete impact events and therefore the timing of these events can be scheduled to minimize impacts to federally-managed species. To minimize duration and magnitude of impact, any required blasting would take place during times of lower biological activity, from October 1 to December 15. During this period, juveniles and adults of all federally-managed fish species and larval summer flounder would be affected by blasting within the resource review area.

Blasting produces pressure waves that can cause swim bladders to rupture, causing severe injury or mortality. The acoustic effects of blasting affect fish hearing and tissues. Blasting can also increase water turbidity and sedimentation in the area surrounding the blasting event, resulting in decreased water quality and impacts on fish respiration. However, prior to blasting, scare charges and fish deterrent boats will be used to minimize injury and mortality. A blasting plan will be developed in coordination with the appropriate regulatory agencies.

Noise generated by dredging, pier construction, and blasting will have an adverse effect to federally-managed fish species. Extended periods of noise throughout the middle Chesapeake Bay are likely to affect migration and spawning patterns. These effects will likely affect population numbers, as multiple year classes of federally-managed fish and their prey are affected by far-reaching and high-intensity

underwater vibration and pressure. A full discussion of the noise analysis and expected impacts to federally-managed fish species is included in the EFH Assessment (**Appendix P**).

All build alternatives would also impact nontidal fish communities by widening the roadway and impacting non-tidal streams. Impacts could range from mortality of fish during construction of culvert extensions and loss of natural habitat from the placement of culvert pipes and other in-stream structures, to more gradual changes in stream conditions or aquatic connectivity (i.e., fish passage). Alternatives B and C would have approximately one-fifth of the nontidal waterway impacts than Alternatives D, E, F, and G (**Table 9-9**).

All build alternatives would also impact tidal and nontidal fish species by increasing impervious land cover. Alternatives F and G would have the greatest fish impacts from degraded water quality due to increased impervious area. See **Table 8-6** and **Table 8-7** for a comparison of impervious surfaces increases by alternative.

13.7 Blue Crabs and Horseshoe Crabs

Blue crabs (*Callinectes sapidus*) and horseshoe crabs (*Limulus polyphemus*) are important species, both commercially and ecologically, within the Chesapeake Bay and its tributaries. Certain life stages of blue crab, particularly juveniles and molting crabs, are a primary food source for eel, drum, spot, Atlantic croaker, striped bass, sea trout, catfish, some sharks, and cownose rays. Horseshoe crab eggs provide food for striped bass as well as migrating shorebirds along the Atlantic flyway. Silver perch, American eel, weakfish, kingfish, silversides, summer flounder, and winter flounder are also predators of horseshoe crab eggs and larvae.

Both blue crabs and horseshoe crabs are an important part of the trophic web. As omnivores, they feed on a varied diet that includes clams, oysters, mussels, smaller crustaceans, worms, algae, mollusks, and carrion. Horseshoe crabs are vulnerable due to a history of harvest for use as eel and conch bait, fertilizer, and medicinal research.

13.7.1 Regulatory Context and Methodology

The MDNR regulates Maryland's blue crab harvest. These regulations, designed for sustainability and ecosystem health, encompass size limits, seasonal and gender restrictions, and guidelines for harvesting methods, bushel limits, and licensing requirements. The MDNR also regulates Maryland's horseshoe crab harvest for sustainable commercial and medical use as well as for ecological function. These regulations encompass daily limits, seasonal and gender restrictions, harvesting areas, and permit tier type. The MDNR partners with the Atlantic States Marine Fisheries Commission (ASMFC), which manages horseshoe crabs under the Interstate Fishery Management Plan for Horseshoe Crab, last amended in 2021. The ASMFC aims to reduce mortality, increase horseshoe crab spawning and research, and protect critical habitat.

Annually, the MDNR collaborates with VIMS to conduct the winter dredge survey in the Chesapeake Bay, estimating blue crab numbers. The publicly available survey data were analyzed, with a specific focus on the resource review area and the local blue crab fishery, to gain insights into the 2023 population dynamics (MDNR, 2023c).

Information on the locations and type of horseshoe crab habitat within the resource review area was obtained from MDNR's Living Resources – Chesapeake Bay Horseshoe Crab Habitat GIS layer, which provides locations of horseshoe crab habitat in the Chesapeake Bay (MD iMap, 2023). It should be

noted that horseshoe crab habitat areas in this dataset were derived from sightings that were confirmed by DNR Fisheries Service; therefore, this data source does not include all potential horseshoe crab habitat.

13.7.2 Affected Environment

Within the Chesapeake Bay, male blue crabs tend to prefer the fresher waters of Maryland and the Chesapeake Bay's upper tributaries, while females like the saltier waters in the main part of the Chesapeake Bay. The blue crab uses multiple habitats in the Chesapeake Bay throughout its life. Blue crab habitats include underwater grasses and oyster reefs, and they range from shallow, brackish waters to deeper, saltier waters. Blue crab distribution varies with age, sex, and season. They tend to be abundant in shallow-water areas during warm weather. As the water temperature drops each year, they burrow into sediment in the deeper parts of the Chesapeake Bay for the winter. Blue crabs are bottom dwellers that use beds of submerged aquatic grasses as sources of food, nursery habitat for young, and shelter during mating and molting.

Blue crab populations are naturally highly variable from year to year. In managing blue crab fisheries, resource managers look at overall trends rather than just the number of blue crabs in any given year. In 2017, Maryland, Virginia, and the Potomac River Fisheries Commission adopted a target population abundance of 196 million spawning-age female blue crabs, with a low target threshold of 72.5 million. In 2023, the abundance surpassed expectations, reaching 152 million, well above the low target threshold (MDNR, 2023c). It is estimated that the total number of blue crabs, male and female, living in the Chesapeake Bay in the year 2023 was around 323 million, which is a 42 percent increase from the previous year's estimate, but still below the historical average of about 450 million. The total blue crab population has had an overall declining trend since 2019. The adult male, adult female, and juvenile populations have all declined, and juvenile recruitment has been below average for six consecutive years. There are several factors likely contributing to blue crab population declines, including harvest, water quality, loss of critical habitat such as SAV and marshes, increased predation, rising water temperatures, and changes in ocean currents, which affect juvenile recruitment to nursery areas. The Chesapeake Bay comprises 50 percent of the blue crab harvest in the U.S. Recreational and commercial crabbing is a very popular activity within and around the resource review area and public shellfisheries are shown on **Figure 13-4**. The Chesapeake Bay Bridge is a hotspot for recreational and commercial crabbing activities. The existing bridge structure provides important habitat for blue crabs, acting as a congregation area providing shelter and food.

Figure 13-4 also shows horseshoe crab habitat exists on both the Anne Arundel County and Queen Anne's County shorelines, north of the Bay Bridge. On the western shore, habitat exists along the shoreline of Sandy Point State Park and into Mezick Pond, occurring on beaches, vegetation, and structures. On the eastern shoreline of the Chesapeake Bay at Kent Island, horseshoe crab habitat occurs from Terrapin Nature Area south to the Bay Bridge, occurring both on beaches and structures. Spawning in the Chesapeake Bay usually begins in late May when large numbers of adults move onto beaches to mate and lay eggs. Per coordination with MDNR, horseshoe crab stock in the Chesapeake Bay has not been assessed; however, their abundance is low compared to the coastal stock. Horseshoe crab spawning and nesting have been documented to occur on beaches in the vicinity of this project along the bridge and north of the bridge and elsewhere.

Figure 13-4: Horseshoe Crab Habitat



13.7.3 Environmental Consequences

13.7.3.1 No-Build Alternative

The No-Build Alternative would have no impact to blue crabs or horseshoe crabs or their habitats.

13.7.3.2 Build Alternatives

All build alternatives have the potential to impact blue crab and horseshoe crab habitat. Impacts to blue crabs would be largely associated with the removal of suitable habitat, such as shoreline marshes, SAV, and benthic habitat, including deep water habitat for overwintering crabs. Horseshoe crab habitat impacts vary from 290 linear feet associated with southern alignment Alternatives C, E, and G to 2,100 linear feet associated with northern alignment Alternatives B and D, and 2,240 linear feet associated with Alternative F. Most documented horseshoe crab habitat is located north of the Bay Bridge, which results in the major difference in potential impacts between build alternatives. These alternatives would impact the horseshoe crab through the direct removal of beach habitat and shoreline alterations for construction of the northernmost bridge crossing over Sandy Point State Park beach and waterway entrance to Mezick Pond, as well as the impacts to the existing landside connection of the westbound lanes exiting the Eastern Shore. These activities could result in mortality to horseshoe crab adults and/or eggs. These impacts can fragment the existing spawning beach habitat that are crucial to reproduction. Immediate impacts along the shoreline habitat can also increase the opportunity for pollutants to be introduced into the water, impacting water quality and potentially further harming horseshoe crabs and their eggs.

The addition of a SUP option would result in 300 linear feet of additional impacts to horseshoe crab habitat from Alternative F and 430 linear feet of additional impacts to horseshoe crab habitat from Alternatives B and D. The addition of a SUP option with any of the southern alternatives, Alternatives C, E, and G would not result in any additional impacts to mapped horseshoe crab habitat.

13.8 Waterfowl Staging and Concentration Areas

Waterfowl staging and concentration areas, located in tidal waters and tidal and nontidal wetlands, are areas of open water and adjacent marshes where, as documented by MDNR, waterfowl gather during migration and throughout the winter season. SAV beds serve as an important food source for waterfowl, as they include plant material and animals living among the beds (SAV is discussed in **Section 13.3, Submerged Aquatic Vegetation**). Many of North America's most iconic waterfowl are found in the Chesapeake Bay Watershed. Located near the mid-point of the Atlantic Flyway, the Chesapeake Bay is an important stopover for migrating waterfowl and other birds. During the breeding season, the watershed is home to a variety of waterfowl, including diving ducks, dabbling ducks, sea ducks, geese, brants, and swans. Roughly one-third of the waterfowl that winter along the Atlantic Coast do so on the Chesapeake Bay (Reshetiloff, 2023).

13.8.1 Regulatory Context and Methodology

Waterfowl staging and concentration areas are protected through COMAR Title 27, the MDNR Critical Area Commission for the Chesapeake and Atlantic Coastal Bays. Therefore, these habitat areas are regulated within the 1,000-foot Critical Area boundary and the 100-foot Critical Area Buffer, as previously described in **Section 12, Chesapeake Bay Critical Area**. The location of waterfowl staging and concentration areas within the resource review area was determined through a review of the Maryland Living Resources – Waterfowl Areas, a GIS data polygon layer

(MD iMap, 2023) and through coordination with MDNR WHS, which provided a response letter dated January 18, 2024 (see **Appendix M**) that identified these areas within the 2-mile-wide Tier 1 study corridor.

13.8.2 Affected Environment

Substantial areas of tidal marsh habitat associated with several tidal waterways are present in Queen Anne's and Anne Arundel counties, where waterfowl congregate. Three waterfowl staging and concentration areas overlap with the resource review area (**Figure 13-5**). One area is located on the western shoreline of the Chesapeake Bay, south of U.S. 50/301, and includes shorelines of Meredith Creek and Whitehall Creek. A second area is located along the eastern shoreline of the Chesapeake Bay, north of U.S. 50/301 and west of Kent Island. The third area is in Prospect Bay, south of U.S. 50/301 and east of Kent Island.

13.8.3 Environmental Consequences

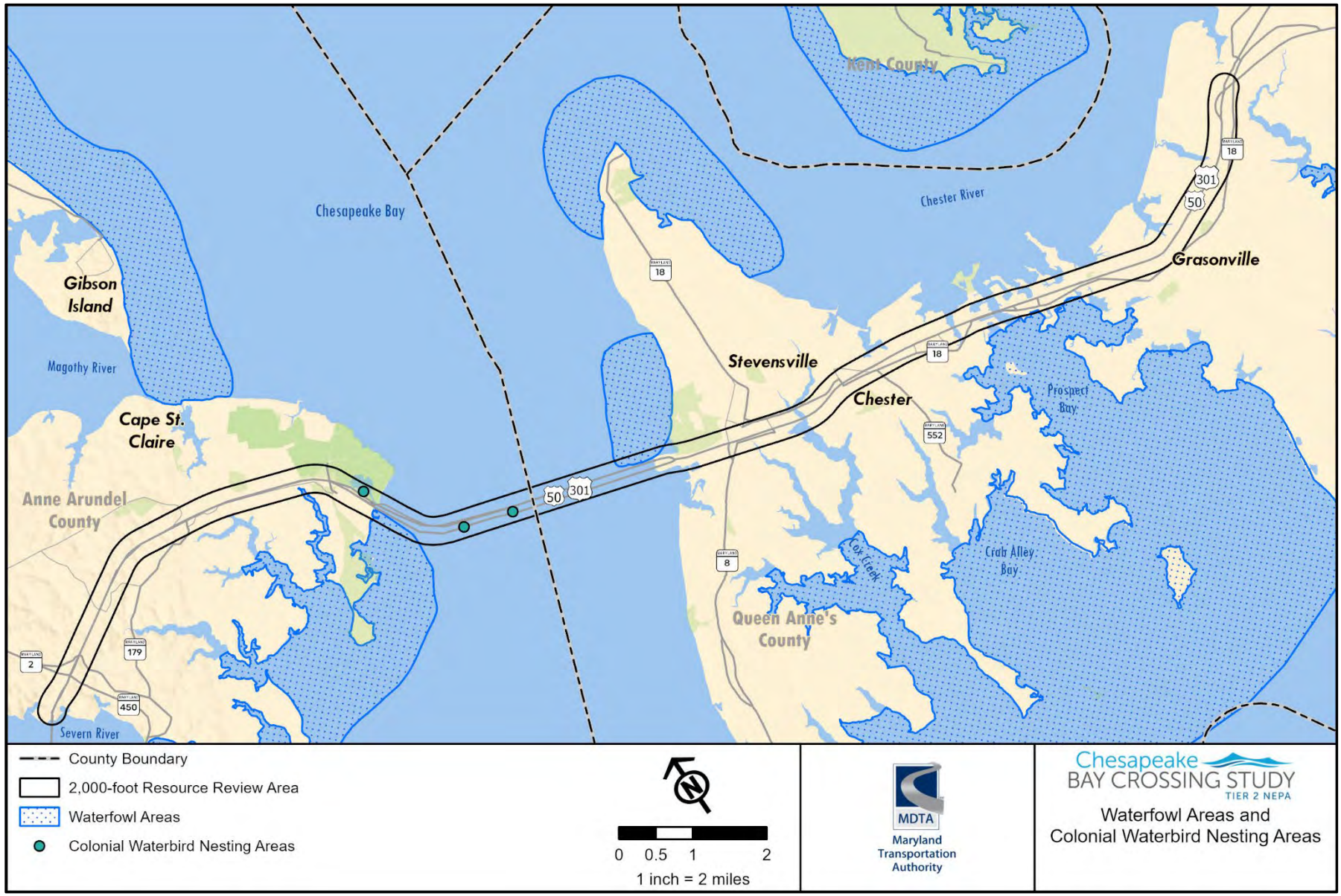
13.8.3.1 No-Build Alternative

The No-Build Alternative would have no impact to waterfowl staging and concentration areas.

13.8.3.2 Build Alternatives

All build alternatives would impact waterfowl staging and concentration areas, as they would widen the U.S. 50/301 mainline of the Bay Bridge and overlap the edges of two mapped waterfowl staging and concentration areas within the Chesapeake Bay. Alternatives B, D, and F (northern alignments) however, would impact almost three times more of the mapped waterfowl staging and concentration areas, totaling 7.1 acres. This difference in impacts is due mostly to the habitat located on the north side of the westbound lanes, and near the shoreline of Queen Anne's County. Alternatives C, E, and G are each estimated to impact 2.5 acres of this habitat. Because these boundaries are largely situated within the open water, it is anticipated that waterfowl would still be able to congregate north of the proposed northern build alternatives (Alternatives B, D, and F). Natural resource maps showing the northern alignments are included in **Appendix B**, and maps showing southern alignments (Alternatives C, E, and G) are included in **Appendix C**. The addition of a SUP option with any of the northern alternatives, Alternatives B, D, and F would result in 0.1 acre of additional impacts to waterfowl staging and concentration areas. No additional impacts to waterfowl staging and concentration areas would occur with the addition of a SUP option with any of the southern alternatives, Alternatives C, E, and G.

Figure 13-5: Waterfowl Staging and Concentration Areas and Colonial Waterbird Nesting Areas



13.9 Colonial Waterbird Nesting Areas

Colonial waterbird nesting sites (two or more nesting pairs) are areas where waterbirds congregate during the nesting season. Common colonial waterbird species within the Chesapeake Bay include herons, egrets, and terns. Nesting sites are typically colonized by waterbirds every year. Accurate estimates of colonial waterbird breeding population trends are deficient, owing to a lack of range-wide, standardized survey efforts. Traditional, coordinated avian count methods that cover broad geographic scales, such as the road-based Breeding Bird Survey (BBS), are not conducive for obtaining colonial waterbird trend estimates, because many of these species breed in remote habitats often surrounded by water and far from roads (Loman et al., 2024).

13.9.1 Regulatory Context and Methodology

In Maryland, colonial waterbird nesting areas are regulated as protected resources within the Critical Area, discussed in **Section 12, Chesapeake Bay Critical Area**. Great Blue Heron nesting colonies are protected in the Critical Area during their breeding season (February 15 through July 31). A 660-foot protection buffer is afforded to nesting colonies of Great Blue Heron. Colonial waterbirds are further protected by the USFWS under the Migratory Bird Treaty Act (MBTA), discussed in **Section 14, Terrestrial Habitat and Biota**. Birds listed as federally threatened or endangered are also protected under the ESA, discussed in **Section 15, Rare, Threatened, and Endangered Species**. The presence of colonial waterbird nesting sites within the 2-mile-wide Tier 1 study corridor (which includes the resource review area) was determined through correspondence with MDNR WHS, which provided a response letter dated January 18, 2024 and updated information specific to the resource review area in an email dated April 1, 2025 (see **Appendix M**).

13.9.2 Affected Environment

Correspondence with MDNR WHS indicated the potential presence of colonial nesting waterbirds using the pier "islands" associated with the Bay Bridge, as nesting sites. Species identified to use these areas include the Great Egret (*Ardea alba*), Snowy Egret (*Egretta thula*), Cattle Egret (*Bubulcus ibis*), and Black-Crowned Night Heron (*Nycticorax nycticorax*).

Nests of Great Blue Herons are found in colonies, high up in trees close to water, and one colony has been documented within the resource review area. According to MDNR WHS, there is an active colony at Mezick Pond in Sandy Point State Park in Anne Arundel County (**Appendix M**). Colonial waterbird nesting areas are shown on **Figure 13-5**, as provided by MDNR WHS.

13.9.3 Environmental Consequences

13.9.3.1 No-Build Alternative

The No-Build Alternative would have no impact to colonial waterbird nesting areas.

13.9.3.2 Build Alternatives

Impacts to colonial waterbird nesting areas are anticipated from any of the build alternatives. Colonial waterbirds using the Bay Bridge pier islands as nesting sites would be disturbed by any of the build alternatives if construction occurs during the breeding season (which cumulatively for these species is April 1 through August 15).

The precise location of the documented active Great Blue Heron colony within Mezick Pond is not known. It is assumed that Alternatives B, D, and F (northern alignments) would result in the greatest disturbance to the colony on Mezick Pond due to the greater tidal wetland impacts at Mezick Pond and the fill that would be required within the waterway entrance to Mezick Pond to create the westbound roadway connection to the Bay Bridge.

13.10 Marine Mammals

Marine mammals may occur within the resource review area. A review of the NOAA Office of Response and Restoration's Environmental Sensitivity Index (ESI) Marine Mammal Polygons GIS layer indicated the potential for four species to occur within the resource review area: bottlenose dolphin (*Tursiops truncates*), West Indian manatee (*Trichechus manatus*), harbor porpoise (*Phocoena Phocoena*), and humpback whale (*Megaptera novaeangliae*), although the West Indian manatee and harbor porpoise were noted as rare and the humpback whale was noted as extremely rare (ORR, 2023). The humpback whale is listed as endangered under the Endangered Species Act (ESA) and is protected under the Marine Mammal Protection Act (MMPA); the other species are not listed under the ESA but are protected under the MMPA. Federally listed marine mammal species are discussed in **Section 15, Rare, Threatened, and Endangered Species**.

13.10.1 Regulatory Context and Methodology

The MMPA prohibits "any person, vessel, or conveyance to take any marine mammal in waters or on lands under the jurisdiction of the United States," where take "means to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal, including, without limitation, any of the following: The collection of dead animals or parts thereof; the restraint or detention of a marine mammal, no matter how temporary; tagging a marine mammal; or the negligent or intentional operation of an aircraft or vessel, or the doing of any other negligent or intentional act which results in the disturbing or molesting of a marine mammal." The USFWS shares responsibility with NOAA Fisheries for implementing the MMPA. Since bottlenose dolphins are the most likely species to be present within the resource review area, and management of this species is under NOAA's purview, NOAA Fisheries would manage MMPA compliance for the project. NOAA Fisheries may issue incidental take authorizations allowing the unintentional "take" (including harassment by noise) of marine mammals incidental to specified activities, including construction, during periods of not more than 5 consecutive years (16 USC § 1361).

NOAA Fisheries is required to examine the proposed project impacts under the MMPA and estimate the extent of take. NOAA Fisheries typically assigns a density estimate to a population of marine mammals, however the transient dolphin population in the Chesapeake Bay would be estimated based on best available data. NOAA Fisheries uses this population estimate to examine whether the proposed take would affect a small percentage of the total population and this helps them determine whether an Incidental Harassment Authorization (IHA) is warranted.

The consultation process with NOAA Fisheries requires an Incidental Take Assessment, including an underwater noise monitoring plan, which defines the project, duration, location, affected species, affected population, potential presence of the affected species, acoustic frequency hearing ranges of the species, exposure analysis, and anticipated impact of the activity to determine the need for the IHA and whether it is justified. If an IHA is deemed necessary and an authorization is determined to be justified, NOAA Fisheries develops a proposed IHA, if applicable, within 45 days from when the Incidental Harassment Permit application package has

been determined to be complete. There is a mandatory 30-day public comment period for all proposed IHAs. NOAA Fisheries will develop a response to public comments and publish an issuance or denial in the Federal Register within 45 days of the close of the public comment period.

13.10.2 Affected Environment

The University of Maryland Center for Environmental Science Chesapeake (UMCES) DolphinWatch program compiles reported sightings of bottlenose dolphins from the public. A review of the Chesapeake DolphinWatch website indicates that there were nearly 2,000 dolphin sightings in the Chesapeake Bay in 2022 and about 1,500 dolphin sightings in 2023 (UMCES, 2023). Dolphins are typically seen in the Bay from May through October, including around the Bay Bridge. Rodriguez, et al. (2021) analyzes the DolphinWatch data and indicates that dolphins are reported in the Middle Chesapeake Bay, where the project is located, from June through the end of October. Dolphin sightings between June 2017 and October 2019 were fairly evenly distributed, with a total of 1,788 confirmed sightings throughout the Chesapeake Bay, 556 of which were within the Middle Chesapeake Bay. According to this dolphin sightings data, if sightings were averaged across all months of occurrence, one would expect to see about 37 dolphins each month from June through October in the Middle Chesapeake Bay during this 3-year period. Dolphins are most common in July of each year, when water temperatures are high and dolphin prey fish species are most prevalent (Gannon and Waples, 2004). **Table 13-18** provides the calculated expected dolphin density in the proposed action area, as presented in the EFH Assessment (**Appendix P**), with a geometric mean dolphin density for the three years of data included in Rodriguez et al. (2021) of 0.129 dolphins per square kilometer. The MDTA included the dolphin density data in an analysis of the number of individual dolphins likely to be affected by pile driving.

Table 13-18 : Calculation of Expected Dolphin Density in the Proposed Action Area

Year	Minimum Dolphin Density (per km^2)	Maximum Dolphin Density (per km^2)	Geometric Mean Dolphin Density* (per km^2)
2017	0.0612	0.0763	0.129
2018	0.210	0.236	
2019	0.104	0.120	

*The Maximum Dolphin Density for 2017-2019 was used to calculate the Geometric Mean Dolphin Density.

Bottlenose dolphins are included in the high-frequency cetacean functional hearing group, with an estimated auditory bandwidth of 150 to 160 Hz according to the NOAA Fisheries Technical Guidance for Assessing Effects of Anthropogenic Sound on Marine Mammals (89 FR 84872). Bottlenose dolphins rely on hearing underwater to forage, communicate, detect predators, and navigate, and have an echolocation range of up to 140 meters, or about 459 feet (Akamatsu, et al., 1998).

The harbor porpoise would more frequently be seen in the Chesapeake Bay between January to May, although it is considered rare and very little information on their presence in the Chesapeake Bay is known. The West Indian manatee is also rare within the Chesapeake Bay. They are more typically found in warmer waters of the U.S. and the Caribbean. The humpback whale is extremely rare within the Chesapeake Bay and is more often found near the mouth of the Bay. In

late April 2025, a humpback whale was sighted at the mouth of the Potomac River; this was likely a migrating juvenile that would not typically be found so far upstream from the mouth of the Bay (Chesapeake Bay Magazine, 2025).

13.10.3 Environmental Consequences

13.10.3.1 No-Build Alternative

The No-Build Alternative would have no impact to marine mammals.

13.10.3.2 Build Alternatives

Bridge construction can negatively impact bottlenose dolphins through habitat alteration, noise pollution, and increased human activity. The disruptions from construction dredging can affect the natural substrate and shoreline, impacting foraging grounds. The loud noise and vibration from pile driving can disrupt dolphin communication and navigation and cause them stress. The increased human presence may cause dolphins to avoid areas of construction and lead to displacement from their typical habitat. Increased ship traffic associated with construction may also increase the potential for vessel strikes.

All build alternatives would have the potential to impact dolphins by means of harassment via underwater noise impact from blasting and pile driving activities, which can disrupt dolphin communication, navigation, foraging patterns, and cause dolphins stress. Other marine mammals that rarely or extremely rarely occur within the project area are unlikely to be impacted. Based on current design assumptions, pile driving is assumed to require both impact and vibratory driving of 36-inch, 48-inch, and 96-inch steel pipe piles; 36-inch square pre-stressed concrete piles; and 19.6-inch-wide sheet piles, backed by 14-inch steel H-piles. It is anticipated that all build alternatives would have comparable impacts to dolphins, though Alternatives F and G may impact dolphins for a longer duration due to the need for larger bridge piers.

Preliminary design assumptions indicate that pile driving would likely occur throughout years 1 through 3 of construction of the eastbound bridge and its pier protection, and years 7 through 12 for the westbound bridge and its pier protection, for a total of 9 years of intermittent pile driving. Pile driving is estimated to occur on about 120 days for the eastbound bridge within the 3-year pile driving window, and about 138 days for the westbound bridge within a 6-year window. It is important to understand that although the pile driving time will be protracted, it will not happen on a daily basis and when it occurs, it will not always occur for full days. Exact timing for pile driving has not been determined, but it could possibly take place throughout multiple seasons of the year, with breaks for time-of-year restrictions to protect aquatic species, for adverse weather conditions, to set-up or break-down equipment, and to conduct other construction activities.

While there will be a 12-hour quiet period implemented each day within the MDTA RPA LOD in which pile driving will not be conducted, extended periods of noise throughout the middle Chesapeake Bay are likely to affect dolphin movement throughout the Chesapeake Bay. These effects will not likely affect population numbers, since dolphins are not dependent on the Chesapeake Bay for foraging or rearing their young. The fact that pile driving for the eastbound and westbound bridges will be separated by at least a 3-year gap will allow dolphins to return to previous movement within the Bay before a new phase of noise impact begins for the second bridge.

See **Appendix P**, the EFH Assessment, for a summary of underwater sound wave mechanics and project assumptions related to pile driving. The distance of the sound effects of pile driving on dolphins is dependent upon the pile size, material, and methods used. Note that the extent of all pile driving isopleths are shown in Figure 13-6: Level B Harassment Zone of Influence from Vibratory Pile Driving for High Frequency Cetaceans**Figure 13-6** and **Figure 13-7**, but in practice, multiple piles may be driven at any given time, resulting in concurrent isopleths or zones of dolphin behavioral modification.

Figure 13-6: Level B Harassment Zone of Influence from Vibratory Pile Driving for High Frequency Cetaceans

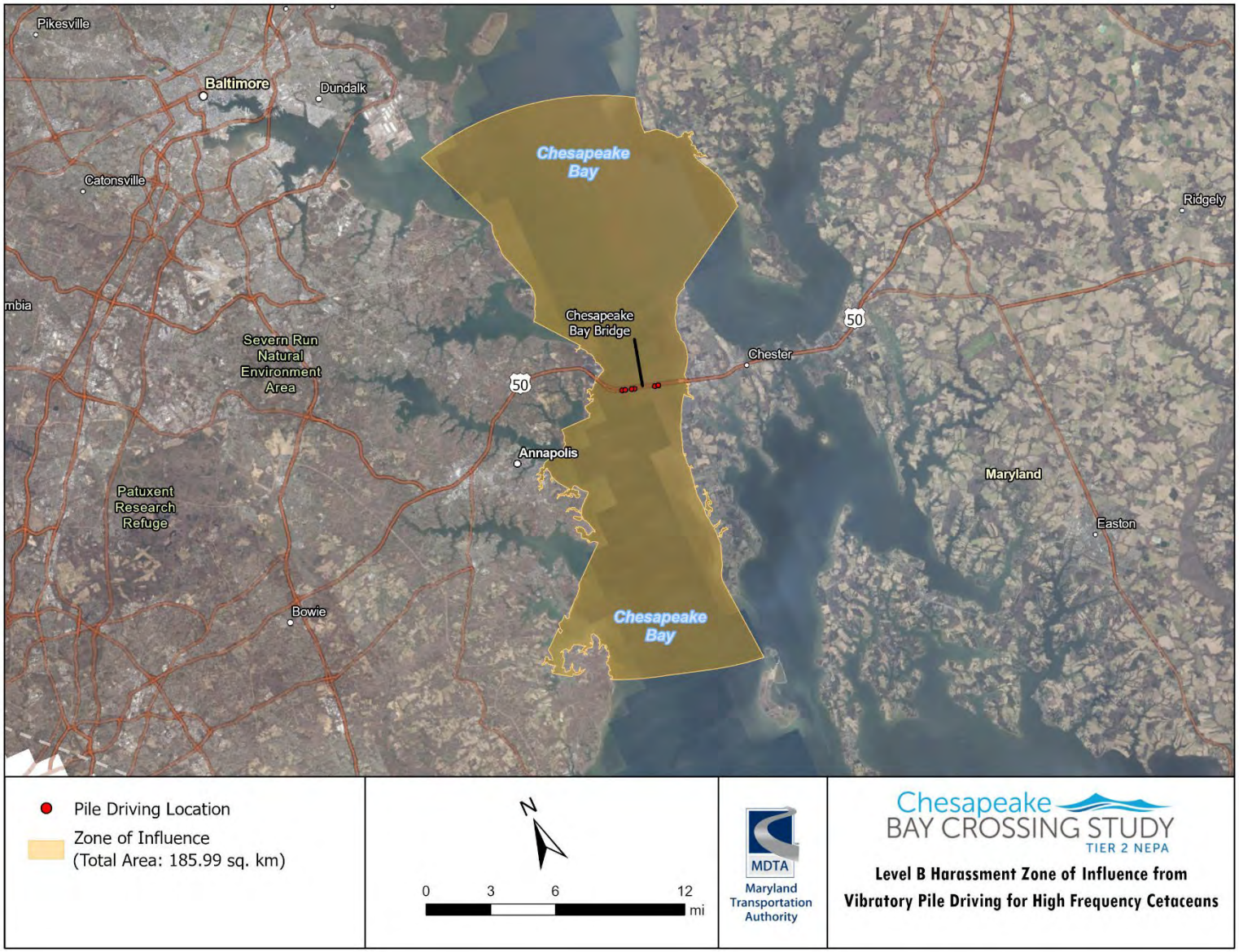
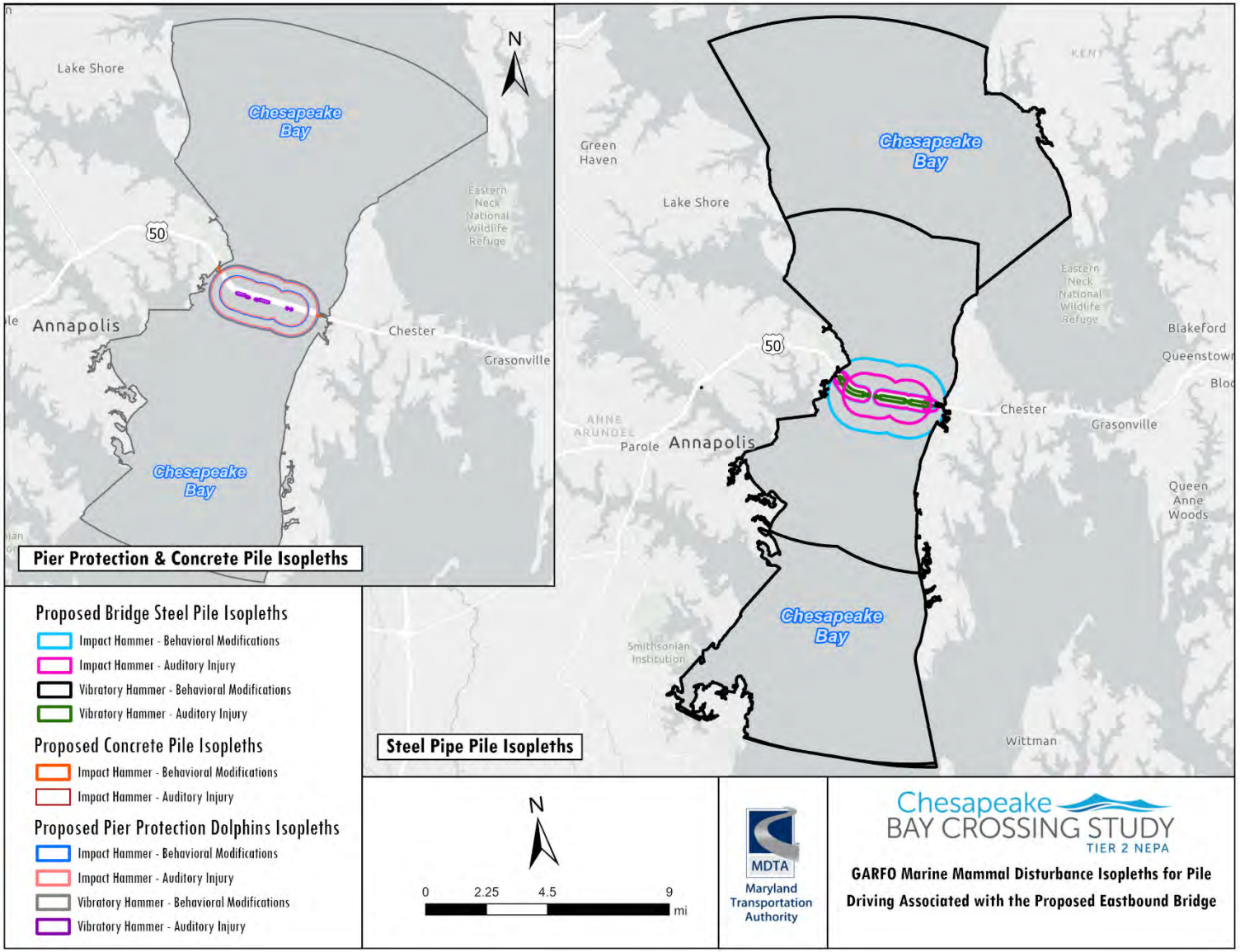


Figure 13-7: GARFO Marine Mammal Disturbance Isopleths for Pile Driving Associated with the Proposed Eastbound Bridge



See **Table 13-19**: GARFO Tool Summary: Response of High-Frequency Cetaceans to Impact and Vibratory Hammer Operation for the pile driving isopleths by pile type and hammer type for the onset of injury and behavioral modification for high-frequency cetaceans, such as dolphins, determined using the GARFO Multi-Species Pile Driving Calculator.

Table 13-19: GARFO Tool Summary: Response of High-Frequency Cetaceans to Impact and Vibratory Hammer Operation

Pile Type	Impact Hammer			Vibratory Hammer	
	Onset of Auditory Injury		Behavior Modification	Behavior Modification	
	Peak threshold (FT)	SEL_{cum} (FT)	RMS Threshold (FT)	SEL_{cum} (FT)	RMS Threshold (FT)
36" SQ Concrete	0.1	77.2	82.4	N/A	N/A
36" Steel Pipe	0.3	1,049.5	1,120.3	182.7	32,808.4
48" Steel Pipe	0.5	568.0	960.8	393.6**	70,683.6**
48" Steel Pipe (60" Steel Pipe Proxy)*	0.3	1,426.7	1,522.8	393.6**	70,683.6**
96" Steel Pipe	1.5	4,171.6	7,068.4	247.9**†	70,683.6**
14" Steel H-Pile	0.2	900.2	960.8	8.5	1,522.8
AZ Sheet Pile	0.2	1,426.7	1,522.8	84.8	15,228.3

**In order to create an increasing trend in noise effect between all steel pipe pile sizes, two 48" steel pipe proxies were used to create a range of likely impacts. The noise proxy levels for a 48" steel pipe did not produce the expected impacts for the SEl_{cum} and RMS Threshold and therefore the noise proxy for a 60" steel pipe was used instead.*
***The GARFO tool only includes vibratory proxies for 36" steel pipes and 72" steel pipes. Therefore, for every steel pipe greater than 36" in diameter, 72" steel pipe sound proxy levels were used.*
† It is assumed that up to 8 96" Steel Pipe piles may be driven in a day and up to 16 piles of all other sizes may be driven in a day.
Sound proxy levels used were not attenuated and a 10dB attenuation was then added in the GARFO tool. 14" Steel H-Piles and AZ Sheet Piles were calculated with a 5dB attenuation.

The GARFO Multi-Species Pile Driving Calculator (NMFS, 2024) estimates the spatial extent of sound impact to marine species. According to the GARFO calculator, vibrations from pressure waves due to impact pile driving are unlikely to cause auditory injury to dolphins unless they are within the immediate vicinity (within 1.5 feet) of the impact, however the pressure waves are likely to affect dolphin behavior. The behavior modification impact isopleths generated from pile driving indicate that impact hammering would affect dolphin behavior within about 7,068 feet, or 1.3 miles, of the impact, while vibratory hammering of piles would result in much larger behavioral effects to dolphins, with the potential to affect dolphin behavior up to 13.4 miles from the point of impact.

The potential number of dolphins impacted by the Level A Zone of Influence (ZOI) for onset of injury and the Level B ZOI for behavioral modification were determined by first determining the ZOIs based on the isopleth impact radii and an assumption of no sound and vibration diffraction resulting in a ZOI that stops at the land water interface. ZOIs were developed (**Table 13-20**) and then overlaid with the dolphin density data from Rodriguez, et. al. (2021) (**Table 13-18**) to determine the number of dolphins potentially exposed to these noise impacts on a daily basis (**Table 13-21**).

The estimated physical injury of dolphins by impact hammering in a 24-hour period would be 0.662 dolphins per day and by vibratory hammering would be 0.023 dolphins per day. It is estimated that noise from impact hammering would affect behavioral modification of 0.756 dolphins per day and from vibratory hammering would affect behavioral modification of 66.67 dolphins per day. Vibratory hammering would have by far the most widespread impact to dolphins spatially and would impact the most individuals.

Table 13-20: Maximum Distances (Isopleths) and Level A and B ZOIs

Pile Driving Method	Onset of AUD INJ Peak Isopleth (km)	Onset of AUD INJ SEL Isopleth (km)	Level A ZOI (km^2)	Behavior RMS Isopleth (km)	Level B ZOI (km^2)
Impact	<0.001	1.27	5.13*	2.15	25.86*
Vibratory	NA	0.08	0.18*	21.54	516.82**

* Assumes 4 96" steel pipe piles being installed simultaneously.
See **Figure 13-7 for a determination of Level B ZOI for vibratory trestle pile installation.

Table 13-21: Estimated Dolphin Exposures in a 24-Hour Period from Pile Driving (two trestle piles [36" steel pipes], one main support pile [36" drilled shaft] and one pier protection pile [19.6" sheet pile])

Pile Driving Method	Level A ZOI (km^2)	Daily Level A Exposures[1] (dolphins)	Level B ZOI (km^2)	Daily Level B Exposures[1] (dolphins)
Impact	5.13	0.662	25.86	0.756
Vibratory	0.18	0.023	516.82	66.67

[1]Daily exposure is calculated by multiplying the ZOI in km^2 by the dolphin density (0.129 dolphins/km^2).

Potential blasting requirements are unknown at this preliminary stage of design; however, based on the depth and size of some existing piers, the MDTA assumes discrete blasting events will be required. Preliminary design assumes that mechanical demolition will be used wherever feasible; however, some pier elements will be blasted because they are in deep water or are too large to demolish mechanically. According to current design assumptions, blasting would occur in years 6 and 7 for the eastbound bridge, totaling 9 blast events, and would occur again in years 14 and 15 for the westbound bridge, totaling 7 blasting events. While blasting would have an acute effect on dolphins in close proximity to the charge, the duration of impact would be short. The MDTA will conduct blasting when dolphins are unlikely to be present in the project vicinity to avoid potential injuries, scare charges would be used prior to blasting, and timing of blasting would be coordinated with NOAA Fisheries to ensure the least potential impact.

13.11 Avoidance, Minimization, and Further Mitigation Strategies

This section discusses avoidance, minimization, and further mitigation strategies for all of the aquatic habitats and biota discussion in this section. The MDTA would consider all design opportunities to minimize impacts, including less invasive in-water construction methods, such as using concrete piles where possible to reduce noise and vibration impacts; longer bridge spans to minimize permanent fill within aquatic habitat; construction phasing to limit concurrent pile driving operations; and employing construction BMPs to reduce in-water noise. The MDTA intends to observe the TOYRs for aquatic biota to the greatest extent practicable. It is anticipated that not all time-of-year restrictions will be able to be employed due to schedule constraints and the possibility of conflicting time-of-year restrictions. To address this, the MDTA will work with the resource agencies to develop a construction plan and best management practices that provide

protection for sensitive resources at a similar level to time-of-year restrictions to the extent practicable.

Several time-of-year restrictions are relevant to aquatic species:

- February 15 through July 15, inclusive of any year, to protect anadromous fish and vulnerable life stages of finfish from dredging and underwater noise typically associated with pile driving activities.
- For Use I and II streams with anadromous fish, generally, no in-stream work is permitted from March 1 through June 15 of any given year to protect spawning fish.
- For Use I and II streams with yellow perch, generally, no in-stream work is permitted from February 15 through June 15 of any given year to protect spawning fish.
- To minimize disturbance to wintering and staging waterfowl, no water-dependent work would be conducted from November 15 through March 1 of any year.
- Colonial waterbirds using the bridge pier islands as nesting sites are afforded protection under Critical Area regulations as well as the MBTA. The cumulative breeding season for these species is April 1 through August 15 of any given year. Construction or human presence within the immediate area of the pier islands during the breeding season can cause nest abandonment and result in death of eggs or young and should be avoided.
- Great Blue Heron colonies are afforded protection by the MBTA and in the Critical Area during the breeding season (February 15 through July 31) and within a 660-foot radius of the colony site.
- In accordance with COMAR 26.24.02.06, dredging is prohibited during certain times of the year to protect shellfish, including oysters. Mechanical dredging within 500 yards of shellfish areas is prohibited from December 16 through March 14 and from June 1 through September 30 of any year. Dredging within the boundaries of NOBs is restricted during the periods of December 16 through March 14 and June 1 through September 30, regardless of the dredging method.
- Time-of -year restrictions for dredging within 500 yards of SAV, regardless of the method, are from April 15 through October 15 of any year.

Because SAV coverage can change from year to year, the 5-year average extent of SAV will be re-determined during final design and used to evaluate impacts for permitting.

In accordance with the MMPA, the MDTA would coordinate with NOAA Permits and Conservation Division to secure an Incidental Harassment Authorization (IHA) for the Selected Alternative's impact on bottlenose dolphins. Once issued, the IHA would be valid for one year and would include appropriate BMPs to minimize harassment to the extent practicable. The IHA would be secured for subsequent years of construction as needed. Commitments and considerations related to reducing impact to marine mammals are included below.

The MDTA will determine, in coordination with NOAA Fisheries, whether it is practicable to implement a Zone of Safe Fish Passage (ZSFP) within the Chesapeake Bay during construction, to allow fish to move safely to their spawning grounds in the spring season. Potential fish habitat and water quality impacts due to demolition, construction, and the increase in impervious surfaces related to the project would be managed through implementation of ESC BMPs along with water quality monitoring plans, which will ensure that construction activities comply with state water quality standards, and BMPs and specialized construction methods specific to EFH and HAPC.

The MDTA will commit to the following avoidance and minimization methods related to marine mammals, federally-endangered aquatic species (sturgeon and sea turtles), EFH and HAPC:

Underwater Noise/Hydroacoustic Energy

1) Use noise attenuation and minimization measures during pile driving, including:
   a) Surrounding piles with a bubble curtain system.
   b) Using a "soft start" or "ramping up" pile driving (e.g., driving does not begin at 100% energy).
2) Develop an underwater noise monitoring plan to describe the underwater noise generated by project activities and adaptive management measures planned to address the underwater noise.
3) Employ scare charges and fish deterrent boats ahead of blasting activities.
4) Implement an effective quiet time of no pile driving for 12 hours per day.
5) Develop a detailed blast plan with minimization measures, and submit to NOAA Fisheries for review, in advance of any detonation activity.

Turbidity and Sedimentation

1) Limit the amount and extent of turbidity and sedimentation by using appropriate sedimentation and turbidity controls such as silt curtains, settling basins, and cofferdams. The MDTA will specify the measures to be used in the construction plans:
   a) Install erosion control measures prior to ground disturbance;
   b) Inspect daily and maintain continuously in an effective operating condition all ESC measures until such time as they are removed with prior permission from the MDE inspector;
   c) Upon project completion, remove and stabilize all temporary construction materials with sediment and erosion control measures to prevent reentry into waterways.
2) MDTA commits to the use of mechanical dredging.

Reduced Water Quality

1) Avoid, to the greatest extent practicable, the use of creosote or pressure treated (Chromated Copper Arsenate or Alkaline Copper Quaternary etc.) piles and do not locate any treated piles in areas containing shellfish or in sensitive habitats.
2) Remove cofferdams or other diversion structures only after water quality is consistent with ambient levels outside the structure.
3) Remove contaminants and sediments from water discharge prior to entering aquatic habitats.
4) Evaluate dredge material to determine the appropriate disposal method and location.
5) Manage concrete wash water and cooling water effluent from concrete saw operations to ensure they do not enter the Bay untreated.

Habitat Alteration

1) Remove temporary structures and fills including monitoring devices in their entirety. Return aquatic habitats impacted by temporary activities, fills, or structures to pre-construction or better condition, including contours, elevations, substrate, and vegetation.
2) Include methods to document fish stuns/kills in the Underwater Noise Monitoring Plan and coordinate these methods with NOAA Fisheries Habitat and Ecosystem Services Division.

3) Coordinate with GARFO on specific recommended time-of-year restriction dates, based on the proposed activities and location.
4) Staging of activities to reduce intensity of disturbance.
5) Avoiding areas where protected species congregate for spawning/foraging or overwintering.

Vessel Interaction

1) Do not moor vessels in SAV or in such a way that could shade SAV.
2) Enforcement of reduced construction vessel speeds (e.g., below 10 knots).
3) Employing species spotters to reduce species/vessel collisions; and keeping appropriate distance from protected species if spotted.

Impingement and Entrainment

1) Use of construction equipment that reduces potential for impingement and entrainment such as utilizing intake screens and using environmental buckets on mechanical dredges.

As the project progresses through design, avoidance and minimization measures will continue to be evaluated, including implementation of specialized construction methods to ensure the protection of sensitive resources. Specialized construction methods may include time-of-year restrictions, detailed monitoring plans, and project implementation schedules. A number of additional avoidance and minimization methods related to EFH and HAPC will be considered by MDTA in coordination with the resource agencies as design progresses, as outlined in the *EFH Assessment*, **Appendix P.**

The MDTA would also construct and extend culverts and place associated riprap so that movement of aquatic species is not obstructed, with the consideration of open-bottom culverts, where practicable. If existing culverts do not meet current aquatic life passage standards and are being extended rather than replaced, then opportunities for improving aquatic life passage are limited.

MDTA will coordinate with MDNR in later phases of the project to confirm and locate active nesting colonies and to coordinate avoidance and minimization such as colony disturbance buffers and TOYR.

Impacts to SAV would require mitigation at a 3:1 ratio for restoration or in-kind creation, and a 6:1 ratio for enhancement of out-of-kind creation, as regulated by MDE/BPW (COMAR 23.02.01.11). During final design, additional coordination would be required with resource and regulatory agencies including MDNR, MDE, and USEPA, to develop acceptable mitigation opportunities, as required by project permitting. Impacts to SAV would be re-evaluated during permitting based on the five-year composite coverage from VIMS and any recent surveys. MDTA will coordinate with resource agencies on the need for additional SAV surveys in later project phases. The MDTA will incorporate necessary measures to avoid, minimize, or otherwise offset impacts to SAV, as appropriate.

Additional minimization and mitigation strategies related to aquatic biota are discussed in **Section 8, Surface Water Resources**, **Section 9, Waters of the U.S., Including Wetlands**, **Section 12, Chesapeake Bay Critical Area**, and **Section 15, Rare, Threatened, and Endangered Species**.

14 TERRESTRIAL HABITAT AND BIOTA

The resource review area for terrestrial habitat and biota extends 1,000 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split. A large portion of the terrestrial areas associated with the resource review area consists of highly disturbed areas associated with development and transportation infrastructure. The undeveloped portions are largely coastal forests dominated by upland pines and hardwoods as well as nontidal wetland areas.

This section concentrates primarily on the terrestrial habitat provided by the undisturbed forested areas and includes total forest cover, individual trees species, champion and specimen trees, and invasive species. **Section 14.2** provides a description of terrestrial biota, including mammals, birds, amphibians, reptiles, and insect species expected to utilize the resource review area.

Terrestrial habitat also includes wetlands and vernal pools. These resources provide critical terrestrial habitat by supporting diverse plant and animal species that rely on these areas for breeding, foraging, and shelter. Wetlands identified in the resource review area that may also function as vernal pools are noted in the Resource Table in **Appendix E, Wetland Delineation Report**.

14.1 Terrestrial Habitat

14.1.1 Regulatory Context and Methodology

Forest coverage and non-forest habitat types within the resource review area were identified using the Chesapeake Conservancy Land Cover forest layer and cross-referencing it with Maryland iMap Orthoimagery aerial photography, dated 2023 for Anne Arundel County and 2024 for Queen Anne's County. Forest community characteristics typical of the Coastal Plain within this section of Maryland were identified using published resources from MDNR's Wildlife and Heritage Service, including *The Natural Communities of Maryland* (Harrison, 2016) and *Maryland's Key Wildlife Habitats* (MDNR, 2016). Field forest surveys were not performed for this study. Field surveys will be conducted in later phases of design. While no targeted forest surveys were performed, some trees were identified and recorded as part of the wetland field delineations.

It is assumed that all tree impacts outside of the Critical Area would be regulated in accordance with the Maryland Reforestation Law (Maryland Code, 2015 COMAR 08.19). Reforestation Law applies to all highway construction projects with state funding. Replacement of forest cleared for highway projects must be performed on an acre-for-acre basis, on public lands, and within three growing seasons of project completion. Forest impacts within the Critical Area are regulated by the Critical Area Commission or the local jurisdiction (**See Section 12.0, Chesapeake Bay Critical Area**). The State of Maryland describes champion trees through its Big Tree Program, established in 1925 as part of MDNR's Forest Service (MDNR, 2023d). The program identifies and recognizes the largest trees of each species within the state. Champion trees are determined based on a scoring system that considers the tree's height, circumference, and crown spread. The total points awarded determine the champion status.

The term specimen tree refers to mature, notable trees possessing distinctive characteristics that have a specific protection status due to their age and size. Specimen trees are those having a DBH of 30 inches or more, or trees having 75 percent or more of the diameter of the current state

champion tree. Champion, large, and specimen trees in the resource review area would be identified, if required, during final design in coordination with the MDNR per the Maryland Reforestation Law. Maryland has regulations and guidelines related to tree conservation and protection, including those provided for champion trees and specimen trees under the Maryland Reforestation Law and for all trees in the Critical Area under the Critical Area Act.

EO 13112, *Invasive Species*, defines invasive species as alien species whose introduction does, or is likely to cause, economic or environmental harm or harm to human health. In accordance with EO 13112, and as amended by EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species*, no federal agency can authorize, fund, or carry out any action that it believes is likely to cause or promote the introduction or spread of invasive species.

Invasive plant species potentially occurring within the resource review area were identified using published resources, including *Plant Invaders of Mid-Atlantic Natural Areas* (Swearingen et al., 2010), and information from the Maryland Invasive Species Council. While targeted field surveys for invasive species were not conducted, some invasive species were identified and recorded as part of the wetland field delineations performed within the field delineation study limits. The Chesapeake Bay Land Use and Land Cover database was also reviewed to summarize existing non-forest terrestrial habitat found in the resource review area (CBP, 2023).

14.1.2 Affected Environment

The most productive terrestrial habitats within the resource review area include forest and tidal (including shorelines) and nontidal wetlands. Wetland characteristics are described in **Section 9.0, Waters of the U.S., including Wetlands** and **Appendix E: Wetland and Waterway Delineation Report**. Forest habitats in the review area encompass a diverse array of forest communities dominated by a mix of hardwood and pine forests. One prevalent forest community is the pine-oak heath forest, characterized by a mixture of pines, such as loblolly (*Pinus taeda*) and longleaf pine (*Pinus palustris*), and oaks (*Quercus spp*.). This community thrives in the sandy soils of the Coastal Plain and supports a variety of plant and animal species adapted to these conditions. Bottomland hardwood forests are also located within the resource review area. These forests consist of a mix of hardwood species including oaks, hickories (*Carya spp*.), maple (*Acer spp*.), and gum (*Nyssa spp.)* and are found along the wide floodplains of Coastal Plain rivers and streams. The periodic flooding helps to rejuvenate the soil and contributes to the overall health and diversity of the bottomland hardwood forest ecosystem. Another forest community prevalent within the resource review area is the tidal hardwood swamp. These communities are typically dominated by pumpkin ash (*Fraxinus profunda*) and swamp black gum (*Nyssa biflora*) and are located within areas subject to flooding, within the tidal reaches of the resource review area.

Forest cover constitutes the largest land cover category within the Anne Arundel County portion of the resource review area. The largest forested tracts are associated with the stream valleys and floodplain of major waterways such as Mill Creek, Whitehall Creek, and Meredith Creek. The Queen Anne's County section of the resource review area contains scattered areas of forested habitat through the Kent Island area due to the high level of development. The easternmost section of the resource review area is also highly developed in the area just east of Kent Island but transitions to forested tracts and agricultural land within the easternmost section (Maryland iMap; Maryland Land Use 2018).

Forest cover within the resource review area was identified using the Chesapeake Conservancy Land Cover forest layer and cross-referencing it with Maryland iMap Orthoimagery aerial photography, dated 2023 for Anne Arundel County and 2024 for Queen Anne's County. **Figure 14-1** and **Figure 14-2** provide a depiction of existing forest cover. Total forest cover is 960 acres, which is 20 percent of the total resource review area. FIDS habitat represents contiguous forest areas, which are important habitat for a number of terrestrial species. FIDS habitat is discussed in **Section 12, Chesapeake Bay Critical Area**.

Figure 14-1: Forest – Anne Arundel County

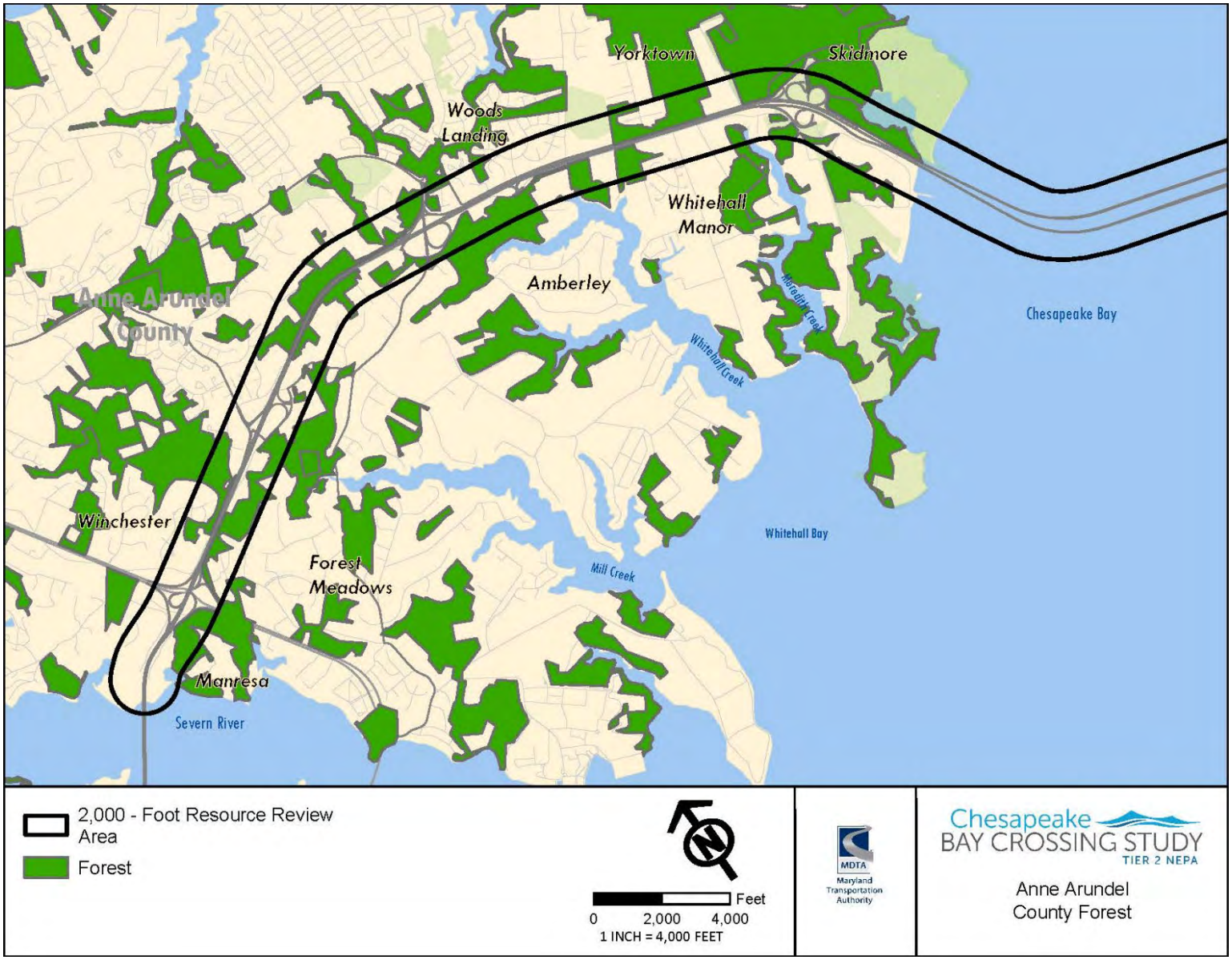
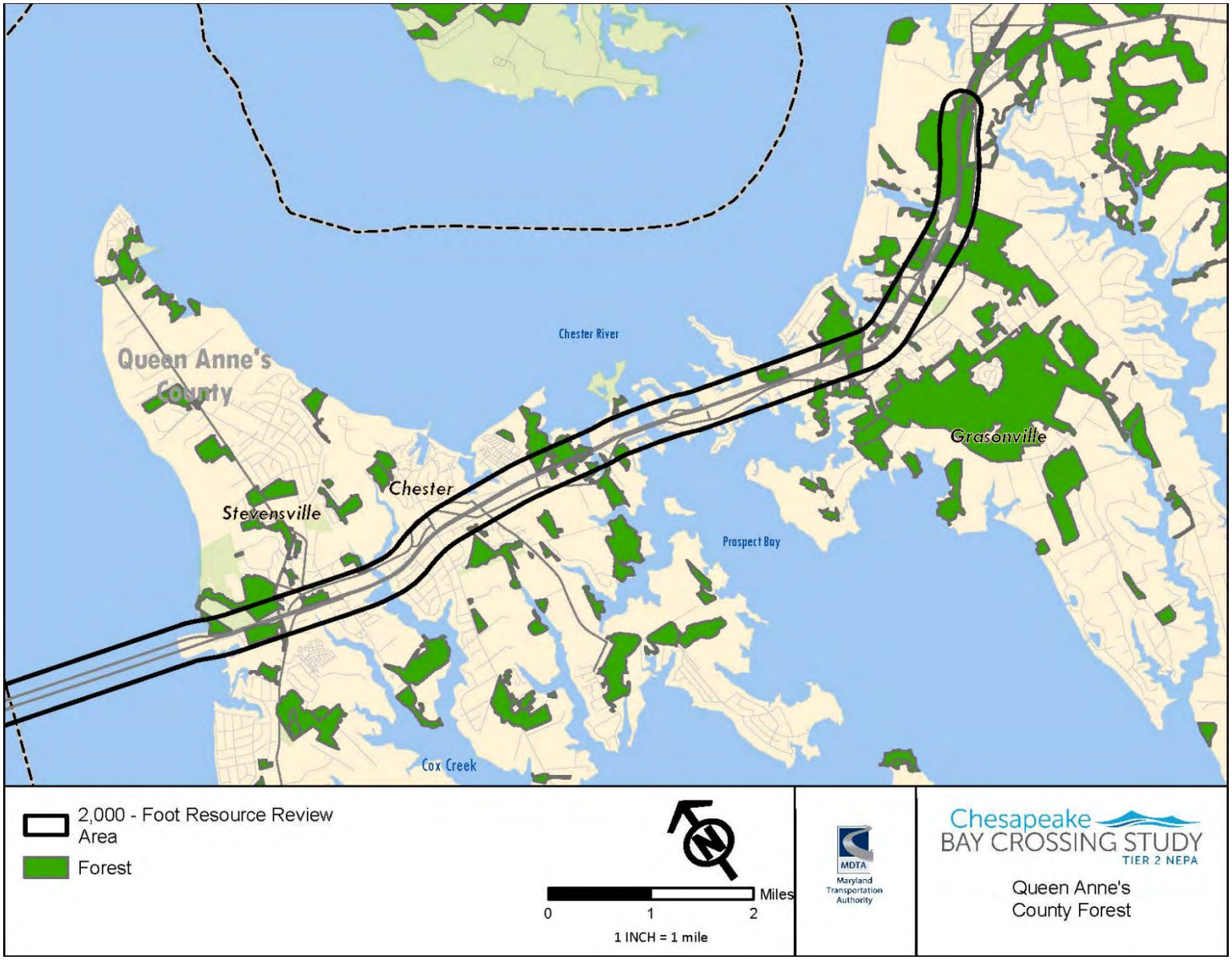


Figure 14-2: Forest Cover – Queen Anne's County



Although a forest survey has not yet been performed for the project, tree species were identified and recorded during the wetland delineations performed within the wetland delineation field study limits. **Table 14-1** identifies the tree species identified during the wetland field delineations.

Table 14-1: Tree Species Identified

Common Name	Scientific Name	Common Name	Scientific Name
Black cherry	*Prunus serotina*	Boxelder	*Acer negundo*
Sweetgum	*Liquidambar styraciflua*	American elm	*Ulmus americana*
Silver maple	*Acer saccharinum*	Persimmon	*Diospryos virginiana*
Red maple	*Acer rubrum*	River birch	*Betula nigra*
Eastern red cedar	*Juniperus virginiana*	Basswood	*Tilia americana*
Black oak	*Quercus velutina*	Tulip poplar	*Liriodendron tulipifera*
Southern red oak	*Quercus falcata*	American hophornbeam	*Ostrya virginiana*
Pin oak	*Quercus palustris*	American hornbeam	*Carpinus caroliniana*
White oak	*Quercus alba*	Black gum	*Nyssa sylvatica*
Swamp white oak	*Quercus bicolor*	Callery pear	*Pyrus calleryana*
Willow oak	*Quercus phellos*	Green ash	*Fraxinus pennsylvanica*
Northern red oak	*Quercus rubra*	American sycamore	*Platanus occidentalis*
Chestnut oak	*Quercus montana*	White mulberry	*Morus alba*
Weeping willow	*Salix babylonica*	Mockernut hickory	*Carya tomentosa*
Black willow	*Salix nigra*	Bitternut hickory	*Carya cordiformis*
Black locust	*Robinia pseudoacacia*	Shellbark hickory	*Carya laciniosa*
Loblolly pine	*Pinus taeda*	Persian silk tree	*Albizia julibrissin*
Eastern white pine	*Pinus strobus*	Princess tree	*Paulownia tomentosa*
Pitch pine	*Pinus rigida*	Black walnut	*Juglans nigra*
American holly	*Ilex opaca*	American beech	*Fagus grandifolia*

Although Maryland's Big Tree Program does not provide specific location information, Anne Arundel County has 117 listed big trees and Queen Anne's County has 45 listed big trees.

Targeted surveys for invasive species will be performed during final design. **Table 14-2** provides a list of non-native plant species listed as invasive (Swearingen et al., 2010) that could potentially occur within the resource review area per review of published resources as well as invasive species that were identified during the wetland delineation field delineations.

Table 14-2: Invasive Plant Species

Common Name	Scientific Name	Common Name	Scientific Name
Aquatic Plants			
Eurasian water-milfoil	*Myriophyllum spicatum*	Parrot-feather	*Myriophyllum aquaticum*
Giant salvinia	*Salvinia molesta*	Water chestnut	*Trapa natans*
Hydrilla	*Hydrilla verticillata*	-----	-----
Grasses and Sedges			
Bamboo*	*Bambusa vulgaris*	Japanese stiltgrass*	*Microstegium vimineum*
Bog bulrush	*Schoenoplectus mucronatus*	Wavyleaf basketgrass*	*Oplismenus hirtellus ssp*
Common reed*	*Phragmites australis*	-----	-----
Herbaceous			
Beefsteak plant*	*Perilla frustescens*	Garlic mustard*	*Alliaria petiolata*
Canada thistle	*Cirsium arvense*	Ground ivy*	*Glechoma hederacea*
Chinese lespedeza	*Lespedeza cuneata*	Japanese knotweed	*Fallopia japonica*
Common daylily*	*Hemerocallis fulva*	Nodding star of Bethlehem	*Ornithogalum nutans*
Dame's rocket	*Hesperis matronalis*	Sleepydick	*Ornithogalum umbellatum*
European stinging nettle	*Urtica dioica*	Purple loosestrife*	*Lythrum salicaria*
Fig buttercup	*Ficaria verna*	Spotted knapweed	*Centaurea stoebe ssp.*
Shrubs			
Amur honeysuckle*	*Lonicera maackii*	Morrow's honeysuckle*	*Lonicera morrowii*
Autumn olive*	*Elaeagnus umbellata*	Multiflora rose*	*Rosa multiflora*
Japanese barberry*	*Berberis thunbergii*	Privet*	*Ligustrum obtusifolium*
Japanese meadowsweet	*Spiraea japonica*	Wineberry*	*Rubus phoenicolasius*
Linden viburnum	*Viburnum dilatatum*	Winged burning bush	*Euonymus alatus*
Trees			
Callery pear*	*Pyrus calleryana*	Silk tree*	*Albizia julibrissin*
Norway maple	*Acer platanoides*	Tree of heaven	*Ailanthus altissima*
Paper mulberry	*Broussonetia papyrifera*	White mulberry*	*Morus alba*
Princess tree*	*Paulownia tomentosa*	-----	-----
Vines			
Black swallow-wort	*Cynanchum louiseae*	Kudzu	*Pueraria montana*
Chinese wisteria	*Wisteria sinensis*	Mile-a-minute*	*Persicaria perfoliata*
Chocolate vine	*Akebia quinata*	Oriental bittersweet*	*Celastrus orbiculatus*
Common periwinkle	*Vinca minor*	Pale swallow-wort	*Cynanchum rossicum*
English ivy*	*Hedera helix*	Porcelainberry*	*Ampelopsis brevipedunculata*
Japanese honeysuckle*	*Lonicera japonica*	Sweet autumn virginsbower	*Clematis terniflora*
Japanese hop	*Humulus japonicus*	Winter creeper	*Euonymus fortunei*
Japanese wisteria*	*Wisteria floribunda*	-----	-----

* *Identified during wetland delineation field work*

Non-forest terrestrial habitats located in the resource review area include shorelines, field/grassland, scrub/shrub, low vegetation (such as mowed lawns and landscaping), barren land, and emergent wetlands. Several large tracts of freshwater and estuarine wetlands were identified and surveyed as part of the wetland field delineations performed. See **Section 9, Waters of the U.S., including Wetlands** for detailed descriptions of these resources. Wetlands are very typically a transitional area between land and water, supporting a diverse array of both aquatic and terrestrial species. They can provide essential habitat and food sources. Vernal pools for example are temporary habitats that form during rainy seasons when water collects in natural depressions. These pools provide a natural environment for specialized species that adapt to intermittent water availability. It is common to have some species' breeding cycles correlate directly with the vernal pool's emergence.

Common reed was the most prevalent invasive species identified during the wetland delineation field work. The resource review area contains large freshwater and tidal emergent wetlands dominated by common reed (see **Appendix E**).

14.1.3 Environmental Consequences

Proposed build alternatives were evaluated to determine potential project impacts to terrestrial habitat. Potential impacts include habitat fragmentation, the disruption of wildlife habitats and migration corridors, overall ecosystem connectivity, and the introduction and spread of invasive plant species.

14.1.3.1 No-Build Alternative

The No-Build Alternative would have no additional impact to terrestrial habitats.

14.1.3.2 Build Alternatives

Construction of the build alternatives would involve the physical removal and disturbance of vegetated areas. Impacts from the build alternatives were evaluated based primarily on the most productive vegetated habitats in the review area, which includes forests and wetlands. Impacts to wetlands that may also provide habitat to terrestrial species are identified in **Section 9, Waters of the U.S., Including Wetlands**. Impacts to FIDS habitat are identified in **Section 12, Chesapeake Bay Critical Area**. **Table 14-3** identifies the total acreage of mapped forested areas within each build alternative. **Table 14-4** identifies the total acreage of mapped forested areas within the SUP areas associated with each build alternative.

Table 14-3: Forest Impacts

Resource	No-Build	Build Alternative					
		B	C	D	E	F	G
Mapped Forested Area (acres)	0	27.3	27.3	87.2	87.2	88.6	88.6

Table 14-4: SUP Forest Impacts

Resource	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
Mapped Forested Area (acres)	0	0.5	0.2	0.5	0.2	0.5	0.2

Potential forest impacts would be at least three times greater for Alternatives D, E, F, and G, than they would for Alternatives B and C. This is directly correlated to the shorter length of Alternatives B and C along U.S. 50/301. The largest area of mapped forest in Anne Arundel County that is impacted by all build alternatives is located east of Oceanic Drive, north of U.S. 50/301. This is located largely surrounding Mezick pond, and adjacent to a Habitat Protection Area north of Mezick Pond (described in greater detail in **Section 15, Rare, Threatened, and Endangered Species**). Field evaluations and review of imagery reveal that much of this area west of Mezick Pond would not be considered forest; however, it would still function as terrestrial habitat. More significant areas of mapped forest in Anne Arundel County that would be impacted only by Alternatives D, E, F, and G include undeveloped areas near the headwaters of Mill Creek and Whitehall Creek. The addition of a SUP option would result in 0.2 acres of additional forest impacts for any of the southern alternatives, Alternatives C, E, and G, and 0.5 acres of additional forest impacts for any of the northern alternatives, Alternatives B, D, and F.

The largest area of mapped forest in Queen Anne's County that would be impacted by all build alternatives is located between the eastern shoreline of the Chesapeake Bay and MD 8. This area, however, has undergone several disruptions in recent years due to development in and surrounding the Chesapeake Bay Marina. More substantial areas of mapped forest in Queen Anne's County that would be impacted only by Alternatives D, E, F, and G include a large tract of forest north of U.S. 50/301, just west of the split into two roadways. Most of the proposed disturbance to terrestrial habitat associated with any build alternative is in areas of existing forest edge or already fragmented habitat, typical of an existing transportation corridor like U.S. 50/301.

During final design, impacts to specimen trees will be determined during field forest surveys performed to determine the tree's location, species, size, and health.

14.1.4 Avoidance, Minimization, and Further Mitigation Strategies

The MDTA would approach design and development with the goal of minimizing and further mitigating impacts to terrestrial habitat. During final design, a formal forest stand delineation would be performed to identify the limits of forested areas, regulated under the Maryland Reforestation Law or Critical Area Law, and the location and condition of any specimen trees.

Forest impacts outside of the Critical Area would adhere to the requirements identified within the Maryland Reforestation Law authorization. Impacts to forests and trees within the Critical Area would adhere to the Critical Area authorization requirements. Either authorization would provide the impact minimization requirements which may include:

- Tree Protection Zones (TPZ) – Establishment of clearly marked boundaries around forested areas to prevent encroachment during construction; protective fencing at the

edge of individual trees critical root zones (1.5 times DBH); no heavy equipment storage or soil compaction within the TPZ.

- Erosion and Sediment Controls – Installation of silt fence or other erosion control measures to prevent excess sediment from damaging tree roots.
- Root Protection – Minimization of excavation and trenching near root zone.
- Monitoring and Maintenance – Perform regular inspections of tree protection measures throughout the construction period.

Per the requirements established under EO 13112, the MDTA would prioritize minimization of the spread of existing, or introduction of additional invasive species. During construction this would be accomplished by avoiding invasive species hot spots whenever possible and incorporating best practices, including:

- Cleaning equipment before entering or leaving the site to prevent transferring seeds or plant material.
- Limiting soil disturbance.
- Preserving native vegetation.
- Integrated Vegetation Management can also be an effective tool to control invasive plants and maintain native and diverse vegetation along the forest edge over the long term.

For unavoidable impacts, mitigation strategies would focus on controlling the spread of invasive species and restoring the affected areas. These include removing invasive species mechanically or chemically prior to the start of construction activities and replanting with native vegetation. The native vegetation would help to restore biodiversity.

Additional minimization and mitigation strategies related to terrestrial habitat are discussed in **Section 12, Chesapeake Bay Critical Area** and **Section 15, Rare, Threatened, and Endangered Species**.

14.2 Terrestrial Biota

Maryland is home to an estimated 90 species of mammals, 93 species and subspecies of reptiles and amphibians, more than 400 species of birds, and an untold number of insect and other invertebrate species including crustaceans, spiders, and mollusks (MDNR, 2023e).

14.2.1 Regulatory Context and Methodology

Several federal and state regulations protect terrestrial wildlife in Maryland. The protection of all migratory birds is governed by the MBTA (16 USC 703-712), under which it is illegal to “take, kill, possess, transport, or import migratory birds or any part, nest, or egg of any such bird” unless authorized by a valid permit. In accordance with the U.S. Department of the Interior Acting Solicitor’s legal opinion (M-37085) dated April 11, 2025, the MBTA does not prohibit ‘incidental’ (i.e., accidental, not intentional) take of migratory birds, including occupied nests. Thus, only intentional take of migratory birds, including occupied nests, is prohibited by the MBTA. A list of migratory birds protected by the MBTA is included in 50 CFR 10.13 and includes most of the species found within Maryland. Under the Fish and Wildlife Conservation Act (16 USC 2901-2912), the USFWS has developed a list of migratory birds that might become candidates for listing under the ESA (16 USC 1531-1543) known as Birds of Conservation Concern (BCC) (USFWS,

2021). These BCC are particularly at risk from further degradation of their habitats, and federal agencies are encouraged to consider these species in accordance with EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*.

The Bald and Golden Eagle Protection Act (16 USC 668-668c) prohibits the take, possession, sale, purchase, barter, transport, export, or import of any Bald or Golden Eagle (alive or dead), including any part (such as feathers), nest, or egg without a valid permit issued by the Secretary of the Interior (50 CFR 22.3). The Act prohibits disturbance of any bald or golden eagle; to "disturb" includes agitating or bothering "to a degree that causes, or is likely to cause, based on scientific information available: 1) injury to an eagle; 2) a decrease in productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

The conservation of terrestrial wildlife in Maryland is managed through the implementation of the State Wildlife Action Plan (SWAP). SWAPs were initiated by the USFWS in 2005, requiring all 50 states and the District of Columbia to create a conservation plan for wildlife species and to determine those Species of Greatest Conservation Need (SGCN) as a condition for receiving funding through the State and Tribal Wildlife Grants program, which provides funding to eligible states to assist with the conservation of at-risk species before they become threatened or endangered. The SWAP must be updated every 10 years, and Maryland prepared its most recent SWAP in 2015 (MDNR, 2016).

In Maryland, colonial waterbird nesting areas and FIDS habitat are regulated as protected resources within the Critical Area and are discussed further in **Section 12, Chesapeake Bay Critical Area** and **Section 13 Aquatic Habitat and Biota**. Colonial waterbirds and migratory birds are also protected under the MBTA. Field investigations/surveys for terrestrial biota were not conducted for the project; however, incidental observations of species made during the preliminary wetland field delineations were recorded species.

14.2.1.1 Terrestrial Mammals

A review of publicly available literature was conducted to identify mammals likely to occur within the resource review area, where the range and habitat of the species includes all or part of the resource review area. This included reports on mammals available from MDNR and USFWS, and a review of recent field guides and range maps.

14.2.1.2 Reptiles and Amphibians

Reptile and amphibian species known to occur or that have the potential to occur within the resource review area were assessed by conducting a review of publicly available literature, online sources, reports from MDNR and USFWS, a review of field guides, and professional judgement. Sources included *The Reptiles and Amphibians of Maryland: Taxonomy Based on Crother 2017* (MDNR, 2023g) and *The Maryland Amphibian and Reptile Atlas* (MARA; MDNR, 2018). The MARA project was a 5-year survey of reptile and amphibian species found in Maryland, conducted between January 2010 and December 2014. Data for the MARA project were collected through citizen observations as well as from data provided by HerpMapper, the Herpetological Education and Research Project, the Maryland Biodiversity Project, the MBSS, and the Maryland Marine Mammal and Sea Turtle Stranding Network.

14.2.1.3 Birds

The occurrence of breeding birds within the resource review area, or nearby areas within the watershed crossed by the resource review area, was documented from breeding bird data obtained from the Maryland & DC Breeding Bird Atlas 3 (MD-DC BBA3). The MD-DC BBA3 is a 5-year survey of breeding birds within Maryland and the District of Columbia conducted between January 2020 and December 2024. The MD-DC BBA3 surveys are conducted by volunteers, and data is compiled using the MD-DC BBA3 portal in eBird, an online data collection platform managed by the Cornell Lab of Ornithology. Volunteers collect data within designated atlas blocks measuring approximately 10 square miles each. Observers record species observed as well as a behavior code for each species to identify the likelihood of the species to be breeding in the observed location. A breeding status (Observed, Possible, Probable, or Confirmed) is assigned to identify the likelihood that the species is breeding within the block (MOS, 2020). Data was obtained on March 25, 2025, for the 2020-2024 field seasons from breeding bird survey results on eBird (MD-DC BBA3, 2025). MD-DC BBA3 blocks that intersected with the resource review area were reviewed to compile a list of species observed. This list was then cross-referenced with USFWS' list of BCC (USFWS, 2021).

In addition to a review of MD-DC BBA3 data, protected migratory bird occurrence information was obtained from the USFWS Information for Planning and Consultation (IPaC) online system. Peregrine Falcon nesting site information was obtained from MDNR, and Bald Eagle nesting site information was obtained from the Maryland Bird Conservation Partnership's Maryland Bald Eagle Nest Monitoring Program.

14.2.2 Affected Environment

14.2.2.1 Terrestrial Mammals

Based on a review of field guide range maps, 42 mammal species were identified as potentially occurring in the resource review area, as shown in **Table 14-5** (MDNR, 2023f; Webster et al., 1985). Of these, 13 species are considered SGCN (MDNR, 2016).

Table 14-5: Terrestrial Mammal Species Potentially Occurring Within the Resource Review Area

Common Name	Scientific Name	Common Name	Scientific Name
Opossum	*Didelphis virginiana*	Southern flying squirrel	*Glaucomys volans*
Masked shrew	*Sorex cinereus*	American beaver*	*Castor canadensis*
Southeastern shrew[1]	*Sorex longirostris*	Marsh rice rat	*Oryzomys palustris*
Northern short-tailed shrew	*Blarina brevicauda*	White-footed mouse	*Peromyscus leucopus*
Least shrew[1]	*Cryptotis parva*	Meadow vole	*Microtus pennsylvanicus*
Eastern mole	*Scalopus aquaticus*	Woodland vole	*Microtus pinetorum*
Southeastern star-nosed mole[1]	*Condylura cristataparva*	Common muskrat	*Ondatra zibethicus*
Little brown bat[1]	*Myotis lucifugus*	Norway rat	*Rattus norvegicus*
Northern long-eared bat[1]	*Myotis septentrionalis*	House mouse	*Mus musculus*
Silver-haired bat[1]	*Lasionycteris noctivagans*	Meadow jumping mouse	*Zapus hudsonius*
Tricolored bat[1]	*Perimyotis subflavus*	Coyote	*Canis latrans*
Big brown bat[1]	*Eptesicus fuscus*	Red fox	*Vulpes vulpes*
Eastern red bat[1]	*Lasiurus borealis*	Gray fox	*Urocyon cinereoargentius*
Hoary bat[1]	*Lasiurus cinereus*	Raccoon*	*Procyon lotor*
Evening bat[1]	*Nycticeius humeralis*	Striped skunk	*Mephitis mephitis*

Common Name	Scientific Name	Common Name	Scientific Name
Eastern cottontail*	*Sylvilagus floridanus*	Long-tailed weasel	*Mustela frenata*
Eastern chipmunk	*Tamias striatus*	Mink[1]	*Neovison vison*
Groundhog	*Marmota monax*	North American river otter	*Lontra canadensis*
Eastern gray squirrel*	*Sciurus carolinensis*	White-tailed deer*	*Odocoileus virginianus*
Delmarva fox squirrel[1]	*Sciurus niger cinereus*	-----	-----

[1] *Denotes Species of Greatest Conservation Need (SGCN)*
* *Denotes species observed incidentally during 2023 wetland field delineations.*
Sources: MDNR, 2023f; Webster et al., 1985

14.2.2.2 Reptiles and Amphibians

The resource review area crosses eight MARA project atlas blocks, and 40 species (19 reptile and 21 amphibian species) were documented as occurring within these blocks during the 2010-2014 MARA project; seven species are considered SGCN as shown in **Table 14-6** (MDNR, 2016). Eight reptile species and four amphibian species were observed incidentally while conducting wetland filed delineations.

Table 14-6: Amphibian and Reptile Species Documented Within the Resource Review Area

Common Name	Scientific Name	Common Name	Scientific Name
Spotted salamander	*Ambystoma maculatum*	Eastern spadefoot	*Scaphiopus holbrookii*
Marbled salamander	*Ambystoma opacum*	Snapping turtle*	*Chelydra serpentina*
Northern dusky salamander	*Desmognathus fuscus*	Painted turtle*	*Chrysemys picta*
Northern two-lined salamander	*Eurycea bislineata*	Diamond-backed terrapin[1]	*Malaclemys terrapin*
Four-toed salamander	*Hemidactylium scutatum*	Northern red-bellied cooter*	*Pseudemys rubriventris*
Eastern red-backed salamander	*Plethodon cinereus*	Eastern box turtle[1]*	*Terrapene carolina*
Mud salamander[1]	*Pseudotriton montanus*	Red-eared slider*	*Trachemys scripta elegans*
Red salamander[1]	*Pseudotriton ruber*	Eastern mud turtle	*Kinosternon subrubrum*
American toad	*Anaxyrus americanus*	Common five-lined skink	*Plestiodon fasciatus*
Fowler's toad	*Anaxyrus fowleri*	Broad-headed skink	*Plestiodon laticeps*
Eastern cricket frog	*Acris crepitans*	North American racer	*Coluber constrictor*
Cope's gray treefrog	*Hyla chrysoscelis*	Eastern kingsnake[1]	*Lampropeltis getula*
Green treefrog	*Hyla cinerea*	Rough greensnake	*Opheodrys aestivus*
Spring peeper*	*Pseudacris crucifer*	Eastern ratsnake*	*Pantherophis alleghaniensis*
New Jersey chorus frog	*Pseudacris kalmi*	Common wormsnake	*Carphophis amoenus*
American bullfrog	*Lithobates catesbeianus*	Ring-necked snake	*Diadophis punctatus*
Green frog*	*Lithobates clamitans*	Common watersnake*	*Nerodia sipedon*
Pickerel frog*	*Lithobates palustris*	Dekay's brown snake	*Storeria dekayi*
Southern leopard frog*	*Lithobates sphenocephalus*	Common gartersnake*	*Thamnophis sirtalis*
Wood frog	*Lithobates sylvaticus*	Eastern copperhead	*Agkistrodon contortrix*

[1] *Denotes Species of Greatest Conservation Need (SGCN)*
* *Denotes species observed incidentally during 2023 wetland delineation field work.*

Common Name	Scientific Name	Common Name	Scientific Name

Source: MDNR, 2018

The MDNR Environmental Review Program letter of January 23, 2024 (**Appendix L**) identified diamond-backed terrapin nesting habitat within the 2-mile-wide Tier 1 study corridor, which includes the resource review area. West of the Bay Bridge, this habitat is on beaches along Meredith Creek and on the Chesapeake Bay mainstem shoreline south of the Bay Bridge along Moss Pond, reaching the northern part of Goose Pond. On the Eastern Shore, nesting habitat is located south of the bridge on the Chesapeake Bay mainstem shoreline, and along the northern shores of Kent Island near Kent Narrows and on Long Point, continuing eastward to Queenstown.

14.2.2.3 Birds

The resource review area crosses eight MD-DC BBA3 blocks, and 228 species were documented across all eight blocks, with 71 species confirmed to be breeding in at least one of the blocks (20 species were coded as Probable, 10 as Possible, and 127 as Observed). Of the documented species, 92 are considered SGCN (MDNR, 2016), 22 are considered Birds of Conservation Concern (BCC) by the USFWS (USFWS, 2021), and 19 species are considered FIDS (CAC, 2000). Forty-eight species of birds were observed incidentally in the resource review area during wetland delineation field delineations.

Bird species documented in the reviewed MD-DC BBA3 blocks, their breeding status, conservation status, and whether they were observed incidentally are provided in **Appendix J: Bird Species Documented in the Resources Review Area,** which lists all species observed in multiple blocks with differing breeding evidence codes listed under their highest documented code.

Table 14-7 lists SGCN and BCC bird species documented by the MD-DC BBA3 as being confirmed, probable, or possible for breeding in atlas blocks intersected by the resource review area. These species were then grouped into four generalized habitat categories: Forest (to include forest edges); Shoreline; Field/Grassland (to include scrub/shrub); and Wetland to facilitate discussion of potential impacts to habitats utilized by these species of concern. Some species can be found in more than one habitat but are listed in **Table 14-7** under their primary habitat category.

As noted in **Appendix L**, other SGCN or BCC were "observed" during the MD-DC BBA3, but were less likely, or not likely to be breeding residents in the area and are considered migrants or winter residents. Migrants, wintering residents, and species that showed no evidence of breeding were excluded from **Table 14-7**. While these species do not use the area for breeding, a critical component of species survival, impacts to the resource review area could affect their migratory or wintering grounds.

Table 14-7: BCC and SGCN Bird Species Likely Breeding Within the Review Area By Habitat

Common Name	Scientific Name	Common Name	Scientific Name
Habitat Type: Forest			
Chimney Swift[1, 3, P]	*Chaetura pelagica*	Ovenbird[1, 2, P]	*Seiurus aurocapilla*

Common Name	Scientific Name	Common Name	Scientific Name
American Woodcock[1, P]	*Scolopax minor*	Black-and-white Warbler[1, 2, S]	*Mniotilta varia*
Bald Eagle[1, C] *	*Haliaeetus leucocephalus*	Northern Parula[1, 2, S]	*Setophaga americana*
Acadian Flycatcher[1, 2, C]	*Empidonax virescens*	Scarlet Tanager[1, 2,3, P]	*Piranga olivacea*
Wood Thrush[1, 2, 3, P]	*Hylocichla mustelina*	---	---
Habitat Type: Shoreline			
Willet[1, 3, C]	*Tringa semipalmata*	Common Tern[1, C]	*Sterna hirundo*
Spotted Sandpiper[1, S]	*Actitis macularius*	Peregrine Falcon[1, C]	*Falco peregrinus*
Least Tern[1, 3, C]	*Sternula antillarum*	---	---
Habitat Type: Field/Grassland			
Grasshopper Sparrow[1, 3, P]	*Ammodramus savannarum*	Northern Bobwhite[1, S]	*Colinus virginianus*
Yellow-breasted Chat[1, 3, P]	*Icteria virens*	American Kestrel[1, S]	*Falco sparverius*
Habitat Type: Wetland			
Snowy Egret[1, C]	*Egretta thula*	Sora[1, S]	*Porzana carolina*
Great Egret[1, C]	*Ardea alba*	Least Bittern[1, S]	*Ixobrychus exilis*
Great Blue Heron[1, C] *	*Ardea herodias*	Marsh Wren[1, P]	*Cistothorus palustris*

[1] Denotes Species of Greatest Conservation Need (SGCN); [2] Denotes Forest Interior Dwelling Species; *[3] Denotes Birds of Conservation Concern (BCC); [C] Denotes confirmed breeding status; [P] Denotes probable breeding status; [S] Denotes possible breeding status; * Denotes species observed incidentally during 2023 wetland field delineations.*
Source: MD-DC BBA3, 2025; USFWS, 2021;

A review of the Maryland Bird Conservation Partnership's Maryland Bald Eagle Nest Monitoring Program was conducted on October 31, 2023. One Bald Eagle nest is known to be present within the resource review area. The nest is in Stevensville, MD, located west of MD 8, approximately 1,200 feet north of U.S. 50/301. Correspondence with MDNR WHS (dated January 18, 2024; **Appendix M**) indicated the potential presence of several protected nesting bird species within the 2-mile-wide Tier 1 study corridor, which includes the resource review area, including the Least Tern, Sora, Black Rail (*Laterallus jamaicensis*), Peregrine Falcon, Great Egret, Snowy Egret, Cattle Egret, Black-Crowned Night Heron, and Great Blue Heron. However, additional correspondence with MDNR noted that the Black Rail has not been documented as breeding in Sandy Point State Park in the last 25 years and is therefore not of concern. The presence of several of these species within the resource review area is discussed further in **Section 15, Rare, Threatened, and Endangered Species** and the herons and egrets are also discussed in **Section 13.9, Colonial Waterbird Nesting Areas**.

14.2.3 Environmental Consequences

The MDTA evaluated potential impacts to terrestrial wildlife including birds, mammals, reptiles, and amphibians. Species impacts have the potential to result from habitat loss, fragmentation, or degradation. Impacts to species can also be a direct result of active construction.

14.2.3.1 No-Build Alternative

The No-Build Alternative would have no additional impact to terrestrial biota.

14.2.3.2 Build Alternatives

The proposed build alternatives were evaluated with respect to potential impacts to terrestrial biota based on the total amount of terrestrial habitat within the limits of each build alternative. All the build alternatives would impact terrestrial biota through the direct loss of habitat, including forest cover, non-forested vegetated edge areas, and wetlands. Impacts to species can also be a direct result of active construction. Per the results identified in **Section 14.1, Terrestrial Habitat,** and **Section 9.1, Regulated Wetlands and Waterways,** the largest potential for impacts to terrestrial wildlife habitat is associated with Alternatives D, E, F, and G, as these alternatives extend farther east and west, along U.S. 50/301 and impact substantially more habitat. Alternatives B and C would result in approximately three times less mapped forest habitat impact, and approximately two times less delineated wetland habitat impact than the other build alternatives. The greatest potential project-related wildlife impacts would occur from Build Alternative F, which would result in the greatest forest and wetland impacts. The addition of a SUP option with any of the northern alternatives, Alternatives B, D, and F would result in more than twice the mapped forest habitat impact than would occur with the addition of a SUP option with any of the southern alternatives.

Loss of forest can create barriers for animal movement, isolating populations and reducing genetic diversity. FIDS are particularly vulnerable to loss of large interior forests designated as FIDS habitat. Although FIDS habitat is a valuable resource and there is guidance for protections from project disturbance, FIDS habitat is not directly regulated outside the Critical Area and therefore impacts to FIDS habitat are discussed in **Section 12, Chesapeake Bay Critical Area**.

The majority of terrestrial biota impacts for all build alternatives would occur within habitat edges along the existing roadways. These habitats have already been impacted by the increasingly developed landscape and the species they support are primarily opportunistic edge-type species that are found in urban and suburban areas. In forested areas, impacts from roadway widening would remove existing edge habitat, and shift the limits of edge habitat towards more interior habitats. This shifting of edge habitat is not anticipated to alter the wildlife assemblages in these areas but may slightly shrink available interior habitats, potentially reducing disturbance-sensitive species like FIDS. This potential is greatest with Alternative D, E, F and G.

There are 24 total species of potential breeding birds in need of conservation (SGCN and BCC) in the resource review area (**Table 14-7**) and the number of species potentially impacted in each of the four habitat categories ranges from four (field/grassland) to nine (forest). The nine forest species are comprised mostly of FIDS, which generally avoid the fragmented forest patches or scrubby edge habitat that characterizes most of the forests impacted by the build alternatives. As noted above, impacts to these species would primarily be related to a slight reduction in available interior habitat as the forest edge is shifted inward. Reductions in available habitat would be of particular concern for BCC and SGCN species, many of which are in decline due to habitat loss and other stressors. Alternatives B and C would impact these species the least (27.3 acres) while Alternatives D, E, F and G would impact three times more forest edge habitat.

Six species of documented birds of concern occupy wetland habitats during the breeding season, but only three of those (Snowy and Great Egrets and Great Blue Heron) were documented as confirmed breeders (birds showing strong evidence of nesting) in the resource review area during the MD-DC BBA3. The additional three species were documented as either possible breeders (birds observed in the habitat but showing no obvious nesting behavior) or probable breeders (birds showing behaviors implying they intend to nest or may be nesting). General effects to these

species would primarily be a shift in their feeding grounds, as they have relatively diverse diets and can occur anywhere there is water nearby. However, a Great Blue Heron colony is located on Mezick Pond that could be impacted, particularly by the northern build alternatives, Alternatives B, D, and F (See **Section 13.8.3** for more discussion).

The fewest number of SGCN and BCC species in any habitat categories occupy shorelines or fields/grasslands, habitat categories that will see the least area of impact from any of the build alternatives as shorelines occupy a relatively narrow zone, and grasslands/meadows are limited within the corridor. Most of the potential shoreline impacts, affecting shorebird habitat are common to all the build alternatives along the Chesapeake Bay and Cox Creek, but Alternatives D, E, F, and G also could impact shoreline areas at Kent Narrows. Very few grassland or meadow habitats exist within the alternatives and the small areas that do are at the eastern end of the study limits. Impacts to these habitats and the SGCN/BCC species that could occupy them would be minimal for all alternatives, though slightly higher for Alternatives D, E, F, and G which extend to the eastern limits.

Impacts to wildlife within an existing transportation corridor are often directly related to construction activities. Less mobile wildlife (e.g., turtles, salamanders, or small mammals like moles and voles) have a greater potential to be killed during construction than other more mobile species (e.g., birds, including waterfowl and falcons, and larger mammals like deer and fox). Movement of species from construction disturbance, however, also increases the potential for mortality from vehicle strikes. This effect would be most substantial within the smallest fragmented forest stands surrounded by development, where the remaining habitat is too small to support wildlife populations. Because the project will improve an existing roadway corridor primarily populated by edge and disturbance acclimated species, impacts are anticipated to be minimal. In addition, impacts to potential FIDS habitat would be minor, resulting from slightly contracted forest interiors.

Construction activities also generate noise, vibration, and light pollution, disturbing wildlife behavior and stressing sensitive species. Noise from equipment can disrupt communications, mating calls, and predator-prey interactions.

Bald Eagles occupying the known eagle nest located in the resource review area along MD 8, could potentially be impacted by the project. USFWS guidance recommends a buffer of 660 feet for any activities visible from the nest, and activities in the vicinity of the nest that may cause disturbance should be avoided between December 15 and June 30 (or following fledging of young and dispersal from the nest area). The LOD for Alternatives B, C, D & E is greater than 660 feet away from the nest location and based on the USFWS National Bald Eagle Management Guidelines (USFWS, 2007), is therefore not likely to require an Eagle Disturbance Take permit under the Bald and Golden Eagle Protection Act. Alternatives F and G extend along MD 8 in close proximity to the nest location, and construction would be expected within less than 660 feet, and perhaps even less than 330 feet of the nest. The MDTA will continue to coordinate with USFWS to evaluate potential impacts to Bald Eagles in final design when details on type and duration of construction activities are defined. If construction is deemed likely to cause disturbance to a nest, a “take” permit would be obtained from USFWS to allow the work to proceed during the active season and to outline project-specific guidelines to reduce the likelihood of disturbance. Impacts to the nest itself would require a “take” permit regardless of season.

14.2.4 Avoidance, Minimization, and Further Mitigation Measures

The MDTA would approach design and development with the goal of minimizing and mitigating impacts to terrestrial habitat and biota. A formal survey of forest and urban trees would be required during final design, in accordance with the Maryland Reforestation Law. Efforts to avoid and minimize forest impacts are discussed in **Section 14.1, Terrestrial Habitat**. The MBTA prohibits intentional "take" of native and naturally occurring migratory birds including occupied nests. The MDTA would continue coordination with the MDNR during more detailed design and construction to ensure compliance with all applicable environmental regulations associated with terrestrial biota and would incorporate impact minimization and further mitigation strategies as directed, which may include:

- Pre-construction surveys and monitoring to identify species at risk and establish buffer zones around sensitive habitats.
- Adhering to construction-related time-of-year restrictions and species-specific time-of-year restrictions and avoiding tree clearing during bird nesting seasons.
- Bridge designs to reduce risk of bird collisions.
- Proactive management to discourage bird nesting on construction site equipment.
- Limited nighttime construction and scheduling loud activities during daylight hours to reduce disturbance to nocturnal species.
- Incorporation of ESC measures to prevent habitat degradation.
- Incorporation of wildlife protection mechanisms during construction, including exclusion fencing and trenches to provide escape routes for reptiles and small mammals.
- Consideration of wildlife overpasses or underpasses into the engineering design to maintain ecological connectivity.
- Replanting of native trees and shrubs post-construction to restore lost habitat.
- Native forbs and grasses may be suitable for planting along highway clear zones and can restore lost habitat for pollinators.

A TOYR for construction within the Bald Eagle nesting period may be required by USFWS within a 660 buffer around the known Bald Eagle nest near MD 8. Other avoidance and minimization techniques may include consideration of alignment shifts to reduce clearing and maintain visual buffers between the nest and construction activities, and seasonal nest monitoring during construction to ensure activities are not disturbing reproduction and rearing. A TOYR for construction within the Peregrine Falcon nesting period may be required by USFWS within a designated buffer around any known Peregrine Falcon nests. The buffer distance will be determined in coordination with USFWS. The MDTA will continue to coordinate with USFWS regarding potential impacts to Bald Eagles and other MBTA-protected species as the project progresses.

Additional minimization and mitigation strategies related to terrestrial biota are discussed in **Section 12, Chesapeake Bay Critical Area** and **Section 15, Rare, Threatened, and Endangered Species**.

15 RARE, THREATENED, AND ENDANGERED SPECIES

The resource review area for RTE species extends 1,000 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split. Rare species are plants and animals that are very uncommon, scarce, or infrequently encountered. Threatened species are those that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range. Endangered species are those that have become so rare they are in danger of becoming extinct.

15.1 Regulatory Context and Methodology

Section 7 of the ESA of 1973 (16 USC Sections 1531-1544) requires all federal agencies to use their authorities to conserve species listed as federally endangered or threatened in consultation with the USFWS or NOAA Fisheries. Section 7(a)(2) (16 USC § 1536) establishes substantive requirements for federal agencies to ensure, in consultation with the USFWS, any action authorized, funded, or carried out is not likely to jeopardize the continued existence of any endangered or threatened species or destroy or adversely modify designated critical habitat. Section 7 implementing regulations (50 CFR Part 402) specify how federal agencies must fulfill their Section 7(a)(2) consultation requirements. Section 9 of the ESA (16 USC § 1538) prohibits any action that causes a "take" of species listed as endangered or threatened. "Take" is further defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or to attempt any of these. The USFWS administers the ESA for all terrestrial and nontidal freshwater species and designated critical habitat, while NOAA Fisheries administers the ESA for marine and anadromous species and designated critical habitat.

The Maryland Nongame Endangered Species Conservation Act (Md. Code Ann., Nat. Res. § 10-2A-01 through 09) regulates activities that impact plants and wildlife, including their habitats, listed on the Maryland Threatened and Endangered Species list. Protections under the Act are for species listed as Endangered, Threatened, or In Need of Conservation (animals only). Species with a status of In Need of Conservation are animals whose population is limited or declining in Maryland such that it may become threatened in the foreseeable future if current trends or conditions persist. Any federal, state, local, or private constructing agency is required to cooperate and consult with MDNR regarding the presence of listed species within a study area, field verification of habitat and/or populations of listed species, and avoidance and minimization efforts, as appropriate.

The IPaC official species list was obtained from the USFWS IPaC website on April 28, 2025 (see **Appendix N)** and a species list was obtained from the NOAA Fisheries Greater Atlantic Region ESA Section 7 Mapper website on February 5, 2025 (see **Appendix O**). On the IPaC website, determination keys are used to identify whether a project qualifies for a pre-determined consultation outcome based on existing programmatic consultations or internal USFWS standing analyses. If a project qualifies, USFWS concurrence letters are instantly generated to streamline consultation. The IPaC species list was last updated on October 28, 2025 and will continue to be updated, and any relevant determination keys completed, after the Preferred Alternative has been identified. In accordance with Section 7 of the ESA, the MDTA has prepared Biological Assessments (BAs) (**See Appendices Q and R**) to evaluate the potential impact of the proposed replacement of the existing Bay Bridge and associated approach roadway improvements on ESA-listed or proposed terrestrial and aquatic species. FHWA submitted the BAs and letters

requesting initiation of Section 7 consultation to USFWS and NOAA Fisheries on November 28, 2025. Development of the BAs was coordinated with USFWS and NOAA Fisheries and coordination will continue as the Tier 2 Study progresses, and additional engineering detail becomes available.

The MDNR WHS division was contacted by email on October 27, 2023, regarding the potential for impacts to state-listed RTE species and protected habitats within the 2-mile-wide Tier 1 study corridor, which includes the resource review area. A response was received on January 18, 2024 and an update via email was received on April 1, 2025 (see **Appendix M**). In addition, mapped MDNR SSPRAs were reviewed online to identify areas supporting or providing habitat buffers for RTE species within the resource review area. SSPRAs are mapped to include both sensitive species habitat and a buffer. This allows potential activities anywhere within or near the SSPRA to be flagged for more detailed review by MDNR to determine if a sensitive species could potentially be affected. SSPRAs are discussed in **Section 16, Unique and Sensitive Areas**.

15.2 Affected Environment

15.2.1 Federally Listed Species

The USFWS official species list indicated the potential presence of one listed species and two species proposed for listing, as shown in **Table 15-1**. Critical habitat has not been designated for any ESA-listed species under USFWS jurisdiction potentially occurring within the resource review area. There is no proposed designated critical habitat for the monarch butterfly within the resource review area.

Table 15-1: USFWS Federally Listed and Proposed Species

Common Name	Scientific Name	Federal Status
Northern long-eared bat	*Myotis septentrionalis*	Endangered
Tri-colored bat	*Perimyotis subflavus*	Proposed Endangered
Monarch butterfly	*Danaus plexippus*	Proposed Threatened

The northern long-eared bat (NLEB) range extends across the eastern and north-central U.S. The NLEB overwinters in hibernacula (typically caves or abandoned mines) and roosts during the summer under bark or in cavities or crevices of live trees or snags, the species of which varies. NLEBs may also roost in caves, sinkholes, or other karst features, and in man-made structures, including buildings, barns, utility structures, window shutters, bridges, and bat houses. Threats to the NLEB include the fungal disease white-nose syndrome, wind energy-related mortality, and habitat loss (USFWS, 2022). Coordination with USFWS would continue as the design moves forward.

The tricolored bat (TCB) is wide ranging across the eastern and central U.S. During the winter, TCBs are found in caves and mines, although in the southern U.S., where caves are sparse, tricolored bats are often found roosting in road-associated culverts. During the spring, summer and fall, tricolored bats are found in forested habitats where they roost in trees, primarily among live or dead leaf clusters of living or recently dead deciduous trees. TCB may also be found roosting in lichen, moss, or artificial roosts such as bridges, barns, and concrete surfaces. Threats to TCB include white-nose syndrome, wind-related mortality, and habitat loss (USFWS, 2021). Coordination with USFWS would continue as the design moves forward.

Suitable roosting habitat for NLEB and TCB occurs within the resource review area, with the largest area of forested habitat located in Queen Anne's County at the U.S. 50/301 split. These forest interiors provide good foraging habitat for bats, primarily for NLEB. The remainder of the resource review area parallels the existing roadway, where forest edges are more prevalent and provide less foraging habitat, though edge habitat are used by TCB. There are multiple large bridge crossings within the resource review area that may provide daytime and nighttime roosting habitat, including maternity and hibernation sites for bats. In an existing transportation corridor such as U.S. 50/301, with the continual human presence and partial fragmentation of forest, large bridge crossings may serve a similar habitat function as caves for the bats and provide more optimal conditions for roosting. Bridges are a more valuable habitat for bats when they are over water and near existing forest, providing temperature regulation and protection from the weather. Bats typically hibernate in caves or mines. A review of the USGS Mineral Resources Online Spatial Data shows that no mine features are present within the resource review area (Horton and San Juan, 2021). Additional detail on RTE bats and bat habitats in the study area can be found in the Biological Assessment in **Appendix Q**.

Monarch butterflies are long-distance migrants, beginning their migration from southeast Canada in the early fall and overwintering in central Mexico until February and March. The migration occurs over multiple generations, with adult monarch butterflies laying eggs on their obligate host plant, milkweed (*Asclepias* spp.) (MDNR, n.d.-a.). Monarch habitat includes fields, roadside areas, open areas, wet areas, and urban gardens with flowering plants. Adult monarchs feed on the nectar of many flowers, but they breed only where milkweeds are found. Monarchs are present within the resource review area during late summer and early fall. There is proposed designated critical habitat for the monarch butterfly; however, there is none within the resource review area.

A review of the NOAA Fisheries Greater Atlantic Region ESA Section 7 Mapper shows the resource review area overlaps Section 7 Consultation Areas for six federally listed species under NOAA Fisheries jurisdiction, including two fish and four sea turtles, as shown in **Table 15-2**.

Table 15-2: NOAA Fisheries Federally Listed Species

Common Name	Scientific Name	Federal Status
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Green sea turtle	*Chelonia mydas*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered

Juvenile, subadult, and adult Atlantic sturgeon are found migrating and foraging throughout the Chesapeake Bay. Adult and subadult stages of Atlantic sturgeon are present between late March and November, while juvenile stages are present year-round. Juvenile, subadult and adult Atlantic sturgeon opportunistically forage, particularly in areas with soft substrate. Juvenile prey items include aquatic insects, larvae, and other invertebrates, and subadult and adult stages feed on benthic prey such as mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish. Telemetry data collected from 2021 to 2024 and provided by NOAA Fisheries indicated the presence of Atlantic sturgeon in the Chesapeake Bay North array (located just south of the Bay

Bridge), with detections of Atlantic sturgeon occurring mainly during the warmer months. The telemetry data provided by NOAA Fisheries are discussed further in **Section 13.6** and are included in **Appendix K**. Adult stages of shortnose sturgeon are believed to be present year-round throughout the Chesapeake Bay (NOAA Fisheries, 2022a). NOAA Fisheries assumes that the shortnose sturgeon could be overwintering anywhere in the Bay from November 1 to February 28. Shortnose sturgeon are bottom feeders that feed on mollusks as well as benthic crustaceans and insects (Dadswell, 1979). Sturgeon feed opportunistically where appropriate forage items are available. They prefer highly productive foraging habitat that includes over tidal/mud flats, in SAV, and shellfish beds. Sturgeon spawn in upstream habitat of large tidal rivers just below the fall line in areas with cobble habitat. Threats to the Atlantic sturgeon include fisheries interactions and bycatch, habitat degradation, habitat impediments, and vessel strikes (NOAA Fisheries, 2022a; NOAA Fisheries, 2023a). Threats to the shortnose sturgeon include habitat impediments, habitat degradation, and fisheries interactions and bycatch (NOAA Fisheries, 2023b).

Adult and juvenile stages of the loggerhead, Kemp's ridley, green, and leatherback sea turtles are found migrating and foraging in the Chesapeake Bay. These four species of sea turtles migrate north to the mid-Atlantic in the spring, arriving in May, and leave the area generally by the end of November (NOAA Fisheries, 2022b, 2023c, 2023d, and 2023e). Sea turtles may forage in a variety of habitat types including SAV, shellfish beds, in areas where crustaceans and gastropods are prevalent, and in pelagic zones on jellyfish. Loggerhead sea turtles forage in coastal areas, feeding mostly on bottom dwelling invertebrates. Kemp's ridley sea turtles foraging in coastal areas consume mostly crabs and occasionally discarded bycatch. Green sea turtles are primarily herbivorous, feeding on algae and seagrasses (including SAV), and occasionally consuming sponges, invertebrates, and discarded fish. Leatherback sea turtles consume soft-bodied prey such as jellyfish. Threats to the loggerhead, Kemp's ridley, green, and leatherback sea turtles include bycatch in fishing gear, loss and degradation of nesting habitat, vessel strikes, direct harvest of the sea turtles and their eggs, and ocean pollution/marine debris. Additionally, threats to the Kemp's ridley sea turtle include predation of eggs and hatchlings, and threats to the green sea turtle include *Fibropapillomatosis*, a tumor-causing disease (NOAA Fisheries, 2022b, 2023c, 2023d, and 2023e).

A detailed discussion of sturgeon and sea turtle species is presented in the Atlantic and Shortnose Sturgeon and Sea Turtles Biological Assessment (**Appendix R**).

As noted in **Section 13.10, Marine Mammals**, four species may occur within the resource review area; only the humpback whale is listed as endangered under the ESA, but all are protected under the MMPA. These species are listed in **Table 15-3**.

Table 15-3: Marine Mammals

Common Name	Scientific Name	Federal Status
Bottlenose Dolphin	*Tursiops truncates*	MMPA
West Indian Manatee	*Trichechus manatus*	MMPA
Harbor Porpoise	*Phocoena Phocoena*	MMPA
Humpback Whale	*Megaptera novaeangliae*	Endangered

The bottlenose dolphin has been sighted in the Chesapeake Bay, typically during summer months, although the West Indian manatee and harbor porpoise were noted as rare, and the humpback whale was noted as extremely rare (ORR, 2023).

15.2.2 State-Listed Species

Correspondence with MDNR WHS dated January 18, 2024 (see **Appendix M**) indicated the presence of several state-listed RTE species within the 2-mile wide Tier 1 study corridor, including those shown in **Table 15-4**. MDNR also noted a number of protected habitats and other species of concern, some of which occur within the resource review area and are described below.

Table 15-4: State-Listed Species

Common Name	Scientific Name	Federal Status
Least Tern	*Sternula antillarum*	Threatened
Sora Rail	*Porzana carolina*	Rare

A Habitat Protection Area is located between the Oceanic Drive interchange and Mezick Pond, within Sandy Point State Park in Anne Arundel County, due to the presence of rare breeding birds, including the state threatened Least Tern, state rare Sora, and state endangered and federally threatened Black Rail. However, additional correspondence with MDNR noted that the Black Rail has not been documented as breeding in Sandy Point State Park in the last 25 years and is therefore not of concern. Nesting colonies of the least tern have also been documented on rooftops in the Stevensville area of Queen Anne's County.

Nesting sites for the Peregrine Falcon (*Falco peregrinus anatum*) have been identified on structures underneath the roadway of the Bay Bridge near the suspension span and on the U.S. 50 Bridge over the Severn River which is to the west of the study limits. While the Peregrine Falcon is not a state-listed RTE species, it is a species with the status of In Need of Conservation in Maryland, in addition to being afforded protection by the MBTA. Waterbird species that use the bridge pier "islands" for nesting are protected under the MBTA and Critical Area regulations and include Great Egret (*Ardea alba*), Snowy Egret (*Egretta thula*), Cattle Egret (*Bubulcus ibis*), and Black-crowned Night Heron (*Nycticorax nycticorax*).

Known habitat for the Delmarva fox squirrel is located north of U.S. 50/301, from Winchester Creek to Little Queenstown Creek in Queen Anne's County. The Delmarva fox squirrel is considered a species In Need of Conservation in Maryland. Known habitat consists of forests with relatively mature trees, either hardwoods or loblolly pine, with a relatively sparse understory.

Great Blue Heron (*Ardea herodias*) nesting colonies are documented within the resource review area and are protected under the MBTA and under Critical Area regulations during their breeding season. Great Blue Heron are discussed in **Section 13.9, Colonial Waterbird Nesting Areas**. Waterfowl staging and concentration areas, discussed in **Section 13.8** are located along the shoreline of Whitehall Creek, Meredith Creek, and the Chesapeake Bay south of the Bay Bridge in Anne Arundel County, and along the shoreline of the Chesapeake Bay north of the Bay Bridge and in Prospect Bay in Queen Anne's County.

15.3 Environmental Consequences

The build alternatives were evaluated to determine potential impacts to federal and state listed RTE species.

15.3.1 No-Build Alternative

The No-Build Alternative would have no impacts to federal or state RTE species.

15.3.2 Build Alternatives

The build alternatives could potentially adversely impact RTE species from demolition, construction, and operational activities that could remove or degrade habitat, cause physical injury, or alter behavior. Impactful activities may include interaction with construction equipment, increased vessel traffic, tree clearing and grubbing operations, dredging activities, water jetting, in-water construction/de-construction activities, equipment or gear deployment, pile driving, or cutting and filling of land. These activities would result in environmental effects such as underwater noise and increased turbidity and may include vessel strikes and entrainment/entrapment depending on construction means and methods employed. The addition of an SUP option with any of the build alternatives would not result in additional displacements of any listed species.

15.3.2.1 Federally Listed Species

A preliminary assessment by USFWS (email dated May 28, 2025 in **Appendix N**), noted that the proposed build alternatives are not likely to jeopardize the continued existence of monarch butterfly or TCB, and, as the monarch butterfly and TCB are proposed and not listed, conferencing is not required under Section 7 for these proposed species. However, federal agencies may choose to voluntarily conference with USFWS to help inform future consultation if the proposed rule to list the species under the ESA is finalized and listing becomes effective. Although not required, conferencing with USFWS for TCB was chosen due to similar habitat requirements and life history to NLEB, allowing analysis of impacts to NLEB to be closely associated with impacts to TCB.

A detailed analysis and discussion of potential impacts to bat species are presented in the Draft Northern Long-Eared Bat and Tricolored Bat Biological Assessment (**Appendix Q**). Based on preliminary assessment of the information available to date, the project may affect but is not likely to adversely affect listed bat species in the action area. Further evaluation of impacts will be conducted during final design, and the effects determination will be re-assessed as more detailed construction means and methods are made available.

All build alternatives would have similar types of potential to impact NLEB and TCB, including permanent impacts to habitat, including forest clearing and construction on bridges, culverts, and temporary impacts related to construction activities, including noise and light. The primary difference between build alternatives is the magnitude of those impacts, with the longer alternatives, Alternatives D, E, F, and G, including additional tree clearing, wetland and stream impacts, and impacts to bridges, culverts, and buildings.

All life stages of NLEB and TCB could potentially be impacted by modification to natural and artificial roosting habitat, serving as day or night roosts. NLEB and TCB are both insectivorous species; however, they differ in foraging strategies, with NLEB having greater success, and are more likely to be found, within intact forests and TCB having greater success in forest edges and other open spaces. The build alternatives primarily affect forest edges and fragments, rather than undisturbed forest interiors, as well as streams and wetlands, which also provide habitat to NLEB and TCB. Although no known maternity roosts or hibernacula are known to be located within the

LOD of any build alternative, the removal of larger forested areas, (e.g., forest located at the U.S. 50/301 split in Queen Anne's County, or forest located surrounding Whitehall Creek in Anne Arundel County) would impact suitable bat habitat. An assessment of suitable bat habitat within a portion of the study area indicates that the majority of forested resources are close to the highway and generally composed of invasive vegetation, providing low-quality bat habitat for NLEB and TCB. Generally, higher quality forest habitat is available well beyond the road surface and would allow NLEB and TCB to forage, roost, and travel beyond the impacts of the build alternatives.

As the study area does not contain caves or karst features, bats may seek bridges, culverts, and buildings as day or night roosts. Day roosts protect bats while resting or tending to young, while night roosts are needed for bats to digest food while feeding (Keeley and Tuttle, 1999). Due to the requirements of day roosts, human-made structures along busy highways are less likely to be quality habitat. Contrastingly, bats are more likely to seek bridges at night as they retain heat, reducing the energetic cost of thermoregulation (Keeley and Tuttle, 1999). Bats show preference for bridges as night roosts that are fully exposed to sun and with space between beams of the deck (Keeley and Tuttle, 1999) Within the study area, there is the potential presence of bats roosting under existing bridges over waterways such as Kent Narrows. Culverts 36-inch or wider in diameter as well as buildings may serve to support NLEB and TCB as roosting locations. Based on the greater potential artificial roosting habitat presented in these locations, it is assumed that Alternatives D, E, F, and G would have greater potential for impacts to bats than Alternatives B and C. Within the scope of Alternatives B and C, evidence of bats using bridges, culverts, and buildings was not found during field surveys, indicating that NLEB and TCB are probably absent.

Bats may experience decreased foraging efficiency under the effects of noise at 56 dBA to 88 dBA as well as changes to call frequency and amplitude of echolocation at 88 dBA (Bunkley and Barber, 2015). Additionally, bats foraging near highways, especially those with high traffic volumes, may experience decreased foraging efficiency up to 60 meters from road surface (Siemers and Schaub, 2011). Within the study area, noise ranges from 47 dBA to 75 dBA, and modeling of future construction noise levels indicates that noise may reach 83 dBA within 100 feet of land-based construction. Noise from pile driving and bridge demolition occur in the subaqueous environment and are not expected to impact NLEB, TCB, and suitable bat habitat. Over time, bats may adjust to low noise levels or louder noise levels at greater distances. As a result, bats that may be roosting within the action area are likely adjusted to heightened noise levels and would likely shift roosting locations or temporarily abandon the roost during construction activities.

Artificial light, especially at night, may negatively affect bats by entombing them in their roost, forcing them to abandon roosts, or disrupting behaviors such as foraging or avoiding predators (Zeale et al., 2016). Temporary lighting may encourage insect-gleaning species, such as the NLEB and TCB, to forage; however, the effects are relative to individuals (Voigt et al., 2021). Some studies have shown that members of the *Myotis* genus forage less within areas lit by streetlamps and forage more in darker areas (Rydell, 1992). However, artificial light may disturb the forage base for bats, as congregating insects will be preyed upon by multiple predators (Van Grunsven et al., 2020). Finally, bats may be at greater risk of predation as they take less optimal paths to avoid artificial light (Voigt and Kingston, 2016). Temporary artificial light may be needed to support extended day and overnight construction activities on the Bay Bridge. Where required, temporary lighting would be focused on the Bay Bridge spans, limiting the impact to suitable bat

habitat. Changes to the permanent lighting regime have yet to be finalized, however, they would comply with MDTA and SHA Lighting Guidelines (MDTA, 2019). DarkSky International principles would also be considered to reduce spillover of light into suitable bat habitat.

Construction activities for all build alternatives could cause direct mortality and disturb habitat for monarch butterflies along roadsides and in open fields adjacent to the roadways. Alternatives D, E, F, and G would have a greater potential for impact than Build Alternatives B and C, due largely to the extension of proposed roadway improvements in Queen Anne's County included with these four alternatives, with the presence of more adjacent open fields and agriculture.

NOAA Fisheries Federally Listed Species

A detailed analysis and discussion of potential impacts to sturgeon and sea turtle species are presented in the Draft Atlantic and Shortnose Sturgeon and Sea Turtles Biological Assessment (**Appendix R**). Based on assessment of the information available to date, the project is likely to adversely affect listed sturgeon and sea turtle species in the resource review area. Further evaluation of impacts will be conducted during final design, and the effects determination will be re-assessed as more detailed construction means and methods are made available.

All build alternatives have a similar potential to impact marine mammals due to the proposed construction in the Chesapeake Bay. No impacts to federally listed marine mammals, such as the West Indian manatee and humpback whale, or the harbor porpoise are anticipated, as these species are identified as rare near the Chesapeake Bay Bridge and only transient in the upper Bay and are therefore unlikely to be present within a build alternative LOD. Potential impacts to the bottlenose dolphin, a species that is not federally listed, are discussed in **Section 13.10.**

Sturgeon

All build alternatives would have similar types of potential to impact Atlantic and shortnose sturgeon, including permanent impacts from the placement of piers on the Bay bottom, and temporary impacts related to construction activities. The primary difference between build alternatives is the magnitude of those impacts, with the wider alternatives across the Bay (Alternatives F & G) requiring larger bridge piers, and the longer alternatives, Alternatives D, E, F, and G, including additional proposed construction at Kent Narrows. Although SAV is not identified within Kent Narrows, it is documented as present in Prospect Bay to the south; therefore, there is potential for sturgeon to be in the vicinity.

Adult, subadult, and juvenile Atlantic sturgeon and adult shortnose sturgeon could potentially be affected by construction activities due to their utilization of the area during seasonal breeding migrations; additionally, adult shortnose sturgeon and juvenile Atlantic sturgeon could be affected due to overwintering in the area. Atlantic and shortnose sturgeon are bottom feeders and opportunistic foragers and therefore found throughout the Chesapeake Bay where suitable forage (e.g., benthic invertebrates such as mollusks and crustaceans) and appropriate habitat conditions (e.g., areas of SAV) are present. The physical disturbance of sediments and entrainment of associated benthic resources could reduce the availability of sturgeon prey species, although recolonization of the opportunistic benthic species would occur quickly. Studies of anadromous fish such as striped bass indicate that adverse effects to fish typically occur at 1,000 mg/L (Burton, 1993), and effects to certain benthic communities could occur at 390 mg/L (EPA, 1986). Both

Atlantic sturgeon and shortnose sturgeon are thought to be at least as tolerant of elevated turbidity as other anadromous fish.

Dredges and other mechanisms have the ability to impinge or entrain sturgeon during routine operation. Details on the duration and timing of dredging based on current design assumptions are outlined in **Section 13.5.3.2**. Impingement/entrainment may cause injury or death in certain cases. Sturgeon are not typically susceptible to entrainment in mechanical dredges, because bucket dredges are relatively stationary, and the operation entails lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the bucket up through the water column, and emptying the bucket into a barge at a slow pace. Additionally, mechanical dredging lacks suction, and the culmination of these factors allows fast, strong swimming sturgeon to move away from dredging activities. The risk of capture by mechanical dredges is higher in areas where large numbers of sturgeon may aggregate, such as overwintering sites or foraging areas. Additionally, overwintering sturgeon may be less responsive to stimuli and more at risk. Overwintering sturgeon in the action area include juvenile Atlantic sturgeon and adult shortnose sturgeon.

Increased turbidity effects from dredging are not anticipated to affect sturgeon species, as the life stages most vulnerable to increased sediment are eggs and non-mobile larvae, which would not be present in these areas. Any sturgeon in the vicinity would be sufficiently mobile to avoid any sediment plume or reductions in dissolved oxygen (NOAA Fisheries, 2012). Changes in water quality parameters resulting from discharges, construction activities, and demolition may adversely affect sturgeon. Both species of sturgeon are similarly sensitive to certain water quality parameters. Dissolved oxygen levels below 4.0 mg/L have been shown to have deleterious effects on sturgeon. Likewise, temperatures above 28 degrees C have also been demonstrated to be harmful. Lowered DO, changes in temperature, addition of pollutants, and increased sedimentation may interrupt the basic life functions of sturgeon such as their behavior, foraging ability, migration, and reproduction.

Strikes from construction vessels are possible, but extremely unlikely since construction vessels would be within deeper waters and have shallow drafts, and sturgeon would typically be at greater depths, eliminating construction vessel strike risk (Balazik et al., 2012).

Exposure to underwater noise levels can result in injury to sturgeon. The distance of the sound effects would be dependent upon the pile size, material, and methods of pile driving. Current pile driving assumptions, including anticipated sequence and duration, are included in **Section 13.6.3.2**. Though specific construction means and methods have not been developed, estimates of noise levels were calculated based on construction means and methods of similar projects, including Nice-Middleton Bridge and Francis Scott Key Bridge, using the NOAA Fisheries GARFO Multi-Species Pile Driving Calculator (NMFS, 2025). Calculations were completed for multiple pile driving scenarios anticipated for the main structure, trestles, and pier protection dolphins based on the current Tier 2 Study high-level assumptions. These assumptions and the corresponding noise analysis will continue to be refined as the Tier 2 Study progresses. For this study, the maximum distance to the 206 dB Peak (the threshold for injury to sturgeon from a single pile strike) is estimated to be 60.6 feet, and the maximum distance to the 187dB cSEL (the threshold for injury to sturgeon from multiple exposures to noise over a period of time) is estimated to be 7,068.4 feet, which would occur during impact pile driving of the 96-inch diameter steel pipe piles. To be exposed to potentially injurious levels of noise during impact pile driving of the steel

piles, a sturgeon would need to be within 60.6 feet of the pile for a single strike or remain within 7,068.4feet of the pile being driven for a prolonged time period. The expectation is that adult and juvenile sturgeon would modify their behavior and move away from the area upon exposure to underwater noise levels of 150 dB_{RMS} (the sound pressure threshold for causing behavioral effects to sturgeon), an area extending up to 32,808.4 feet from pile driving activities. The initiation of daily pile driving with a soft start technique would also give sturgeon in the area time to move out of the range of any injurious sound waves. While it is anticipated that sturgeon will leave the area following the initiation of pile driving with a soft start, no active removal of sturgeon from the area will occur due to the large size and depth of the study area, and any sturgeon remaining within the 187 dB cSEL isopleth for a prolonged time period will be at risk for injury. As specific population data are not available at this time, estimates of the number of sturgeon expected to be exposed to injurious levels of noise cannot be determined; however, MDTA will continue to coordinate with NOAA Fisheries and will calculate estimates if specific population data are made available. A full discussion of the noise analysis and expected impacts is included in the Draft Atlantic and Shortnose Sturgeon and Sea Turtles Biological Assessment (**Appendix R**).

Demolition of the existing structures may include mechanical means and controlled explosive demolition (blasting). Current blasting assumptions, including anticipated duration and time of year, are included in **Section 13.10.3.2**. Any required blasting will take place during times of lower biological activity, from October 1 through December 15. Blasting generates pressure waves that have been shown to cause swim bladders to rupture, killing fish (Keevin and Hempen, 1997). Specific impacts from blasting to sturgeon are not able to be quantified at this time due to a lack of specific population data available in the vicinity of the Chesapeake Bay Bridge and the limited details known at this time regarding the demolition plans for the existing structure. Adult and subadult Atlantic sturgeon may still be present in the Chesapeake Bay through November, and adult shortnose sturgeon and juvenile Atlantic sturgeon are present year-round, and therefore blasting could result in serious injury or mortality.

Sea Turtles

All build alternatives have the potential to impact adult and juvenile leatherback, loggerhead, green, and Kemp's ridley turtles due to proposed construction in the Chesapeake Bay. However, Alternatives D, E, F, and G are anticipated to have the greater potential for impact to sea turtles due to the proposed construction at the Kent Narrows and the presence of SAV habitat identified to the south in Prospect Bay. Potential impacts to sea turtles include reduced availability of prey due to the physical disturbance of sediments; increased turbidity; entrainment or impingement in dredging equipment; vessel strikes; and noise. Localized impacts to prey are expected to be negligible, and as sea turtles are highly mobile, turbidity impacts would be minimal.

The physical disturbance of sediments and entrainment of associated benthic resources could reduce the availability of sea turtle prey, but the impacted benthic habitat represents an insignificant amount of the available habitat in the region, and recolonization of the opportunistic benthic species would occur quickly, making these localized impacts to sea turtle habitat and prey negligible. Sea turtles can mainly be affected by impaired water quality through the reduction of their forage base. Low DO, high temperatures, or release of pollutants that may detrimentally affect benthic communities and aquatic vegetation would directly impact sea turtle foraging and feeding.

Turbidity effects to sea turtles from dredging are not anticipated. One major issue associated with suspended sediments is its effect on the respiration of marine fauna. However, sea turtles breathe air and increased suspended sediments are not likely to affect turtle respiration. The most likely effect is if a sediment plume causes a barrier to normal behaviors. As sea turtles are highly mobile, they are likely to be able to avoid any sediment plume, which typically only last for a short duration near the bottom after the dredge passes. Mechanical dredging will be used, and sea turtles are typically not susceptible to entrainment in mechanical dredging because bucket dredges are relatively stationary. The operation entails lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the bucket up through the water column, and emptying the bucket into a barge at a slow pace. Details on dredging based on current design assumptions are outlined in **Section 13.5.3.2**.

Sea turtles are susceptible to vessel strikes from construction vessels since they spend time close to the surface; however, sea turtles are more vulnerable to being struck by faster moving vessels. Vessel interactions could result in serious injury or mortality to sea turtles. However, the dredge equipment, barges, and support vessels that would typically be used for this type of project move at slow speeds (i.e., on average 8 to 10 knots) and have shallow drafts. Vessel interactions could result in serious injury or mortality to adult and juvenile sea turtles.

Sea turtle species can be adversely affected by noise generated by in-water activities, including pile driving. Current pile driving assumptions, including anticipated sequence and duration, are included in **Section 13.6.3.2**. Estimates of noise levels were calculated using the NOAA Fisheries GARFO Multi-Species Pile Driving Calculator (NMFS 2024). Exposure to underwater noise levels can result in injury to sea turtles. For this study, the maximum distance to the 232 dB Peak during pile driving is expected to be 1.5 feet, and maximum distance to the 204 dB cSEL during pile driving is expected to be 28,069.2 feet, which would occur during impact pile driving of the 96-inch diameter steel pipe piles. Exposure to the 232 dB Peak is unlikely to occur because sea turtles are extremely unlikely to be within 1.5 feet of the pile when pile driving begins. Sea turtles are expected to avoid areas where noise is above the 175 dB RMS behavioral threshold, an area estimated to extend up to 706.8 feet from the pile (during the most impactful pile-driving scenario, impact pile driving of the 96-inch diameter steel pipe piles). Sea turtles would be at risk of exposure to injurious levels of noise if they are within the 204 dB cSEL isopleth for a prolonged period of time during pile driving. It is not possible to estimate how many turtles would be affected by pile driving, since there is no population estimate for sea turtles within the middle Chesapeake Bay. A full discussion of the noise analysis and expected impacts is included in the Draft Atlantic and Shortnose Sturgeon and Sea Turtles Biological Assessment (**Appendix R**).

Limited data is available regarding impacts of blasting on sea turtles, though some studies have demonstrated that blasting can result in mortality to sea turtles (Keevin and Hempen, 1997). Current blasting assumptions, including anticipated duration and time of year, are included in **Section 13.10.3.2.** Any required blasting will take place during times of lower biological activity, from October 1 through December 15. Adult and juvenile green, Kemp's ridley, leatherback and loggerhead turtles may still be present in the action area through November and therefore blasting could result in serious injury or mortality. Quantification of impacts to sea turtles from blasting is not possible at this time for the Bay Crossing Study due to the lack of specific population data available in the vicinity of the Chesapeake Bay Bridge and the limited details known at this time regarding the demolition plans for the existing structure.

15.3.2.2 State-Listed Species

No direct impacts to the Habitat Protection Area located between the Oceanic Drive interchange and Mezick Pond within Sandy Point State Park are anticipated, as the LODs immediately southeast of the interchange are located within existing right-of-way and further from the area designated as habitat for the state listed Least Tern, and Sora. However, the area between U.S. 50/301 and Mezick Pond, south of the Habitat Protection Area, contains estuarine habitat that could be used by nesting shorebirds and is within the LOD of the northern build alternatives (Alternatives B, D, and F).

The structures underneath the Bay Bridge near the suspension span used by Peregrine Falcons, and the bridge pier "islands" used by nesting waterbirds, would be temporarily unavailable with all build alternatives during construction of the new bridge, but the areas would be available for use by these species after the new bridge spans are constructed.

The Delmarva fox squirrel habitat located on the north side of U.S. 50/301, near the eastern study limits, would not be affected by Alternatives B and C, as these build alternatives do not extend this far east. Alternatives D, E, F, and G have the potential to affect the mature forest habitat between U.S. 50/301 just prior to the split, and the U.S. 50 westbound on-ramp from U.S. 301.

Impacts to SSPRAs are discussed in **Section 16, Unique and Sensitive Areas.**

15.4 Avoidance, Minimization, and Further Mitigation Measures

The MDTA would approach design and development with the goal of minimizing and further mitigating impacts to RTE species. More detailed discussion on minimization and mitigation of impacts to federally listed species is provided in the Draft Biological Assessments in **Appendices Q and R**.

All build alternatives are located immediately adjacent to the existing Bay Bridge and U.S. 50/301, minimizing the LOD to previously impacted areas and habitats that may already experience human disturbances, which will minimize impacts to RTE species and habitats. Although in-water construction and demolition may temporarily or permanently alter habitat for RTE species, minimization and further mitigation measures will focus on maintaining habitat, as feasible, and providing clear limits protecting adjacent habitat. Proper ESC measures and fencing of the LOD would protect adjacent wooded foraging habitat for bats and open field habitat for monarchs. Avoidance of nighttime construction would also minimize potential impacts to bat species. Consideration of TOYR for removal of bridge nesting habitats for Peregrine Falcon will be coordinated with the agencies during final design.

Avoidance and minimization methods that MDTA will commit to that are related to underwater noise/hydroacoustic energy; turbidity and sedimentation; reduced water quality; habitat alteration; and vessel interaction are included in **Section 13.11**. The MDTA will determine, in coordination with NOAA Fisheries, whether it is practicable to implement a zone of safe fish passage (ZSFP) within the Chesapeake Bay during construction of a build alternative. A ZSFP would allow fish to move safely to their spawning grounds in the spring season. Methods to minimize the effects of turbidity may include the usage of silt curtains, time of year restrictions, and minimizing sediment plumes within migratory corridors.

Other methods to minimize potential effects to RTE species habitat include proper siting and/or survey techniques to ensure suitable/productive habitat is avoided where feasible, restrictions on

activities in productive benthic habitat (SAV, NOBs, and/or productive mudflats), restrictions in anadromous fish spawning areas/habitat (cobble areas in upstream locations), minimization of turbidity plumes, and reducing dredging in these areas. Construction and demolition activities that may interrupt spawning, rearing, foraging, overwintering, and/or migration of RTE species would be minimized to the greatest extent practicable. Pollutant discharges associated with authorized activities would meet all applicable water quality standards. Additionally, temperature and DO levels would remain within the appropriate ranges to reduce any effects to listed species under NOAA Fisheries jurisdiction. Activities that increase the uptake of heavy metals, other chemicals, or create areas of low dilution, would be minimized to the greatest extent practicable. Transportation projects that are authorized (i.e., permitted), funded, or undertaken by a federal entity are required to adhere to guidance developed through ESA Section 7 Consultation with USFWS. The Draft Northern Long-Eared Bat and Tricolored Bat Biological Assessment (**Appendix Q**) details avoidance and minimization measures that can be implemented to avoid and minimize impacts to protected bat species.

- To mitigate the risk of incidental "take" of protected bats species, the MDTA would conduct further consultation with USFWS and MDNR prior to the beginning of construction.
- A time of year restriction on tree clearing activities will be developed in coordination with USFWS and MDNR.

Assessments of bridges, culverts equal to or greater than 36 inches in diameter or width, and buildings identified for take have been conducted by the MDTA. These surveys would be conducted every two years and before any impacts to any identified bridges, culverts, or buildings to ensure bats are probably absent.

Surveys for NLEB and TCB conducted by the MDTA follow the USFWS Range-Wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines (USFWS, 2024). The protocols outlined in these guidelines also apply to the TCB.

- Seasonal restrictions on culvert and bridge removal, replacement, and tree clearing during the hibernation season (November 16 to March 31), spring staging season (April 1 to May 14), summer occupancy season (April 1 to September 30), pupping season (May 15 to July 31), and fall swarming season (August 16 to November 15) may be required to avoid the incidental "take" of bats.

The MDTA will continue to coordinate with USFWS and DNR to mitigate impacts to federally listed bat species. The MDTA assessed bridges and culverts in accordance with USFWS guidance to evaluate the presence or absence of listed or proposed listed bat species. MDTA has completed a forest habitat assessment to determine the presence and relative value of forested habitat for bats within the study area. A time of year for tree clearing activities will be developed in coordination with USFWS and MDNR.

Additional minimization and mitigation strategies related to RTE species are discussed in **Section 12, Chesapeake Bay Critical Area**.

16 UNIQUE AND SENSITIVE AREAS

For the purposes of the Tier 2 Study, Unique and Sensitive Areas are defined as habitats and biological resources that have special environmental attributes worthy of protection and retention. The resource review area for unique and sensitive areas extends 1,000 feet on either side of the U.S. 50/301 centerline from the Severn River to the U.S. 50/301 split.

16.1 Regulatory Context and Methodology

The ESA of 1973 is designed to protect critically imperiled species from extinction as a "consequence of economic growth and development untempered by adequate concern and conservation." In addition to protecting critically imperiled species from extinction, the ESA also designates critical habitat that are essential to conserve listed species. There is no designated critical habitat within the resource review area. See **Section 15, Rare, Threatened, and Endangered Species** for a detailed description of the ESA.

Maryland's GreenPrint Program was established to identify and "preserve the most ecologically valuable natural lands in Maryland" (Maryland's Green Infrastructure Assessment, 2023). These areas have been identified in MDNR's Green Infrastructure Assessment, which identifies the State's remaining large blocks of forest and wetlands ("hubs") and the habitat pathways ("corridors") that connect them. Hubs are defined as contiguous forest blocks and wetland complexes of at least 250 acres, rare or sensitive species habitats, biologically important rivers and streams, and existing conservation lands managed for natural values. Corridors are linear stretches of land, at least 1,100 feet wide, which help animals, plant seeds, water, and other important resources move between hubs. Areas of disconnect between the hubs and corridors are called "gaps" (MDNR, 2016).

Targeted Ecological Areas (TEA) are lands and watersheds of high ecological value that have been identified as conservation priorities by the MDNR for natural resource protection. These areas, which include Green Infrastructure (GI) hubs and corridors, represent the most ecologically valuable areas in Maryland.

SSPRA is a digital map data layer in Maryland's iMap GIS portal developed by MDNR representing the general locations of documented RTE species in Maryland. SSPRAs are categorized into four groups. Group 1 includes federally listed species, Group 2 includes state listed species, Group 3 includes species or natural communities of concern to MDNR, and Group 4 includes buffered locations of Bald Eagle nests. While the SSPRA boundary is not specifically regulated, it serves as a habitat buffer for unique and sensitive habitats that may sustain regulated species

Maryland's iMap GIS portal was used to identify the presence of TEA and SSPRA within the limits of the resource review area. TEA's identify GI hubs and corridors and SSPRA represent several unique and sensitive areas including regulated areas under the Critical Area Criteria and other areas of concern statewide, including Natural Heritage Areas, Listed Species Sites, Other or Locally Significant Habitat Areas, Colonial Waterbird Sites, WSSC, and Geographic Areas of Particular Concern. While impacts to GI are not specifically regulated, identification and comparison of impacts to GI from the Study alternatives is useful in evaluating the relative

potential effects of the alternatives on these ecologically valuable lands considered to be unique and sensitive to the State of Maryland.

16.2 Affected Environment

The resource review area contains approximately 98 acres of GI corridors and 176 acres of GI hubs for a total GI of 274 acres. This represents approximately 6 percent of the resource review area. A large section of GI corridor was identified outside of the resource review area, on Kent Island. This corridor provides a connection to GI hubs on Kent Island to a hub/corridor complex located within the eastern portion of the study area, between Queenstown and Grasonville. No GI corridors were identified within the Anne Arundel County section of the resource review area. GI hubs were identified within Anne Arundel County however, associated with Sandy Point State Park. This hub provides an important habitat for birds migrating along the East Coast Flyway. **Figure 16-1** identifies the location of the GI corridors and hubs within and adjacent to the resource review area.

The resource review area contains approximately 813 acres of SSPRA. This represents approximately 17 percent of the resource review area. The SSPRA identified on Kent Island is located along U.S. 50/301 and a small area identified as the Terrapin Nature Area, north of U.S. 50/301. Further east, SSPRA were identified west of Queenstown, south of U.S. 50/301 along the eastern shoreline of Prospect Bay and the Queenstown Harbor Lakes Course, north of U.S. 50/301, along the eastern bank of the Chester River. A relatively small area of mapped SSPRA was also identified within the Anne Arundel County portion of the resource review area and is associated with Sandy Point State Park, located on the north side of U.S. 50/301, along the west bank of the Chesapeake Bay. **Figure 16-2** identifies the location of SSPRA within and adjacent to the resource review area. The location of, and anticipated impacts to SSPRA located within the Critical Area are presented in **Section 12, Chesapeake Bay Critical Area**.

16.3 Environmental Consequences

Proposed build alternatives were evaluated to determine potential impacts to unique and sensitive areas, including areas designated as TEA GI corridors and hubs and areas designated as SSPRA.

16.3.1 No-Build Alternative

The No-Build Alternative would have no impact to unique and sensitive areas.

16.3.2 Build Alternatives

Potential impacts to Unique and Sensitive areas were evaluated by measuring the amount of the associated mapped resources (GI and SSPRA) identified within the build alternative LODs. **Table 16-1** depicts the total amount of potential impacts to GI hubs and corridors associated with the build alternatives. **Table 16-2** depicts the total amount of potential impacts to GI hubs and corridors associated with the SUP option for each of the build alternatives.

Table 16-1: Impacts to Green Infrastructure Hubs and Corridors (acres)

Resource	No-Build	Build Alternative					
		B	C	D	E	F	G
GI Corridors	0	0	0	20.3	20.3	20.3	20.3
GI Hubs	0	0.4	0.4	1.0	1.0	1.0	1.0
Total*	**0**	**0.4**	**0.4**	**21.3**	**21.3**	**21.3**	**21.3**

**Totals may not match sum of breakout values due to rounding.*

The addition of a SUP option with any of the build alternatives would result in no impacts to GI corridors and less than 0.1 acre of impacts to GI hubs, across all build alternatives.

Table 16-2: SUP Impacts to Green Infrastructure Hubs and Corridors (acres)

Resource	No-Build	Associated Build Alternative					
		B	C	D	E	F	G
GI Corridors	0	0	0	0	0	0	0
GI Hubs	0	0.1	0.1	0.1	0.1	0.1	0.1
Total	**0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**

Figure 16-1: GI Corridors and Hubs

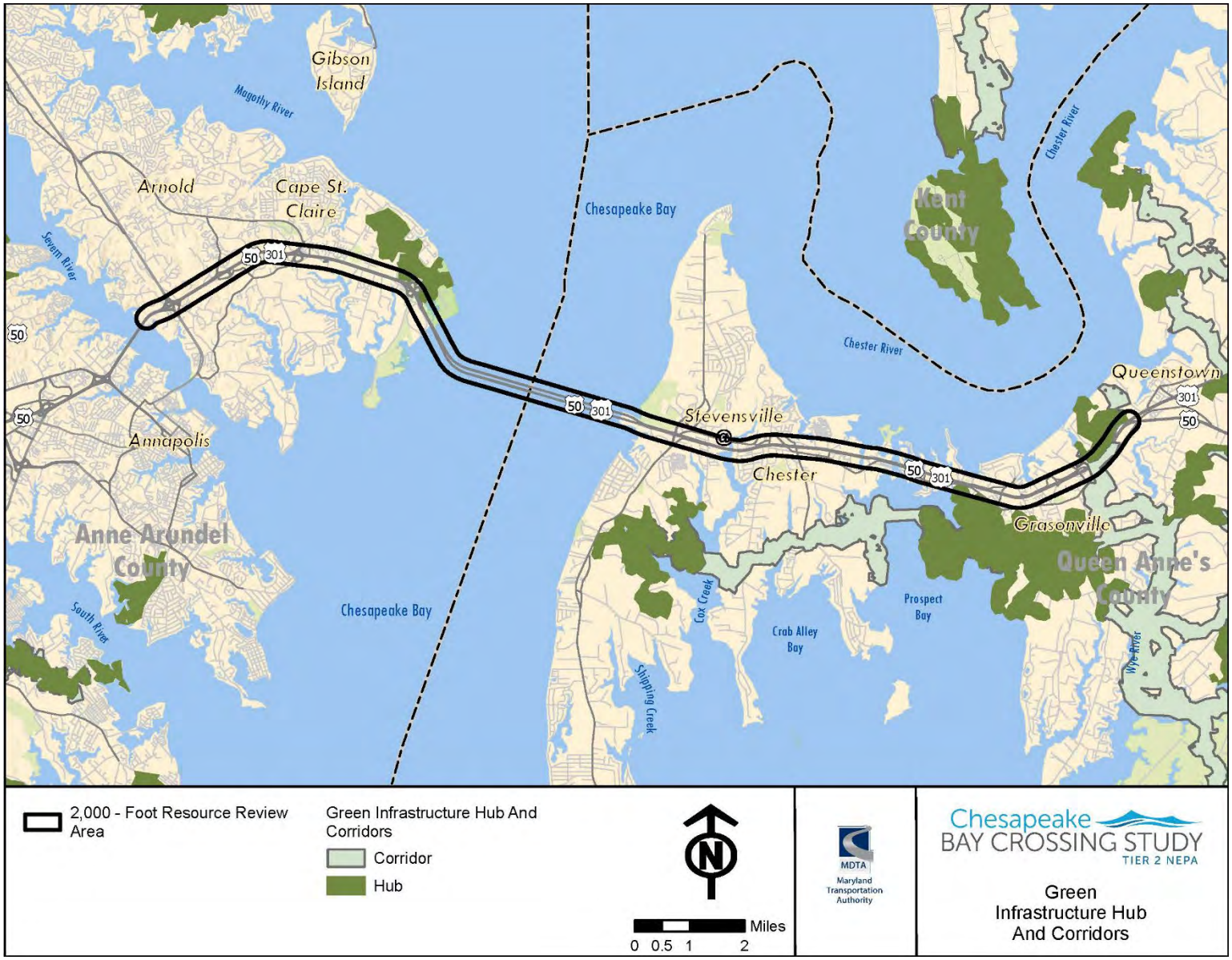
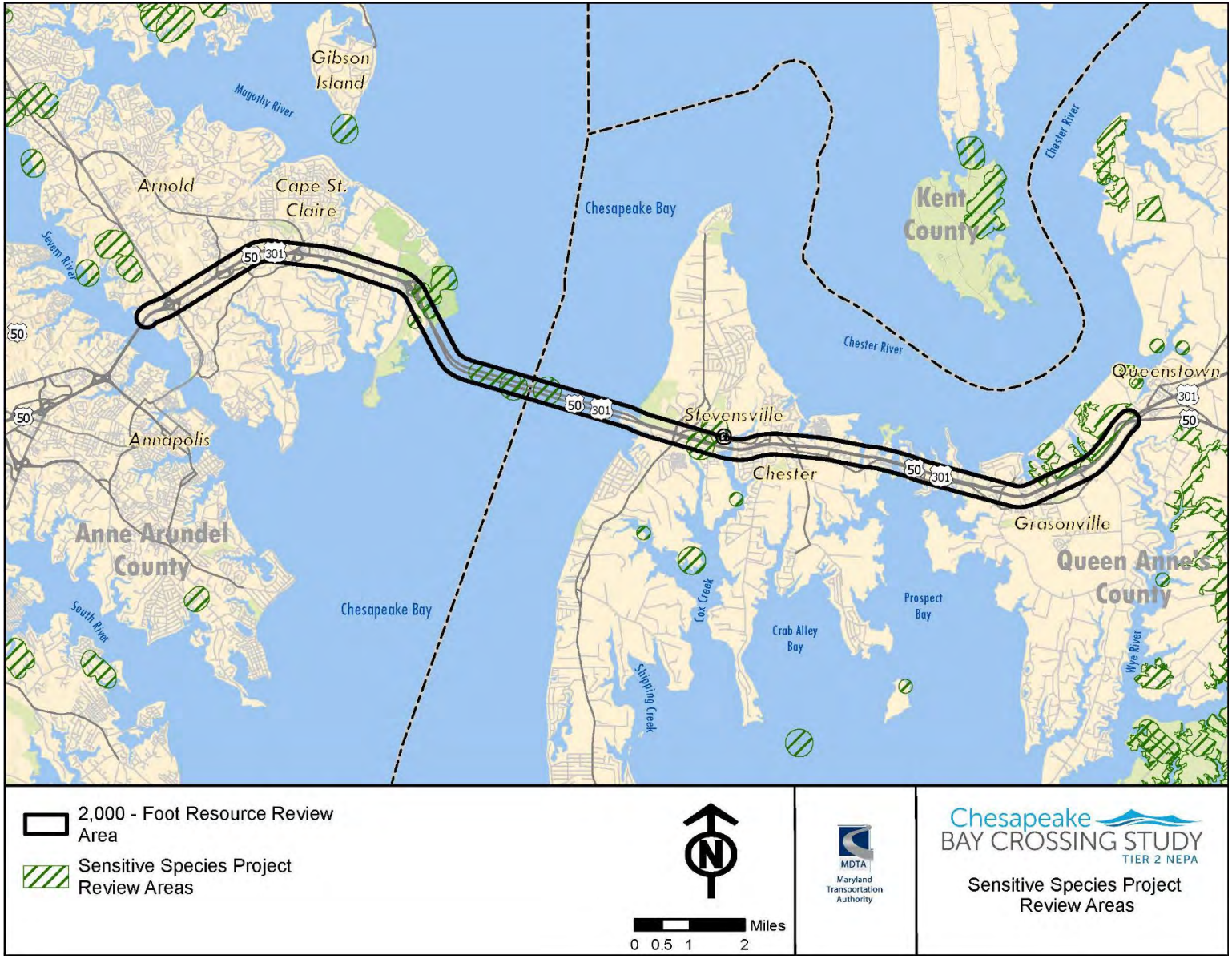


Figure 16-2: SSPRAs



Alternatives B and C cross relatively small sections of mapped GI hubs associated with Sandy Point State Park, located along the north side of U.S. 50/301 in Anne Arundel County. Alternatives D, E, F, and G impact these same GI hubs associated with Sandy Point State Park but also impact large areas of GI within Queen Anne's County, near Wye Harbor. This area contains relatively large tracts of undisturbed forested areas located between U.S. 50/301 and the Chester River. The addition of a SUP option with any of the build alternatives would result in less than 0.1 acres of additional impacts to GI hubs and corridors.

Table 16-3 depicts the total areas of SSPRA identified within the build alternative LODs (these areas are the amount of SSPRA within a build alternative, not impacts to SSPRA from that build alternative). **Table 16-4** depicts the total areas of SSPRA identified within the SUP area associated with the build alternatives. **Table 16-3** and **Table 16-4** also identify the associated SSPRA Group as described in **Section 16.2**. All identified SSPRA are either Group 2, areas associated with state listed species or Group 3, which include species or natural communities of concern to MDNR. SSPRAs are also shown on the natural resource map sets for the northern alignments (**Appendix B**) and southern alignments (**Appendix C**).

Table 16-3: SSPRAs within each Build Alternative (acres)

SSPRA	No Build	Build Alternative					
		B	C	D	E	F	G
SSPRA Group 2	0	80.6	80.1	90.1	89.6	91.7	91.0
SSPRA Group 3	0	29.4	29.3	29.4	29.3	30.8	30.3
Total*	**0**	**110.0**	**109.4**	**119.4**	**118.8**	**122.5**	**121.2**

**Totals may not match sum of breakout values due to rounding.*

Source: https://data.imap.maryland.gov/datasets/maryland:maryland-living-resources-sensitive-species-project-review-areas

Table 16-4: SSPRAs within SUP Area Associated with each Build Alternative (acres)

SSPRA	No Build	Associated Build Alternative					
		B	C	D	E	F	G
SSPRA Group 2	0	3.0	3.0	3.0	3.0	2.9	3.0
SSPRA Group 3	0	1.4	1.6	1.4	1.6	1.3	1.6
Total*	**0**	**4.3**	**4.5**	**4.3**	**4.5**	**4.2**	**4.6**

**Totals may not match sum of breakout values due to rounding.*

Alternative C contains the least amount of mapped SSPRA at 109.4 acres, while Alternative F contains the highest amount of mapped SSPRA at 122.5 acres. Most of the SSPRA within all build alternatives is associated with Group 2, areas associated with state listed species. The addition of a SUP option with any of the build alternatives would result in between 4.2 and 4.6 acres of additional impacts to SSPRAs, with the northern alternatives, Alternatives B, D and F having slightly less impact than the southern alternatives.

Alternatives B and C cross a relatively large SSPRA area associated with Sandy Point State Park. The SSPRA in this area is classified as both Groups 2 and 3. Alternatives B and C also cross mapped SSPRA on Kent Island, just west of Cox Creek. The SSPRA in this area is classified as Group 2.

All build alternatives cross SSPRA associated with the open waters of the Chesapeake Bay, between Kent Island and Anne Arundel County. The SSPRA within the open waters are classified as Group 2 and 3.

Alternatives D, E, F, and G also cross the SSPRA areas associated with Sandy Point State Park and Kent Island; however, since these alternatives extend further east, they also cross the relatively large areas of SSPRA located near Wye Harbor. The SSPRA in this area is classified as Group 2.

In general, Alternatives D, E, F, and G have the potential to impact more resources associated with SSPRA (approximately 10 acres more) than Alternatives B and C. Potential impacts associated with the SSPRA areas would correlate directly to the species it is identified to protect. More species-specific potential impacts are described in **Section 15, Rare, Threatened, and Endangered Species**.

16.4 Avoidance, Minimization, and Further Mitigation Strategies

The MDTA would continue to coordinate with MDNR during the design, construction, and post-construction phases to ensure compliance with all applicable environmental regulations associated with unique and sensitive areas. Potential impact minimization and further mitigation strategies may include:

- Prioritizing designs that avoid GI infrastructure and SSPRA-designated areas to the maximum extent practicable.
- Incorporating low impact design strategies where feasible.
- Incorporating SWM BMPs.
- Incorporating TOYRs to limit work during breeding or migration seasons for sensitive species.
- Design of underpasses, overpasses, or culverts to allow safe animal movement.
- Habitat restoration by replanting disturbed areas with native vegetation.
- Post-construction monitoring to assess mitigation effectiveness.

Additional avoidance, minimization and further mitigation strategies related to Unique and Sensitive areas are discussed **in Section 9, Waters of the U.S., Including Wetlands, Section 10, Coastal Zone, Section 12, Chesapeake Bay Critical Area, Section 13, Aquatic Habitat and Biota, Section 14, Terrestrial Habitat and Biota,** and **Section 15, Rare, Threatened, and Endangered Species**.

17 REFERENCES

17.1 Federal Regulations and Executive Orders

Bald and Golden Eagle Protection Act (16 U.S.C. § 668 et seq.)

Bolstering Ecosystems Against Coastal Harm (BEACH) Act of 2024 (Pub. L. 118-117)

Bridge Act of 1906 (33 U.S.C. § 491 et seq.)

Clean Water Act (33 U.S.C. § 1251 et seq.)

Coastal Zone Management Act of 1972 (16 U.S.C. § 1451 et seq.)

Coastal Barrier Resources Act of 1982 (16 U.S.C. § 3501 et seq.)

Council on Environmental Quality NEPA Implementing Regulations (40 CFR §1500 -1508)

Endangered Species Act (16 U.S.C. § 1531-1544 et seq.)

EO 11990, *Protection of Wetlands*, May 24, 1977, 42 FR 26961

EO 11988, *Floodplain Management*, May 24, 1977, 42 FR 26951

EO 13112, *Invasive Species*, February 3, 1999, 64 FR 6183

EO 13186, Responsibilities of Agencies to Protect Migratory Birds, January 17, 2001, 66 FR 3853

EO 13508, *Chesapeake Bay Protection and Restoration*, May 12, 2009, 74 FR 23099EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species*, December 5, 2016, 81 FR 88609

Farmland Protection Policy Act of 1981 (7 U.S.C. § 4201 et seq.)

Fish and Wildlife Conservation Act (16 U.S.C. § 2901-2912 et. seq.)

General Bridge Act of 1946 (33 U.S.C. § 525 et seq.)

Location Hydraulic Studies, 23 CFR 650.111

Magnuson-Stevens Fishery Conservation and Management Act of 1976 (16 U.S.C. § 1801 et seq.)

Marine Mammal Protection Act of 1972 (16 U.S.C. § 1361 et seq.)

Marine Protection, Research, and Sanctuaries Act (16 U.S.C. § 1401 et seq.)

Migratory Bird Treaty Act (16 U.S.C. § 703-712 et seq.)

National Environmental Policy Act of 1969 (42 U.S.C. § 4321 et seq.)

National Flood Insurance Act of 1968 42 U.S.C. 4001 et seq.), amended to the Flood Disaster Protection Act of 1973 (42 U.S.C. 4002 et seq.)

Occupational Safety and Health Act of 1970 (29 U.S.C. § 651 et seq.)

Paleontological Resources Preservation Act of 2009 (16 U.S.C. § 470 et seq.)

Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. § 401 et seq.)

Safe Drinking Water Act of 1974 (42 U.S.C. § 300f et seq.)

The Navigable Waters Protection Rule: Definition of ‘‘Waters of the United States’’ (85 FR 22250), Issued April 21, 2020; Effective June 22, 2020

U.S. Department of Transportation Order 5650.2, Floodplain Management and Protection, Issued April 23, 1979

U.S. Department of Transportation Order 5660.1A, Preservation of the Nation’s Wetlands, Issued August 24, 1978

Wild and Scenic Rivers Act of 1968 (16 U.S.C. § 1271 et seq.)

17.2 State Regulations

17.2.1 Statutes

Chesapeake Bay Critical Area Act (1984): COMAR Title 27 Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, Title 27.01.09.

Chesapeake Bay Critical Area (COMAR 27.01.09.04)

Maryland Forest Conservation Act (FCA) (1991), the Tree Solutions Now Act of 2021 and subsequent legislation (2023-2024)

Dredged Material Management Act of 2001

Maryland Nongame Endangered Species Conservation Act (Md. Code Ann., Nat. Res. § 10-2A-01 through 09

Maryland Reforestation Law

Scenic and Wild Rivers System Act of the State of Maryland (1968)

State of Maryland Wetland Protection Act of 1991

Postmining Land Use (COMAR 26.20.30)

Water Appropriations and Use Permit process (COMAR 26.17.06 and 26.17.07)

17.2.2 Regulations

Construction on Nontidal Waters and Floodplains (COMAR 26.17.04)

Forest Conservation (COMAR 08.10)

Maryland Water Quality Standards. (COMAR 26.08.01 and COMAR 26.08.02)

Maryland Waterway Construction Act (COMAR 26.17.04)

Environment Article Title 5, Subtitle 5-901 through 5-911; Annotated Code of Maryland; COMAR 26.23; (Nontidal Wetlands)

Environment Article Title 16; COMAR 26.24; (Tidal Wetlands)

Natural Resources Article 4 Section 4-213 – Submerged Aquatic Vegetation – Removal or eradication (§ 4-213)

Natural Resources Article 4 Section 4-213 – Oyster Sanctuaries (§ 4-213)

Wetlands of Special State Concern (COMAR 23.06.01)

COMAR 08.02.01A

COMAR 08.02.04

COMAR 26.24.02.06

17.3 Literature Cited and References

Anne Arundel County. n.d. Anne Arundel County Topographic Map. Retrieved February 2025: https://en-us.topographic-map.com/map-vcf1h/Anne-Arundel-County/?center=39.01922%2C-76.46968&zoom=15&popup=39.02569%2C-76.46656.

Anne Arundel County. 2023. Parcels dataset. (supplemented by field survey). https://opendata.aacounty.org/datasets/AnneArundelMD::parcels-12/about

Anne Arundel County. 2022. Master Plan for Water Supply and Sewerage Systems. Effective July 19. Retrieved December 2023: https://www.aacounty.org/sites/default/files/2023-07/Water-And-Sewer-Master-Plan-2022-Council-Approved.pdf.

Anne Arundel County. 2021. Plan 2040: Anne Arundel County General Development Plan. Adopted May 3. Retrieved December 2023: https://www.aacounty.org/planning-and-zoning/countywide-planning/plan2040.

Anne Arundel County Engineering Record Drawing and Monuments. Retrieved January 2025: https://gis.aacounty.org/portal/apps/webappviewer/index.html?id=dfaf0eab572c40b6b709ae1567f1ed8b

ArcGIS. 2022. MDOT SHA Right-Of-Way (Polygons). https://www.arcgis.com/home/item.html?id=6b9156c1986640f1a87efacee03e20f5

ArcGIS. 2020. MDOT SHA NPDES. https://www.arcgis.com/home/item.html?id=4c36b512a0884a1388723ed5fa1f847c.

ArcGIS. 2014. Maryland's surface water use classes as described in COMAR Section 26.08.02.08. https://www.arcgis.com/home/item.html?id=21708d15949846d39540bcf5789ea49c. Updated October 1.

ArcGIS. 2003. Maryland Soils – Chesapeake Bay Bottom Survey. Updated September 12, 2017. Retrieved May 2025: https://www.arcgis.com/apps/mapviewer/index.html?panel=gallery&layers=2a10ce98884e44bb8119980746869a92.

Atlantic Coastal Fish Habitat Partnership (ACFHP). 2009. Species-Habitat Matrix Project Summary Report. August. Available at: https://www.atlanticfishhabitat.org/wp-content/uploads/2018/09/Species-Habitat-Matrix-Summary-Report.pdf.

Balazik, M.T., K.J. Reine, A.J. Spells, C.A. Fredrickson, M.L. Fine, G.C. Garman, and S.P. McIninch. 2012. The Potential for Vessel Interactions with Adult Atlantic Sturgeon in the James River, Virginia. North American Journal of Fisheries Management, 32:6, 1062-1069, DOI: 10.1080/02755947.2012.716016.

Bonzek, C.F., J. Gartland, D.J. Gauthier, and R.J. Latour. 2022. Annual Report - 2021 Data collection and analysis in support of single and multispecies stock assessments in Chesapeake Bay: The Chesapeake Bay Multispecies Monitoring and Assessment Program. Virginia Institute of Marine Science, William & Mary. doi: 10.25773/k7xj-e205

Buckler, D.R. and G.E. Granato. 1999. Assessing Biological Effects from Highway-Runoff Constituents. U.S. Geological Survey Open-File Report 99-240. Retrieved March 2025: https://pubs.usgs.gov/of/1999/ofr99-240/pdf/ofr99240.pdf.

Bureau of Utility Operations. 2023. Anne Arundel County Water Distribution System. Retrieved December, 2023: https://www.aacounty.org/public-works/utilities/water-distribution-system.

Chesapeake Bay Foundation (CBF). 2022. *State of the Bay 2022*. Retrieved July 2024: https://www.cbf.org/document-library/cbf-reports/2022-state-of-the-bay-report.pdf.

CBF. 2004a. *A Citizen's Guide to the Critical Area Program in Maryland*. June. Retrieved December 2023: https://www.cbf.org/document-library/cbf-guides-fact-sheets/Citizens-Guide-to-MD-Critical-Area-Programdf0b.pdf.

CBF. 2004b. *A Citizen's Guide to the Forest Conservation Act in Maryland*. June. Retrieved December 2023: https://www.cbf.org/document-library/cbf-guides-fact-sheets/Citizens-Guide-to-Forest-Conservationcd1a.pdf.

Chen, W.B., W.C. Liu, M.H. Hsu, C.C. Hwang. 2015. Modeling investigation of suspended sediment transport in a tidal estuary using a three-dimensional model. Applied Mathematical Modelling, Vol. 39, Issue 9: 2570-2586. May 1. Retrieved December 2023: Modeling investigation of suspended sediment transport in a tidal estuary using a three-dimensional model - ScienceDirect.

Chesapeake Bay Magazine. 2025. *Humpback Whale Spotted Breaching Inside the Potomac River*. Retrieved May 2025: https://www.chesapeakebaymagazine.com/video-humpback-whale-spotted-breaching-inside-the-potomac-river/. Article by Meg Walburn Viviano. May 13.

Chesapeake Bay Program (CBP), 2023, Chesapeake Bay Land Use and Land Cover (LULC) Database 2022 Edition: U.S. Geological Survey data release. Developed by the Chesapeake Conservancy, U.S. Geological Survey and University of Vermont Spatial Analysis Lab, https://doi.org/10.5066/P981GV1L.

CBP. 2023. DataHub, Version 4.9.2. Retrieved December 2023: https://datahub.chesapeakebay.net/.

C-MAP® Chart Explorer. 2025. Retrieved January 2025: https://www.lowrance.com/lowrance/type/mapping/c-map-chart-explorer/?_gl=1*bfoxo3*_up*MQ..*_ga*MTU5NDk3NzA5NC4xNzM3NzQxODUx*_ga_N41JFZ8276*MTczNzc0MTg1MS4xLjEuMTczNzc0MTg1OS4wLjAuMA

Council on Environmental Quality (CEQ). 1997. Environmental Justice Guidance Under the National Environmental Policy Act. Retrieved December 2023: https://www.epa.gov/environmentaljustice/ceq-environmental-justice-guidance-under-national-environmental-policy-act.

Cowardin, L.M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. U.S. Fish and Wildlife Service FWS/OBS-79/31. December. Reprinted 1992.

Critical Area Commission (CAC). 2000. *A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area*. May 1. Prepared by C. Jones, J. McCann, and S. McConville, Maryland Department of Natural Resources. 58 pp. Retrieved December 2023: https://dnr.maryland.gov/criticalarea/Documents/forms_navbar/tweetyjune_2000.pdf.

Dadswell, M.J. 1979. Biology and population characteristics of the shortnose sturgeon, Acipenser brevirostrum LeSueur 1818 (*Osteichthyes:Acipenseridae*), in the Saint John River Estuary, New Brunswick, Canada. Canadian Journal of Zoology. 57(11): 2186-2210. https://doi.org/10.1139/z79-287.

Division of Geology and Mineral Resources (DGMR). 2023. Acidic Soil, Metal in Soils and Acid Rock Drainage. Virginia Department of Mines Minerals and Energy. Retrieved December 2023: https://www.dmme.virginia.gov/DGMR/acidicsoils.shtml.

Environmental Protection Agency (EPA). n.d.-a. Wetland Regulatory Authority, The Wetland Fact Sheet Series: Wetlands Overview. https://www.epa.gov/sites/production/files/2015-03/documents/404_reg_authority_fact_sheet.pdf.

EPA. n.d.-b. Watershed Academy Web: Fundamentals of Rosgen Stream Classification System. https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=1199.

EPA. 2025. Enforcement and Compliance History Online review. Retrieved January 2025: https://echo.epa.gov/facilities/facility-search/results

EPA. 2024a. Safe Drinking Water Act. Retrieved July 2024: https://www.epa.gov/sdwa. Last updated April 10, 2024

EPA. 2024b. Sole Source Aquifers for Drinking Water. Retrieved July 2024: https://www.epa.gov/dwssa/map-sole-source-aquifer-locations. Last updated April 30, 2024.

EPA. 2023a. Retrieved December 2023: https://www.epa.gov/radon/what-epas-action-level-radon-and-what-does-it-mean#:~:text=EPA%20recommends%20homes%20be%20fixed,L%20and%204%20pCi%2FL. Last updated July 6, 2023.

EPA. 2023b. National Recommended Water Quality Criteria - Aquatic Life Criteria Table. https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table. Last updated October 2, 2023.

EPA. 2023c. About Waters of the United States. https://www.epa.gov/wotus-rule/about-waters-united-states. Last updated October 10.

EPA. 2000. Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria for Rivers and Streams in Nutrient Ecoregion IX. EPA 822-B-00-019.

EPA. 1986. Quality Criteria for Water 1986. Office of Water Regulations and Standards. EPA 440/5-86-001. May 1. https://www.epa.gov/sites/default/files/2018-10/documents/quality-criteria-water-1986.pdf.

U.S. Army Engineer Research and Development Center (ERDC). 2008. Technical Guidelines for Environmental Dredging of Contaminated Sediments. ERDC/EL TR-08-29.

Federal Emergency Management Agency (FEMA). n.d. *FEMA's National Flood Hazard Layer (NFHL) Viewer*. Retrieved July 2023: https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html.

FEMA. 2023. National Risk Index Map showing Landslide Risk Index. Retrieved December 2023: https://hazards.fema.gov/nri/map.

Federal Highway Administration (FHWA). 1987. *Environmental Review Toolkit, Guidance for Preparing and Processing Environmental and Section 4(f) Documents*. FHWA Technical Advisory T 6640.8A. October 30. Washington, DC: U.S. Department of Transportation

Harrison, J.W. 2016. *The Natural Communities of Maryland: 2016 Natural Community Classification Framework*. Maryland Department of Natural Resources, Wildlife and Heritage Service, Natural Heritage Program, Annapolis, Maryland. Publication #03-662016-597. 35 pages. https://dnr.maryland.gov/wildlife/Documents/Natural_Communities%20_Maryland_2016_Framework.pdf.

Hinson, K.E., M.A.M. Friedrichs, P. St-Laurent, F. Da, and R.G. Najjar. 2022. Extent and Causes of Chesapeake Bay Warming. Journal of the American Water Resources Association 58 (6): 805–825. https://doi.org/10.1111/1752-1688.12916.

Horton, J.D., and C.A. San Juan. 2021. Prospect- and Mine-Related Features from U.S. Geological Survey 7.5- and 15-Minute Topographic Quadrangle Maps of the United States (ver. 10.0, May 2023): U.S. Geological Survey data release. Retrieved November 2023: https://doi.org/10.5066/F78W3CHG.

Interstate Commission on the Potomac River Basin (ICPRB). 2025. *Map: Stream Health in the Chesapeake Bay Watershed*. Accessed December 2025:

https://www.potomacriver.org/focus-areas/aquatic-life/macroinvertebrates/chessie-bibi-index-for-streams/interactive-map/.

Kranz, P.M. 1989. Dinosaurs in Maryland. Maryland Geological Survey Educational Series No. 6. Retrieved March 2025: http://www.mgs.md.gov/output/reports/ES/ES_6.pdf.

Llansó, R.J. and D.M. Dauer. 2002. Methods for calculating the Chesapeake Bay benthic index of biotic integrity. Final Report, Chesapeake Bay Benthic Monitoring Program, p.24.

Loman, Z.G., C.S. Loftin, C.S. Spiegel, and R. Boettcher. 2024. Trends in Atlantic flyway breeding colony sizes for five colonial waterbird species. U.S. Department of Interior, Fish and Wildlife Service, Cooperator Science Series FWS/CSS-155-2024, Washington, D.C. Retrieved February 2025: https://doi.org/10.3996/css39732465.

Lopes, T.J. and S. Dionne. 1998. A Review of Semivolatile and Volatile Organic Compounds in Highway Runoff and Urban Stormwater. U.S. Geological Survey Open-File Report 98-409. Retrieved March 2025: https://pubs.usgs.gov/of/1999/ofr99-240/pdf/ofr99240.pdf.

Martin, E.H. 2019. Chesapeake Fish Passage Prioritization: An Assessment of Dams in the Chesapeake Bay Watershed. The Nature Conservancy. https://maps.freshwaternetwork.org/chesapeake/

Maryland's Green Infrastructure Assessment. 2023. Retrieved November 2023: https://geodata.md.gov/greenprint/.

Maryland Integrated Mapping Application (MD iMap). 2023. https://imap.maryland.gov/.

MD iMap. 2019. Maryland Ecosystem Services - Groundwater Recharge - m3 per year. Updated July 17, 2019. Available at: https://data.imap.maryland.gov/maps/ba29333cd39f4debaf13174c17b50dab/explore?location=39.002603%2C-76.360564%2C12.08.

MD iMap. 2018. Maryland LiDAR Queen Anne's County – Shaded Relief and Anne Arundel County DEM feet. https://data.imap.maryland.gov/datasets/

MD iMap. 2017. https://imap.maryland.gov/.

MD iMap. 2015. Maryland Benthic Habitat - Chesapeake Bay Benthic Habitat. Updated August 2, 2017. Available at: https://data.imap.maryland.gov/datasets/1e6cf46ed99045bdbe09ac51bd1f66ae/explore?location=38.988391%2C-76.400389%2C12.32.

MD iMap. 2013. Maryland Living Resources - Forest Interior Dwelling Species. Updated August 4, 2017. Available at: https://data.imap.maryland.gov/datasets/ae2e53392ffd462daac93e101ca1696f_10/explore?location=0.002591%2C102.706250%2C0.00.

MD iMap. 2010. Maryland Living Resources - Waterfowl Areas. Updated August 2, 2017. Available at: https://data.imap.maryland.gov/datasets/maryland-living-resources-waterfowl-areas/explore?location=38.825124%2C-76.461700%2C9.81.

MD iMap. 2003. Maryland Finfish - White Perch Spawning Habitat. Updated August 3, 2017. Available at: https://data.imap.maryland.gov/datasets/maryland::maryland-finfish-white-perch-spawning-habitat/explore

Maryland Biological Stream Survey. MBSS 2000-2004 Volume II Ecological Assessment of Streams Sampled in 2001.

Maryland-DC Breeding Bird Atlas 3 (MD-DC BBA3). 2025. Accessed March 2025: https://ebird.org/atlasmddc/explore.

Maryland Department of Emergency Management (MDEM). 2024. Accessed December 2024: https://mdem.maryland.gov/Pages/resources-Landslides-and-Mudslides.aspx.

Maryland Department of Environment (MDE). n.d.-a. Regulations for Floodplain Development. Retrieved December 2023: https://mde.maryland.gov/programs/water/StormwaterManagementProgram/FloodHazardMitigation/Pages/floodplainregs.aspx.

MDE. n.d.-b. Laws and Regulations Governing the MDE Water Supply Program. https://mde.maryland.gov/programs/Water/water_supply/pages/regulations.aspx.

MDE. n.d.-c. Wetlands and Waterways Program. Retrieved December 2023: http://mde.maryland.gov/programs/water/WetlandsandWaterways/Pages/index.aspx.

MDE. n.d.-d. *Best Management Practices for Working in Nontidal Wetlands, Wetland Buffers, Waterways, and 100-Year Floodplains.* 12-NT-0433/201261660. Retrieved December 2023: https://mde.maryland.gov/programs/water/WetlandsandWaterways/Documents/10_Best_Management_Practices_Working_NontidalWetlands_WetlandBuffers_Waterways_100-Year_Floodplains.pdf.

MDE. 2024a. Wellhead Protection. Retrieved July 2024: https://mde.maryland.gov/programs/water/water_supply/source_water_assessment_program/pages/wellhead.aspx.

MDE. 2024b. Maryland's Searchable Integrated Report Database [Combined 303(d)/305(b) List]. Retrieved February 2024: http://www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Pages/303d.aspx.

MDE. 2023. State Groundwater Discharge Permit 21-DP-2885 for Kent Narrows-Stevensville-Grasonville Wastewater Treatment Plant. NPDES ID No. MD2885R08. Effective date: April 1. 2023, Expiration date: March 31, 2028. Retrieved December 2023: https://mes-mde.mde.state.md.us/WastewaterPermitPortal/.

MDE. 2019a. Designated Use Classes for Maryland's Surface Waters. Information updated August 2023. Retrieved December 15, 2023: https://mdewin64.mde.state.md.us/WSA/DesigUse/index.html

MDE. 2019b. *Innovative Reuse and Beneficial Use of Dredged Material Guidance Document*. In collaboration with Maryland Department of Transportation and Maryland Port Administration. https://mde.maryland.gov/programs/marylander/Documents/Dredging/FINAL_IBR_GUIDANCE_12.05.2019_MDE.pdf. December.

MDE. 2018. Maryland Model Floodplain Ordinance. https://mdfloodmaps.net/pdfs/MD_Model-FPMO_Ordinance_January2018.pdf. January.

MDE. 2015. Total Maximum Daily Load of Polychlorinated Biphenyls in the Magothy River Mesohaline Chesapeake Bay Tidal Segment, Anne Arundel County, Maryland. Final Report. Approved by EPA March 16, 2015. Retrieved December 2023: https://mde.maryland.gov/programs/water/TMDL/DocLib_Magothy_02131001/Magothy_River_PCB_TMDL_fa.pdf.

MDE/Maryland Department of Natural Resources (MDNR). 2014. Biological Assessment Methodology for Non-Tidal Wadeable Streams. Last revised June 4.

MDE. 2008. Map of Maryland's 12-Digit Watersheds. Information updated July 22, 2015. Retrieved December 15, 2023: https://mde.maryland.gov/programs/water/TMDL/DataCenter/Pages/12DigitWatershed.aspx

MDE. 1999. Maryland's Source Water Assessment Program. 39 pp. January 29. Retrieved December, 2023: https://mde.maryland.gov/programs/Water/Water_Supply/Documents/www.mde.state.md.us/assets/document/water/swap-new.pdf.

Maryland Department of Health (MDH). 2023. *Maryland: 2005-2016 Average Radon Measurements by ZIP Code*. Retrieved December 2023: https://maps.health.maryland.gov/phpa/eh/radon/.

Maryland Department of Natural Resources (MDNR). n.d.-a. Monarch Butterfly. Retrieved November 2023: https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/monarch.aspx#:~:text=To%20help%20monarchs%2C%20follow%20these,swamp%2C%20and%20butterflyweed%20are%20best!

MDNR. n.d.-b. Scenic and Wild Rivers. Retrieved December 2024: https://dnr.maryland.gov/land/Pages/Stewardship/Scenic-and-Wild-Rivers.aspx.

MDNR. n.d.-c. Maryland Green Infrastructure. Retrieved November 2023: *https://geodata.md.gov/imap/rest/services/Biota/MD_GreenInfrastructure/MapServer*.

MDNR. 2023a. Scenic and Wild Rivers. Retrieved December 2023: https://dnr.maryland.gov/land/pages/stewardship/scenic-and-wild-rivers.aspx.

MDNR. 2023b. Bay Grasses (Submerged Aquatic Vegetation). Retrieved December 2023: https://dnr.maryland.gov/waters/bay/Pages/sav/About.aspx.

MDNR. 2023c. Blue Crab Winter Dredge Survey. Retrieved December 2023: https://dnr.maryland.gov/fisheries/pages/blue-crab/dredge.aspx.

MDNR. 2023d. Big Champion Trees of Maryland. Retrieved December 2023: https://dnr.maryland.gov/forests/Pages/trees/bigtree.aspx.

MDNR. 2023e. Maryland's Wildlife Species. Retrieved December 2023: https://dnr.maryland.gov/wildlife/pages/plants_wildlife/mdwllists.aspx.

MDNR. 2023f. Maryland Mammals. Retrieved October 2023: https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/Mammals.aspx

MDNR. 2023g. The Reptiles and Amphibians of Maryland (Taxonomy based on Crother 2017). Retrieved November 2023: https://dnr.maryland.gov/wildlife/Documents/herpchecklist.pdf.

MDNR. 2023h. Maryland's Natural Areas. Retrieved November 2023: https://dnr.maryland.gov/wildlife/pages/naturalareas/natural-areas-by-county.aspx.

MDNR. 2019. Maryland Chesapeake Bay Oyster Management Plan. May.

MDNR. 2018. *The Maryland Amphibian and Reptile Atlas*. November 26. Johns Hopkins University Press, H.R. Cunningham and N.H. Nazdrowicz, eds. 312 pp.

MDNR. 2016. *2015-2025 Maryland State Wildlife Action Plan: Chapter 4, Maryland's Key Wildlife Habitats*. https://dnr.maryland.gov/wildlife/Documents/SWAP/SWAP_Chapter4.pdf.

MDNR. 2010. Maryland Living Resources – Sensitive Species Project Review Areas. Published February 4, 2010; information updated August 4, 2017, data updated December 14, 2021. Retrieved November 2023: https://data.imap.maryland.gov/datasets/maryland::maryland-living-resources-sensitive-species-project-review-areas/about.

MDNR. 2005. *Maryland Streams: Take a Closer Look*. Compiled by Sean Smith et al., Landscape and Watershed Analysis Division. May. https://dnr.maryland.gov/ccs/Publication/00012830.pdf.

MDNR. 1972. Tidal Wetland Boundary Maps. Retrieved October 2023: https://geodata.md.gov/imap/rest/services/Hydrology/MD_WetlandMaps1972/MapServer

Maryland Department of Planning. 2018. Land Use GIS files. Retrieved January 2025: https://planning.maryland.gov/Pages/OurProducts/downloadFiles.aspx.

Maryland Department of Transportation State Highway Administration (MDOT SHA). 2017. *Maryland's Transportation Environmental Regulatory Process (TERP)*. June.

Maryland Geological Survey (MGS). 2025. Maryland Geology – Fossils. Retrieved March 2025: http://www.mgs.md.gov/geology/fossils/index.html.

MGS. 2024. Retrieved December, 2024: http://www.mgs.md.gov/geology.

MGS. 2023. Aquifers in Maryland: Coastal Plain Region. Retrieved December, 2023: http://www.mgs.md.gov/groundwater/md_groundwater.html.

Maryland Ornithological Society (MOS). 2020. *Maryland & DC Breeding Bird Atlas 3, 2020-2024, Handbook and Guidelines*. February. 70 pp. Retrieved November 2023: https://is-ebird-wordpress-prod-s3.s3.amazonaws.com/wp-content/uploads/sites/80/2020/02/RESC_MDDCBBA3_AtlaserHandbook_Feb2020_V5.pdf.

Maryland State Highway Administration (MD SHA). 2023. Highway Drainage Manual. September, 2023.

MDTA. 2024a. *Draft Chesapeake Bay Crossing Study Tier 2 NEPA Wetland and Waterway Delineation Report*. January.

MDTA. 2024b. *Chesapeake Bay Crossing Study Tier 2 NEPA Notice of Intent to Prepare an Environmental Impact Statement Additional Project Information Document*. November.

Mid-Atlantic Fishery Management Council (MAFMC). 1998. Amendment 12 to the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan.

Mineral Resources Data System (MRDS). 2023. *Mineral Resource Data System by common geographic areas*. District of Columbia and Maryland. KML files. U.S. Geological Survey. Retrieved from https://mrdata.usgs.gov/mrds/geo-inventory.php.

National Marine Fisheries Service (NMFS). 2012. Biological Opinion for the James River Federal Navigation Project. Northeast Regional Office.

Navigation Project. Northeast Regional Office. National Oceanic and Atmospheric Administration (NOAA). 2023. Nautical Charts. Retrieved December 2023: https://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml.

Naylor, M.D. n.d. Historic Distribution of Submerged Aquatic Vegetation (SAV) in Chesapeake Bay, MD. Maryland Department of Natural Resources. Retrieved January 2025: https://mobjack.vims.edu/sav/special_reports/DNR_HistoricSAV_final_report.pdf

NOAA National Marine Fisheries Service (NOAA Fisheries). 2023a. Atlantic Sturgeon. Retrieved December 2023: https://www.fisheries.noaa.gov/species/atlantic-sturgeon.

NOAA Fisheries. 2023b. Shortnose Sturgeon. Retrieved December 2023: https://www.fisheries.noaa.gov/species/shortnose-sturgeon.

NOAA Fisheries. 2023c. Kemp's Ridley Turtle. Retrieved December 2023: https://www.fisheries.noaa.gov/species/kemps-ridley-turtle.

NOAA Fisheries. 2023d. Green Turtle. Retrieved December 2023: https://www.fisheries.noaa.gov/species/green-turtle.

NOAA Fisheries. 2023e. Leatherback Turtle. Retrieved December 2023: https://www.fisheries.noaa.gov/species/leatherback-turtle.

NOAA Fisheries. 2022a. Greater Atlantic Region ESA Section 7 Mapper. Retrieved December 2023: https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=a85c0313b68b44e0927b51928271422a.

NOAA Fisheries. 2022b. Loggerhead Turtle. Retrieved December 2023: https://www.fisheries.noaa.gov/species/loggerhead-turtle.

NOAA Fisheries. 2021. Essential Fish Habitat Mapper. Retrieved January 2025: https://www.fisheries.noaa.gov/resource/map/essential-fish-habitat-mapper. Last updated July 22, 2021.

NOAA Fisheries. 2020. Habitat Areas of Particular Concern within Essential Fish Habitat. Retrieved December 2023: https://www.fisheries.noaa.gov/southeast/habitat-conservation/habitat-areas-particular-concern-within-essential-fish-habitat. Last updated June 24, 2020.

Natural Resources Conservation Service (NRCS). 2024. Web Soil Survey. Retrieved May 2024: https://websoilsurvey.nrcs.usda.gov/app/. Last modified July 31, 2019.

New Jersey Department of Agriculture (NJDA). 2012. *The Standards for Soil Erosion and Sediment Control in New Jersey*. State Soil Conservation Committee. May.

Office of Response and Restoration (ORR). 2023. Chesapeake Bay and the Outer Coasts of Maryland and Virginia 2016 ESI TERRESTRIAL MAMMAL Polygons. Retrieved December 2023: https://www.fisheries.noaa.gov/inport/item/55162.

Orth, R.J., et al.. 2017. Submersed Aquatic Vegetation in Chesapeake Bay: Sentinel Species in a Changing World. BioScience, Volume 67, Issue 8, August 2017, Pages 698–712, https://doi.org/10.1093/biosci/bix058.

Park, C. 2012. A Dictionary of Environment and Conservation. Oxford University Press. Retrieved December 2023: 10.1093/acref/9780198609957.001.0001.

Patrick, C.J., D.J. Wilcox, J.R. Whiting, A.K. Kenne, and E.R. Blue. 2024. 2023 Distribution of Submerged Aquatic Vegetation in Chesapeake Bay and Coastal Bays. Virginia Institute of Marine Science, December. Retrieved February 2025: https://www.vims.edu/research/units/programs/sav/reports/2023/.

Patrick, C.J., D.J. Wilcox, J.R. Whiting, A.K. Kenne, and E.R. Smith. 2023. 2022 Distribution of Submerged Aquatic Vegetation in Chesapeake Bay and Coastal Bays. Virginia Institute of Marine Science, December. Retrieved February 2025: https://www.vims.edu/research/units/programs/sav/reports/2022/.

Pomeroy, J.S. 1988. Map showing landslide susceptibility in Maryland. Department of Interior, U.S. Geological Survey. Miscellaneous Field Studies, Map MF-2048 Pamphlet. Retrieved December 2023: https://pubs.er.usgs.gov/publication/mf2048.

Queen Anne's County. n.d. Queen Anne's County Property Viewer. https://gis.qac.org/qac272/Index.html?configBase=https://gis.qac.org/Geocortex/Essentials/REST/sites/QAC_Property_Viewer/viewers/QAC_Property_Viewer/virtualdirectory/Resources/Config/Default

Queen Anne's County. 2022. Queen Anne's County 2022 Land Preservation, Parks & Recreation Plan. Retrieved February 2025: https://dnr.maryland.gov/land/Documents/Stewardship/2022-LPPRP-Queen-Annes-County-Final.pdf.

Queen Anne's County. 2014. Department of Public Works Sanitary District, 2011 Comprehensive Water and Sewage Plan Amendment No. 11-05 September 9.

Queen Anne's County. 2011. Comprehensive Water and Sewerage Plan. May 10. Retrieved December, 2023: https://www.qac.org/DocumentCenter/View/9053/Comprehensive-Water--Sewer-Plan-FINAL?bidId.

Reshetiloff, K. 2023. *Chesapeake's abundance lures wintering waterfowl*. Bay Journal. December 12. Retrieved February 2025: Chesapeake's abundance lures wintering waterfowl. https://www.bayjournal.com/columns/bay_naturalist/chesapeake-s-abundance-lures-wintering-waterfowl/article_4463317a-887f-11ee-a208-8768dc34c5a7.html.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs.

Rosgen, D.L. 1994. A classification of natural rivers. Catena Vol. 22, Issue 3:169-199. June. https://doi.org/10.1016/0341-8162(94)90001-9.

Roth, N. E., M. T. Southerland, G. M. Rogers, and J. H. Vølstad. 2003. "Maryland Biological Stream Survey 2000-2004: Volume II: Ecological Assessment of Watersheds Sampled in 2001." Maryland Department of Natural Resources, Annapolis.

Roth, N.E., M.T. Southerland, J.C. Chaillou, P.F. Kazyak, and S.A. Stranko. 2000. Refinement and Validation of a Fish Index of Biotic Integrity for Maryland Streams. Versar, Inc., Columbia, MD, with Maryland Department of Natural Resources, Monitoring and Non- Tidal Assessment Division. CBWP-MANTA-EA-00-2.

Severn River Association. 2024. *Maryland Scenic Rivers: The Severn*. Retrieved June 2024: https://severnriver.org/wp-content/uploads/MD-Scenic-Rivers-The-Severn.pdf.

Severn River Commission. 2024. Retrieved June 2024: https://www.aacounty.org/severn-river-commission.

Smith, G.F., K.N. Greenhawk, D.G. Bruce, and E.B. Roach. 2001. A digital presentation of the Maryland oyster habitat and associated bottom types in the Chesapeake Bay (1974-1983). Journal of Shellfish Research 20(1):197-206. June.

Southerland, M.T., G.M. Rogers, M.J. Kline, R.P. Morgan, D.M. Boward, P.F. Kazyak, R.J. Klauda, S.A. Stranko. 2005. New Biological Indicators to Better Assess the Condition of Maryland Streams. DNR-12-0305-0100. Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division. Annapolis, MD.

Stranko, S., D. Boward, J. Kilian, A. Becker, M. Ashton, M. Southerland, B. Franks, W. Harbold and J. Cessna. 2019. Maryland Biological Stream Survey: Round Four Field Sampling Manual. Maryland Department of Natural Resources. Publication #12-1212011-491. https://dnr.maryland.gov/streams/Publications/R4Manual.pdf.

Stranko, S.A., D.M. Boward, J.V. Kilian, C.J. Millard, A.J. Becker, R. Gauza, A. Schenk, A. Roseberry-Lincoln, and M. O'Connor. 2007. Maryland Biological Stream Survey Sampling Manual. Maryland Department of Natural Resources, Annapolis, Maryland.

Swearingen, J., B. Slattery, K. Reshetiloff, and S. Zwicker. 2010. *Plant Invaders of Mid-Atlantic Natural Areas, 4th ed*. National Park Service and U.S. Fish and Wildlife Service. Washington, DC. 168 pp. https://www.invasive.org/alien/pubs/midatlantic/midatlantic.pdf.

The Severn Riverkeeper. 2024. Retrieved June 2024: http://severnriverkeeper.org/about-the-severn-river.

U.S. Army Corps of Engineers (USACE). n.d. Dredged Material Management Plan Overview. Retrieved December 2023: https://www.nab.usace.army.mil/Missions/Civil-Works/Dredged-Material-Management-Plan-DMMP/.

USACE. 2023a. Civil Works Overview. Retrieved December: https://www.nab.usace.army.mil/Missions/Civil-Works/Nav-Maps/

USACE. 2023b. USACE Hydrographic Surveys. Retrieved December: https://www.arcgis.com/apps/dashboards/4b8f2ba307684cf597617bf1b6d2f85d.

USACE. 2023c. USACE Federal Navigation Channel Maps. Retrieved December 2023: https://www.nab.usace.army.mil/Missions/Civil-Works/Nav-Maps/.

USACE. 2020a. National Wetland Plant List, Version 3.5. Retrieved October 2023: http://wetland-plants.usace.army.mil/.

USACE. 2020b. Atlantic and Gulf Coastal Plain 2020 Regional Wetland Plant List.

USACE. 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0). Engineer Research and

Development Center, Wetlands Regulatory Assistance Program ERDC/EL TR-10-20. November.

USACE. 1999. The Highway Methodology Workbook Supplement: Wetland Functions and Values, A Descriptive Approach. New England District NAEEP-360-1-30a. 32 pp. September.

USACE. 1987. Corps of Engineers Wetlands Delineation Manual. Waterways Experiment Station, Wetlands Research Program Technical Report Y-87-1. Final Report – January.

USACE Baltimore District Regulatory Branch. September 2023. The Maryland Stream Mitigation Framework Version 1 Final (MSMF V.1. Final) Manual for Stream Impact and Stream Mitigation Calculation.

U.S. Census Bureau (USCB). 2020. *2020 Census Urban Areas of the United States and Puerto Rico*. Cartographic Boundary Shapefiles – Urban Areas, 2020 Urban Areas Wall Map. Retrieved December 2023: https://www2.census.gov/geo/maps/DC2020/UA20/UA_2020_WallMap.pdf.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS). n.d. Maryland Field Office Technical Guide.

USDA/NRCS. 2024. Soil Data Access (SDA) Prime and other Important Farmlands. Retrieved June 2024: https://www.nrcs.usda.gov/publications/Legend%20and%20Prime%20Farmland%20-%20Query%20by%20Soil%20Survey%20Area.html.

USDA/NRCS. 2018. *Field Indicators of Hydric Soils in the United States, Version 8.2*. L.M. Vasilas, G.W. Hurt, and J.F. Berkowitz (eds.). In cooperation with the National Technical Committee for Hydric Soils.

USDA/NRCS. 2017. National Soil Survey Handbook. Title 430-VI. August. Retrieved June 2024: https://directives.nrcs.usda.gov/sites/default/files2/1712932090/35155.pdf.

USDA/NRCS. 2002. Soil Survey of Queen Anne's County, Maryland. 250 pp. Retrieved June 2024: https://archive.org/details/usda-soil-survey-of-queen-annes-county-maryland-2002/page/28/mode/2upttps//usda-soil-survey-of-queen-annes-county-maryland-2002.

USDA/NRCS. 1973. Soil Survey of Anne Arundel County, Maryland. 183 pp. Retrieved June 2024: https://archive.org/details/usda-soil-survey-of-anne-arundel-county-maryland-1973/page/8/mode/2up.

U.S. Department of the Interior (USDOI). 2023. National Wild and Scenic Rivers System. Retrieved October 2023: https://www.rivers.gov/rivers/rivers/.

U.S. Fish and Wildlife Service (USFWS). National Wetlands Inventory: Wetlands Mapper. Retrieved July 2023: https://www.fws.gov/wetlands/Data/Mapper.html.

USFWS. 2007. National Bald Eagle Management Guidelines. National Bald Eagle Management Guidelines. Available at: http://www.fws.gov/migratorybirds 4

USFWS. 2021. Birds of Conservation Concern 2021. United States Department of the Interior, U.S. Fish and Wildlife Service, Migratory Birds, Falls Church, Virginia: http://www.fws.gov/birds/management/ managed-species/birds-of-conservation-concern.phpUSFWS. n.d. Coastal Barrier Resources Act. Retrieved December 2023: https://www.fws.gov/program/coastal-barrier-resources-act. USFWS. 2024. Range-Wide Indiana Bat & Northern Long-Eared Bat Survey Guidelines. March. Retrieved March 2025: https://www.fws.gov/sites/default/files/documents/2024-10/2024_usfws_rangewide_ibat-nleb_survey_guidelines.pdf.

USFWS. 2024. Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines. U.S. Fish and Wildlife Service, Region 3, Bloomington, MN. 95 pp.

USFWS. 2023. Myotis septentrionalis Current Range. Retrieved November 2023: https://ecos.fws.gov/docs/species/shapefiles/usfws_A0JE_V01_Myotis_septentrionalis_current_range.zip.

USFWS. 2022. Species Status Assessment Report for the Northern long-eared bat (Myotis septentrionalis). Version1.2. Retrieved November 2023: https://www.fws.gov/media/species-status-assessment-report-northern-long-eared-bat.

USFWS. 2014a. John H. Chafee Coastal Barrier Resources System Stevensville Unit MD-32 and Wesley Church Unit MD-33. Map 24-016A. Published August 1, 2014. Retrieved December 2023: https://www.fws.gov/sites/default/files/documents/24-016A.pdf.

USFWS. 2014b. John H. Chafee Coastal Barrier Resources System Eastern Neck Island Unit MD-34P and Wilson Pond Unit MD-35. Map 24-017A. Published August 1, 2014. Retrieved December 2023: https://www.fws.gov/sites/default/files/documents/24-017A.pdf.

USFWS. 1993. Wetlands Classification System. Retrieved January 2024: https://www.fws.gov/policy-library/660fw2.

USFWS. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. Biological Services Program. December.

U.S. Department of Transportation. 1979. Order 5650.2, “Floodplain Management and Protection” April 23. Retrieved December 2023: https://www.fhwa.dot.gov/engineering/hydraulics/policymemo/order56502.pdf.

U.S. Geological Survey (USGS). 2025a. National Map Viewer. Retrieved February 2025. https://apps.nationalmap.gov/downloader/.

USGS. 2025b. USGS Groundwater Data for the Nation. National Water Information System: Web Interface. Retrieved February 2025: https://waterdata.usgs.gov/nwis/gw. Last modified February 11, 2025.

USGS. 2024. *StreamStats*. Retrieved December 15, 2023: https://streamstats.usgs.gov/ss/.

USGS. 2023a. *U.S. Landslide Inventory*. Retrieved December 2023: https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=ae120962f459434b8c904b456c82669d.

USGS. 2023b. Retrieved December 15, 2023: https://www.usgs.gov/special-topics/water-science-school/science/wastewater-treatment-water-use#overview.

USGS. 2020. Annual Water Data Reports. Retrieved December 2023: https://wdr.water.usgs.gov/. Page last modified September 17, 2020.

USGS. 2017. Confined Aquifer Wells. MD-DE-DC Water Science Center. Retrieved January, 2024. https://md.water.usgs.gov/groundwater/web_wells/current/confined/counties/index.html. Page last modified January 18, 2017.

University of Maryland Center for Environmental Science (UMCES). 2024. DolphinWatch. Retrieved March 2024: https://www.umces.edu/dolphinwatch.

Versar. 2022. Chesapeake Bay Water Quality Monitoring Program: Long-term Benthic Monitoring and Assessment Component Level 1 Comprehensive Report. July 1984-December 2021 (Volume 1). Available at: https://www.baybenthos.versar.com/Docs/LTB_2021_Volume1.pdf.

VIMS. n.d. Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP). Retrieved December 2023: https://www.vims.edu/research/units/programs/multispecies_fisheries_research/chesmmap/

Wagner, D.P., D.S. Fanning, and J.E. Foss. 1982. Identification of Source Materials for Acid Leachates in Maryland Coastal Plain. Transportation Research Record Issue 892:25-28

Watts, B.D. 2013. Waterbirds of the Chesapeake Bay: A Monitoring Plan, Edition 1.0. December. Retrieved February 2025: https://www.ccbbirds.org/wp-content/uploads/2014/01/Waterbirds-of-the-Chesapeake-Bay-A-Monitoring-Plan.pdf.

Weary, D.J., and D.H. Doctor. 2014. Karst in the United States: A Digital Map Compilation and Database: U.S. Geological Survey Open-File Report 2014-1156, 23 pp. https://dx.doi.org/10.3133/ofr20141156.

Webster, W.D., J.F. Parnell, and W.C. Biggs, Jr. 1985. *Mammals of the Carolinas, Virginia, and Maryland*. University of North Carolina Press, Chapel Hill and London. May. 255 pp. https://www.buteobooks.com/pages/books/13596-1/william-david-webster-james-f-parnell-walter-c-biggs-jr/mammals-of-the-carolinas-virginia-and-maryland-hc.

Weisberg, S.B., J.A. Ranasinghe, D.M. Dauer, L.C. Schaffner, R.J. Diaz, and J.B. Frithsen 1997. An estuarine benthic index of biotic integrity (B-IBI) for Chesapeake Bay. Estuaries, 20, pp.149-158.