The Resilience to Disasters & Emergencies Index (REDI)

A Unified Index of Resilience Capacity and Survivability

Constantine E. Kontokosta, PhD, PE, AICP, LEED AP
NYU (CUSP, Polytechnic & Schack)

With Research Assistance from:
Awais Malik & Schuyler Poukish

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NYS RISE
Resiliency Institute for Storms & Emergencies

BACKGROUND

Project Motivation:

- No comprehensive measure of local resilience capacity at the neighborhood level
- Govt. needs a decision-making tool for effective prioritization of resource allocation and evaluation of rebuilding investments

http://stormrecovery.ny.gov/governor%E2%80%99s-office-storm-recovery-announces-40-million-create-network-resilient-community-centers-7

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 separately at Census tract level

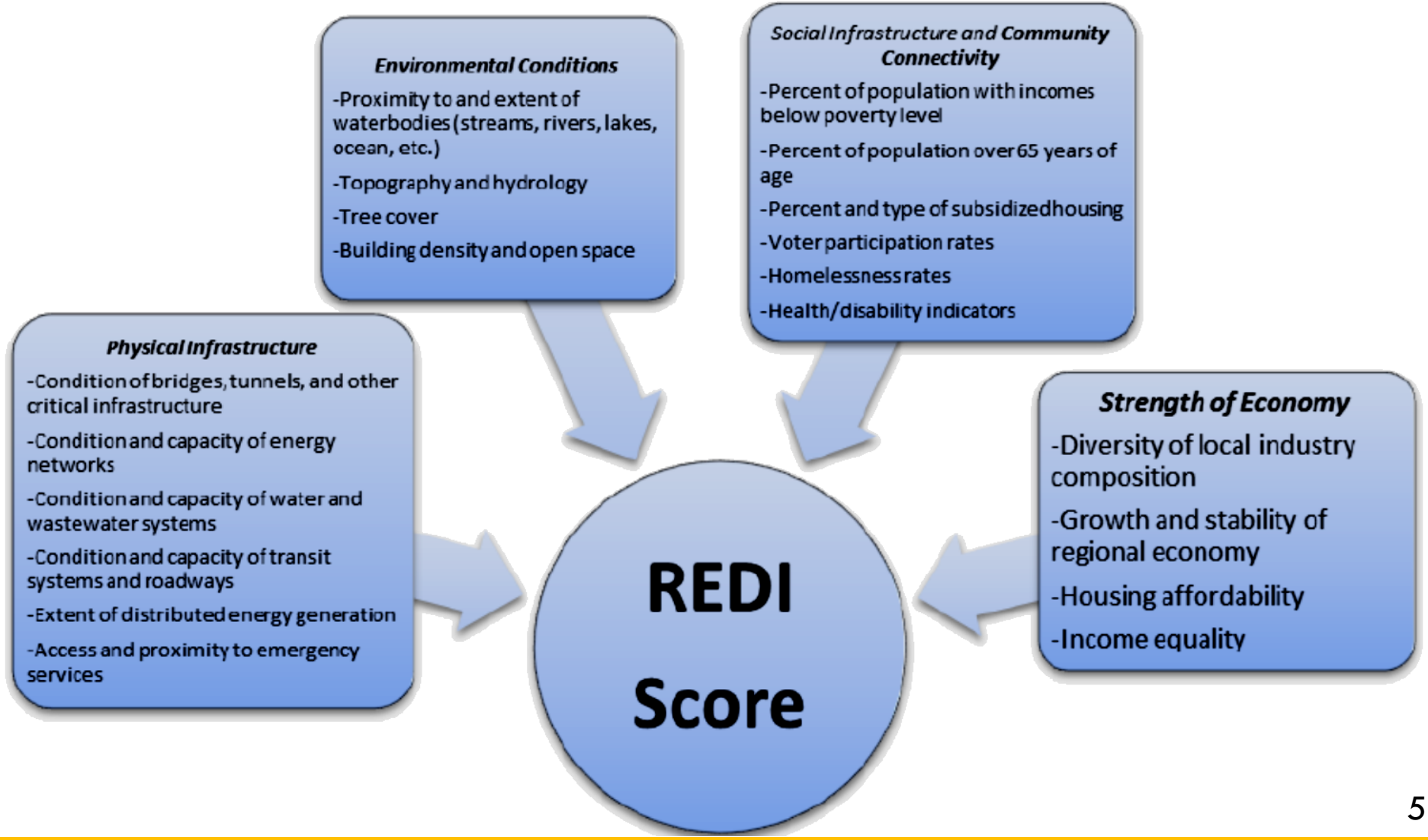
Data Sources

- 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

Note: All Data used is OPEN

METHODOLOGY

- REDI Score Composition



METHODOLOGY

- Defining Resilience Capacity

REDI Scores using Standardized Scores:

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

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 indictor i for Locality j

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

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

Indicator Variables

- ~ 30 variables selected for initial REDI iteration
- Indicator Variable Weights:
  - 1 = Adds Resilience
  - –1 = Adds Vulnerability
- REDI scores for each borough calculated separately
  - Normalized to 1 – 100 range
  - Higher score indicates greater resilience capacity

Indicator Variables

Social Infrastructure & Community Connectivity

- Population Density
- Population Under 18
- Population Over 65
- Single-occupancy household density
- Households with under 18 occupants
- Vacant Housing Units
- Population Over 25 not graduated High School
- Population Over 25 with at least Bachelor's degree
- Population Over 3 not enrolled in school
- Percent Population with no Health Insurance Coverage
- Percent Families with Income below Poverty Line

Physical Infrastructure

- Fire Stations
- Police Stations
- Health Services
- Libraries
- Schools
- Subway Entrances
- Adult Social Services
- Child Social Services
- Residential Developmental Disabilities Services
- OEM Evacuation Centers within 1 mile radius of Tract Center

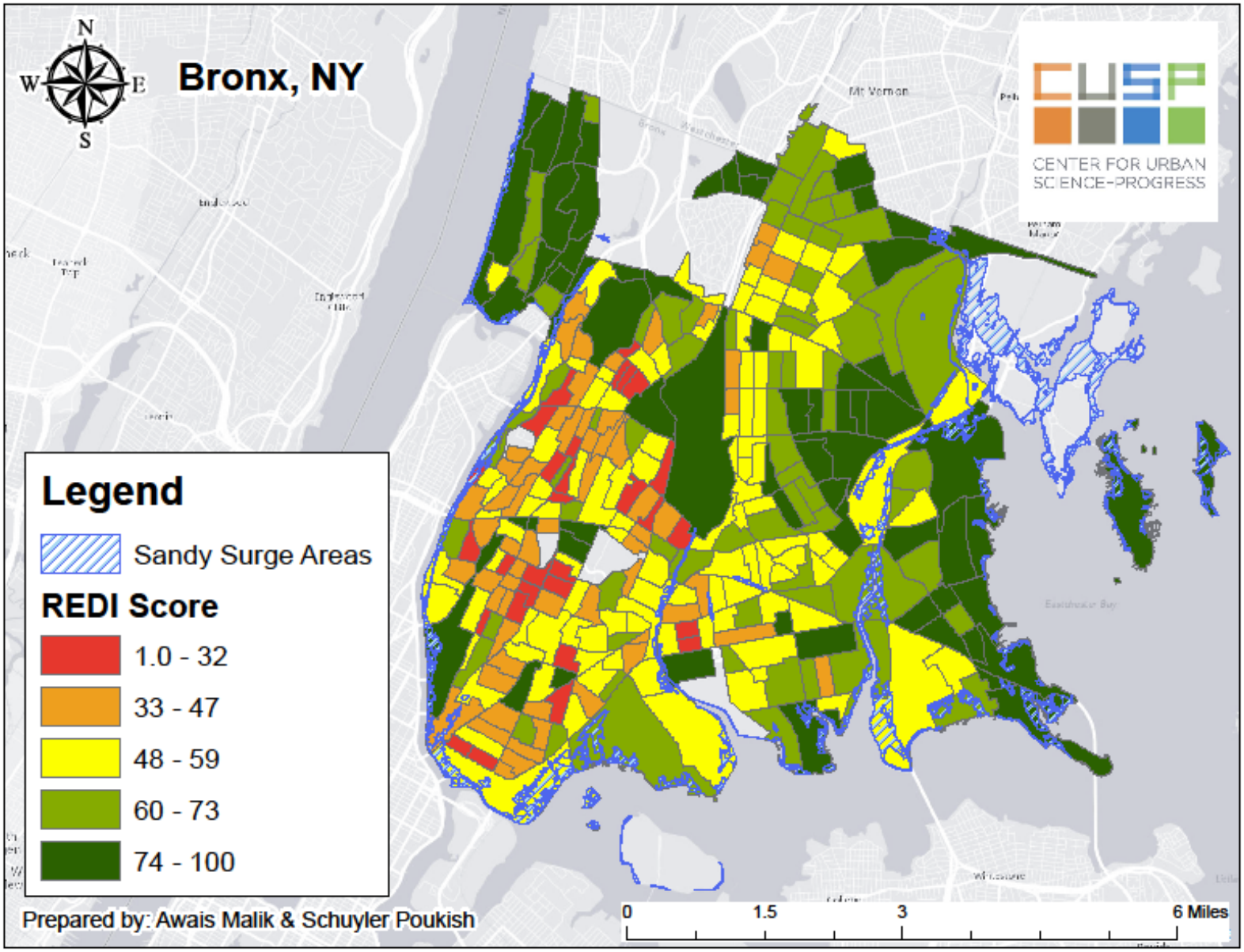
Strength of Economy

- Unemployed Population Over 16 in Labor Force
- Gini Index for Income Inequality
- Lack of Economic Diversity (Derived Indicator)
- Median Household Income

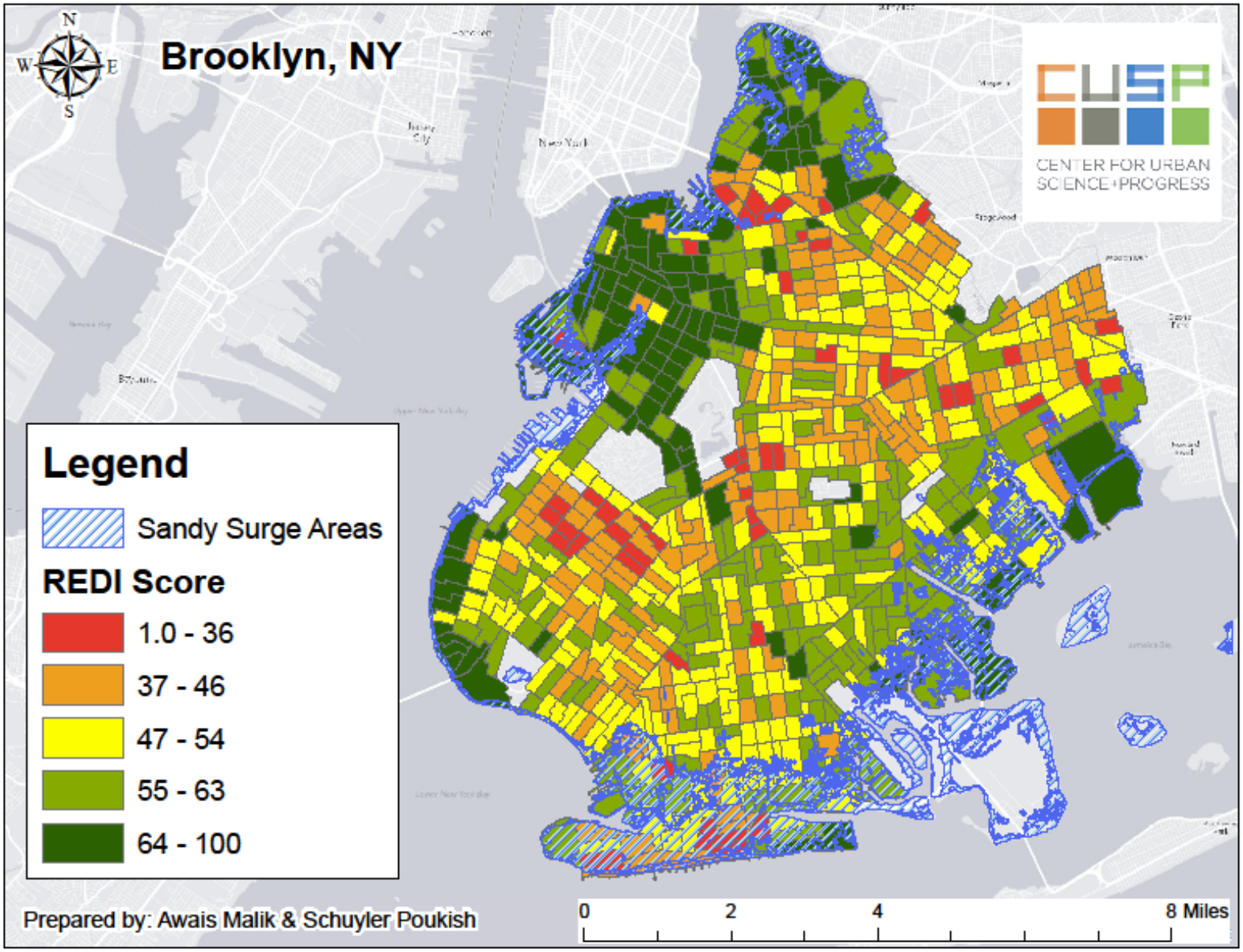
Environmental Conditions

- Percent of Tract covered by Sandy
- Tree Density
- Building Density
- Percent of Tract Open Space

Mapping REDI Scores



Mapping REDI Scores



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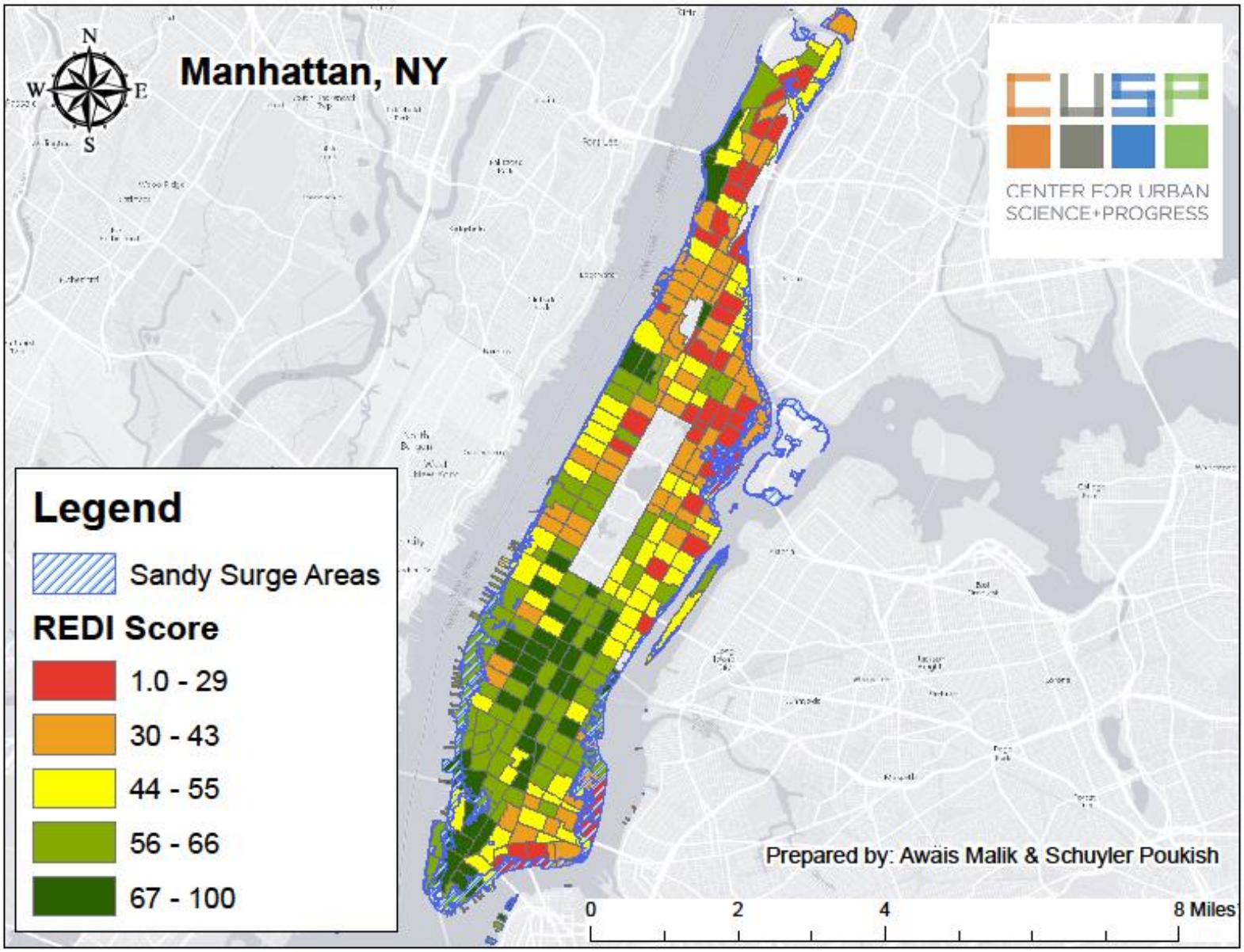

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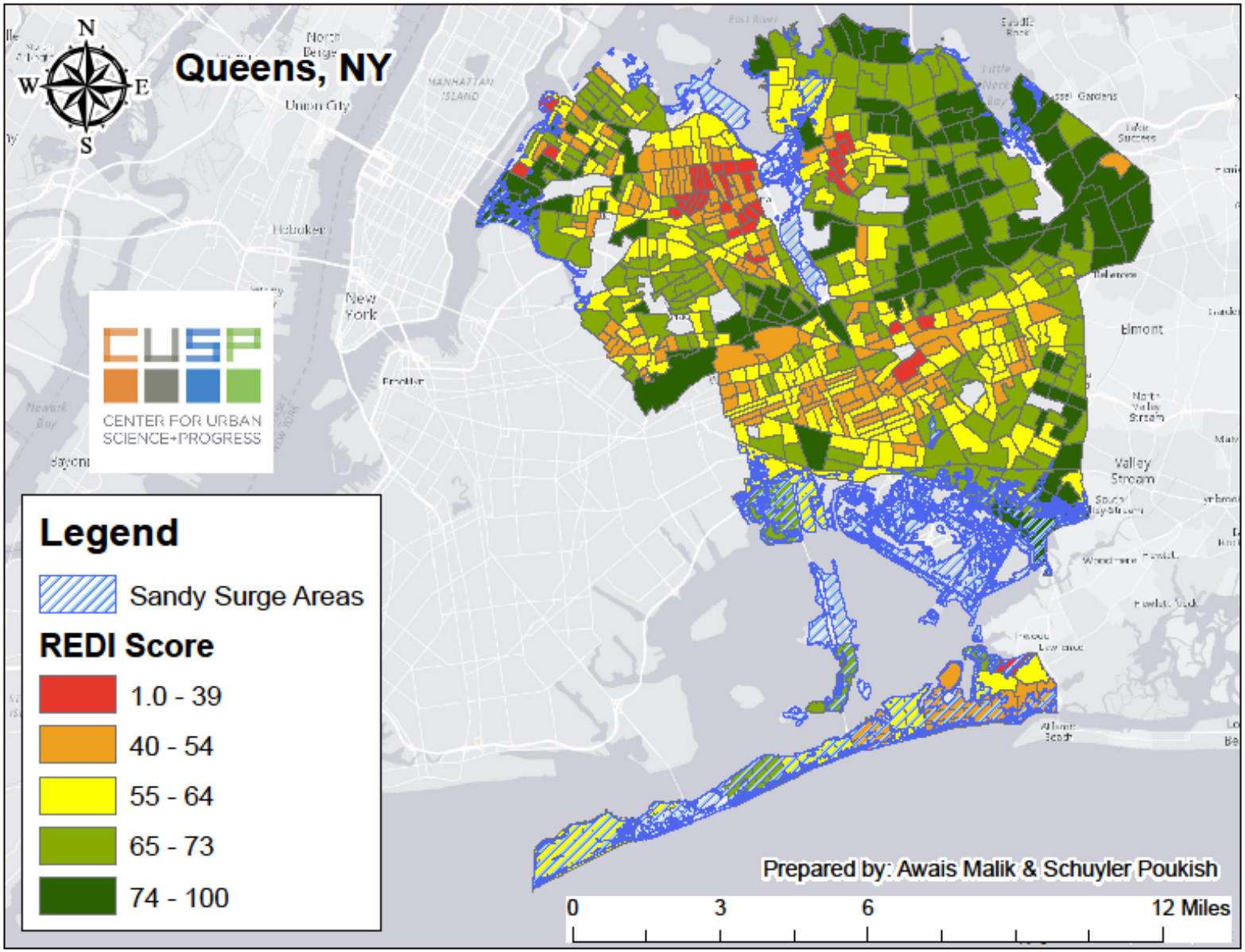

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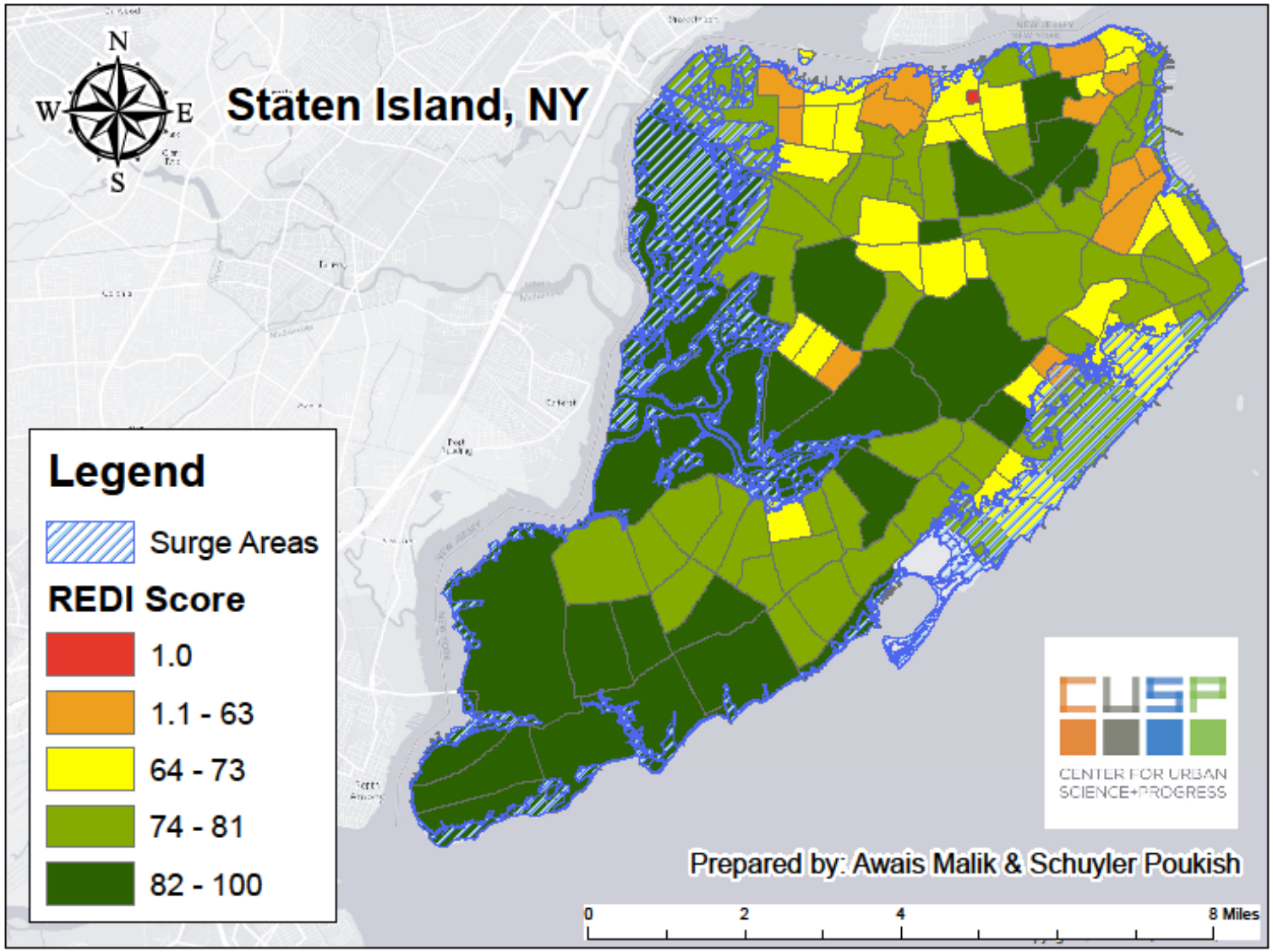

Next Steps

- Iteratively improve REDI scores
  - Incorporate additional indicator variables
  - Create REDI scores for each of the 4 subcategories separately
  - Combine all 5 boroughs into a single dataset
- Discuss neighborhood case studies
  - Application of REDI scores to Sandy outcomes
- 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 New York State