

# (S200) Sea-level Rise

## Transportation Vulnerability Analyses

APA's 2012 National Planning Conference  
*Los Angeles, California*

### Presenters

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Tamika Graham, Transportation Planner



# Learning Objectives

- ❑ Review broad sea-level rise (SLR) impacts to transportation
- ❑ Understand our process for assessing this vulnerability
- ❑ Learn easy-to-use GIS techniques to conduct assessment

# Wilmington Area Planning Council

- ❑ “WILMAPCO”
- ❑ Metropolitan Planning Organization
- ❑ Long-range transportation Plan
- ❑ Complete regional/local plans





WILMAPCO Region  
New Castle Co., DE - 538,000  
Cecil Co., MD - 101,000

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image PA Department of Conservation and Natural Resources-PAMAP/USGS

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# Today's Presentation

- ❑ Background
- ❑ Approach
- ❑ Regional Impacts
- ❑ Local Impacts (Cluster Profiles)
- ❑ Policy Recommendations
- ❑ Methodology & Software Demo.



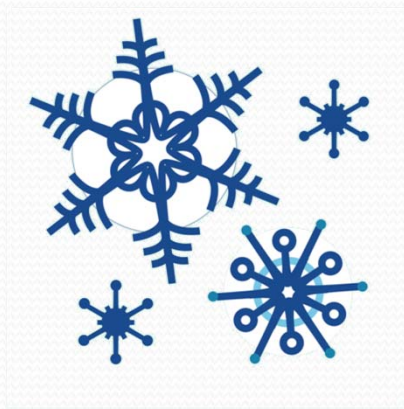
Photo: Peggy Schultz

# Background



# Sea-level Trends

- ❑ Lots of fluctuation in Earth's history
- ❑ 125,000 years ago: 4 to 6 meters higher than today
- ❑ 21,000 years ago: 120 meters below present



# SLR Projections

- ❑ Earth will continue warming trend
- ❑ Flooding from severe storms to increase
- ❑ Global seas projected to rise 0.59 – 1.9 feet by 2100
- ❑ Higher rates with accelerated polar ice melt
- ❑ Delaware and Maryland developed local projections

# Key Transportation Impacts

- ❑ Flooding/inundation
- ❑ Infrastructure erosion
- ❑ Sea-channel navigability
- ❑ Port facilities



Photo: Peggy Schultz

# SLR Adaptation

- ❑ **Elevation** (roads, runways, rail lines)
- ❑ **Relocation** (section of roads inland)
- ❑ **Fortification** (levees, sea-walls, dikes)
- ❑ **Abandonment** (development restrictions)

# Integrated SLR Adaptation and Response



Source: Maryland Commission on Climate Change

# Goals

- ❑ Inform and influence adaptation planning
- ❑ Identify at-risk existing/planned infrastructure
- ❑ Address climate change ahead of federal regulations
- ❑ Continue work of Delaware and Maryland

# Study Approach



Photo: Peggy Schultz

# Steering Committee

Public

State Environmental

State Highway/DOT

County Planning

Univ. of Delaware



# INUNDATION LAYERS

## WILMAPCO Region

Sea-level Rise Vulnerability Assessment

### Inundated Land Area

Scenario	New Castle	Scenario	Cecil
0.5 m	9.0%	2 ft	1.0%
1.0 m	10.6%	5 ft	1.2%
1.5 m	11.9%	10 ft	1.3%

— Base Roadways  
++++ Base Railways  
Existing Waterway

#### Cecil Co. Scenarios

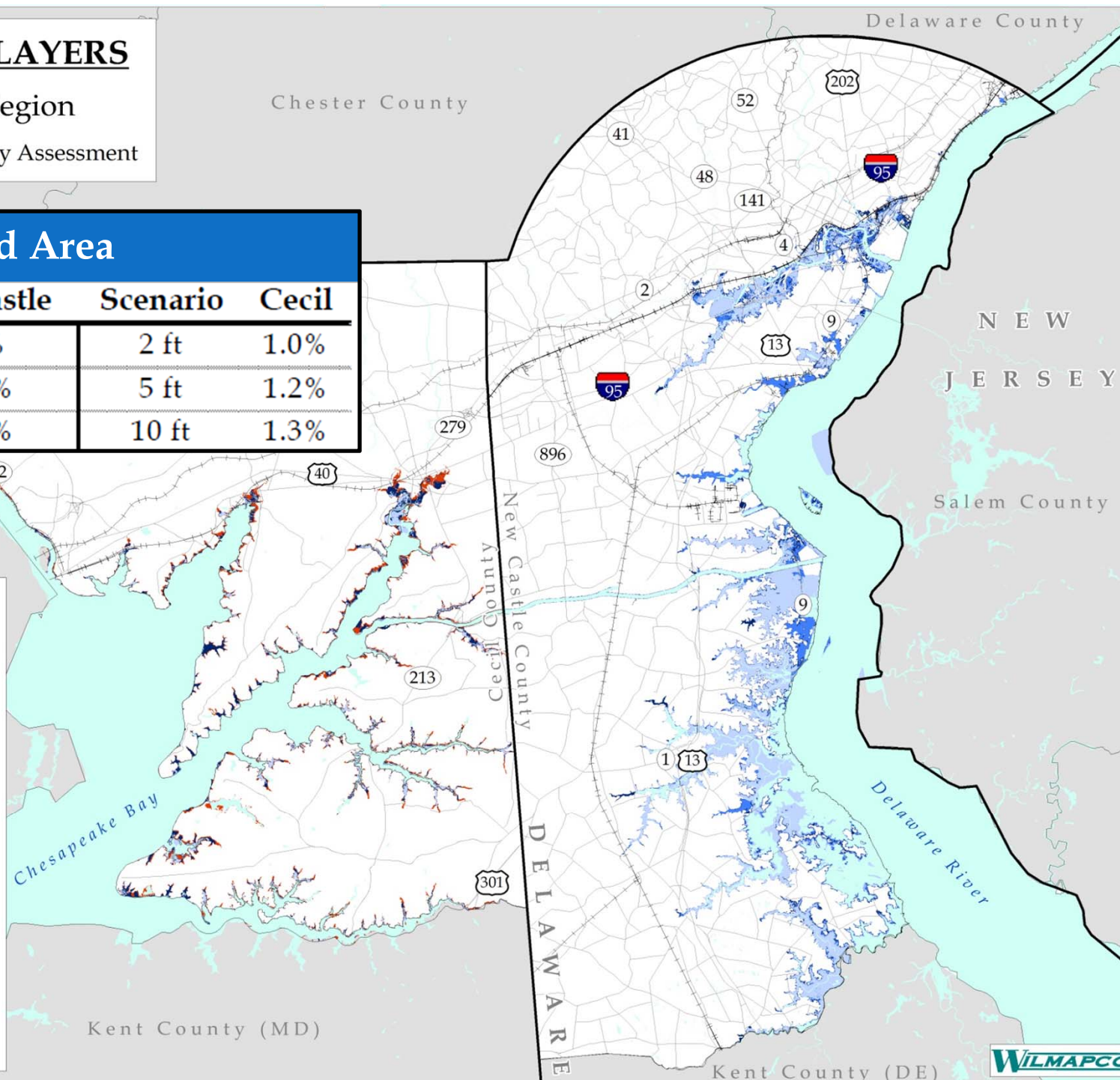
2 ft  
5 ft  
10 ft


#### New Castle Co. Scenarios

0.5 m (1.6 ft)  
1.0 m (3.3 ft)  
1.5 m (4.9 ft)



Sources: DNREC, Towson, SHA, DelDOT





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graph TD; A[Inundation Scenarios] --> B[Neighborhoods Affected]; B --> C[Group into 20 Clusters];
```

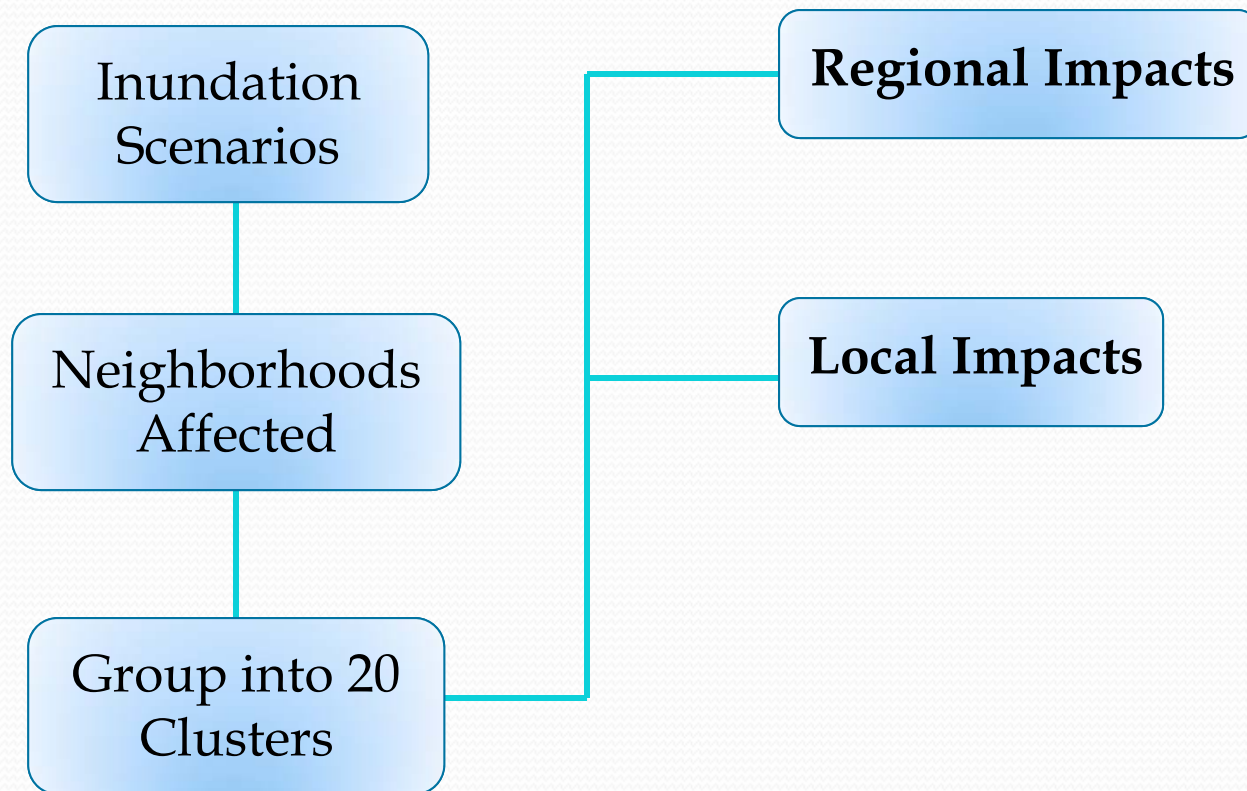
Inundation  
Scenarios

**Delaware:** 0.5m, 1.0m, 1.5m  
**Maryland:** 2ft, 2-5ft, 5-10ft (surge)

Neighborhoods  
Affected

Census Blockgroups

Group into 20  
Clusters



# Regional Impacts



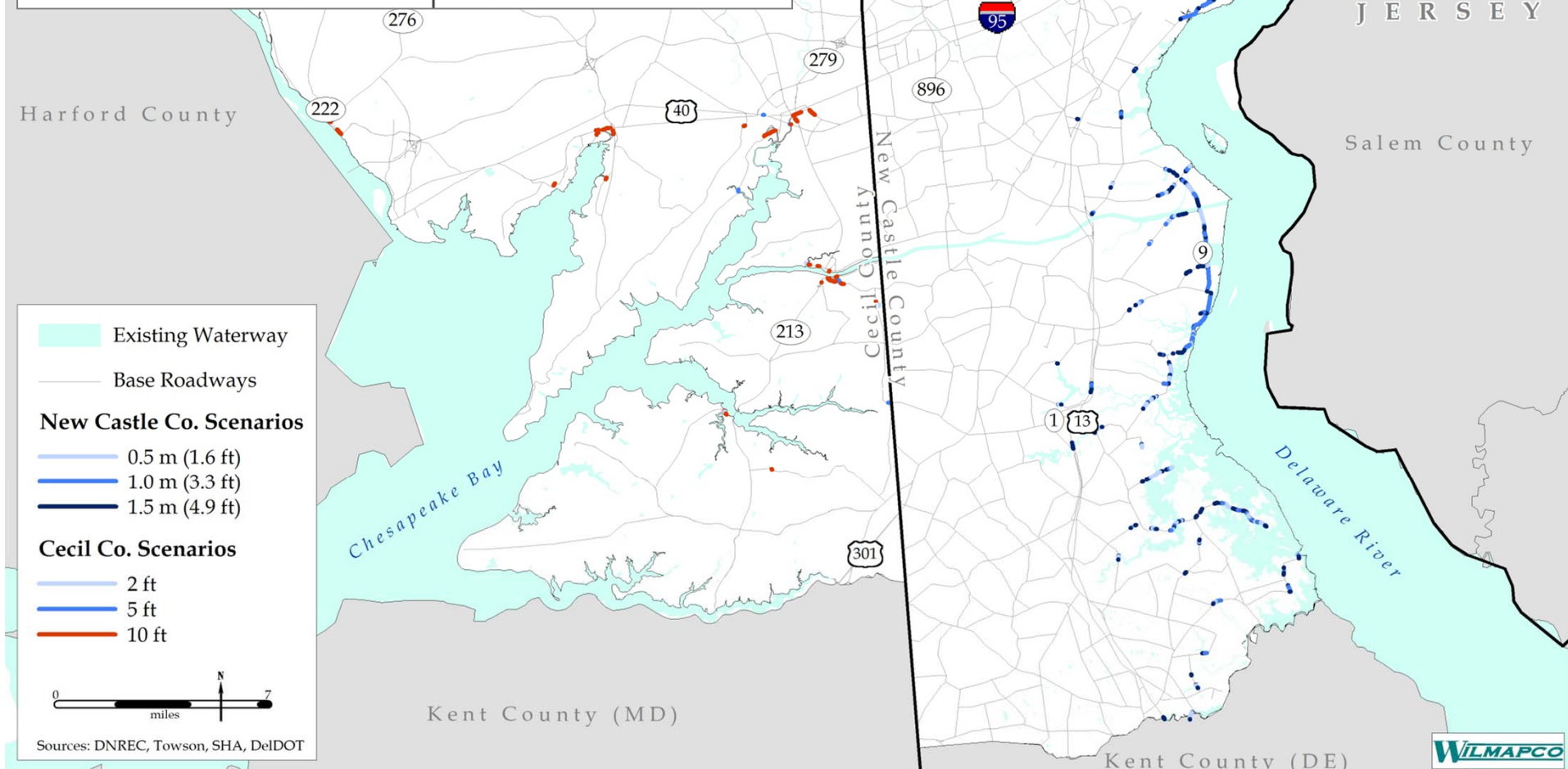
Microsoft Corp.  
Pictometry Bird's Eye

# ROADWAY IMPACTS

## WILMAPCO Region

Sea-level Rise Vulnerability Assessment

Scenario	New Castle (in miles)	Scenario	Cecil (in miles)
0.5 m	8.9	2 ft	0.1
1.0 m	19.6	5 ft	0.6
1.5 m	27.9	10 ft	3.5



# ROADWAY IMPACTS

## WILMAPCO Region

Sea-level Rise Vulnerability Assessment

Roadway	0.5 m	1.0 m	1.5 m
<i>(in miles)</i>			
<i>New Castle County</i>			
SR 9	1.60	5.83	7.54
Cedar Swamp Road	0.60	1.16	2.01
US 13	0.41	0.89	1.96
Walnut Street	0.18	0.93	1.02
Polktown Place	0.41	0.68	0.91
Staves Landing Road	0.38	0.51	0.89
Dutch Neck Road	0.46	0.58	0.86
Old Airport Road	0.41	0.47	0.81
Reedy Point Road	0.52	0.65	0.75
River Road	-	0.73	0.75

Existing Waterway

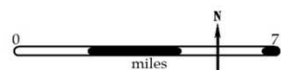
Base Roadways

### New Castle Co. Scenarios

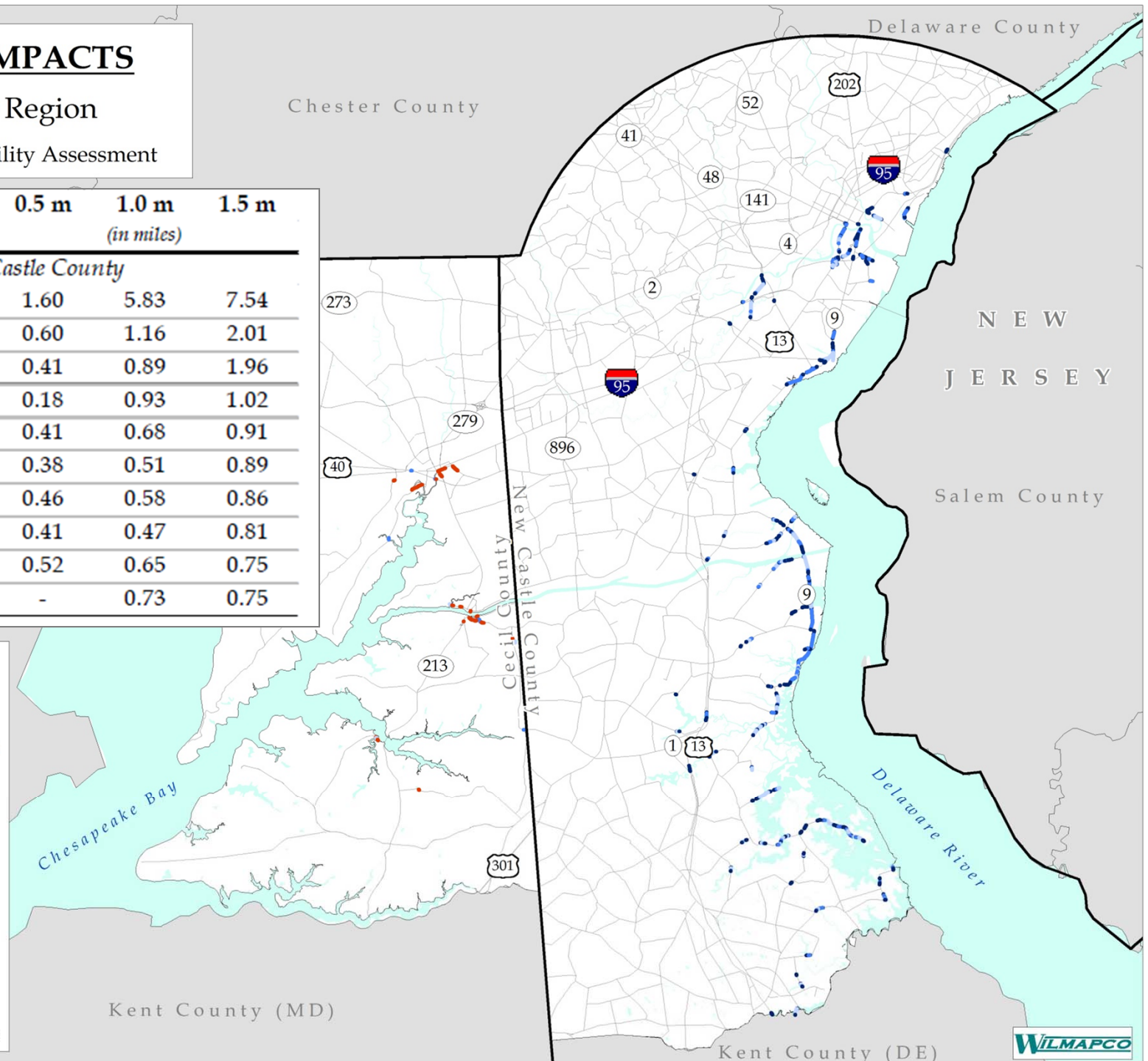
0.5 m (1.6 ft)  
1.0 m (3.3 ft)  
1.5 m (4.9 ft)

### Cecil Co. Scenarios

2 ft  
5 ft  
10 ft



Sources: DNREC, Towson, SHA, DelDOT



WILMAPCO

# ROADWAY IMPACTS

## WILMAPCO Region

Sea-level Rise Vulnerability Assessment

Chester County

PENNSYLVANIA

MARYLAND

Harford County

NEW  
JERSEY

Salem County

New Castle County  
Cecil County

Kent County (MD)

Kent County (DE)

Existing Waterway

Base Roadways

### New Castle Co. Scenarios

0.5 m (1.6 ft)

1.0 m (3.3 ft)

1.5 m (4.9 ft)

### Cecil Co. Scenarios

2 ft

5 ft

10 ft



Sources: DNREC, Towson, SHA, DelDOT

2 ft 5 ft 10 ft  
(in miles)

### Cecil County

SR 7	-	0.01	0.57
Old Field Point Road	-	0.07	0.46
SR 222	-	-	0.41
Howard Street	-	-	0.30

Chesapeake Bay

Delaware River

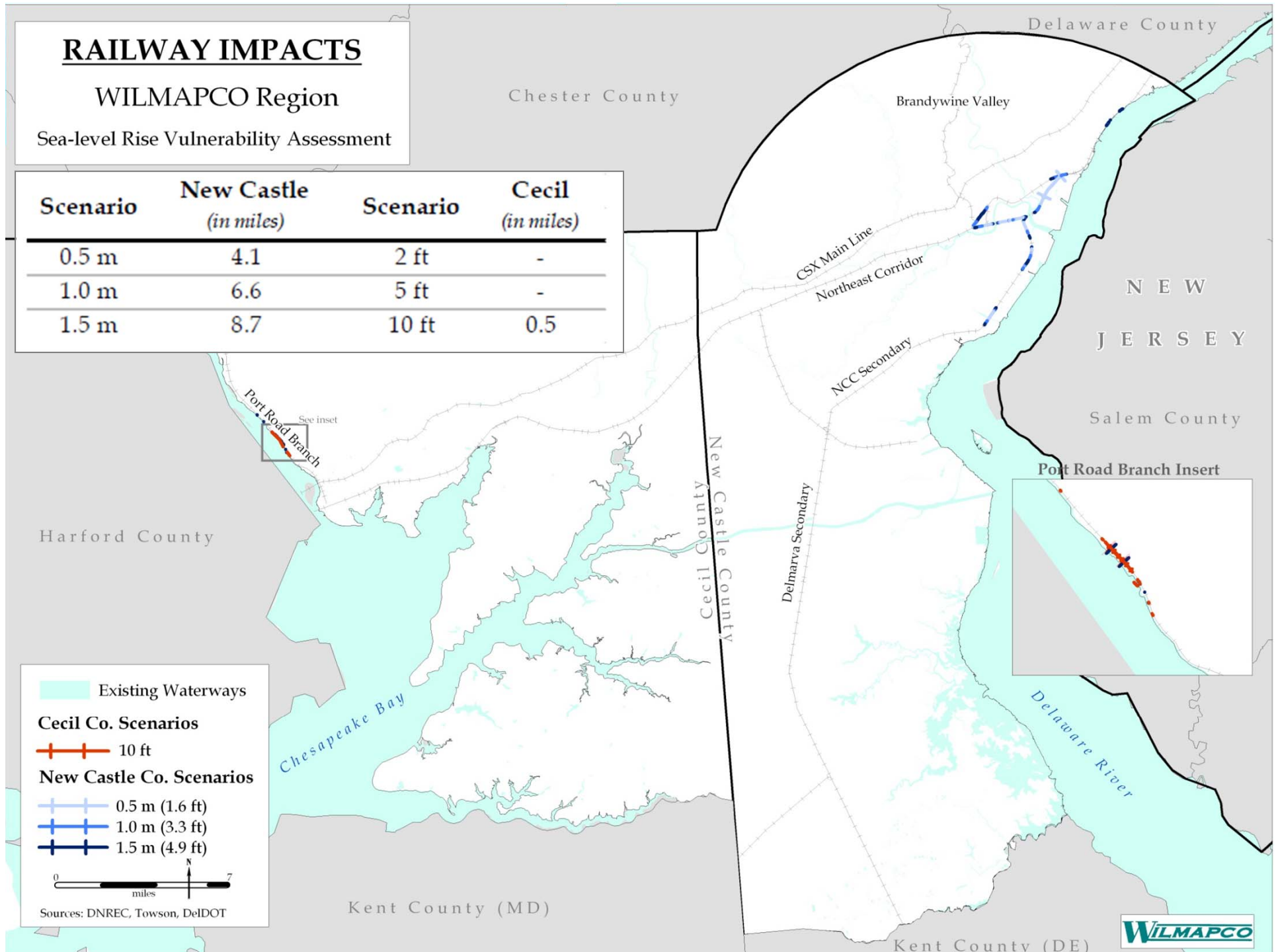
WILMAPCO

# RAILWAY IMPACTS

## WILMAPCO Region

Sea-level Rise Vulnerability Assessment

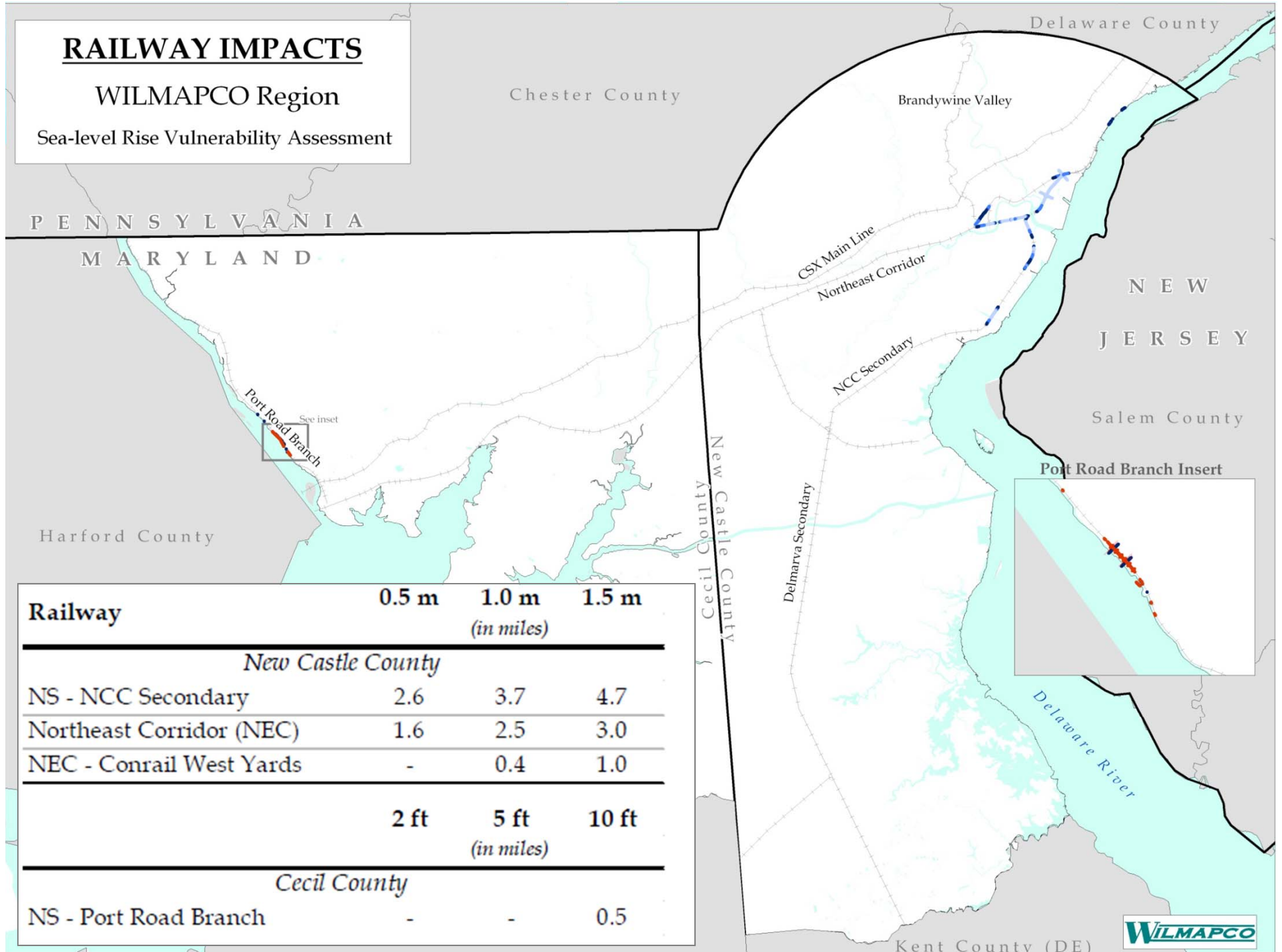
Scenario	New Castle (in miles)	Scenario	Cecil (in miles)
0.5 m	4.1	2 ft	-
1.0 m	6.6	5 ft	-
1.5 m	8.7	10 ft	0.5



# RAILWAY IMPACTS

## WILMAPCO Region

Sea-level Rise Vulnerability Assessment



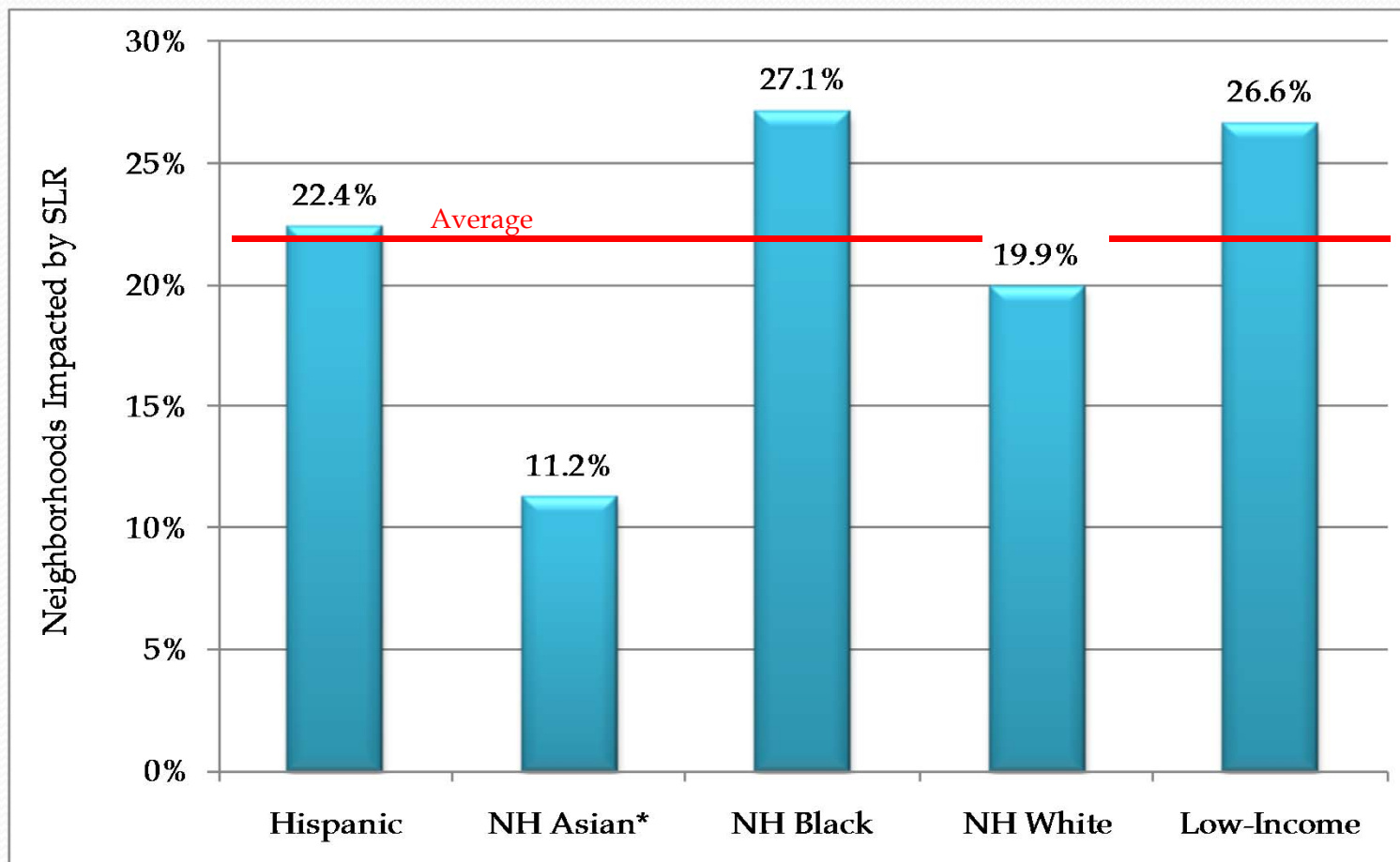
# Other Measures

- ❑ Bridges
- ❑ Tolling Facilities
- ❑ Evacuation Routes
- ❑ Fixed-route Bus Routes/Stops
- ❑ Train Stations
- ❑ Port/Marinas
- ❑ Airports
- ❑ Commercial Units
- ❑ Residential Units
- ❑ Social Equity
- ❑ Planned Projects
- ❑ Critical Roadway Index



Photo: Peggy Schultz

# Social Equity



\* NH = Non-Hispanic

Data: 2005-2009 American Community Survey

# Planned Projects

Project	In-service	Cost	Level Impact
Cecil Transit Bus Connection to Harford County	2011	\$1 m	2 ft
Elkton Bus Service Circulator	2012	\$60 k	2 ft
Washington Street, New Castle & Frenchtown Road at DE 9	2013	\$7.5 m	0.5 m
I-295: Westbound from I-95 to US 13	2014	\$5.2 m	0.5 m
I-95: Susquehanna River to DE Line (highway/bridge expansion)	2040	\$505 m	2 ft
City of New Castle Improvements (SR9/3rd and SR9/6th)	2016	\$1.4 m	0.5 m
Christina River Bridge	2020	\$21.7 m	0.5 m
Southern New Castle County Improvements	2020	\$46.2 m	0.5 m
Southbridge Streetscape Improvements Phase I (TE)	2012	\$1.2 m	1.0 m
SR 9, River Rd. Area, Dobbinsville (viaduct)	2020	\$12.7 m	1.0 m
City of New Castle Improvements (SR9/Delaware St)	2016	\$3.1 m	1.5 m

# Critical Roadway Index

## Demographics

- 2010 Population & Employment
- 2030 Population & Employment
- Environmental Justice

## Inundation Scenarios

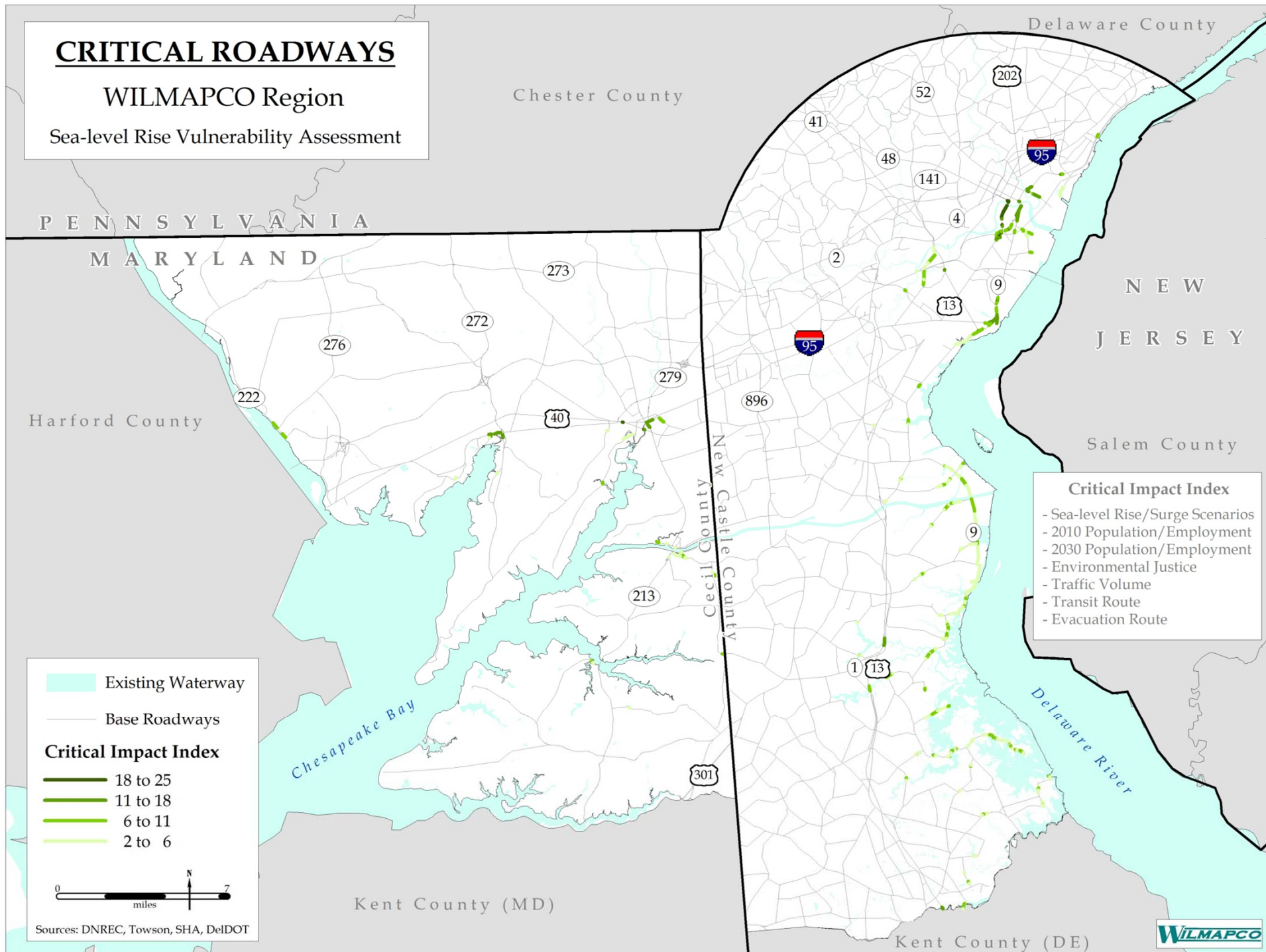
## Traffic Characteristics

- Traffic Volume
- Transit Routes
- Evacuation Routes

# CRITICAL ROADWAYS

## WILMAPCO Region

Sea-level Rise Vulnerability Assessment



## Local Impacts (Cluster Profiles)

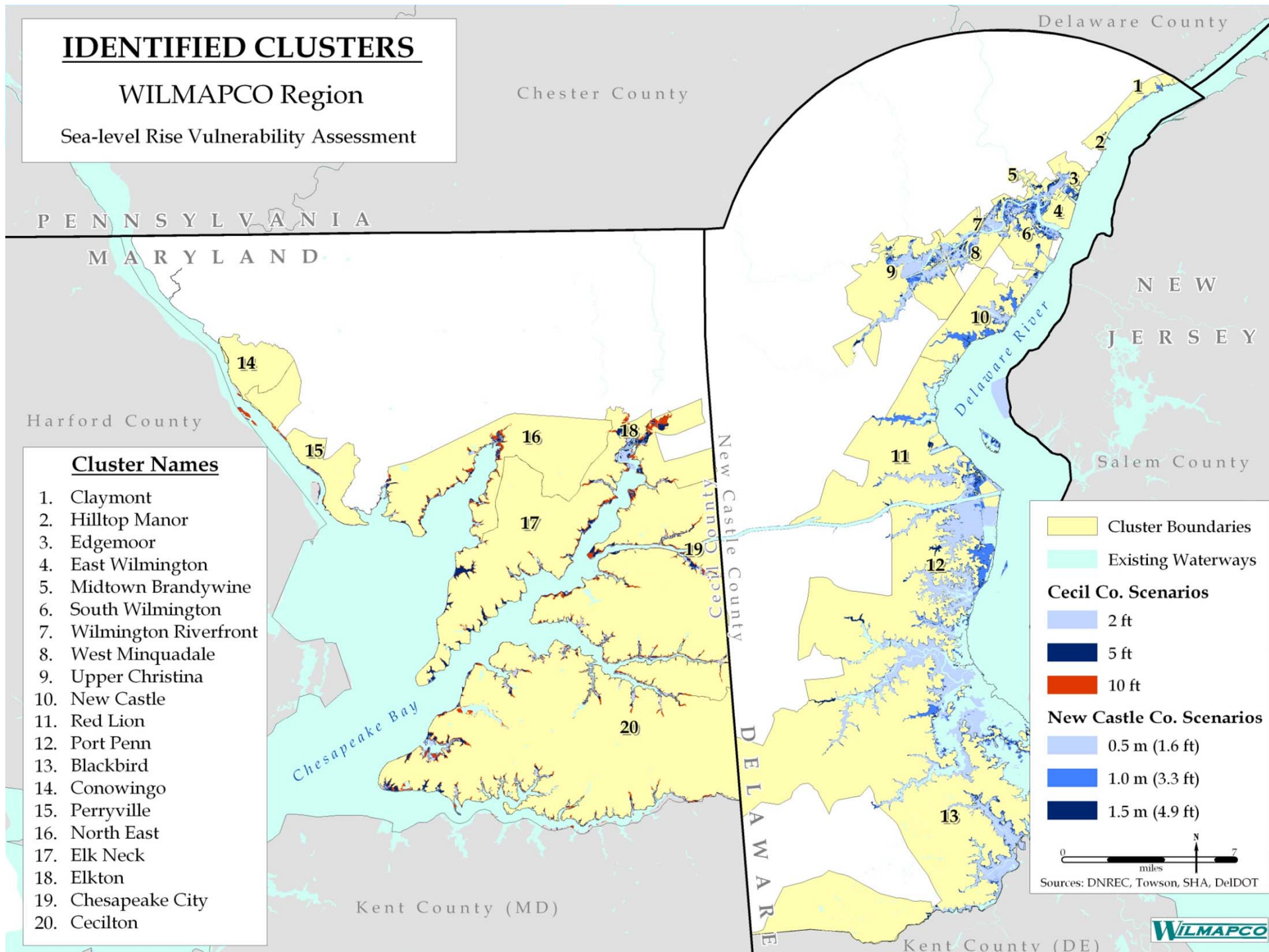


Photo: Peggy Schultz

# IDENTIFIED CLUSTERS

## WILMAPCO Region

Sea-level Rise Vulnerability Assessment



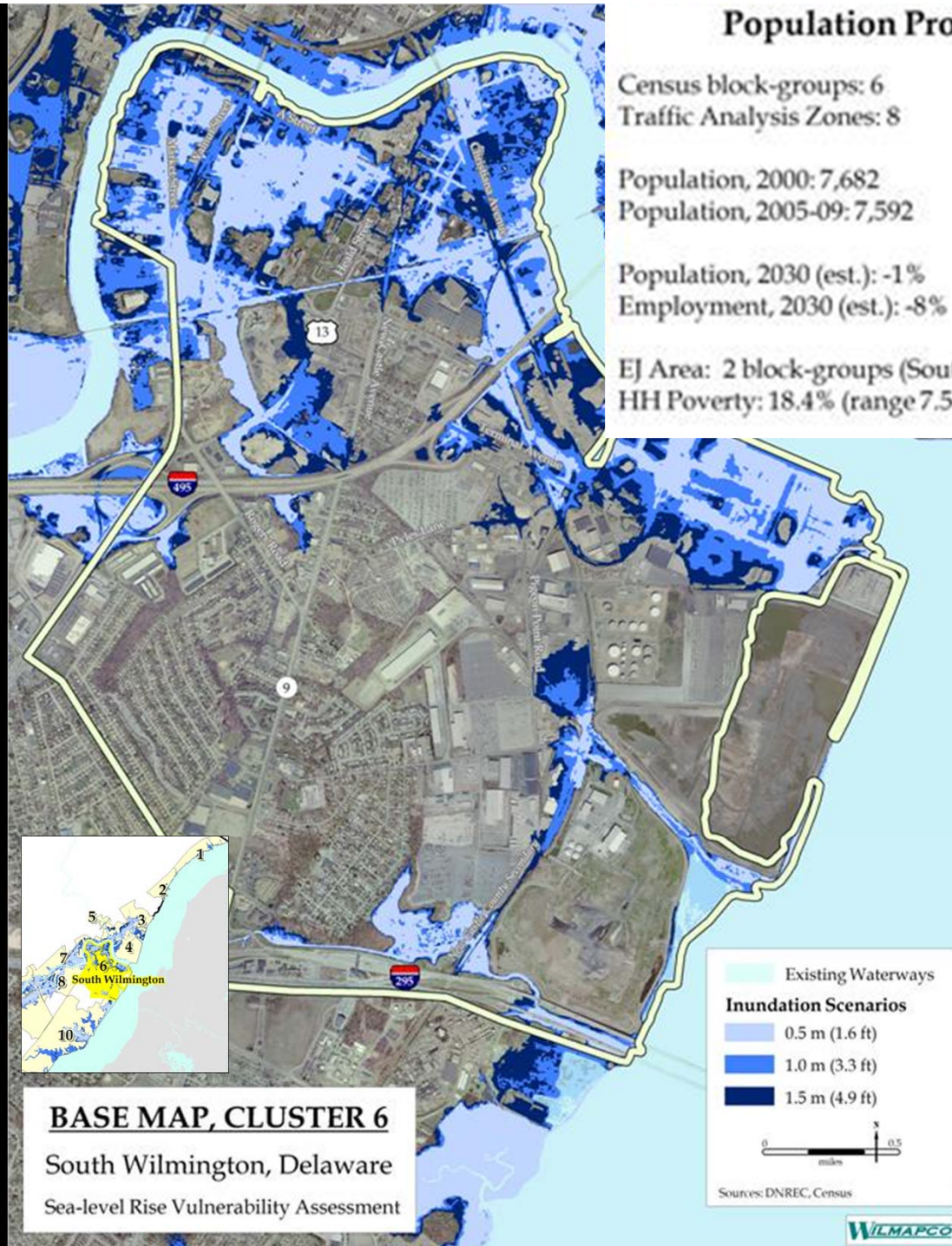
## Population Profile

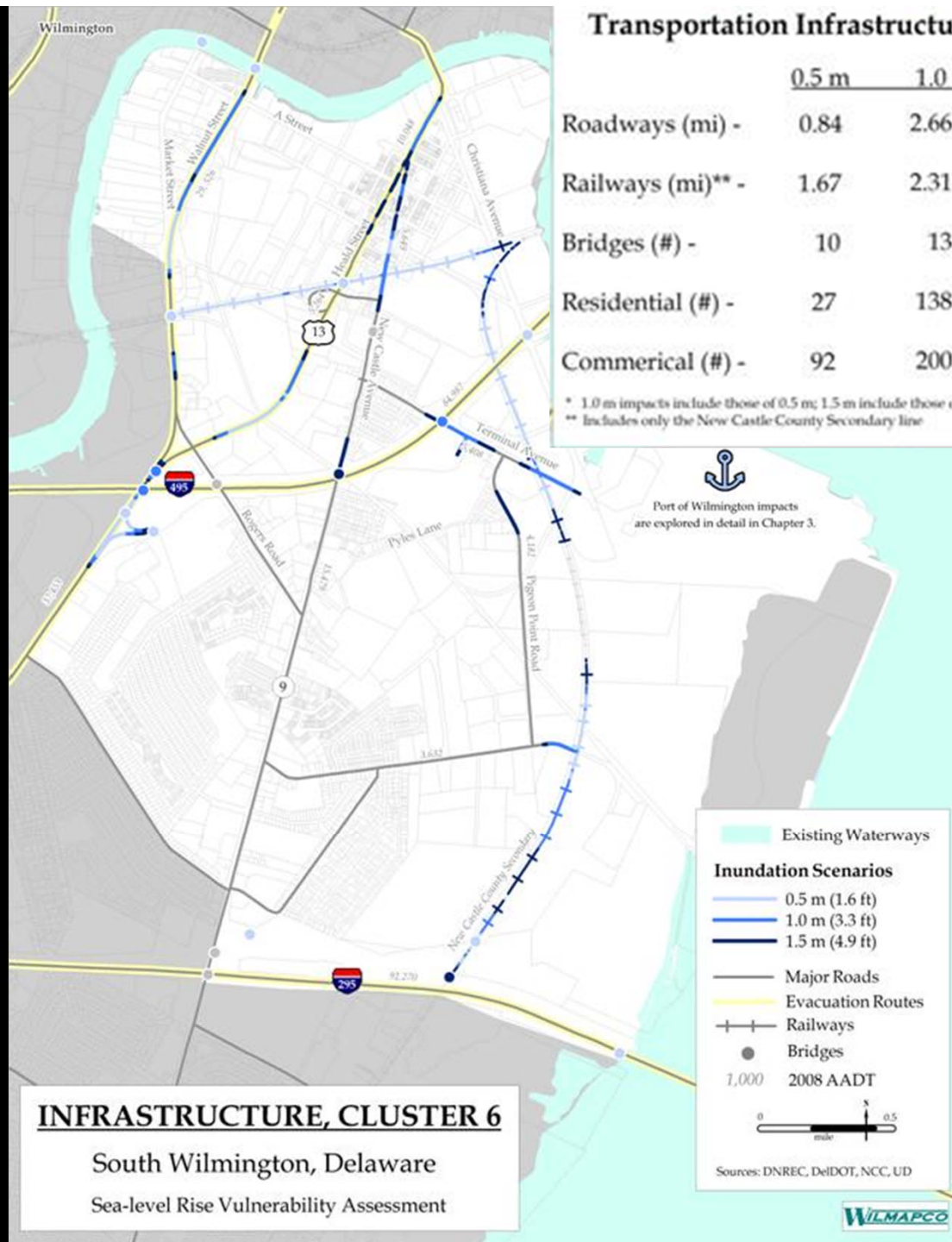
Census block-groups: 6  
Traffic Analysis Zones: 8

Population, 2000: 7,682  
Population, 2005-09: 7,592

Population, 2030 (est.): -1%  
Employment, 2030 (est.): -8%

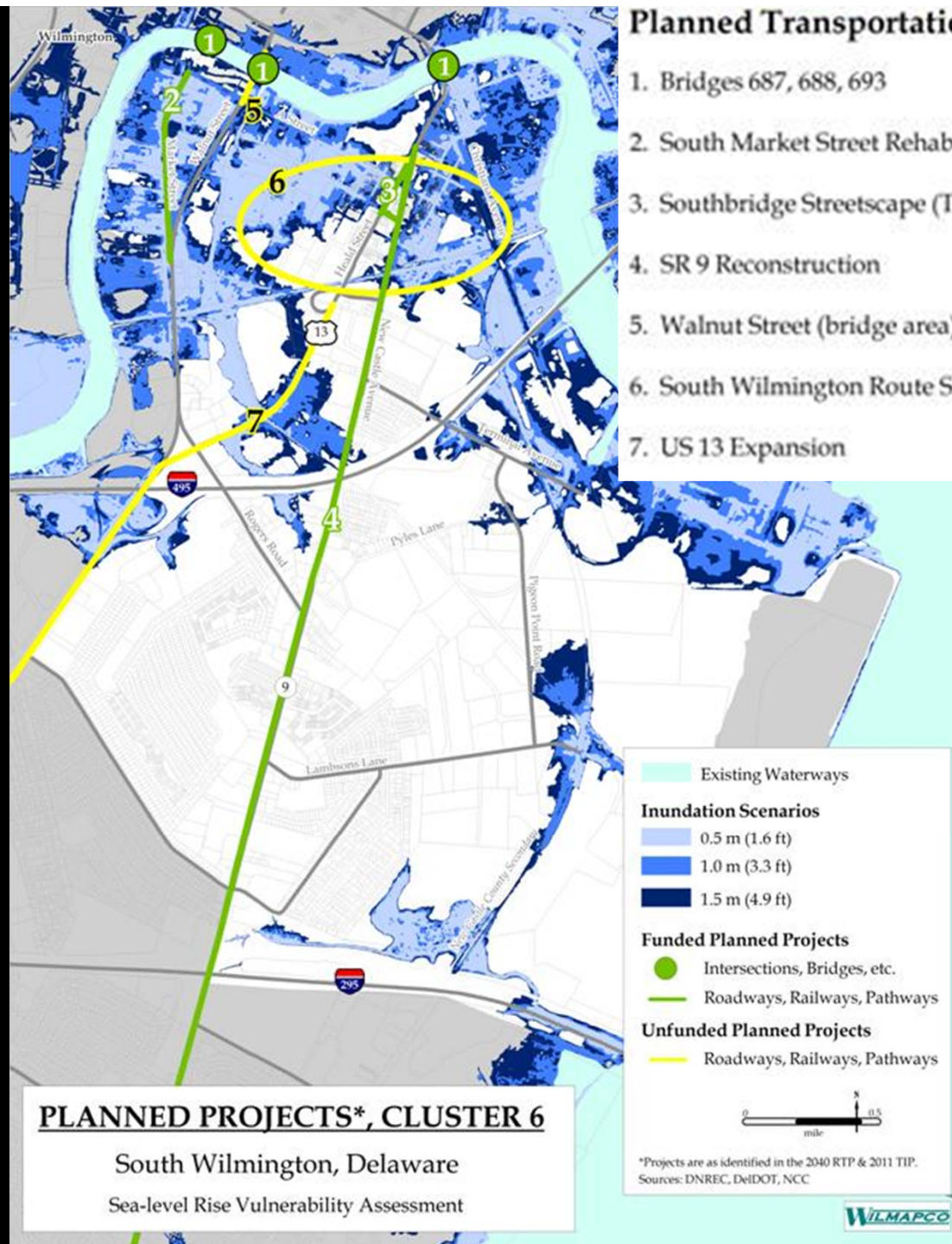
EJ Area: 2 block-groups (Southbridge)  
HH Poverty: 18.4% (range 7.5%-39.1%)





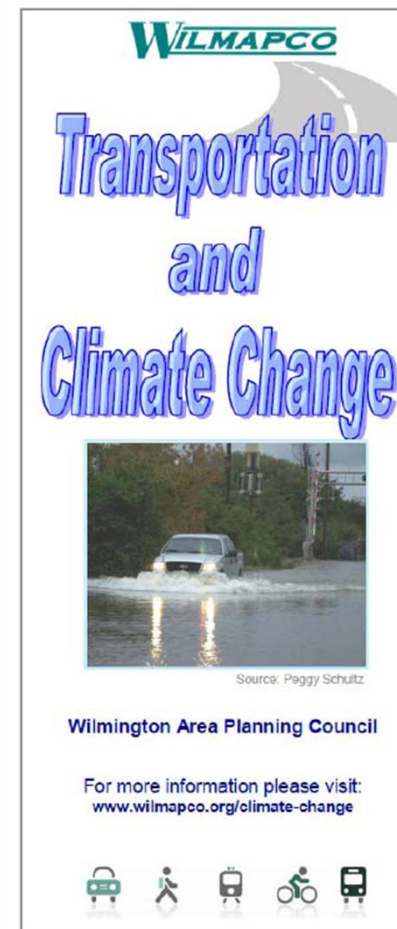
## INFRASTRUCTURE, CLUSTER 6

South Wilmington, Delaware  
 Sea-level Rise Vulnerability Assessment



# Policy Recommendations

- ❑ Incorporate climate change into RTP
- ❑ Measure effectiveness
  - ❑ Climate Change Adaptation Tool for Transportation
- ❑ Monitor planned projects
- ❑ Enhance climate change outreach
- ❑ Support ongoing climate change efforts



# Methodology



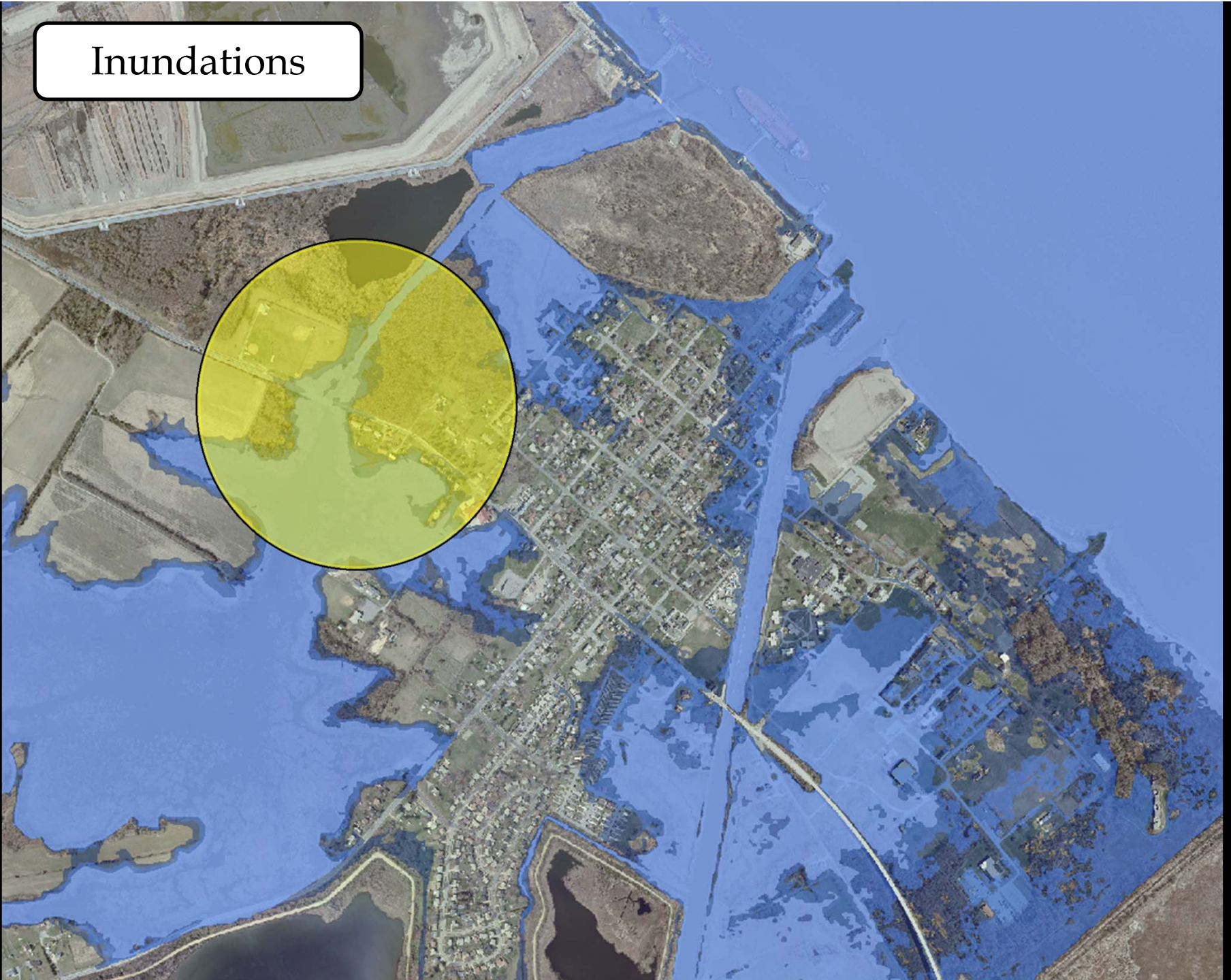
# GIS Analysis

- ❑ Heads-up digitizing and assignment
  - ❑ Roads, rail and bridges
  - ❑ Painstaking, but necessary
- ❑ Automated query-based analysis
  - ❑ Bus stops, commercial/residential units
- ❑ Air photo assessment
  - ❑ Tolling facilities, train stations, marinas, seaport

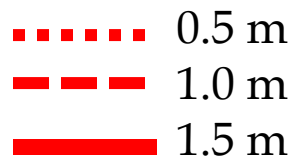
## Current Conditions



# Inundations

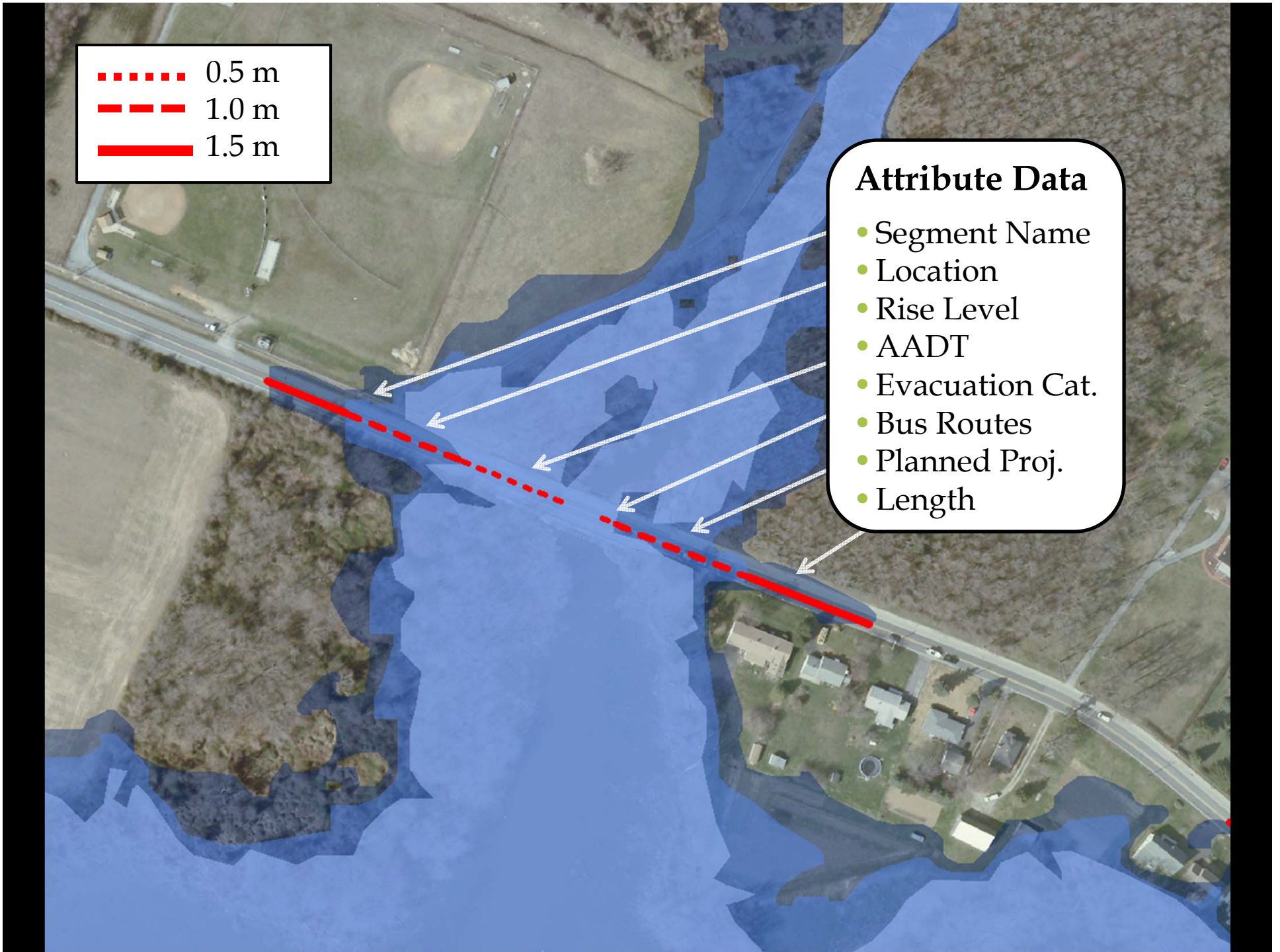


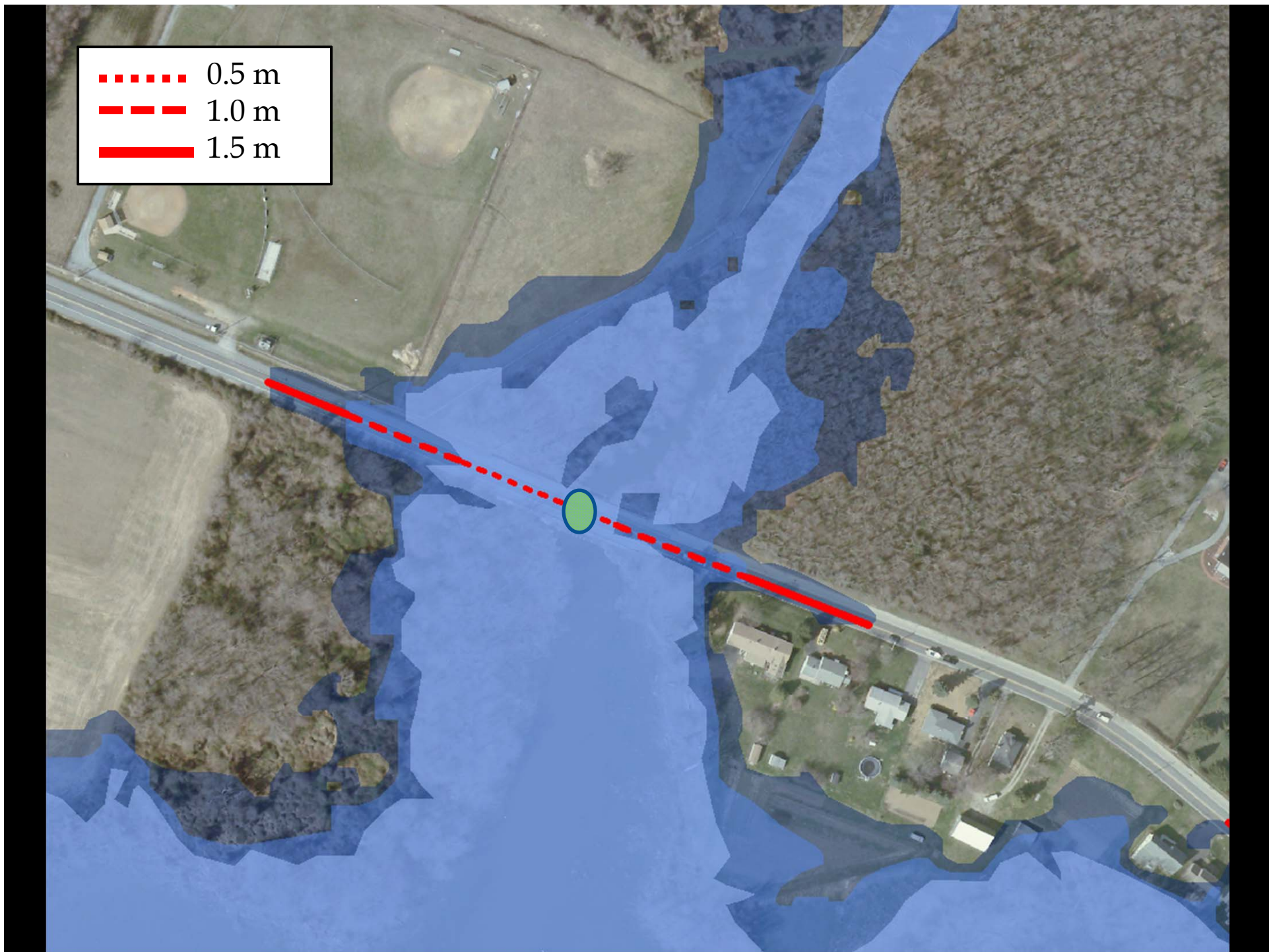




### Attribute Data

- Segment Name
- Location
- Rise Level
- AADT
- Evacuation Cat.
- Bus Routes
- Planned Proj.
- Length





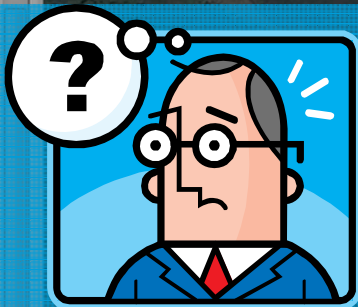


### Attribute Data

- Bridge number
- Year built
- Carried
- Intersection
- Rise
- Evacuation
- Planned Proj.



# Demonstration



[wilmapco.org/slr](http://wilmapco.org/slr)

[bswiatek@wilmapco.org](mailto:bswiatek@wilmapco.org)

[tgraham@wilmapco.org](mailto:tgraham@wilmapco.org)

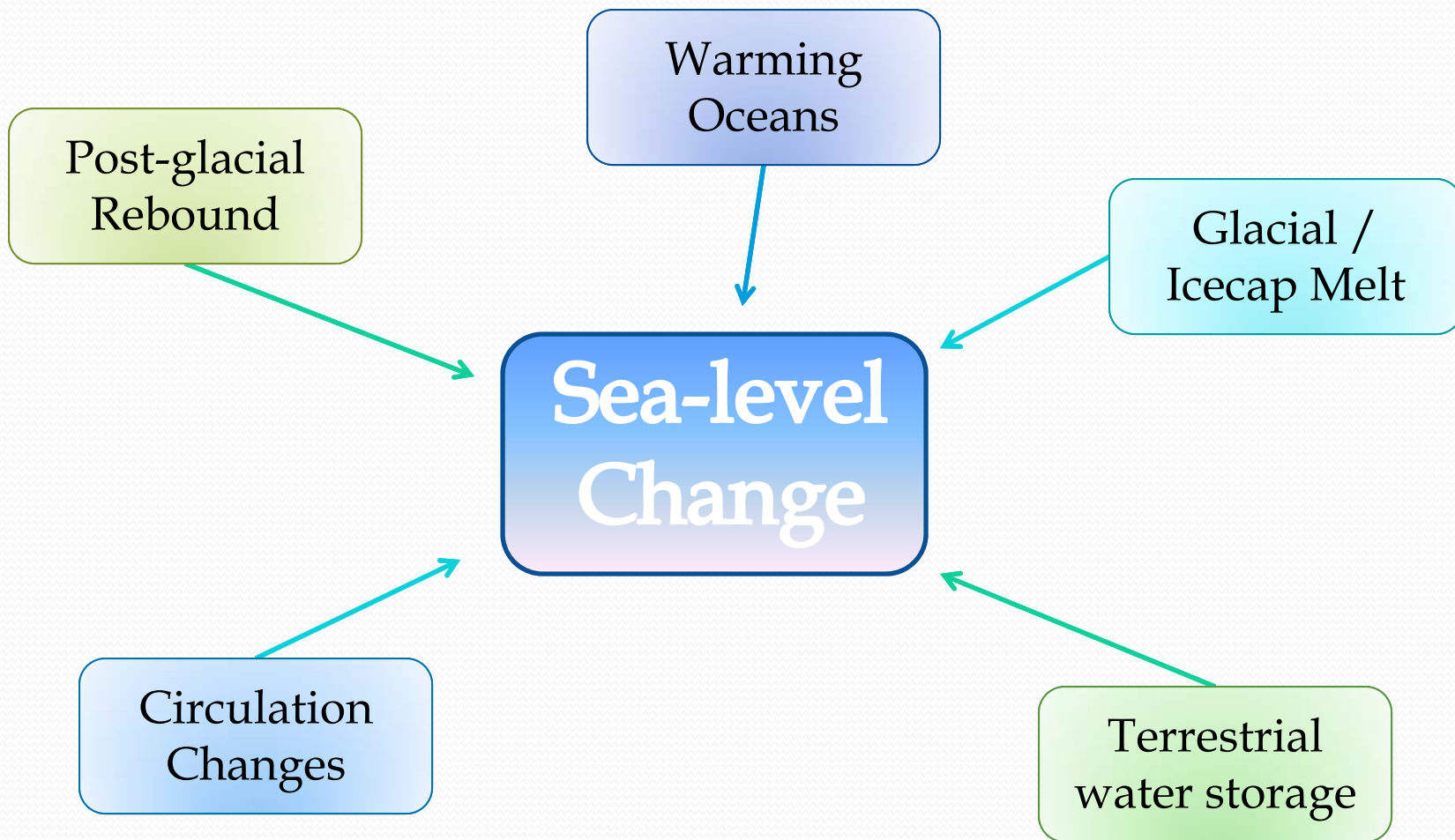
302-737-6205

Updated 1 layer

Zoom: 0.9176 mi

Editing: None

Selecting: None



## SLR Rates (mm/year)



## 20<sup>th</sup> Century SLR

- Global: <2 mm/year
- Mid-Atlantic: 2.4 – 4.4 mm/year

Sources: DNREC &  
MD Commission on Climate Change