

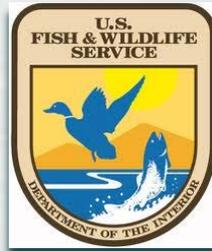
Lynnhaven River Basin Ecosystem Restoration Study Virginia Beach, Virginia

COL Paul B. Olsen, P.E.
Commander, Norfolk District



US Army Corps of Engineers
BUILDING STRONG®

In Cooperation With The City of Virginia Beach, Virginia



Purpose of Briefing

Approval to release Lynnhaven Ecosystem Final Report for State and Agency review

Presentation Outline:

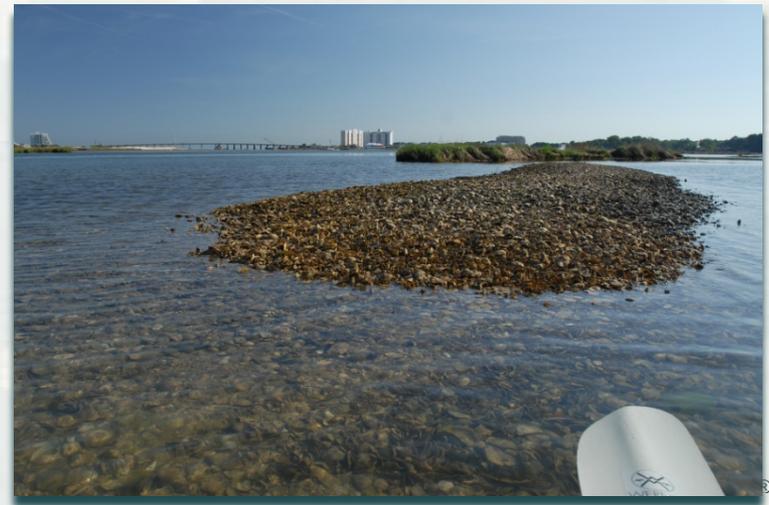
1. Introduction
2. BLUF
3. Background and context
4. Study specifics
5. Recommendations
6. Oversight and compliance
7. Summary



Bottom Line Up Front (BLUF)

- ❖ We recommend four measures...
 1. Restoration of Wetlands (38 acres)
 2. Restoration of Submerged Aquatic Vegetation (94 acres)
 3. Reintroduction of Bay Scallop (22 acres)
 4. Construction of Reef Habitat (31 acres)

- ❖ ...at a total project first cost of \$34.4 Million (65% Federal and 35% Non-Federal)



Study Purpose

Evaluate aquatic ecosystem restoration (and protection opportunities) within the Lynnhaven River Basin & recommend a sustainable restoration plan



A “Nested” Project

- ❖ Committee on Transportation and Infrastructure of the U.S. House of Representatives, Docket 2558, adopted May 6, 1998
- ❖ Chesapeake Bay Protection and Restoration EO 13508
- ❖ Supports the USACE Campaign Plan; UCP 2A, 2B, 4B and 4D2
- ❖ Environmental Operating Principles



Study Area



- ❖ 64 square mile tidal estuary in the lower Chesapeake Bay Watershed
- ❖ Located within the boundaries of the city of Virginia Beach, Virginia





Resource Significance: Why Lynnhaven?

❖ Institutionally Significant:

- Chesapeake Bay was first estuary in the United States targeted for intensive, government sponsored restoration efforts
- Chesapeake Bay Program partnership (1983 and 1987)
- Chesapeake Bay Restoration Act of 2000

❖ Publically Significant:

- Supports thousands of boaters and residents
- Home to First Landing State Park containing cypress swamps and wetlands connected to the river
- Source of the “Lynnhaven Fancy,” a world renowned oyster



Resource Significance (con't)

❖ Technically Significant:

- 53 documented species of fish
- 40+ species of mammals
- 8 bat species (including a state endangered species)
- 50+ species of reptiles and amphibians
- 130+ species identified in Virginia's Wildlife Action Plan
- 30+ protected bird species

The Lynnhaven River could serve as a microcosm for the Chesapeake Bay



Virginia Beach

❖ Population trend

- Population: 438,000
- Continued annual growth of 0.5% through 2030

❖ Population Description

- Mainly, suburban residential low to medium density single family dwellings
- Higher multi-family dwellings and urban development located along major roadways



Source: Wikimapia



Ecosystem Restoration Challenges

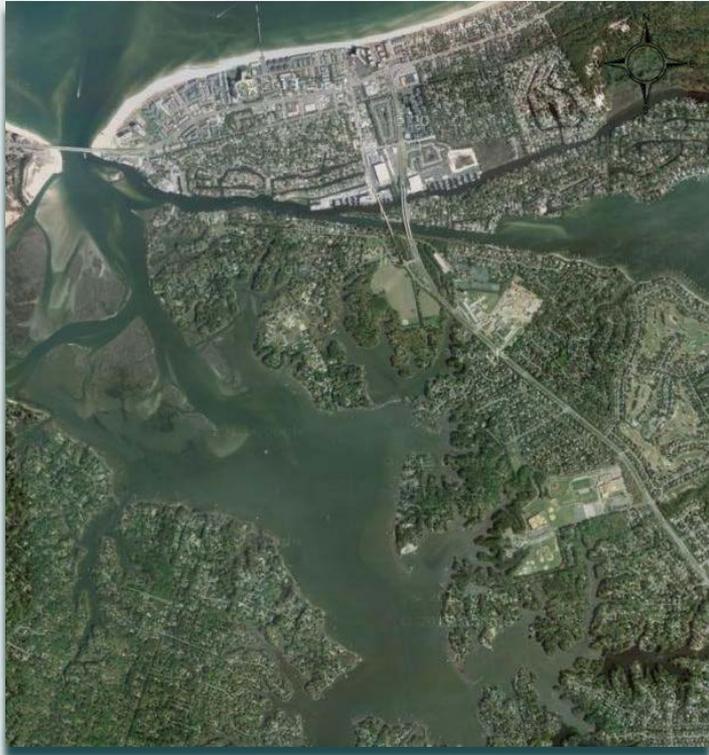
- Loss of reef habitat
- Reduced water quality
- Siltation
- Degraded benthic diversity
- Loss of SAV habitat (only 6 acres were observed in 2010)
- Reduced blue crab population
- Loss of bay scallops (absent from the Lynnhaven System since the 1930's)
- Loss of tidal wetlands (860 acres in 1979 to ~699 acres in 2007)
- Increased invasive wetland species
- Sea level rise



Ecosystem Restoration Challenges (con't)



1937



2012



Future Without Project Conditions

- ❖ Limited improvement to the Lynnhaven River Basin ecosystem due to the efforts of the City of Virginia Beach and other organizations.
- ❖ Slight increase in SAV due to local efforts
- ❖ Critically low levels of benthic habitat
- ❖ Continued absence of bay scallops
- ❖ Continued loss of pristine, high quality wetland habitat



Study Specifics



Objectives

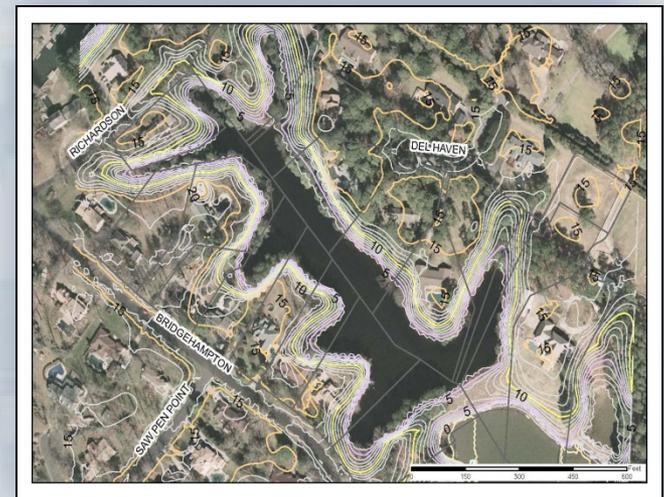
To restore aquatic ecosystem structure, function and dynamic processes to a less degraded, more natural condition by:

- Increasing the diversity, productivity, and sustainability of reef habitat by constructing 25-35 acres of three-dimensional reef habitat
- Restoring and maintaining between 20 and 100 acres of self-sustaining population of SAVs
- Preserving marsh function by restoring 20-25 acres of native marsh
- Reducing acreage of invasive marsh plants by 75% per site
- Restoring a self-sustaining population of bay scallops



Initial Array of Measures

1. Increase the Amount of Hard Reef Habitat
2. Restore Submerged Aquatic Vegetation
3. Reintroduce the Bay Scallop
4. Restore Wetlands
5. Restore Benthic Habitat
6. Reconnect Tidal Wetlands (Dam Removal)



Screened Measures

1. Dam Removal

- Removal of dams to restore tidal flow and restore lost estuaries
- No public support

2. Restore Benthic Habitat

- This measure involves removing the fine sediment through dredging
- Removed due to the long-term O&M required



Four Restoration Measures

1. Increase the Amount of Hard Reef Habitat
2. Restore Submerged Aquatic Vegetation
3. Reintroduce the Bay Scallop
4. Restore/Diversity Wetlands



Restoration Measure #1

Increase Reef Habitat

❖ Benefits

- Increased bottom habitat
- Increased species diversity and community productivity

❖ Risks

- Sedimentation due to run off
- Subsidence due to bottom conditions

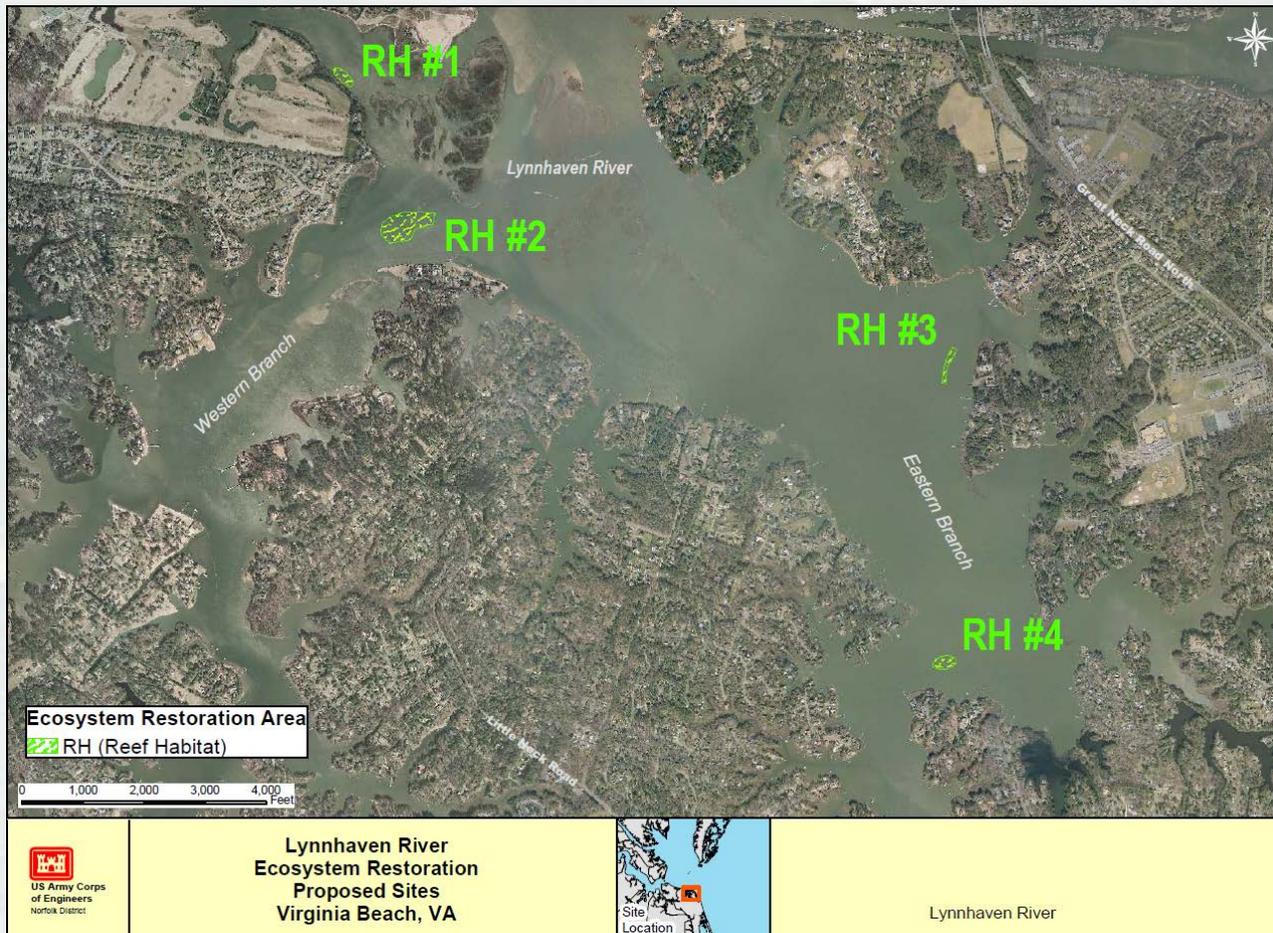
❖ Site Selection Parameters:

- Water Depth
- Water Quality
- VMRC leases
- Proper bottom conditions

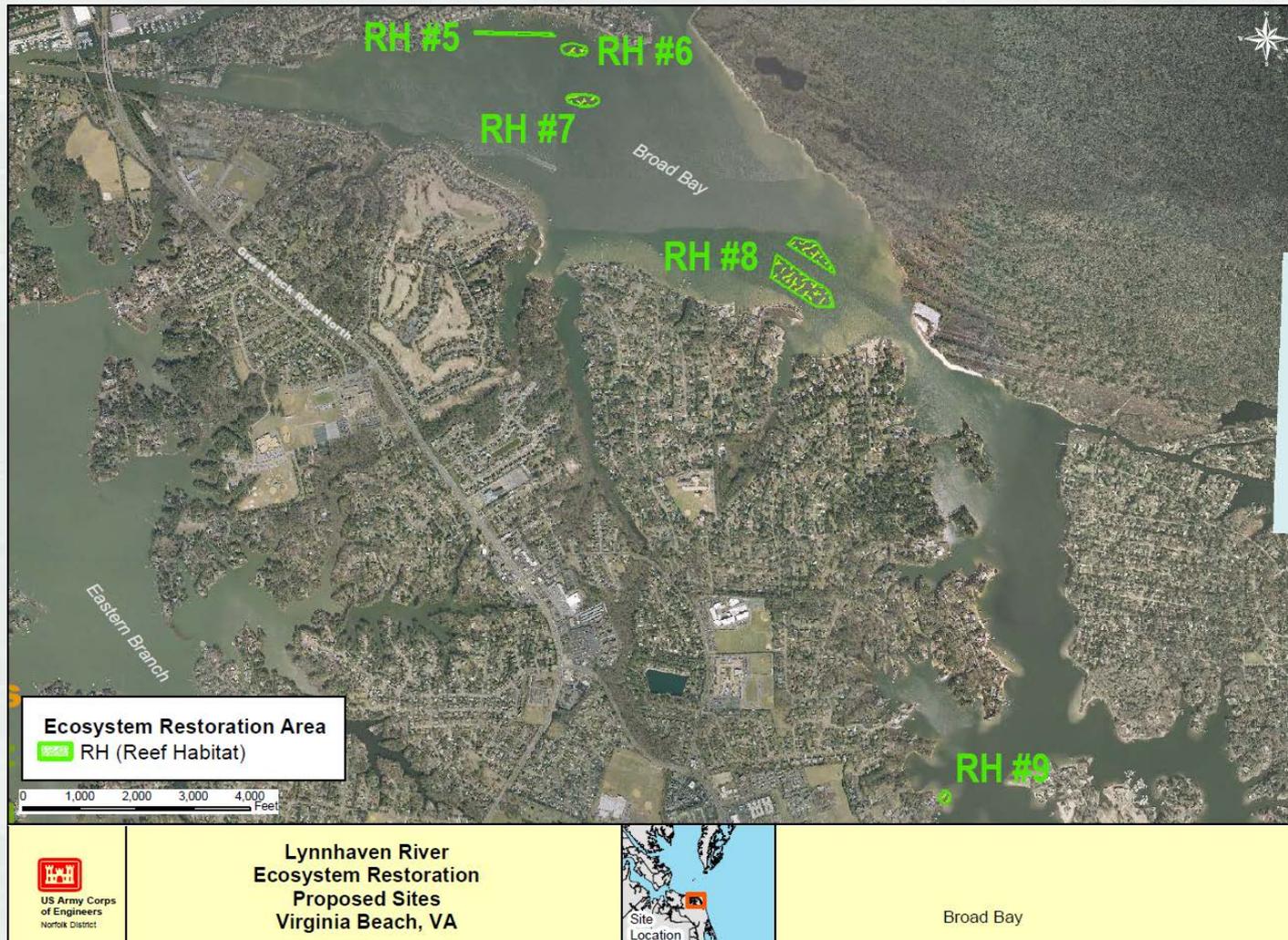
❖ Nine sites (31 acres) carried forward



Reef Habitat Restoration Sites Sites 1-4



Reef Habitat Restoration Sites Sites 5-9



Restoration Measure #2

Submerged Aquatic Vegetation (SAV)

- ❖ **Benefits**
 - Stabilized bottom conditions
 - Increased dissolved oxygen in the water column
 - Reduced shoreline erosion
 - Increased habitat to many species (e.g. blue crab, menhaden, shad, croaker and striped bass)
 - Nutrient sequestration

- ❖ **Risk**
 - Failure of SAV seeding (factors – cow nose ray foraging, boat propeller damage, storm events and adverse changes in water quality)
 - Failure of rhizomes and viable seeds to over-winter

- ❖ **Site Selection Parameters:**
 - Water depth
 - Historic SAV beds
 - VMRC leases
 - Sedimentation rates
 - Hydrodynamics

- ❖ 12 sites (94 acres) carried forward for consideration



Restoration Measure #3

Reintroduction of Bay Scallops

- ❖ Benefits
 - Improved water quality (filter feeders)
 - Improved species diversity and community productivity

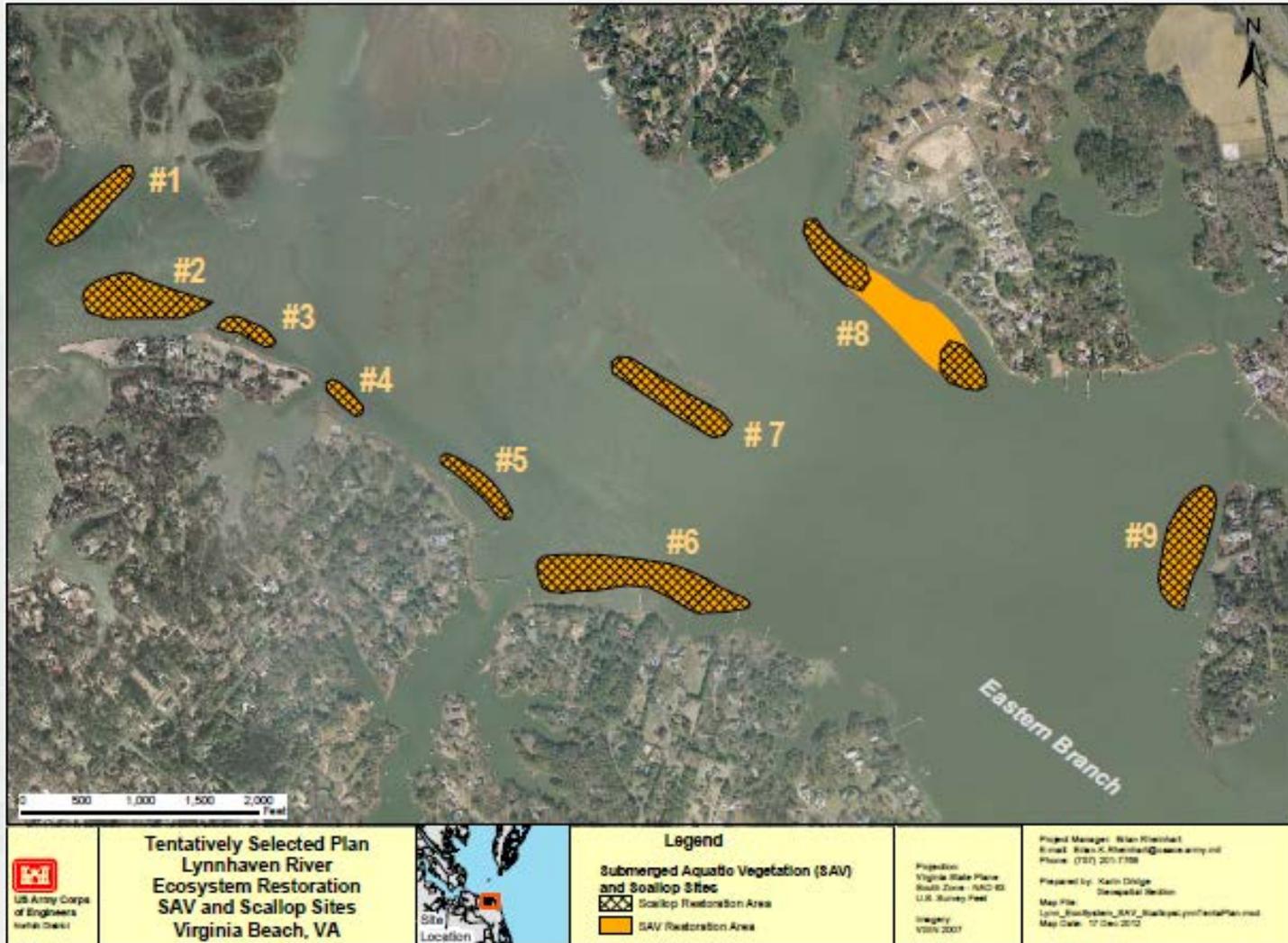
- ❖ Risk
 - Relies on SAV restoration (Measure #2)
 - Relies on scallop recruitment at a sustainable rate
 - Threatened by Cow-nose rays

- ❖ Site Selection Parameters (*The same as SAV*):
 - Water Depth
 - Historic SAV beds
 - VMRC leases
 - Sedimentation rates
 - Hydrodynamics

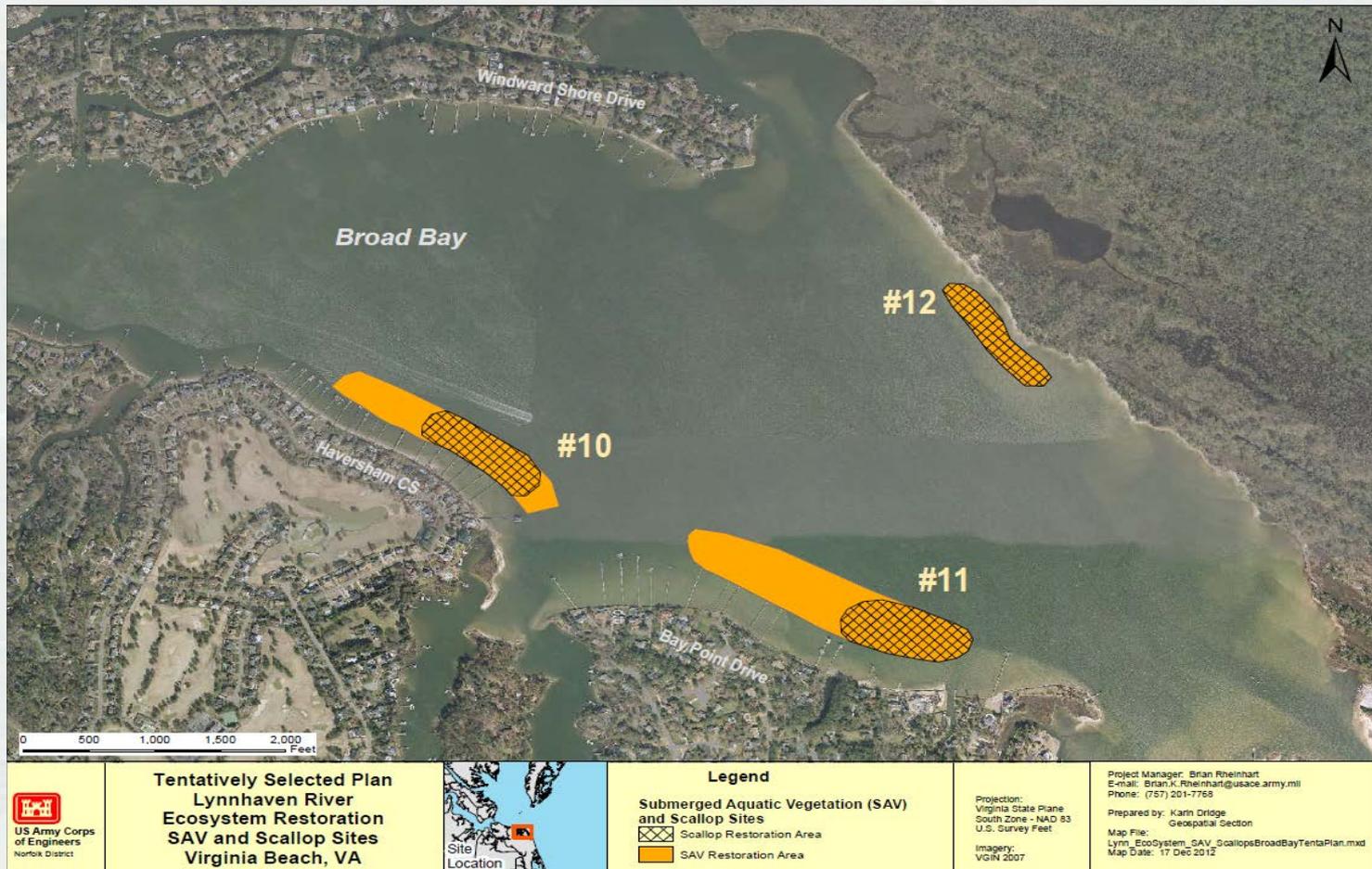
- ❖ 12 Sites directly tied to 12 SAV sites



SAV and Bay Scallop Restoration Sites Sites 1-9



SAV and Bay Scallop Restoration Sites Sites 10-12



Restoration Measure #4

Restore Wetlands

- ❖ Benefits
 - Restoration of native salt marsh community
 - Removal of an invasive plant species
 - Improve diversity and marsh productivity

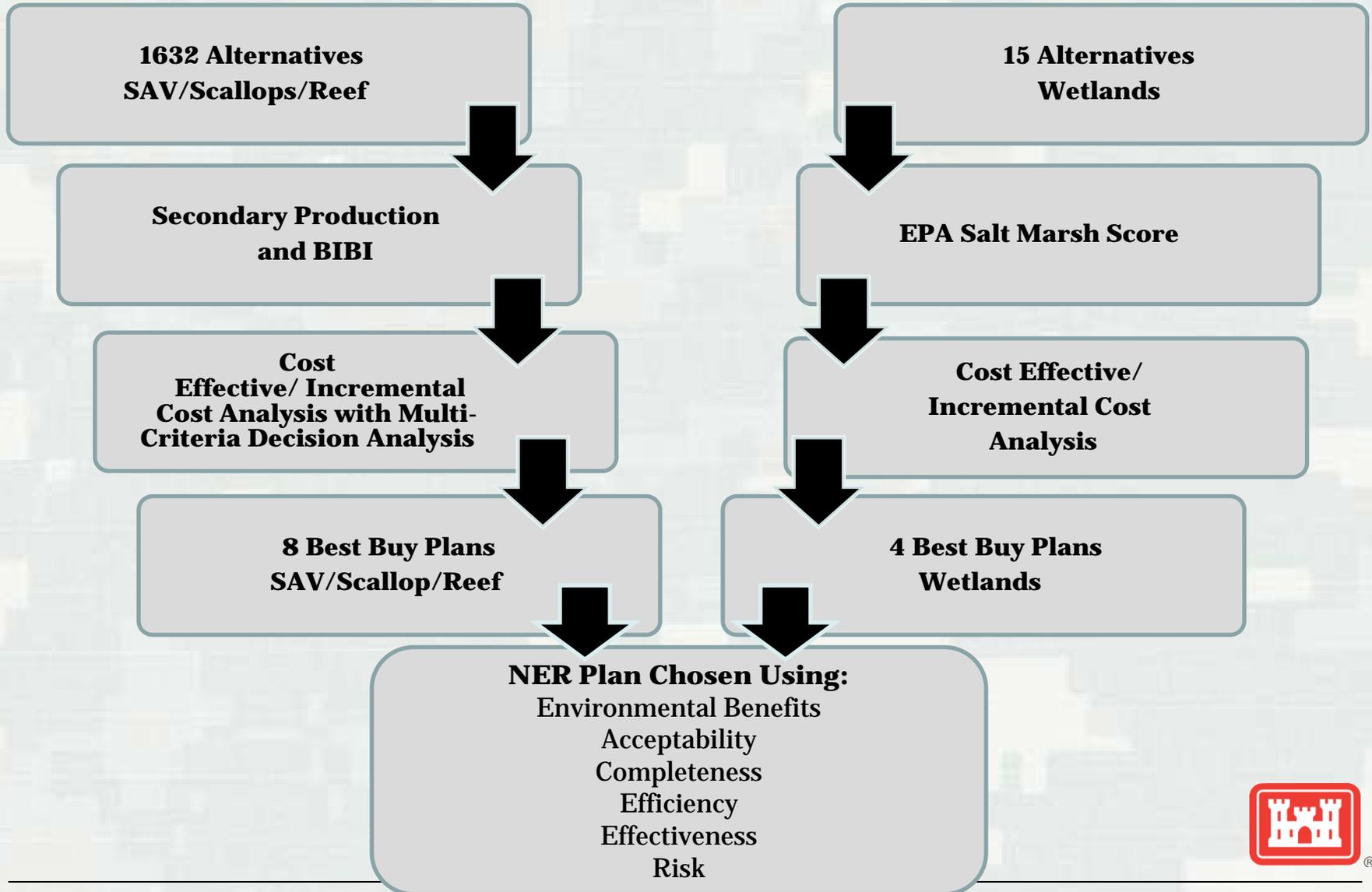
- ❖ Risk
 - Continued success of *Phragmites* at project sites
 - Failure of native plantings
 - Unexpected site conditions
 - Sea level rise

- ❖ Site Selection Parameters
 - Constructability
 - Access
 - Presence of invasive species

- ❖ Four sites within the Lynnhaven River Basin have been identified for restoration or diversification of wetlands



Path to Recommendation



Environmental Benefits Assessment

❖ Three parameters:

- 1. Benthic Index of Biological Integrity (BIBI):** measures the diversity and density of the benthic community
- 2. Secondary Production:** measures production of biomass and is typically measured as weight of living animal tissue
- 3. EPA Salt Marsh Model:** eight wetland and landscape components to assess and evaluate salt marsh wildlife habitat values



Final Recommended Plan: Reef Habitat (Measure #1)

Nine reef habitat sites in the Lynnhaven mainstem and Broad Bay Linkhorn complex (31 acres)

Method

- ❖ Small reef structures (10.5 acres) with a density of 2000 reef structures per acre
- ❖ Large reef structures (21 acres) with a density of 500 reef structures per acre



Final Recommended Plan: Submerged Aquatic Vegetation (Measure#2)

Twelve SAV sites in Broad Bay (42 acres) and the Lynnhaven Mainstem (52 acres)

Method

Sites will be seeded with two species, widgeon grass and eelgrass



Final Recommended Plan: Bay Scallop Reintroduction (Measure #3)

Twelve SAV sites in Broad Bay
and the Lynnhaven Mainstem
(22 acres)

Method

Direct stocking of juveniles
and adults within the SAV
or use of broodstock adults
kept in cages



Final Recommended Plan: Wetlands Restoration (Measure #4)

Two wetland restoration sites: Princess Anne (~4 acres) and Great Neck North (~19 acres)

Method

- ❖ Restore indigenous salt marsh plant community and reduce the population of invasive plant species
- ❖ Physically alter site and apply herbicides to counter phragmites



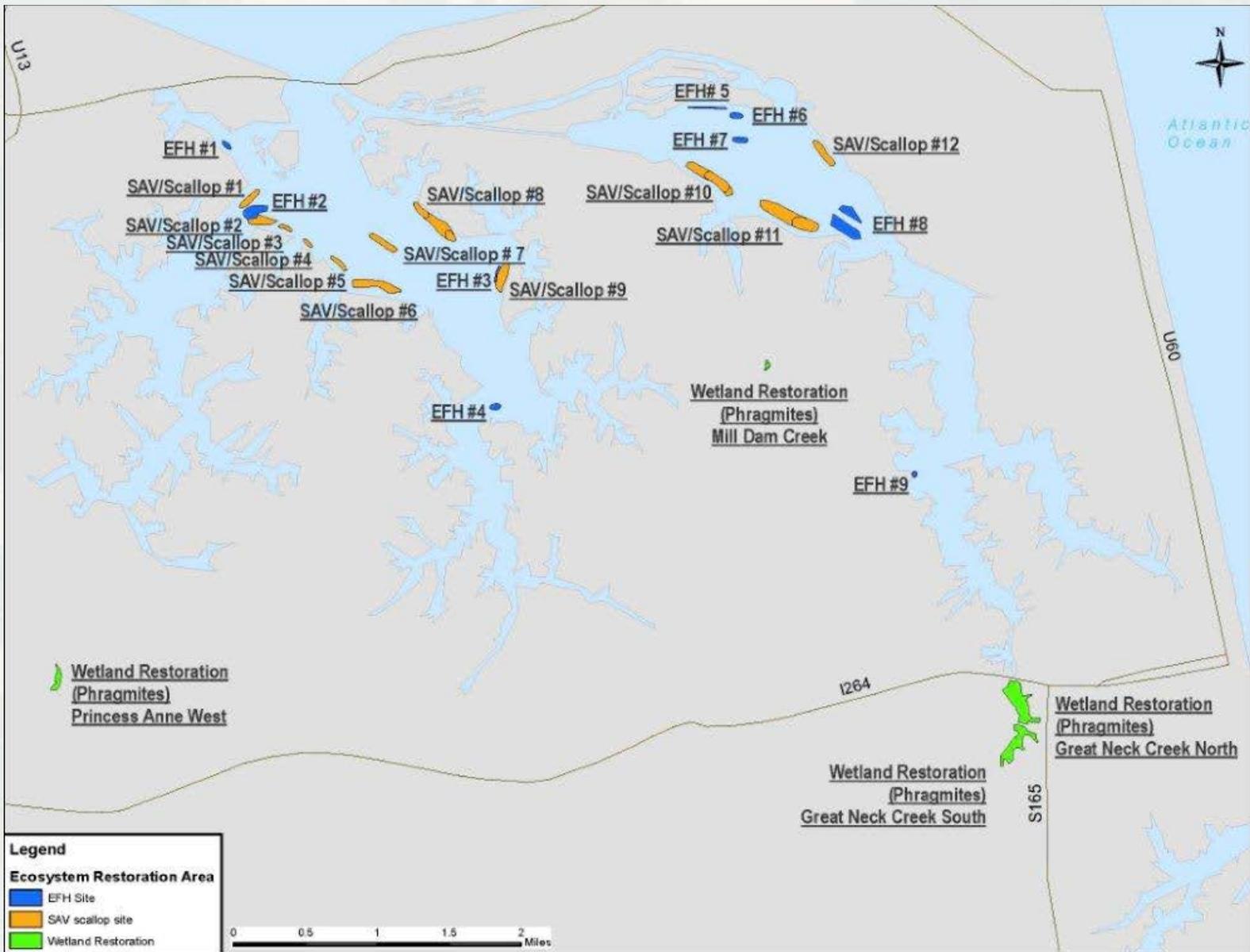
Final Recommended Plan: Wetland Diversification (Measure # 4)

Two wetland diversification sites:
Great Neck South site (~13 acres)
and Mill Dam Creek site (~0.9
acre)

Method

- ❖ Construct habitat features – widen drainage dikes, create shallow pools, use material onsite to create mounds
- ❖ Re-vegetate with native plants





Recommended Plan Costs (Oct 2012)

Cost Item	Total Costs
Construction	27,148,000
Adaptive Management	1,750,000
Lands, Easements, and Rights of Way	\$725,000
Construction Management	\$2,127,000
Preconstruction, Engineering, and Design	<u>\$2,663,000</u>
Total First Costs	\$34,413,000

Federal Share (65%)

Non-Federal Share (35%) – Less credit for previously owned Real Estate.



Monitoring and Adaptive Management

Measure	Monitoring Components	Adaptive Management
Wetland Restoration/ Diversification	<ul style="list-style-type: none"> • Presence of phragmites • Success of native plantings • Integrity of features • Secondary production 	<ul style="list-style-type: none"> • Application of herbicides to control phragmites • Replace native species
Reef Habitat	<ul style="list-style-type: none"> • Species Composition • Biomass • Growth rates of biota on the reefs 	Modify reef placement or structure design
Submerged Aquatic Vegetation	<ul style="list-style-type: none"> • Extent • Density • Productivity 	Reseed as needed
Bay Scallop Reintroduction	<ul style="list-style-type: none"> • Population count • Spat bags 	Restock scallops



Sea Level Rise

❖ SLR effects evaluated in accordance with EC 1165-2-212:

Low

- 0.73 ft in 50-years
- Historical rate of SLR (Sewells Point tide gauge)

Intermediate

- 1.14 ft in 50-years
- National Research Council curve 1

High

- 2.48 ft in 50-years
- National Research Council curve 3

❖ **Wetlands**- By building vertically through the accumulation of sediments and plant organic matter, marshes can keep pace with local ocean level rise

❖ **SAV**- Depending on rate of SLR, SAV will migrate into newly inundated areas

❖ **Reef Habitat**- Plant community associated with reef habitat may change due to light attenuation changes

Datum: NAVD88



Environmentally Compliant

- ✓ No significant environmental compliance issues identified
- ✓ Environmental Assessment prepared
- ✓ Public Review Completed: April 2013 - May 2013
- ✓ FONSI expected
- ✓ Coastal Zone Management Act consistent
- ✓ Fish & Wildlife Coordination Act compliant



Incorporates Environmental Operating Principles

- ✓ Fosters sustainability as a way of life throughout the organization
- ✓ Considers environmental consequences of all Corps activities and acts accordingly
- ✓ Supports economic and environmentally sustainable solutions
- ✓ Meets our corporate responsibility and accountability under the law for activities undertaken by the Corps, which may impact human and natural environments
- ✓ Considers the environment in employing a risk management and systems approach throughout the life cycles of project.
- ✓ Leverages scientific, the economic and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner
- ✓ Employs an open, transparent process that respects views of individuals and groups interested in Corps activities



Reviews

❖ **Agency Technical Review**

- Review managed by ECO-PCX, MVD led effort
- All ATR Comments Resolved
- Certification completed 10 July 2013
- Cost DX Certification received 26 July 2013

❖ **Independent External Peer Review**

- Exclusion from IEPR Granted 31 July 2013

❖ **Model Review and Approval for Use**

- The following models were approved for use by the HQ Model Certification Team:
 - Regional-use of the Estuarine Benthic Index of Biotic Integrity (BIBI) for Chesapeake Bay. Approved on 11 July 2013
 - Regional-use of the Wildlife Habitat Value of New England Salt Marshes Model. Approved on 11 July 2013
 - Single-use of the Environmental Benefits Model and application of the Multi-Criteria Decision Analysis. Approved on 11 July 2013



Public Involvement

- ❖ Interagency intergovernmental Steering Committee solicited input and leveraged expertise from stakeholders
- ❖ Public Meetings held to identify restoration opportunities
- ❖ Agency coordination
 - National Marine Fisheries Services
 - Virginia Department of Historic Resources (VDHR)
 - VA Division of Water
 - U.S. Fish and Wildlife Service
 - National Park Service and Virginia Department of Conservation and Recreation (VDCR)
 - Virginia Department of Environmental Quality (VDEQ)
- ❖ Public and Agency Review of Draft Report: April- May 2013
- ❖ No significant concerns



Summary

- ❖ The Recommended Plan consists of 94 acres of submerged aquatic vegetation restoration, 38 acres of wetlands restoration, 31.5 acres of reef habitat restoration, and 22 acres for reintroduction of the bay scallop.
- ❖ The Recommended Plan is feasible based on environmental, engineering and economic criteria and is acceptable by environmental, cultural, and social laws and standards.
- ❖ The selected plan is supported by the non-Federal sponsor, the city of Virginia Beach. The sponsor has the capability to provide the necessary non-Federal requirements identified and described in report Section 11.2, Division of Plan Responsibilities.



Schedule

- ❖ Civil Works Review Board: 24 September 2013
- ❖ State and Agency Review: 08 October 2013
- ❖ State and Agency Review Complete: 06 December 2013
- ❖ Issuance of Final Chief's Report: 14 February 2014
- ❖ Secretary and OMB Approval: 30 June 2014
- ❖ Design Start: July 2014
- ❖ Construction Start: February 2017



Recommendation

**Approve the release of
the Lynnhaven River Basin Integrated Feasibility
Report and Environmental Assessment for
State and Agency Review.**



Questions?



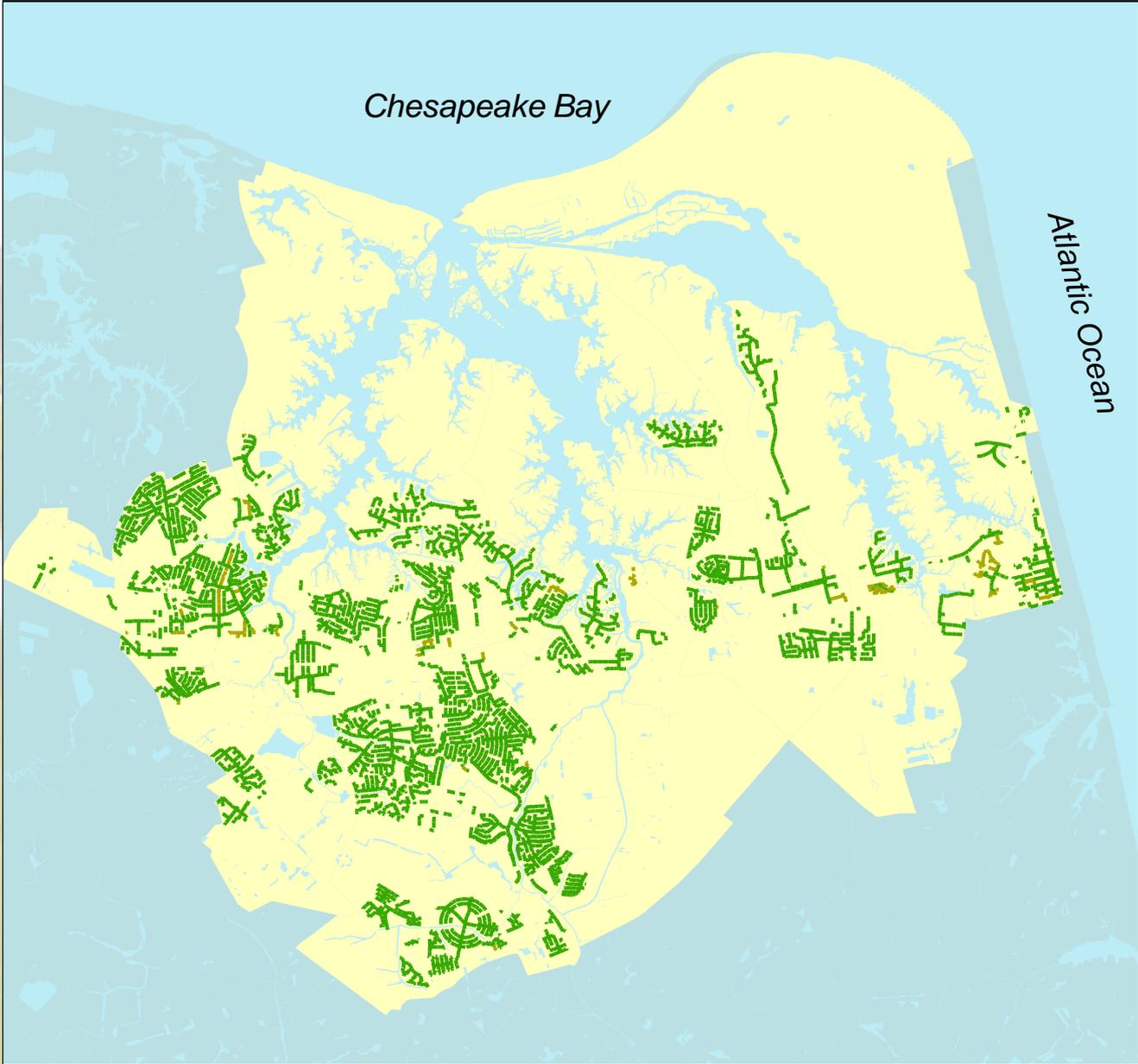
Lynnhaven River Basin Ecosystem Restoration Study

**City of Virginia Beach
Civil Works Review Board
Presentation**

**Mr. Stephen McLaughlin
Virginia Beach Public Works
September 24, 2013**



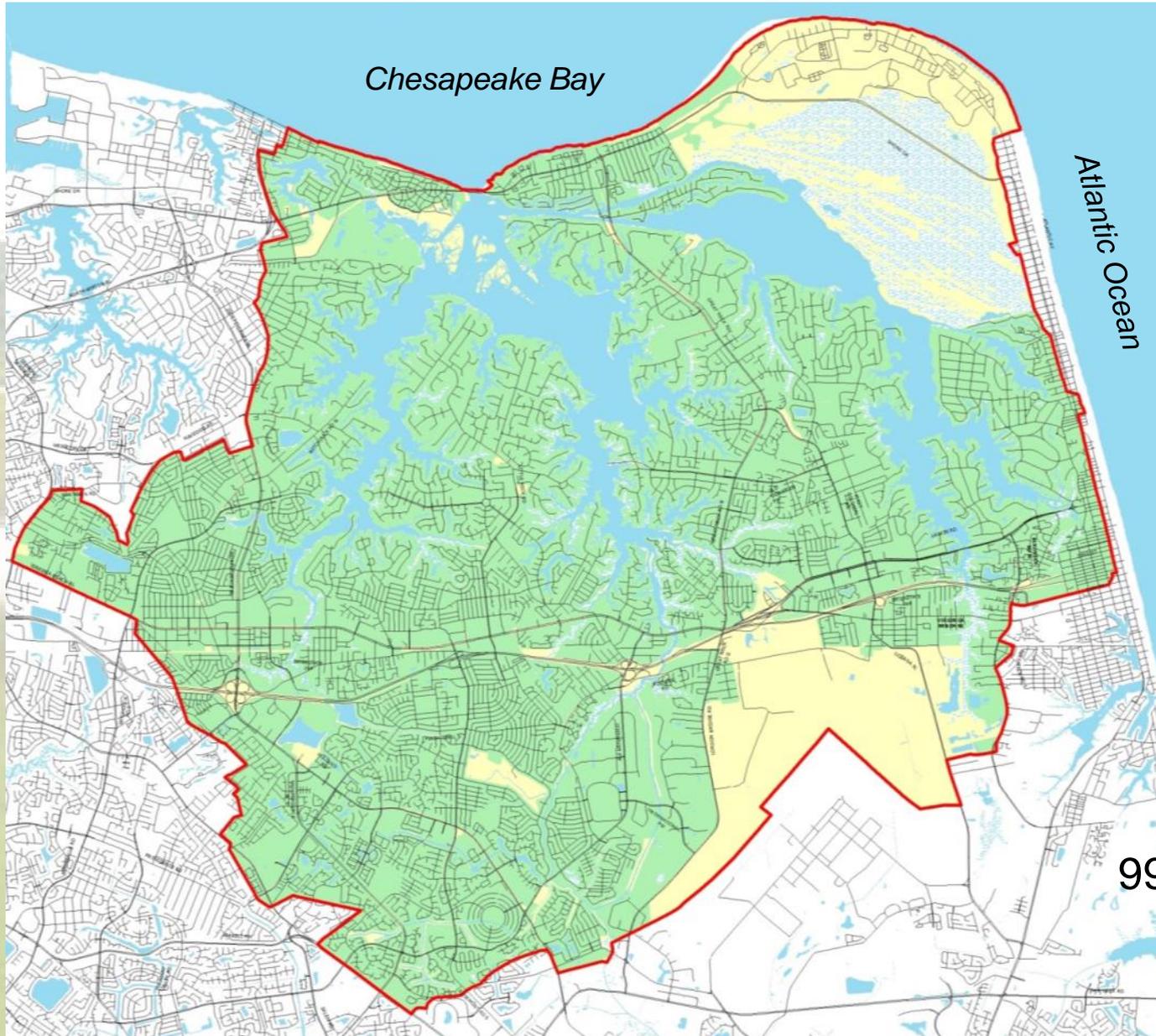
Public Sewer Access in the Lynnhaven



1972

20% of properties

Public Sewer Access in the Lynnhaven



2012
99.5+% of properties

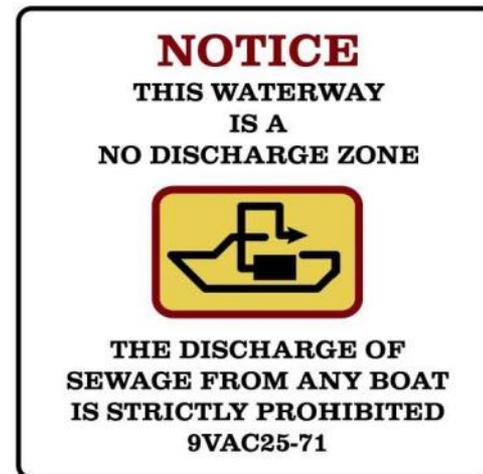
Sanitary Sewer and Environmental Enhancement Projects in the Lynnhaven Watershed

- **Since 1971, over 150 Sanitary Sewer Extensions and Rehabilitation Projects totaling \$231,800,000**
- **In last 10 years, over 70 Sanitary Sewer Projects totaling \$82,800,000**
- **In last 10 years, over 20 Environmental Enhancement Projects totaling \$7,300,000**

***Expenditures are in 2013 dollars.**

LRNow Programs: Promote Pollutant Reduction

Scoop the Poop



No Discharge Zone

Conservation Landscaping



Rain Water Harvesting

LRNow Programs: Habitat Restoration

Sanctuary Reef Construction



Oyster Gardening



Living Shorelines Homeowner Assistance

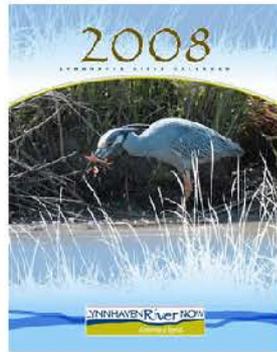
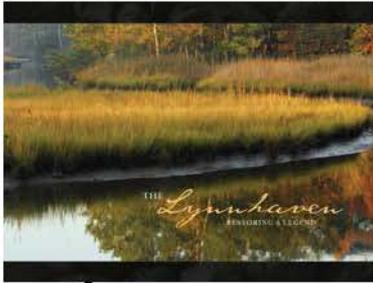


Wetlands in the Classroom

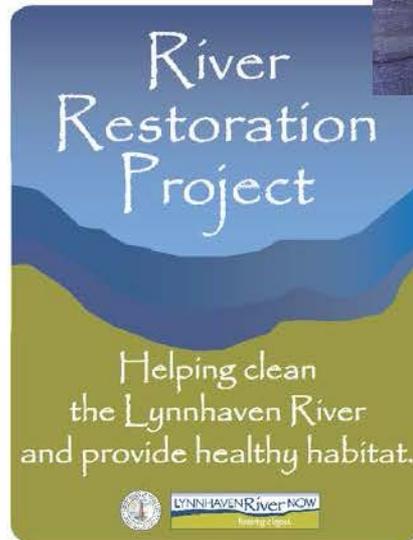
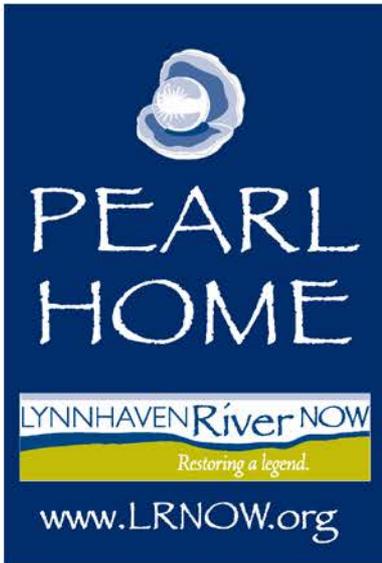


LRNow Programs: Community Education

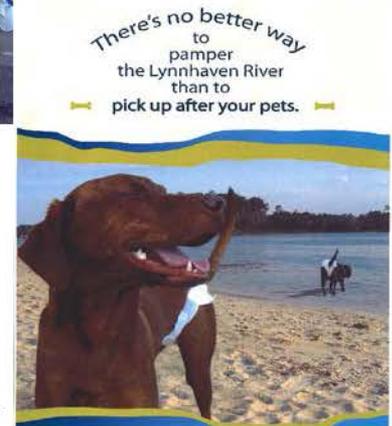
Newsletters and Publications



Pearl Homes Program



Workshops,
Forums
Educational Events
Television Ads





Davis Island oyster castle – 4 months after installation [Sept 27, 2012]



August 26, 2013

Mr. Jim Spore
City Manager, City of Virginia Beach
2401 Courthouse Drive
Virginia Beach, VA 23456

Mr. Jim Spore:

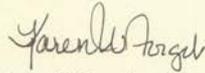
Lynnhaven River NOW is pleased to write this letter of support for the U.S. Army Corps of Engineers Lynnhaven Ecosystem Restoration Project. Lynnhaven River NOW is a grassroots environmental organization with over 4,000 members in Virginia Beach. Our work for the past eleven years has been dedicated to restoring and protecting the Lynnhaven River.

Lynnhaven River Now has worked with the City of Virginia Beach and the US Army Corps of Engineers throughout the development of the various restoration plans that make up the project. We are pleased with the final project as it will build on restoration work that has already been done in the Lynnhaven River and help to move us closer to a sustainably healthy ecosystem.

The Lynnhaven Ecosystem Restoration Project has been carefully planned and we hope for favorable action from the Civil Works Review Board

We appreciate the commitment of the City of Virginia Beach and the US Army Corps of Engineers to the Lynnhaven Ecosystem Restoration Project. Many years of planning and hard work have gotten us to this point and we look forward to implementation of these restoration efforts.

Sincerely,



Karen W. Forget
Executive Director

CC: Colonel Paul Olsen, Commander, Norfolk District, US Army Corps of Engineers



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Thank You

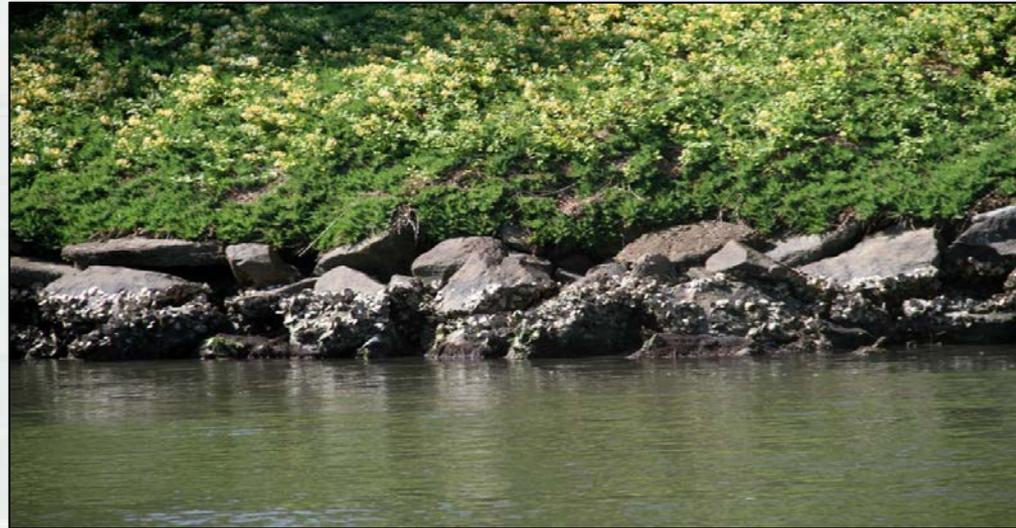


- smclaugh@vbgov.com
- **757.385.4131**

Lynnhaven River Basin Ecosystem Restoration Study Virginia Beach, Virginia

KENT D. SAVRE
Brigadier General, USA
Commanding

24 September 2013



Lynnhaven River Basin Ecosystem Restoration Study

Importance for Restoration

American Public

- Chesapeake Bay Protection and Restoration Executive Order 13508, signed by President Obama in 2009 recognized the Bay as a national treasure.
- The area is home to thousands of residents and users.

Environment

- Located along the Atlantic Flyway, serves as a stopping point for transients and wintering grounds for northern species. May also serve as a microcosm of the Chesapeake Bay, since deterioration of the Bay is analogous to observed changes within the Lynnhaven River Basin.



Lynnhaven River Basin Ecosystem Restoration Study

North Atlantic Division Rationale for Supporting Recommendation

- **Plan provides ecosystem restoration within the City of Virginia Beach, VA, consistent with Environmental Operating Principles.**
- **Study Accomplished through Multiple Agency Involvement.**
- **Transparent Process.**
- **NER Plan supported by sponsor and other agencies.**
- **Report complies with HQ policy guidance and requirements.**



Lynnhaven River Basin Ecosystem Restoration Study

NAD Quality Assurance

**Ensuring a quality product, including
extensive coordination with the vertical
team on...**

- **Environmental**
- **Plan Formulation**
- **Engineering & Cost**



Lynnhaven River Basin Ecosystem Restoration Study

Support for Recommendation

- **Completed DQC, ATR (Ecosystem Restoration PCX led), Cost Engineering MCX certification and Division QA.**
- **Completed NAD review for Legal and Policy Compliance**



Lynnhaven River Basin Ecosystem Restoration Study

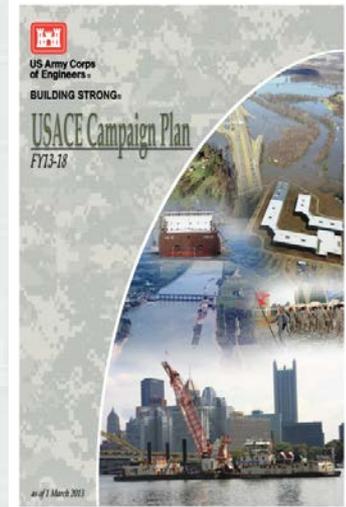
USACE Campaign Plan

The goals and objectives included in the Campaign Plan of the Corps have been fully integrated into the Lynnhaven study process, specifically:

Objective 2a – Modernize the Civil Works project planning program and process.

Objective 2b – Enhance and refine the Civil Works budget development process through a systems-oriented watershed approach, priorities, and collaboration.

Objective 4b – Enhance trust and understanding with customers, teammates and the public through strategic engagement and communication.



Lynnhaven River Basin Ecosystem Restoration Study

North Atlantic Division Recommendation

- **Concur with findings and recommendations of the Norfolk District Commander.**
- **Confirm that the report complies with all applicable policy and laws in place at this stage of project development.**
- **Request that report be released for State and Agency Review.**



Summary of Agency Technical Review and Model Review for Lynnhaven River Basin, VA Ecosystem Restoration

Camie Knollenberg

Agency Technical Review Leader

Jodi Creswell

PCX Operational Director

Ecosystem Restoration National Planning
Center of Expertise

24 September 2013



US Army Corps of Engineers
BUILDING STRONG®

ATR Team

Team Member	ATR Role	Office
Camie Knollenberg	ATR Lead and Plan Formulation	St. Paul District
Tomma Barnes	Environmental Compliance/Monitoring and Adaptive Management	Wilmington District
Scott Miner	Economics (Cost Effective/ Incremental Cost Analysis)	Sacramento District
Heather Sachs	Real Estate	Baltimore District
Bradley Perkl	Cultural Resources	St. Paul District
Andrew Casper	Model Application	ERDC
Lynn Bocamazo	Hydraulics and Hydrology	New York District
Gary Smith/Jim Neubauer	Cost Engineering	Cost Engineering Mandatory Center of Expertise (Walla Walla District)



ATR Team

Team Member	ATR Role	Office
Andrew Casper	Model Application	ERDC



ATR Process

- **Reviews completed for:**
 - **Alternative Formulation Briefing**
 - **Certified 07 September 2011**
 - **Draft Report**
 - **Certified 10 July 2013**
 - **Final Report**
 - **Certified 20 August 2013**



ATR Process

- **154 Comments generated**
 - **AFB 104 comments**
 - **Draft Report 50 comments**
 - **Final Report 0 comments**
- **All comments have been closed**



Primary Issues

- **Plan formulation gaps**
- **Multi-Criteria Decision Analysis (MCDA)**
- **Non-standard real estate estates**
- **Monitoring and adaptive management**
- **Cultural resources no effect determination**
- **Cost Engineering Level of Detail**



Assuring Quality of Planning Models

All 4 Ecosystem Output Models have been approved for Regional or Single-use

Model	Approval Type	Date
Estuarine Benthic Index of Biotic Integrity	Regional	12/18/12
Wildlife Habitat Value of New England Salt Marsh	Regional	5/8/12
Total Suspended Solids Metric	Single-use	7/2/13
Secondary Production Metric	Single-use	7/2/13



HQUSACE POLICY REVIEW CONCERNS

Civil Works Review Board

Lynnhaven River Basin, Virginia Ecosystem Restoration Study

Debby Scerno
Office of Water Project Review
Planning and Policy Division
Washington, DC – 24 September 2013



US Army Corps of Engineers
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HQUSACE Team Reviews:

- **FSM was held September 2005**
- **AFB was held April 2012**
- **Draft Report was reviewed May/June 2013**
- **Final Feasibility Report/EA HQUSACE review completed**



Significant Policy Questions from AFB and Draft Report Reviews

- **Alternative Evaluation and Comparison**
- **Adaptive Management and Monitoring**



Alternative Evaluation and Comparison

CONCERN: The use of units other than habitat units was not well explained.

REASON: The use of alternative units is policy compliant, however, since many in the chain of command are expecting to see habitat units for ecosystem restoration projects, clear explanations were necessary for smooth transition up the chain of command.

RESOLUTION: Explanations and justifications were improved.

RESOLUTION IMPACT: Concern Resolved.



Adaptive Management and Monitoring

CONCERN: The report contained only conceptual information about how success of restoration would be assessed, e.g., general information on methods used to estimate outputs.

REASON: Section 2039 of WRDA 2007 requires that criteria for judging success be clearly stated, e.g., factors such as density & species composition of submerged aquatic vegetation or wetlands. Conceptual information did not meet the WRDA requirement.

RESOLUTION: The final report was revised to include ecological performance measures consistent with WRDA 2007.

RESOLUTION IMPACT: Concern Resolved.



HQUSACE POLICY REVIEW TEAM RECOMMENDATION

Release the Chief's Report for State & Agency Review



Incorporation of Lessons Learned

Norfolk District Systems Approach



Lessons Learned (con't)

- PDT turnover
- Use of non-standard benefits
- Changes in policy
- Feasibility versus PED level design



Lynnhaven River Basin Ecosystem Restoration Study

North Atlantic Division Lessons Learned

- **Ecosystem Restoration plan formulation needs more rigorous oversight, which should be accomplished by the SMART Planning process.**
- **More oversight is needed to support PDTs on the path to CWRBs, who are not familiar with the process.**



BACKUP SLIDES



Risk Management

Measure	Risk	Uncertainty	Prevention/ Mitigation
Reef Habitat	Low	<ul style="list-style-type: none"> ▪ Sedimentation ▪ Dissolved oxygen levels 	<ul style="list-style-type: none"> ▪ Site selection
Submerged Aquatic Vegetation	Moderate	<ul style="list-style-type: none"> ▪ Cow nose ray foraging ▪ Boat propeller damage ▪ Storm events ▪ Changes in water quality 	<ul style="list-style-type: none"> ▪ Widgeongrass ▪ “No Wake” Zones ▪ Reseeding as a part of adaptive management

*Current water quality supports restoration of proposed measures



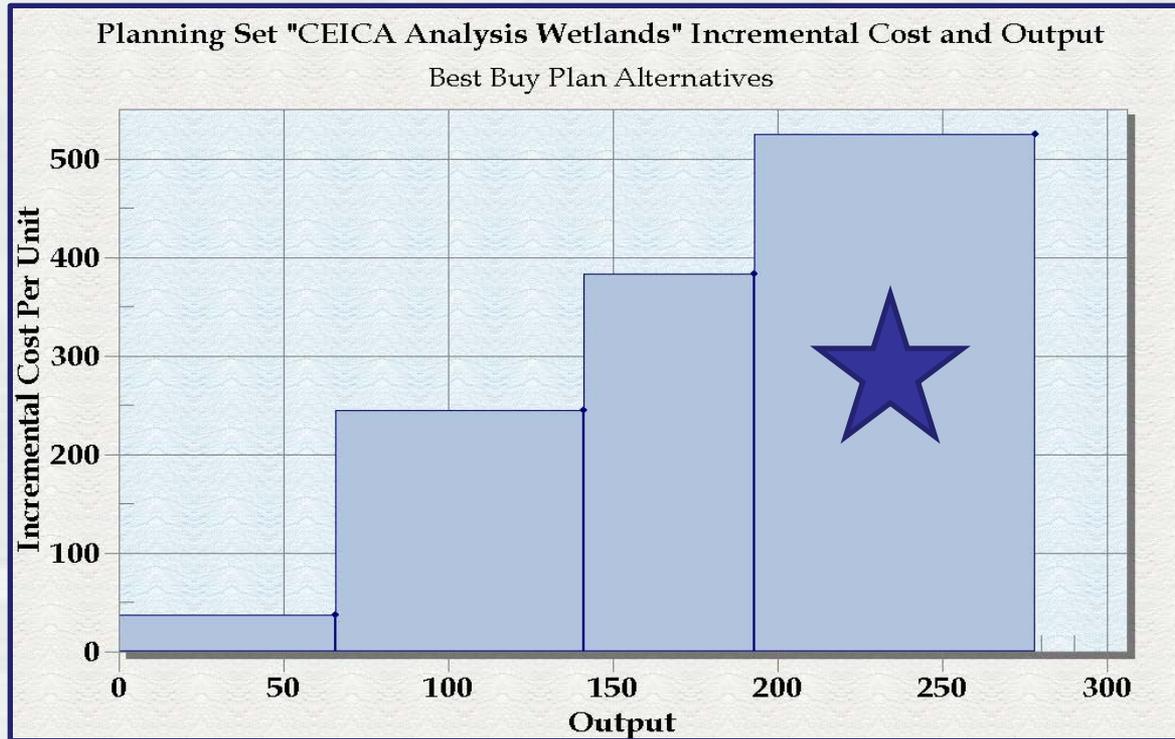
Risk Management (con't)

Measure	Risk	Uncertainty	Prevention/ Mitigation
Wetland Restoration/ Diversification	Moderate	<ul style="list-style-type: none"> ▪ Persistent Phragmites ▪ Plant mortality ▪ Contaminated soils 	<ul style="list-style-type: none"> ▪ Conditions favorable for native plants ▪ Herbicide ▪ Goose exclusion structures ▪ Tier 1 analysis of soils ▪ Construction BMPs
Bay Scallop Reintroduction	Highest of all four measures	<ul style="list-style-type: none"> ▪ Successful SAV restoration ▪ Recruitment ▪ Storm events ▪ Predation 	<ul style="list-style-type: none"> ▪ Lessons learned from North Carolina ▪ Restocking ▪ Predator deterrents

*Current water quality supports restoration of proposed measures



Cost Effectives /Incremental Cost Analysis: Wetlands



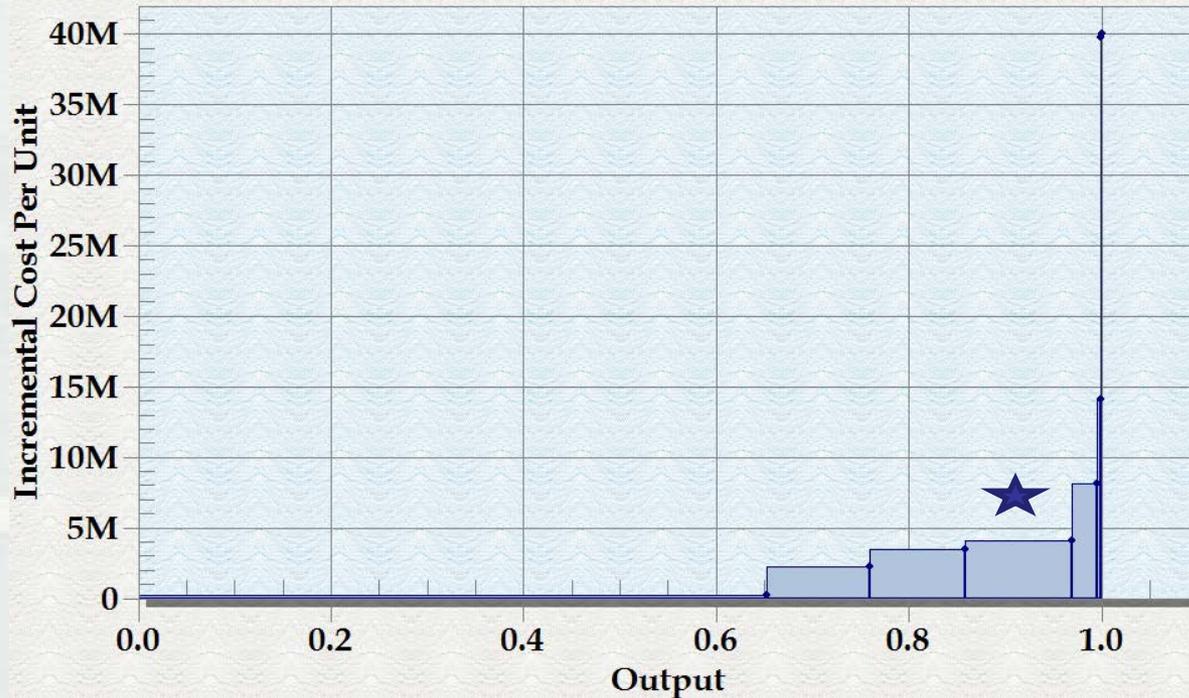
 = Selected Plan



Cost Effective/Incremental Cost Analysis: Reef Habitat/SAV/Scallops

Planning Set "CEICA Analysis Without TSS Reduction Parameter" Incremental Cost and Output

Best Buy Plan Alternatives



 = Selected Plan

