Development of a Street-Scale Hydrodynamic Model, Calibration, and Future Flooding Scenarios for the City of Portsmouth: Figures for Comprehensive Plan

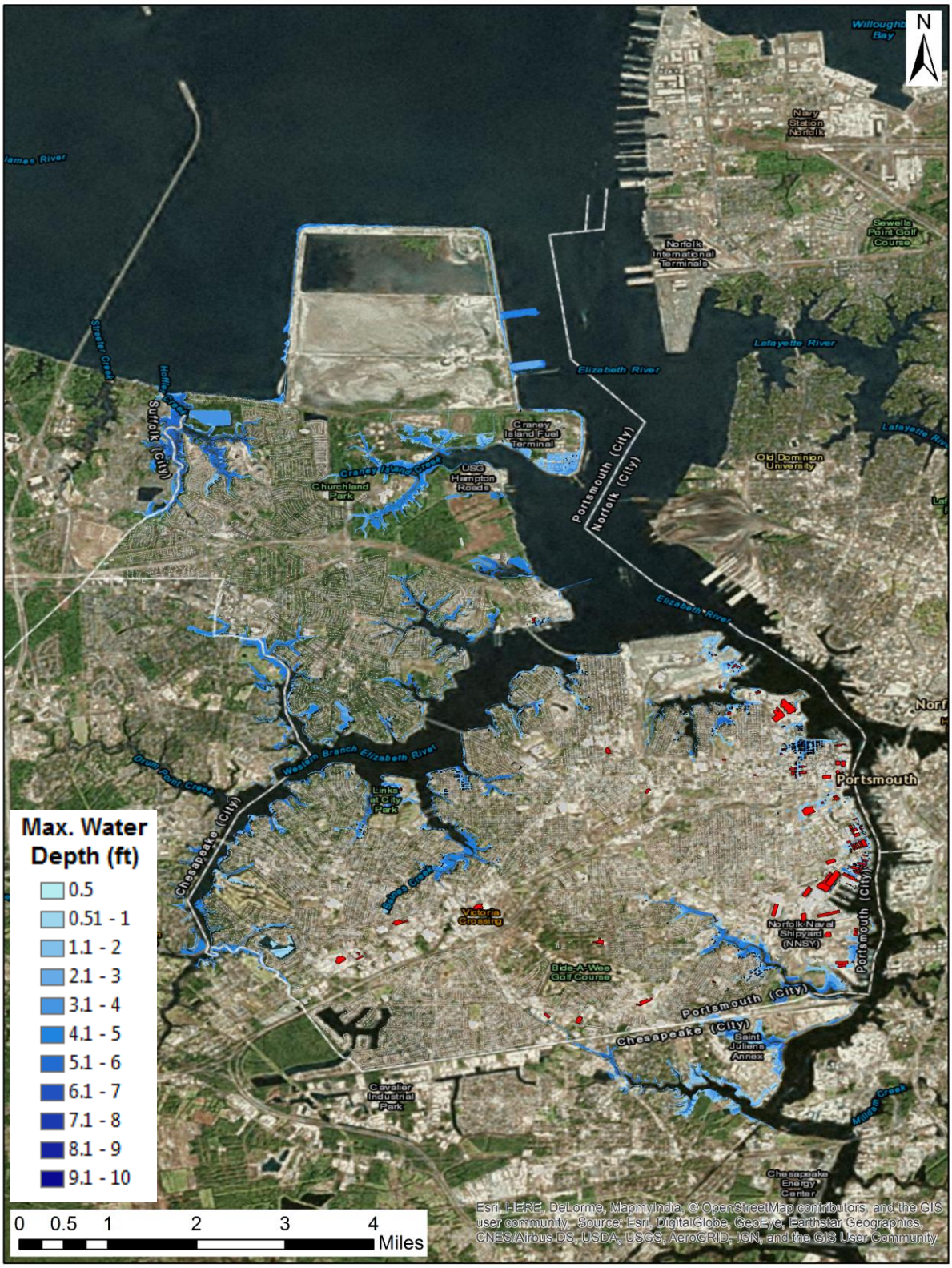

Fig. 1. Scenario 1 2009 Nor'Ida (Extratropical Storm Surge Calibration) City-wide flood map with inundated buildings highlighted in red.

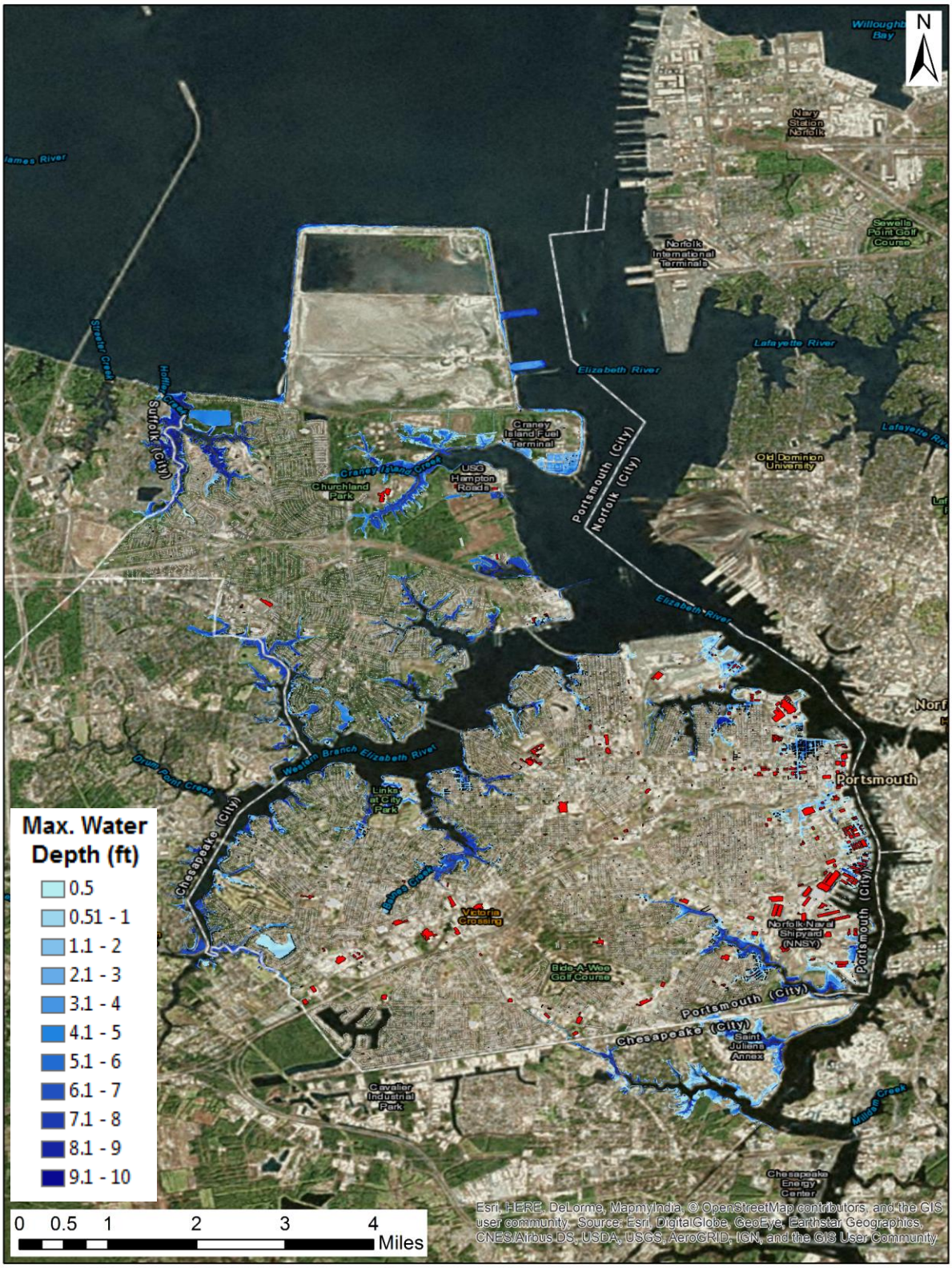

Fig. 2. Scenario 2 2003 Hurricane Isabel (Tropical Storm Surge Calibration) City-wide flood map with inundated buildings highlighted in red.

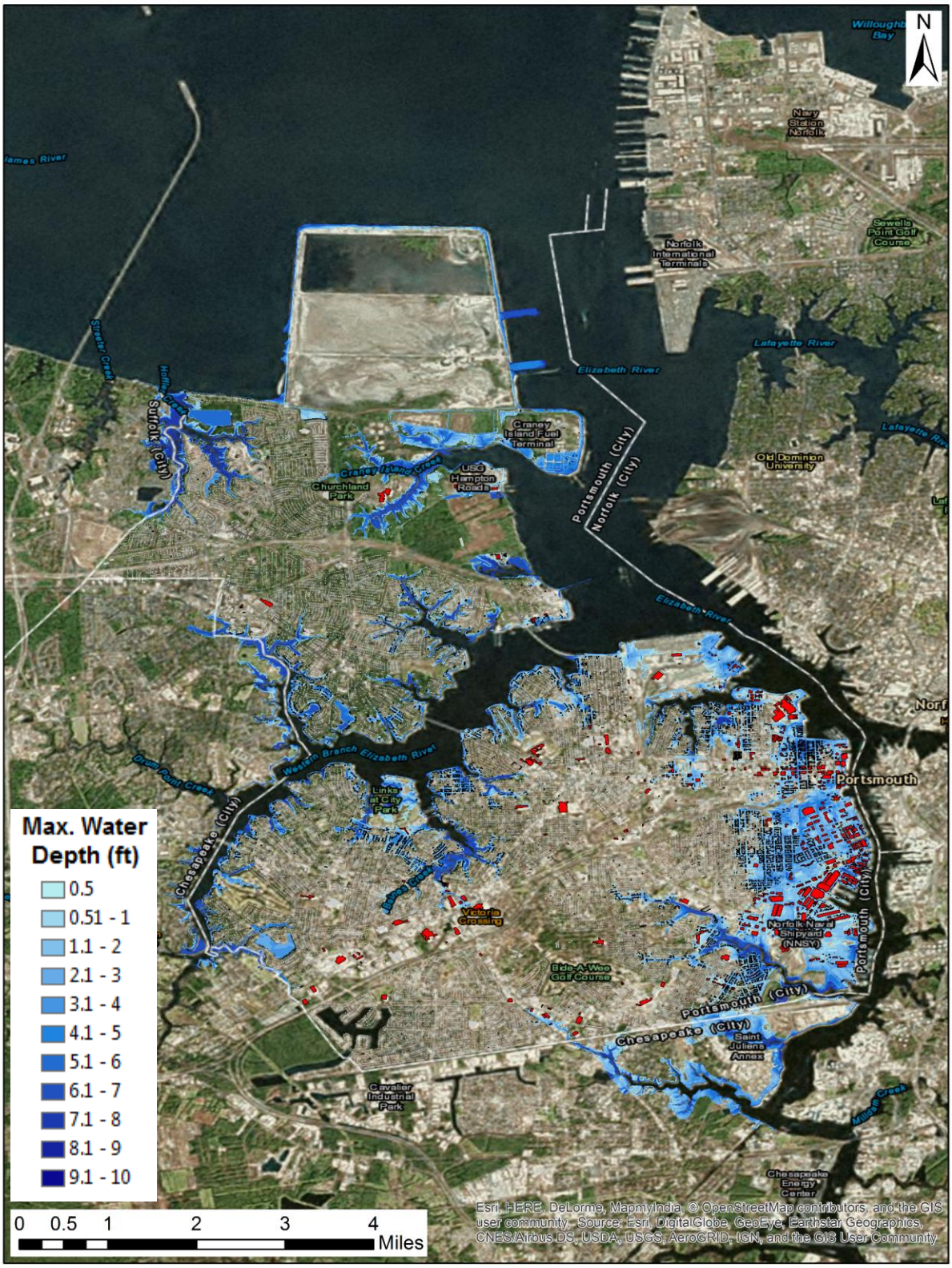

Fig. 3. Scenario 3 2003 Hurricane Isabel in Portsmouth 2040 (+1.9 ft) IPCC Highest Projected Sea Level Rise-- City-wide flood map with inundated buildings highlighted in red.

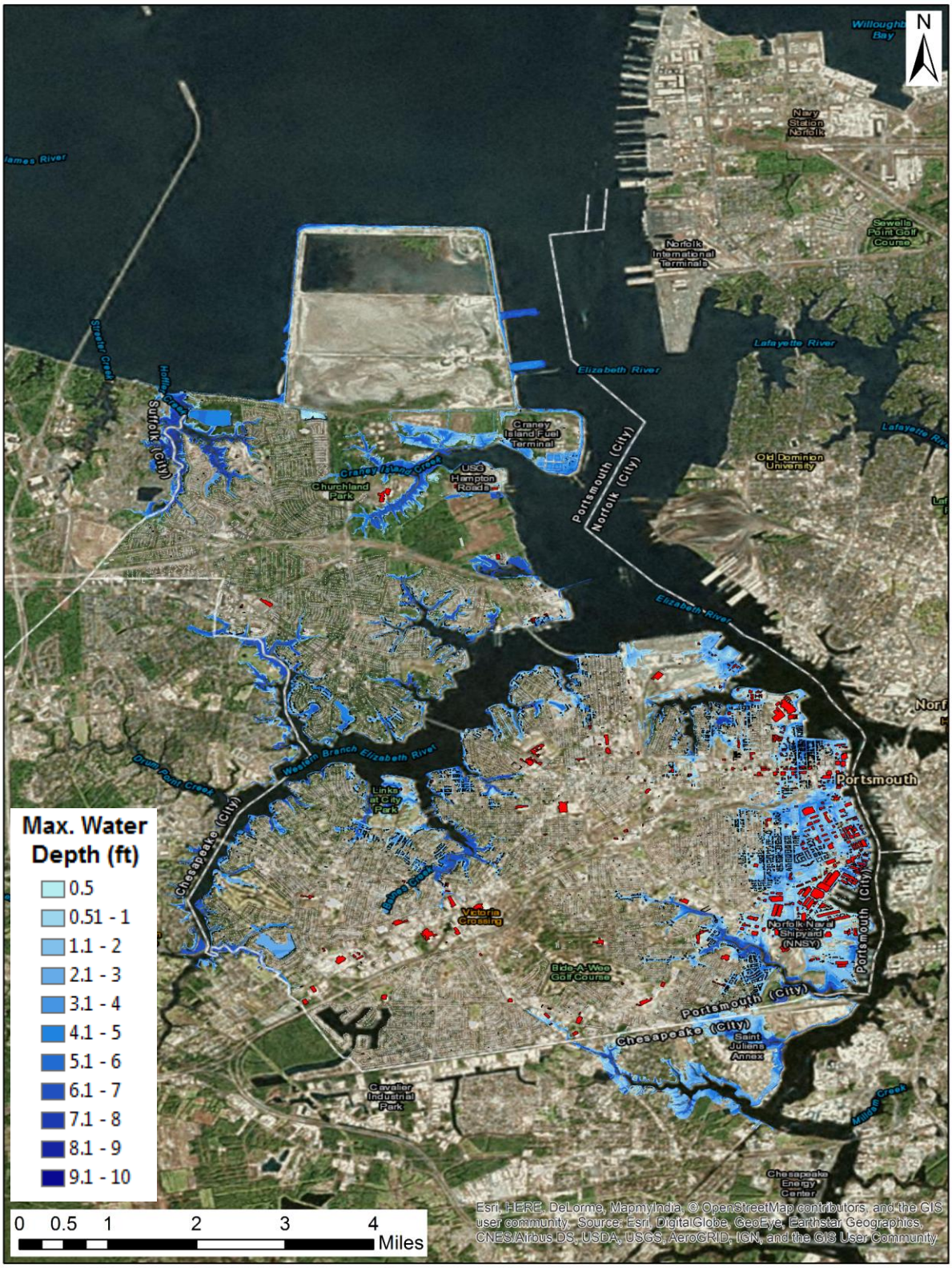

Fig. 4. Scenario 4 2003 Hurricane Isabel in Portsmouth 2040 (+1.5 ft) IPCC High Projected Sea Level Rise-- City-wide flood map with inundated buildings highlighted in red.

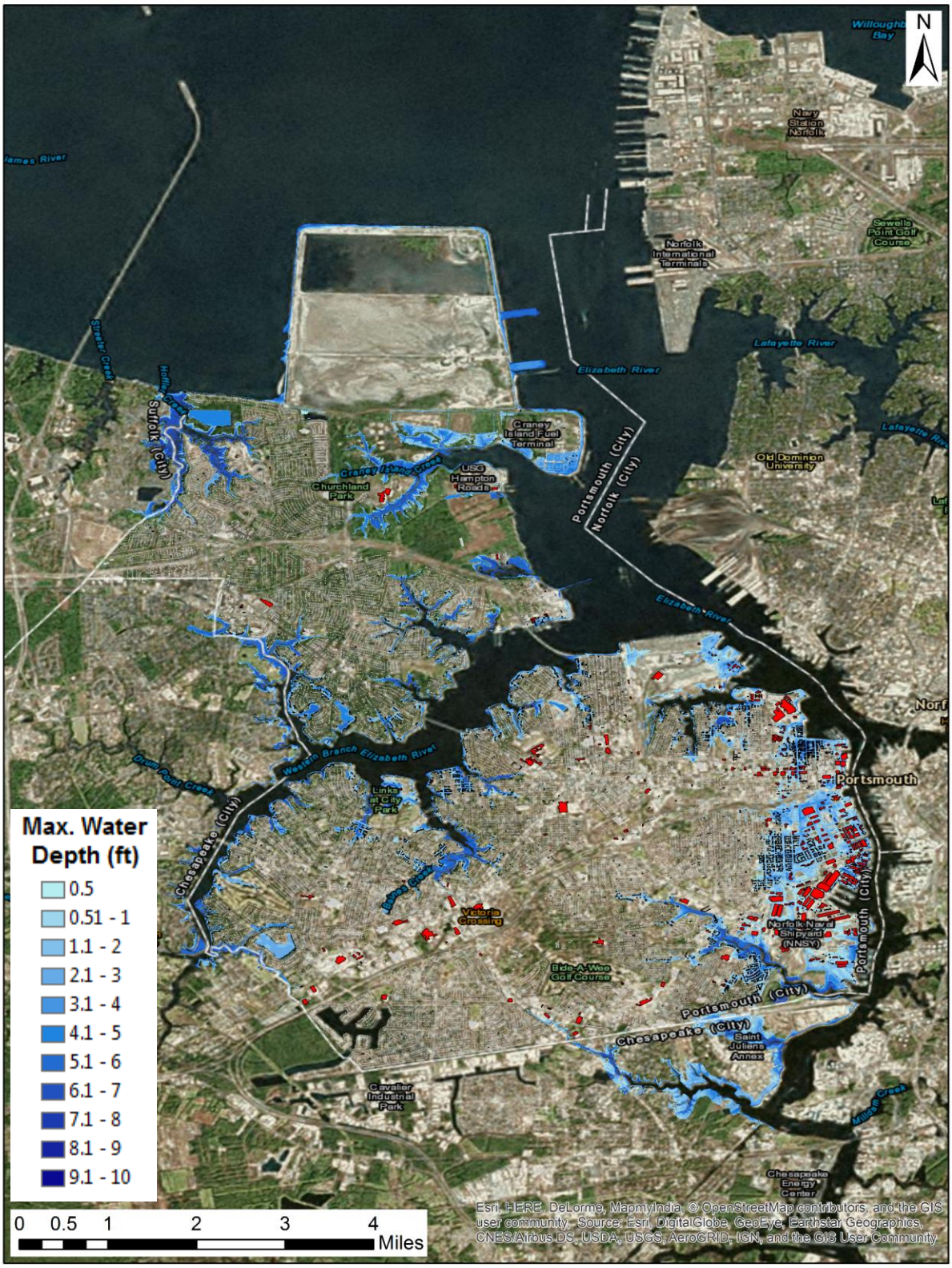

Fig. 5. Scenario 4 2003 Hurricane Isabel in Portsmouth 2040 (+1.0 ft) IPCC Low Projected Sea Level Rise-- City-wide flood map with inundated buildings highlighted in red.

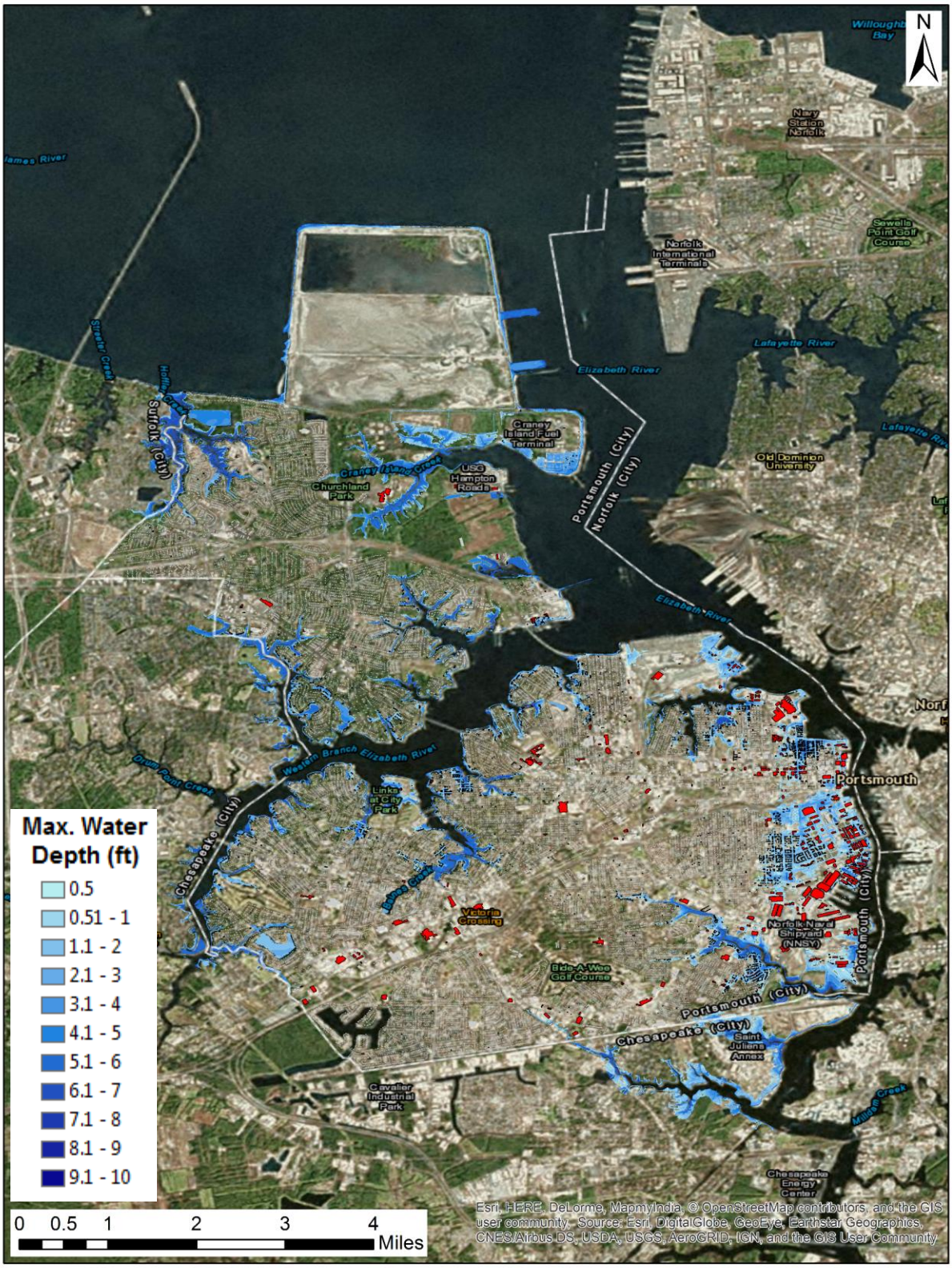

Fig. 6. Scenario 6 2003 Hurricane Isabel in Portsmouth 2040 (+0.7 ft) Historic Trend from Sewells Point-- City-wide flood map with inundated buildings highlighted in red.

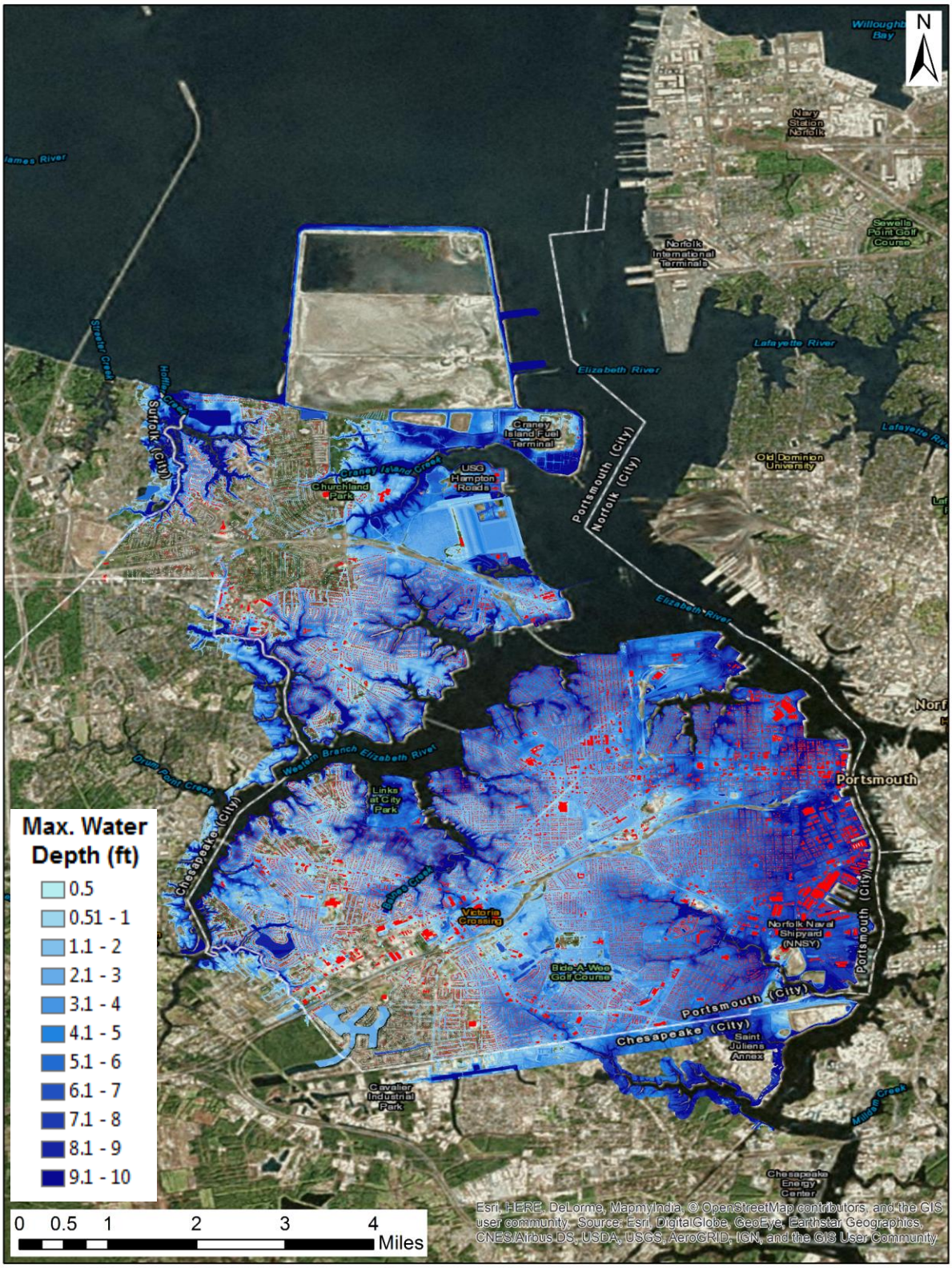

Fig. 7. Scenario 7 2003 Hurricane Isabel in Portsmouth 2100 (+7.5 ft) IPCC Highest Projected Sea Level Rise-- City-wide flood map with inundated buildings highlighted in red.

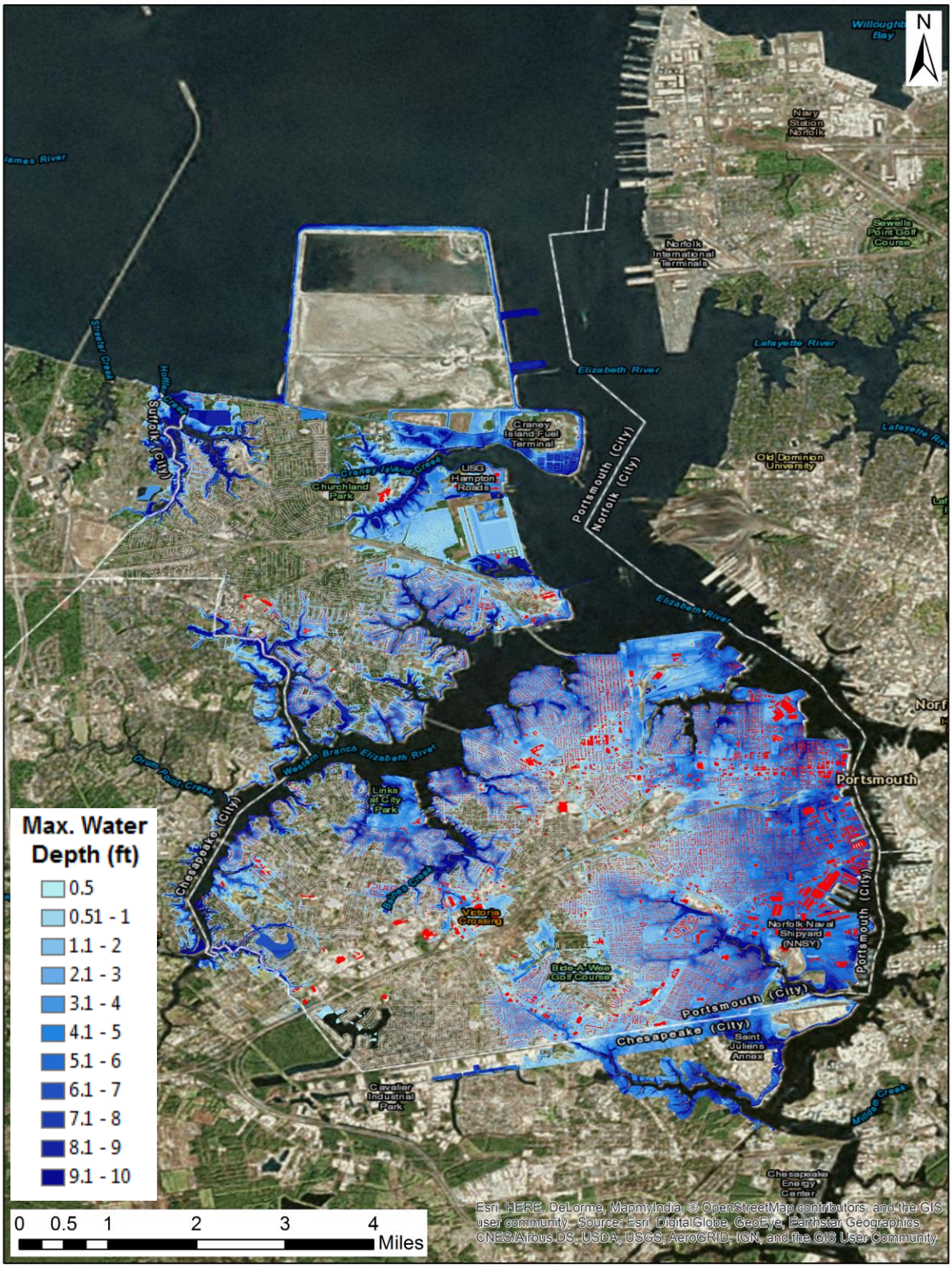

Fig. 8. Scenario 8 2003 Hurricane Isabel in Portsmouth 2100 (+5.5 ft) IPCC High Projected Sea Level Rise -- City-wide flood map with inundated buildings highlighted in red.

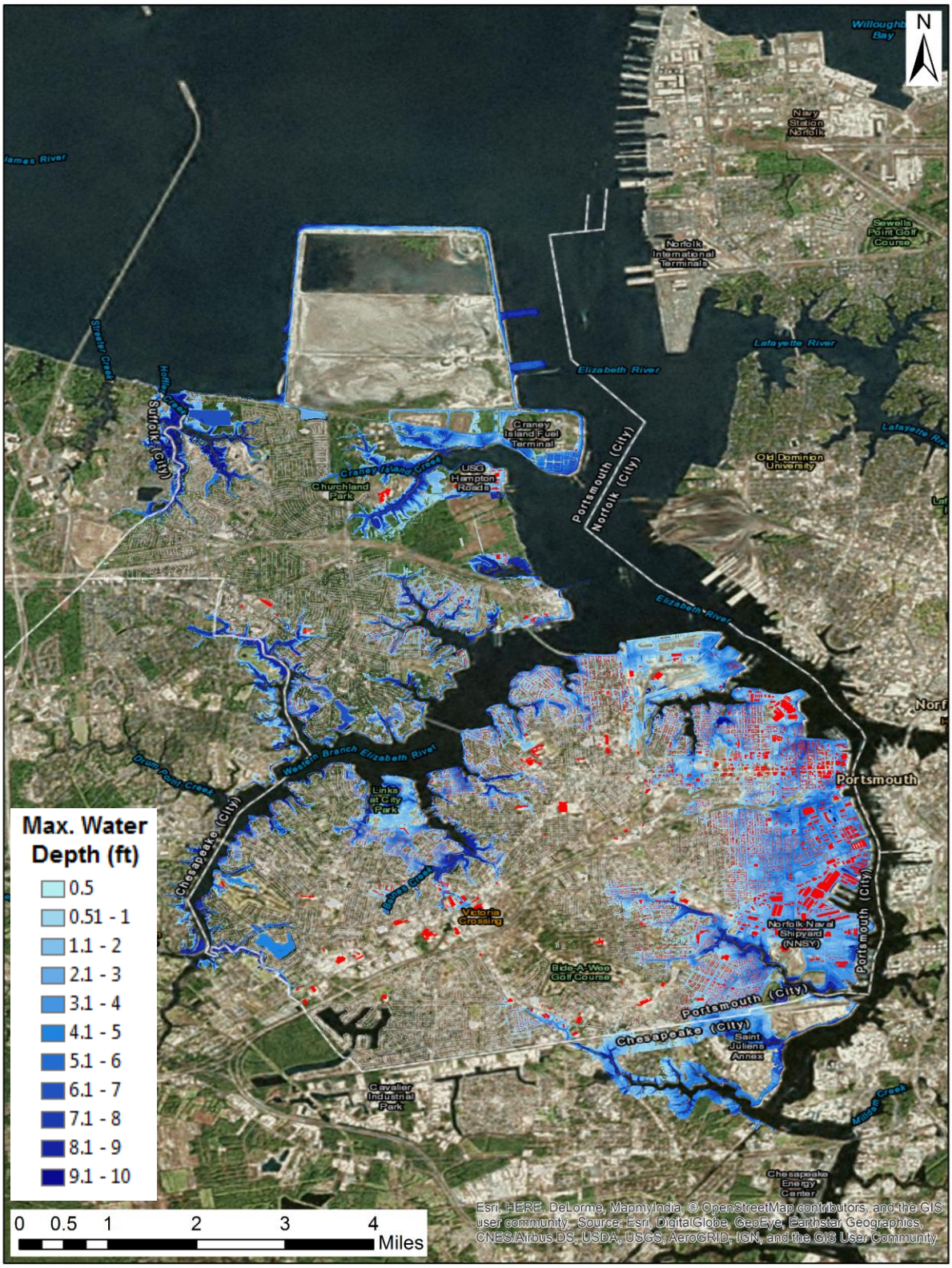

Fig. 9. Scenario 9 2003 Hurricane Isabel in Portsmouth 2100 (+3.3 ft) IPCC Low Projected Sea Level Rise-- City-wide flood map with inundated buildings highlighted in red.

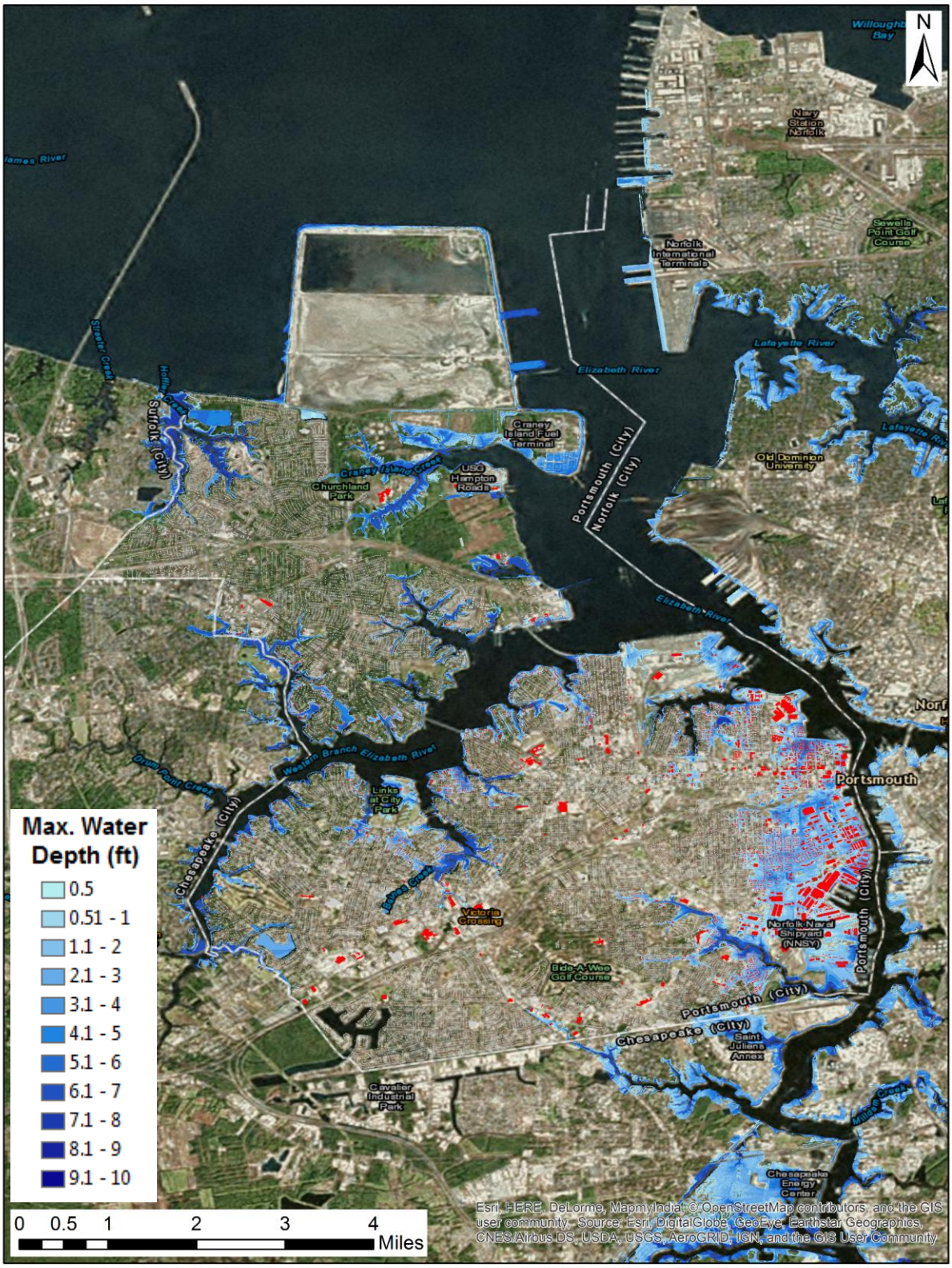

Fig. 10. Scenario 10 2003 Hurricane Isabel in Portsmouth 2100 (+1.6 ft) Historic Trend from Sewells Point-- City-wide flood map with inundated buildings highlighted in red.

Development of a Street-Scale Hydrodynamic Model, Calibration, and Future Flooding Scenarios for the City of Portsmouth: Figures for Comprehensive Plan

Scenario Comparisons:

Base Case for Hurricane Isabel vs. 4 2040 Scenarios:

1. S2. 2003 Hurricane Isabel (Tropical Storm Surge Calibration) Original Storm
2. S6. 2003 Hurricane Isabel in Portsmouth 2040 (+0.7 ft) Historic Trend from Sewells Point
3. S5. 2003 Hurricane Isabel in Portsmouth 2040 (+1.0 ft) IPCC Low Projected Sea Level Rise
4. S4. 2003 Hurricane Isabel in Portsmouth 2040 (+1.5 ft) IPCC High Projected Sea Level Rise
5. S3. 2003 Hurricane Isabel in Portsmouth 2040 (+1.9 ft) IPCC Highest Projected Sea Level Rise

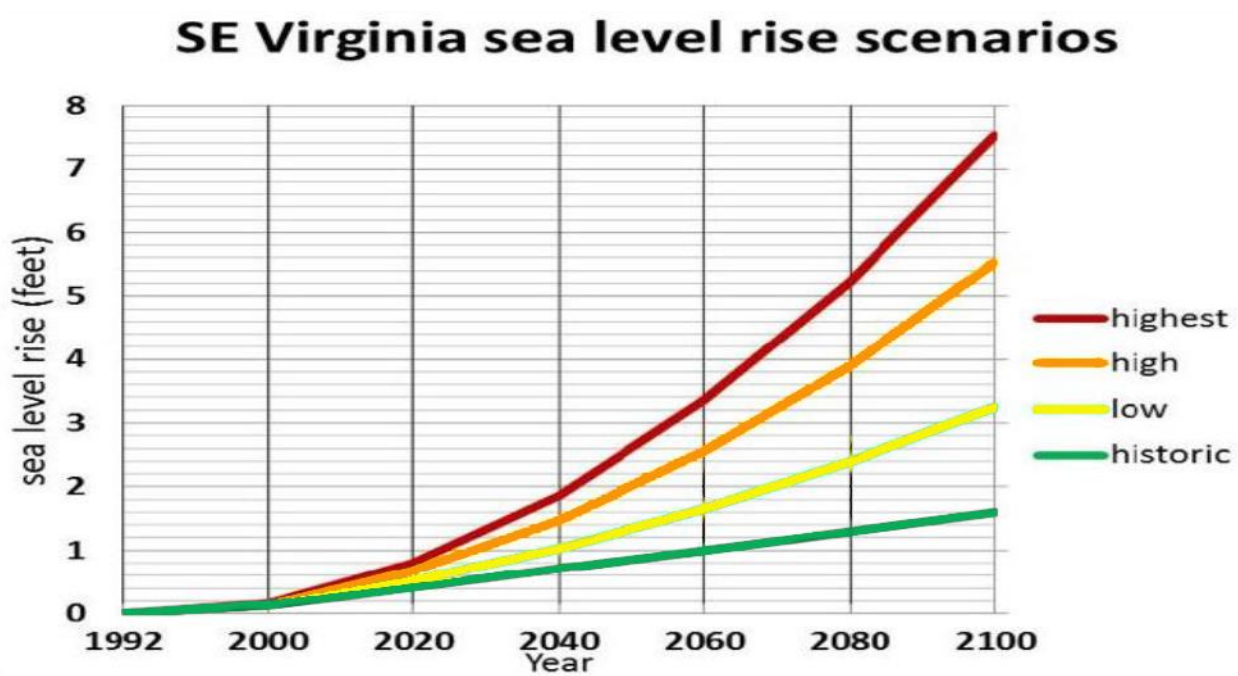

Fig. 11. Sea Level Rise Planning Figure from VIMS Recurrent Flooding Study for Tidewater Virginia (SJR 76, 2012).

Highlighted buildings and flood layers in the next few figures are color-coded using the key above and represent the lowest water level scenario wherein those areas or structures are inundated. For example:

- Red highlighted structures are only predicted to be inundated by an Isabel-like storm in 2040 if SLR trends hold to the highest projected rate.
- Orange highlighted structures could be inundated by an Isabel-like storm in 2040 if SLR trends hold to the high or highest projected rate.
- Yellow highlighted structures could be inundated by an Isabel-like storm in 2040 if SLR trends hold to the low, high, or highest projected rate.
- Green highlighted structures could be inundated by an Isabel-like storm in 2040 if SLR trends hold to the historic, low, high, or highest projected rate.
- Blue highlighted structures likely flooded during Hurricane Isabel, and are at the greatest risk of flooding now, or anytime in the future by an Isabel-like storm in 2040 if SLR trends hold true.

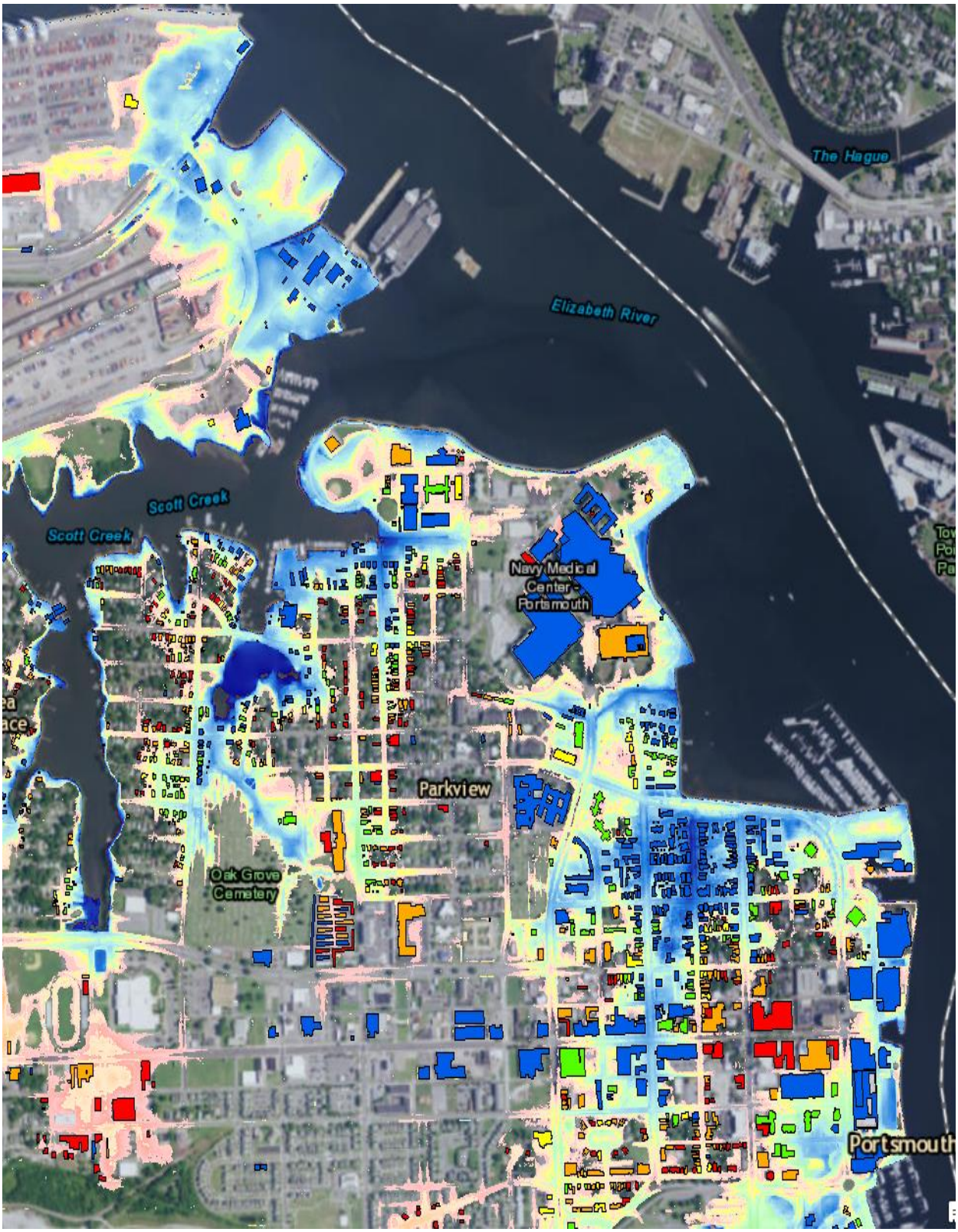

Fig. 12. Sea level rise planning scenario comparisons for the Hurricane Isabel Base Case vs. 4 2040 Scenarios in Parkview and Old Towne Portsmouth along the Elizabeth River.

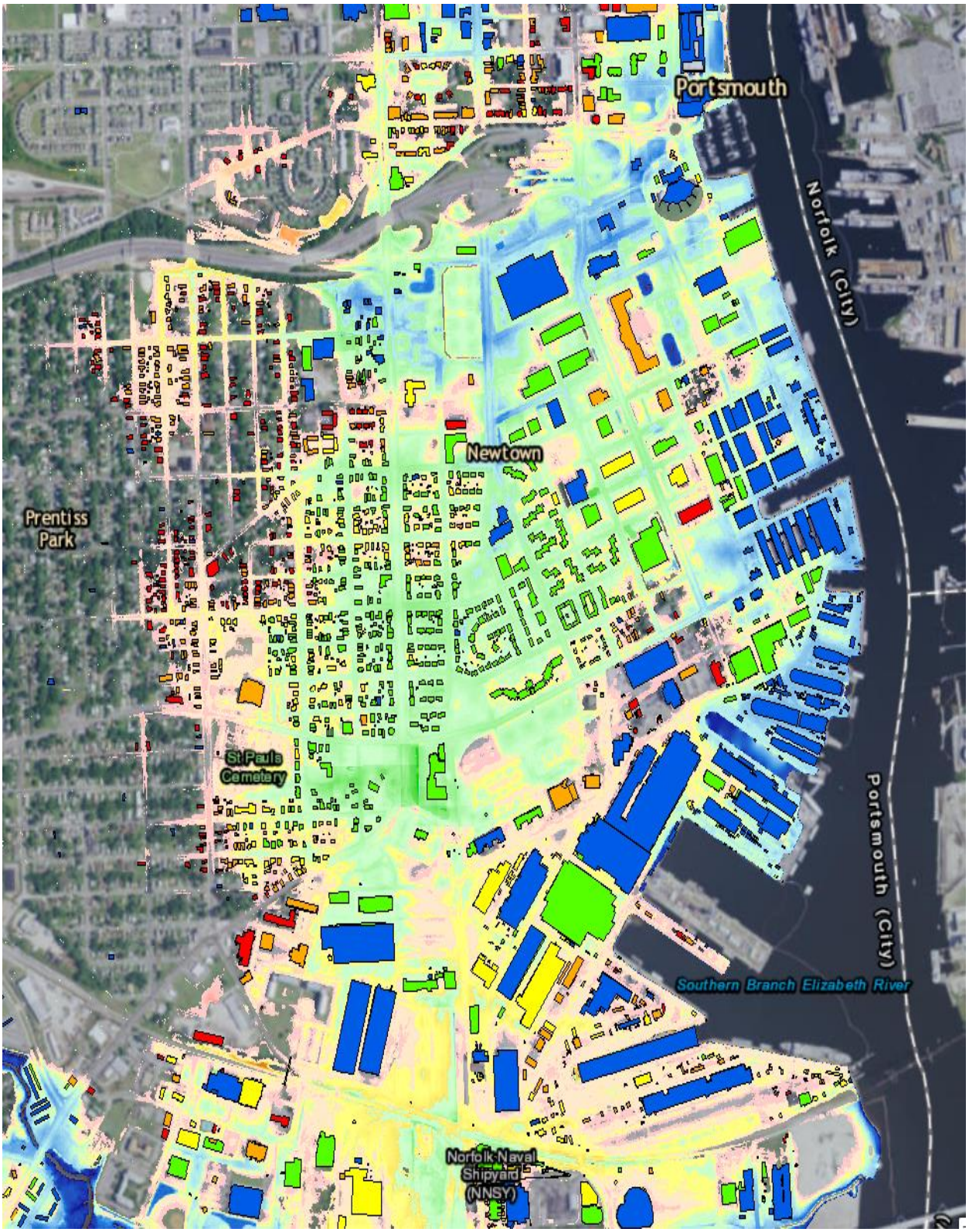

Fig. 13. Sea level rise planning scenario comparisons for the Hurricane Isabel Base Case vs. 4 2040 Scenarios in Prentice Park and Newtown Portsmouth along the Elizabeth River.

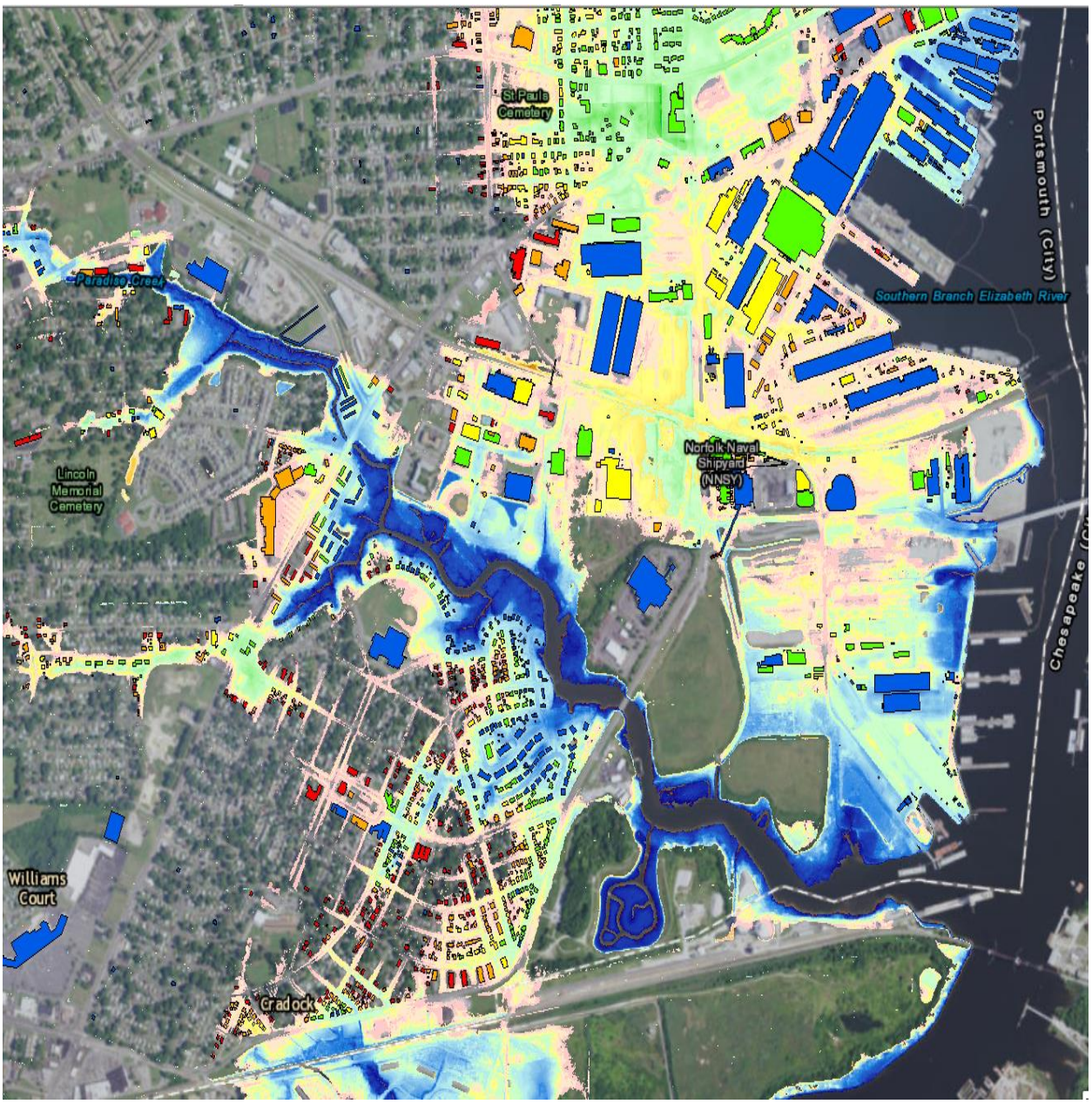

Fig. 14. Sea level rise planning scenario comparisons for the Hurricane Isabel Base Case vs. 4 2040 Scenarios at the Norfolk Naval Skip Yard along the Elizabeth River.

Development of a Street-Scale Hydrodynamic Model, Calibration, and Future Flooding Scenarios for the City of Portsmouth: Figures for Comprehensive Plan

Cited Research:

Loftis, J.D., Wang, H.V., Hamilton, S.E., and Forrest, D.R. (2017). Combination of Lidar Elevations, Bathymetric Data, and Urban Infrastructure in a Sub-Grid Model for Predicting Inundation in New York City during Hurricane Sandy. *Computers, Environment, and Urban Systems.* (*In Revision*). Preprint PDF

Loftis, J.D., Wang, H.V., DeYoung, R.J., and Ball, W.B. (2016). Using Lidar Elevation Data to Develop a Topobathymetric Digital Elevation Model for Sub-Grid Inundation Modeling at Langley Research Center, *In*: Brock, J.C.; Gesch, D.B.; Parrish, C.E.; Rogers, J.N., and Wright, C.W. (eds.), Advances in Topobathymetric Mapping, Models, and Applications. *Journal of Coastal Research*, Special Issue 76, 134-148. Coconut Creek (Florida), ISSN 0749-0208. PDF

Loftis, J.D. (2014). Development of a Large-Scale Storm Surge and High-Resolution Sub-Grid Inundation Model for Coastal Flooding Applications: A Case Study During Hurricane Sandy. Ph.D. Dissertation. *College of William & Mary*. PDF

Loftis, J.D., Wang, H., and DeYoung, R. (2013). Storm Surge and Inundation Modeling in the Back River Watershed for NASA Langley Research Center. *NASA Technical Report*: NASA/TM-2013-218046. PDF

Wang, H., Loftis, J.D., Forrest, D., Smith, W., and Stamey, B. (2015). Modeling Storm Surge and inundation in Washington, D.C., during Hurricane Irene and the 1936 Potomac River Great Flood. *Journal of Marine Science and Engineering*, *3*(3), 607-629. PDF

Wang, H., Loftis, J.D., Liu, Z., Forrest, D., and Zhang, J. (2014). Storm Surge and Sub-Grid Inundation Modeling in New York City during Hurricane Sandy. *Journal of Marine Science and Engineering,* 2(1), 226-246. PDF