

THE RESILIENCE TO DISASTERS AND EMERGENCIES INDEX (REDI)

A Unified Index of Resilience Capacity and Survivability
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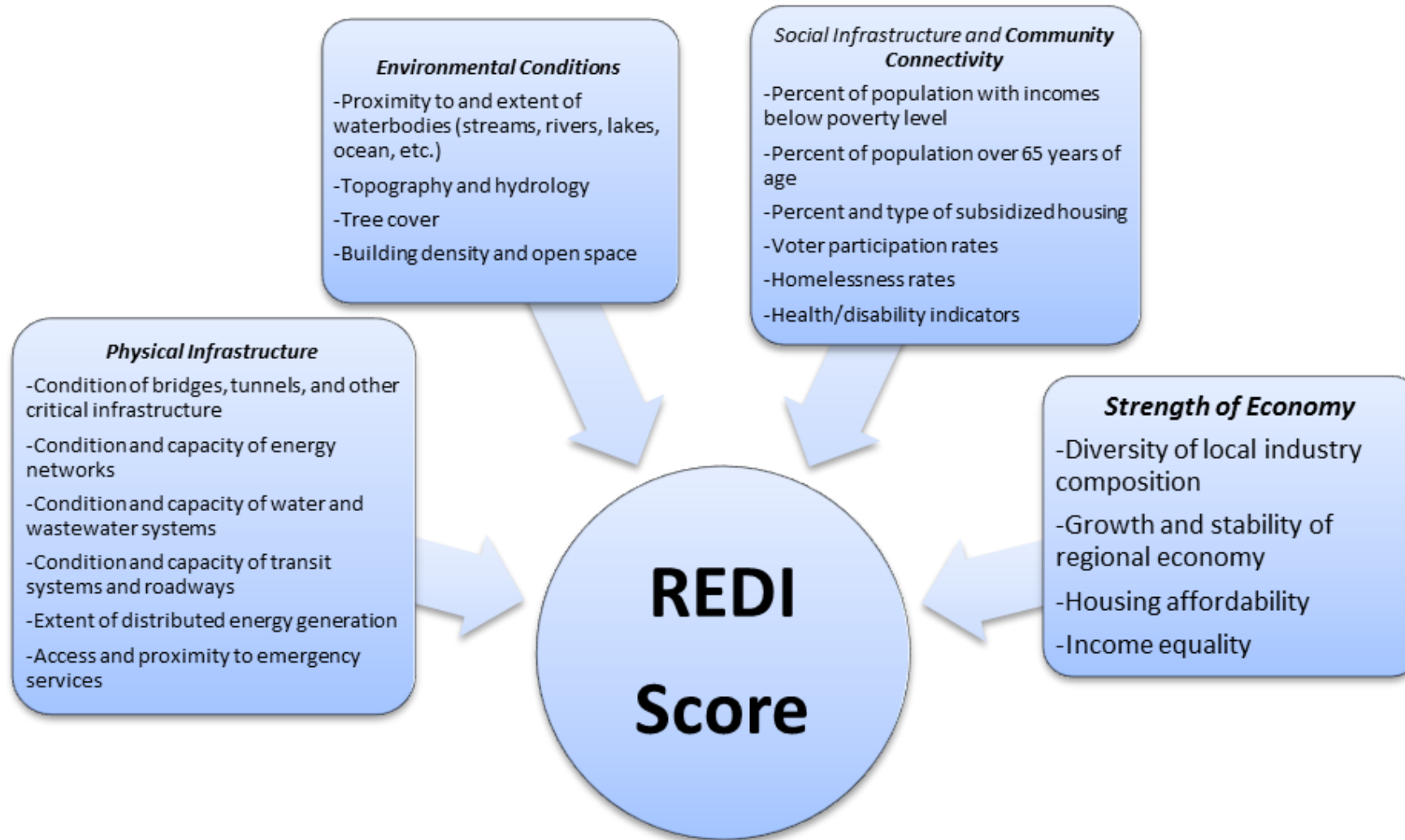


RESILIENCY INSTITUTE FOR
STORMS & EMERGENCIES

Project Objectives

- Develop a unified, multi-factor index of local and regional resilience capacity and vulnerability
 - The **REDI Score**[™] combines measures of physical infrastructure, economic and social vulnerability to classify the relative resilience capacity embedded in localized urban systems
 - Use cases:
 - Benchmark local resilience capacity for spatial-temporal comparative analysis
 - Prioritize investment decisions for mitigation measures and preparedness
 - Measure and evaluate investment decision outcomes
- Create an interactive visualization of New York City highlighting the vulnerability and resilience capacity
 - Currently analyzing each Borough at the Census tract level

Methodology: Index Composition



Data Sources

- Dept. of City Planning
- Dept. of Transportation
- Metropolitan Transit Authority
- Office of Emergency Management
- Federal Emergency Management Agency
- Dept. of Information Technology & Telecommunications
- Dept. of Finance
- United States Census Bureau



Defining Risk-Adjusted Resilience Capacity

- Python, ArcGIS, and CartoDB: Interactive mapping tool for visualizing data
- Risk assessment by census tract and borough; can be applied to other geographies
- Vulnerability heat map as a basis for intuitive evaluation
- Social and economic attributes overlaid with critical facilities and infrastructure and vulnerability

REDI Scores using Standardized Scores:

$$REDI_j = \left(\frac{1}{N}\right) \sum_{i=1}^n (w_i \times x_{ij})$$

where,

$REDI_j$ = RED Index for Locality j

N = Number of indicator variables

w_i = Weight for indicator i (optional)

x_{ij} = Indicator Value for indicator i for Locality j

where Indicator Value =

$$z_j = \frac{x_{ij} - \overline{x_{ik}}}{\sigma_{ik}}$$

where,

z_j = standard score for Locality j

x_{ij} = difference from baseline in indicator i for Locality j

$\overline{x_{ik}}$ = mean difference in indicator i for Region k

σ_{ik} = standard deviation of difference in indicator i for Region k

Methodology: Calculating REDI Scores

- 33 variables
- Weights: 1 = Resilient factor, -1 = Vulnerable factor

NYC DCP Facilities & Transit Sites	Weight
Adult Social Services	-1
Child Social Services	-1
Subway Entrances	1
Residential Developmental Disabilities Services	-1
Health Services	1
Fire Stations	1
Police Stations	1
Libraries	1
Schools	1

Methodology: Calculating REDI Scores

2010 Census – Demographics & Socioeconomic Conditions	Weight
Population Density (per sq. mile)	-1
Total Population: Under 5 years	-1
Total Population: 5 to 9 years	-1
Total Population: 10 to 14 years	-1
Total Population: 15 to 17 years	-1
Total Population: 65 and 74 years	-1
Total Population: 75 to 84 years	-1
Total Population: 85 years and over	-1
Households: Nonfamily households: Householder living alone	-1
Households: Households with one or more people under 18 years	-1
Housing units: Vacant	-1

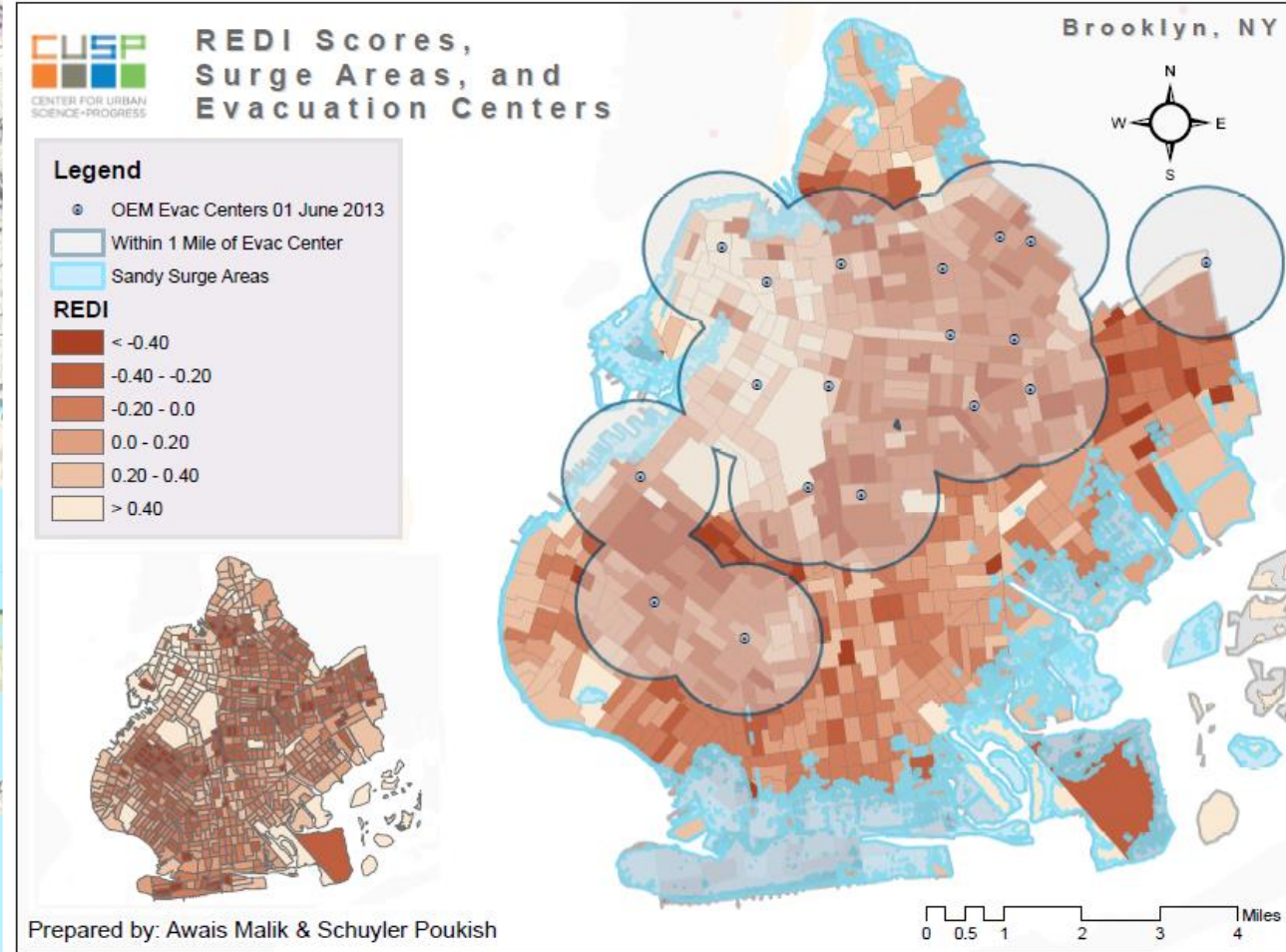
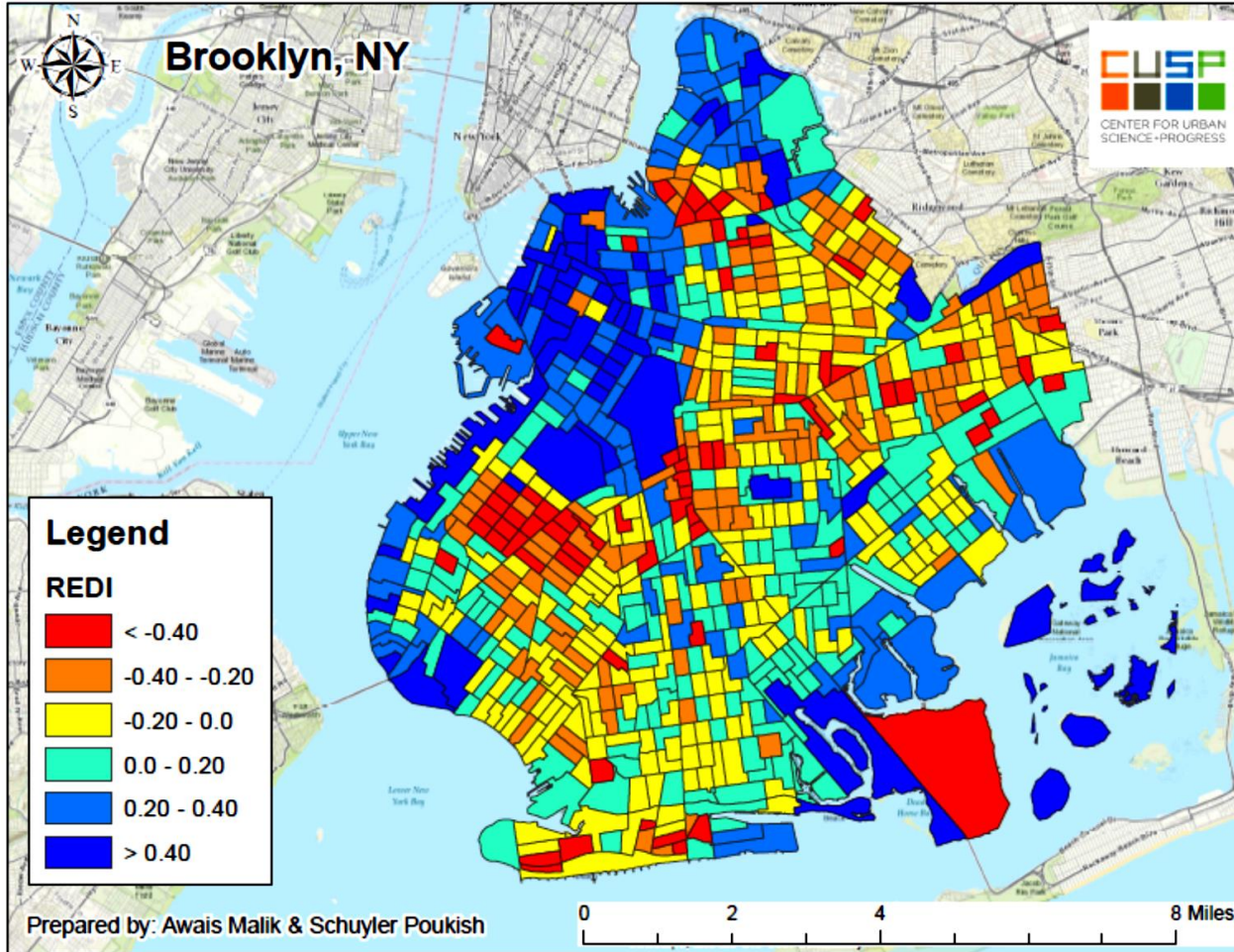
Methodology: Calculating REDI Scores

ACS (2008 – 2012) – Demographics & Socioeconomic Conditions	Weight
Population 25 Years and over: Less Than High School	-1
Population 25 Years and over: Bachelor's degree	1
Population 3 Years and over: Not Enrolled In School	-1
Civilian Population In Labor Force 16 Years And Over: Unemployed	-1
Median household income (In 2012 Inflation adjusted dollars)	1
Families: Income in 2012 below poverty level	-1
Civilian Non – Institutionalized Population: No Health Insurance Coverage	-1
Lack of Economic Diversity (Derived Indicator)	-1

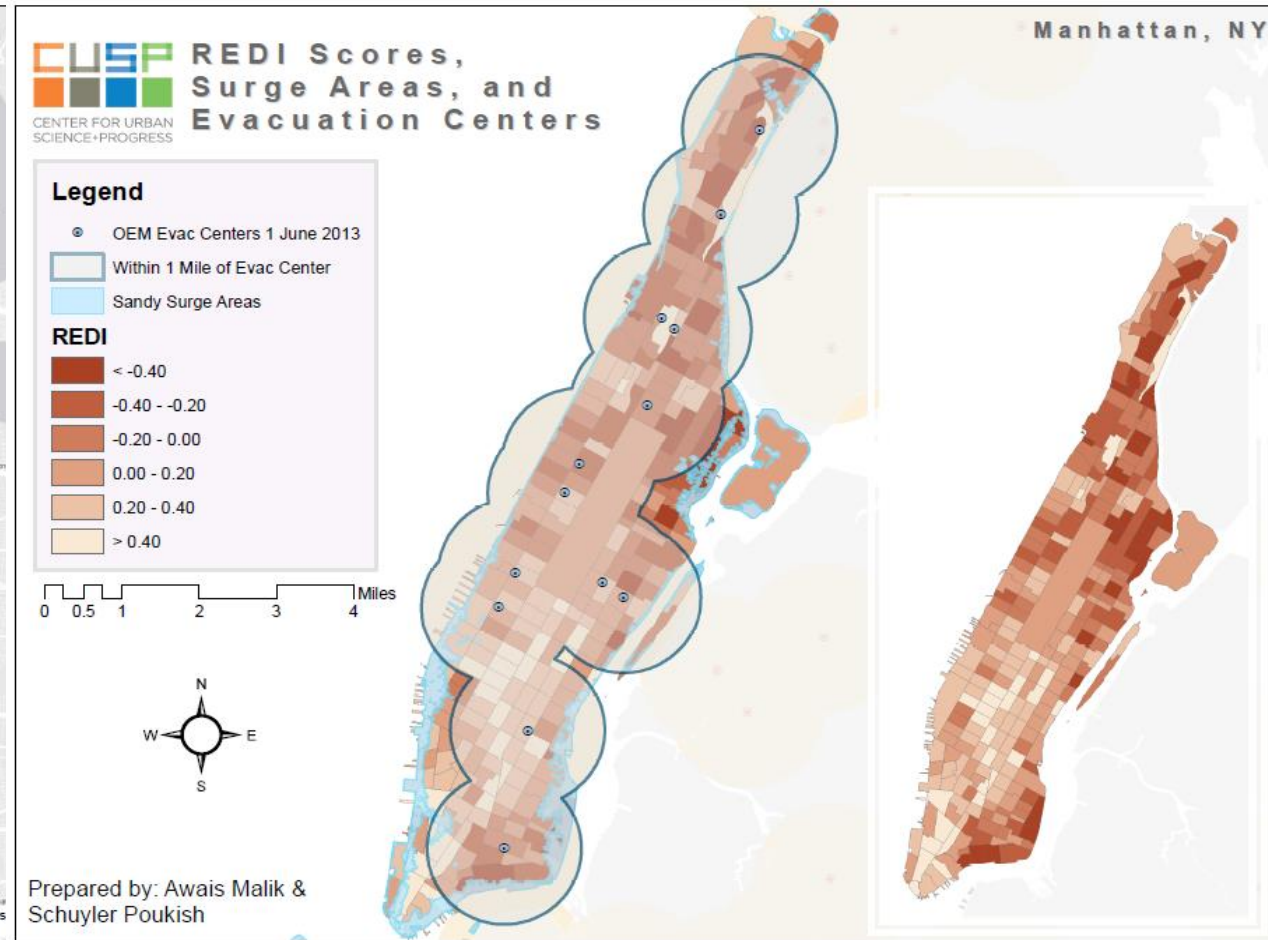
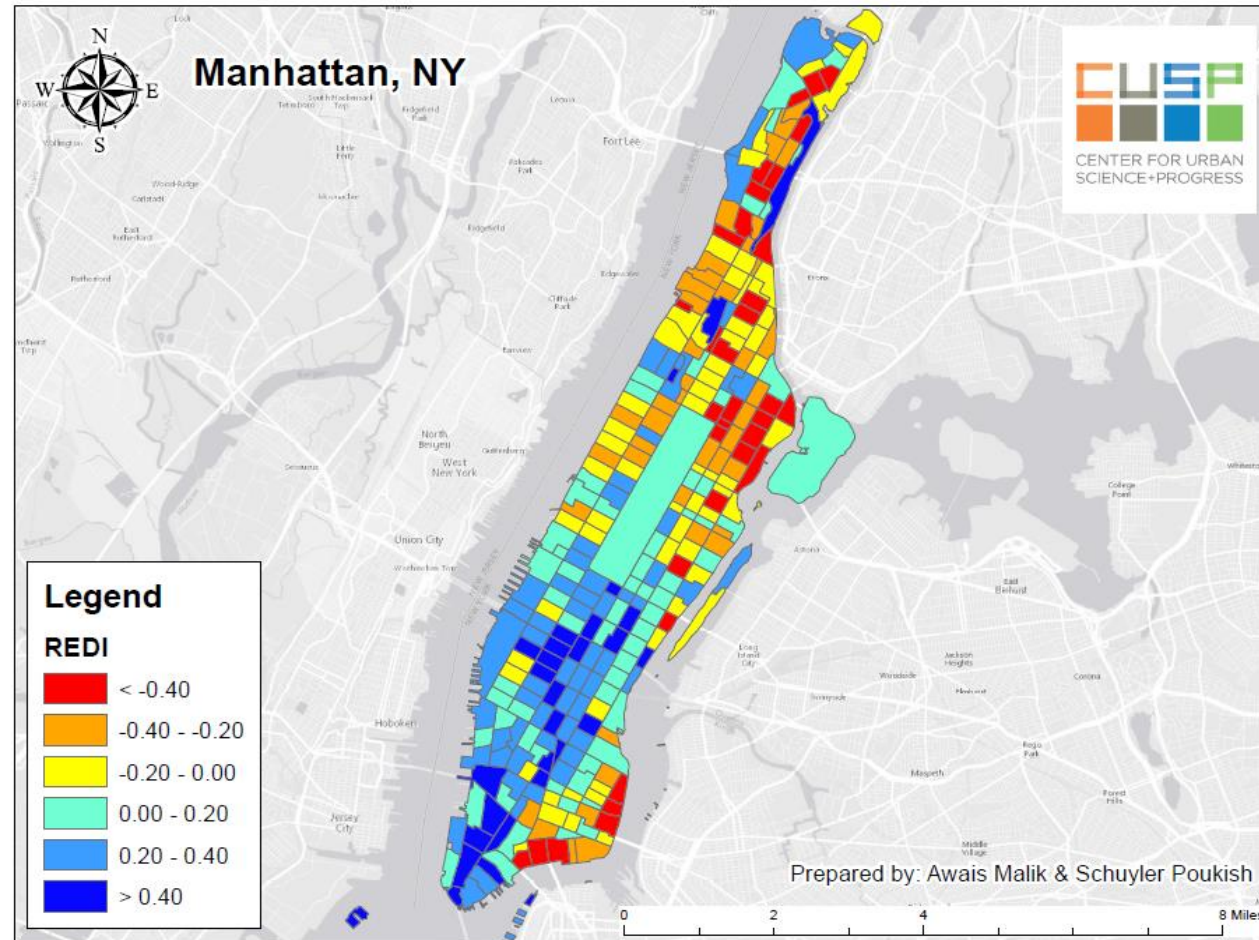
Methodology: Calculating REDI Scores

Climate Storms & Flooding Emergencies	Weight
Percent of Tract covered by Sandy surge / Topography & Hydrology	-1
Number of Evacuations Centers within 1 mile radius from Census Tract Centroid	1
Environmental Factors	
Number of Trees in each Census Tract	1
Building Density	-1
Percent of Census Tract covered by Open Space	1

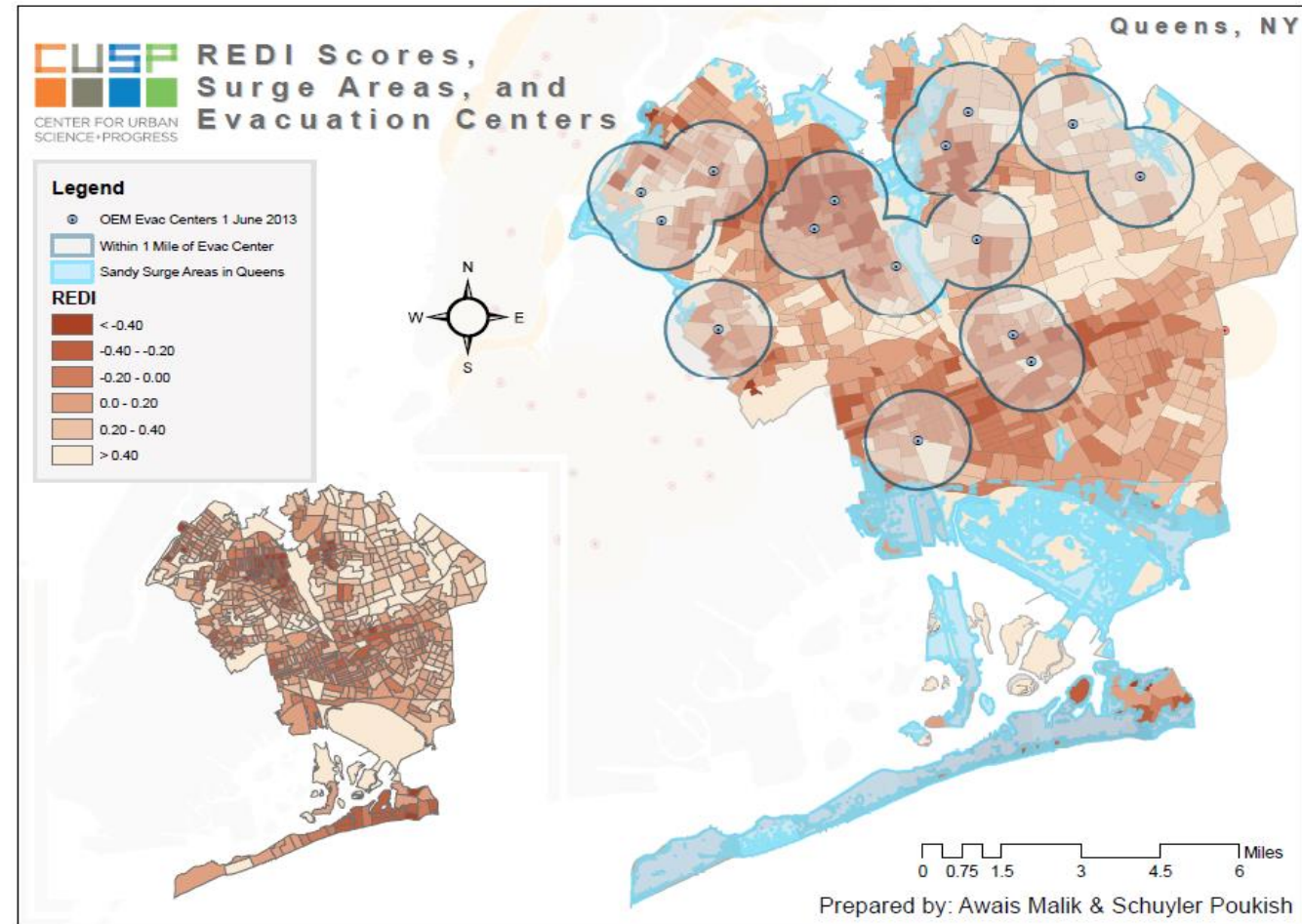
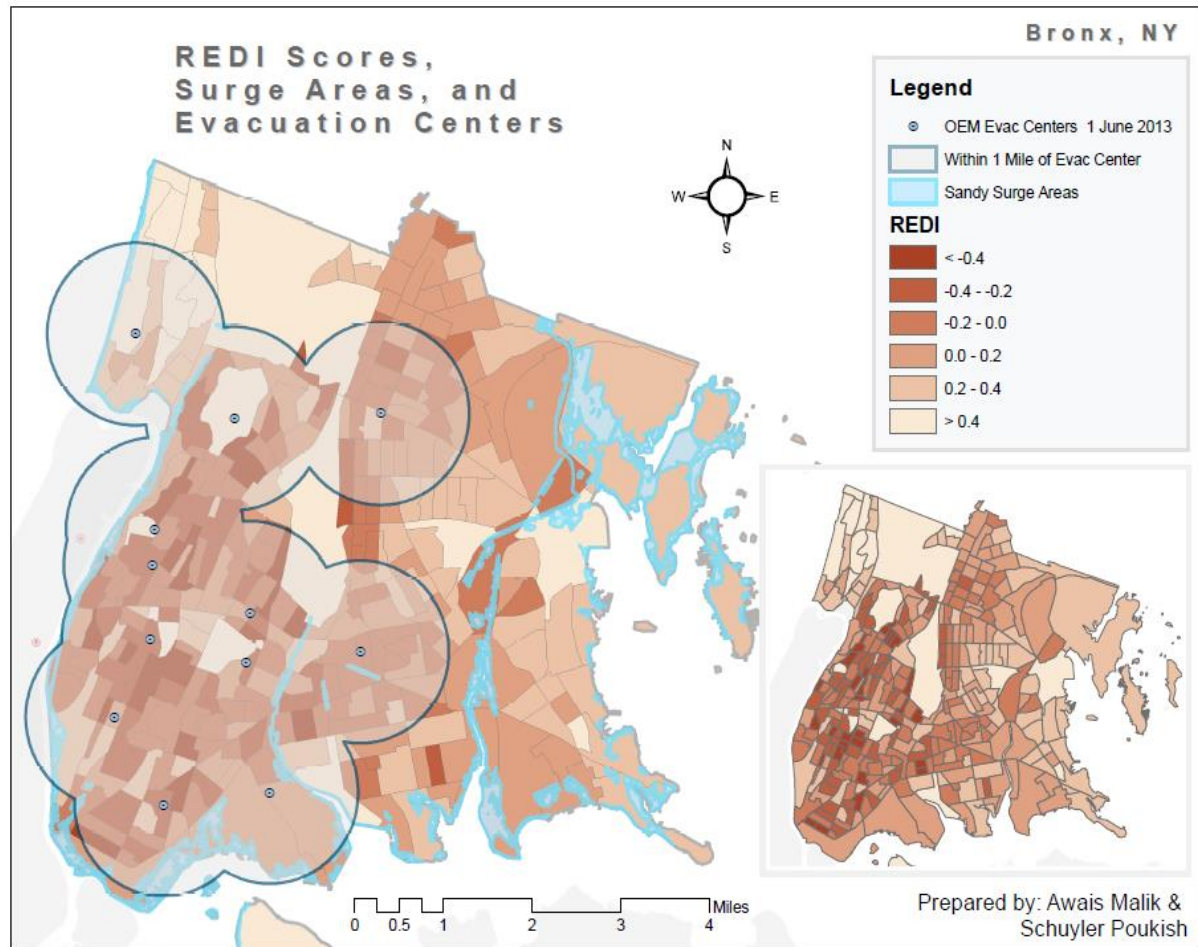
Mapping REDI Scores - Brooklyn



Mapping REDI Scores - Manhattan



Mapping REDI Scores – Bronx & Queens



Next Steps & Deliverables

- Iteratively improve REDIndex by incorporating additional indicator variables
- Discuss neighborhood case studies – application of scores to Sandy outcomes
- Deliver final report
- Develop spatial-temporal database of critical infrastructure, built environment, social, economic variables
 - Improve GIS database platform
 - How to efficiently handle ‘big’ data?
- (TBC) Launch interactive visualization tool of online mapping, query, and analysis of REDI Scores for NYC
- (TBC) Expand to NYS