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Gov 1021 Final Project

We Need a Definition of Suburbs – Here’s Why:

In 2017, Boston’s African American households had a median net worth of \$8. For Boston’s white households had a median net worth of \$247,000.¹ This disparate outcome of generational wealth can be largely attributed to differences land and home ownership, caused by decades of redlining. Now, many redlined areas in major cities are primed for displacement and gentrification due to lower homeownership rates.² Many see suburbs as a historic symptom of this systemic discrimination.³

These arguments presume a common knowledge of what a suburb is. This, it turns out, can be problematic. Although there are stereotypical characteristics of a suburb, the reality is that many areas can be viewed in this definition. In the U.S., no government agency, however, has created a definition for identifying suburbs. The Census Bureau and the Office of Management and Budget are the typical agencies the public might turn to, but they offer no explicit classifications. Most classifications split the U.S. into two types, urban and rural, with suburbs lying somewhere within the urban area.

This lack of categorization denies the public a chance for nuanced understanding of social and economic trends. This can be a major cause of polarization, especially apparent during the rural-urban divide debates during the 2016 and 2018 elections⁴. This lack of nuance dismisses trends that may be happening to the majority of Americans living in the suburbs.

Historic significance and polarization are two major reasons that we need a suburb definition. Other areas where a less immediate, but still important, case can be made such as resource prioritization, zoning, and regional planning. This is the case of why the definition is important. The next question – how to create the definition – is difficult to answer.

Baseline Assumptions

Given the broad use of suburbs in everyday articles and discussions, it is necessary to check the baseline assumptions that are associated with the idea of a suburb. For the purposes of this article, there should be three starting assumptions while creating and evaluating definitions.

First, suburbs are part of a larger metropolitan area. A suburb cannot exist without its accompanying urban area. This crafts the dynamic that has charged suburban and urban areas since the first white flight and redlining started happening in the 1930’s.

¹ <https://www.bostonglobe.com/metro/2017/12/11/that-was-typo-the-median-net-worth-black-bostonians-really/ze5kxC1jJelx24M3pugFFN/story.html>

² <https://www.urbandisplacement.org/redlining>

³ <https://www.washingtonpost.com/outlook/2019/06/19/why-racial-wealth-gap-persists-more-than-years-after-emancipation/>

⁴ <https://www.citylab.com/equity/2019/11/election-results-subsurban-voters-rural-urban-density-index/601585/>

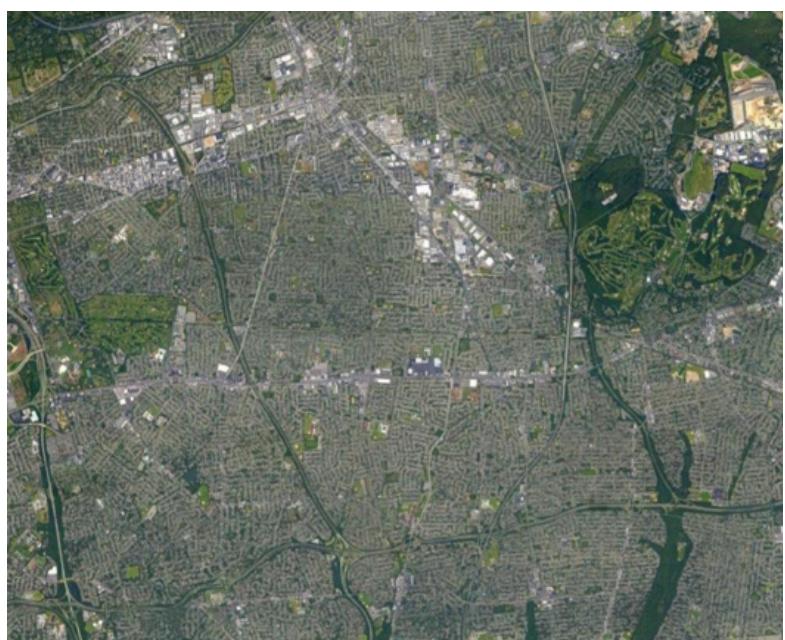
Suburbs have evolved differently across the U.S., so the scope of these assumptions is the greater New York City metropolitan area. The next two assumptions are place-based to identify our prototypical urban and suburban areas.

The second assumption is that there should be very little or no areas on the island of Manhattan that are suburbs. As the “suburb” term has evolved over time, New York City’s Manhattan area has served as a cultural reference point as the antithesis of a suburb. The same can’t be said of other cities like Los Angeles, San Francisco, or Chicago. Despite being large cities, there are likely checkered suburban-like neighborhoods within these cities.⁵

Lastly, our prototypical suburb refers back to the first modern suburb created. This is Levittown, New York. It is a planned development in Long Island built in the early 1950’s with sprawling housing that is connected to New York City’s urban area through a system of feeder roadways and highways. This model suburb led to the creation of seven total Levittown developments around the U.S. Figure 1 below shows satellite images of our assumed urban and suburban areas.



Manhattan
Prototypical Urban Area



Levittown, New York
Prototypical Suburban Area

Figure 1: Satellite Images of Prototypical Suburban and Urban Areas

As we look at our prototypical urban Manhattan and suburban Levittown, the two major differences are around the green space and roads. In Manhattan, green space is limited, except for dedicated areas where it is abundant. Alternatively, Levittown appears to have much more green space in a given area, but each of these is smaller. Most people likely have a backyard and front yard with a lawn of grass.

⁵ Citylab; Suburbs Are Urban Places, Too; <https://www.citylab.com/design/2016/01/suburbs-are-urban-places-too/421971/>

Streets are the other area of difference. Manhattan was built on a grid, so all of their streets follow a similar straight line across the island and make connections all across the city. They generally appear to be narrow, and the surrounding building appear to be large. Levittown's roads show enclaves of housing developments where the roads all connect to larger roads. Buildings appear to be spread out through the community.

Current Definitions

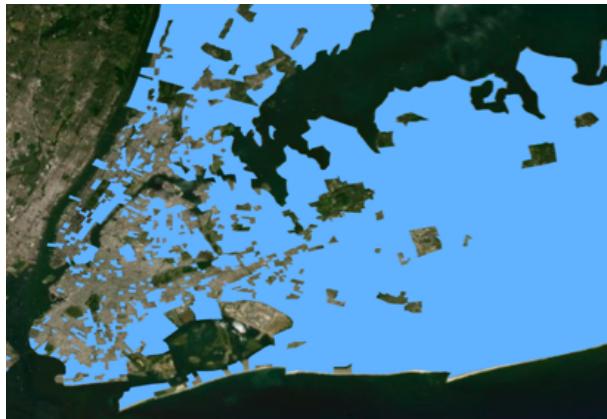
There is no standard definition for suburbs. But that doesn't mean people aren't working on it. Researchers at Harvard's Joint Center on Housing have been aiming to solve just this problem.⁶ In their 2019 report, they offered 3 definitions: "Census-Convenient", "Suburbanisms", and "Typology" (see Appendix for full table). Each of these methods offers a potential solution for our suburban-definition need.

Here is a summary of their synthesized definitions:

- **Census-Convenient** looks for non-city areas within metropolitan statistical areas (MSAs) as defined by the Census.
- **Suburbanisms** looks more into the different areas that are stereotypically seen in a suburban neighborhood along a spectrum. Peak suburbia has high rates of car commuting, homeownership, and single-family houses.
- **Typology** looks at the proportion of housing built by time periods – for suburbs, these are likely built between 1950-1969, which is largely when baby boomers returning from WWII moved away from the city.

I evaluated these definitions by plotting by Census tract for Suburbanisms and Typology definitions. These are shown in Figure 2 below. Census tracts that fulfilled the criteria for a suburb by each definition are highlighted in blue.

⁶ https://www.jchs.harvard.edu/sites/default/files/Harvard_JCHS_Airgood-Obrycki_Rieger_Defining_Suburbs.pdf



Typology
(Housing Stock made in 1950-1969)



Suburbanisms
(Homeownership, car commuting, family houses)

Figure 2: Current Suburb-Defined Census Tracts in New York City Metropolitan Area (Suburb Tracts Highlighted in Blue)

These definitions provide a contrasting view of New York City and the surrounding area. This helps to visualize how large the gap is when defining suburbs. The housing stock Typology definition likely needs more nuance and limiting factors because there are too many identified suburbs in the Manhattan area. These are prominent along Manhattan's upper east side, which may represent apartment buildings built in the 1950's and 1960's, rather than the prototypical Levittown planned development.

Suburbanism's definition feels much more limiting. But it does identify Levittown as a suburb, so without further assumptions, this model appears valid for identifying suburbs.

Can Satellites Help?

Suburbs, though common, may not be best suited for filtered definitions based on Census information. The common expression – “I know it when I see it” – applies well to suburbs. You can see this in how the housing Typology definition still identified many areas in downtown New York City. Here, satellites are likely to prove more reliable.

Satellites offer the opportunity to codify some of the easy-to-see trends, like the road styles, building heights, and green-space differences between the urban and suburban. These can be investigated through two techniques: LIDAR and Spectral Band Measures.

LIDAR

LIDAR is a newer technique of satellite imaging. It can provide three dimensional views using satellites, rather than focusing on the images alone. When we are thinking about suburbs and the built environment, it makes sense to think that a higher dimensional space will provide better information in crafting our suburb definition.

Figure 3 shows samples from the LIDAR images available in New York City. Red shows points collected above 34 feet. Blue and green colors points show the lower elevation points.

From this, we can see the water surrounding the New York City boroughs. More importantly, we can see the areas of the city tagged in red that have the highest buildings and, very likely, the most population density.

Thinking about suburbs, it seems that we are justified in assuming that Manhattan has no suburbs because the island is almost entirely red, meaning the highest elevation buildings. Interestingly, there is a line of density moving across Brooklyn and Queens. Our suburbs are likely to be in the surrounding areas, closer to the ocean.

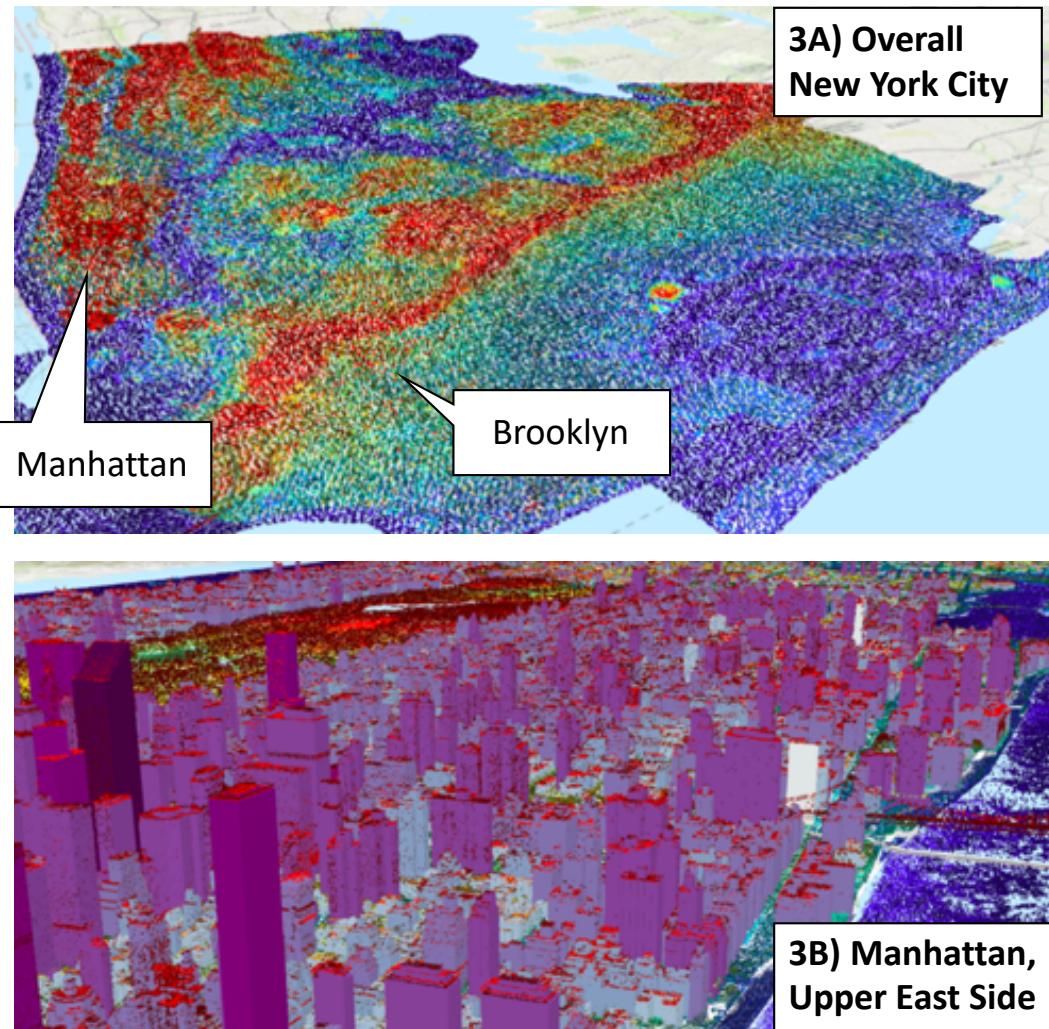


Figure 3: LIDAR Maps of New York City

Although LIDAR can be useful, it tends to be more difficult data to collect and provide to the public for free. Accordingly, we have this for New York City, but free resources to conduct this kind of analysis would be expensive and difficult to do at scale for all the suburbs in the New York City metropolitan area. The best use is to check our initial assumptions and allow us to build up a better understanding of suburbs, if any exist, within New York City. Based on these maps, suburbs are unlikely to be within Manhattan or along certain major roads within

Brooklyn and Queens. However, there are opportunities for suburbs to exist in the Southern part of the metro area, especially closer to the waterfront.

LandSat

Landsat data are widely used for geospatial analyses. Using bands of light collected over a period of time, satellite imaging can create collections of images to analyze each band of light. Image collections can alleviate issues like cloud cover or seasonal effects on the images.

There are many different band formulas that can be used for spatial analyses. Figure 4 shows a commonly used formula used to measure vegetation, called Normalized Difference Vegetation Index (NDVI). Greener areas are showing stronger bands associated with vegetation, and red areas are showing little or none of these bands.

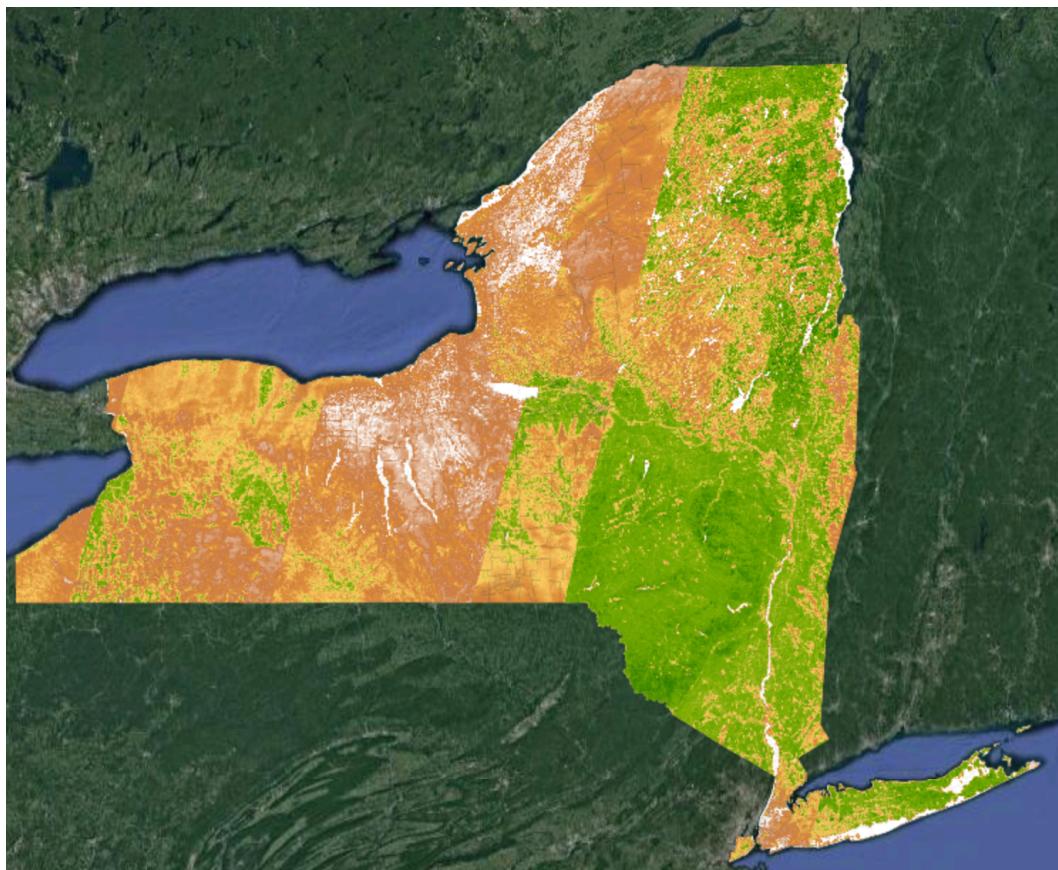


Figure 4: NDVI For New York State (Winter 2017)

On its own, a formula is interesting but will not aid us in our endeavor to identify suburbs. We need to find an average measure for vegetation for neighborhoods. Using Census tracts, we can take a few of these spectral band formulas to create suburb predictions across the New York City metro area. Figure 5 shows these for three bands. For each, I created classifications using above- or below-average groups within the band indices. Each has a legend with detailed band information.

This is a brief overview of each formula:

- **Normalized Difference Vegetation Index (NDVI)** focuses on living and healthy vegetation
- **Normalized Difference Built-Up Index (NDBI)** focuses on the built environment
- **Enhanced Built-Up and Barenness Index (EBBI)** focuses on both vegetation and the built environment



Figure 5: Spectral Band Suburb Identification by New York City Area Census Tracts (Suburbs Highlighted in Blue)

Although these appear similar, there are stark differences when you look closely across each. All identify Central Park in Manhattan, which is a clear outlier, but NDVI and EBBI do not identify many other Census Tracts on the island. NDBI does identify some neighborhoods on the Upper West Side of Manhattan. There are significant differences in the northern New York City region and northern Long Island. Some predictions contain large gaps in these areas, while others predict entire regions to be uniformly suburban.

Evaluation & Discussion

When there is no available definition, it is difficult to measure the effectiveness or usefulness of a methodology. That said, we can assume a little more than our original two places

to evaluate our different predictions. Using a few common websites,^{7,8} we can compile a list of places that are commonly referred to as some of the best suburbs in the New York City area. Table 1 shows the results of analyzing our outputs with these “best” suburbs in the area.

The ideal state is for a method to have both precision and accuracy. As previously discussed, the Typology definition is far too broad to be effective. It has flagged half the Census tracts as being suburbs. This could make sense. But many of these were flagged in the Manhattan area as well, so there is reason to doubt the accuracy of this model. Suburbanisms is much more precise in its definition. Despite only flagging 1 in 5 Census tracts as a suburb, it partially identified all but two of our testing suburbs.

The satellite-based definitions stand up well compared to our Census-based definitions. On this limited sample, the EBBI method fully identified the most suburbs, but it did miss two suburbs entirely. NDVI was also effective. NDBI was the least effective method out of these options. Even still, this method fully identified half of our test group.

Table 1: Evaluation of Online-Referenced Suburbs

Source	Place	Census-Based Definitions		Satellite-Based Definitions		
		Typology	Suburbanisms	NDVI	NDBI	EBBI
Base Assumption	Manhattan*	Suburb		Partial	Partial	Partial
Base Assumption	Levittown	Suburb	Suburb	Suburb		Suburb
HomeSnacks (Ranking List)	Scarsdale	Partial	Partial	Partial	Suburb	Suburb
HomeSnacks (Ranking List)	Sands Point	Suburb	Partial		Suburb	
HomeSnacks (Ranking List)	Lawrence	Suburb	Suburb	Suburb		
HomeSnacks (Ranking List)	North Hills	Partial	Suburb	Suburb	Suburb	Partial
HomeSnacks (Ranking List)	Oyster Bay Cove	Suburb	Partial	Suburb	Suburb	Suburb
Niche (Discussion Board)	Greenville	Suburb		Partial	Partial	Suburb
Niche (Discussion Board)	Great Neck Gardens	Suburb	Suburb	Suburb	Suburb	Suburb
Niche (Discussion Board)	Syosset	Suburb	Suburb	Suburb	Suburb	Suburb
Niche (Discussion Board)	Jericho	Suburb	Suburb	Suburb		Suburb
Niche (Discussion Board)	Kensington	Partial		Partial	Partial	Suburb
Niche (Discussion Board)	Chappaqua	Suburb	Partial			Suburb
Niche (Discussion Board)	Bronxville	Partial	Partial	Partial	Partial	Suburb
# Suburbs Fully Identified		9	6	7	6	10
# Suburbs Partially Identified		4	5	4	3	1
Total Census Tracts Flagged as Suburbs		50%	21%			

*Manhattan not considered a suburb for this analysis

Future Research Areas

There are inherent limitations conducting this analysis in a relatively small region of the U.S. Despite this, the New York City has ongoing issues with segregation and gentrification. A 2019 New York Times report found realtors in Long Island were treating homebuyers differently

⁷HomeSnacks; These Are The 10 Best New York City Suburbs For 2018; <https://www.homesnacks.net/best-new-york-suburbs-127347/>

⁸ Niche; The Best Suburbs to Raise a Family in New York; <https://www.niche.com/places-to-live/search/best-suburbs-for-families/s/new-york/>

in a way to dissuade integration through the housing search process.⁹ This continued disparate treatment makes it clear that there is an importance in creating a suburban framework specific for the New York City metro area.

This analysis proposes five methods to identify suburbs across the region of New York. EBBI and NDVI performed well to identify suburban areas throughout the region. This might be the case in other areas across the upper Midwest and Northeast of the United States. Further testing can validate this hypothesis. Realistically, this method would be less effective for suburbs in areas with much different climates, building density, or vegetation types, due to the satellite imaging reliance on these to make predictions. That isn't to say, however, that this analysis can't be tweaked for further external validity.

As a final note, there are questions about how to use this data. This is the most important question. Suburbs are a cause and a product of long-term social injustice in the U.S., and data should be made available to allow this classification to be more appropriately used in research. Sunlight on this data and the associated systemic trends can be used to fight this injustice. The effort of this analysis is to join other research happening in the U.S. and create this classification to further our understanding on the impact of social injustice and inequality.

⁹NY Times; What Happens When Black People Search for Suburban Homes;
<https://www.nytimes.com/2019/11/18/nyregion/fair-housing-discrimination-long-island.html>

Appendix:

Full Table on Suburban Categorizations

Figure 1: Three suburban definitions and how we categorized them as city or suburb for the dichotomous comparison

Definition	Dichotomous City or Suburban Categorization							
	City				Suburban			
Census-Convenient (Kneebone & Nadeau, 2015)	City: located within first principal city listed in official MSA name or within any other listed principal city with a population > 100,000							
Suburbanisms (Moos & Mendez, 2015)	Category 1: Car commuting, homeownership, and single-family housing rates below metro average	Category 2: Car commuting rate above metro average	Category 3: Homeownership rate above metro average	Category 4: Single-family housing rate above metro average	Category 5: Single-family housing and car commuting rates above metro average	Category 6: Homeownership and car commuting rates above metro average	Category 7: Homeownership and single-family housing rates above metro average	Category 8: Car commuting, homeownership, and single-family housing rates above metro average
Typology (Cooke & Marchant, 2006)	Urban Core: more than 400 housing units built before 1940 per square mile; and contiguous tracts with more than 200 pre-1940 housing units/square mile with a population density greater than 1,000 people/square mile				Inner Suburban: more than 400 housing units built 1950-1969 per square mile; and contiguous tracts with more than 200 1950-1969 housing units/square mile with a population density greater than 1,000 people/square mile	Outer Suburban: In an MSA and not categorized as urban core or inner suburban		

Github Account with analysis and data collection code:

<https://github.com/ericenglin/suburbs-analysis>