Flash Flood Potential Index for WFO Mount Holly/Philadelphia

Ray Kruzdlo
NOAA/National Weather Service
Mount Holly, NJ
Raymond.Kruzdlo@noaa.gov

Joseph Ceru
NOAA/National Weather Service
Pueblo, CO
Joe.Ceru@noaa.gov

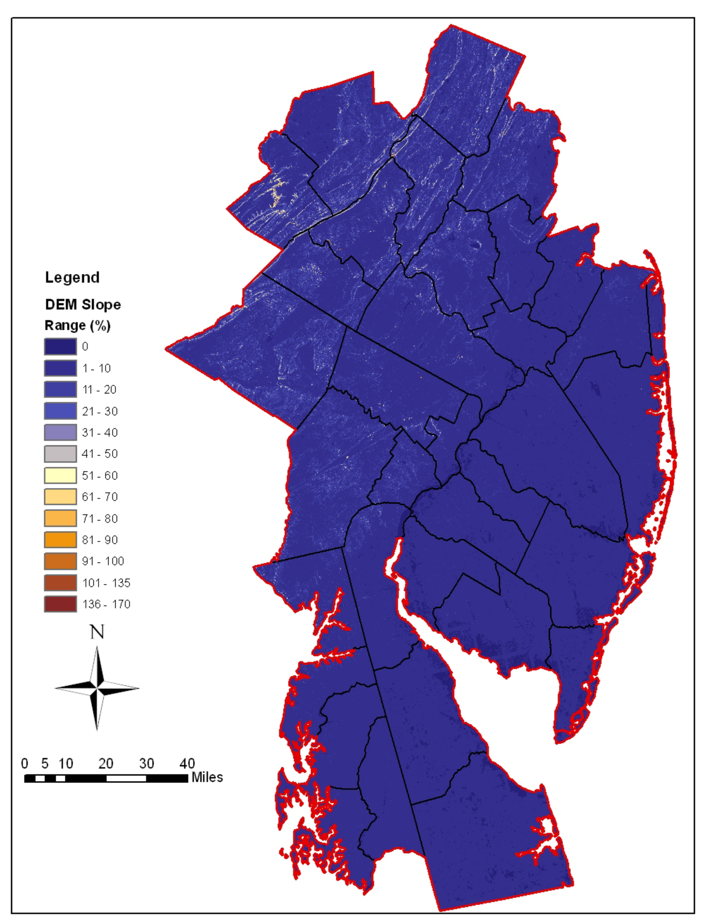
Introduction

The Flash Flood Potential Index (FFPI) incorporates physiographic characteristics of an individual drainage basin to determine its hydrologic response. In flash flood situations, the hydrologic response is influenced by many factors, including (1) soil type, (2) terrain slope, (3) vegetation and forest canopy, and (4) land use, especially urbanization.

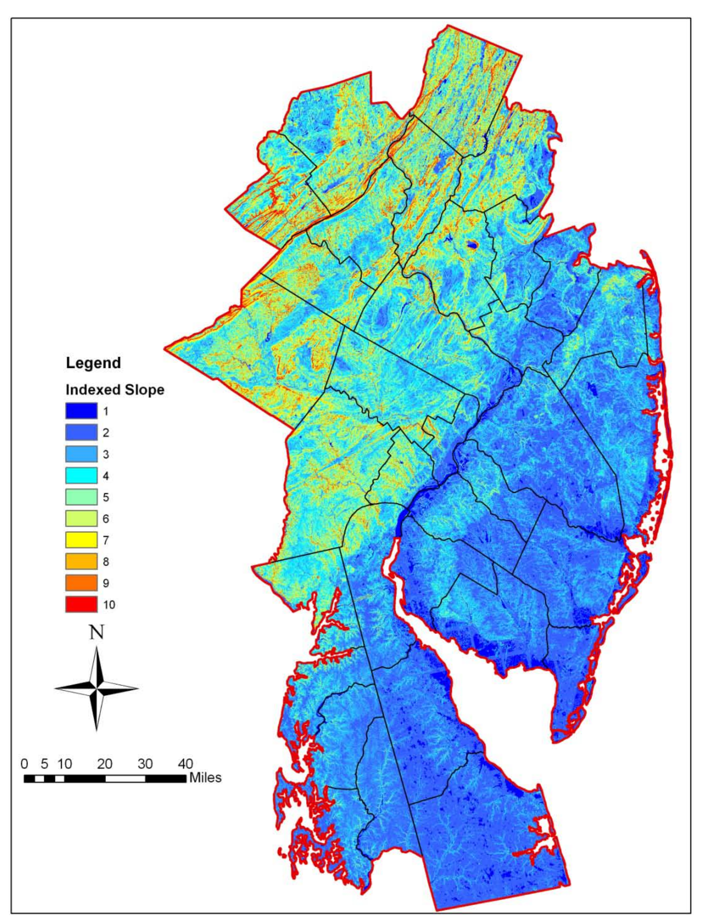
An FFPI is developed by obtaining high resolution maps of these characteristics as raster datasets over the domain of interest, then using GIS technology to resample, reclassify and combine the data. The result is a quasi-static numerical index of flash flood potential specific to a geographic area.

Specifically, this study assesses the roles of soil type, slope, forest canopy, and urbanization across the National Weather Service, Mount Holly, NJ, Hydrologic Service Area (HSA).

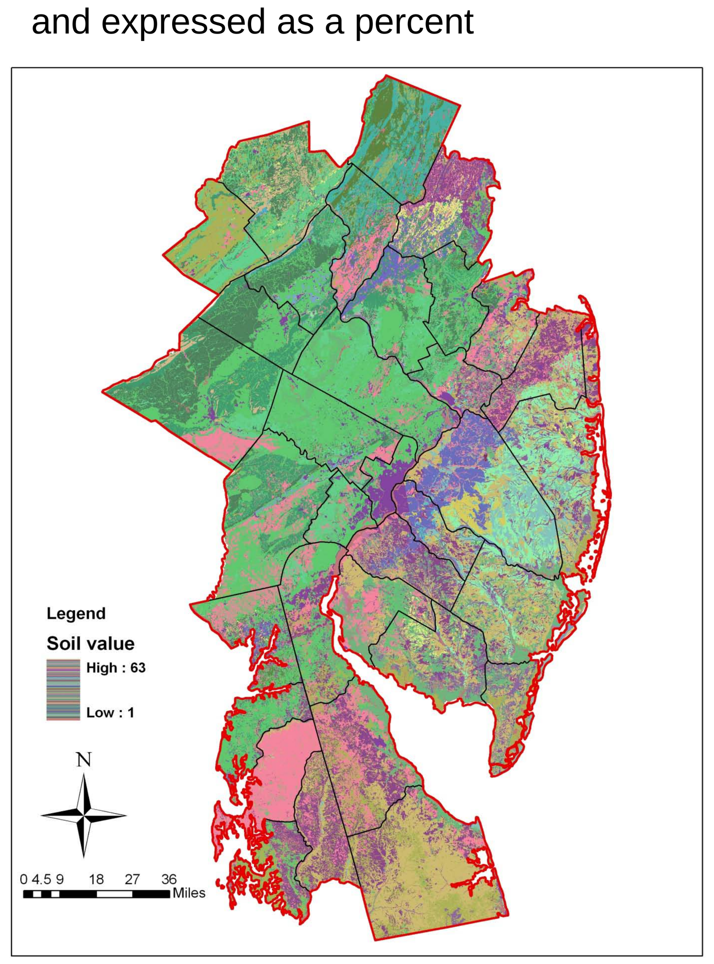
Data



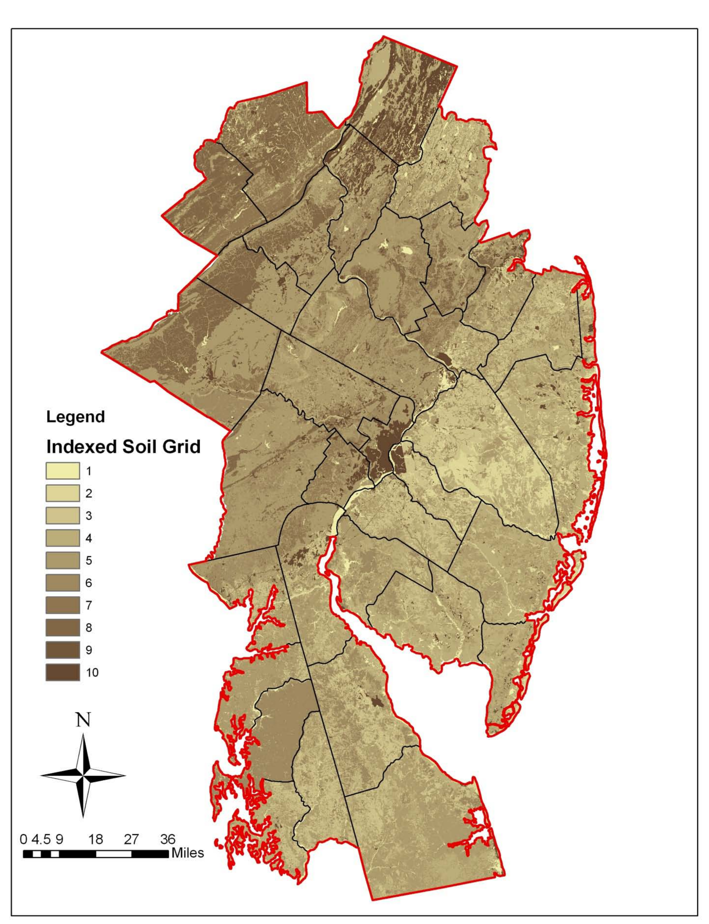
DEM Slope Grid - Derived from the USGS Digital Elevation Model (DEM) and expressed as a percent



Indexed Slope Grid – Reveals the steeper slopes that will yield more runoff.



Soil Type Grid – Derived from the NRCS STATSGO dataset.

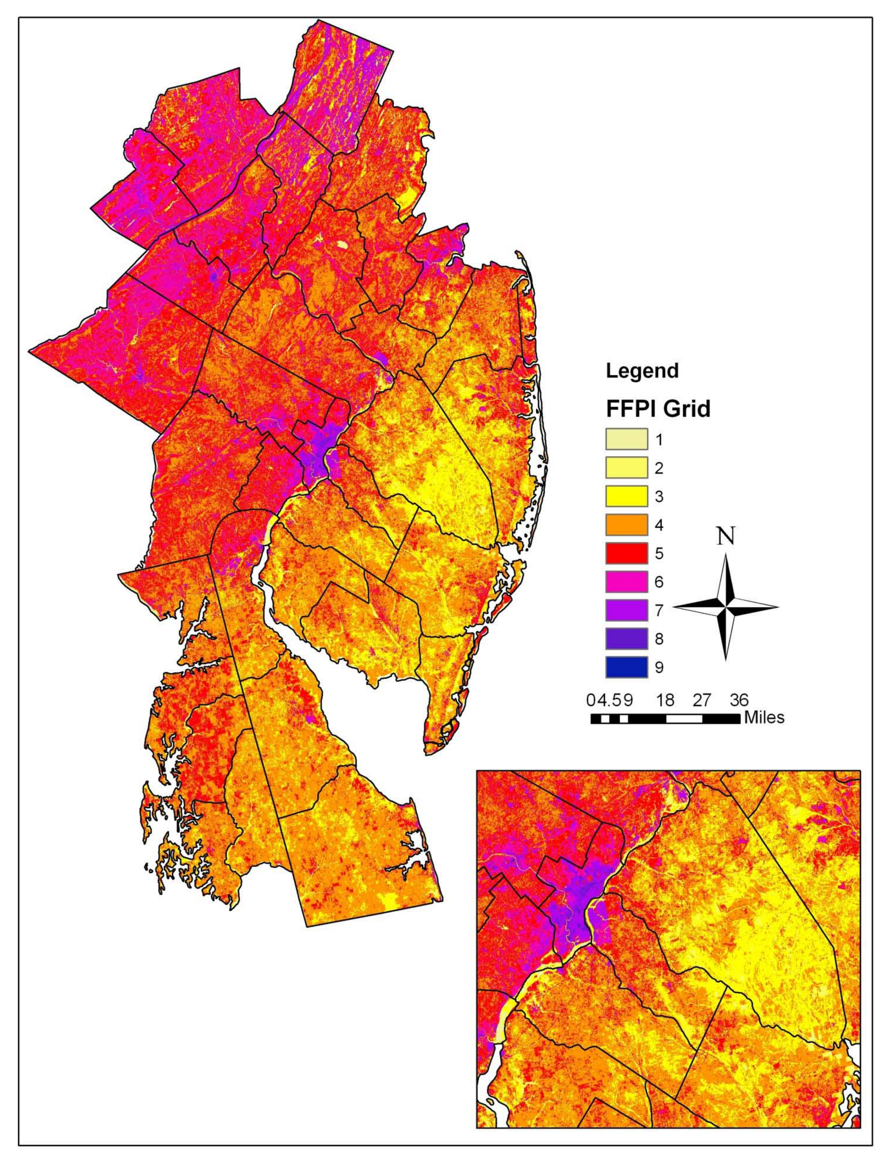


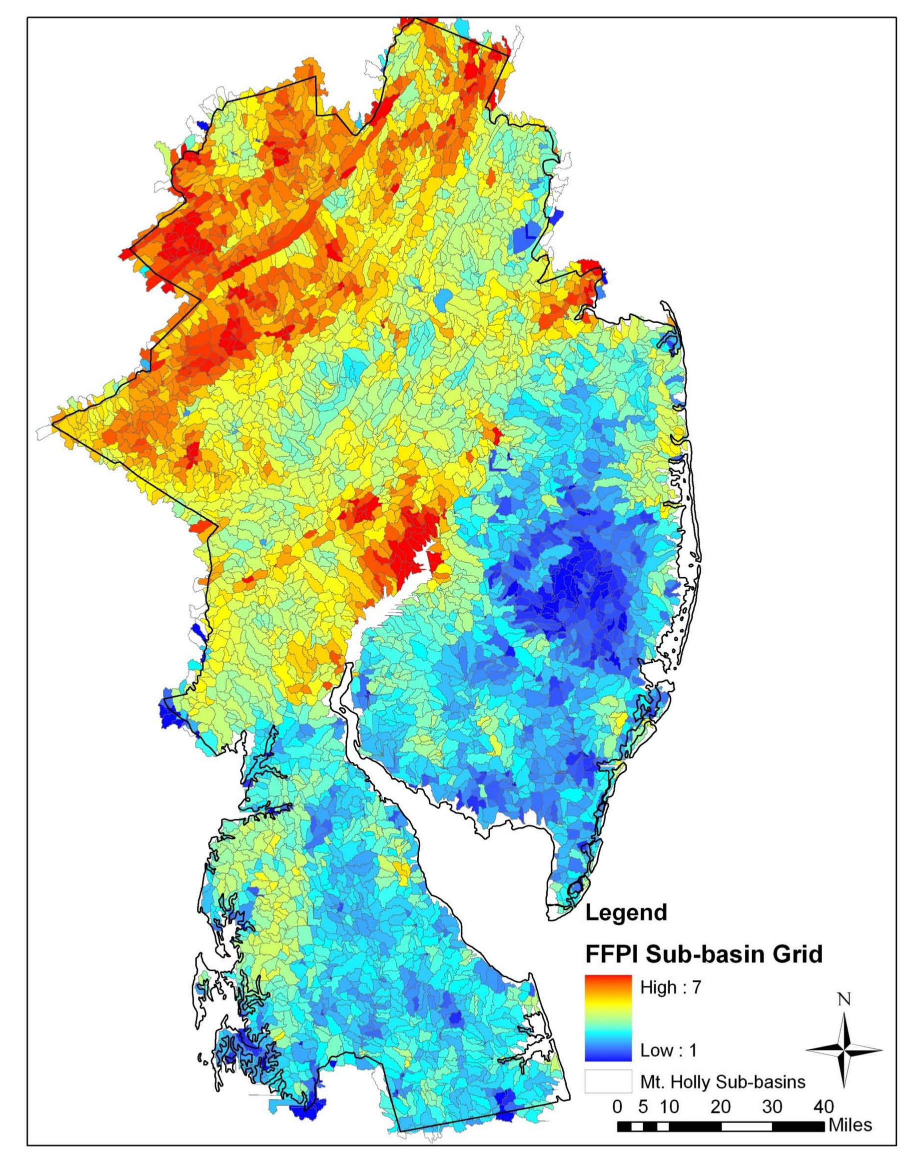
Indexed Soil Type Grid – Reveals where a specific type of soil or impervious surface can affect runoff.

Classification and Indexing

Slope	Soil	Land Cover	Forest Density
Exponential scale where the slope of 30% or more was given a 10 on the FFPI. A 100% slope = 45° angle.	Sixty three specific classes were reclassified into fifteen. Water was given a 1 on the FFPI; Sand a 2; Loam a 6;Clay a 9; and Bedrock/Impervious Surfaces a 10.	Fifteen classes were indexed. Water was given a 1 on the FFPI; Wetlands a 2; Deciduous Forest a 5; Developed/Medium a 9; and Developed/Heavy a 10.	Forest Density was simply classified in percent coverage. 100% coverage was given a 1 on the FFPI and 0% was given a 10.

Results





The results of this study are two-fold: first, users can now visualize how each individual dataset affects flash flooding potential, both individually and collectively through map algebra; and second, users can now determine the flash flood potential for each of the HSA's sub-basins by comparing the final indexed result to the NWS's Flash Flood Monitoring Prediction Advanced (FFMPA) small-basin shape file.

Conclusions

In some cases, this FFPI simply verifies our previous experiences. More importantly, it identifies areas prone to flash flooding that were not necessarily identified in the past. In addition, the index directs us to one or more of the specific drivers, whether it be slope, soil, forest canopy, or land use, that cause or doesn't cause flash flooding. We now have answer as to why or why not a specific area floods and the reasons behind it.

Further GIS layers, such as roads and highways, can be integrated to see where our biggest threats lie (low lying areas or low water crossings).

Producing a shapefile and adding this index into AWIPS will lead to more precise warnings and greater lead time.

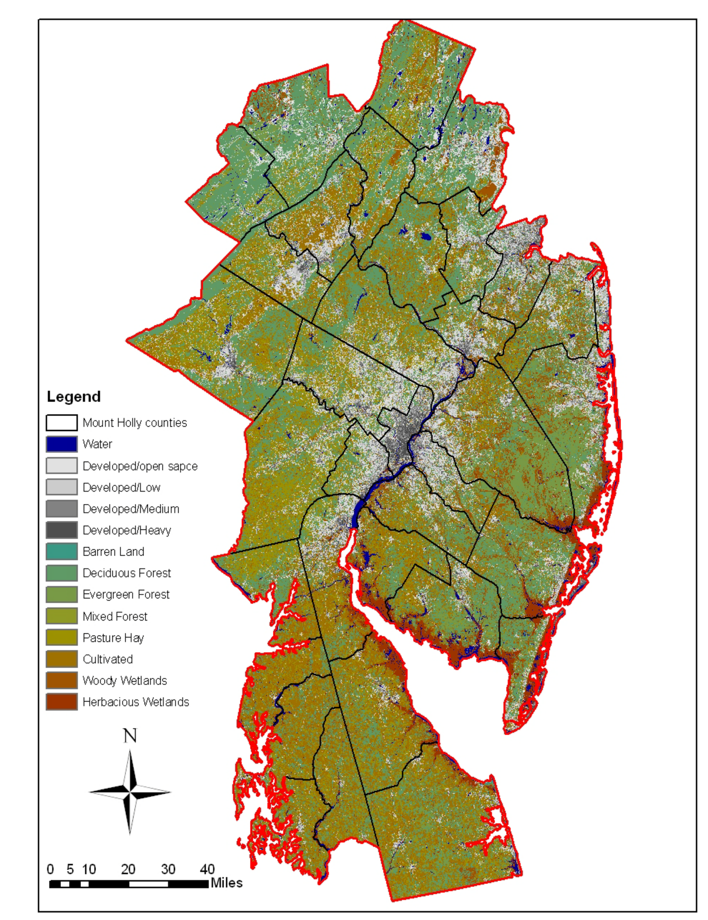
Acknowledgements

The FFPI concept was developed by Greg Smith of the CBRFC. Classification and indexing methodologies, developed by Jim Brewster of NWS WFO Binghamton, NY, were also used to create this FFPI.

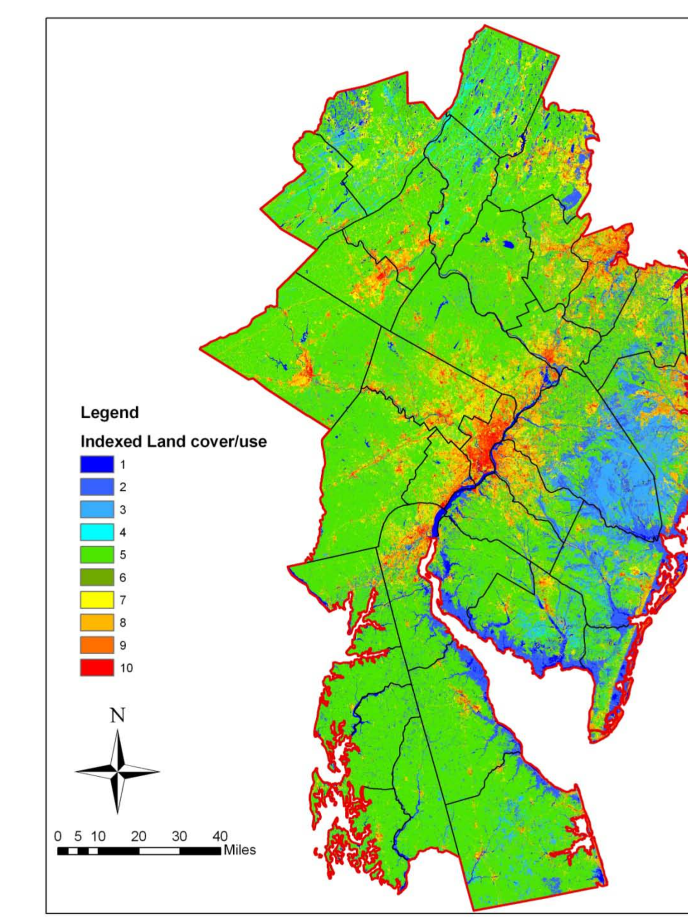
Methodology

I. Collect geographic datasets (Slope from USGS Digital Elevation Model, Soil from NRCS STATSGO, Land Cover from MRLC, and Forest Density from AVHRR).
II. Project datasets to a consistent spatial reference (Albers Equal Area).
III. Resample datasets to same spatial resolution (30 meters).
IV. Reclassify datasets into a standard index, 1 through 10, based on attributes. Forest Density is inversely proportionate where high density is given a low potential index.
V. Sum all FFPI data layers and create a mean FFPI data layer (FFPI = (Slope + Land Cover + Soils + Forest)/4).
VI. Generate sub-basin based FFPI coverage by taking the mean of the FFPI grid cells that fall within each basin.

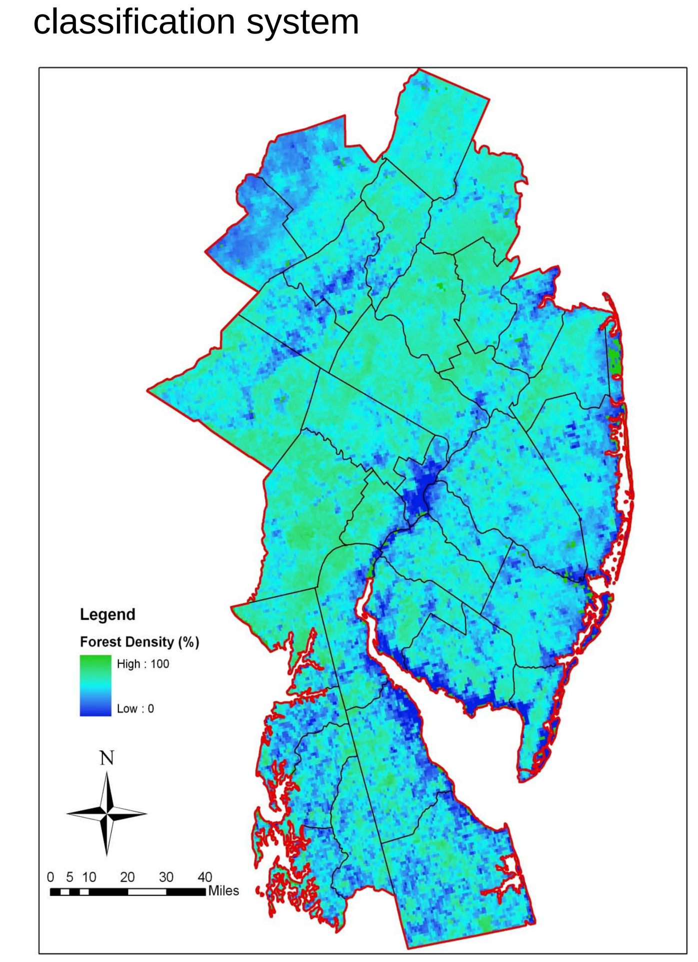
Data



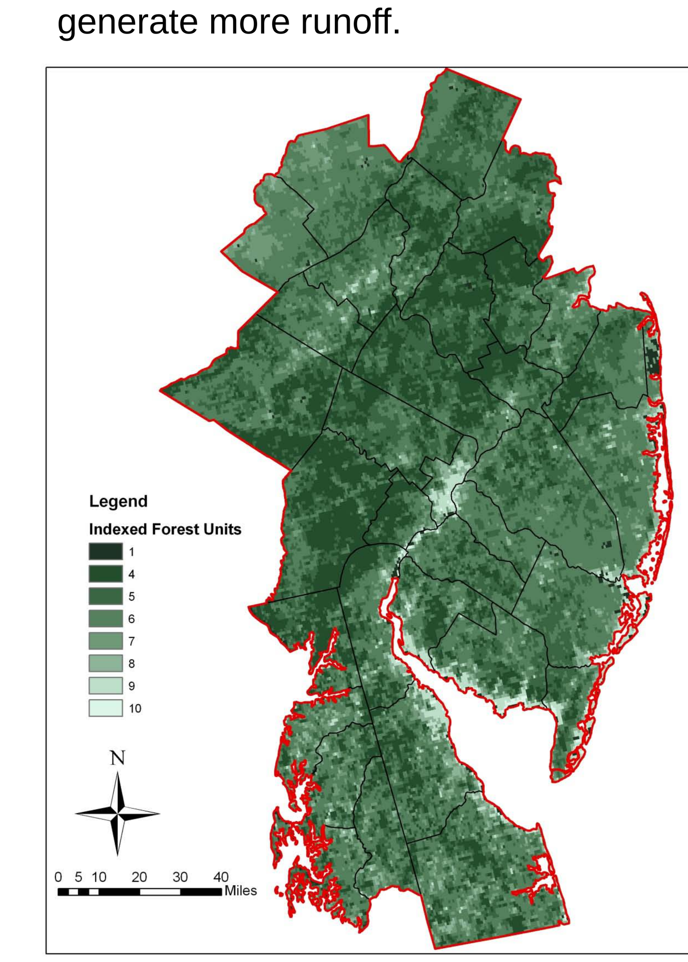
Land Cover / Land Use Grid – Derived from the MRLC and is a numbered classification system



Indexed Land Use / Land Cover Grid – Reveals where impervious surfaces will generate more runoff.



Forest Density Grid – Derived from USDA AVHRR data and is expressed in a percent.



Indexed Forest Density Grid – Reveals where thicker vegetation and forest canopy will result in precipitation interception and less runoff.