Determining Optimal Locations for New EV Charging Stations in Staten Island, NY

GGRC30 Advanced GIS Final Term Project

Mariam Walaa 1003023818 - Dec 1, 2021

Background & Problem

- Currently, there are 1,755 EVs in Staten Island. (9.6% of New York City's 18,203 EVs).
- There are 18 public charging stations & 4 private charging stations in Staten Island.
- EVs are important for the health of the environment, and this project aims to determine where to locate new charging stations to improve adoption of EVs.
- To determine where to locate new charging stations, we need to understand coverage provided by existing charging stations and where the demand exists most.

Research Questions

- What is the distribution of EVs by ZIP Code vs Census Tract in Staten Island?
- How much coverage is provided by existing charging stations in Staten Island?
- Where are the optimal locations for new charging stations in Staten Island?

Data

1. ACS Census (2019)
2. ZIP Code Boundaries (NYC Open Data)
3. New York Street Network (NYC Open Data)
4. Census Tract Boundaries (Census Bureau – 2018)
5. Electric Vehicle Charging Stations (AFDC – Nov 2021)
6. Electric Vehicle Counts By ZIP Code (EV Hub – Nov 2021)
7. New York Digital Elevation Model (DEM) Tiles (CUGIR – 1995)

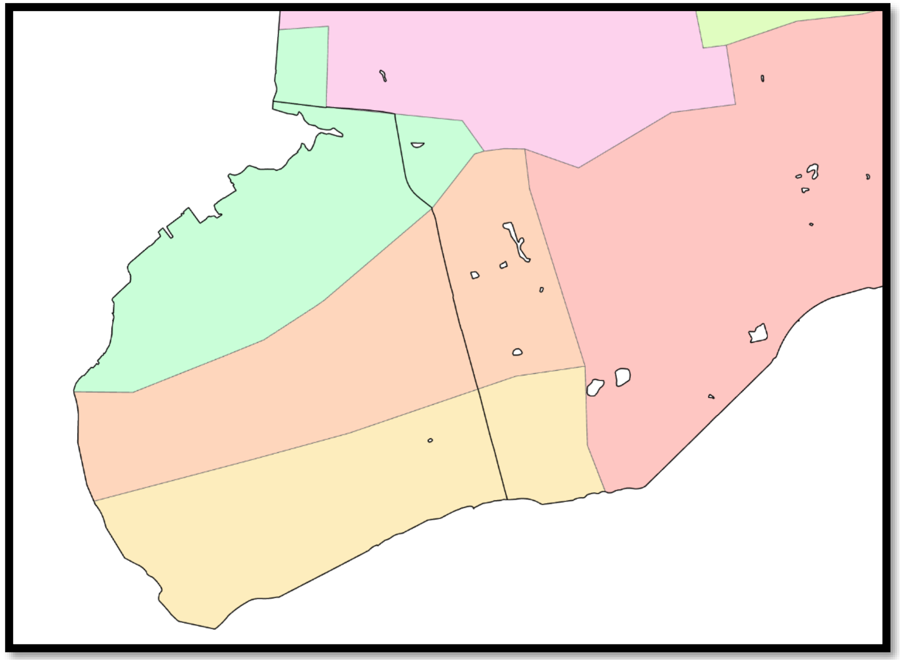

Figure 1: Census Tract Boundaries Fall Under Multiple ZIP Codes

Methods

1. Areal Weighting

EV Counts are converted from **ZIP Codes to Census Tracts** by Areal Weighting and Aggregation.

2. Suitability Analysis

Land Use, Slope, and Distance To Existing Charging Stations create Suitability Index to **manually select Candidate Stations**.

3. Service Area Network Analysis

Service Areas for Charging Stations are used to determine areas with coverage and **areas with no coverage**.

4. Location-Allocation Network Analysis

The Maximize Attendance tool is used to determine **Top Charging Station** location from candidate stations.

Areal Weighting & Aggregating Method

Calculate Proportion of Each CT in ZIP Code → Distribute EV Count By CT Proportion → Re-Aggregate EV Count Up To CT

Weighted Overlay Distribution

Category	Weight
Distance to Existing Stations	35%
Land Use	35%
Slope	30%

Results

- Service Area analysis shows coverage provided by existing charging stations.
- CT Estimates are used as inputs for demand points in Location-Allocation.
- Suitability index is used to manually select candidate charging stations for input into Location-Allocation.

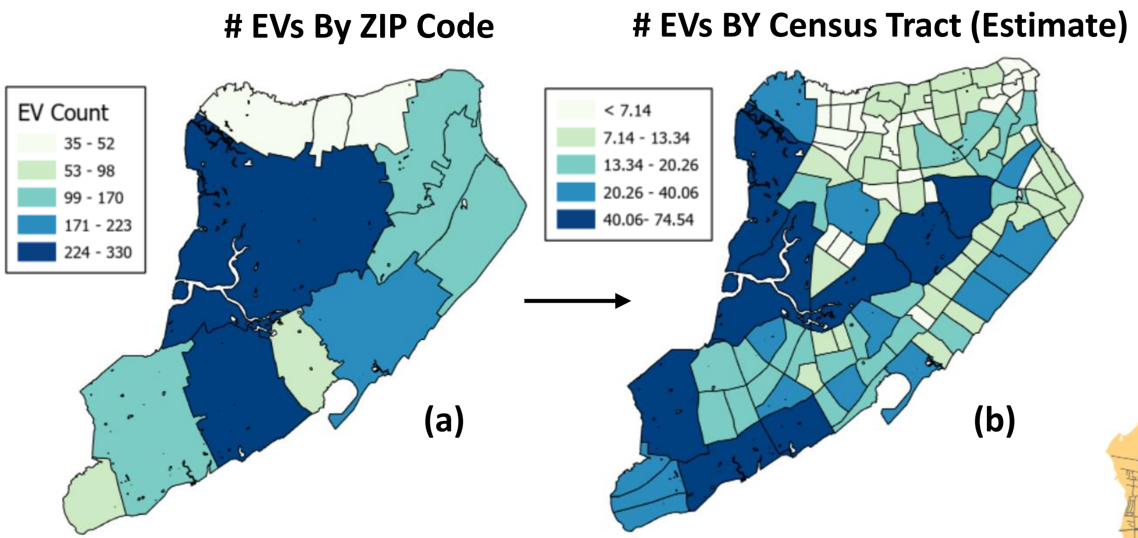

Figure 2: Areal Weighting Results

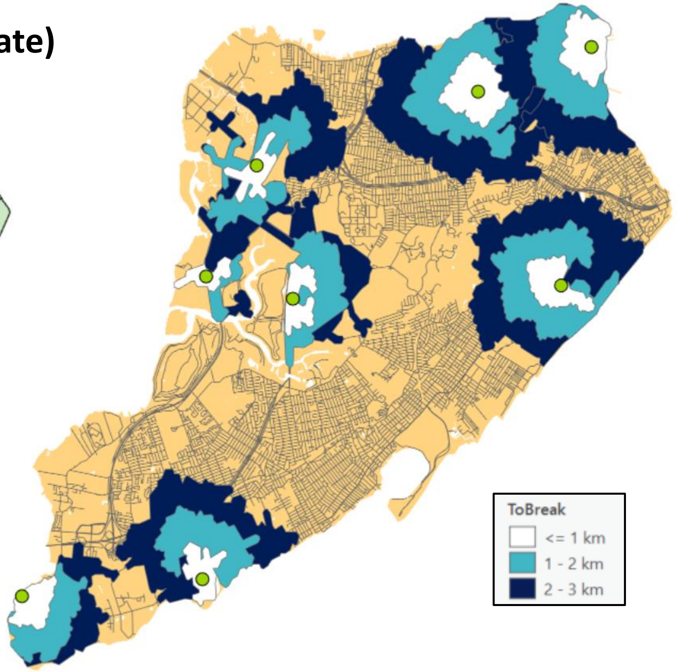

Figure 3: Service Area Analysis Results

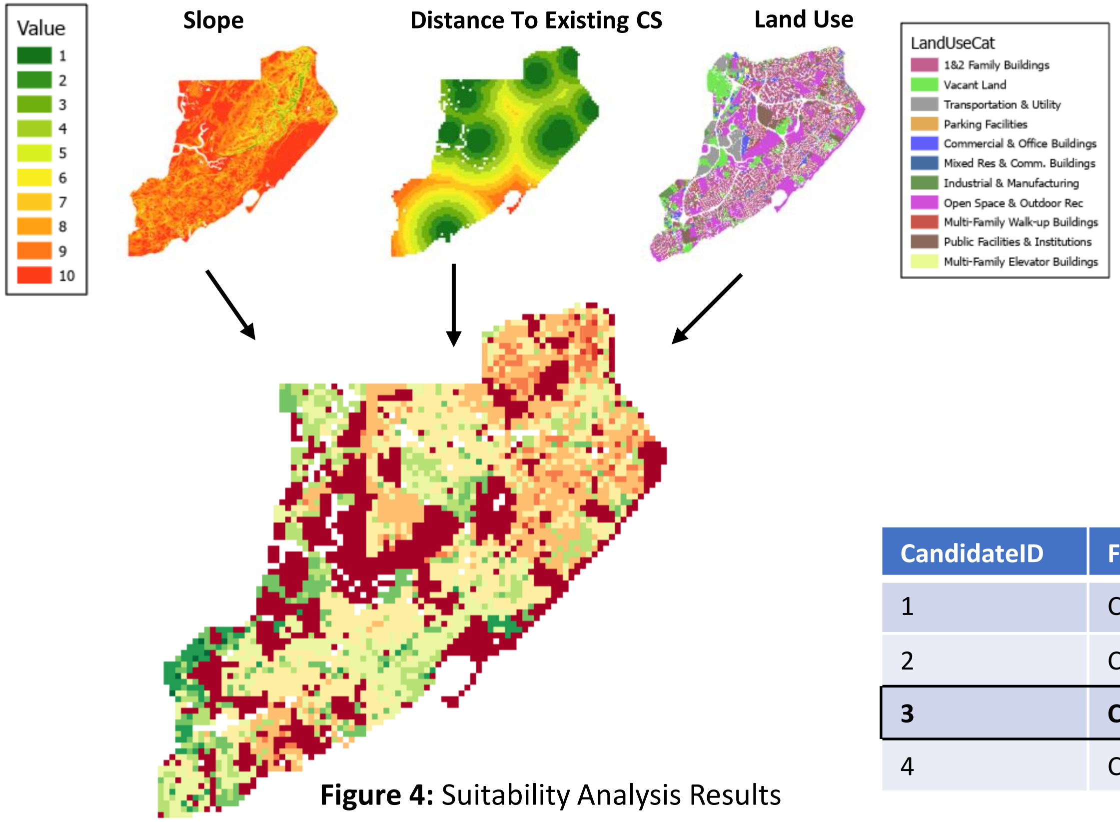

Figure 4: Suitability Analysis Results

Land Use	Scale
Vacant Land & Parking Facilities	10
Industrial Manufacturing	8
Mixed Commercial + Residential, Public Institutions & Facilities	6
Family Buildings (Residential)	2
Transportation & Utility, Open Space & Rec. Centers	Restricted

CandidateID	FacilityType	DemandCount	DemandWeight
1	Candidate	0	0
2	Candidate	0	0
3	**Chosen**	**10**	**64.99**
4	Chosen	4	53.11

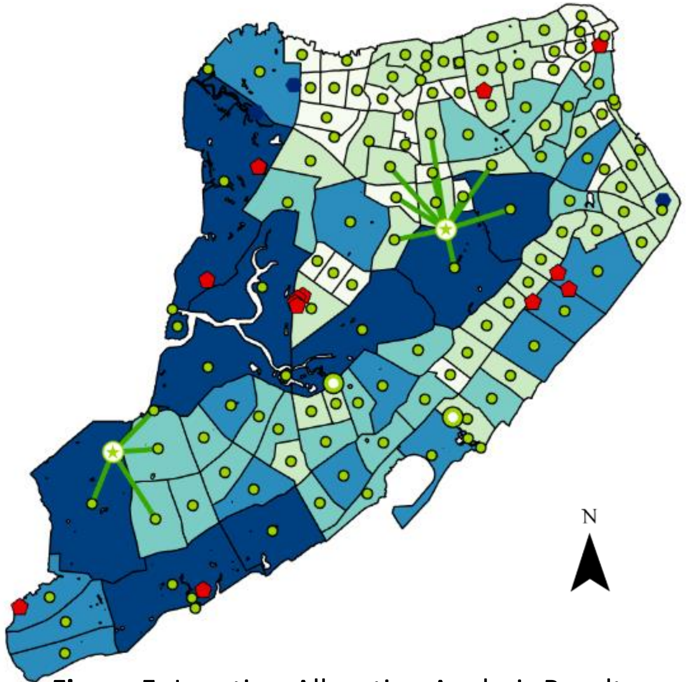

Figure 5: Location-Allocation Analysis Results

Discussion & Limitations

- The Areal Weighting method does not account for Land Use, so large CTs may get large #s of EVs while having no residential area for EV owners to live in. An alternative approach would be to distribute EV counts by Land Use proportions instead of by CT proportions so that EV counts distribute better.
- We determine coverage of existing stations in terms of distance. It may be useful to determine coverage in terms of EVs served and assign new charging stations to meet remaining demand.
- The Street Network uses distance (<=3km) as impedance to determine coverage, whereas an alternative approach could be to factor in traffic, different impedance function, date/time, etc.
- Improving data preparation can lead to better results (missing DEM tile for Suitability Analysis, removing slivers or gaps between polygons when converting from ZIP Code to Census Tract, etc.).

Conclusions

- Based on Service Area Analysis, we find that Staten Island has potential to gain more coverage in central areas with the addition of new EV charging stations.
- We identify ideal charging station locations from 4 hand-selected candidates using Suitability Analysis and Location-Allocation analysis together, as well as areal weighting to re-distribute EV counts to determine demand for charging.