John Smith's Voyages of Exploration

Using GIS to Visualize the Chesapeake of 1607-1609

John Wolf, National Park Service
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Presentation Overview

- Chesapeake Bay Gateways Network
- John Smith's *Voyages of Exploration*
- Proposed National Historic Trail Designation
- Assumptions - Using GIS for Time Travel
  - decision rules for interpreting the 1608 landscape
  - GIS data pre-processing
- From GIS to Visualization
- Next Steps

Chesapeake Bay Gateways Network

- Network of 140+ special parks, wildlife refuges, museums, sailing ships, communities, and trails
- Coordinated by the National Park Service in partnership with the Chesapeake Bay Program
- Focus on linking places people value to an understanding of the Chesapeake Ecosystem

Gateway Projects

- Special Emphasis in 2005-2006 on John Smith interpretive projects. Topics can include:
  - Smith's experience and ways of retracing his paths
  - the early 17th century environment and ecology of the Bay
  - indigenous cultures of the Chesapeake region
  - early European settlement of the Bay
  - comparisons of the early 17th century Bay with that of today

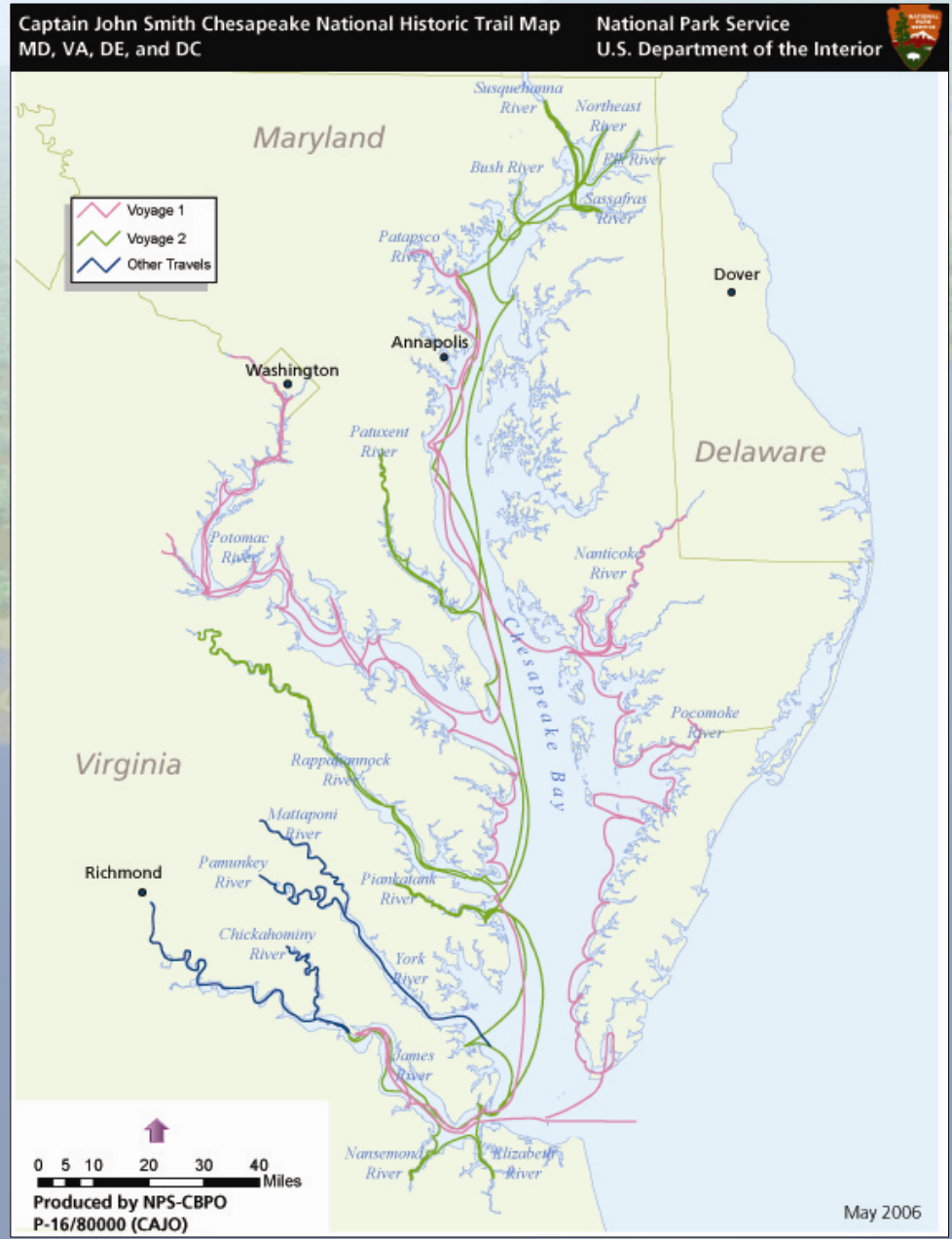
Chesapeake Bay Gateways Network

Proposed National Historic Trail

- *Feasibility Study and Environmental Assessment* Completed
- Bills introduced in House and Senate
- Recommends NPS Trail-wide oversight of a regional partnership of managing entities
- Comprehensive Management Plan to be developed if Trail is authorized

Project Goal

- Development of a web-based mapping, visualization, and educational system to illustrate
  - John Smith's voyages around the Bay
  - 17th Century natural environment
  - Native American settlements



Project Partners

Penn State Cooperative Extension
Geospatial Technology Program

Historic
St. Mary's City

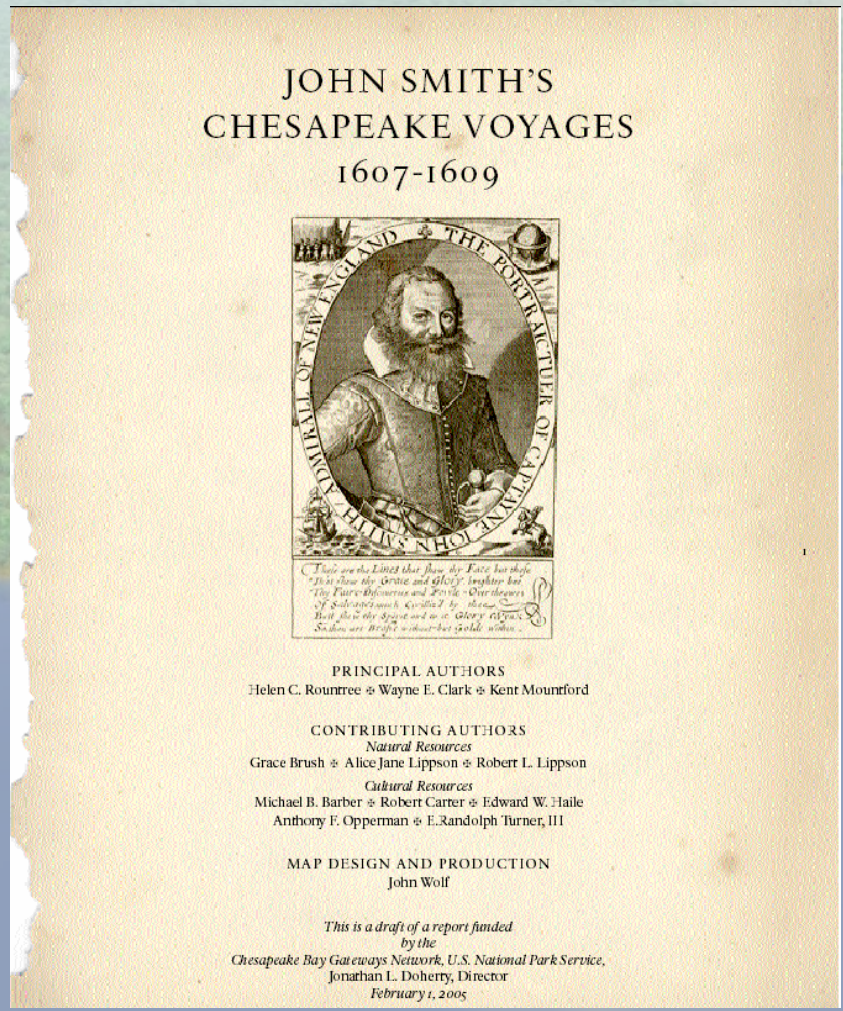
Smithsonian
National Museum of Natural History

Technology

- **ArcGIS** (ESRI) – mapping/GIS
- **Visual Nature Studio** (3D Nature) - visualization

Sources

- *John Smith's Chesapeake Voyages 1607-1609* (Chesapeake Bay Gateways Network 2005)
- Maryland Historical Trust
- Virginia Department of Historic Resources



JOHN SMITH'S
CHESAPEAKE VOYAGES
1607-1609

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MAP DESIGN AND PRODUCTION
John Wolf

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Jonathan L. Doherty, Director
February 1, 2005

Tidewater Chesapeake Landscape Today

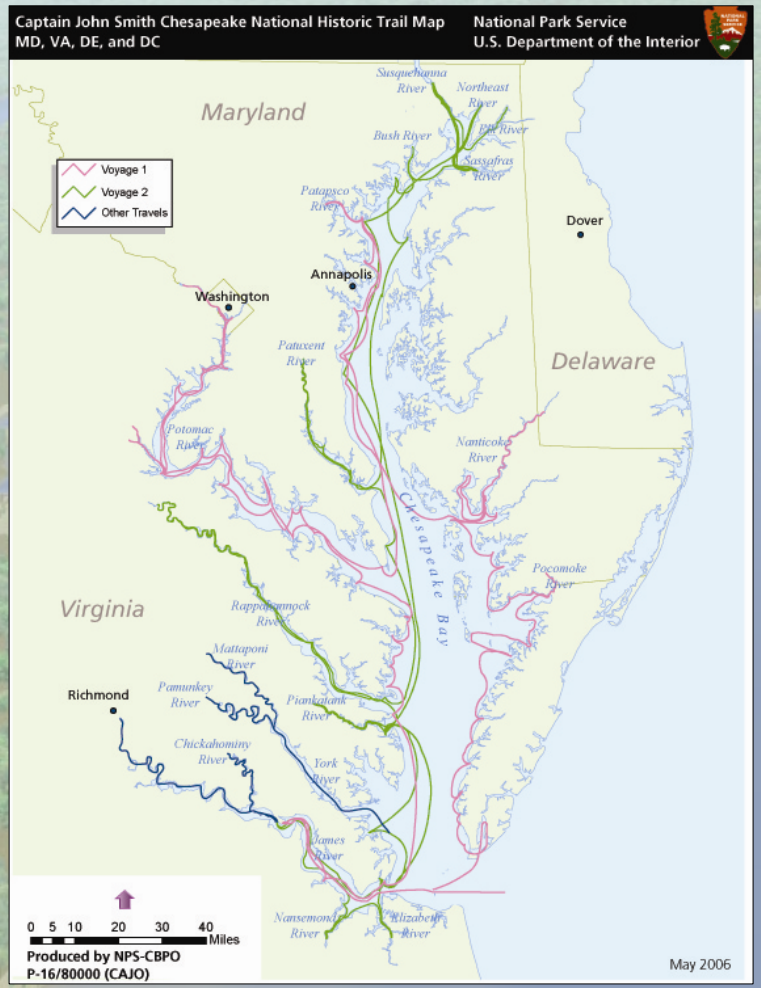
The 64,000 square mile Bay watershed has the highest land to water ratio of any estuary in the world.

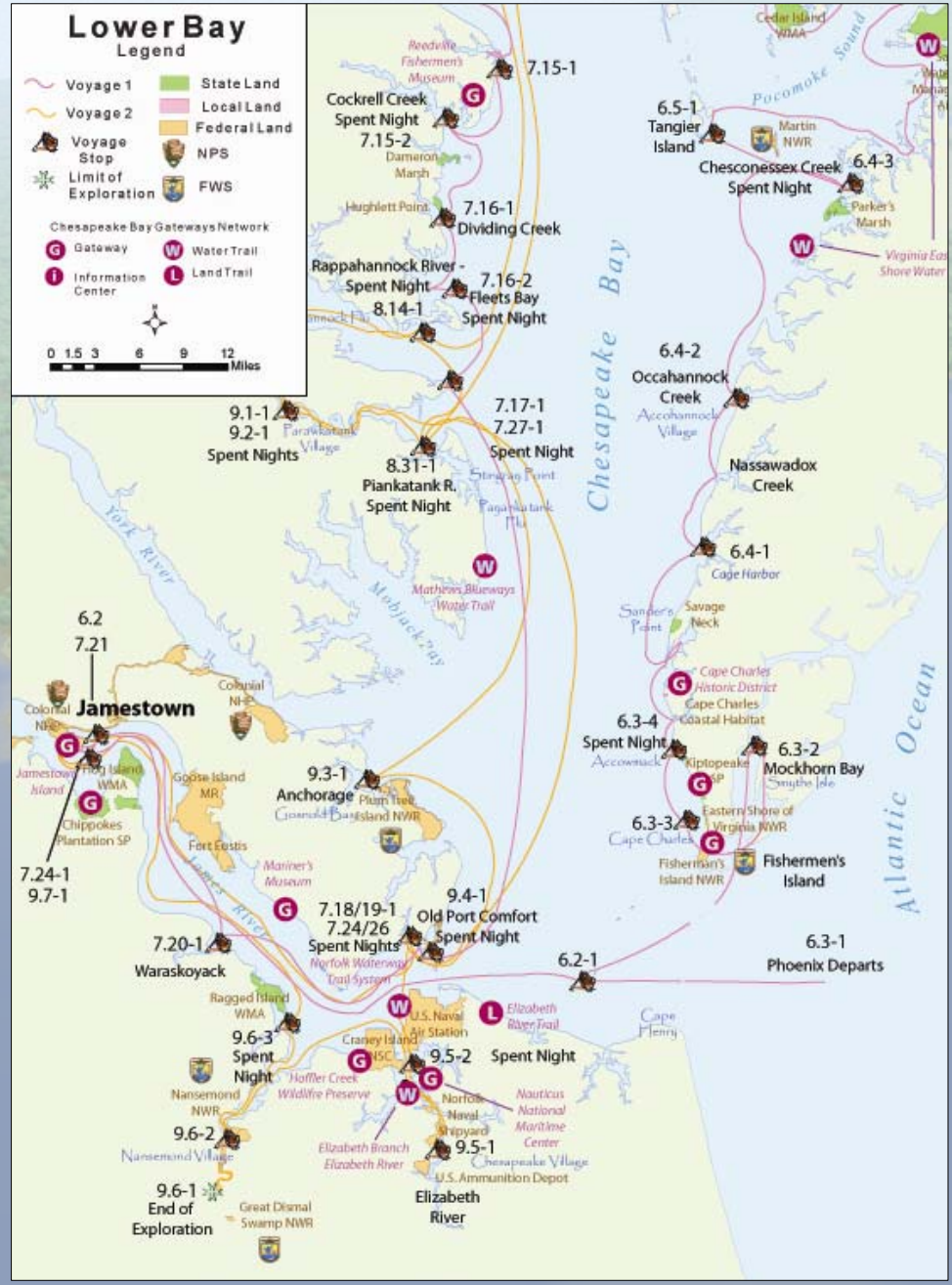
16 million people live in the watershed with another million expected by 2010.

Tidewater Chesapeake Landscape 1608

- Forests
  - Tall well-spaced trees
  - White Oak dominant
- Native American population
  - between 24,000 and 33,000 (Piedmont and Coastal Plain)
  - villages clustered along waterways and river valleys
  - cornfields

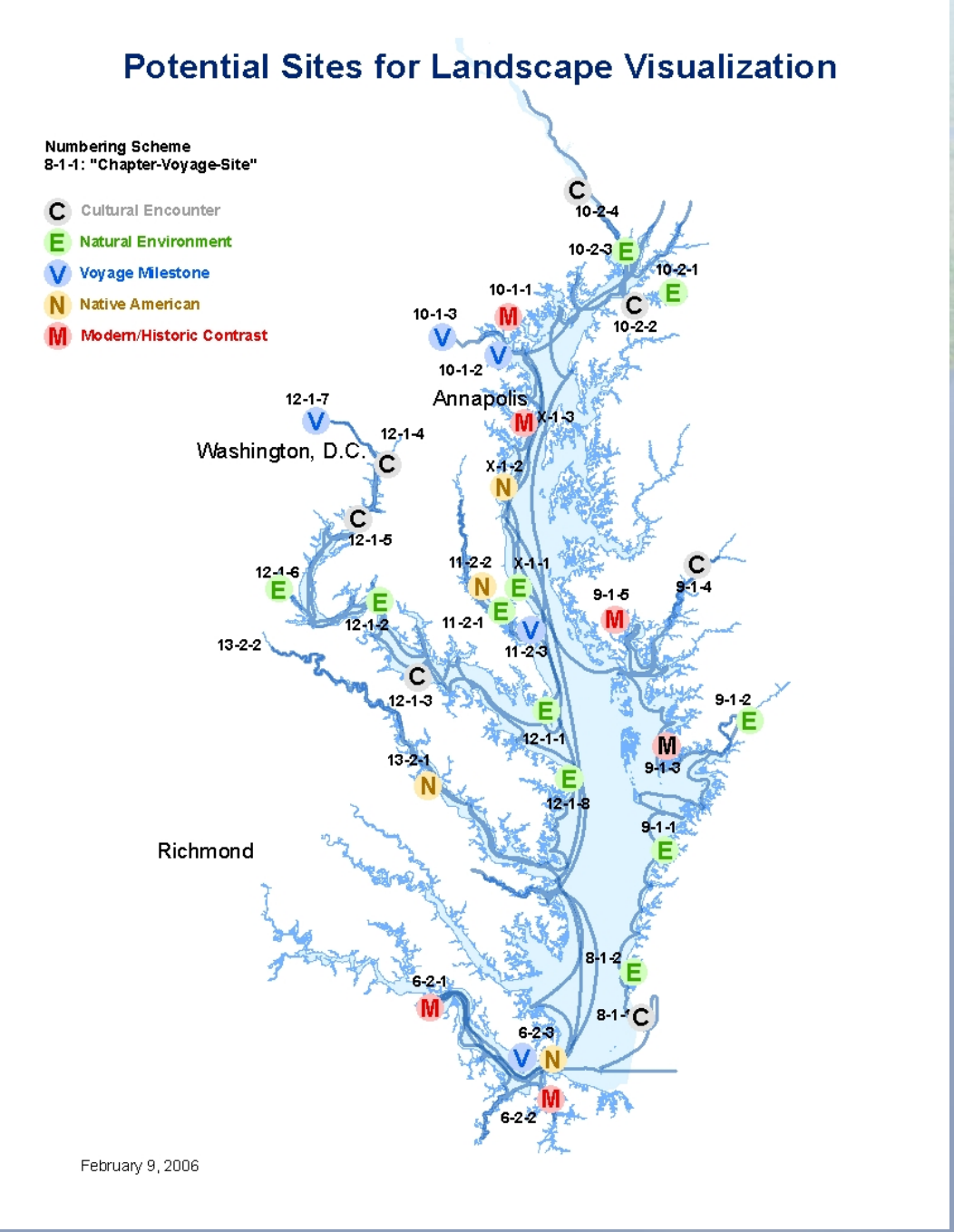
Tracing the Voyage Routes





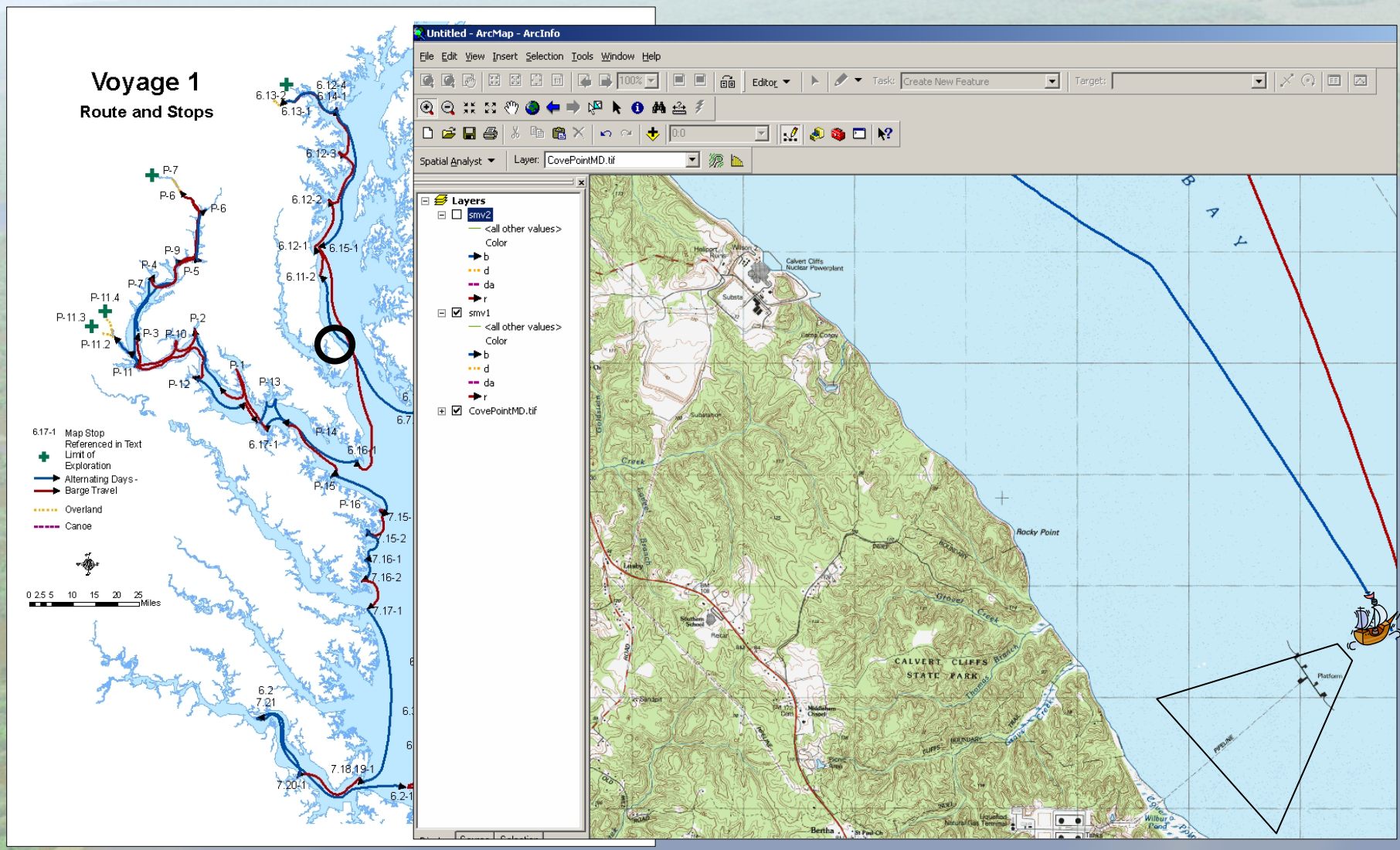
Selection of Sites

- Sites along Smith's Voyage routes
- Chesapeake Bay Gateways locations
- Contrasting past with present
- Topographic variation



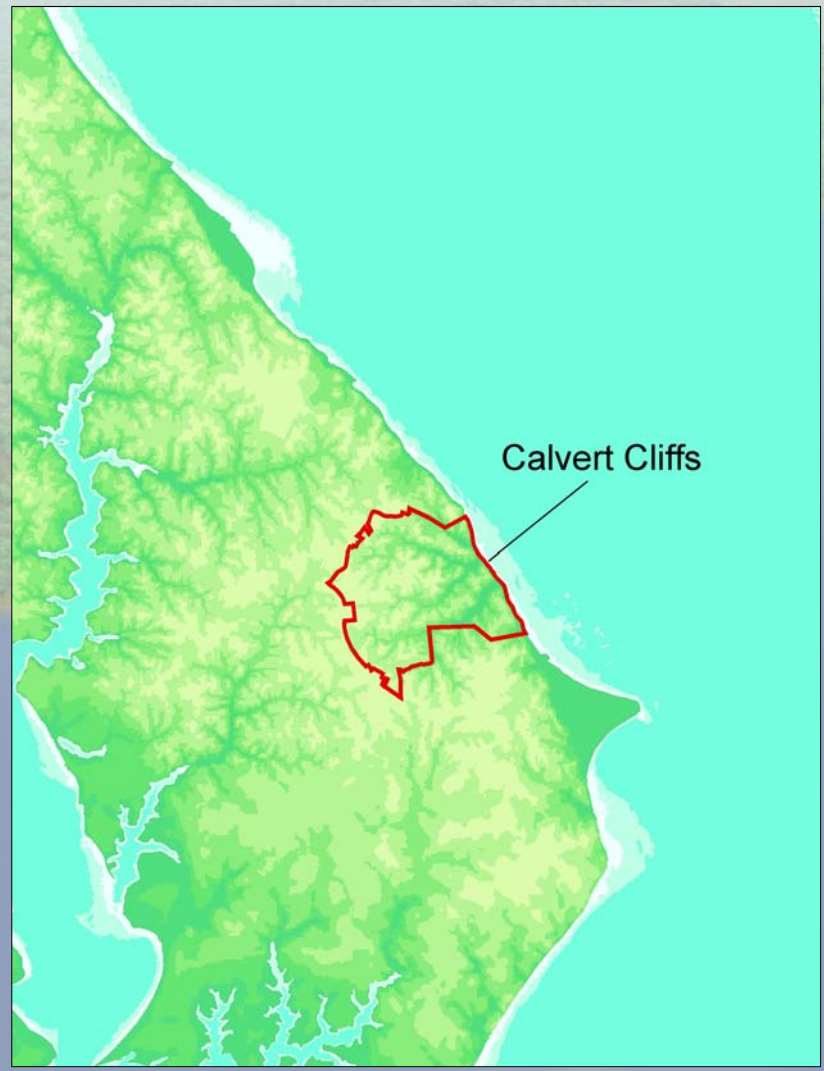
Select Study Area

Use Topo Maps and Voyage Routes to select area needed to support desired 3D Views



Calvert Cliffs, Maryland

10 m DEM

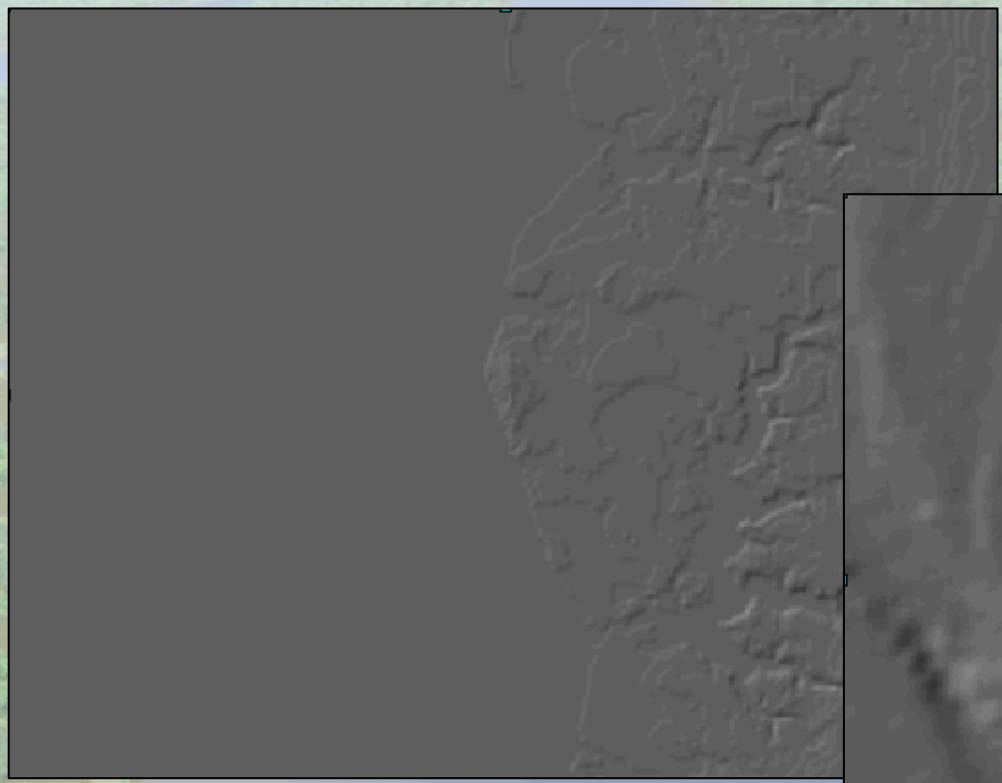


10 m Bathymetry

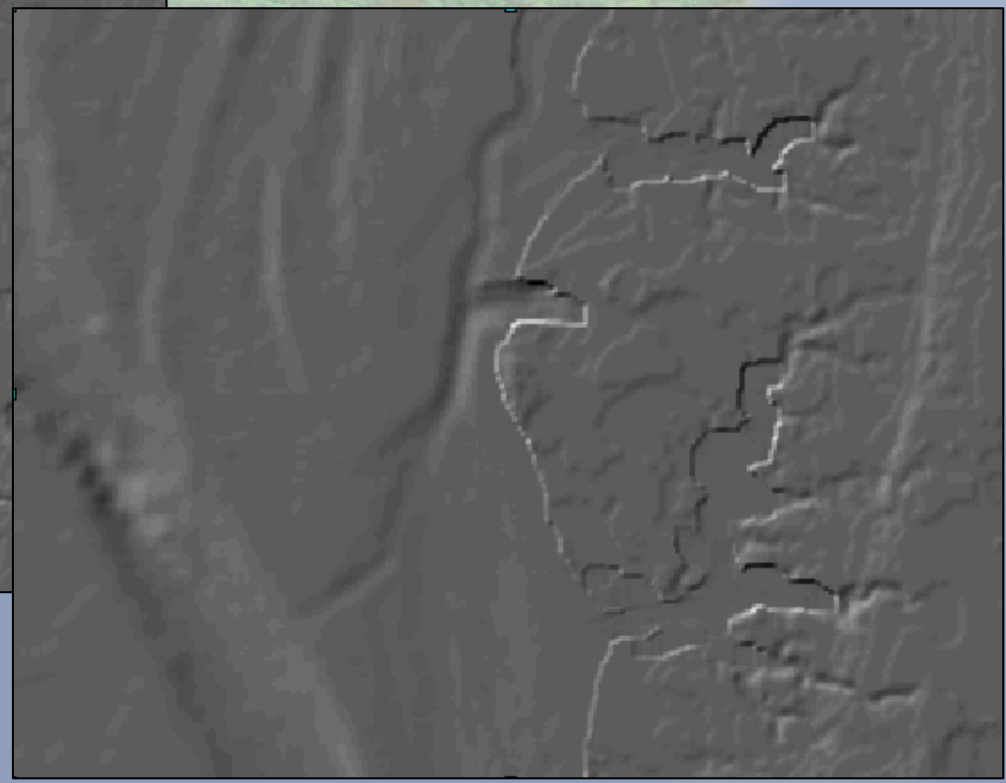
Select Study Area
Use Topo Maps and Voyage Routes to select area needed to support desired 3D Views

Clip DEM
Clip 10m DEM using study area extent

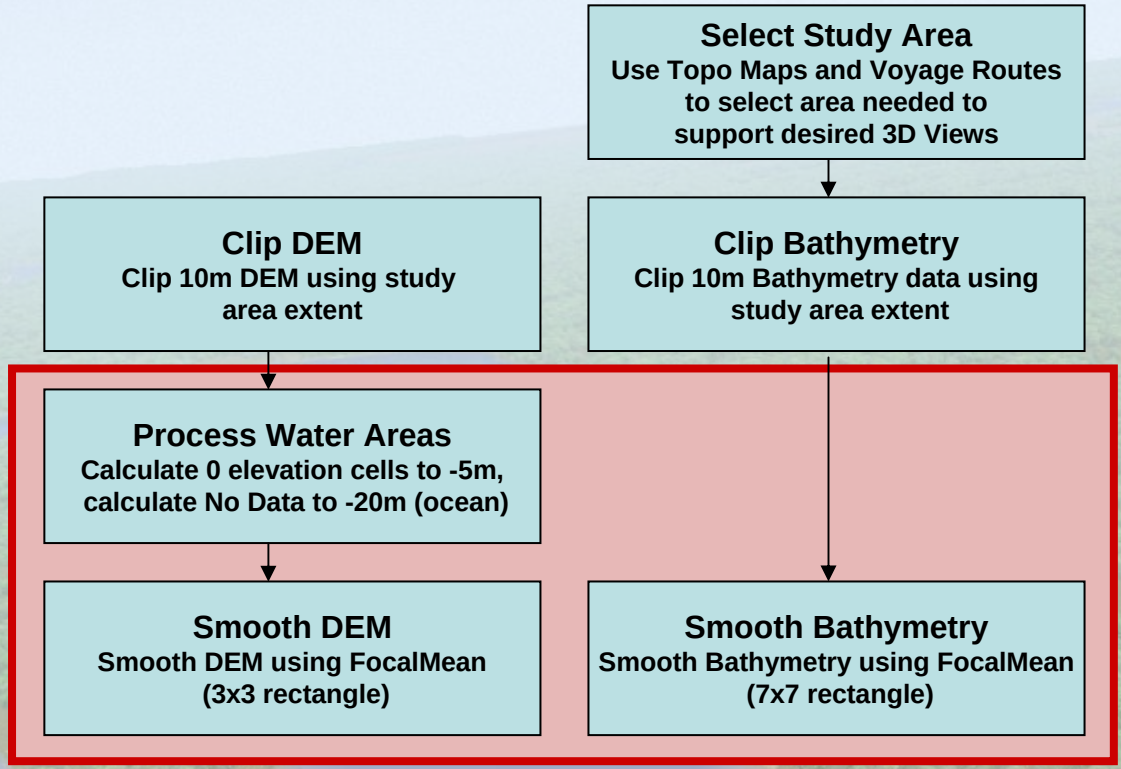
Clip Bathymetry
Clip 10m Bathymetry data using study area extent



10m DEM

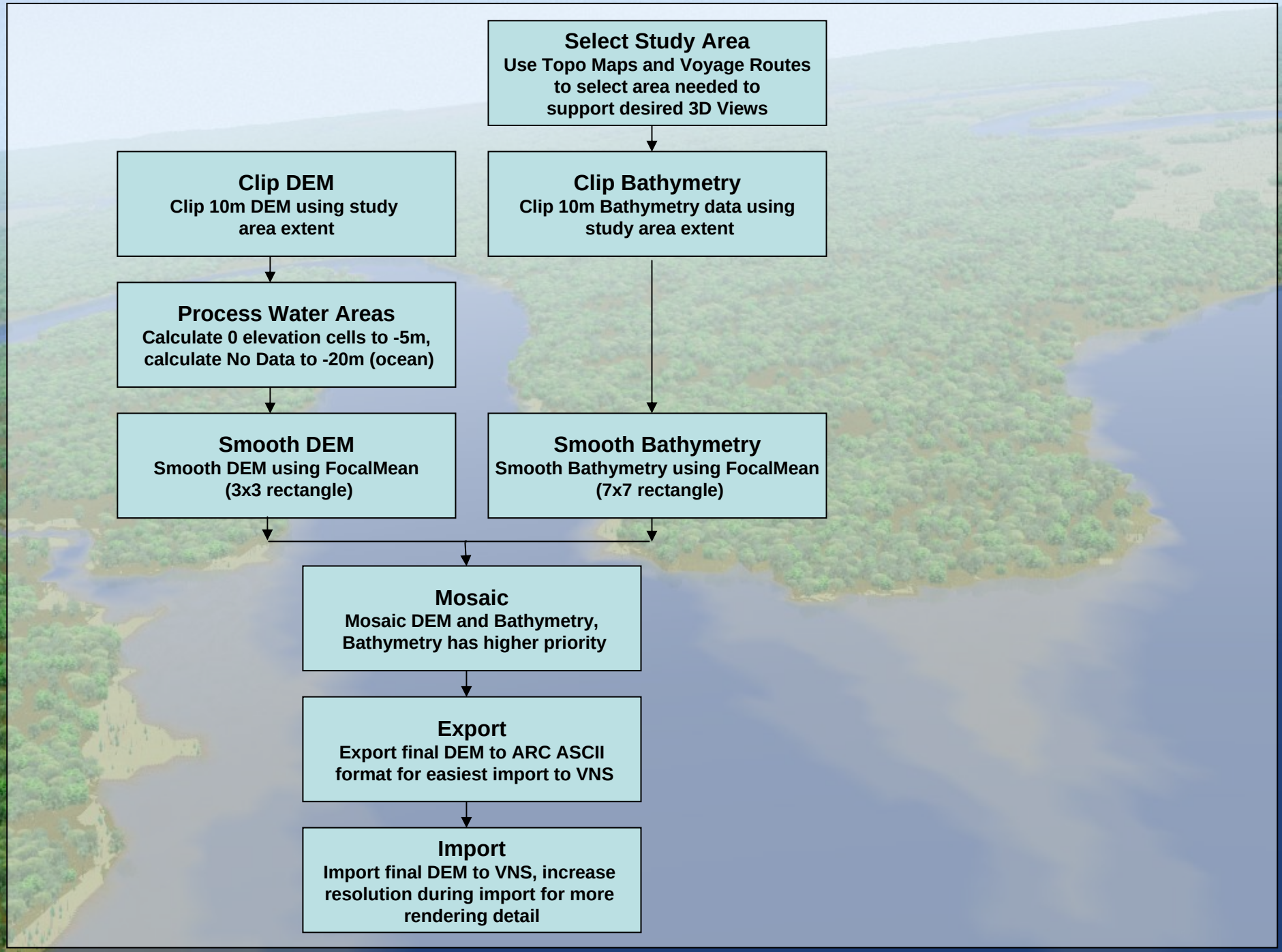


10m DEM with Bathymetry



Manipulating grids to

- *enhance visual effects*
- *minimize stair-stepping*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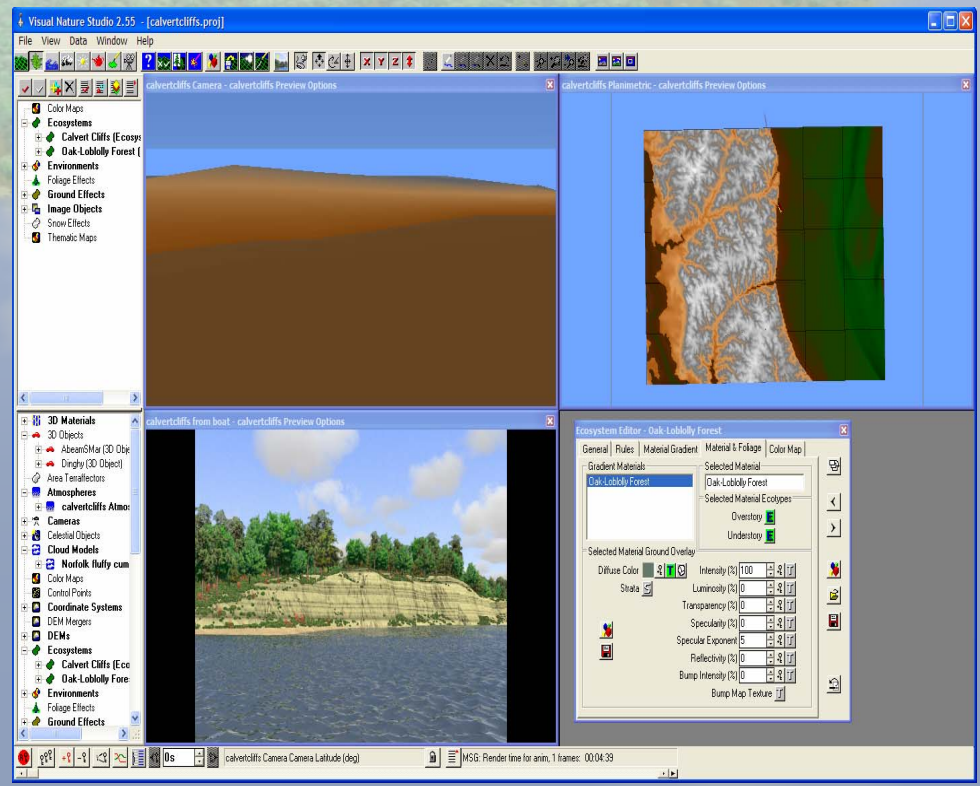
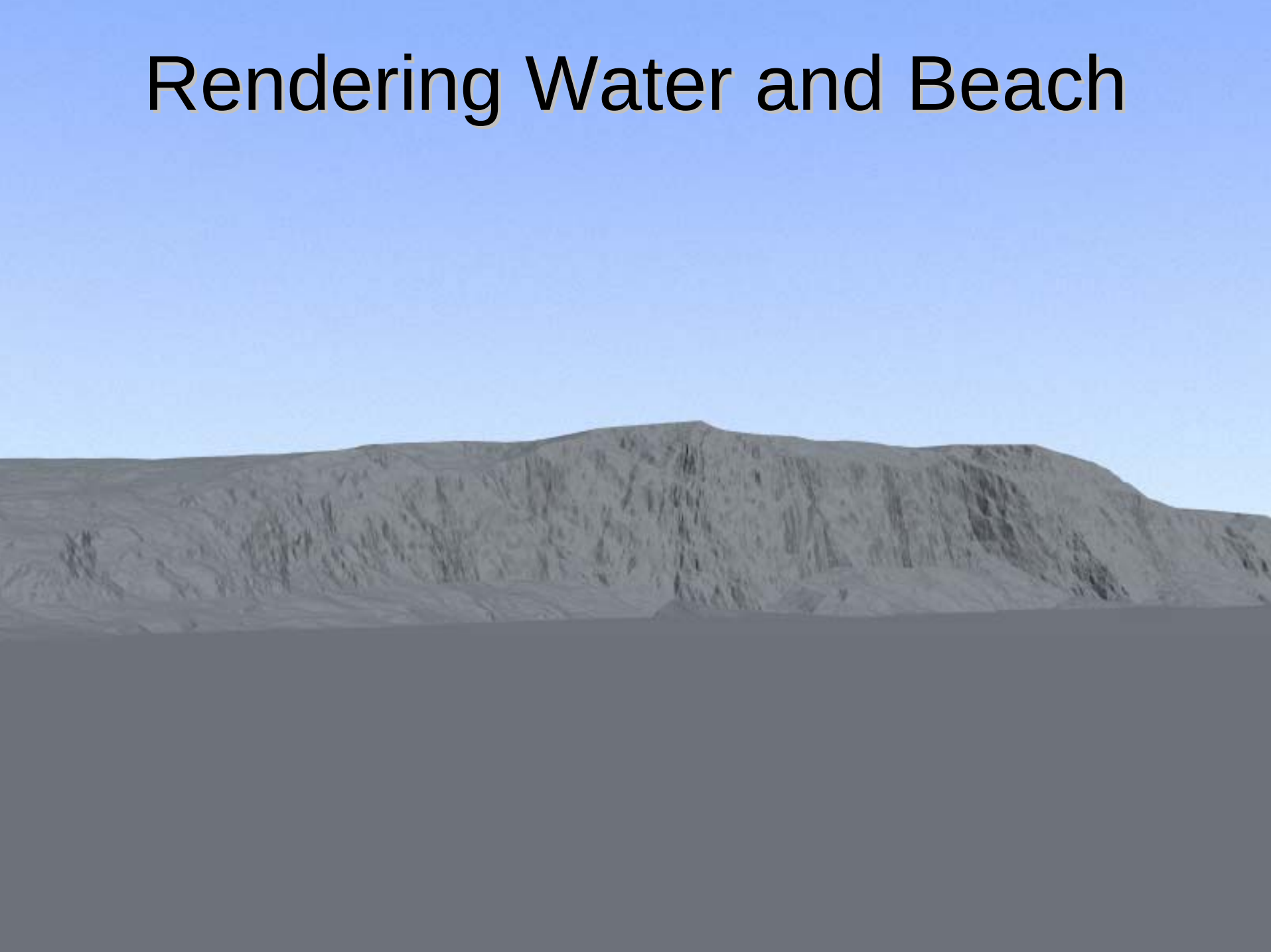
Clip Bathymetry
Clip 10m Bathymetry data using study area extent
Process Water Areas
Calculate 0 elevation cells to -5m, calculate No Data to -20m (ocean)
Smooth DEM
Smooth DEM using FocalMean (3x3 rectangle)
Smooth Bathymetry
Smooth Bathymetry using FocalMean (7x7 rectangle)
Mosaic
Mosaic DEM and Bathymetry, Bathymetry has higher priority
Export
Export final DEM to ARC ASCII format for easiest import to VNS
Import
Import final DEM to VNS, increase resolution during import for more rendering detail

Visual Nature Studio

- Photorealistic landscape visualization package
- Works directly with GIS data (shapefiles, grids)
- Also works with 3D modeling software
  - Lightwave 3D
  - Inspire 3D
  - 3D Studio Max



Rendering Water and Beach



Rendering Water and Beach

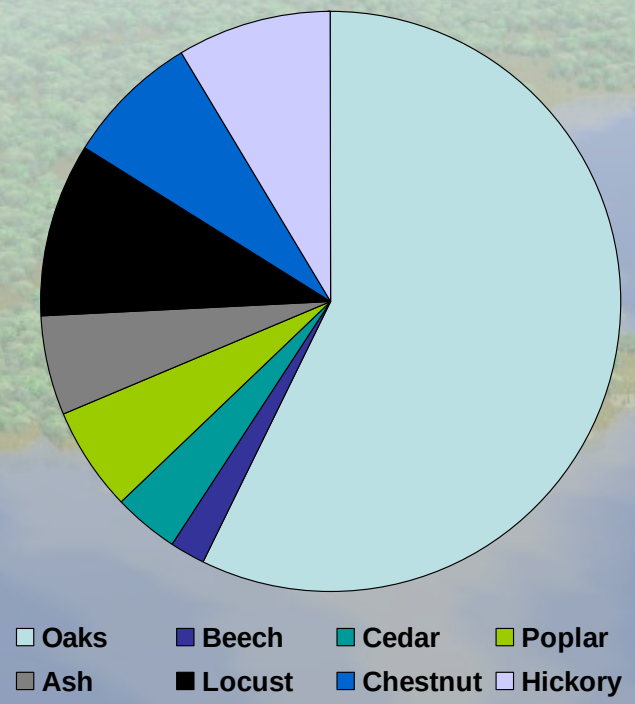
Rendering the Cliffs

Rendering the Cliffs

Rendering Vegetation

Calvert Cliffs Boundary Trees

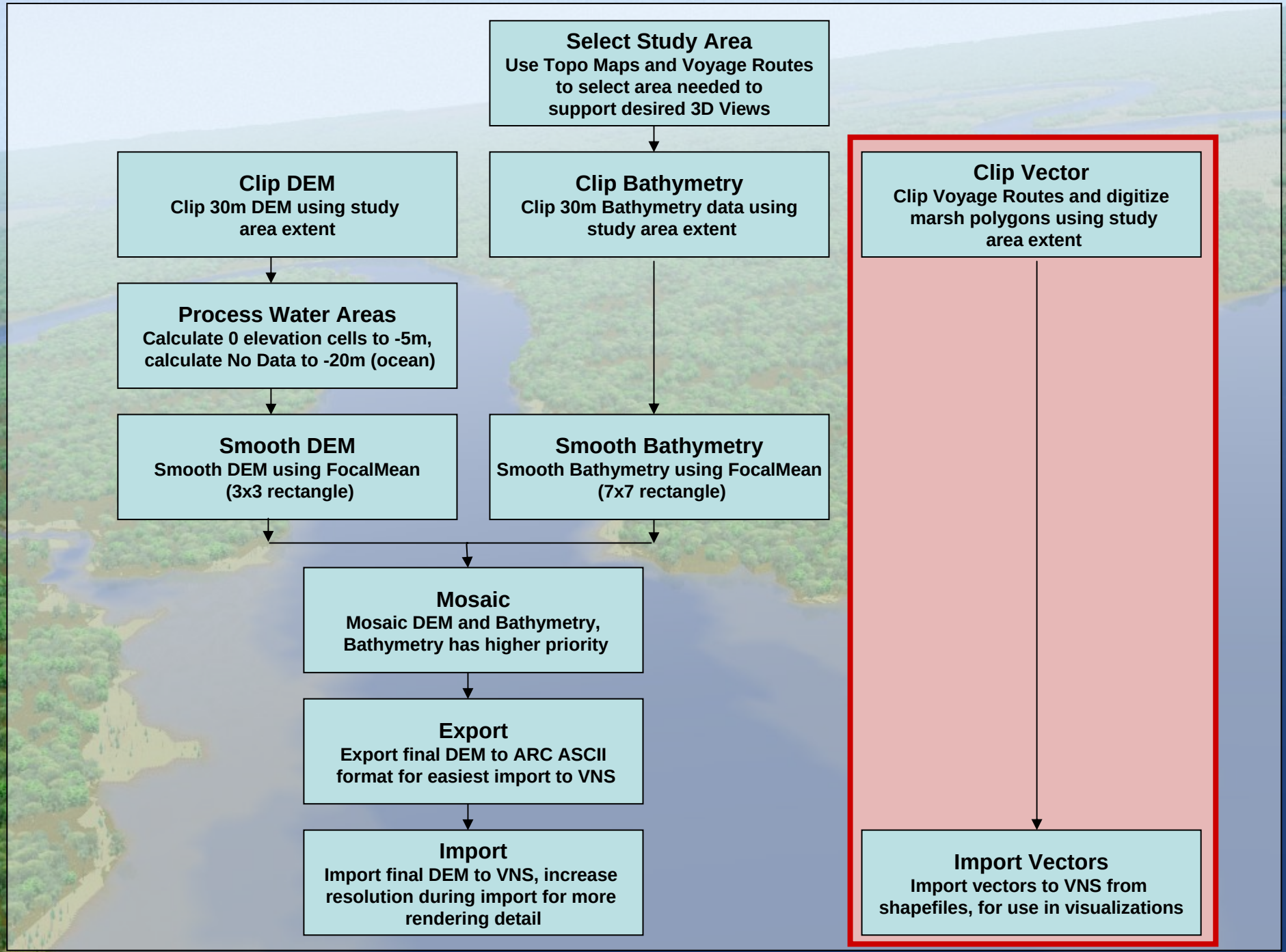
- Forest composition evaluated using 17th century land patents
- Dominated by oaks, with locust, chestnut and hickory also present



Stevenson, J.C. and K. Sundberg. 1997. *Historical Shoreline Configurations at Cove Point from original patents and later Shoreline Surveys.* Final report to Cove Point Natural Heritage Trust, Lusby, MD.

Rendering Vegetation

Clouds, Sky, and Light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Clip Bathymetry
Clip 30m Bathymetry data using study area extent
Clip Vector
Clip Voyage Routes and digitize marsh polygons using study area extent
Process Water Areas
Calculate 0 elevation cells to -5m, calculate No Data to -20m (ocean)
Smooth DEM
Smooth DEM using FocalMean (3x3 rectangle)
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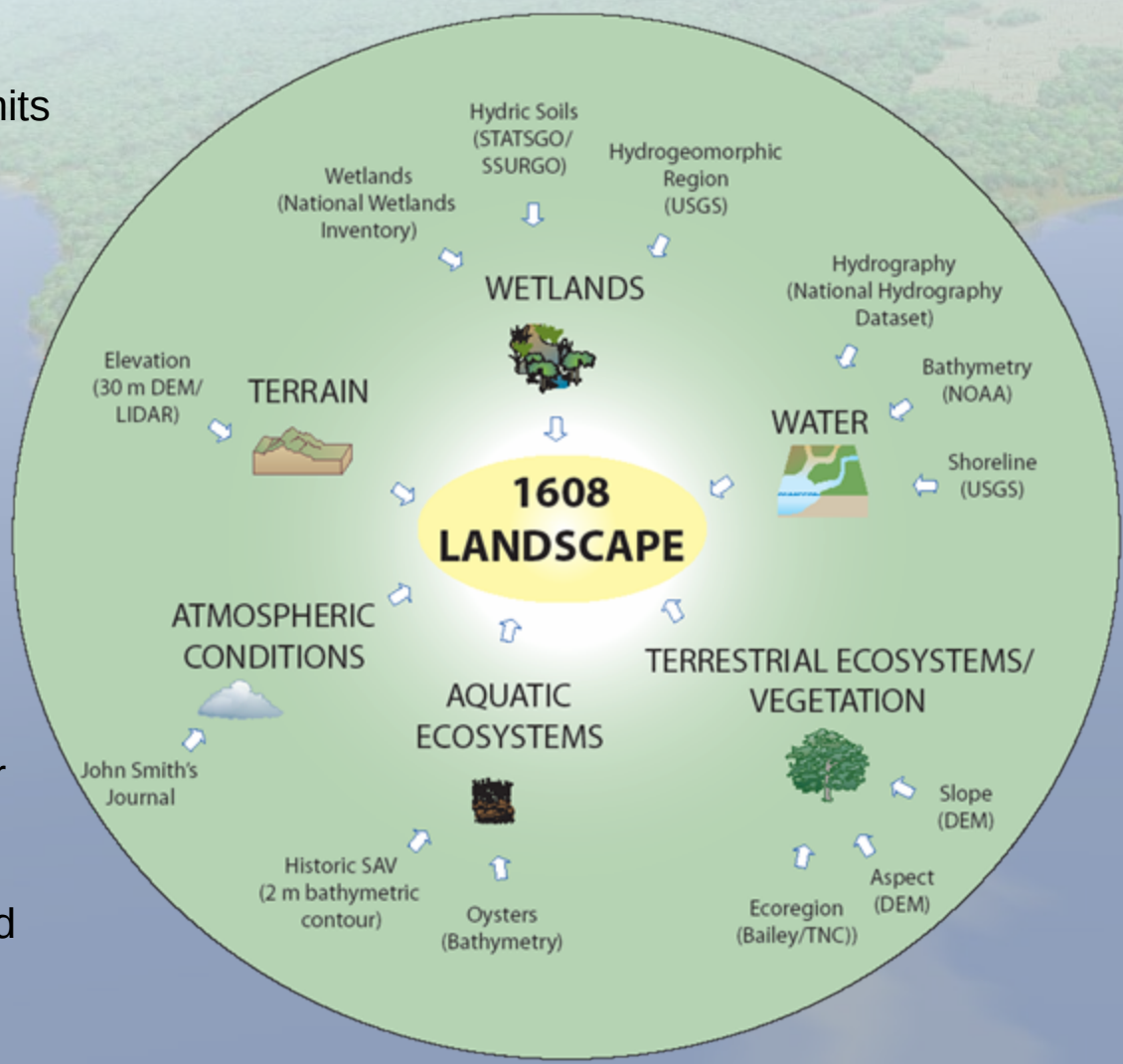
Export
Export final DEM to ARC ASCII format for easiest import to VNS
Import
Import final DEM to VNS, increase resolution during import for more rendering detail
Import Vectors
Import vectors to VNS from shapefiles, for use in visualizations

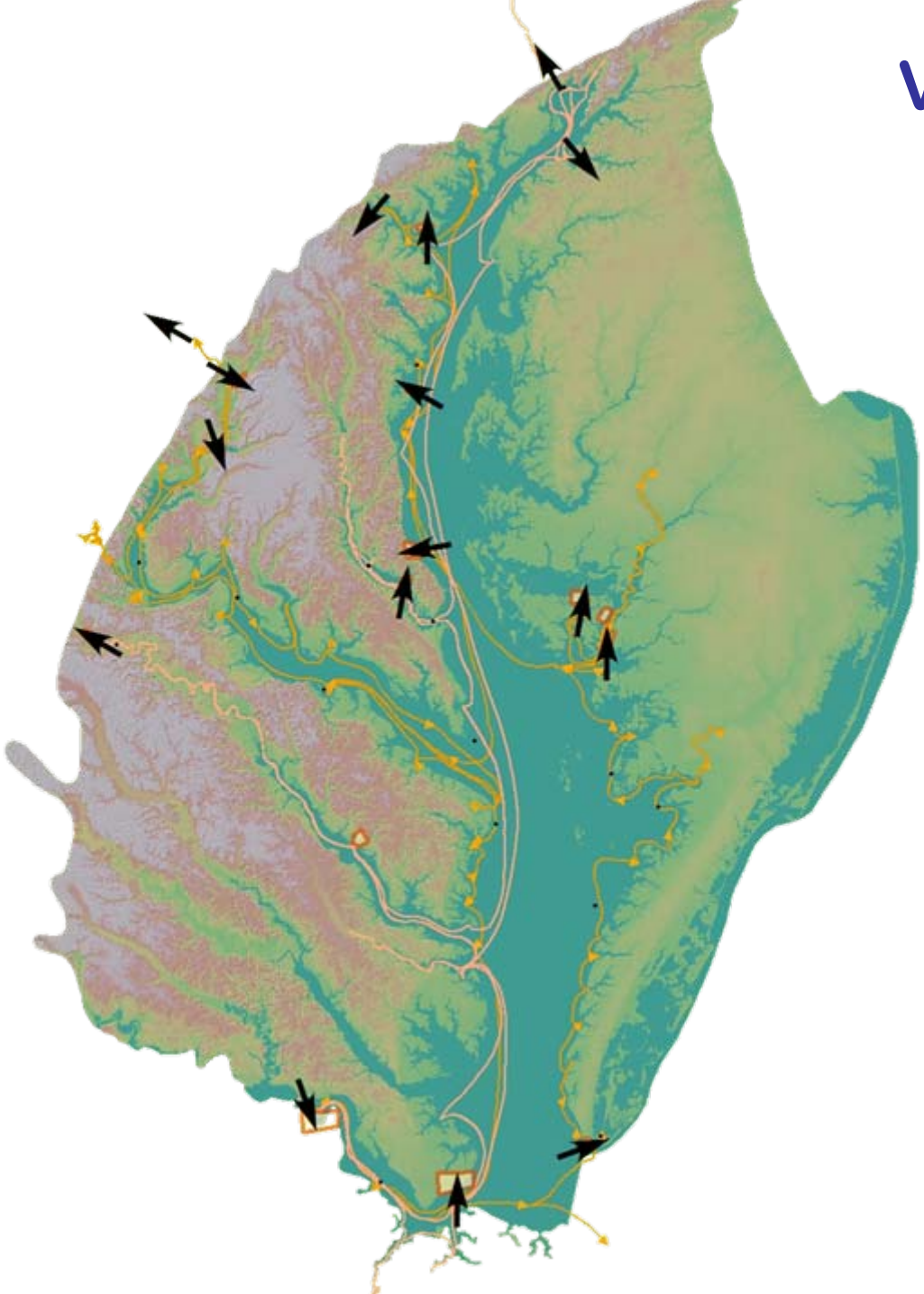
Possible Enhancements

- Native Vegetation
  - TNC's Ecological Land Units and Landform data
- Wetland extent
  - Hydric soils
- Shoreline
  - 2 m bathymetric contour
- Water
  - Remove impoundments, ditches, etc.
- Submerged Aquatic Vegetation
  - 2-4 m depth
- Oysters
  - Extend beyond deepwater limits of SAV
- Atmospheric conditions
  - Render based on date and weather conditions (from Smith's journal)
- LIDAR



Putting It All Together - 3d Models, 2d Image Billboards & More!

VIRGINIA
Massawomecks
MONACANS
MANNAHOACKS
POWHATAN
POWHATAN
Held this state & fashion when Capt. Smith was delivered to him prisoner 1607
MANGOAGS
CHAWONS
SASQUESAHANOUGH
TOCKWOGHS
KUSKARAWAOKS
PEACK BAY
Kings howses
Ordinary howses
Scale of Leagues
THE
VIRGINIAN
SEA



Visualization Process

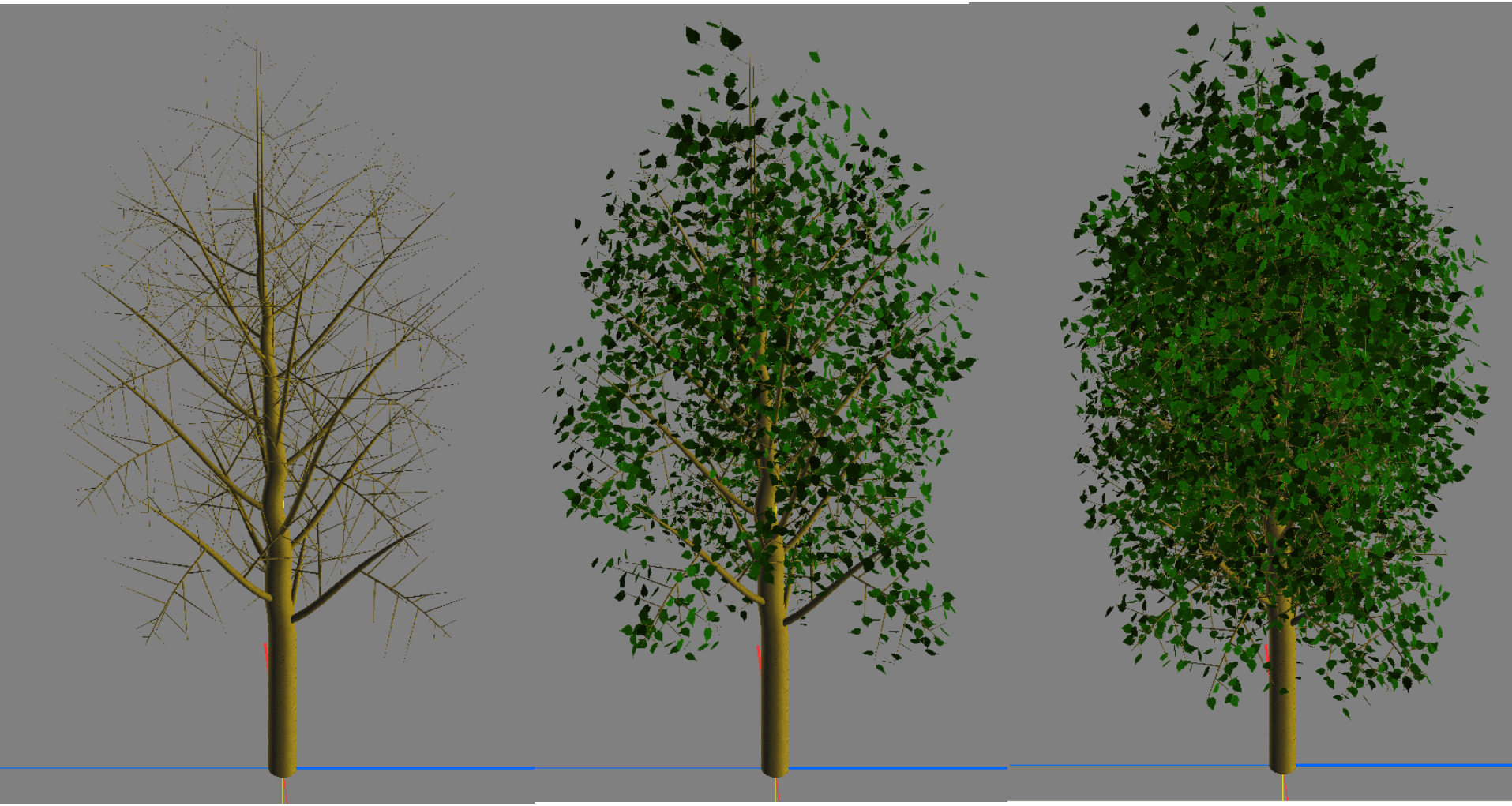
- Site Selection
- Establish Views
- Build Ecosystem Library
- Build 3d Components
- Construct Final Graphics

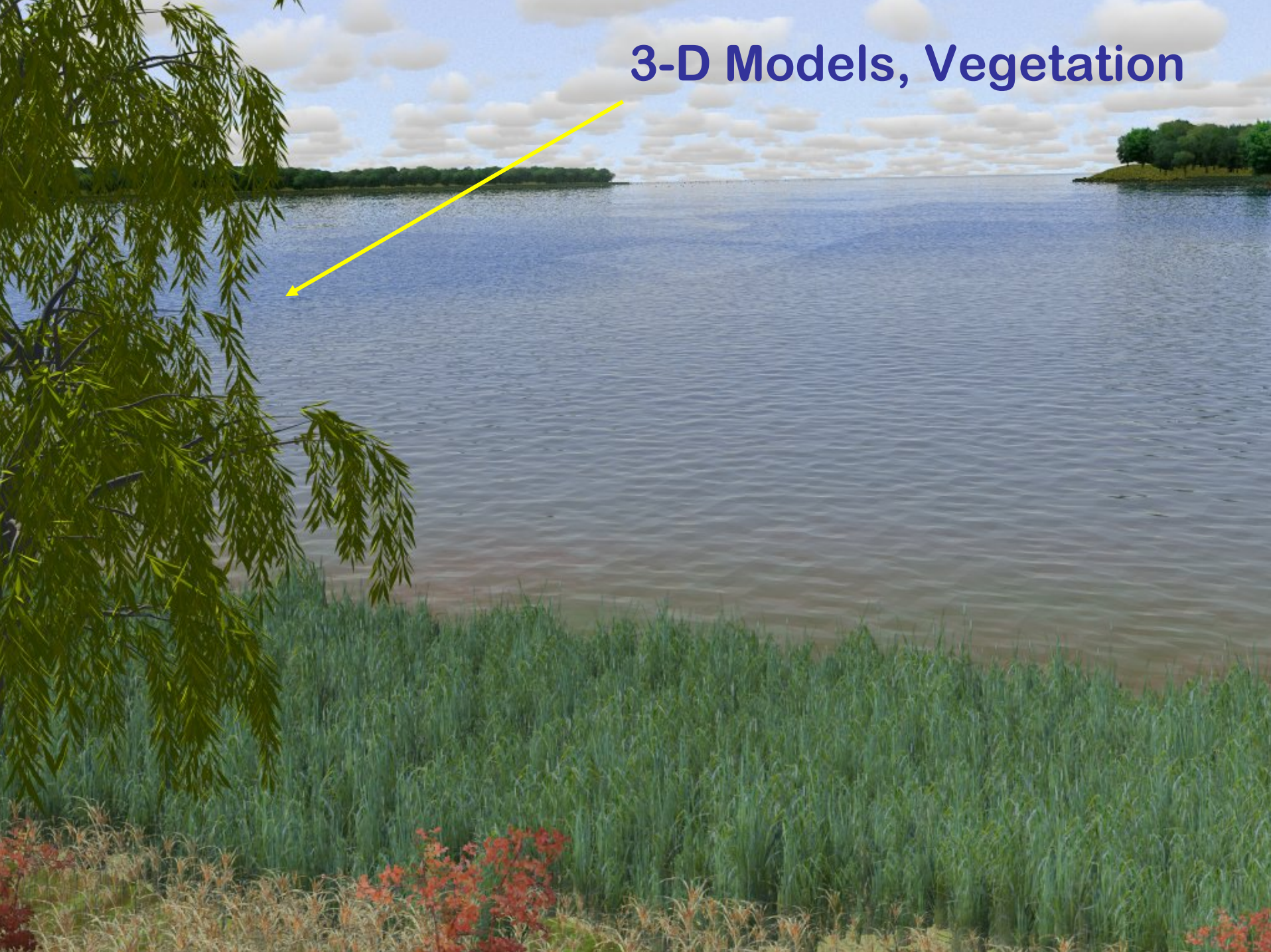
VNS Landscape Render – Aerial Perspective


VNS Landscape Render - Oblique

Build Ecosystem Library

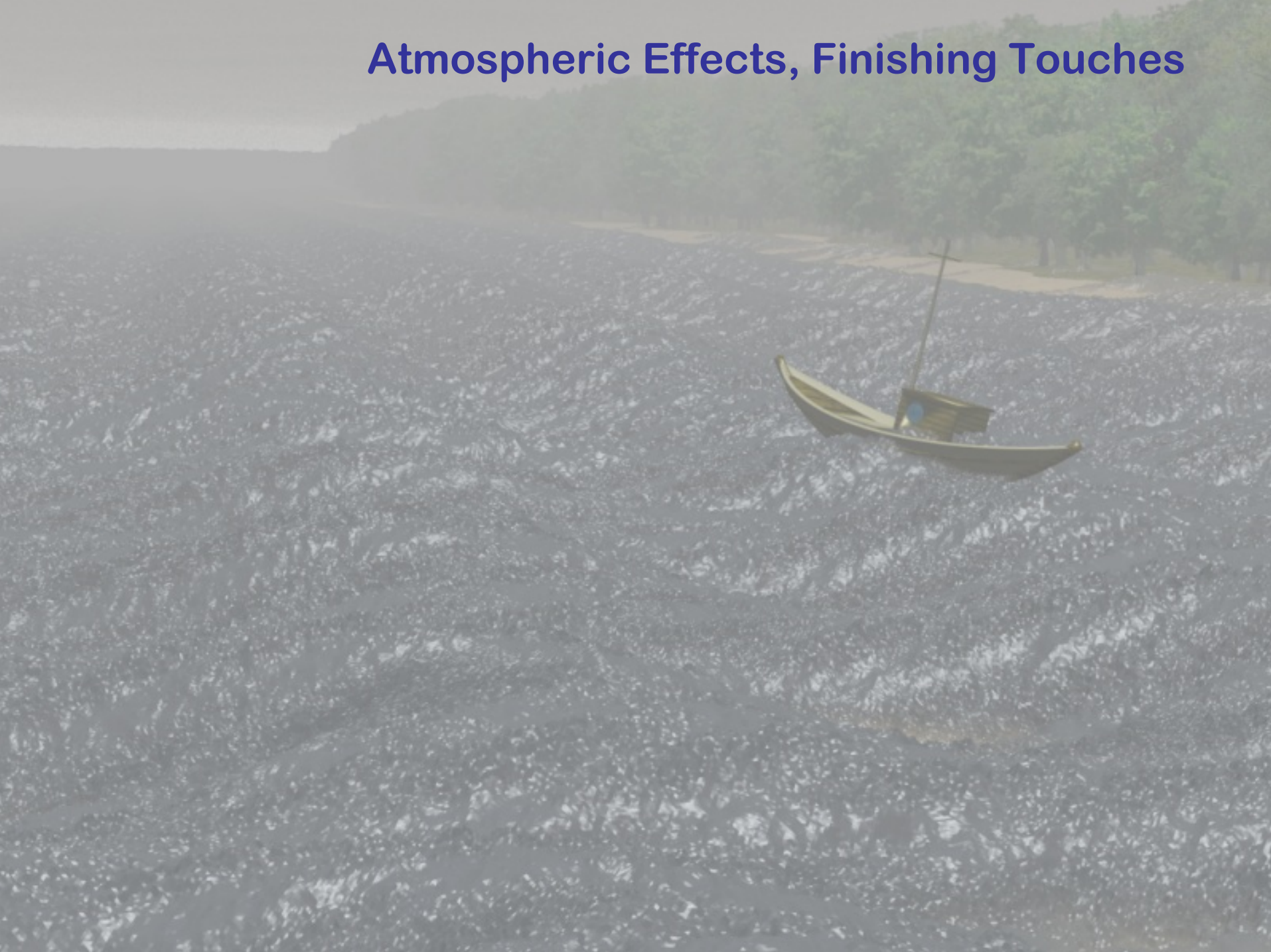
3d Models, Vegetation



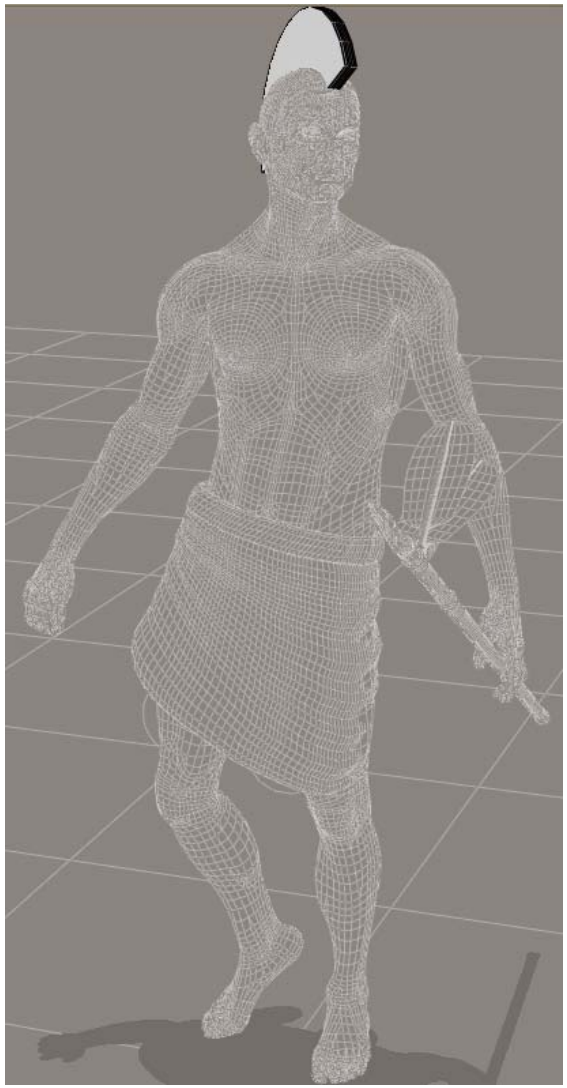

3-D Models, Vegetation

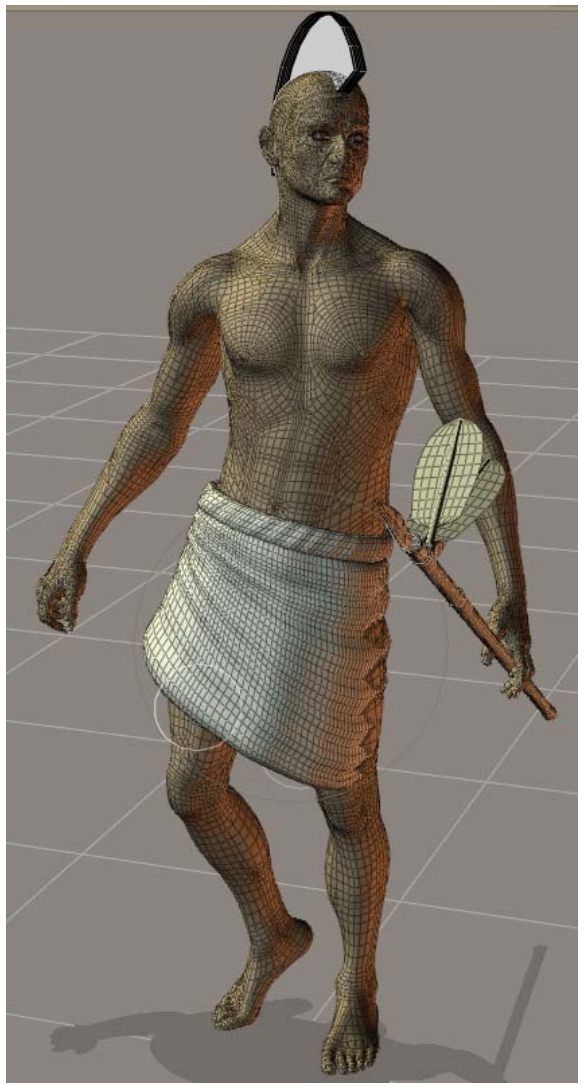
Atmospheric Effects, Finishing Touches

Atmospheric Effects, Finishing Touches



3d Models, People

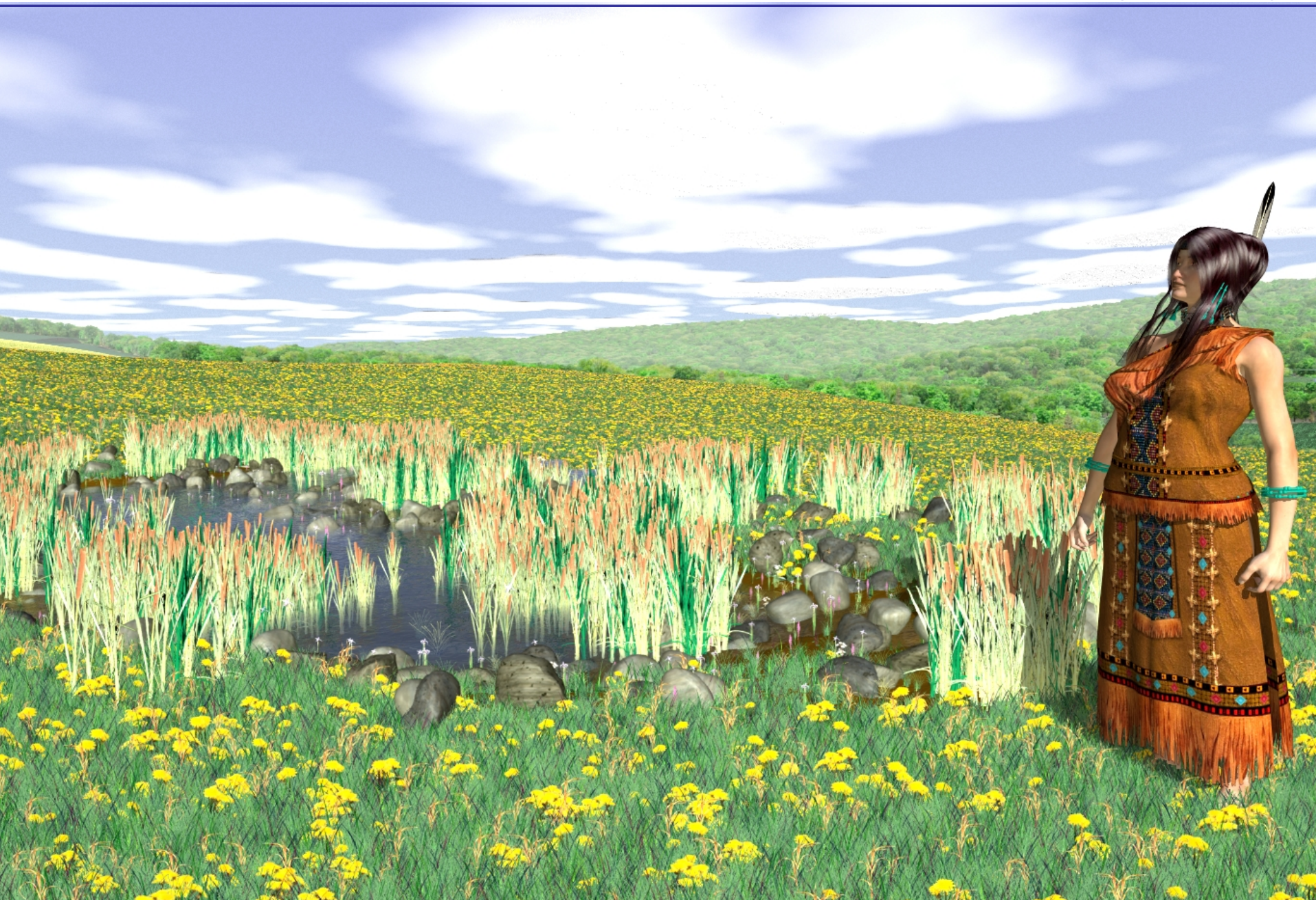




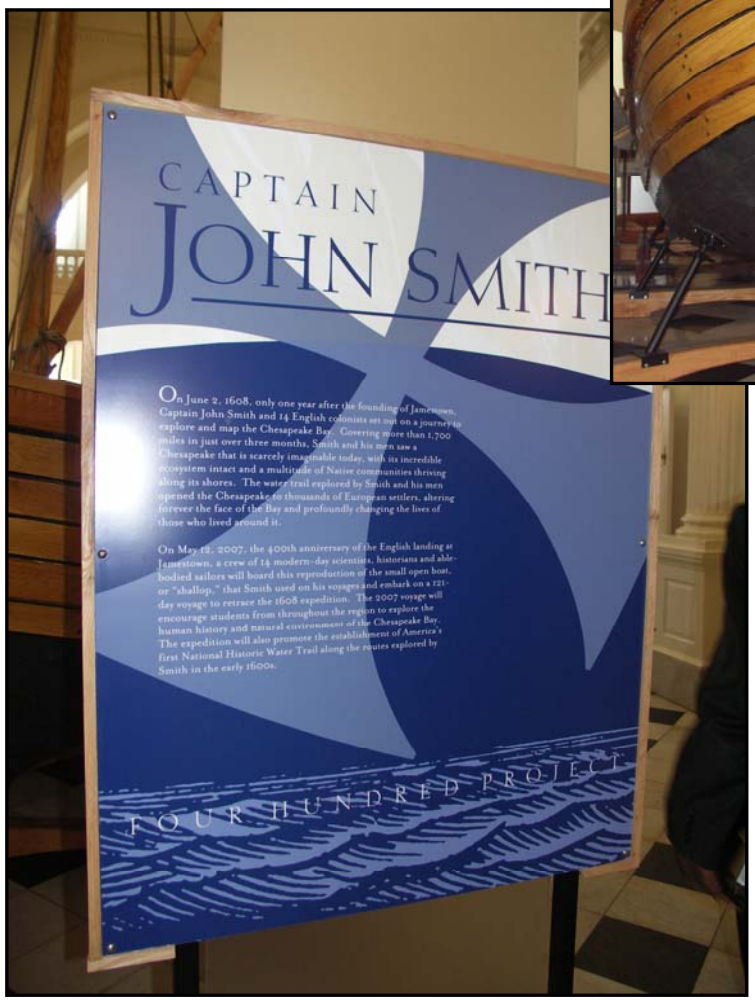
Rendered 3d Models

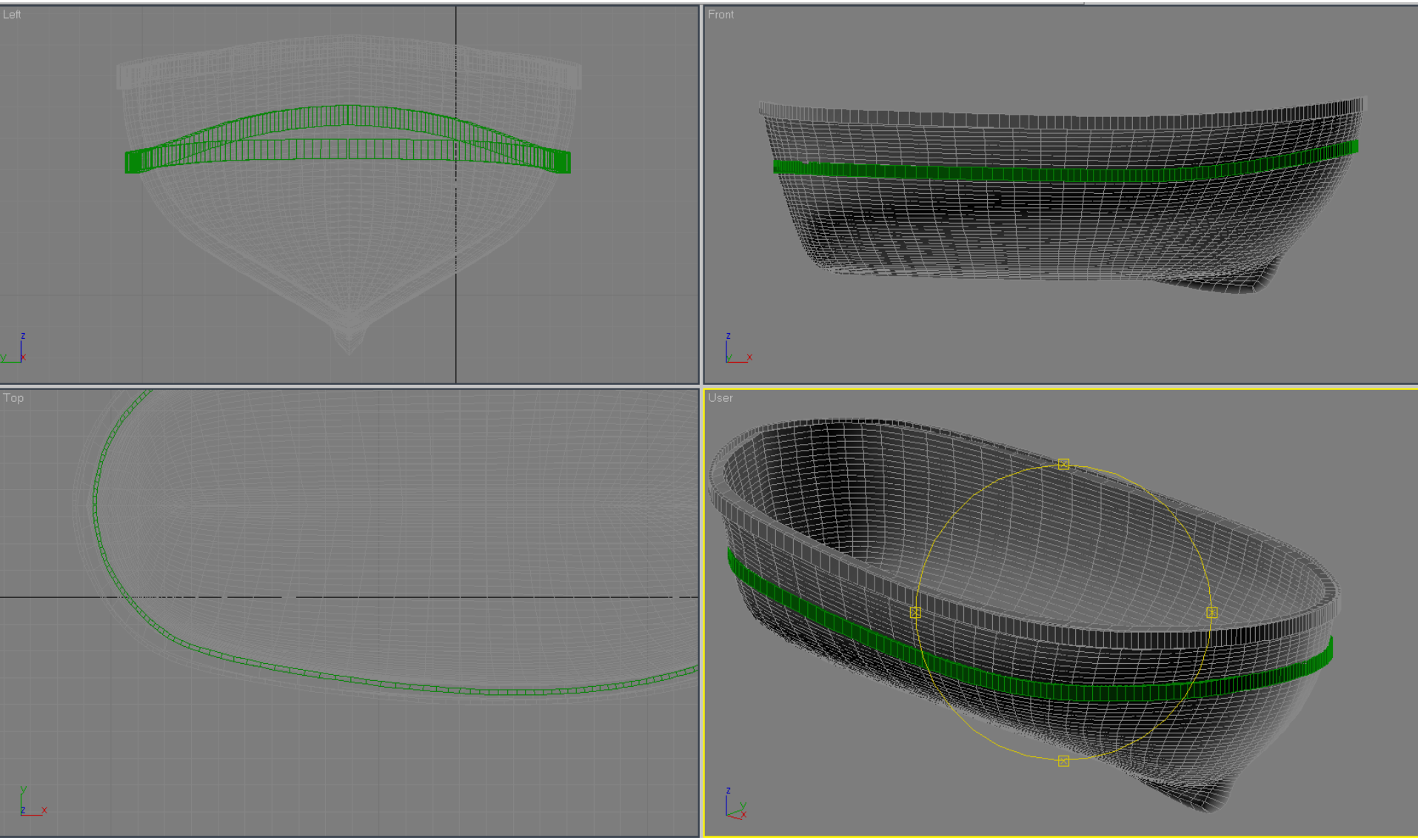
Rendered 3d Models

Rendered 3d Models (VNS)

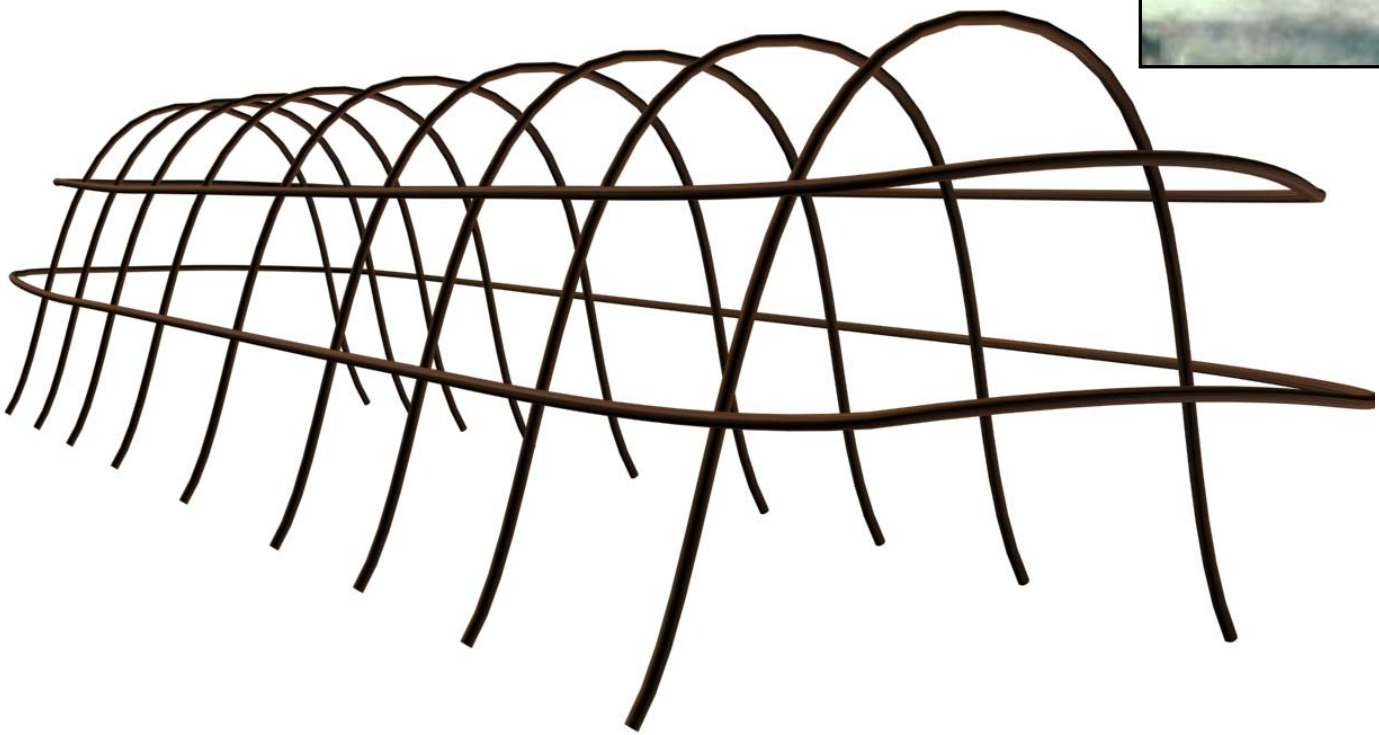


3d Models, Shallop



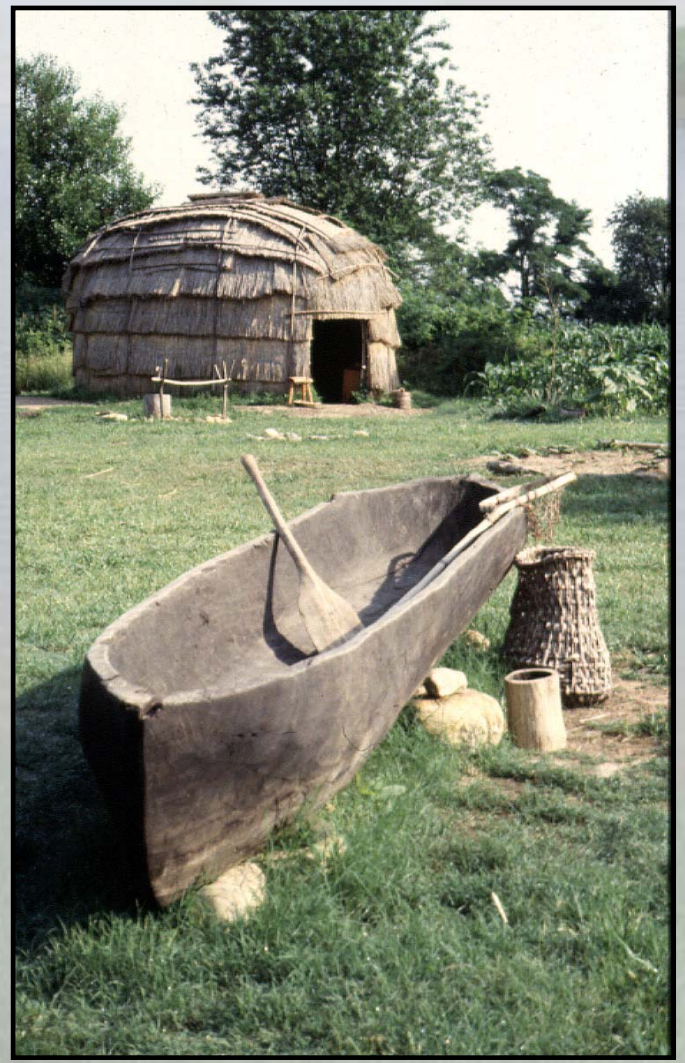

Left
Front
Top
User

3d Models, Longhouse



Longhouse

Canoe

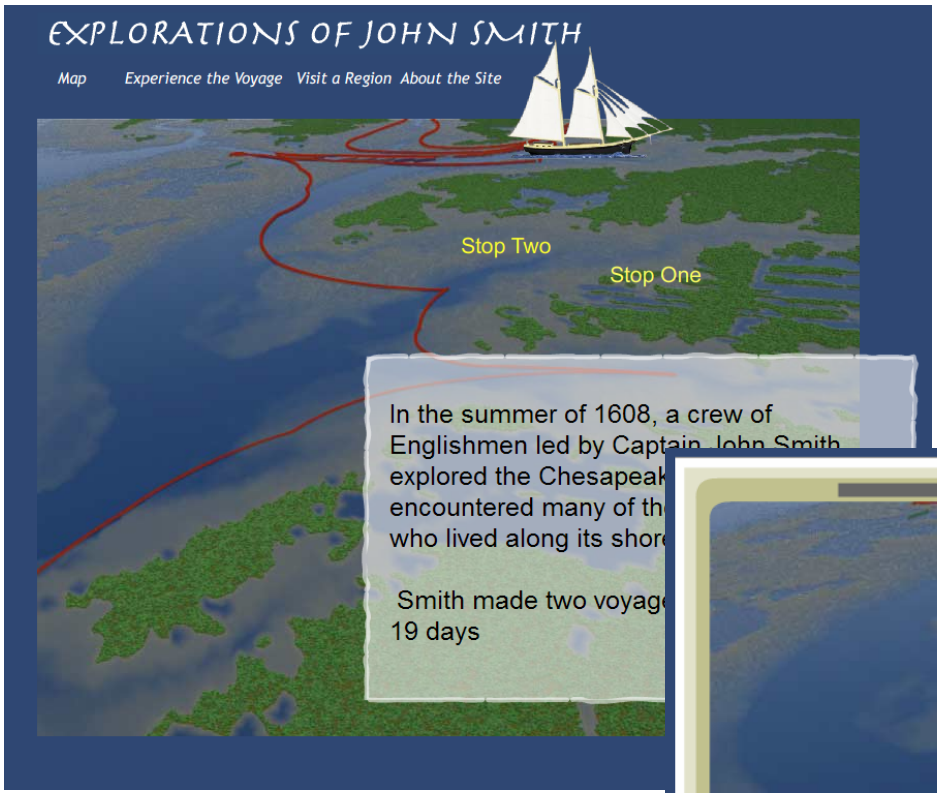


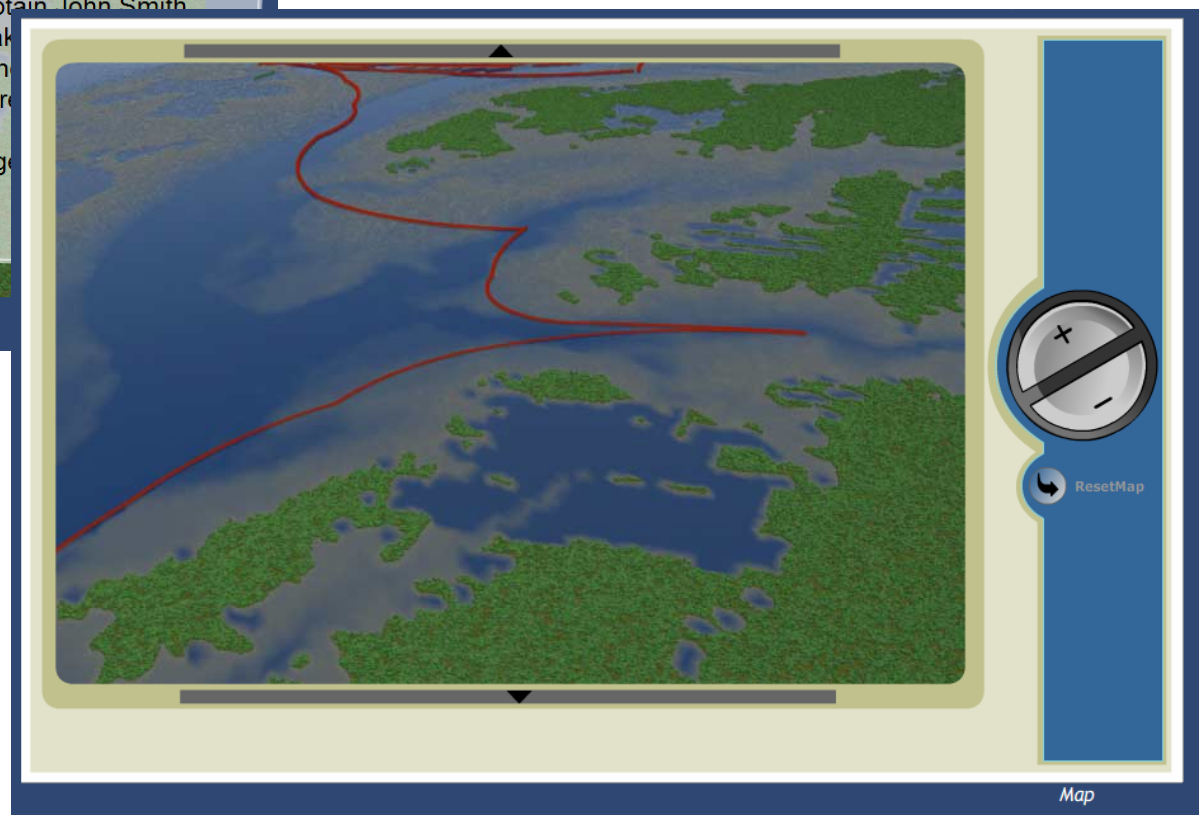
Customized Water Texture

“Then & Now” Comparisons

Photoshop Composite

Multi-Media, Online Education





- Ecology
- Ecological Impacts of Landuse (over time)
- Native American Culture

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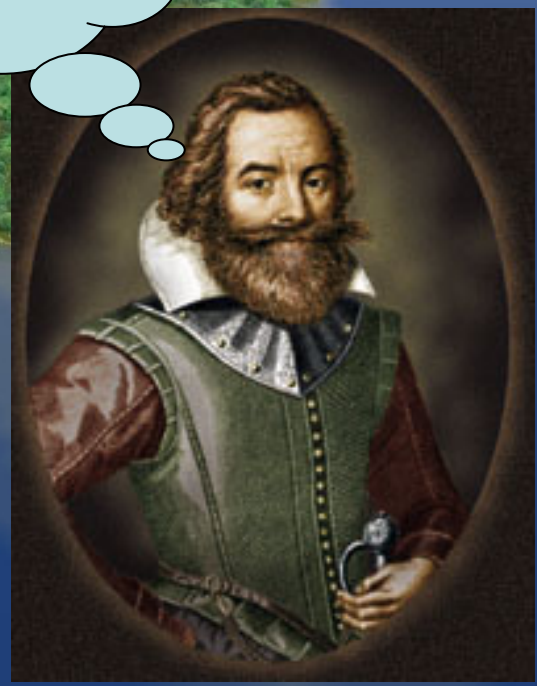
Thank You!



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