

Nantucket Buildout Analysis



An Interactive Qualifying Project
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
degree of Bachelor of Science

by
Jonathan Barr
Peter Durkin
James Heineman
David Simpson

Date:
14 December 2018

Report Submitted to:

Ms. Rita Higgins
Mr. Gregg Tivnan
Mr. Andrew Vorce
Nantucket Town Manager's Office

Professor Scott Jiusto
Professor Fred Looft
Worcester Polytechnic Institute

This report represents work of WPI undergraduate students submitted to the faculty as evidence of a degree requirement. WPI routinely publishes these reports on its web site without editorial or peer review. For more information about the projects program at WPI, see <http://www.wpi.edu/Academics/Projects>.

Link to project: <https://wp.wpi.edu/nantucket/projects/2018-projects/tmo/>

Abstract

The goal of this project was to perform a buildout analysis for the Town of Nantucket that could inform the Master Plan in 2020/2021. The analysis is based off current zoning, wetlands, and other land use criteria.

To realize this goal, the team acquired the town's assessor, GIS, and building permit data. This data was analyzed using Microsoft Excel and ArcGIS Pro. The tables, maps, and graphs produced from the data resulted in the current day depiction of residential dwellings and parcels and three different buildout scenarios: a hypothetical maximum residential buildout scenario, a high residential dwelling growth scenario for 2030, and a low residential dwelling growth scenario for 2030.

Acknowledgements

We wanted to take this time to thank all the people who dedicated their time and resources to speak and meet with us throughout the project. We could not have completed this project without their help and wanted to extend our most sincere gratitude to the following:

Liaisons:

Ms. Rita Higgins - Select Board Member
Mr. Gregg Tivnan - Assistant Town Manager
Mr. Andrew Vorce - Director of Planning

Advisors:

Professor Scott Jiusto
Professor Fred Looft

Other Contributors:

Debbie Dilworth - Town Assessor
Matt Fee - Select Board Member
David Gray - Sewer Director
Tucker Holland - Housing Specialist
Chuck Larson - Manager of Strategic Projects
Brooke Mohr - Affordable Housing Trust Fund
Peter Morrison - Nantucket Data Platform
Nathan Porter - GIS Coordinator
Rob Ranney - Assessor Administrative Assistant
Rob McNeil - DPW Director
Lauren Sinatra - Energy Director
Leslie Snell - Deputy Director of Planning

Special Thanks To:

Young's Bicycle Shop
Nantucket Yacht Club

Table of Contents

Abstract	1
Acknowledgements	2
Table of Figures	5
Executive Summary	6
1 Introduction	10
2 Background	12
2.1 Buildout Analysis: Definition and Development	12
2.1.1 Why Perform a Buildout Analysis?	12
2.1.2 How to Perform a Buildout Analysis	13
2.2 Historical Expectations on Nantucket	17
2.2.1 Whaling	17
2.2.2 Decline of Whaling	17
2.2.3 Retaining Whaling Values	19
2.3 Present Day Needs and Constraints	20
2.3.1 Preservation and Conservation	20
2.3.2 The Ferry and Local Reliance	21
2.3.3 Zoning and Building Restrictions	22
2.3.4 Recent Growth	22
2.4 Using a Buildout Analysis as a Tool	23
2.4.1 Nantucket Master Plan	24
2.4.2 Case Studies	24
2.5 Present Issues to Analyze	28
2.5.1 Affordable Housing on Nantucket	28
2.5.2 Wastewater System Capacity	29
2.5.3 Electrical Use and Capacity	30
3 Methodology	32
Mission Statement	32
3.1 Present Day Nantucket	32
3.2 Hypothetical Maximum Buildout Scenario	33
3.3 2030 Low and High Development Scenarios	34

4 Scenarios and Analysis	35
Introduction	35
4.1 Nantucket Present Day: 2018	37
• 4.1.1. <i>There are 10,456 dwellings on Nantucket currently</i>	38
• 4.1.2 <i>There are 1.22 dwellings per residential parcel</i>	38
• 4.1.3 <i>Town accounts for 40.9% of the total number of residential dwellings</i>	39
4.2 Hypothetical Maximum Buildout Scenario	39
• 4.2.1 <i>Current zoning regulations may permit up to 5,461 new dwellings</i>	40
• 4.2.2 <i>Town represent 47.8% of potential new dwellings, totaling 2,610 dwellings</i>	40
• 4.2.3 <i>New dwelling development will occur on three residential parcel types</i>	41
• 4.2.4 <i>Commercial Zone Implications Are Less Definitive</i>	43
• 4.2.4.a <i>Commercial zones may permit up to 1,440 new dwellings</i>	43
4.3 2030 Planning Projections	45
• 4.3.1 <i>“Low” growth would see 1260 new dwellings created by 2030</i>	45
• 4.3.2 <i>“High” growth would see 2,484 new dwellings created by 2030</i>	46
• 4.3.3 <i>Building permit trends are a method to estimating dwelling creation rates</i>	47
4.4 Advancement of the 2018 Buildout Analysis	49
• 4.4.1 <i>Applications of Buildout Scenarios</i>	49
• 4.4.2 <i>Buildout Analysis as a Living Tool</i>	50
• 4.4.3 <i>Future Recommendations</i>	52
Bibliography	53
Appendix A: Manual of a Buildout Analysis:	
Appendix B: Town Zoning Districts:	
Appendix C: Excel Column Definitions:	
Appendix D: Glossary	
Appendix E: Land Use Dictionary	
Appendix F: G.L. 139-8: Residential Development Options	
Appendix G: Maximum Buildout Charts	

Table of Figures

Figure 1 - Zoning Map of Callicoon, NY (Meltz, 2010)	14
Figure 2 - Residence Map of Callicoon, NY (Meltz, 2010)	14
Figure 3- Built out Area of Callicoon, NY (Meltz, 2010)	14
Figure 4- Buildable Area of Callicoon, NY (Meltz, 2010)	14
Figure 5- Buildable Area of Callicoon, NY (Meltz, 2010)	15
Figure 6 - Environmental Zones of Callicoon, NY(Meltz, 2010)	15
Figure 7- Projected Residencies of Callicoon, NY (Meltz, 2010)	15
Figure 8 - Sample Lot Calculation	16
Figure 9 - Callicoon Buildout Analysis Total Lot Analysis (Meltz, 2010)	16
Figure 10 - Nantucket Population from 1790 to 2018 (World Population Review, 2017)	19
Figure 11 - Cape Cod future buildout (Cape Cod Commission, pg. 17, 2012)	26
Figure 12 - Median Sales Prices of Martha's Vineyard Homes (Martha's Vineyard Buyers Agency, 2018)	27
Figure 13 - Nantucket Seasonal demand 2010 -2011 (Antonio, Phillips, Taleb, 2011)	31
Figure 14 - TMO Master Table	35
Figure 15 - Nantucket Districts & Dwelling counts	37
Figure 16 - Nantucket District & Parcel Data, Present Day; Excerpt from Table 1	38
Figure 17 - Selection from Table 1 - Nantucket District & Parcel Data, Max Buildout Scenario	40
Figure 18 - New Residential Dwellings in Residential Zones	41
Figure 19 - Undeveloped Parcels	41
Figure 20 - Secondary Dwelling Eligible Parcels	42
Figure 21 - Subdividable Parcels	42
Figure 22 - Maximum Buildout	43
Figure 23 - New Residential Dwellings in Commercial Zones	43
Figure 24 - New Residential Dwellings in Commercial Zones Calculations	44
Figure 25 - Commercial Buildout Map	44
Figure 26 - Selection from Table 1 - Nantucket District & Parcel Data	45
Figure 27 - Selection from Table 1 - Nantucket District & Parcel Data	46
Figure 28 - Nantucket Single Family Dwelling Permits, FY01 - FY18	47
Figure 29 - Nantucket 2030 Scenario Comparison	48
Figure 30 - Total new dwellings projected by 2030 from both scenarios	48
Figure 31 - Sewer needs areas & piping overlaid with maximum buildout map	50

Executive Summary

Introduction

A buildout analysis is a detailed study that projects the hypothetical number of future dwellings, subject to constraints. The analysis serves as a foundation for a Master Plan, a decade-long community development plan that can be used to project different town needs including sewerage, electricity, affordable housing, population growth, school class size expectation, other town services and needs.

This buildout analysis only explored the buildout of residentially zoned parcels, as these parcels represent the majority of future Nantucket housing developments. A brief computation on development in commercial zones is included in the full report, but was not the primary focus of the analysis. All of the data obtained for this project came from town databases and is current as of September, 2018.

Mission Statement

The purpose of this project was to perform a buildout analysis for the Town of Nantucket to estimate the island's future residential dwelling growth and provide a tool that can be used to analyze the town's infrastructural needs. The buildout analysis was conducted by determining the number of current residential dwellings, creating a hypothetical maximum scenario, and then projecting both high and low dwelling growth scenarios for 2030.

Methods

1. Present Day Nantucket
 - I. Parcel data collection from GIS, assessor's office
 - II. Divide residential dwellings into different island districts
 - III. Identify all parcels that already have one or more dwellings per parcel in residential zones
 - IV. Calculate dwellings/parcel to find the average number of dwellings per parcel
2. Hypothetical Maximum Buildout Scenario
 - I. Parcel data collection from assessor's office and GIS Coordinator
 - II. Categorization of parcel data - which parcels are buildable and subdividable
 - III. Clean data to eliminate inconclusive data
 - IV. Data Analysis and Mapping
3. 2030 Low and High Development Scenarios
 - I. Parcel data collection from planning department
 - II. Conduct focus group of experts to create hypothetical 2030 dwelling numbers scenarios

- III. Create a low and high dwelling growth scenario
- IV. Tool for town planners

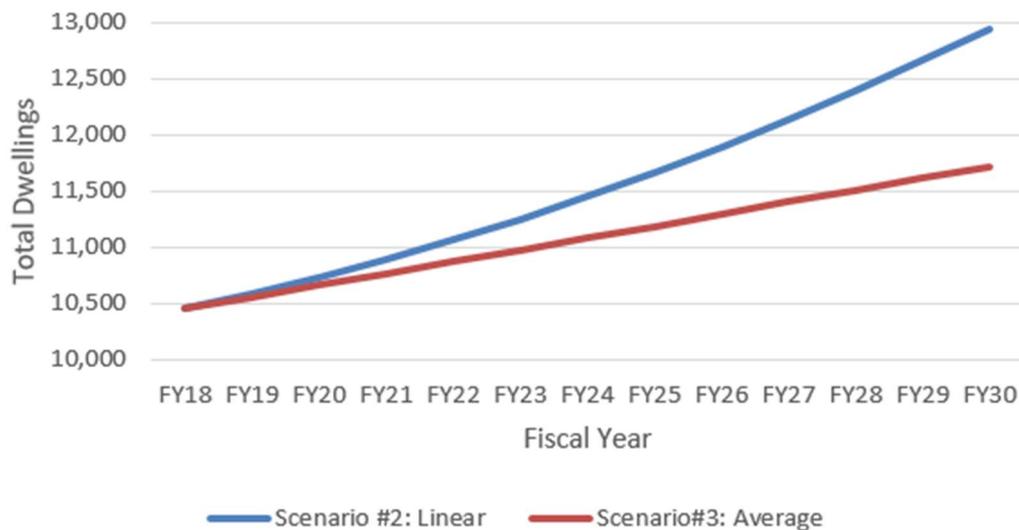
Results

The Master Buildout Analysis data in Table 1 first reveals Present Day (green) Nantucket by district, which is a snapshot of the current residential parcels and single/multi-dwelling parcels existing on Nantucket. These values provide the basis of comparison for the next section, Hypothetical Maximum Buildout (purple). This second section is the maximum buildout of residentially zoned parcels, broken down by total and district. These values are not a prediction; but instead provide an estimate the potential development capacity on the island. There are also associated uncertainties and assumptions that are discussed in the main report. The last two sections, Low and High Scenarios (yellow), present possible dwelling growth by 2030, the expected end of the community's next Master Plan. Using building permit data, the projected Low and High Scenarios can be compared to both Present Day Nantucket and the Hypothetical Maximum in this table.

District	Present Day: 2018					Hypothetical Max Buildout			2030 Low Scenario		2030 High Scenario	
	Residential Parcels	Total Dwellings	% of Total Dwellings	Parcels with 1 Dwelling	Parcels with 2+ Dwellings	New Dwellings	% New Dwellings	% Potential Growth	New Dwellings	% Potential Growth	New Dwellings	% Potential Growth
Grand Total	10697	10456	100%	6821	1760	5461	100%	52.2%	1260	12.1%	2484	23.8%
Town	4166	4276	40.9%	2933	661	2610	47.8%	61.0%	602	14.1%	1187	27.8%
Scon	963	554	5.3%	355	97	598	11.0%	107.9%	138	24.9%	272	49.1%
Airport	377	335	3.2%	221	54	368	6.7%	109.9%	85	25.4%	167	49.9%
Surf	595	719	6.9%	349	167	289	5.3%	40.2%	67	9.3%	131	18.2%
Brant	318	330	3.2%	215	55	239	4.4%	72.4%	55	16.7%	109	33.0%
Quid	169	156	1.5%	82	36	124	2.3%	79.5%	29	18.6%	56	35.9%
Tom	612	522	5.0%	354	83	116	2.1%	22.2%	27	5.2%	53	10.2%
Dionis	273	336	3.2%	124	104	115	2.1%	34.2%	27	8.0%	52	15.5%
Mad	325	284	2.7%	242	21	101	1.8%	35.6%	23	8.1%	46	16.2%
Polpis	147	178	1.7%	62	55	98	1.8%	55.1%	23	12.9%	45	25.3%
Harbor	255	300	2.9%	124	84	91	1.7%	30.3%	21	7.0%	41	13.7%
Other	2497	2466	23.6%	1760	343	712	13.0%	28.9%	163	6.6%	325	13.2%

The Low Scenario was the average amount of single family dwelling permits from 2001 to 2018 subtracting average demolition, calculated to be 105 net new dwellings per year. The High Scenario is the linear trend of single family dwelling permits from 2015 to 2018, showing 13.6 new dwelling permits issued per year. This trend assumed that the current increasing rate of building permits issued would continue from now until 2030. Graph 1 illustrates the two scenarios.

Scenario Comparison



Finding Statements

These finding statements illustrate the critical takeaways from the Buildout Analysis. The findings are broken down into Present Day Nantucket and three Hypothetical Buildout Scenarios.

Present Day Nantucket

- There are 10,456 dwellings on Nantucket currently
- There are 1.22 dwellings per residential parcel
- Town accounts for 40.9% of the total number of residential dwellings

Hypothetical Maximum Buildout Scenario

- There are three main types of parcels that could see new residential dwelling development. These parcel types are:
 - Undeveloped: Parcel currently with no dwellings
 - Secondary Dwelling Eligible: Parcel with 1 dwelling and ground cover for a second dwelling
 - Subdividable: Parcel with land area and ground cover available
- Current zoning regulations may permit up to 5,461 new dwellings on the Island
- Town could fit 2,610 new dwellings in residential zones

2030 Low and High Development Scenarios

- “Low” growth would see 1260 new dwellings created by 2030
- “High” growth would see 2,484 new dwellings created by 2030

Recommendations

This project has potential to be the baseline for future IQP projects on Nantucket. Due to the time constraints of the project, the team was unable to look deeply into the different impact areas that our buildout could affect. There are three main recommendations stated below that are focused on advancing the use and effectiveness of the Buildout Analysis: the various applications of the analysis, the tools of the analysis that can be modified, and recommendations for further adjustments and updates for the information collected.

1. Apply this Buildout Analysis to Nantucket Town services: This Analysis of hypothetical new dwellings could be used to project future Town needs such as electricity, affordable housing, potable water, etc.
2. Use the Buildout Analysis as a tool: This Analysis has the ability to be updated and readjusted as seen fit for future uses. There are six different data sources that were used to create the Buildout Analysis. This data can be updated in order to ensure that the analysis is as accurate as possible for the Master Plan.
3. Address uncertainties: Some uncertainties in this analysis are conserved areas, wetland boundaries, development of tertiary dwellings or other dwelling sources, geometric issues such as septic systems, wells, or leach fields, and more that are not mentioned here explicitly. We recommend that if the town performs a buildout analysis in the future, these uncertainties be taken into consideration and managed more thoroughly.

1 Introduction

Nantucket, an island economy just 30 miles off the coast of Massachusetts, is a vibrant community with a booming tourist industry. However, because of Nantucket's identity as a tourist destination, house values have sharply risen over the past decade, leaving much of the working and middle classes priced out of the affordable housing market (Housing Nantucket, 2018). As Nantucket's population and home values have continued to increase, the island and its non-profit organizations struggle to conserve the land and its natural beauty (Nantucket Land Bank, 2018). This can create a conflict of interest: space is needed to house people and serve tourists (G. Tivnan, Phone Interview, Sept. 20th, 2018); yet at the same time, tourists are attracted to the island because of its historic importance and ambience, as well as its beautiful conserved spaces.

The many conflicts in development, town services and community interests makes a new master plan a valuable document to this community. For a master plan to be effective, estimating a town's growth trajectory and land use is a basic requirement. A common tool to estimate growth is a buildout analysis, which uses zoning laws, conservation regulations, and existing property lines to create an estimate of how many new dwellings and commercial buildings can actually be built subject to various constraints. According to conversation tools.org:

"A build-out analysis answers basic questions: If existing land development ordinances and open space programs (or lack thereof) remain unchanged, how much land might ultimately be developed? At what density and where? And with what impact on the community?"

Eventually, towns use their buildout analysis to prepare and communicate financial estimates, whether it be for infrastructure (e.g. town water, power, etc.), their school system, or emergency services (Nantucket Planning and Economic Commission, 2009).

In 1997, a buildout analysis was conducted on Nantucket to guide affordable housing efforts on the island. Not only is that analysis now out of date, there were some limitations with the study. For example, it did not include the utility growth that would result from projected population increases, nor did the analysis provide a timetable or scenario for population growth (A. Vorce, Phone Interview, Sept 13, 2018). A new master plan, scheduled for 2020/21, will incorporate these, and other concerns such as sewerage, electricity, water, and how much affordable housing can be provided for the town. All of these concerns are affected by dwelling growth; for example, Nantucket's sewerage system, which is primarily located throughout the town district, doesn't extend to the entirety of the island and requires installation and upgrading due to the buildout that Nantucket could see in the next few years. By using a buildout analysis as a tool, it's possible to estimate the amount of sewer piping needed to sustain the island based on the projection of new dwellings. In fact, all town services and needs, as well as the

2020/21 Master Plan, would benefit from an updated buildout analysis with different growth scenarios.

The purpose of this project was to create a buildout analysis for the Town of Nantucket to estimate the island's future growth and provide a tool that can analyze the town's infrastructural needs. The buildout analysis was conducted by determining current residential dwellings, creating a hypothetical maximum scenario, and then projecting both high and low dwelling growth scenarios for 2030.

2 Background

The purpose of this section is to provide background information and definitions that will provide understanding of this project.

2.1 Buildout Analysis: Definition and Development

To understand the term “buildout analysis”, it is important to understand what buildout means. The term buildout has three distinct definitions:

“The growth, development of something”

“The state of maximum development as permitted by plans or regulations”

“The execution of a building or community building plan”

Each definition can be a useful lens to understand what a buildout analysis seeks to provide; as population centers grow in size, it becomes necessary for the governing body to plan not just for an increased population, but for the expansion of the services the town provides, whether it be schooling, electricity, or affordable housing, amongst others.

The third definition provides a link to the larger importance of a buildout analysis; it is a tool that a community can use in preparing a building plan. The community can be a town, city, or any specified area, such as an island. A completed buildout analysis identifies parcels of a community that are not fully developed, areas that are not completely built out. A buildout analysis is a manner to estimate future growth from current laws as well as extrapolate other services and needs for a community (Lacy, 1990). A master plan is a community building plan for future layout of a community that is intended to guide development for the next 10 to 20 years. Topics of a master plan include, but are not limited to, area land use, housing, economic development, and natural resources. A community can use a buildout analysis preemptively or during a period of growth as a method to analyze the future needs and funding of each of these topics.

2.1.1 Why Perform a Buildout Analysis?

A buildout analysis is not limited to analyzing the number of homes that can be constructed. Often, a buildout analysis is used in identifying a larger problem. On Martha’s Vineyard, a buildout analysis provided context for affordable housing needs. On Cape Cod, a buildout analysis looked at the efficiency and future needs of individual and combined wastewater systems. For both communities, the buildout analysis provides context for the scope of the problem or the expected budget of a corresponding project.

With a Nantucket buildout analysis, analyzing the impacts of growth is a high priority (R. Higgins, Phone Interview, Sept 13, 2018). Like every town, Nantucket is finite in size. However, Nantucket is a special case, for a few reasons.

Isolated 30 miles offshore from mainland Massachusetts, items are transported to the island via ferry or airplane. This inflates the cost of living on Nantucket. The median home price is \$1.5 million (Great Point Properties 2018), making availability of affordable housing scarce. Nantucket is unlike other towns due to its tourist and seasonal resident boom, straining the town's resources. The town must prepare enough electricity, sewerage, drinking water and housing for the summer months, much of which are not needed the rest of the year. The community, with direction from the town master plan, can plan for new construction in vacant and underdeveloped land; a buildout analysis gives the town a multitude of maps and estimates of growth.

2.1.2 How to Perform a Buildout Analysis

A Manual of a Buildout Analysis, written by Jeffrey Lacy from the University of Massachusetts Amherst, provides 'a summary of essential steps' in determining vacant land development. The Manual describes different areas that are not developable such as land under public ownership or deed restriction; the exact restrictions are based in each individual town's bylaws. By taking out all land that is unavailable, the 'net usable land area' (NULA) can be calculated. Zoning laws can then be applied to all remaining developable land as appropriate. This allows projected growth data to be made as accurately as possible (Lacy, 1990).

Vacant land is not the only land available to construction. Some parcels are only considered if they meet certain criteria, including parcel size, zone, conservation restrictions, and of the like. Large parcels could be subdivided within existing zoning laws. Secondary dwellings also have the potential to increase the availability of land.

The Callicoon Buildout Analysis of 2010, prepared for Callicoon NY, breaks down the steps to calculate the NULA. Listed below are the steps (Meltz, 2010):

1. Identify areas that already have residential development and therefore would not allow new development
2. Identify properties subject to conservation easements, or are owned by government entities not likely to allow development
3. Identify areas in the town having environmental constraints that would not support new residential development
4. Calculate the amount of new residential development allowed by the current land use regulations in the remaining undeveloped areas of the Town.

These steps are shown through the figures that follow.



Figure 2 - Residence Map of Callicoon, NY (Meltz, 2010)

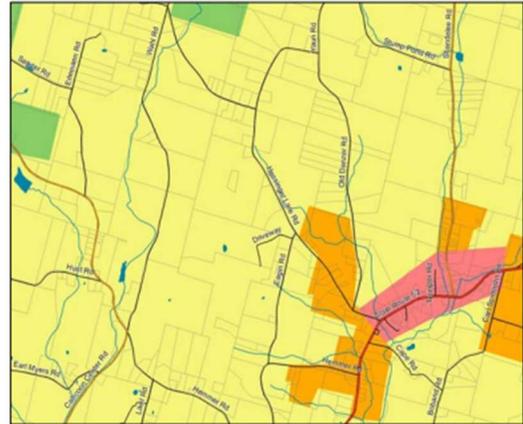


Figure 1 - Zoning Map of Callicoon, NY (Meltz, 2010)

Figure 1 is a residence map of the town of Callicoon, NY. Each green dot in Figure 1 represents an existing residency. The light grey outlines represent property lines. Figure 2 is an assembly of the current zoning district boundaries in the town, with minimum lot sizes and density. Each different zone is color coded. For example, pink might be a commercial zone while light yellow could be a residential zone. Each zone has its own setbacks and zoning regulations (Meltz, 2010).



Figure 3- Built out Area of Callicoon, NY (Meltz, 2010)

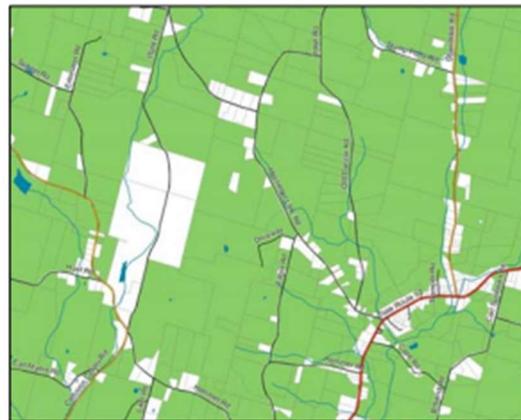


Figure 4- Buildable Area of Callicoon, NY (Meltz, 2010)

Figure 3 highlights, in orange, parcels that are currently built out. A fully built parcel is: a parcel with existing residents that cannot be subdivided, commercial or public land that will likely not be developed, conserved land, or properties with government agencies. Figure 4 shows, in green, land that is available to development subject to further environmental considerations (Meltz, 2010).

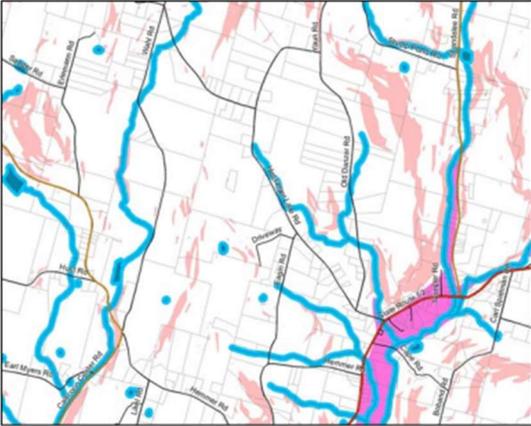


Figure 5 - Buildable Area of Callicoon, NY (Meltz, 2010)

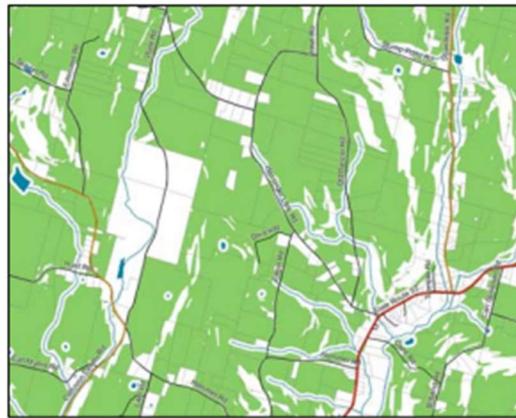


Figure 6- Environmental Zones of Callicoon, NY (Meltz, 2010)

I

Figure 5, the Callicoon analysis maps the environmental constraints. These can include, but are not limited to, water and streams, wetlands, flood hazards, steep slopes, and buffers from streams and wetlands. In figure 5, blue represents water and water buffers, pink is wetlands and wetland buffers, purple is flood hazard and red is steep slopes. Figure 6 maps, in green, the available land after all environmental and built out constraints are included. This is determined as areas that Figures 3 and 5 do not highlight. (Meltz, 2010).



Figure 7- Projected Residences of Callicoon, NY (Meltz, 2010)

Figure 7 shows a map of estimated residences (red dots) for the available land shown in Figure 6. The maximum number of lots can be calculated by dividing the NULA by the minimum lot size for that zone. Plotting these on a map can determine if the maximum can be reached given the geometry of the area, and can be a visual aid in determining areas that may experience the most growth. (Meltz, 2010). Below, Figure 8 briefly describes the calculation to determine the total number of lots that a town can be divided into. "Area" refers to buildable area for each zone; this would be calculated from Figure 6.

ZONE	Area, in Acres	Minimum Lot Size (Acres)	Potential New Lots
Residential - 1	100	1	100
Residential - 5	100	2	50
Limited Use	250	2	125
TOTAL	450		275

Figure 8 - Sample Lot Calculation

Different buildout scenarios can also be considered. In the case of Callicoon, different scenarios were made as follows:

- No environmental constraints considered
- Water, wetlands, and flood hazards considered
- With Water and Wetlands: 100 foot buffers, Flood Hazard constraints considered
- All environmental constraints considered, including Slopes over 25%

Results are located in a final table, Figure 9 (Meltz, 2010)

Callicoon Buildout Results

Using the Current Minimum Lot Size Requirements

Zoning District	BD Business	SD Settlement	RU Rural	CD Conservation	Totals
Existing Residences	104	359	789	286	1,538
Minimum Lot Size	1 acre	1 acre	2 acres	3 acres	
Potential New Residences (No environmental constraints considered)	62	967	6,167	2,861	10,057
Potential New Residences (Water, Wetlands, and Flood Hazards constraints considered)	49	884	6,020	2,724	9,677
Potential New Residences (Water, Wetland, 100 ft buffers of Water and Wetlands, and Flood Hazard constraints considered)	48	819	5,624	2,566	9,057
Potential New Residences (All environmental constraints considered, including Slopes over 25%)	32	724	5,040	1,925	7,721

Figure 9 - Callicoon Buildout Analysis Total Lot Analysis (Meltz, 2010)

Regardless of the template used, GIS (Geographic Information System) software is a critical component of a buildout analysis. GIS details the zoning layers, parcel information, and other codes can be easily manipulated and formed into residential maps, detailing fully built parcels, buildable parcels, and environmental constraints; an output would be buildable areas and new potential residence zone maps.

2.2 Historical Expectations on Nantucket

A thorough understanding of a town's historical and present needs will create a better informed buildout analysis. On Nantucket, preserving the past is equally as important as building the future for the island. While few structures remain from the peak of the whaling era, much of the style and history remains and is a significant draw for tourists. Some of the major historical events are outlined below.

2.2.1 Whaling

In 1659, nine men bought the island for a total investment of 30 pounds and two beaver hats. It later became part of the Province of New York. The first settlers arrived in 1661, most of them being from Salisbury, Massachusetts. In 1686, the Jethro Coffin house was built. It became a historical Landmark in 1968 and is now a historic house museum owned and operated by the Nantucket Historical Association. Whaling emerged in Nantucket in 1712, and quickly became a central part of Nantucket's economy (Macy, Macy 1880).

Though New Bedford rooted itself as the whaling capital of New England in the early 1700's, it was quickly taken over by Nantucket. Its offshore geography and hardworking individuals made it an ideal location for whaling, and it earned the title of "Whaling Capital of the World". Whaling became the main economic source of Nantucket's prosperity and provided a culture to the island that was very unique in its nature. Nearly 90% of Nantucket's economy directly involved whaling, either in preparing ships or oil for sale. The Whaling Museum, which has 60,000 visitors per year, was a candle factory that used sperm whale oil in order to create the candles. Unfortunately, the Great Fire of 1846 greatly damaged the building, and destroyed many of the other buildings built during the whaling era (Tyler, 2015).

2.2.2 Decline of Whaling

By 1830, Nantucket was no longer the "Whaling Capital of the World"; New Bedford had gradually taken over, with more ships and greater availability of labor. The innovation of kerosene in 1846 undercut the usefulness of whale oil; on Nantucket, kerosene began replacing whale oil in street lamps. Railroads became more prevalent in the US (Philbrick, 2015); not only did it make it cheaper to ship oil inland, the discovery of black oil in Pennsylvania in the 1830s

meant that inland oil could be easily shipped. Through the 1840s, silt deposits in the harbor grew significantly, preventing larger ships from being able to enter. Instead, these ships chose New Bedford and its deeper harbor (Philbrick, 2015).

The final blow was the Great Fire in 1846. A seemingly harmless chimney fire broke out in William Gearly's Hat store at eleven in the evening. Nantucket did not have a fire department; instead, two fire companies had a disagreement over who should have the "honor" of putting the fire out. However, the fire quickly spread, aided by the dry, rainless conditions that had preceded for several weeks (Philbrick, 2015). The narrow, densely packed streets allowed the fire to quickly spread; to reduce the fuel for the fire, townspeople decided to blast buildings. However, swirling winds ensured that the blaze would continue, and eventually it reached the docks. Citizens watched as the fire set ablaze to "[w]ooden wharves, ropewalks, cooperages, and storage houses, all soaked with oil, and caked with pitch and grease" (Yesterday's Island, Today's Nantucket, 2013). Eventually, it reached the casks of oil stored in the warehouses, which burst and spilt into the harbor, where the water burned for much of the night. Over one-third of the buildings on Nantucket were destroyed in under 12 hours, including most of the colonial-era houses and buildings along Main Street (Philbrick, 2011).

Nantucket, with resources from previous whaling expeditions, had the grit to rebuild. For a period of about 50 years, buildings were constructed in brick instead of timber - a more fire resistant design (Bergman, 2014). Selectmen ordered the streets be built wider and more spread out to prevent fires from spreading quickly. The town also rebranded itself during the rebuilding process to be a vacation spot rather than a whaling community. The town community came together and residents realized that their survival would depend mostly on the bonds between them (Philbrick, 2011).

Between 1850 and 1870, about half of Nantucket's full time population left the island. Some left as a direct result of the Great Fire, others because of the lack of work. Whales became more scarce, leading to longer voyages. As the need for whale oil decreased, fewer ships left the harbor; fewer ships and longer voyages meant there were fewer jobs for ship mechanics on Nantucket. The final blow to the whaling industry was the Civil War, when Confederate Commerce Raiders destroyed virtually all of Nantucket's remaining vessels (Mello, 2017). In 1840, the population peaked at over 9,000 year-round citizens; by 1870, that number had dropped to little more than 4,100 people. This would then continue to slowly drop until 1920, when the population reached a low of 2,797 residents (World Population Review, 2017).



Figure 10 - Nantucket Population from 1790 to 2018 (World Population Review, 2017)

2.2.3 Retaining Whaling Values

Islanders attempted to industrialize the island to no avail. The Atlantic Straw Factory employed over 200 women from 1850 to 1866. Mitchell and Hayden’s Shoe Factory survived only from 1871 to 1873 before it was destroyed in a fire (White, 2015). Instead, the island flourished as a tourist destination. The Jared Coffin House, formerly known as the Ocean House Hotel, opened in 1847. The building, currently an operating hotel, was one of the primary locations for public celebrations (Abrado, Kates, Kesack, 2013). In 1905 the New York Yacht Club, Station No. 11 opened on the island, bringing in individuals who enjoyed racing their boats. Also in 1905, a proposition to deepen the harbor passed, likely to entertain larger boats with their increasingly wealthier owners (Abrado, Kates, Kesack, 2013).

Citizens realized that the Nantucket “brand” was becoming intrinsic to the success of the community. Advertising the unique aspects of the island, prioritizing history, became a focus. In 1898, the town allotted \$1,000 for advertising efforts, an amount that would steadily increase over the following decades. Pamphlets and maps ensured newcomers and vacationers had the opportunity to explore every nook and cranny of Nantucket (Abrado, Kates, Kesack, 2013).

Visually, much of the island matches the style of the oldest house on the island, the Jethro Coffin House. Built in 1686, it utilized wooden shingles as the siding material, which quickly became a staple on Nantucket. This “shingle phenomenon” had little to do with architecture; shingles were the cheapest and most available building material on the island. The island’s seafarers knew how to build boats, not houses; they utilized shingles as the best waterproofing technique for buildings and boats in constantly wet conditions. It wasn’t until Federal and Greek Revival styles (roughly 1830-1880s) of architecture reached the island that

clapboard siding began to be used on top of brick facades. Renovations and repairs have resulted in over half of the Greek Revival style buildings being re-shingled. Shingle style returned to the forefront of architecture in the mid-1880s, and shingles became the only acceptable siding material (Lang, Stout, 1995).

Today, historical committees require conformity to these traditions, requiring all construction to use wooden shingles; specifically, 5" White Cedar shingles with only 3 ½" visible. Despite their increasing cost, propensity to degrade in damp weather, and the increased maintenance (Lang, Stout, 1995), the townspeople are continuously eager to preserve the visual brand of Nantucket.

2.3 Present Day Needs and Constraints

Traditional house decor and cobblestone sidewalks and roads is an important part of Nantucket's history and brand. The economic reliance on the town center, the ferry and the preservation of the land on the island are growing considerations on Nantucket. Since 1972, zoning laws have provided restrictions, such as height and setback for buildings on the island. A complete analysis must combine both historical and these present needs.

2.3.1 Preservation and Conservation

Throughout the 20th century, Nantucket marketed itself towards middle class families as both a vacation spot and as a destination to live. An abundance of families and space led to single family homes and low density. Multi-family, condominium, and apartment style buildings are extremely uncommon; this has led to astronomical renting and real estate values. To alleviate this problem, Nantucket has allowed large developments, such as 6 Fairgrounds Road and Richmond Great Point, that will provide 300 year-round rentals and 33 additional affordable houses. (Housing Nantucket, 2018). Much of current construction is renovation of existing houses. While there is a trend to renovate single family houses into multi-family, affordable housing is still for year round residents is a major concern on the island. Incorporating the "replacement" trend on Nantucket is vital (A. Vorce, Phone Interview, Sept 13, 2018).

Expansion meets conservation head on, as dozens of conservation organizations on Nantucket preserve the island's natural beauty. Over 60% of the island is conserved by these organizations, while just 4% remains undeveloped (G. Tivnan, Phone Interview, September 20, 2018). Since 1975, Nantucket has been designated a historic district; this provides a great deal of leeway for organizations to preserve land. Historical buildings are bought and preserved; other pieces of land are left empty or are "undeveloped", a process that includes removing structures and buildings (G. Tivnan, Phone Interview, September 27, 2018). The Nantucket Conservation Foundation owns one-third of the island; 75% has been donated since it was founded in 1963 (Nantucket Conservation Foundation, 2018). The Nantucket Land Bank receives funds from the Town of Nantucket; no other group does. Homes bought on the island

pay a 2% tax that the organization uses to buy open spaces and resources. The group has “first right of refusal”, which is first opportunity to buy any piece of land that goes up for sale (Nantucket Land Bank, 2018). There is also discussion to add a further 1% fee to homes sold for over \$4 million, which would be used to fund affordable housing projects (G. Tivnan, Phone Interview, September 27, 2018). Both groups highlight the incredible attitude islanders display towards preserving their island. On the contrary, these groups fuel the issues of density and affordability on Nantucket.

2.3.2 The Ferry and Local Reliance

For Nantucket, the ferry system originating from New Bedford and Hyannis are vital to the livelihood of the island. Despite their reliance on them, the ferry evokes both positive and negative opinions from Nantucketers (Held, Pilsch Jr, 1994).

The ferry on Nantucket operates in the same vicinity as the old harbor for whaling ships. Since the whaling days, the harbor was the center of commerce on the island. It was the hub for work, as the great majority of the economy was based on whale ships and the whale oil they brought back. Today, whaling has been replaced by the tourist industry, and the ferry system is responsible for the main economical requirements for Nantucket: freight and tourists.

Islanders appreciate the necessity of the ferry. Business owners are indebted to a system that provides a constant flow of willing customers across a continuously widening season, which has expanded to reach from March to October (Held, Pilsch Jr, 1994). Not coincidentally, this mimics the economic growth that is becoming considerably less seasonal.

Islanders also appreciate the ferry providing a wide variety of trips to and from the mainland; yet, year round residents do not enjoy the constant stream of tourists and other “non-islanders” that these trips bring during the summer months (Held, Pilsch Jr, 1994). With people and goods come more pedestrian and automotive traffic, congestion, overbuilding, and infrastructure strain. The ferry is also partially responsible for the rapid increase in property values that are concentrated in the town area (Held, Pilsch Jr, 1994); other cities, such as Brisbane, Australia, have been modeled to show that, for every kilometer closer a house is to a ferry stop, the property value increases 4% (Burke, Mulley, Tsai, Yen, 2014). On Nantucket, it would appear that a similar, if not more extreme, increase in property values is occurring.

It seems unlikely that any sort of “decentralizing” of the island would occur. The current location of both the high speed and traditional ferry terminals are side-by-side, and adding another location further away on the island is inconceivable. Businesses also enjoy the center of town by the ferry hub as it ensures a constant high-volume flow of potential customers to enter their shops and restaurants; no other location on the island can guarantee this. This makes the town and ferry an area of primary concern; it becomes the location where infrastructure becomes most taxed and where town services become most important. With this, the ferry becomes a significant design constraint when creating a buildout scenario.

2.3.3 Zoning and Building Restrictions

In the Commonwealth of Massachusetts, individual towns and cities have rights to divide the town into districts as they see fit. They have the authority to adopt ordinances and bylaws to regulate all land buildings and structures. This power comes from Chapter 40A of the Massachusetts General Laws titled ZONING (The Zoning Act, 1975).

It was not until 1972 that Nantucket developed its own set of zoning legislation which explains some of the ill-prepared streets. Similarly, people sought to retain the atmosphere that the island embodies. The town established zoning to promote the health, safety, convenience, morals and general welfare of Nantucket's inhabitants as well as lessen fire danger and congestion (congestion refers to the street traffic on the island). With zoning laws, the town would be able to have more control of road sizes, and space between buildings (Town of Nantucket, 2006).

Chapter 139 of the Code of the Town of Nantucket lays out the exact duties and powers of the zoning board of appeals, but its main duty is to grant variances and special permits when needed. A variance is a request from a property owner or future property owner to deviate from the zoning laws, which the Board decides on a case to case basis. If granted, a special permit is allowed for construction. The Board makes its decision based on a number of different pieces of information which includes: circumstances relating to soil conditions, shape or topography of the land and structures on the land. For example, hills, divots and large rocks or trees restricting construction would come into consideration of the Board's decision.

Chapter 139 of general legislation states that the Town of Nantucket has authority from the state under MGL (Massachusetts General Laws) Chapter 40A to create zoning laws from their own legislation. Under these provisions, the use, construction, repair, alteration and height of buildings and the use of land and the size and shape of lots are regulated by the Town of Nantucket (Code of the Town of Nantucket, 2018). Article 17 of Chapter 139, titled Height Limitations, outlines the height limitations the town has set. There can only be one highest point for each building or structure, for which the maximum height can be measured from. No building or structure shall exceed 32 feet except in Commercial Downtown or Commercial-Mid-Island Districts, which may go up to 40 feet. Similar to a zoning variance, the Board of Zoning Appeal can also give special permit granting authority may grant chimneys, antennas, water tower, and standpipes to exceed such height limitations. These decisions are done on a case to case basis (Code of the Town of Nantucket, 2018).

Knowledge of the zoning laws on Nantucket are vital to a buildout analysis. In the first steps of any analysis, the zoning districts are identified in order to properly parcel out the land.

2.3.4 Recent Growth

Over the past fifty years, much of the growth on Nantucket can be attributed to Walter Beinecke Jr. When he first came to Nantucket, he fell in love with the island and would alter the course of the island's growth. Beinecke prioritized historical architecture and founded the

Nantucket Historical Trust, a nonprofit organization dedicated to preserving the historical integrity of the island's architecture. Beinecke also purchased a mansion on 72 Main Street, the Jared Coffin House, The White Elephant and Zero Main Street Nantucket Boat Basin. When the congregational church required a new steeple, he had one designed off-island and delivered it by helicopter. Eventually his efforts gained recognition and Ronald Reagan awarded him the President's Historic Preservation Award (Cocuzzo, 2016).

"The Nantucket we see today is largely the vision of Walter Beinecke, Jr.," says Michael May, the executive director of the Nantucket Preservation Foundation. "He was one of the first businessmen in the country to understand that historic preservation was an asset to a community that if embraced would strengthen the local economy" (Cocuzzo, 2016).

Beinecke purchased roughly 80% of the commercial real estate in the town and raised the rent of these stores, squeezing out the less appealing ones, and replacing them with higher-end storefronts. Beinecke also renovated the docks to become more appealing to yachters and pressured ferries to increase their rates as well as decreasing their passengers (Cocuzzo, 2016). By 1968 he controlled two of the three gas stations, five inns, the majority of the stores in the town, and a large landmass he put into conservation. Beinecke had been cast in a bad light for his efforts from some residents of the island that saw his actions as a monopoly - that he was using his capital as a way to push them out. Others saw that his vision was overall better for the island. Beinecke eventually sold off his most of his Nantucket properties to the First Winthrop Corporation in 1987 for \$55 million (Cocuzzo, 2016).

Some believe that he would be unhappy with the island's current state. Beinecke's daughter explained, "He would have a fit with the scale of the houses and the things that are being built. They really don't fit with the island." It is ironic that Beinecke would be unhappy with all the wealth he had attracted to the island, considering that it was his goal. What he might be most unhappy with would be the lack of historical integrity in this new development since he was more of a preservationist (Cocuzzo, 2016).

A population boom from 3,700 in 1970 to 11,008 people in 2018 has resulted in real estate inflation and a crisis of affordable housing. The median housing price of \$1,530,000 (Great Point Properties, 2018) has a huge gap from the median income of a Nantucket resident of \$139,101 (Nantucket Island Demographics, 2018). Recent efforts to solve this problem include adding single-family units to the island. While necessary, this was not the appearance Walter Beinecke was trying to retain (RKG Associates, Inc, 2002).

2.4 Using a Buildout Analysis as a Tool

As Nantucket grows as a summer tourist destination, it is important to predict how much growth will take place over the coming years. For this reason, a buildout analysis becomes a vital tool in understanding and preparing for additional growth.

To summarize Background Chapter 2.1, a buildout analysis is “designed to estimate the amount of development that can occur if all developable land within a defined area is developed according to a municipality’s land use regulations” (Meltz, 2010). The purpose of a buildout analysis is to estimate the available amount of land usable for development and plan where ‘buildout’ in accordance with land use regulations. This makes the analysis essential to growth management and planning for towns and cities.

Often, a buildout analysis encompasses all potential buildout. Other buildout analyses, such as Amherst Buildout Analysis, utilize scenarios that include different locations or levels of growth (Applied Geographics, Herr & Associates, 2002). On Nantucket, a buildout analysis should utilize scenarios to capture less mathematical factors, including the preservation and historical factors outlined above. These factors could reduce the actual rate of growth seen. Overall, the goal is to provide an accurate estimation of growth for the duration of the next Master Plan (2020/2021 to 2030) so that it can appropriately plan for the short and long term.

2.4.1 Nantucket Master Plan

Nantucket’s most recent Master Plan was created and implemented shortly before the 2010 census, with the intent of preparing the island for the next 10 years of growth. Nantucket’s Director of Planning, Andrew Vorce, detailed how town officials formulated their first Master Plan, which was a report that took effect over the next ten years to improve the infrastructure and manage the growth for the island (A. Vorce, Phone Interview, Sept 13, 2018). This plan outline budget, new developments, waste treatment, and utilities, among other topics. Factors such as these can be accurately estimated through a buildout analysis.

As a Master Plan is intended to span a decade, the next Master Plan is under development and is set to be completed following the 2020 census (G. Tivnan, Phone Interview, Sept 20, 2018). Drafting a buildout analysis will aid the effectiveness of this upcoming plan. In order to achieve this, the group will look at past buildout analyses as case studies that provide a better understanding of a thorough buildout analysis.

2.4.2 Case Studies

A case study is defined as “an intensive analysis of an individual unit (such as a person or community), stressing developmental factors in relation to environment” (Merriam-Webster, 2018). When planning a project of such scale like a buildout analysis, case studies are useful references. While no case study is exactly the same, extracting similar aspects or methods from different studies will be very beneficial.

For a buildout analysis on Nantucket, the team is utilizing the basic knowledge and execution of a buildout analysis as previously outlined in Background Chapter 2.1. The 1997 Nantucket Buildout Analysis was analyzed so that the new analysis avoids making similar mistakes. Following that are studies of Cape Cod, Massachusetts and Nantucket’s sister island

of Martha's Vineyard. These specific studies were chosen because of their similarities and similar goals to that of a Nantucket buildout analysis. Analyzing different studies will give a more detailed guide of steps that comprise a buildout analysis and how best to execute them.

2.4.2.1 Previous Nantucket Buildout Analysis

A buildout analysis of Nantucket was conducted by the Nantucket Comprehensive Plan Steering Committee, Nantucket Association of Real Estate Brokers, Nantucket Land Council, and the Nantucket Planning and Economic Development Commission in 1996-1997. This report focused on expanding housing as tourism on the island bloomed (Nantucket Planning and Economic Commission, 1997)

Andrew Vorce, current Nantucket Director of Planning, voiced his opinion that the 1997 Buildout Analysis produced inconclusive long term solutions. It didn't take into account the utility demand that would be required from the resulting buildout, and had an overall unrealistic scope of growth (A. Vorce, R. Higgins, Phone Interview, Sept 13, 2018). GIS data was also not a readily available at the time, which made zone marking a timely task with an increased risk of error. With the introduction of GIS mapping, all of Nantucket's geological data can be obtained and stored in the town center databases. New zoning laws and purchases of land over the past 21 years have rendered much of the old report becoming obsolete. As the island continues to draw more tourists every year, a need for a new and effective buildout analysis has now become a priority.

One of the main points of emphasis brought up by Mr. Vorce was that a new buildout analysis may contain less 'buildout' and more 'replacement'. Only 4% of the land on Nantucket is vacant and developable. The island is constantly attracting more tourists and homeowners every single year and results in a lack of housing, especially during the summer season. As a result, older, smaller homes are being renovated to accommodate multiple families. This minimizes land expansion on the already crowded island (A. Vorce, Phone Interview, Sept 13, 2018). Similarly, subdivision and secondary dwellings may constitute a large portion of future development.

To improve upon the 1997 buildout analysis, the group will look at the growth of the island over the next 10 years to accurately predict utilities and town services. The group will also have full access to the town assessor data, as well as GIS programs that can use the data to plot up-to-date and accurate maps for a buildout analysis. In addition, the group will also provide growth scenarios that show a concrete timeline of development, which will result in more effective estimations. In addition, the twelve different zones that have been added since 1997 have been accounted for and reviewed, so that the group may operate on a zone by zone basis if need be in order to plan for all possible buildout scenarios.

2.4.2.2 Cape Cod Buildout Analysis to Regional Wastewater Planning

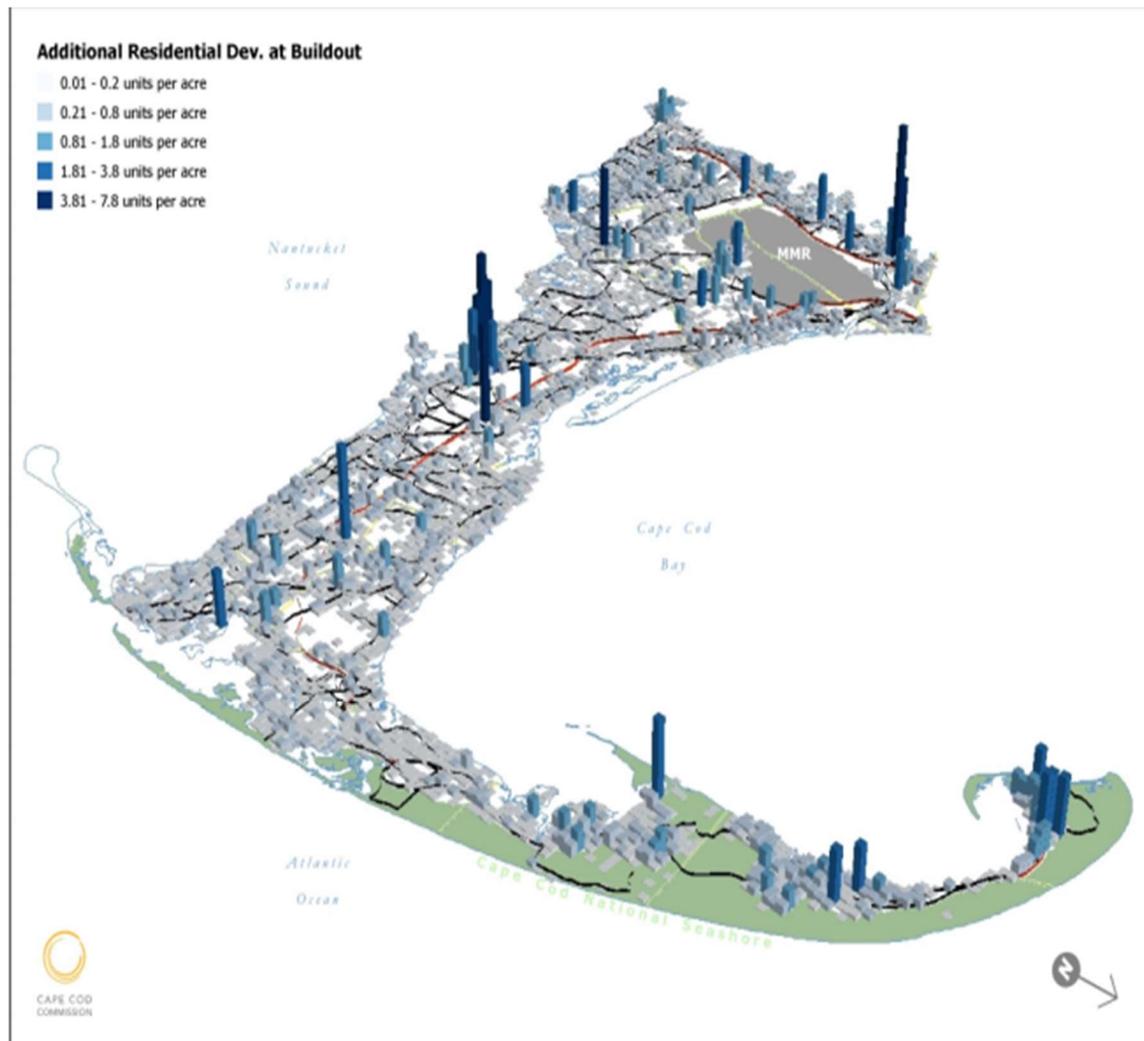


Figure 11 - Cape Cod future buildout (Cape Cod Commission, pg. 17, 2012)

The Cape Cod buildout analysis determined new wastewater planning for the entire region. Wastewater planning is normally conducted over individual towns or counties; the Cape Cod Commission's buildout analysis determined if regionalizing the system would prove to be more cost efficient. The report identifies the water use for each district on the Cape before reaching the buildout analysis itself. With these fundamentals, development scenarios and wastewater treatment options for each area are examined. The report deems where it would be appropriate to send the wastewater and/or build wastewater facilities.

The main scenario stated that 30% population growth would require 30% more capacity - 2.882 billion gallons of additional water. This analysis uses a linear relationship between people and wastewater. Other services however, such as electricity, may not have a linear relationship over time because of efforts to conserve use (Cape Cod Commission, p19-20, 2012).

The main focus of this treatment plan was to account for future growth of town and economic centers, as well as industrial areas all throughout the cape, as seen above in figure 11. The study concluded that in the case of maximum regionalization, including maximum buildout, operation and maintenance would increase by 58.1% in terms of wastewater treatment, and the cost would total an estimated \$4.683 billion (Cape Cod Commission, p19-20, 2012).

On Nantucket, there are two applications for a wastewater system. More people will result in the need for additional capacity in both pipes and the treatment center. New large developments tied into the system will also require the pipes be sized to carry increased volume. Linearly approximating wastewater use through a buildout analysis can be a guideline to estimate these effects.

2.4.2.3 Affordable and Community Housing Zoning Analysis on Martha's Vineyard

As Nantucket's sister island, Martha's Vineyard shares many of the same situational difficulties that impact a buildout analysis, including geography, history, and environmental preservation. A booming tourist destination with a high demand for more housing, Martha's Vineyard's buildout analysis from 2014 put issues into light similar to those of Nantucket. Martha's Vineyard has around 15,000 year-long residents, and sees that number triple in size during the summer seasons. Due to the increasing number of tourists per year, the island has tried to prioritize affordable housing for the workers on the island who operate services such as electrical maintenance and emergency services. However, as shown in figure 12, the median price of homes on the island makes it far from affordable to live on the island year round (Martha's Vineyard Commission, 2014).

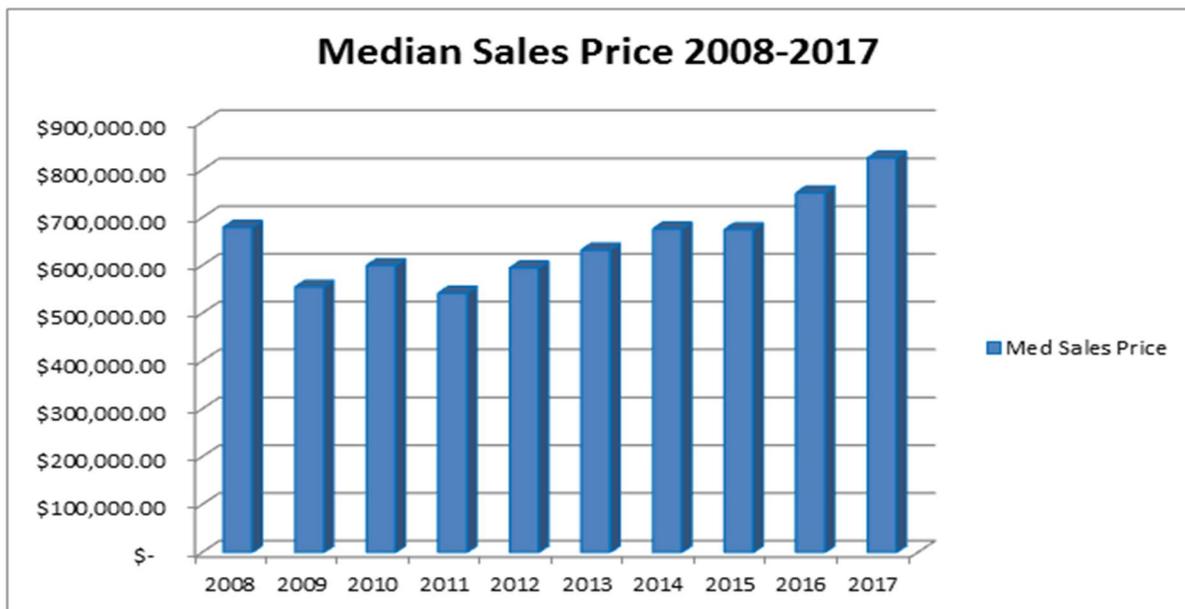


Figure 12 - Median Sales Prices of Martha's Vineyard Homes (Martha's Vineyard Buyers Agency, 2018)

To determine the priority of work, the report contains a table with all 6 towns on the island and the potential buildout options. Each town has various different boxes checked off such as whether it has dormitory housing and inclusionary zoning for affordable housing. This helps to identify what aspects of housing each town on the island has, and what it needs in the future if applicable (Martha's Vineyard Commission, 2014).

The discussion of multi-family homes on Martha's Vineyard is a trend seen on Nantucket as well. It is a partial solution to the housing crisis; it would not result in additional land development but would increase population density (A. Vorce, Phone Interview, Sept 13, 2018).

Despite these suggestions, no numeric data is presented in this analysis. Prevalence of housing types and overall building maps on the island would have made the arguments and ideas presented stronger. On Nantucket, the group's project will aim to estimate affordable housing needs for additional workers that follow additional tourists going to the island.

2.5 Present Issues to Analyze

Growth experienced in recent years has outpaced the infrastructure currently built on Nantucket, posing a serious issue to how much more growth the island can endure. Whether it be housing or electricity, the influx of people has strained islands resources. The upcoming Master Plan will be a tool the community will use to ensure that growth is managed. Affordable housing is the largest and most important impact from a buildout analysis. More housing will increase the need for water, sewage, electricity, and town workers on the island. While the conclusions produced will not be the most complete, they will provide a solid understanding of the town's needs and determine if further review is necessary.

2.5.1 Affordable Housing on Nantucket

The most pressing issue on Nantucket, according to certain town officials, is affordable housing (R. Higgins, G.Tivnan, A. Vorce, Phone Interview, September 13, 2018). The demand and lack of land development inflate the cost for housing on the island. The median housing price of \$1,530,000 (Great Point Properties, 2018), the cost of housing on Nantucket makes it hard for working class individuals to live on the island. In the peak summer months, the island has a shortage of workers (Housing Nantucket, 2018).

There are two primary approaches: The Covenant Housing program and Chapter 40B projects. GL 139-8 was enacted by the Town of Nantucket specifically to bring to life the Covenant Housing Program (The Zoning Act, 1975). The Program created the ability to subdivide lots smaller than zoning allows. The major stipulations are the following:

- One of the two subdivided lots must be available for rent or purchase at "affordable" rates as defined by being affordable to 80% AMI (Area Median Income)

- The smaller lot must be at least 40% of the minimum lot size (dependent on the zone it lies in)

The Covenant Housing Program has succeeded in creating 75 homes for buyers who make 150% AMI. This is a significantly higher AMI than the national standard of 80%. 150% was used on Nantucket as seasonal owners increase the cost of owning a home while not being accounted for in income calculations (Housing Nantucket, 2018).

While Covenant Housing incorporates more natural development, Chapter 40B projects represent full scale development. Chapter 40B is Massachusetts general law that stipulates towns that do not achieve 10% of their housing available to 80% AMI cannot prevent a 40B project from being constructed. Massachusetts approves a 40B project (The Zoning Act, 1975). Currently, Nantucket only has 2.5%; this is only 121 of the required 490 affordable units. (Nantucket Planning Office, 2018). The town would rather control housing on the island, and is actively seeking to increase the amount of affordable houses on Nantucket without such projects (G. Tivnan, Phone Interview, September 20, 2018).

With this, two major projects were discussed with Mr. Gregg Tivnan, the Assistant Town Manager of Nantucket. One project is taking place at 6 Fairgrounds Road, an affordable housing development for the workforce and town employees. 64 units of rental apartments are intended to be issued this fall. In addition, 20 single family residences and 50 seasonal dormitory style housing are also planned for this site (Nantucket Planning Office, 2018). A larger housing development is the Richmond Great Point Development Project. Approved in March 2017, it contains 225 apartments and 52 house lots. This is the first time Nantucket has allowed apartment style complexes (Balling, 2017).

However, these two projects do not entirely create enough affordable housing for Nantucket to reach the 10% threshold; according to Housing Nantucket, the town would be 45 units short after construction of both projects, and projects to be an additional 54 short in 10 years' time (Housing Nantucket, 2018). Further growth will only fuel the need for affordable housing in the coming years, making a new buildout analysis valuable.

2.5.2 Wastewater System Capacity

In running a sewer department, one of the important aspects is knowing where the future needs areas are located. These areas are where future dwellings might be constructed and be in need of sewer systems. The buildout analysis will be informative for the sewer department in this area. Revealing where development has the potential to occur gives the sewer department a blueprint of where their needs areas may be. Knowing where development may occur is extremely useful information for the sewer department to have. The sewer department already has these needs areas figured out in some areas, but layering them with the buildout analysis can reinforce their projections and inform them on areas they may not have known before.

2.5.3 Electrical Use and Capacity

Any buildout analysis that proposes additional houses indicates a growing need for electricity. Nantucket's energy initially relied on whale oil to fuel lamps. In the 1840s, the primary source of energy switched to steam engines and diesel generators. Increased demand of electricity in recent years, especially during tourism season, has forced the island to look for other resources. In 1996, National Grid installed a single 36 MW cable that connected Nantucket to the Cape Cod power grid. The transmission cable cost \$30 million and was laid under the Atlantic Ocean. In 2006, a second cable was needed; this cable provided 38 MW of electricity and cost \$41 million (Town of Nantucket Energy Office, 2018). Figure 13 demonstrates the seasonal condition of Nantucket's energy usage. Though from 2011, it clearly shows that summer peak usage far outstrips other seasons. The spike in residents during the summer is creating the need for additional capacity.

The need of a third cable is looming, but something that the town would seek to avoid if possible as a new cable could cost upwards of \$50 million (Town of Nantucket Energy Office, 2018). In the summer of 2012, Nantucket's peak energy was 40MW, while the summer of 2013 the peak increased 12.5% to 45MW. While the combined capacity of the wires is 74MW, the fear is that a single cable failure during peak season could result in outages on Nantucket until backup generators turn on (National Grid, 2015). Further, National Grid revealed that Nantucket's demand for electricity is growing more than five times faster than the state average. Efforts from the town of Nantucket Energy Office to make the island more energy efficient to defer the need for a third cable include renewable energy incentives such as solar rebate programs (Town of Nantucket Energy Office, 2018). The town has agreed to install a 48 MWh battery energy storage system provided by Tesla. This battery will become the new backup system, should one of the cables fail. The previous backup were two 6 MW diesel generators that Nation Grid described as old and in need of replacement. National Grid has predicted that this new system could delay the need for a third cable by 15-20 years (Cooke, 2017). While this is great for a short term solution, it does not completely solve the island's energy problem

A proper buildout analysis would provide context as to how much energy the island will need in 10 years as well as estimate peak needs for the system. An analysis can detail future demand as small or large increase. This analysis should provide a suggestion as to whether small conservation efforts or expensive construction is necessary.

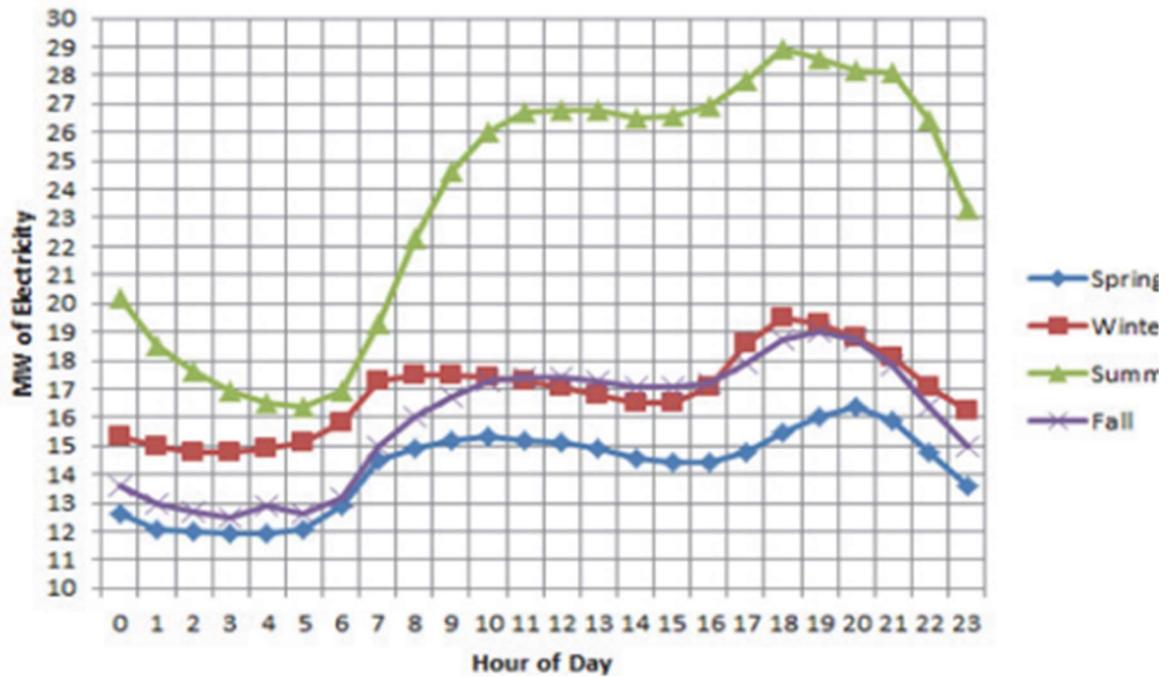


Figure 13 - Nantucket Seasonal demand 2010 -2011 (Antonio, Phillips, Taleb, 2011)

3 Methodology

Mission Statement

The purpose of this project was to perform a buildout analysis for the Town of Nantucket to estimate the island's future residential dwelling growth and provide a tool that can be used to analyze the town's infrastructural needs. The buildout analysis was conducted by determining the number of current residential dwellings, creating a hypothetical maximum scenario, and then projecting both high and low dwelling growth scenarios for 2030.

The following methods were used for each of the analyses:

1. Present Day Nantucket

- I. Parcel data collection from GIS, assessor's office
- II. Divide residential dwellings into different island districts
- III. Identify all parcels that already have one or more dwellings per parcel in residential zones
- IV. Calculate dwellings/parcel to find the average number of dwellings per parcel

2. Hypothetical Maximum Buildout Scenario

- I. Parcel data collection from assessor's office and GIS Coordinator
- II. Categorization of parcel data - which parcels are buildable and subdividable
- III. Clean data to eliminate inconclusive data
- IV. Data Analysis and Mapping

3. 2030 Low and High Development Scenarios

- I. Parcel data collection from planning department
- II. Conduct focus group of experts to create hypothetical 2030 dwelling numbers scenarios
- III. Create a low and high dwelling growth scenario
- IV. Tool for town planners

Specific details relative to each objective and sub-objective will be summarized in the following sections:

3.1 Present Day Nantucket

1. **Parcel data collection from GIS, assessor's office:** All of the analysis utilized the most recent parcel data applicable, with two different spreadsheets from the Town Assessor and GIS Coordinator. The entirety of the datasets were used. Both sets have the same identifier, AV PID, so that the assessor and GIS data spreadsheets can be combined.
2. **Divide residential dwellings into different island districts:** To be able to convey both present day and maximum buildout values, we separated the data according to the 36

Civic League Districts. These are established regions of Nantucket, which make the presentation of information easier to communicate.

3. **Identify all parcels that already have one or more dwellings per parcel in residential zones:** This analysis focused on residential development that already exist. To be able to compare present day (existing dwelling number) to maximum buildout (potential future dwelling numbers), it was important for this analysis to first identify in each district the residential and nonresidential classified parcels, and then sort the residential parcels into those with dwellings and those without dwellings.
4. **Calculate dwellings/parcel to find the average number of dwellings per parcel:** Subdivision and undeveloped parcels can have both primary and secondary dwellings. However, estimating the actual likelihood of an unbuilt parcel to add a second dwelling depends on parcel geometry and ground cover, both of which are based off a primary dwelling that is not yet constructed. As a way to account for this potential, we calculated the current ratio of existing dwellings per parcel, which would be the total number of existing residential dwellings divided by the number of residential parcels with at least one existing dwelling.

3.2 Hypothetical Maximum Buildout Scenario

1. **Parcel data collection from assessor's office and GIS Coordinator:** To complete this scenarios study, our team had to identify residential parcels that were undeveloped, that were large enough to be subdividable, and that had one dwelling but were second dwelling eligible. These additional categories of residential dwellings represented the total residential buildout potential for Nantucket and again formed the basis for additional buildout scenarios beyond the present dwelling scenario described above.
2. **Categorization of parcel data:** Every residential parcel was analyzed based on its land area, ground cover, and zoning regulations, amongst other characteristics to determine if it the parcel was subdividable, eligible for a second (or more) dwelling, or undeveloped.
3. **Clean data to eliminate inconclusive data:** The data presented to the team was inconclusive on some subjects. For example, the data did not incorporate wetland area on an individual parcel basis. The parcel data also did not is it deed or conservation restrictions that would prevent development. As a result, the team spent time with local land use, GIS and assessor experts to determine, on a parcel-by-parcel basis, which parcels should be rejected from residential development consideration.
4. **Data Analysis and Mapping:** The final parcel buildout data was processed to determine how many residential dwellings could be built if all identified possible built outs were actually developed. This data illustrated the worst case, *maximum build out* that could occur on Nantucket, 2018 analysis presented data both by zone and by district. Similarly, mapping the 2018 analysis' results allows for easy visualization of the potential growth for planning purposes.

3.3 2030 Low and High Development Scenarios

1. **Parcel data collection from planning department:** To best estimate accurate dwelling growth, building permit data was obtained from the Planning Department. This data was then used to come up with different growth scenarios that encompassed the master plan, going all the way until 2030.
2. **Conduct focus group to design scenarios:** A focus group with expert opinions was conducted to present the trends in permit data and determine what values or trends were most applicable for Nantucket's future planning.
3. **Create a low and high dwelling growth scenario:** Based on feedback from the focus group review of growth scenarios, two scenarios were formed. The first was a low scenario, assuming that the residential building permit average from 2001-2018 remained constant. The second was a high scenario, and assumed that linear growth from 2015-2018 would continue. These scenarios could then be uniformly applied to all districts/zones to estimate growth across different areas.
4. **Tool for town planners:** The data was summarized, presented in a detailed manner to town planners, and a detailed user manual was developed to help with both future development scenarios. A general database of use and management was given over to the town as well, This allows the Town to update the database and adding fields as needed.

4 Scenarios and Analysis

Introduction

A buildout analysis is a detailed study that projects the hypothetical number of future dwellings (or homes) in a community, subject to zoning regulations and other constraints. The goal of this 2018 analysis was to prepare the town for its Master Plan in 2020/2021; through which the town will plan for its future development including estimations for different needs including sewerage, electricity, affordable housing, and other town services. This chapter presents the major outcomes of the buildout analysis conducted on Nantucket.

The analysis is broken down into four main sections, all of which are shown in Table 1, which summarizes the core project results, and is referenced at the beginning of most of the sections below. The analysis and chapter is broken down into the main section, detailed in the following table:

District	Present Day: 2018					Hypothetical Max Buildout			2030 Low Scenario		2030 High Scenario	
	Residential Parcels	Total Dwellings	% of Total Dwellings	Parcels with 1 Dwelling	Parcels with 2+ Dwellings	New Dwellings	% New Dwellings	% Potential Growth	New Dwellings	% Potential Growth	New Dwellings	% Potential Growth
Grand Total	10697	10456	100%	6821	1760	5461	100%	52.2%	1260	12.1%	2484	23.8%
Town	4166	4276	40.9%	2933	661	2610	47.8%	61.0%	602	14.1%	1187	27.8%
Scon	963	554	5.3%	355	97	598	11.0%	107.9%	138	24.9%	272	49.1%
Airport	377	335	3.2%	221	54	368	6.7%	109.9%	85	25.4%	167	49.9%
Surf	595	719	6.9%	349	167	289	5.3%	40.2%	67	9.3%	131	18.2%
Brant	318	330	3.2%	215	55	239	4.4%	72.4%	55	16.7%	109	33.0%
Quid	169	156	1.5%	82	36	124	2.3%	79.5%	29	18.6%	56	35.9%
Tom	612	522	5.0%	354	83	116	2.1%	22.2%	27	5.2%	53	10.2%
Dionis	273	336	3.2%	124	104	115	2.1%	34.2%	27	8.0%	52	15.5%
Mad	325	284	2.7%	242	21	101	1.8%	35.6%	23	8.1%	46	16.2%
Polpis	147	178	1.7%	62	55	98	1.8%	55.1%	23	12.9%	45	25.3%
Harbor	255	300	2.9%	124	84	91	1.7%	30.3%	21	7.0%	41	13.7%
Other	2497	2466	23.6%	1760	343	712	13.0%	28.9%	163	6.6%	325	13.2%

Figure 14 - TMO Master Table

1. **Present Day: 2018 Case:** The Present Day Case is a snapshot of the current residential parcels and single/multi-dwelling parcels on the island. By identifying these parcels and corresponding numbers per district, the next two scenarios' projections have a concrete baseline for comparison. The Present Day: 2018 columns of the Master Table (green) display this analysis by Civic League district.
2. **Hypothetical Maximum Buildout Scenario:** Maximum buildout is the maximum number of dwellings that can be developed under current zoning regulations. This scenario makes the assumption that every buildable residential zoned parcel in the island is fully built out. Knowing this development cap provides the Town with concrete maximum development numbers. The maximum buildout numbers are listed in the Hypothetical Maximum columns of the Master Table (purple) and illustrate maximum

future development by district and in total. A more detailed explanation of how we derived the numbers presented in this section of the table can be found in our methodology and in Appendix A, Manual of a Buildout Analysis.

3. **2030 Low and High Scenarios**: Scenario building provides other, potentially short-term analyses for the community's use. The scenarios created by the 2018 analysis represent realistic high and low residential dwelling growth projections, for 2030, the expected end of the community's Master Plan. These low and high projections, based on different building permit data trends, were vetted with expert input. The 2030 Low Scenario and 2030 High Scenario columns of the Master Table (yellow) show these analyses, again by district. This section of the Results chapter, below, also outlines the findings from the building permit data and the trends extracted from it.
4. **Advancement of the 2018 Buildout Analysis**: There are countless ways to apply both the maximum and scenario analysis to a Master Plan that would be able to project future needs, both in total and by district. This chapter is broken down into three sections
 - a. **Application of Buildout Scenarios**: A buildout analysis has widespread application potential. A buildout analysis can, through either maximum or scenario buildout, describe future growth of specific regions. This means that many geographic based projections, such as sewerage needs areas or electrical capacities, can project the number of future persons or dwellings in their specific area - meaning budgets and plans can more accurately estimate need.
 - b. **Buildout Analysis as a Living Tool**: The 2018 buildout analysis presented is based on GIS, Assessor, Zoning, and Building Permit data sources. This data is also input and manipulated on a master excel sheet, and described in detail in our Manual of a Buildout Analysis. The manner in which the analysis was performed makes it easy to update these sources each year. It allows for the yearly iterations of the data to determine where development has occurred so that the community can compare actual development to the scenarios presented. This also gives the analysis flexibility to be applied to regions or topics it has not already been attached to. The data in the 2018 analysis came from Town Assessor Debbie Dilworth, GIS Coordinator Nathan Porter, and Deputy Planning Director Leslie Snell, and was the most recent data on file.
 - c. **Future Recommendations**: To keep the buildout analysis up to date as an accurate tool for the town to utilize, further recommendations were made. In reference to the buildout analysis, recommendations are factors that we either didn't consider during the process or we didn't have time to look more in depth at. The less uncertainty that the analysis contains, the more helpful it will be going forward, and it is recommended that these uncertainties be addressed.

Table 1 summarizes the 2018 buildout analysis through three main sections. This chart will be referenced often throughout this report. Often, this report will take selections from the master table to better focus on the topic being described.

Many terms are used consistently throughout this report and are defined as such:

Parcel: a tract of land that is or meant to be owned by an entity

Dwelling unit: a building that has at least one bedroom

Residential: a parcel or dwelling existing in a residential zone

Zone: codes that the government uses to classify parcels of land

Ground cover: the total footprint of a dwelling or large structures on a parcel of land

4.1 Nantucket Present Day: 2018

This section provides a snapshot of how many residential dwellings currently exist, broken down by each different district (Map 1). Data from the Nantucket Civic League clearly defined that the island is composed of 36 different districts. This provides a defined map that the town recognizes, allowing for a visualize map with dwelling numbers per district. By identifying the number of dwellings and parcels per district, projections for the next two scenarios can have a more concrete foundation to be based off of. It is important to note that the town districts encompass a large section of mid island, not just the historic downtown area. This is potentially helpful, considering the growth in the mid-island region will eventually find itself in similar density to downtown, according to focus group feedback that will be discussed in section 4.3. The complete table with all districts can be found in Appendix B. Map 1 visualizes the table entries above to better illustrate where each district lies.

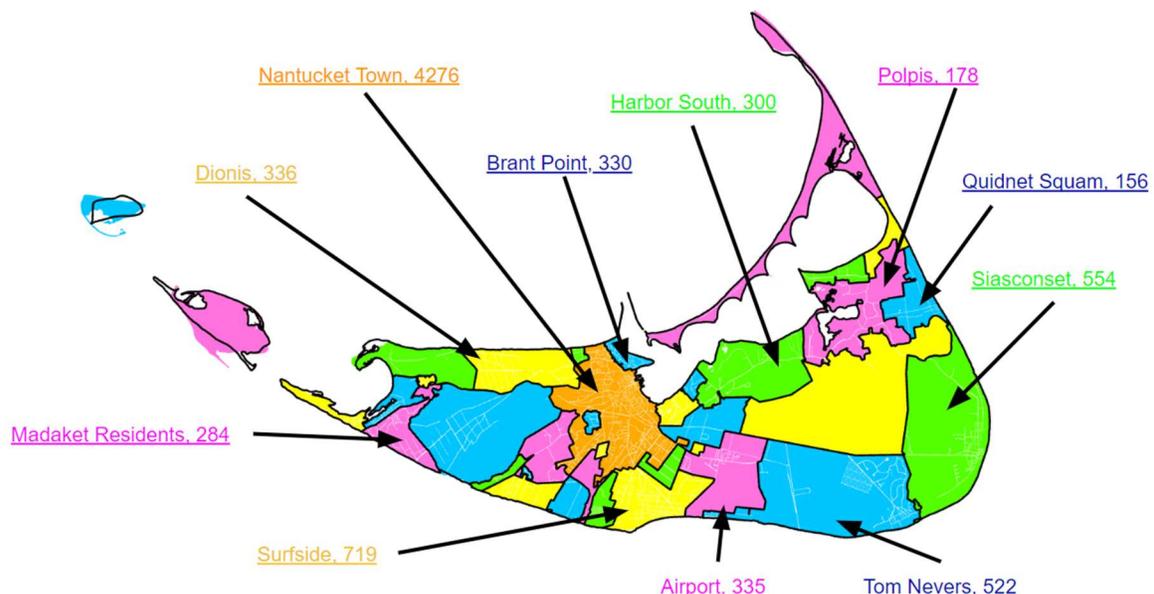


Figure 15 - Nantucket Districts & Dwelling counts

- 4.1.1. *There are 10,456 dwellings on Nantucket currently*

District	Present Day: 2018				
	Residential Parcels	Total Dwellings	% of Total Dwellings	Parcels with 1 Dwelling	Parcels with 2+ Dwellings
Grand Total	10697	10456	100%	6821	1760
Town	4166	4276	40.9%	2933	661
Scon	963	554	5.3%	355	97
Airport	377	335	3.2%	221	54
Surf	595	719	6.9%	349	167
Brant	318	330	3.2%	215	55
Quid	169	156	1.5%	82	36
Tom	612	522	5.0%	354	83
Dionis	273	336	3.2%	124	104
Mad	325	284	2.7%	242	21
Polpis	147	178	1.7%	62	55
Harbor	255	300	2.9%	124	84
Other	2497	2466	23.6%	1760	343

Figure 16 - Nantucket District & Parcel Data, Present Day; Excerpt from Table 1

Table 2 illustrates the Present day: 2018 section of the Master Table (green), with current day residential parcel and dwelling information by district. The main takeaway of the present day Nantucket information is that the number of residential dwellings was determined to be 10,456. With this information, and the number of dwellings by district, the future growth scenarios can be compared to current dwellings in specific zones and on the island as a whole.

- 4.1.2 *There are 1.22 dwellings per residential parcel*

This is a critical calculation that will be used in determining the hypothetical maximum scenario. 8,581 residential parcels currently have dwellings on them, based on the sum of single- and multi-dwelling parcels. By dividing the number of residential dwellings by the current residential parcels with dwellings on them, an average of 1.22 dwellings per residential parcel is derived. The dwellings/parcel ratio (1.22) could potentially change on Nantucket in the future, but the project assumes that number will stay consistent for future scenarios.

- *4.1.3 Town accounts for 40.9% of the total number of residential dwellings*

Town has 4,166 current residential parcels, in which there are 4,276 residential dwellings spread across them, accounting for 40.9% of all total dwellings on the island. This is the largest concentration of residential dwellings on the island out of the 36 different districts. The percentage is a key takeaway since town is the most well-known district and where a sizeable amount of the island's population is located.

4.2 Hypothetical Maximum Buildout Scenario

The first scenario in the buildout analysis process was to establish a hypothetical maximum buildout. Maximum buildout is the maximum number of dwellings that can be developed under current zoning regulations; it makes the assumption that everywhere a dwelling could be built, is built. It is important to note that the value in this scenario is hypothetical, and is a projection tool, not a realistic prediction. Knowing the maximum number of dwellings that can be built throughout the entire island provides a tool for long term planning by identifying all possible development locations. A complete manual of processes can be found in Appendix A. This section will be broken down as follows:

1. **Island Maximum:** This indicates the total number of potential dwellings on Nantucket. The island maximum provides the community with knowledge of overall potential change.
2. **Town District Maximum:** This is the potential number of dwellings for an individual district, exemplified by the Town. In conjunction with the island maximum and present day data, the data produces the number of dwellings that can be built in each of the 36 districts. A district allocation provides the community with intimate knowledge of which districts may see large amounts of growth so that long term planning can appropriately prepare.
3. **Parcel Type Development Breakdown:** By examining existing residential zoning regulations, three types of parcels were identified to have the potential for new dwellings. Knowing the types of growth occurring allows the community to view how potential development can be encouraged or discouraged.

- *4.2.1 Current zoning regulations may permit up to 5,461 new dwellings*

District	Hypothetical Max Buildout		
	New Dwellings	% New Dwellings	% Potential Growth
Grand Total	5461	100%	52.2%
Town	2610	47.8%	61.0%
Scon	598	11.0%	107.9%
Airport	368	6.7%	109.9%
Surf	289	5.3%	40.2%
Brant	239	4.4%	72.4%
Quid	124	2.3%	79.5%
Tom	116	2.1%	22.2%
Dionis	115	2.1%	34.2%
Mad	101	1.8%	35.6%
Polpis	98	1.8%	55.1%
Harbor	91	1.7%	30.3%
Other	712	13.0%	28.9%

Figure 17 - Selection from Table 1 - Nantucket District & Parcel Data, Max Buildout Scenario

Table 3 above represents the Hypothetical Maximum Buildout section of the Master Table (purple). Compared to the 10,456 present day dwellings, 5,461 new dwellings represent a 52.2% increase in total dwellings across Nantucket.

- *4.2.2 Town represent 47.8% of potential new dwellings, totaling 2,610 dwellings*

The grand total of 5,461 dwellings is a hypothetical estimation for the maximum number of new dwellings on the island. Of this total, 2,610 of those 5,461 dwellings would be located in town, representing 47.8% of the maximum buildout. In reference to current day dwelling count, town would have a predicted potential growth of 61.0%. Another district, Siasconset, is projected to have a growth of 107.9%. Siasconset currently has 554 dwellings (see Table 2) and an additional 598 dwellings (see table 3) from the maximum buildout; this would result in the current dwelling count more than doubling.

- 4.2.3 New dwelling development will occur on three residential parcel types

Parcel Type	Affected Residential Parcels	Maximum New Dwellings
TOTAL		5461
Undeveloped	848	1463
Secondary Dwelling Eligible	2066	2066
Subdividable	564	1932

Figure 18 - New Residential Dwellings in Residential Zones

There are three main types of parcels that could see new residential dwelling development:

- Undeveloped: Parcel currently no structures
- Secondary Dwelling Eligible: Parcel with ground cover for a second dwelling
- Subdividable: Parcel with ground cover to be subdivided

These definitions are more in depth in the next section.

The first column in table 4 represents the number of affected current day residential parcels, broken down into one of three parcel types. The second column represents the maximum number of new dwellings that can be made in each type of parcel, which sums up to the total of 5,461. Below are brief definitions and examples of each parcel type.

Undeveloped Parcels:

An undeveloped parcel is a parcel with no structures that has a buildable use code and zone; potential for both primary and secondary dwelling construction. There are currently 848 identified undeveloped parcels on Nantucket, and through subdivisions, secondary dwelling eligibility, and the dwellings per parcel ratio, it was determined that these parcels could yield a max buildout of 1,463 new dwellings.

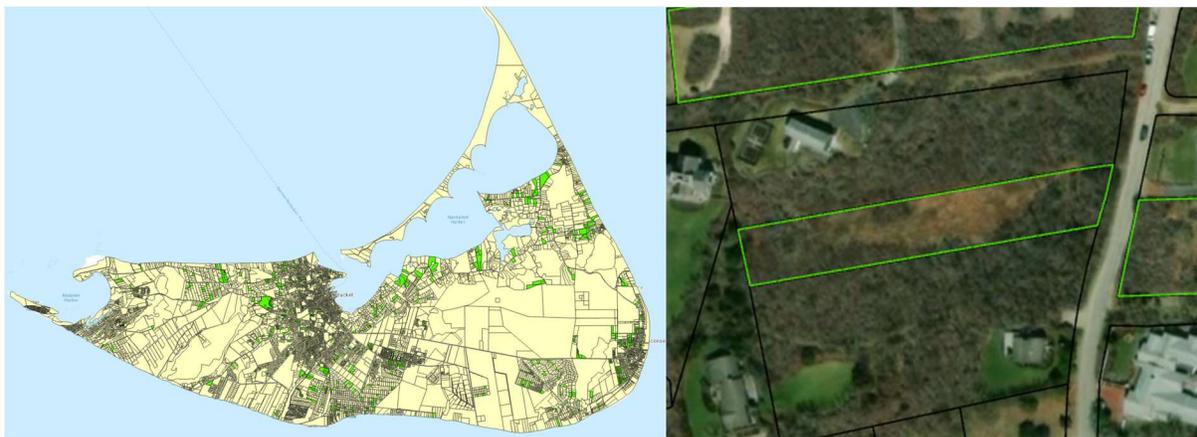


Figure 19 - Undeveloped Parcels

Secondary Dwellings Eligible Parcels:

A secondary dwelling eligible parcel is a parcel that is in a residential zone and is eligible for a secondary dwelling, taking ground cover into consideration. There are currently 2,066 identified secondary dwelling eligible parcels on Nantucket, but because of restrictions for subdivision, these parcels will simply double the amount of dwellings and yield a max buildout of 2,066 new dwellings.



Figure 20 - Secondary Dwelling Eligible Parcels

Subdividable Parcels:

A subdividable parcel is a parcel that is 2.5 times larger than its minimum lot size, in a residential zone, and has enough ground cover available. There are currently 564 identified subdividable parcels on Nantucket, and through these subdivisions, secondary dwelling, and the average of 1.22 dwellings per parcel, these parcels could yield a max buildout of 1,932 new dwellings.



Figure 21 - Subdividable Parcels

All three of these parcel types were then mapped using a GIS program and resulted in the final Nantucket Maximum Buildout Map, shown below:

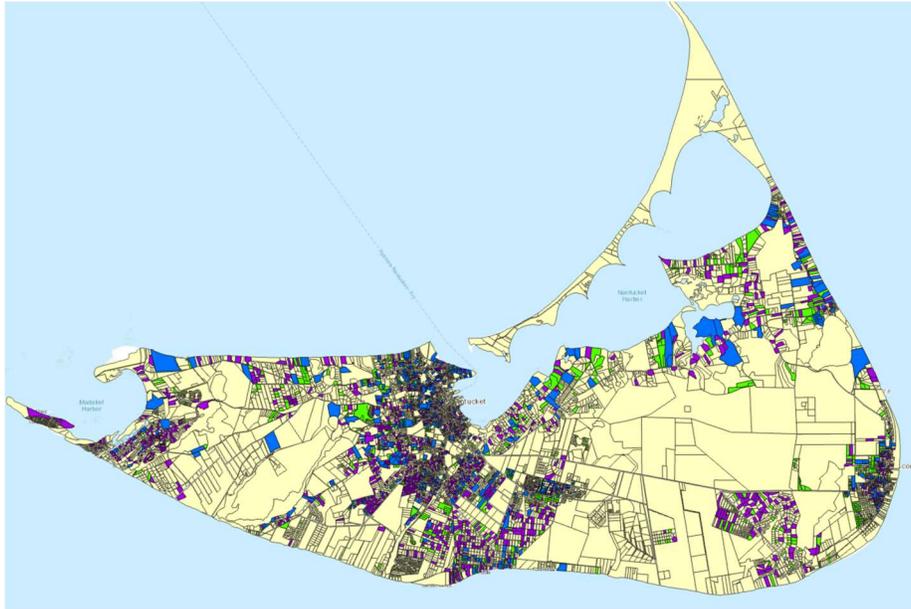


Figure 22 - Maximum Buildout

This is not a prediction, but a hypothetical scenario. It is more of a template to see where all possible buildout can occur.

- **4.2.4 Commercial Zone Implications Are Less Definitive**

This analysis has been based on residential zoning because it is more realistic for development as it encompasses the majority of future dwellings. However, below is a brief look at these additional zones. Chapter 60A, which has the potential to be converted into new residential dwellings is included, as well as commercial zones CMI and CN, where dwellings for the workers of the commercial locations could be built. A similar process as the one outlined in the hypothetical maximum scenario was used, with the same color code.

- **4.2.4.a Commercial zones may permit up to 1,440 new dwellings**

Parcel Type	Affected Non-Residential Parcels	Maximum New Dwellings, Non-Residential Codes
Total		1440
Undeveloped	126	250
Second Dwelling Eligible	217	217
Subdividable	134	973

Figure 23 - New Residential Dwellings in Commercial Zones

Estimated Total Dwellings Available, Commerical Parcels November 28th, 2018	Affected Residential Parcels	Minimum Split Potential, New Parcels	Effective New Dwellings	Maximum New Dwellings, Residential Codes
Seconday Dwellings, New	217	n/a	217	217
Subdividable Parcels	134	755		973
Not Restricted	134	755	755	
Partially Restricted	0	0	0	
Undeveloped Parcels	126	68		250
Not Restricted	126	68	194	
Partially Restricted	0	0	0	
Partially Restricted Ratio	25%		TOTAL	1440

Figure 24 - New Residential Dwellings in Commercial Zones Calculations



Figure 25 - Commercial Buildout Map

Therefore, if we included the potential of residential dwellings in these commercial zones, 1,440 new dwellings would be added to the maximum projection of 5,461. However, this is not as realistic, since the majority of future growth will occur in residential zones, according to our sponsors and focus group. Therefore, these parcels were not taken into account in creating the scenarios. They are included in this section because it is important to note that these commercial zones exist and could potential see buildout. This information would be useful for a future buildout analysis.

4.3 2030 Planning Projections

The main implication was to use the buildout analysis as a tool for future island development in the 2020/2021 Master Plan. Two different scenarios were provided from present day until 2030, encompassing this ten-year period that the master plan would cover, to give realistic dwelling estimates within that time frame. A focus group was conducted to discuss how to best estimate dwelling growth until 2030. This focus group included Select Boardman Mat Fee, Deputy Director of Planning Leslie Snell, Housing Specialist Tucker Holland, Past Select Boardman Rick Atherton, Vice Chair of the Affordable Housing Trust Fund Brooke Mohr, Town Assessor Debbie Dilworth and Administrative Assistant Rob Ranney.

The two scenarios were roughly determined to be a “high” and a “low” estimate of future dwelling growth. The “low” estimate was the average number of dwelling permits issued from 2001 to 2018. The “high” estimate extrapolated the linear trend in dwelling permits from 2015 to 2018. Section 4.3 describes, in detail, the processes used to determine the values shown below.

District	2030 Low Scenario		2030 High Scenario	
	New Dwellings	% Potential Growth	New Dwellings	% Potential Growth
Grand Total	1260	12.1%	2484	23.8%
Town	602	14.1%	1187	27.8%
Scon	138	24.9%	272	49.1%
Airport	85	25.4%	167	49.9%
Surf	67	9.3%	131	18.2%
Brant	55	16.7%	109	33.0%
Quid	29	18.6%	56	35.9%
Tom	27	5.2%	53	10.2%
Dionis	27	8.0%	52	15.5%
Mad	23	8.1%	46	16.2%
Polpis	23	12.9%	45	25.3%
Harbor	21	7.0%	41	13.7%
Other	163	6.6%	325	13.2%

Figure 26 - Selection from Table 1 - Nantucket District & Parcel Data

- 4.3.1 “Low” growth would see 1260 new dwellings created by 2030

Table 7 shows the 2030 “Average” growth scenario section highlighted in red. This trend estimates that 1,260 new dwellings will be created by 2030. Compared to the maximum value of

5,461 potential new dwellings (outlined in 4.2), this scenario represents 23.1% of all possible new development. This is main take away from this section, as it is a realistic minimum amount of new dwellings determined by our focus group.

District	2030 Low Scenario		2030 High Scenario	
	New Dwellings	% Potential Growth	New Dwellings	% Potential Growth
Grand Total	1260	12.1%	2484	23.8%
Town	602	14.1%	1187	27.8%
Scon	138	24.9%	272	49.1%
Airport	85	25.4%	167	49.9%
Surf	67	9.3%	131	18.2%
Brant	55	16.7%	109	33.0%
Quid	29	18.6%	56	35.9%
Tom	27	5.2%	53	10.2%
Dionis	27	8.0%	52	15.5%
Mad	23	8.1%	46	16.2%
Polpis	23	12.9%	45	25.3%
Harbor	21	7.0%	41	13.7%
Other	163	6.6%	325	13.2%

Figure 27 - Selection from Table 1 - Nantucket District & Parcel Data

- **4.3.2 “High” growth would see 2,484 new dwellings created by 2030**

Table 8 shows the 2030 “Linear” growth scenario section highlighted in red. This trend estimates that 2,484 new dwellings will be created by 2030. Compared to the maximum value of 5,461 potential new dwellings (outlined in 4.2), this scenario represents 45.5% of all possible new development.

- 4.3.3 Building permit trends are a method to estimating dwelling creation rates

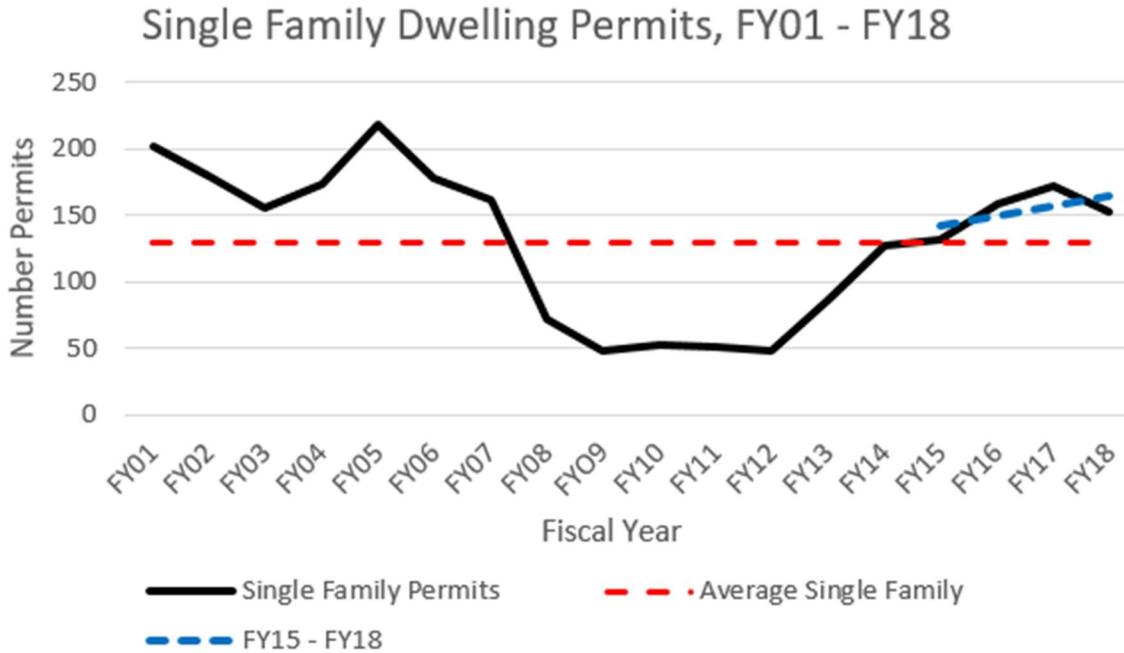


Figure 28 - Nantucket Single Family Dwelling Permits, FY01 - FY18

Graph 1 shows the trend in single family dwelling permits issued from 2001 to 2018. Analyzing the data, two trends were extracted. The first is the average number of permits issued. The average single family dwelling permits from 2001 to 2018 was calculate to be 130, as seen in the graph. After including other dwelling permits and average yearly demolishing, the average new dwellings were determined to be 105 net new dwellings per year. This was the value used to calculate the “Low” scenario, as seen in section 4.1.

The second is the linear trend from 2015 to 2018, which came out to the equation $y=13.6*(x-2014)+91.5$. This equation means that there has been an average of 13.6 new dwelling permits, as compared to the previous year. This trend assumed that the current increasing rate of building permits issued would continue from now until 2030. This is the equation used to produce the “High” scenario discussed in section 4.3.2.

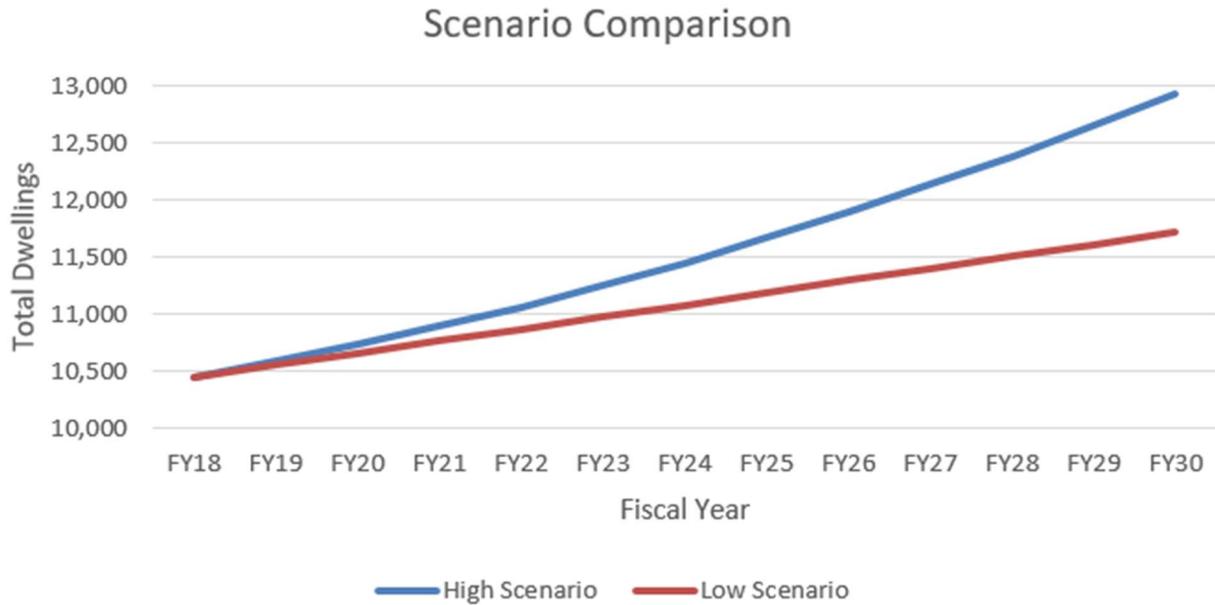


Figure 29 - Nantucket 2030 Scenario Comparison

Graph 2 displays the net number of dwellings created per year based on the trends previously outlined. (Linear growth scenario projects a rate of $y=13.6x+91.5$. Average growth scenarios projects a constant rate of 105 each year.) By summing up the new net dwellings each year from 2019 to 2030, Table 9 shows that the Linear scenario creates 2,484 new dwellings and the Average scenario create 1260 new dwellings.

Dwelling Scenario	FY18	FY24	FY30	TOTAL NEW	% Hyp. Max
Linear Growth	134	200	281	2484	45.5%
Average Growth	134	105	105	1260	23.1%

Figure 30 - Total new dwellings projected by 2030 from both scenarios

4.4 Advancement of the 2018 Buildout Analysis

This project has great potential to be the baseline for future IQP projects on Nantucket. Due to the time constraints of the project, the team was unable to look deeply into the different impact areas that our buildout could affect. To aid the community, the 2018 analysis was created to be a easily modified tool so that the information presented does not have to be completely recreated for future use; instead, it can be updated or modified to better meet the changing needs of the community.

There are three main topics that can advance the use and effectiveness of the 2018 analysis: the various applications of the analysis, the tools of the analysis that can be modified, and recommendations for further adjustments and updates for the information collected.

- *4.4.1 Applications of Buildout Scenarios*

This section describes what possible future applications this buildout analysis could have. The applications are numerous, including making IQP projects on projection of future electricity needs, affordable housing needs, potable water needs, etc. This project did not have the time to make projections with each utility need and town service. We did, however, manage to delve into one and give an example of exactly how our work could aid other departments on Nantucket. Early in the project, the group met with David Gray, director of the Nantucket Sewer Department, and after our meeting we coordinated with his GIS consultants to obtain data on their sewer master plan. This plan detailed the sewer needs areas around the island and where there would soon be installation of new sewer districts and piping to account for the growing amount of homes and people. However, based on our maximum buildout map that we showed to Mr. Gray at our meeting, it was apparent that the sewer department may have underestimated the amount of growth the town could experience, and therefore underestimated their amounts of piping. To aid them, we combined the sewer piping and needs areas layers with our own GIS map of our maximum buildout scenario in order to provide a better estimation for them of what they may need to plan for in the future. The map is shown below.

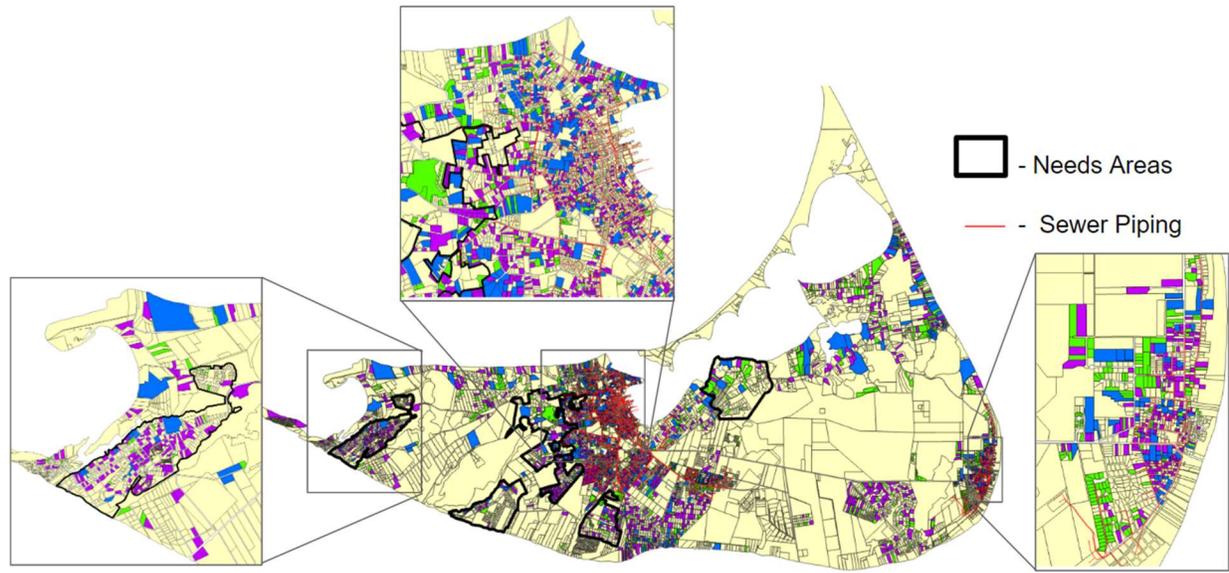


Figure 31 - Sewer needs areas & piping overlaid with maximum buildout map

● 4.4.2 Buildout Analysis as a Living Tool

To construct the 2018 buildout analysis and utilize it as an effective tool, five main data sources were used and present the town with the ability to update and readjust specific data as seen fit. The six data sources are below:

1. Town Assessor Data - The town assessor data was provided in the form of a large excel sheet that detailed the number of dwellings and ground cover per parcel. This data was modified to include the three parcel types we used for our maximum buildout analysis.
2. ArcGIS Pro program / GIS Data - ArcGIS Pro is the program that was used for mapping the maximum buildout scenario map in addition to other maps. GIS data layers, such as the Nantucket Tax Parcels and Sewerage Needs Areas, were provided to us by the town GIS coordinator. By inputting and attaching the modified town assessor data to ArcGIS data layers, we were able to select specific parcels and create new data layers, in this case layers for the three parcel types.
3. Building Permit Data - Building permit data was provided by the Nantucket Planning Department ranging from 2001 to 2018. This data allowed us to take the average number of permits issues in the last 17 years, as well as calculate linear growth over the past few years. This average number of permits helped to form the low scenario for 2030, while the liner growth over the past years helped to form the high scenario.
4. Master Excel Sheet - The master excel sheet is a sheet made by our group that contains all up to date assessor data. What differs this from the assessor data is that it is modified so parcels with a specific characteristic gets sorted as one of the three parcel types. Additionally, these excel sheet also contains all tables, and allows for these tables to be easily adjusted should numbers change. This is because the excel sheet has certain

equations that will recalculate and output a new number based on a pre-existing formula should something be changed.

5. Manual of a Buildout Analysis - To help guide those who will be using the buildout analysis in the future with all the different steps and data that they will need to use, the group wrote a Manual of a Buildout Analysis. This manual gives in-depth steps on what exactly we did to form our buildout analysis, such as collecting and manipulating data, creating GIS layers, and updating the master sheet. It can be referenced in Appendix A.
6. Zoning Regulations - Part of the data that was important in helping identify residential parcels was the use of zoning regulations. This data was provided to us by the Town Manager's Office, and was used to identify parcels that were eligible for development under said zoning regulations.

In addition to these data sources, there are 5 other ways the data can be manipulated to produce new datasets:

1. Yearly Data Input: With new Assessor and GIS data the analysis can be revisited and made accurate on a year to year basis. The formulas currently input allow for new data to be input and calculated automatically. Yearly updates allow for the community to compare development to the scenarios presented within the analysis (both maximum and 2030).
2. Area Requirements: The team made assumptions about the area needed for both potential second dwellings (500 SF) and Covenant homes (800 SF). It also used the definition of Underutilized as being 2 and a half times the minimum lot size. All of these assumptions can be edited to test other values.
3. Residential Parcels: The 2018 analysis only considered residential parcels. This important consideration can be modified to include (or separately analyze) commercial, industrial, open space, or other zones. (The 2018 Analysis did include a brief commercial analysis, noting that the rigorous tuning of data the team performed on the residential parcels was not completed the commercial data.) Other types of parcels would make the analysis more complete.
4. Parcel Groupings: The 2018 analysis extracted parcel data from ArcGIS to input into the Master File. Often, this was to group a selection of parcels by geographic location, where hundreds or thousands of parcels are being selected. Extracting groups of parcels enabled the 2018 analysis to add the district for each parcel, which became a valuable sorting tool. Other custom areas can easily be extracted from ArcGIS and input into the master file for analysis
5. Other Data Trends: The 2018 analysis determined that the average residential parcel has 1.22 dwellings. This is likely not a stagnant value; it likely has a trend that may better estimate the future presence of secondary dwellings. Building permit data could further inform this.

- **4.4.3 Future Recommendations**

In this section we will recommend how to make the study more accurate in terms of eliminating uncertainties and creating more realistic projection scenarios. This could be done in two ways, improving the data we receive, and improving how we use the data. All of the data obtained for this analysis came from town assessor Debbie Dilworth, GIS Coordinator Nathan Porter, and Deputy Director of Planning Leslie Snell, and is the most recent data on file. The team did double checked some data looking at the google map image of Nantucket with Mr. Cormac Collier and Mr. Andrew Vorce.

1. Improve Uncertainty by surveying each parcel individually
 - a. Verify conserved areas and wetland boundaries with professionals
 - b. Create a method that precisely analysis's geometric restrictions
 - c. Determine a way to include frontage, septic systems, leach fields and wells into the master spreadsheet
2. Scenario revision and application/updating
 - a. Net dwelling increase should be continuously compared to our low and high scenarios to see where the trend is headed
 - b. District-based growth should determine trends for individual districts; would enable community to better estimate rates of growth by district rather than uniform distribution

Bibliography

- Abrado, C., Kates, L., & Kesack, R. (2013). *Transition from a Whaling Economy to Tourism: 1846 - 1918*. Retrieved from http://www.acktown.com/uploads/Combined_2013_Tourism_Posters.pdf
- Anderson, M., Beaugrand, K., Carreiro, J., Ceely, R., Day, R., Cozort, M., ... Stott, C. (2018, June). *Understanding Affordable Housing on Nantucket*. PowerPoint. Retrieved from http://www.housingnantucket.org/wp-content/uploads/2018/09/Understanding_AffordableHousing.pdf
- Antonio, R., Phillips, C., & Taleb, J. (2011). Nantucket Baseline Energy Project. Retrieved from <https://www.nantucket-ma.gov/Archive/ViewFile/Item/172>.
- Balling, J. (2017, March 2). Planning Board approves 225 apartments, 52 house lots off Old South Road. Retrieved September 24, 2018, from <http://www.ack.net/news/20170302/planning-board-approves-225-apartments-52-house-lots-off-old-south-road>
- Bergman, M. (2014, August 18). Nuts and Bolts: Great Fire | Nantucket Preservation Trust. Retrieved September 16, 2018, from <https://www.nantucketpreservation.org/nuts-and-bolts-great-fire-3211>
- Buyer's Agents. (2016.) Martha's Vineyard Historical Data Real Estate Market Snapshot. Retrieved from <http://www.mvbuyeragents.com/martha-s-vineyard-historical-real-estate-trends>.
- Cape Cod Commission. (2012). *Cape Cod Buildout Analysis to Support Regional Wastewater Planning* (Planning Report) (p. 21). Retrieved from http://www.capecodcommission.org/resources/initiatives/CCC_Final_Rpt_to_DEP.pdf
- Cocuzzo, R. (2016, July 1). WALTER'S WORLD. Retrieved October 1, 2018, from <http://n-magazine.com/walters-world/>
- Cooke, L. (2017, November 9). Nantucket is going to be powered by a 48 MWh Tesla Powerpack system. Retrieved October 8, 2018, from <https://inhabitat.com/nantucket-to-be-powered-by-a-48-mwh-tesla-powerpack-system/>
- Definition of CASE STUDY. (n.d.). Retrieved October 6, 2018, from <https://www.merriam-webster.com/dictionary/case+study>
- Dellas, K. (2008). Nantucket Today: Are we running out of water? Retrieved September 23, 2018, from <http://www.nantuckettodayonline.com/archives/are-we-running-out-of-water/>
- Genter, E. (2018-a). Nantucket sewage cleanup continues. Retrieved from <http://www.capecodtimes.com/news/20180111/nantucket-sewage-cleanup-continues>
- Genter, E. (2018-b). Nantucket sewage spill called "catastrophic failure." Retrieved October 8, 2018, from <http://www.ack.net/news/20180105/nantucket-sewage-spill-called-catastrophic-failure>
- Great Point Properties. (2018.) Nantucket Real Estate Market Statistics, Graphs and Charts. Retrieved October 5, 2018, from <https://www.greatpointproperties.com/market-news/>
- Herr & Associates, P. B., & Applied Geographics, Inc. (2002). Town of Amherst, MA: Build-Out Analysis and Future Growth Study (Build-Out Analysis) (p. 48). Retrieved from https://www.amherstma.gov/DocumentCenter/View/385/Build-Out_Analysis--Future-Growth-Study?bidId.
- Higgins, R., & Vorce, A. (2018, September 13). Interview with Rita Higgins, Andrew Vorce.
- Higgins, R. (2018, September 20). Interview with Rita Higgins.
- Housing Nantucket. (2018.) Affordable Housing For Nantucket Residents. Retrieved from <http://www.housingnantucket.org/about/>

- Krueger, R. (2002, October). Designing and Conducting Focus Group Interviews.
- Lacy, J. R. (1990, September). Manual of Build-Out Analysis. Retrieved from https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1023&context=larp_ms_projects
- Lang, J. C., & Stout, K. (1995). Building With Nantucket In Mind (Construction Guidelines) (p. 184). Retrieved from <https://www.nantucket-ma.gov/DocumentCenter/View/12329/Building-With-Nantucket-In-Mind-1992-PDF>
- Macy, O., & Macy, W. C. (1880). The History of Nantucket. Macy & Pratt.
- Martha's Vineyard Commission. (2014). Affordable and Community Housing Zoning Analysis on Martha's Vineyard (Build-Out Analysis) (p. 36). Retrieved from <https://mvcommission.org/sites/default/files/docs/zoningandaffordablehousingonmarthasvineyard.pdf>
- Mello, M. (2017). A Compact with the Whales: Confederate Commerce Raiders and New Bedford's Whaling Industry 1861-1865, 40.
- Meltz, D. (2010). Callicoon Buildout Analysis. Retrieved October 6, 2018, from <http://www.donmeltz.com/wordpress/documents/CallicoonBuildoutAnalysis.pdf>
- Nantucket Association of Real Estate Brokers, Nantucket Comprehensive Plan Steering Committee, Nantucket Land Council, & Nantucket Planning and Economic Development Commission. (1997.) Nantucket Buildout Analysis, 1997.pdf. Retrieved from <https://www.nantucket-ma.gov/DocumentCenter/View/1048/Nantucket-Buildout-Analysis-1997?bidId=>
- Nantucket Conservation Foundation. (2018.) Retrieved October 8, 2018, from <https://www.nantucketconservation.org/>
- Nantucket County, Massachusetts Population 2018. (2017). Retrieved October 8, 2018, from <http://worldpopulationreview.com/us-counties/ma/nantucket-county-population/>
- Nantucket Department of Information technology and GIS. (2018). Nantucket Island Zones. Retrieved from https://www.nantucket-ma.gov/DocumentCenter/View/19609/Zoning_2018_04
- Nantucket Department of Information Technology and GIS. (2018). Town and County of Nantucket, MA. Retrieved from <https://nantucketma.mapgeo.io/?latlng=41.315977%2C-70.134826&panel=themes&themes=%5B%22zoning%22%5D&zoom=11>
- Nantucket Finance Committee. (2017.) Section-III FY18 School Budget. Retrieved October 8, 2018, from <https://www.nantucket-ma.gov/DocumentCenter/View/22546/Section-III---School>
- Nantucket Land Bank. (2018). Retrieved October 7, 2018, from <https://www.nantucketlandbank.org/>
- Nantucket Planning and Economic Development Commission, Nantucket Island Chamber of Commerce, & RKG Associates, Inc. (n.d.). *Monitoring the Nantucket Economy* (Economic Study) (p. 51). Retrieved from <https://www.nantucket-ma.gov/DocumentCenter/View/1049/Nantucket-Economic-Base-Study-Update-2002?bidId=>
- Nantucket Planning Board. (2018). *Nantucket Master Plan - April 19, 2009* (Community Master Plan). Retrieved from <https://www.nantucket-ma.gov/DocumentCenter/View/1050/Nantucket-Master-Plan---April-19-2009-?bidId=>
- Nantucket Planning Office. (2018). 6 Fairgrounds Workforce Housing. Retrieved September 24, 2018, from <https://www.nantucket-ma.gov/1045/6-Fairgrounds-Workforce-Housing>
- National Grid. (2015). Nantucket Peak Load - Frequently Asked Questions. Retrieved from https://www.nationalgridus.com/media/pdfs/resi-ways-to-save/0317-ngrid-hes-708459-nantucketfaqs_r2a_web.pdf

- Philbrick, N. (2011). *Away Off Shore: Nantucket Island and Its People, 1602-1890*. Penguin.
- Philbrick, N. (2015). How Nantucket Came to Be the Whaling Capital of the World. Retrieved September 4, 2018, from <https://www.smithsonianmag.com/history/nantucket-came-to-be-whaling-capital-of-world-180957198/>
- Pilsch Jr, M. C., & Held, A. L. (1994). THE IMPACT OF A FERRY SYSTEM UPON ITS COMMUNITIES.
- Sutters, P. (2018). Assessment of island sewer line underway. Retrieved October 5, 2018, from <http://www.capecodtimes.com/news/20180216/assessment-of-island-sewer-line-underway>
- Tivnan, G. (2018, September 20). Interview with Gregg Tivnan, Assistant Town Manager.
- Tivnan, G. (2018, September 27). Interview with Gregg Tivnan, Assistant Town Manager.
- The Zoning Act (1975). Massachusetts Law About Zoning. Retrieved September 3, 2018, from <https://www.mass.gov/info-details/massachusetts-law-about-zoning>
- Town of Nantucket, MA Code. (2018). Retrieved September 3, 2018, from <https://ecode360.com/NA0948>
- Town of Nantucket. (2006.) *Town of Nantucket, Massachusetts 2006 Annual Report* (Annual Fiscal Report). Retrieved from <https://www.nantucket-ma.gov/DocumentCenter/View/5881/FY-2006-Nantucket-Town-Report-PDF>
- Town of Nantucket Department of Public Works. (2009). *Capital Improvement Workshop*. Retrieved from <https://www.nantucket-ma.gov/DocumentCenter/View/741/Capital-Improvement-presentation-March-24-2009-PDF>
- Town of Nantucket Energy Office. (2018). Beat the Peak!: Nantucket's Energy Initiatives. Retrieved September 20, 2018, from <https://www.nantucket-ma.gov/997/Beat-the-Peak-Initiative>
- Town of Nantucket Energy Office. (2018). Brief History of Energy on Nantucket. Retrieved September 20, 2018, from <http://www.ackenergy.org/brief-history-of-energy-on-nantucket.html>
- Tsai, C.-H., Mulley, C., Burke, M., & Yen, B. (2014). Exploring Property Value Effects of Ferry Terminals: Evidence from Brisbane, Australia. Griffith University. Retrieved from https://research-repository.griffith.edu.au/bitstream/handle/10072/115170/100729_1.pdf?sequence=1&isAllowed=y
- Tyler, B. (2015). Whaling Museum History. Retrieved September 24, 2018, from <https://nha.org/research/nantucket-history/histories-of-historic-sites/whaling-museum-history/>
- White, F. M. & B. A. (2015). *Hidden History of Nantucket*. Arcadia Publishing.
- "One-Third of Our Town Is in Ashes" - Nantucket Great Fire. (2013, July 11). Retrieved September 16, 2018, from <http://yesterdayisland.com/nantucket-fire/>

Manual of a Buildout Analysis

Parcel by Parcel Method

Date:

13 December 2018

Created for:

2018 Nantucket Buildout Analysis

Nantucket Town Manager's Office

Authored by:

Jonathan Barr

Peter Durkin

James Heineman

David Simpson

Worcester Polytechnic Institute

Table of Contents

Table of Figures and Tables	2
Abstract	3
Introduction	3
Step 1: Data Collection	4
Software and Other Resources	4
Master File	4
Uncertainty and Assumptions in Data Collection	5
Step 2: Categorization and Data Preprocessing	6
Creating Categories	6
Defining Categories	7
Category Relationships	8
Data Preprocessing	9
Step 3: Data Processing	10
Data Processing: Statistics and Sub-Statistics	10
Data Expansion	12
Step 4: Data Cleaning	13
Uncertainty Analysis	13
Reducing Uncertainty through Rejections	14
Step 5: Data Analysis and Mapping	15
Mapping	15
Methods of Comparison and Analysis	16
Step 6: Adaptable Abilities of the Analysis	18
Conclusion	19

Table of Figures and Tables

Figure 1: General Residential Dwelling Creation Hierarchy.....	8
Figure 2: 2018 Nantucket Residential Dwelling Creation Hierarchy.....	8
Figure 3: Rejection Code Descriptions	15
Figure 4: Second Dwelling Parcels and Figure 5: Combined Parcel Types.....	16
Table 1: District Chart Heading	17
Table 2: Simplified 2018 Maximum Buildout Table.....	18

Abstract

A buildout analysis is a tool that can be used to estimate land area dwelling capacity through the use of zoning regulations and parcel information. With Microsoft Excel and ArcGIS Pro, a team of WPI students performed a parcel by parcel buildout analysis for Nantucket, Massachusetts in 2018. With no large tracts of land available for residential development, a parcel-by-parcel analysis became the most accurate way to estimate potential development. Each parcel is considered based upon data on file at the Nantucket Assessor's Office, allowing each parcel to be individually considered based on its size, zone, building cover, and use codes. With Excel and ArcGIS in tandem, all residentially zoned parcels could be identified as developable, subdividable, eligible for second dwelling, or built out.

Introduction

The purpose of this manual is to: a) describe a repeatable buildout development process separate from the full report, and b) provide example scenario analyses employing the 2018 buildout analysis calculations based off the 2018 analysis.

The major steps of the buildout analysis described in this manual are: Data Collection, Data Pre-Processing and Categorizing Parcels, Data Processing, Data Cleaning, Data Analysis and Mapping, and Adaptable Data Processes.

Step 1: Data Collection

Software and Other Resources

For an accurate buildout analysis, the following tools and resources are suggested:

ArcGIS ¹	Tax Assessor Data ²
Microsoft Excel	GIS Parcel Data ³
	Zoning Regulations ⁴

Master File

The Master Excel File is the basis for analysis. The goal is to have each parcel of land and every descriptive statistic for each parcel available in the same file. This ensures that overlapping data and loss of data is minimized.

Assembling a singular master file for all data input is strongly suggested⁵. The following lists indicate what information the 2018 Nantucket Buildout Analysis utilized from each of the three main data resources.

From GIS Parcel Data⁶:

GIS ID: _ Unique parcel tag that ArcGIS understands

AV PID: _ Town's unique parcel identifier

Zone: _ The regulatory zone in which the parcel resides

Use Code⁷: _ The town's assigned parcel use code

Land Area: _ Area of the parcel in acres

Alternate Parcel ID: _ The combination of the parcel's Map, Lot, and Lot Cut

From the Tax Assessor Data:

Ground Cover⁸: _ Gross area of the building, the footprint of the building

Number of Dwellings⁹: _ Number of buildings that have a bedroom on the property

¹ For the 2018 Analysis, the team used ArcGIS Pro software. Other versions, including ArcMap, are commonly used and all layers and data files are compatible with the Pro software. ArcGIS and ArcMap both require .CSV input files, which easily convert to and from Excel files.

² "Tax Assessor Data" refers to the entire dataset the Town Assessor has on file, both by parcel and by building. This was delivered to the team as an Excel spreadsheet.

³ Provided to the team was a vital ArcGIS base map, which showed all tax parcels on Nantucket with associated GIS tags. The attached .CSV sheet lists all AV PIDs, GIS IDs, and many other basic descriptive stats of every parcel.

⁴ "Zoning Regulations" incorporates all necessary zone data, including, but not limited to, minimum lot size, setbacks, and frontage requirements.

⁵ It is also possible to link Excel spreadsheets together, though a singular master file means no data can be lost in transition or translation.

⁶ The list associated with GIS data is by no means complete; this highlights the most important pieces of information.

⁷ Use Code is the town's assigned tax use, assumedly for tax rate purposes. A dictionary of codes, provided to the team by Town of Nantucket Assessor Debbie Dilworth, is found in Appendix E.

⁸ A more comprehensive definition of ground Cover is found in Appendix D.

⁹ The assessor building data describes each building. Parcels that have multiple buildings will result in the AV PID being listed multiple times. A dwelling was defined as a building in the data with at least one bedroom; buildings with no bedrooms showed an "Alt Building No" = 0. When using the Excel function "Consolidate" to determine the ground cover per parcel, the "Alt

From Zoning Regulations:

Minimum Lot Size: _ The smallest a parcel is allowed to be, per zone

Ground Cover Percentage: _ Maximum amount of surface area that buildings can cover

Secondary Dwelling Regulation: _ The ability for a parcel to have a second dwelling, by zone

Uncertainty and Assumptions in Data Collection

The data assembled from the Assessor, GIS, and Zoning datasets is very accurate. The Assessor data is in constant use and is updated cyclically. GIS data is, for most towns, a preexisting system that is updated at the beginning of each year. Zoning data has low turnover and changes. Each of these characteristics provides a solid base for the analysis.

There are, unfortunately, limitations to the data being used. A buildout analysis needs to reach an acceptable level of uncertainty. While there are many potential sources of error, the 2018 Nantucket Buildout Analysis team identified the following; please note that every analysis is different and that some sources of error may be mitigated or exacerbated. This list is not exhaustive:

Data Entry Errors/Mis-Coded Entries: With large data sets like the Parcel GIS Data and the Assessor Data, there is implicit trust in the dataset; it is likely not feasible to analyze each individual parcel in the dataset. If any of the entries are incorrect then such errors will be unknowingly carried through the process.

Non-Unique Coding: It is entirely possible that GIS codes, Alternate Parcel IDs, or other comparison codes are not unique. AV PID is a unique identifier, though it is not always possible to use this in comparing datasets. In the 2018 Nantucket Buildout Analysis, there were about 600 non-unique GIS IDs of the total of 13,660 parcels. This can duplicate or eliminate some values when inserting or combining data spreadsheets.

Assumptions: Other assumptions may be made in the data collection process. Clearly stating these are critical so that readers may understand limiting or unconsidered factors. For the 2018 Nantucket Buildout Analysis, the team primarily analyzed residential properties. To do so, the team created the definition "Residential Splitability"¹⁰; only parcels that fit this definition were considered¹¹. The team also recognized that ground cover can be a limiting factor when considering subdivision and second dwellings. If no data for ground cover is provided, it can be that either no building exists on the property or that the data does not exist. For both cases, the parcel would not be considered for either subdivision or second dwellings, whether the lack of data is correct (no building exists) or not (the data simply does not exist).

Building No" was also summed, which created a pattern: 1 building summed to 1, 2 buildings summed to 3, 3 to 6, etc. This allowed the team to find the number of dwellings per parcel.

¹⁰ The definition of Residential Splitability determines whether a residential parcel has the ability to split into more than one parcel, rejecting non-residential parcels or those that have bad Use Codes. The full definition can also be found in Appendix C.

¹¹ To create a more complete analysis, the team also analyzed parcels that fit the term "Commercial Splitability", which is defined as a commercial parcel that has the ability to split. The definition can also be found in Appendix C. The team analyzed these parcels because, for long term analysis, there is nothing preventing the use of these parcels from changing. Commercial zones and use codes are not unchangeable. Similarly, Chapter 61A land is a tax code; if the owner changes the use from the 61A definition, then the land may be residential and therefore has potential buildout. In keeping the two categories separate, the team could distinguish and present their findings more clearly.

Step 2: Categorization and Data Preprocessing

To thoroughly analyze an individual town, dwelling categories must be identified. These categories provide a framework (or a set of goals) for the buildout analysis. Data must also be pre-processed and standardized so that it is workable.

Creating Categories

First, clarify what types of new construction should be considered and is feasible. A buildout analysis is not limited to understanding new residential dwellings, nor is it limited to understanding just a single method of dwelling creation. The following major and sub-categories have been provided by the team as examples:

Residential: New Dwellings

1. Vacant buildable lots
2. Subdivision
3. Secondary Dwellings
4. Tertiary Dwellings
5. Renovation
6. Apartments/Condominiums
7. Multi-use properties
8. Vertical Expansion

Commercial: New Storefronts

1. Vacant lots
2. Subdivision
3. Renovation
4. Condensed Storefronts

Industrial: Factories or Farmland

1. Vacant Lots
2. Restoration (Factories)
3. Tear Down/"Undevelopment" (Farmland)

Recreation: Open Space Expansion

1. Vacant Lots
2. Nature worthy lots
3. "Undevelopment"

Residential dwelling creation has the easily understandable methods to expand. A complete buildout analysis will analyze the potential of all sub-categories, though it can be streamlined by considering only the most important ones¹². Similarly, a buildout analysis can expand to include more than one major category, though the relationships between categories must be carefully analyzed and communicated.

For the 2018 Nantucket Buildout Analysis, the team was concerned with the number of new dwellings that can be built for residential use. They are as such:

¹² The importance of a category depends on the town/community being analyzed and the regulations and trends already in place.

Residential: New Dwellings

1. Undeveloped
2. Subdividable
3. Second Dwelling
4. Covenant Housing

Defining Categories

For a buildout analysis to be effective, establishing a definition for each category is vital. Definitions may rely on a parcel *not* belonging to another category; relationships will be established soon after. Definitions should look similar to the following examples from the 2018 Analysis:

Undeveloped: A parcel with no current development (vacant¹³). Parcel may not be wetlands, conserved land, or otherwise unbuildable.

Subdividable: A parcel that has ample room to be split into additional parcels. It must fit the definition of underutilized¹⁴ and have enough ground cover available.

Secondary Dwellings: A parcel that is eligible to construct a separate dwelling of at least 500 SF of ground cover. A parcel that can be subdivided should not be considered in this category¹⁵; similarly, a parcel with no development or already with a second dwelling should not be considered.

Covenant Housing: A parcel that is eligible to split its lot based on the Covenant Housing program. The Covenant Housing program, fully defined in G.L. 139-8B¹⁶, creates affordable housing for parcels that may not allow it. In short, the program allows for subdivisions smaller than minimum lot size if one lot is designated affordable. The team considered this separately of Second Dwelling, but not from subdividable or undeveloped parcels.

¹³ A complete list of vacant parcels was provided to the 2018 team as a GIS layer that was extracted and input into the Master Excel File.

¹⁴ The definition of underutilized is being 2.5x larger than minimum lot size or greater. The definition can also be found in Appendix C, where as a detailed understanding of the term can be found in Appendix D.

¹⁵ It is important to note that subdividable parcel can have a secondary dwelling, provided it has the ground cover to do so. However, individual analysis of subdivided parcels would have been a monumental task for the team. Instead, when totaling new dwellings to be created by subdivided parcels, a dwellings/parcel factor was applied to match the ratio currently observed on Nantucket. For more information, see *Step 3: Data Expansion*.

¹⁶ The full code can be found in Appendix F.

Category Relationships

As described in “Defining Categories”, the definition for each category relies on information about other categories. To convey these relationships, a simple hierarchy or spider web diagram can be established between the sub-categories. This should result in every parcel being assigned to *only one* sub-category. For instance, a sample hierarchy for New Residential Dwellings was created:

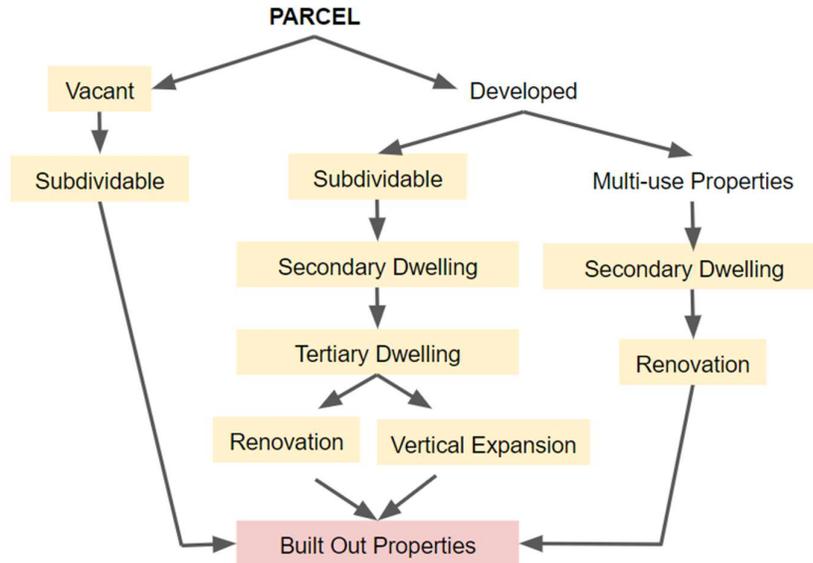


Figure 1: General Residential Dwelling Creation Hierarchy

The steps highlighted in yellow indicate that a parcel can fall into this category and have some sort of new development. If a parcel falls through all steps, it would then be deemed “built out”. This sample may not be accurate for all communities. However, the process in creating it is applicable.

The 2018 team created the following relationship chart:

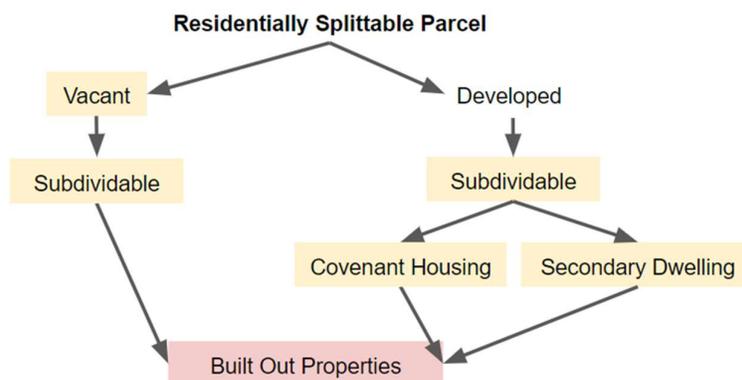


Figure 2: 2018 Nantucket Residential Dwelling Creation Hierarchy

The relationship chart relies on the definitions created above. Only Residentially Splittable Parcels are being considered for this example, explained as follows:

1. All parcels are either vacant or developed.

Vacant Track

- a. If a parcel is vacant, it may be also subdividable. A parcel does not have to be subdividable to be considered Undeveloped.

Developed Track

- b. A parcel should first be considered if it can be subdivided. To be subdivided, a parcel needs to be underutilized and have enough ground cover to support splitting the parcel. If one or both criteria are not met, the parcel moves down the chain.
- c. A parcel will only be considered for Covenant or Secondary dwellings if the parcel is not subdividable.
 - i. For a parcel to be considered for a secondary dwelling, it must have at least 500 SF ground cover available¹⁷, be in a zone that allows for secondary dwellings, and not already be a multi-dwelling parcel.
 - ii. For a parcel to be considered for a Covenant dwelling, the parcel must be at least 1.4 times the minimum lot size and have at least 800 SF ground cover available¹⁸.

If a parcel does not meet the criteria of any of the categories, it is considered built out, meaning it should not see further development.

Data Preprocessing

Data preprocessing refers to the general manipulation and integration of data across all parcels. The data can also infer other information. In the 2018 Nantucket Buildout Analysis, the team preprocessed the following columns of information¹⁹:

1. Convert Land Area, in Acres, to Land Area, SF: This made comparing size much easier than comparing through acreage.
2. Input Minimum Lot Size: this allowed the team to easily view and compare the smallest allowable area the lot can be per zoning regulations.
3. Convert Use Code to Simplified Use Code: The team recognized that some use codes had letters, though these were few. The simplified version allowed for quicker analysis, especially when defining large groups that began with a specific number²⁰.
4. Input Ground Cover, SF: This data comes from the assessor data; the team was informed²¹ that the Gross Building Area should be the area considered as ground cover. For parcels that had multiple buildings, the sum of all buildings was the value input.

¹⁷ 500 square feet was used for this calculation because secondary dwellings do not need to have any sort of considerable size. A house over 500 SF is above the definition of a tiny house (see G.L. 139-2), and the team felt that this was a sufficient size for a small dwelling. This assumption can be changed.

¹⁸ 800 square feet was considered for Covenant dwellings because it was felt that these dwellings were intended for year round use and more than single individuals. 800 SF was determined to be an adequate amount of space to build a fairly sizeable dwelling. This assumption can be changed.

¹⁹ These columns have definitions provided in full in Appendix C. The provided information gives an idea of why the team wanted the piece of information.

²⁰ Codes with a letter returned with error codes when processed; the simplified ensures it processes as normal.

²¹ Assessor information and advice from Debbie Dilworth, Town of Nantucket Assessor.

5. Calculate Max Ground Cover, SF: The maximum ground cover area the parcel can contain. This is a function of Land Area, SF multiplied by its ground cover percentage, which is looked up from Zoning Regulations.
6. Calculate Ground Cover Utilization: The ratio of ground cover used; for most parcels, this value is less than 1²².
7. Calculate Land Utilization Ratio: The ratio defined as the Land Area, in SF divided by the Minimum Lot Size. For most parcels, this value is greater than 1²³.
8. Define Residentially Splittable: Determines if a parcel is both residential and should be considered splittable; based on Use Code. From Land Use Dictionary²⁴, parcels that began with a 1 were residential. The rejected residential codes can be found in Appendix C²⁵.
9. Format Second Dwelling y=0 n=1: Determines if a parcel is already multi-dwelling, as defined through its Use Code; use codes of 1090, 1092, and 1093 indicate some type of multi-dwelling parcel. If the parcel is multi-dwelling, a 0 is returned meaning it cannot hold another second dwelling.
10. Input Vacant: From a GIS layer²⁶, the team extracted all parcels that were vacant²⁷. This enabled the team to view parcels that were vacant in the table for comparison.
11. Input District: The geographic area/district the parcel resides in²⁸.

This allows all data to be readily available for use in subsequent steps.

Step 3: Data Processing

With preprocessed data, the next step is to begin writing excel column code. The goal of the code is to take each parcel and sort it into the appropriate category. When coding parcels, it is important to retain the category relationships established so that a parcel is not identified in two categories.

Data Processing: Statistics and Sub-Statistics

There are two types of processing outputs: descriptive statistics and sub-statistics. From the definition of subdividable provided above, the 2018 team created the following statistics:

1. Descriptive Statistic - Subdividable: For a parcel to be subdividable, it must fit all of the sub-statistics described. It must also not be rejected from subdivision²⁹.
 - a. Sub-Statistic - Residentially Splittable: The parcel must be residentially splittable.

²² The team is not entirely sure why some values are greater than 1; this would seem to indicate that some easement or grandfathering allows this. In any case, these parcels would not be analyzed any further because there is no space for growth.

²³ For parcels where this value is less than 1, a value of "easement" is returned. If there is no minimum lot size or no land area found, a value of "n/a" is returned.

²⁴ The Land Use Dictionary was provided to the team by Debbie Dilworth, assessor for the Town of Nantucket. The dictionary in its entirety is provided in Appendix E.

²⁵ The Use Code is followed by (definition of code), which is the reason the code was rejected.

²⁶ Provided by Nathan Porter, GIS Specialist for the Town of Nantucket

²⁷ Vacant as of November, 2018, to the team's best knowledge.

²⁸ A GIS layer outlining established districts on Nantucket, provided to the team by Nathan Porter.

²⁹ The rejections involved in this process are explained more in depth in Step 4. In code, the Subdivision statistic is where the rejection is considered.

- b. Sub-Statistic - Developed³⁰: The parcel must already be developed to be considered; conversely, it cannot be Developable³¹. If a parcel is developable, it is rejected.
- c. Sub-Statistic - Parcel Split, Variable %: The parcel must have substantial ground cover available so that, if the parcel were to split, the new parcel with the existing building will meet the minimum lot size, as will any new lots. The formula is defined as such:

$$(1 - \text{Ground Cover Utilization}) * (\text{Land Area in SF}) > \text{Minimum Lot Size}$$

The theory the team used is that there is a minimum amount of land the existing structure can; the remaining amount of land (the left side of the equation) must be larger than the minimum lot size (right side) for the parcel to be able to split.

- d. Sub-Statistic - Splitability with Ground Cover: The parcel must be both splittable and have the ground cover available.
- e. Sub-Statistic - Underutilized: The parcel must be underutilized, which means it must be at least two and one-half times larger than minimum lot size³².

The accompanying Excel functions, which the 2018 team developed and used, are given in reference to the above statistics and sub-statistics:

1. =IF(OR([@[Rejection: No Build]]=1,[@[Rejection: No Sub, 2nd]]=1),0,
 [@[Underutilized]*[@[Splitability w/ GC]])
 - a. =IF(OR([@[Rejection Code]]=1,[@[Simplified (Use Code)]]=1020,[@[Simplified (Use Code)]]=1030,[@[Simplified (Use Code)]]=1320,[@[Use Code]]=1305,[@[Use Code]]=1306,[@[Use Code]]=1307,[@[Use Code]]=1321,[@[Use Code]]=1323,[@[Use Code]]=1325,[@[Use Code]]=1333),0,IF(INT([@[Simplified (Use Code)]]/1000)=1,1,0))
 - b. See footnote 24.
 - c. =IFERROR(IF((1-[@[Ground Cover Utilization]])*AA19>[@[Minimum Lot Size]],1,0),0)
 - d. =IF([@[Parcel Split, Variable %]]="no data",0,[@[Parcel Split, Variable %]]*[@[Res Splitability]])
 - e. =IF(OR([@[Land Utilization Ratio]]="n/a",[@[Land Utilization Ratio]]="easement",[@[Developable?]]=1),0,IF([@[Land Utilization Ratio]]>2.5,1,0))

The team created similar statistics for each of the other main categories. A list of the sub-statistics is provided for reference³³.

³⁰ This is not a statistic that is explicitly defined. It is written into the code to occur as outlined in Footnote 28.

³¹ The sub-statistic Developable works as the opposite of what is explained. For a parcel to be Developable, it must not have any ground cover - it must not have any "development" on it. However, for this explanation, it is easier and more worthwhile to explain the process as it is.

³² The definition of underutilized was provided to the team by Andrew Vorce, Director of Planning for the Town of Nantucket.

³³ See Appendix C, which provides a list of column definitions. These definitions provide much of the relationships and understanding provided in the full example.

2. Descriptive Statistic - Second Dwelling
 - a. Sub-Statistic - Residentially Splittable
 - b. Sub-Statistic - Not Subdividable
 - c. Sub-Statistic - Ground Cover: 500 SF
 - d. Sub-Statistic - No Second Dwelling Present
 - e. Sub-Statistic - Zone Requirements
3. Descriptive Statistic - Covenant Housing
 - a. Sub-Statistic - Residentially Splittable
 - b. Sub-Statistic - Not Subdividable
 - c. Sub-Statistic - Ground Cover: 800 SF
 - d. Sub-Statistic - Land Utilization Ratio > 1.4
 - e. Sub-Statistic - Not Underutilized
4. Descriptive Statistic - Undeveloped
 - a. Sub-Statistic - Residentially Splittable
 - b. Sub-Statistic - Ground Cover = 0
 - c. Sub-Statistic - Currently Vacant³⁴

Each of these descriptive statistics were formulaically analyzed similar to that which was presented.

Data Expansion

It is unlikely that every parcel identified creates a singular new dwelling. Certain traits of current parcels indicate how many new dwellings can be created in the future.

The 2018 team's parcel types create dwellings in the following methods:

Undeveloped: Parcels can be subdivided into the integer value of their area divided by the minimum lot size. Parcels can also add a second dwelling³⁵.

Subdividable: Parcels can be subdivided into new parcels based on two conditions: the total area of the parcel and the ground cover remaining.³⁶ New parcels can also add a second dwelling.³⁷

Second Dwelling Eligible: Parcels can add only one dwelling, being the secondary dwelling.

For parcels that would be newly developed (undeveloped or subdividable parcels), the team could not accurately estimate the ability of these parcels to add a second dwelling³⁸. To combat this inability, the team instead used the current ratio of dwellings/parcel, which was 10,456 dwellings on 8,581 residential parcels with a dwelling, which rounded to 1.22. This number is carried through the dwelling calculation.

³⁴ The 2018 team extracted a list of vacant parcels from a GIS layer provided to the team by Nathan Porter, GIS Specialist. This list was then input into the table based on AV PID, with any parcel appearing on the list being considered vacant.

³⁵ The 2018 team determined that developed residential parcels have, on average, 1.22 dwellings on them. Further analysis can be found later in this step.

³⁶ See Step 3, sub-statistic c: Ground Cover, Variable % to understand how ground cover affects subdivision.

³⁷ Because the team incorporated ground cover as a calculation input, it is assumed that the "current" parcel that retains the old dwelling maximizes its ground cover already. This is because it sizes the "current" parcel to be the smallest allowable so that ground cover requirements are met for the existing parcel. With potentially little or no ground cover remaining, no dwelling could be constructed.

³⁸ Based on criteria such as ground cover, where it is dependent on the primary structure which does not already exist.

This number of dwellings that can be developed looks, then, similar to this:

Undeveloped: (Total # Parcels *after* subdivision) x (dwellings/parcel)

Subdividable: (# New parcels after subdivision) x (dwellings/parcel)

Second Dwelling Eligible: (# Second Dwelling Eligible Parcels)

The values output from these equations gave the 2018 team concrete values of potential dwellings.

Step 4: Data Cleaning

Uncertainty Analysis

As stated in Step 1, there are areas of uncertainty in any data set, as well as implicit trust in the data provided. In performing a buildout analysis, accuracy is dependent on cleaning the data on a parcel-to-parcel level. The 2018 team created the following list of potential inaccuracies, as well as briefly described how each can (and did) affect the accuracy of an analysis³⁹:

1. Data Trust (-1 to +1%) - The trust that the data is both up-to-date and accurate; miscoded entries or erroneous values are possible. Unless the data can be personally verified, there is always the potential that some values are not accurate. The 2018 team trusted the data entirely, as there was no way to verify parcels in the 7-week period the team was on Nantucket.
2. Conserved Areas (-5 to 0%) - Certain parcels may be intentionally kept vacant or underutilized for natural and environmental reasons. Though there are Use Codes for open spaces and conserved land, it is possible that code is not specific or does not accurately match the landowner's feeling regarding development. Nantucket has over 60% of its land owned by conservation organizations and parcels like this have use codes that reflect this. Time spent with Cormac Collier, Executive Director of the NLC, identified some parcels that may have been mis-coded. The team decided that there was a distinct possibility that some parcels were missed in this process. Similarly, there is the possibility that conservation organizations will buy land and designate it as conserved, meaning there is less land for development.
3. Wetlands (-5 to 0%) - Wetland restrictions, such as upland requirements and buffers⁴⁰, can restrict the availability of some or the entirety of a parcel. It is possible that some towns have data layers or values per property. Wetlands are the major natural restriction on Nantucket; however, only parcels that are entirely wetlands will have a Use Code as such. The 2018 team identified parcels that are partially or entirely wetlands with the help of Cormac Collier. The team identified parcels as either restricted or partially restricted⁴¹.

³⁹ Percentages estimate the effect the uncertainty will change the maximum buildout estimate. For example, -3% would mean that the team's final estimate could be reduced by 3%.

⁴⁰ G.L. 136 covers wetland requirements. The Conservation Commission Wetlands Protection Regulations also outlines the requirements of these topics (not attached).

⁴¹ Partially restricted parcels are potentially subdividable or vacant parcels that have estimations higher than wetland restrictions would allow. For example, a subdividable parcel that zoning requirements show could split 15 ways may only be able to split 3 or 4 ways. For this reason, the parcel is designated as partially restricted. When calculating maximum buildout,

4. Other Dwelling Sources (0 to +1%) - As mentioned in Step 2, there are potentially dozens of potential dwelling sources; a buildout analysis does not necessarily account or include all types of dwelling sources. The ability and prevalence of sources will differ on both town-by-town and year-to-year levels. This reduces the life of a buildout analysis, as eventually the sources of dwellings will change. The 2018 analysis only calculated the potential dwellings created by 3 sources: vacant parcels, subdividable parcels, and secondary dwellings. There are various other dwelling sources, including tertiary dwellings and renovations, that could produce dwellings that the team did not account for.
5. Large Developments (0 to +2%) - The potential for subdivision of multiple combined lots is a reality of many towns. These developments utilize minimum lots or, in some cases, break the town's zoning code if they can be deemed as affordable housing projects. Richmond Great Point and 6 Fairgrounds provide a significant number of dwellings in a dense area. Predicting these sort of projects, because they can break many of the existing zoning laws⁴².
6. Geometric Restrictions (-5 to 0%) - Depending on the GIS software used, it may not be possible for some geographic restrictions to be accounted for. The 2018 Analysis was unable to determine 2 major geometric restrictions: frontage requirements and abilities and leach field/well requirements and buffers. Frontage requirements were not incorporated because frontage was not a specified value in the assessor or GIS data⁴³. Leach fields require additional space and have a dwelling cap⁴⁴. Wells require a buffer from other wells and leach fields. The team could not accurately distinguish parcels that would require any of these restrictions
7. Unknown Uncertainties (-5 to +5%) - In any analysis, it is possible that code errors or other human errors occur. Though these are mitigated the more time spent on the analysis, it is still important to recognize that fully eliminating all uncertainty will not occur. The 2018 team was reliant on data and expert knowledge provided by individuals not on the project team. As a result, it is entirely possible that miscommunication or incomplete analyses by others impacted the dataset and final values the team produced.

This list is not exhaustive, and the potential margins of error for each category will vary based on location. It is also possible to thoroughly account for each uncertainty, though the overall process would take longer to perform. It is more important to reach an acceptable level of uncertainty.

Reducing Uncertainty through Rejections

It should be a primary goal for every analysis to be as accurate as possible. This means that every uncertainty, such as those listed above, should be captured or otherwise accounted for. Controlling uncertainty can come in a variety of application methods.

partially restricted parcels can only split to 25% of their maximum. See Step 3: Reducing Uncertainty through Rejections for more information.

⁴² Chapter 40B projects, which are designated by the state of Massachusetts, not the Town of Nantucket, are not subject to the same restrictions that typical regulations.

⁴³ Without knowing the frontage of the current parcel or the available frontage, the team could not determine if a parcel could split based on frontage limitations. It would be possible, though time consuming, to input each parcel frontage individually, though the team did not have the time to do this.

⁴⁴ Per Andrew Vorce, a 10,000 SF area allows for a 4-bedroom maximum. This concept was not incorporated.

The 2018 Nantucket Buildout team used Rejection Codes to reduce the uncertainty of Conserved Areas and Wetlands. The goal of the rejections was to systematically identify parcels that fit a desired description while retaining the organization of the data. A sample of the 2018 team’s rejection coding principle is outline below:

Code #	Code Description	Additional Notes
1	Rejected for incorrect parcel use code	
2	Rejected for island	Tuckernuck and Muskeget
3	Rejected for wetlands/conservation restriction	
4	Rejected for existing construction	
5	Partial rejection, potential for 2nd dwelling	
6	Rejected for shape and surroundings	
7	Rejected for surrounded by conservation land	
8	Rejected for large development	Project in progress or planned
9	Partial rejection, cannot be subdivided	Frontage, restriction, etc.
10	Rejected for Incorrect/Not-updated Parcel mapping	
11	Partial rejection for partial subdivision available	Wetlands, other natural restrictions
12	Rejected for No Sub/No 2nd Dwelling	Regulation or restriction
13	Vacant Lot	Make developable
14	Rejected for 6 Fairgrounds lots	

Figure 3: Rejection Code Descriptions

It is apparent that some of these rejections would result in similar outcomes. For instance, codes 1, 2, 3, and many others would result in the parcel being rejected from any buildout consideration. However, the layer of detail remains so that, when proof-checked, the data provides more information than a simple rejection.

The coding also shows the extent to which development is restricted; codes 4, 5, and 9 were not considered for subdivision but were for second dwellings. Code 11 was considered separately in maximum buildout calculations⁴⁵. Code 13 indicated that a parcel that was not vacant should be considered as such.

The application of rejection codes is not limited to wetlands or deed restrictions. From the list of uncertainties the team presented, topics such as geometric restrictions could be applied similarly; codes for unrestricted and by area needed would capture another layer of data.

Step 5: Data Analysis and Mapping

With all uncertainties captured or accounted for, the final step is to analyze the data and display the data in an organized manner.

Mapping

GIS systems provide the ability to map the findings and find primary locations future development. Through ArcGIS, converting the Excel file to .CSV allows for the data to be input as a data table for the map. To ensure mapping is possible, the original GIS tag for each parcel must be retained in the

⁴⁵ Partially restricted parcels (wetlands) are parcels that were initially estimated to produce a large number of new parcels. However, wetlands considerations reduce the amount of available land that is buildable to where the original estimate far exceeds the potential of the parcel. When calculating maximum buildout, the 2018 team assumed that 25% of all potential new parcels (from current code 11 parcels) could actually be developed.

data set⁴⁶. This enables the software to pair the base map tax parcels to the dataset. Sorting and highlighting along desired characteristics⁴⁷ allows for specific categories to be mapped with ease. It is also possible to take highlighted parcels and create a stable layer containing only the desired parcels⁴⁸.

Separate layers allowed for split viewing and analysis, such as areas with greatest potential for a specific types for dwellings. Similarly, overlaying a district layer would enable defined areas to be viewed.

The 2018 Nantucket Buildout Analysis created the following maps to exemplify the processes described:



Figure 4: Second Dwelling Parcels



Figure 5: Combined Parcel Types

The left map shows one layer of only Second Dwelling Eligible parcels. This was defined in the data as entries as Second Dwelling Eligible = 1. The right map shows all 3 layers: Second Dwelling Eligible, Subdivision, and Undeveloped.

Methods of Comparison and Analysis

For the data output of a buildout analysis to be effective, there are two categories of comparison to be developed: internal or external.

Internal Comparison: The data is compared to itself by district, zone, total, or other comparative identity of the data. Finding appropriate ratios or percentages of the total may be useful statistics to describe future development by location. The percentages would add to 100%.

External Comparison: The data is compared to another set of data, preferably data that is imbedded in current assessor data, such as number of current dwellings. This enables the data to be shown as growth from present day. These percentages would not add up to 100%.

⁴⁶ Do not change the name of the GIS ID column.

⁴⁷ It is possible to highlight both from the map and from the table. The 2018 team utilized the table to highlight entries that fit some certain criteria, i.e. Subdividable = 1, to plot all potential subdividable parcels.

⁴⁸ Once the data is highlighted, right click the tax parcel data layer from the layer menu. Select "create new layer from selection" to create the layer of desired data.

Internal comparison is beneficial because it splits the data into smaller groups. The processing in Step 3, though comprehensive, only finds a grand total of all affected parcels in the region. Organizing findings based on internal comparisons allow the data to be more easily communicated and explained. There are two primary ways to compare data: by district⁴⁹ or by zone. Each informs a different point of view.

By District: This method informs where, geographically, new dwellings (or other development) can be seen⁵⁰. When communicating this data, attributing values to a well-known and defined area is particularly useful.

By Zone: This method informs the effectiveness or potential a specific regulation category, being a zone⁵¹. In communicating this data, it can be easy to estimate how changing zoning would affect the potential for growth. Area change in zoning region would not be captured in this analysis.

It may also be beneficial to display data both ways, either in the same or in separate charts; this will depend on the breadth of information used in compiling these charts.

The 2018 Nantucket Buildout Analysis team found internal and external results by both district and zone. The chart headings for the District Chart are shown below:

District	Scenario #1: Hypothetical Max		
	New Dwellings	% New Dwellings	% Potential Growth
Grand Total	A	B %	C %
District A	D	E %	F %

Table 1: District Chart Heading

There are two distinct sections to the header: the district (or zone) and the maximum buildout. This enables additional analyses to be shown in the same table while still remaining separate.⁵² The leftmost column is the district or zone being analyzed. The row and column descriptions are as follows:

Grand Total: The sum or analysis of all districts analyzed.

District A: The set of values for a specific district.

A = Sum of potential new dwellings across all districts (see D). This is a numerical data output.

B % = Sum of % Dwelling by district (see E). All districts will sum to 100%. This is an internal comparison.

⁴⁹ A district is an identifiable geographic region of the town/city that is being analyzed; it might be a village or cardinal direction. It has defined edges that are well known. District must also be extracted from ArcGIS through individual parcel selection or shape outlines, then be input into the master file.

⁵⁰ It is possible to find values such as these by PivotTables in Excel, where the District is a specified row in the output table.

⁵¹ Similar to the above footnote, except the Zone is a row of the output table.

⁵² The 2018 team analyzed present day Nantucket and created growth scenarios for 2030. Maintaining everything in one chart made comparison from present to future (maximum and scenario) easier to compare and present as a comparison.

C % = Potential New Dwellings (A) divided by Current Dwellings (not in display). This value can be greater than 100%. This is an external comparison.

D = Potential New Dwellings in District A. Is the sum of all potential dwelling source values. This is a data output.

E % = Potential New Dwellings in District A divided by Sum of Potential New Dwellings (A). This is an internal comparison.

F % = Potential New Dwellings in District A (D) divided by Current Dwellings in District A (not shown). This is an external comparison.

A simplified version of the 2018 analysis table is shown below.

District	Present Day: 2018			Hypothetical Max Buildout		
	Residential Parcels	Total Dwellings	% of Total Dwellings	New Dwellings	% New Dwellings	% Potential Growth
Grand Total	10697	10456	100%	5461	100%	52.2%
Town	4166	4276	40.9%	2610	47.8%	61.0%
Scon	963	554	5.3%	598	11.0%	107.9%
Airport	377	335	3.2%	368	6.7%	109.9%
Surf	595	719	6.9%	289	5.3%	40.2%
Brant	318	330	3.2%	239	4.4%	72.4%
Quid	169	156	1.5%	124	2.3%	79.5%
Tom	612	522	5.0%	116	2.1%	22.2%
Dionis	273	336	3.2%	115	2.1%	34.2%
Mad	325	284	2.7%	101	1.8%	35.6%
Polpis	147	178	1.7%	98	1.8%	55.1%
Harbor	255	300	2.9%	91	1.7%	30.3%
Other	2497	2466	23.6%	712	13.0%	28.9%

Table 2: Simplified 2018 Maximum Buildout Table

Step 6: Adaptable Abilities of the Analysis

A buildout analysis is not a one-time document. Instead, it should be treated as a workbook that can constantly be updated and the analysis “re-run” to determine trends in development. Though most of the workbook is automated and can be re-run with only minimal data input, there are 3 main concerns that the 2018 analysis identified as areas that should be continuously analyzed and may have to be input by hand.

Updated Assessor and GIS Data: Yearly iterations of these datasets can be input into the analysis. The appropriate formulas will re-analyze the data, meaning the analysis can estimate development between the original and new datasets. Unfortunately, the technological limitations of the 2018 analysis made it impossible to make these sheets automatically update or link between different spreadsheets easily. However, the structure of the Master File should allow for fairly easy input.

Wetlands: For the 2018 analysis, wetland areas were identified and noted by hand through Rejection Codes. This means that there is no constant update feature to this portion of the analysis, and changing areas of wetlands may drastically affect the number of potential new dwellings⁵³.

Dwellings/Parcel Ratios: The 2018 team determined that the current ratio was =1.22. This value, though incorporated in many equations, may be adjusted in the future⁵⁴. Though it is possible to change this value in the table, there is no other estimated value that could be used or extracted from the data.

District or Zone Changes: With updated assessor data, zone changes would be easily accounted for. However, districts were a 2018 team input and are not linked or defined anywhere else⁵⁵. Similarly, any other areas of interest must be input by hand or extracted from ArcGIS, a process that has potential for error. However, new parcel groupings mean the analysis can inform highly specific areas in the community.

Area Requirements: The 2018 analysis assumed some key values: 500 SF minimum for a second dwelling and 800 SF minimum for a Covenant Home. These values can be changed in the data columns to test other values.

Other Utilized Trends: The team utilized the 1.22 dwellings per parcel ratio in calculating future dwellings. This can be changed based on estimates other than the team's analysis of current dwelling ratios.

These are not all encompassing; however, they create areas for uncertainty and future work to maintain the analysis.

Conclusion

The processes described in this manual do not represent the steps that could be taken to fully complete a buildout analysis. They do, however, create a cohesive and mostly complete analysis that can be applied across more towns.

The many assumptions shown in this analysis can be easily changed and re-coded in revisions of the Nantucket Analysis or for other communities. This gives the document and processes the ability to change with time and development. With modification, it can be used to estimate periods of time as well as be applied to town service needs or growth.

⁵³ When wetlands expand or shrink, the amount of available land changes as well; an expansion could lead to additional dwellings and vice versa. Because the current data is hand input, it would not be easy to input changes to wetland area except by hand.

⁵⁴ The 1.22 dwelling/parcel ratio was incorporated in subdivision and undeveloped parcels. The team recognized that most new parcels could potentially have a second dwelling, though determining a reasonable rate was deemed beyond the knowledge of the team. Some debated factors include second dwelling construction rate, land and ground cover available in subdivided parcels, and future considerations and rate changes; none of these were within the team's expertise. By taking the current rate, the team felt that it provided an estimate better than 1 or 2 dwellings, though should be available to be changed.

⁵⁵ The team's input found that extracting parcels left many parcels either unbound or separated from the appropriate district name. This left many parcels as belonging to the district "#N/A", later deemed "Unspecified". Though the number of current parcels and dwellings registers over 600, the number of new dwellings is under 40; the team felt that this error was rather inconsequential to the estimated total.

Appendix B: Town Zoning Districts




Town of Nantucket - GIS Mapsheet

Nantucket Island Zones

Includes Cumulative Zoning Updates through the April 2018 Annual Town Meeting

<i>District</i>	<i>Minimum Lot Size (in Square Feet)</i>	<i>Frontage</i>	<i>Ground Cover Ratio</i>	<i>Front Setback</i>	<i>Side/Rear Setback</i>
ROH, SOH	5,000	50 ft	50 %	0	5 ft
R-1, SR-1	5,000	50 ft	30 %	10 ft	5 ft
R-5, R-5L	5,000	50 ft	40 %	10 ft	10 ft min. on one side, 5 ft thereafter* Rear: 5 ft
R-10, R-10 L, SR-10	10,000	75 ft	25 %	20 ft (15 ft)	10 ft (5 ft)
R-20, SR-20	20,000	75 ft	12.5 %	30 ft	10 ft
R-40	40,000	75 ft	10 %	30 ft	10 ft
VR	20,000	100 ft	10 %	20 ft	10 ft
LUG-1	40,000	100 ft	7 %	35 ft	10 ft
LUG-2	80,000	150 ft	4 %	35 ft	15 ft
LUG-3	120,000	200 ft	3 %	35 ft	20 ft
MMD	10 acres	300 ft	0.5%	50 ft	50 ft
CDT	3,750	35 ft	75 %	0	0 / 5 ft
RC	5,000	50 ft	50 %	0	5 ft
RC-2	5,000	40 ft	50 %	10 ft	5 ft
CMI	5,000	50 ft	50 %	0	0
CN	7,500	50 ft	40 %	10 ft	5 ft / 10 ft
CTEC	10,000	50 ft	40 %	10 ft	5 ft / 10 ft
CI	15,000	75 ft	50 %	20 ft	0/10 ft
VN	10,000	50 ft	30 %	10 ft	10 ft
VTEC	40,000	100 ft	25 %	30 ft	20 ft

For further explanation and exceptions, see Nantucket Zoning Bylaws Chapter 139 - 16A

Figure 15 - Current Nantucket Island Zones (Nantucket Department of Information Technology and GIS, 2018)

There are 26 districts labeled on the Nantucket GIS Map that can be broken down into 5 main zones. Town Overlay District Residential, Town Overlay District Commercial, Country Overlay District Residential, Country Overlay District Commercial and Special Districts. The explanations of the given abbreviations are as followed.

Town Overlay District Residential

Residential Old Historic	ROH
Residential-1	R-1
Residential-5	R-5
Residential-5 Limited	R-5L
Residential-10	R-10
Residential-10 Limited	R-10L
Residential-20	R-20
Residential 40	R-40

Country Overlay District Residential

Scosset Old Historic	SOH
----------------------	-----

Sconset Residential-1	SR-1
Sconset Residential-10	SR-10
Sconset Residential-2	SR-20
Village Residential	VR
Limited Use General 1	LUG-1
Limited Use General 2	LUG-2
Limited Use General 3	LUG-3
Town Overlay District Commercial	
Residential Commercial	RC
Residential Commercial 2	RC-2
Commercial Downtown	CDT
Commercial-Mid-Island	CMI
Commercial-Neighborhood	CN
Commercial Trade, Entrepreneurship and Craft	CTEC
Commercial Industrial	CI
Country Overlay District Commercial	
Village Neighborhood	VN
Village Trade, Entrepreneurship and Craft	VTEC
Special districts	
Moorlands Management	MMD
Special Our Island Home	OIH
Assisted/Independent Living Community District	ALC

Appendix C: Excel Column Definitions, Residential Analysis

AV PID - Perfectly unique Parcel ID. Not available in all information, but when possible, use.

Map - Relates to GIS mapping information.

Lot - Lot # within Map region.

Lot Cut - Cut # within a Lot.

Alternate Parcel ID Number - Assessor Data provided this alternate identification for each lot. Seemed to be defined from Map, Lot, and Lot Cut, but was inconsistent and not always unique.

GIS ID - ArcMap-defined GIS ID.

Use Code - Assessor data as to the use of the land. Uses vary from residential, commercial, open space, and so on. Definition of codes can be found in Appendix E. Comes in 3 distinct forms: 4 digits (ex: 1093), 3 digits and a letter (ex: 109L), and 3 digits (ex: 109). Codes with 3 digits are actually multiple use codes as defined in Appendix E, as they begin with 0.

Cls - Classification of the parcel; R (Residential), I (Industrial), C (Commercial), E (Tax Exempt), S (Special), and O (Open Space).

Zone - The zone in which the parcel is located. Associated data for each zone is extracted from a separate excel sheet. Definitions can be found in Appendix B. Data was extracted from Excel Sheet "*Zone Requirements*".

State Use - Similar to Use Code, but is the codes as the Massachusetts definitions are applied; most are similar or identical. This column is not used at all.

AYB: Actual Year Built of building. Different from EYB (Effective Year Built), which includes major renovations.

Custom Alt. ID - Team-defined Alternate ID; combination of Map, Lot, and Lot Cut (similar to Alternate Parcel ID Number, but with consistent definition); not always unique.

Land Area in SF - Assessor data of acres converted into SF.

Minimum Lot Size - Minimum parcel size based off Zone. VLookUps data from another sheet.

Simplified (Use Code) - A 3 or 4 digit standardized expression of Use Code. If the Use Code has a letter, the function uses Excel's "Left" function to return the 3 leftmost characters (always digits) and then adding a "0" to the end. This provides a cleaner and simpler use code. All other codes are returned as normal.

Ground Cover, SF - Ground cover is the amount of area buildings cover in the parcel. The definitions as to what factors into ground cover is described in full in G.L. 139-2, and is described as used in this analysis in Appendix D. The team utilized the assessor data provided on November 7th, 2018, which can be found in the Excel Sheet "*Assessor Building Data*". To compile the data, the team used the Excel's "Consolidate" function to condense data to each AV PID, from which "VLookup" correlated to each AV PID in the main data set. Parcels that did not have a ground cover returned a value of 0.

Max Ground Cover, SF - The maximum ground cover allowed in a specific parcel. Each parcel has a maximum percentage ground cover, found in the Sheet "*Zone Requirements*" and G.L. 139-8 which can be found in Appendix F (simplified version in Appendix B). The Land Area in SF multiplied by this value, attributed through "VLookup", gives the maximum

allowed ground cover. If a zone did not have a ground cover percentage (ALC and OIH) it returned a value of 0. (These zones were to be considered as completely built out, as recommended by Andrew Vorce.)

Ground Cover Utilization - The ratio describing how much ground cover is being utilized as the parcel currently is. Value is determined as Ground Cover, SF divided by Max Ground Cover, SF. In the case that Max Ground Cover, SF is 0, a value of "n/a" was returned.

Second Dwelling GC = 500 SF - The team's estimation as to whether a parcel has sufficient ground cover to potentially build a secondary dwelling. This does not incorporate the geographic requirements (distance between buildings, setbacks, etc.) as required in Appendix B. If the Maximum Ground Cover, SF less Ground Cover, SF is greater than 500, a value of 1 is returned. In any other instance, a value of 0 is returned.

Parcel Split, GC < 50% - The team's initial estimation for parcel splitting. Conceptually, the team felt that a parcel could split if it utilized less than half of its ground cover, which can be determined from Ground Cover Utilization. If this was less than .5, a value of 1 was returned. If this was greater than .5, a value of 0 is returned. The team eventually determined that this approach had significant downside, in that parcels that barely used over half their allotted ground cover still had the potential to split, as the parcel would not need to split evenly.

Parcel Split, Variable % - The team's current estimation for parcel splitting. The team developed an equation that would determine if lots could split unevenly. The equation is as follows:

$(1 - \text{Ground Cover Utilization}) * \text{Land Area in SF} > \text{Minimum Lot Size}$

The left side of the equation estimates the area remaining on the parcel as though the current building(s) utilize only the minimal amount of land needed. If this area is greater than the minimum lot size for the zone in which the parcel resides, then this returns a value of 1, indicating it can split. If this area is smaller than the minimum lot size for the zone, then this returns a value of 0.

Land Utilization Ratio - The ratio at which a parcel utilizes its land. Is defined as Land Area in SF divided by Minimum Lot Size. In instances where the ratio is less than 1, this returns a value of "easement" as the team assumes that some legal allowance occurred. If there is no Minimum Lot Size, this returns a value of "n/a". Values greater than or equal to 1 are returned exactly.

Underutilized - Parcels that are underutilized. As defined by Andrew Vorce, a parcel is underutilized only if it is more than 2.5 times larger than the minimum lot size. If the Land Utilization Ratio is greater than 2.5, then a value of 1 is returned, indicating that the parcel is underutilized. All other values, including "easement" and "n/a", return a value of 0. If a parcel is Developable, then it is not deemed underutilized and returns a 0.

Res Splitability - The team's definition as to whether a parcel will have the ability to split. For this analysis, the team considered only residential parcels. To view only residentially coded parcels, the team utilized Simplified (Use Code). Certain residential codes do not allow for new development; they are as follows: any 102(letter), any 103(letter), 1305, 1306, 1307, 1321, 1323, 1325, any 132(Letter), and 1333. Exact definitions of these can be found in Appendix E. To distinguish the other residential parcels, the team's function finds that, if the "Integer" value of the Simplified Use Code divided by 1000 is equal to 1, then it is residential and non-restricted and a value of 1 is returned. All other values return a 0.

Com Splitability - (Only found in the team's commercial analysis) The team's definition of a commercial parcel's ability to split. The commercial analysis the team performed included parcels that were multi-use, commercially, or Chapter 61A coded (beginning with a 0, 3 or a 7, respectively; also included multiple use code 0712). Commercial lands were incorporated

because they have the potential split and be coded differently. Chapter 61A land includes parcels that are agricultural in nature but have the potential to be changed from 61A land, meaning that, long term, development is a possibility.

Splitability w/ GC - The team's combination of Splitability and Parcel Split, Variable Percentage. Only parcels that are splittable (ones that are residential) and have adequate ground cover to split are to be considered for this step. This is another binary output, defined to be Splitability multiplied by Parcel Split, Variable Percentage. If both inputs are 1, then a value of 1 is returned, indicating that both parameters are met. All other combinations return a value of 0.

Subdividable - The team's combination of Splitability w/ GC and Underutilized and Rejection Code. If Rejection: No Build or Rejection: No Sub, 2nd = 1, then the parcel cannot be subdivided and would return a 0. This binary output is defined to be Splitability w/ GC multiplied by Underutilized. If both inputs are 1, a value of 1 is returned, indicating that all 3 parameters have been met. Any other combination of inputs results in a value of 0 being returned.

Parcel Split by GC and LU - This estimates the number of new parcels a parcel can split into (if it has the space to do so). A value is only returned if Under/Split w/ GC is equal to 1 for the specific parcel. To determine the number of lots this parcel can split into is based off 1 of 2 processes: either the amount of ground cover available for construction, or the Land Utilization Ratio.

The amount of ground cover available for construction is similar to the process defined in Parcel Split, Variable Percentage with one adjustment:

$$[(1 - \text{Ground Cover Utilization}) * \text{Land Area in SF} / \text{Minimum Lot Size}] + 1$$

The added parts to this function is the division by the Minimum Lot Size. This takes the available ground cover, converted to land area, and determines how many new parcels could be made. The addition of +1 to the end incorporates the existing building and the parcel on which it would reside on in case of splitting.

The Land Utilization Ratio is a simpler but also limiting factor in this equation. Considering that this ratio is based solely off Land Area in SF and Minimum Lot Size, the "Integer" of this value indicates the maximum number of parcels that the specific parcel could form.

Whichever "Integer" value is smaller is the value returned as the number of parcels the specific parcel could split into. As noted above, if Under/Split w/ GC has a value of 0, a value of 0 is returned.

Second Dwelling n=1 y=0 - From the assessor data, the team's analysis of parcels that currently have multiple dwellings on them. The team used Simplified (Use Code); values of 1040, 1050, and 1090 (for definitions of each use code, see Appendix E) returned a value of 1. All other codes returned a value of 0.

Second Dwelling Ability - The team's definition of a parcel's ability to construct a second **separate** dwelling. In determining which parcels were eligible for secondary dwellings, the following criteria had to be met:

1. If "Zone Requirements" indicated that the zone did not allow secondary dwellings, the parcel was eliminated from consideration.
2. Both Parcel Split by GC and LU and Max Developable must return a 0. This eliminates parcels that subdivide or are undeveloped based off those restrictions and respective rejections.

3. Either Second Dwelling GC = 500 SF or Rejection: No Sub, 2nd = 1. This captures parcels that either have space or are coded to allow for 2nd dwellings and have space.
4. For parcels that were not eliminated by these criteria, the value of Splitability multiplied by Second Dwelling Y=0 N=1 was returned. If both values are 1, a value of 1 is returned, indicating that the parcel is residential and does not already contain a second dwelling.

Developable? - From ArcGIS, parcels that are able to be developed upon show a value of 1. This value is found from a "VLookUp" from "*DevelopableParcels*" as a False function, meaning non-exact matches (parcels not found in the list of "*DevelopableParcels*") return a 0. Parcels that are not splittable, from Splitability, are also rejected. Parcels with Rejection Code = 13 also return a 1.

Max Parcels - The maximum number of parcels an undeveloped residential lot can split into. Considering that some of these lots are oversized, it is possible that they could split into smaller parcels. If Developable is 1, then the parcel is considered. The team utilized the Land Utilization Ratio; if the ratio is "easement", then a value of 1 is returned, indicating that only 1 house can be built on it. Otherwise, the "Integer" of the value is returned.

Covenant Housing Able - The team developed this as a way to determine if a parcel is eligible to develop a separate covenant housing dwelling and split it. There are many restrictions the team placed on data, including:

Land Utilization Ratio: Parcels that are "easement" or less than 1.4x minimum lot size or greater than 2.5 (Underutilized) would result in a 0 being returned.

Splitability: A parcel must be splittable as defined above. If not, then a 0 is returned.

Developable: A parcel that is developable would return a 0. (Similar to Second Dwelling Ability parcels, where Underutilized parcels are eliminated from consideration, there are too many unknowns in the process to adequately estimate their frequency. Unknowns include new house size, rezoning, and so forth.)

Ground Cover Utilization: **G.L. 139-8[f][2]** (Appendix F) states that the combined ground cover ratio cannot be exceeded. The team included this by taking the Max Ground Cover, SF less Ground Cover, SF; if this was less than 800 SF (a data value assumed to be sizeable enough to build a complete second dwelling yet not overly restricting) then the parcel returned a 0.

If ALL of these restrictions did not result in a 0 being returned, then a 1 could be returned.

Number Buildings: The number of buildings on the parcel, as defined from the Assessor building data, from the consolidated table.

Number Dwellings: The number of dwellings on the parcel, as defined as having at least one bedroom. Similar to calculating the number of buildings, except a building returned a 0 if it did not have a bedroom. In this manner, the consolidated table summed only building numbers that had a bedroom.

District: The Civic League District in which the parcel resides. This data was extracted from ArcGIS. As a result, some parcels return #N/A because of extraction inconsistencies.

Rejection Code - The team utilized this column to evaluate, by hand, any parcels that may have been mis-identified in the assessor data. The codes are as follows:

1. Land is actually conserved, but is identified as residential in assessor data. This will eliminate these instances.
2. Properties on either island are eliminated from all consideration as they likely will not follow typical splitting or construction models.
3. Land is extensively wetlands or otherwise unusable.

4. Land is already constructed on.
5. Land is restricted but could still see 1 (or to be otherwise specified) dwelling on it because of conservation restrictions. (ID'd by Cormac Collier)
6. Shape of land is constricting.
7. Parcel is surrounded by conserved land and likely will not see construction.
8. Large developments that require different rules; eliminated for this part of analysis.
9. Unable to subdivide because of frontage or lot restrictions.
10. Incorrect or un-updated parcel lines or splits.
11. Partial subdivision possible by associated # or %
12. No construction on parcel for other reason
13. Land is actually vacant
14. 6 Fairgrounds parcels

999. Unusual case, to be discussed with Cormac Collier or otherwise ignored.

Rejection: No Build: If Rejection Code indicated that no additional construction should be expected to occur, this column returned a 1. Rejection Codes of 1, 2, 3, 6, 7, 8, 10, 12, and 999 indicate no further construction.

Rejection: No Sub, 2nd: If Rejection Code indicates that subdivision is not possible but a secondary dwelling can be constructed. Codes 4, 5, and 9 return a 1.

Appendix D: Glossary and Definitions of Key Words and Phrases

The following definitions are vital to understanding both the team's many Excel Spreadsheets and assumptions about parcels.

Dwelling Unit: According to the team's analysis, this is defined as a building that has at least one bedroom (from "*AssessorBuildingData*"). This means that the building can be occupied by an individual and is expected to do so.

Ground Cover: The total land area that can be covered by structures as noted in G.L. 139-2 (not attached). The team occasionally abbreviates this to be GC. Each zone, in Sheet "*Zoning Requirements*", has a maximum percentage of area that can be covered; this value is multiplied by the total area of the parcel to find the maximum ground cover allowable. The following example shows three different buildings:

Parcel	Area	Zone	Zone GC %	Max GC
A	5000	R-1	30%	1500
B	7500	R-1	30%	2250
C	7500	R-5	40%	3000

Note how the ground cover for building B is greater than that of A despite being in the same zone. Also note that C has a higher maximum because its zone allows for it. Often, the team uses ground cover in terms of how much is remaining. The same three buildings have a specified house area, as shown below:

Parcel	Max GC	House Area	House, 1st Floor	Remaining GC
A	1500	2250	1250	250
B	2250	2250	2250	0
C	3000	2250	1500	1500

Note how the total area of the house is not the deciding factor; it is mainly the first floor area. (Other structures, such as barns over 200 SF and porches, are included in this value; see G.L. 139-2 for the complete list of included structures.)

The value of "remaining GC" is referenced fairly often as the team determines which parcels are underutilized or have adequate area for secondary dwellings. Underutilized parcels must have enough land area to split, but if the existing building utilizes too much ground cover, it becomes an issue as outline below:

Parcel	Lot Size	Minimum Lot Size	House, 1st Floor	Remaining GC	Area for Orig. Parcel	Remaining Land Area	# Addtl Lots
D	15000	5000	1500	3000	5000	10000	2
E	12500	5000	1500	2250	5000	7500	1
F	10000	5000	2000	1000	6667	3333	0

Buildings D, E, and F are all R-1 parcels that have a 30% GC ratio as stated above. Note how, for each building, the varying lot size and 1st Floor area affect how many lots the parcel *could* turn into; D has enough ground cover to enable it to split into a three total parcels (including the original), E can split into 2, and F cannot split at all. The team employed similar techniques in determining if parcels had adequate ground cover to split.

For Secondary Dwellings, parcels (that cannot split into 2 or more parcels, outlined partially in the function above) were deemed to be able to build a second dwelling only if the “remaining GC” was greater than an assumed value of 800 SF.

Parcel: An area of land that can be owned by an entity. On Nantucket, all parcels are owned, though not all are developed.

Residential: Existing within a residential zone or classified area. This term broadly applies to both parcels and dwelling units, as non-residential parcels account for over ¼ of parcels on Nantucket. This enables the team to analyze a distinct set of parcels rather than all.

Subdividable: Land that can be subdivided given that it is: underutilized, has enough remaining ground cover, is residentially splittable, and is not otherwise restricted to split (whether by wetlands or other regulation).

Underutilized: A lot that is 2.5x larger than its minimum lot size is said to be “underutilized”. This was a definition provided to the team by Andrew Vorce, Director of Planning on Nantucket. This would manifest itself as follows:

Parcel	Area	Zone	Zone Min. Lot Size	Land Utilization Ratio
G	10000	R-1	5000	2
H	12500	R-1	5000	2.5
I	7500	R-5	7500	1

In this example, only H is underutilized by definition. Though G could be evenly split into 2 parcels, it does not fit the definition and is therefore excluded from this specific dataset.

Zone: The set of zones recognized and used by the Town of Nantucket, as specified in Appendix B. These regulatory zones have specific requirements and uses.

Appendix E: Land Use Dictionary

Use Code Definitions as provided by Town of Nantucket Assessor's Office
Prepared as part of WPI IQP: Nantucket Buildout Analysis, 2018

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
0101	Single Fam M01	R	0101		0101		0101	
0102	MU CNDO M05	R	0102		0102		0102	
0103	Mobile Hom	R	0103		0103		0103	
0104	2 FAM MIX M01	R	0104		0104		0104	
0105	3 FAM MIX M01	R	0105		0105		0105	
0106	AC LND IMP	R	0106		0106		0106	
0107		R	0107		0107		0107	
0108		R	0108		0108		0108	
0109	MULTI HSES M01	R	0109		0109		0109	
010C	Single Fam M94	R	0101		0101		0101	
010D	2 FAM MIX M94	R	0104		0104		0104	
010E	2 FAM MIX M96	R	0104		0104		0104	
010F	3 FAM MIX M94	R	0105		0105		0105	
010G	3 FAM MIX M96	R	0105		0105		0105	
010I	Single Fam M96	R	0101		0101		0101	
010J	MULTI HSES M94	R	0109		0109		0109	
010K	MULTI HSES M96	R	0109		0109		0109	
0111	APT 4-8 M01	R	0111		0111		0111	
0112	APT 9+ M01	R	0112		0112		0112	
011L	4-8 APT M94	R	0130		0130		0130	
0120	PR RES OPN	R	0120		0120		0120	
0121	BOARDNG HS	R	0121		0121		0121	
0122	FRAT/SOROR	R	0122		0122		0122	
0123	DORMITORY M01	R	0123		0123		0123	
0124	REC/CONVEN	R	0124		0124		0124	
012C	DORMITORY M94	R	0123		0123		0123	
012I	DORMITORY M96	R	0123		0123		0123	
012O	CONDO DORM M06	R	0123		0123		0123	
0130	PRI RES	R	0130		0130		0130	
0131	RES ACLNPO	R	0131		0131		0131	
0132	RES ACLNUD	R	0132		0132		0132	
0134	PRI RS C/I	R	0134		0134		0134	
0135	CONS RES M01	R	0130		0130		0130	
0136	CONS RES M00	R	0130		0130		0130	
0140	PR RES IND	R	0140		0140		0140	
0201	SFR OPEN	O	0201		0201		0201	
0202	WET RES PV	O	0202		0202		0202	
0210	PRI OPN SP	O	0210		0210		0210	
0211	NONPROD VC	O	0211		0211		0211	
0300	HOTELS	C	0300		0300		0300	
0301	MOTELS	C	0301		0301		0301	
0302	INNS	C	0302		0302		0302	
0303		C	0303		0303		0303	
0304	NURSING HM	C	0304		0304		0304	
0305	HOSP PVT	C	0305		0305		0305	
0306	TRANS RES	C	0306		0306		0306	
0310	PRI COMM	C	0310		0310		0310	
0311	RTL GAS ST	C	0311		0311		0311	
0312	GRAIN ELEV	C	0312		0312		0312	
0313	LUMBER YRD	C	0313		0313		0313	
0314	TRK TERM	C	0314		0314		0314	
0315	DOCKYARDS	C	0315		0315		0315	
0316	COMM WHS M94	C	0316		0316		0316	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
0318	COM GRNHS M00	C	0318		0318		0318	
031A	FARM BLDGS M00	C	0317		0317		0317	
031B	FARM BLDGS M01	C	0317		0317		0317	
031C	FARM BLDGS M94	C	0317		0317		0317	
031F	MIX USE CR M96	C	0318		0318		0318	
031I	COMM WHS M96	C	0316		0316		0316	
031J	COM GRNHS M94	C	0318		0318		0318	
031K	FARM BLDGS M96	C	0317		0317		0317	
031R	COMM WHS M01	C	0316		0316		0316	
031V	COMM WHS M00	C	0316		0316		0316	
031Z	COM GRNHS M96	C	0318		0318		0318	
0320	MU CNDO M06	C	0320		0320		0320	
0321	HRDWARE ST	C	0321		0321		0321	
0322	STORE/SHP M94	C	0322		0322		0322	
0323	SHOPNGMALL	C	0323		0323		0323	
0324	SUPERMKT	C	0324		0324		0324	
0325	STORE/SHP M94	C	0325		0325		0325	
0326	REST/CLUBS M01	C	0326		0326		0326	
0327	JUNKYARD M96	C	0327		0327		0327	
032C	REST/CLUBS M94	C	0326		0326		0326	
032I	STORE/SHP M96	C	0322		0322		0322	
032R	STORE/SHP M01	C	0322		0322		0322	
0330	AUTO V S&S	C	0330		0330		0330	
0331	AUTO S S&S	C	0331		0331		0331	
0332	AUTO REPR M94	C	0332		0332		0332	
0333	FUEL SV/PR	C	0333		0333		0333	
0334	GAS ST SRV	C	0334		0334		0334	
0335	CAR WASH	C	0335		0335		0335	
0336	PARK GAR	C	0336		0336		0336	
0337	PARK LOT	C	0337		0337		0337	
0338	OTH MTR SS	C	0338		0338		0338	
033I	AUTO REPR M96	C	0332		0332		0332	
0340	OFFICE BLD M94	C	0340		0340		0340	
0341	BANK BLDG	C	0341		0341		0341	
0342	PROF BLDG	C	0342		0342		0342	
0343	LAUNDROMAT	C	0343		0343		0343	
0340	OFFICE CONDO M0	C	0340		0340		0340	
034R	OFFICE BLD M01	C	0340		0340		0340	
0350	POST OFF	C	0350		0350		0350	
0351	EDUC BLDG	C	0351		0351		0351	
0352	NOT USED	C	0352		0352		0352	
0353	FRATNL ORG	C	0353		0353		0353	
0354	TRANSPORT	C	0354		0354		0354	
0355	FUNERAL HM	C	0355		0355		0355	
0356	PROF ASSOC	C	0356		0356		0356	
0360	MUSEUMS	C	0360		0360		0360	
0361	ART GAL M94	C	0361		0361		0361	
0362	MOVIE THTR	C	0362		0362		0362	
0363	DRIVEINTHT	C	0363		0363		0363	
0364	THEATER	C	0364		0364		0364	
0365	STADIUMS	C	0365		0365		0365	
0366	ARENAS	C	0366		0366		0366	
0367	RACETRACK	C	0367		0367		0367	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
0368	AMUSE PARK	C	0368		0368		0368	
0369	OTHER CULT	C	0369		0369		0369	
036I	ART GALL M96	C	0360		0360		0360	
036R	ART GAL M01	C	0361		0361		0361	
036U	ART GAL M05	C	0361		0361		0361	
0370	BOWLING	C	0370		0370		0370	
0371	ICE SKATE	C	0371		0371		0371	
0372	AGRIC P RE	C	0372		0372		0372	
0373	SWIM POOL	C	0373		0373		0373	
0374	HEALTH SPA	C	0374		0374		0374	
0375	TENNIS CLB M94	C	0375		0375		0375	
0376	GYMS	C	0376		0376		0376	
0377	OTH IN REC	C	0377		0377		0377	
037I	TENNIS CLUB M96	C	0375		0375		0375	
037R	TENNIS CLB M01	C	037R		037R		037R	
0381	TENNIS ODR	C	0381		0381		0381	
0382	RIDING STB	C	0382		0382		0382	
0383	BEACHES	C	0383		0383		0383	
0384	MARINAS	C	0384		0384		0384	
0385	FISH&GAME	C	0385		0385		0385	
0386	CAMPGROUND	C	0386		0386		0386	
0387	YTH CAMPS	C	0387		0387		0387	
0388	OTHR OUTDR	C	0388		0388		0388	
0389	STRUCT-61B	C	0389		0389		0389	
038C	GOLF CRSE M94	C	0380		0380		0380	
038I	GOLF CRSE M96	C	0380		0380		0380	
038R	GOLF CRSE M01	C	0380		0380		0380	
038V	GOLF CRSE M00	C	0380		0380		0380	
0390	DEVEL LAND	C	0390		0390		0390	
0391	POT DEVEL	C	0391		0391		0391	
0392	UNDEV LAND	C	0392		0392		0392	
0393	AH-NOT 61A	C	0393		0393		0393	
0400	MFRG M94	I	0400		0400		0400	
0401	IND WHSES	I	0401		0401		0401	
0402	IND OFFICE	I	0402		0402		0402	
0403	ACCLND MFG	I	0403		0403		0403	
0404	R-D FACIL	I	0404		0404		0404	
0410	SAND+GRVL M96	I	0410		0410		0410	
0411	GYPSUMMINE	I	0411		0411		0411	
0412	ROCK MINE	I	0412		0412		0412	
0413	OTH MINES	I	0413		0413		0413	
0420	PUB TANKS	I	0420		0420		0420	
0421	TANKS LNG	I	0421		0421		0421	
0422	ELEC PLANT	I	0422		0422		0422	
0423	ELEC ROW	I	0423		0423		0423	
0424	ELECSUBSTA	I	0424		0424		0424	
0425	GAS PLANT	I	0425		0425		0425	
0426	GAS ROW	I	0426		0426		0426	
0427	GAS STG	I	0427		0427		0427	
0428	GAS SUBSTA	I	0428		0428		0428	
0430	TEL X STA	I	0430		0430		0430	
0431	TEL REL TW	I	0431		0431		0431	
0432	CBL-TV TR	I	0432		0432		0432	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
0433	RAD/TV TR	I	0433		0433		0433	
0440	IND LD DV	I	0440		0440		0440	
0441	IND LD PO	I	0441		0441		0441	
0442	IND LD UD	I	0442		0442		0442	
0501	IND ASC TR	P	0501		0501		0501	
0502	DOM/FOR CP	P	0502		0502		0502	
0503	DOM/FOR ME	P	0503		0503		0503	
0504	PUB UTIL	P	0504		0504		0504	
0505	MCH PL/WR	P	0505		0505		0505	
0506	PIPE LINES	P	0506		0506		0506	
0601	C61 TEN YR	S	0601		0601		0601	
0602	C61 5 YEAR	S	0602		0602		0602	
0610	FOREST C61	S	0610		0610		0610	
0710	CRANBERRY	S	0710		0710		0710	
0711	TOBACCO SD	S	0711		0711		0711	
0712	TR CRP VEG M00	S	0712		0712		0712	
0713	FIELD CRPS	S	0713		0713		0713	
0714	ORCHARDS	S	0714		0714		0714	
0715	VINEYARDS	S	0715		0715		0715	
0716	TILL FORAG	S	0716		0716		0716	
0717	PROD WOOD	S	0717		0717		0717	
0718	PASTURE	S	0718		0718		0718	
0719	NURSERIES	S	0719		0719		0719	
071I	TR CRP VEG M96	S	0712		0712		0712	
0720	NONPRNECLD	S	0720		0720		0720	
0722	NONPRWETLD	S	0722		0722		0722	
0800	RECREATION	S	0800		0800		0800	
0801	61B HIKE	S	0801		0801		0801	
0802	61B CAMP	S	0802		0802		0802	
0803	61B NATURE	S	0803		0803		0803	
0804	61B BOAT	S	0804		0804		0804	
0805	61B GOLF	S	0805		0805		0805	
0806	61B HORSE	S	0806		0806		0806	
0807	61B HUNT	S	0807		0807		0807	
0808	61B FISH	S	0808		0808		0808	
0809	61B AL-SKI	S	0809		0809		0809	
0810	61B NR-SKI	S	0810		0810		0810	
0811	61B SWIM	S	0811		0811		0811	
0812	61B PICNIC	S	0812		0812		0812	
0813	61B GLIDE	S	0813		0813		0813	
0814	61B TARGET	S	0814		0814		0814	
0900	US GOVT	E	0900		0900		0900	
0901	COMM-MASS	E	0901		0901		0901	
0902	COUNTY	E	0902		0902		0902	
0903	MUNICIPAL	E	0903		0903		0903	
0904	PRI SCHOOL	E	0904		0904		0904	
0905	P/HOS CHAR	E	0905		0905		0905	
0906	CHURCH ETC	E	0906		0906		0906	
0907	121A CORP	E	0907		0907		0907	
0908	HSNG AUTH	E	0908		0908		0908	
0909	RELIGIOUS	E	0909		0909		0909	
0910	CHARITABLE	E	0910		0910		0910	
0920	NON PROFIT	E	0920		0920		0920	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
1001	PLANNED DEV	R	1010		1010		1010	
1002	DO NOT USE	R	1010		1010		1010	
1010	Single Fam M01	R	1010		1010		1010	
1011	SFR (NL)	R	1011		1011		1011	
1012	SFR EXCVIE	R	1012		1012		1012	
1013	SFR WIFRNT	R	1013		1013		1013	
1014	AFFORDABLE	R	1014		1014		1014	
1015	HISTPRES 01	R	1010		1010		1010	
1017	ONE BIG BEACH	R	1010		1010		1010	
1018	SFR HOST	R	1016		1016		1016	
101B	SFR 40B	R	1010		1010		1010	
101F	SFR CR	R	1010		1010		1010	
101H	HFH SFR	R	1010		1010		1010	
101L	SFR 99 YR LEASE	R	1010		1010		1010	
101V	DO NOT USE	R	1010		1010		1010	
1020	Condo	R	1020		1020		1020	
1021	Condo NL	R	1021		1021		1021	
1022	Condo House	R	1022		1022		1022	
1023	CONDO WF M05	R	1023		1023		1023	
1024	HNC CONDO	R	1020		1020		1020	
1025	HFH CONDO	R	1020		1020		1020	
1028	CONDO INTERVAL	R	1020		1020		1020	
102G	RESCNDOGAR	R	102G		102G		102G	
102H	HFH CONDO	R	1020		1020		1020	
102R	CONDO WF M01	R	1023		1023		1023	
1030	Mobile Hom	R	1030		1030		1030	
1031	Trailer	R	1031		1031		1031	
1040	TWO FAMILY	R	1040		1040		1040	
1041	ACCESS APT	R	1041		1041		1041	
1043	2 FAM WF	R	1043		1043		1043	
1048	2FAM HOST	R	1048		1048		1048	
104R	2 FAM POTENTIAL	R	1040		1040		1040	
1050	THREE FAM	R	1050		1050		1050	
1051	THREE FAM	R	1051		1051		1051	
1053	3 FAM WF	R	1053		1053		1053	
1058	3FAM HOST	R	1058		1058		1058	
1060	AC LND IMP M01	R	1060		1060		1060	
1063	ACC WF	R	1063		1063		1063	
1068	IMP HOST	R	1068		1068		1068	
106V	AC LND IMP M00	R	1060		1060		1060	
1070	COOPERATIV M01	R	1070		1070		1070	
1073	CO OP WF M01	R	1073		1073		1073	
107L	LEASED RESIDENT	R	1070		1070		1070	
107U	COOPERATIV M05	R	1070		1070		1070	
107V	CO OP WF M00	R	1073		1073		1073	
1080	INTERVAL M01	R	1080		1080		1080	
1081	INTERVAL M05	R	1080		1080		1080	
108V	INTERVAL M00	R	1080		1080		1080	
1090	MULTI HSES M01	R	1090		1090		1090	
1092	MULTI EXVW	R	1092		1092		1092	
1093	MULTI WF	R	1093		1093		1093	
1098	MULT HOST	R	1098		1098		1098	
109C	MULTI HSES M94	R	1090		1090		1090	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
109F	MULTI CR	R	1090		1090		1090	
109I	MULTI HSES M96	R	1090		1090		1090	
109J	MULTI HSES M94	R	1091		1091		1091	
109K	MULTI HSES M96	R	1091		1091		1091	
109R	MULTI NO 2ND DW	R	1091		1091		1091	
109V	MULTI HSES M00	R	1090		1090		1090	
1110	APT 4-8 M01	R	1110		1110		1110	
1111	APT 8+UP	R	1111		1111		1111	
1112	APT CO-OP	R	1112		1112		1112	
1120	APT OVR 8 M01	R	1120		1120		1120	
112C	APT OVR 8 M94	R	1120		1120		1120	
1210	BOARDNG HS	R	1210		1210		1210	
1220	FRAT/SOROR	R	1220		1220		1220	
1230	DORMITORY M01	R	1230		1230		1230	
123C	DORMITORY M94	R	1230		1230		1230	
1240	REC/CONVEN	R	1240		1240		1240	
1250	ASST LIVING	R	1250		1250		1250	
125C	ASST LIVING M94	R	1250		1250		1250	
1300	RES ACLNDV M00	R	1300		1300		1300	
1302	VACANTEXVW	R	1302		1302		1302	
1303	VACANT WF	R	1303		1303		1303	
1304	ENCROACHMENT	R	1300		1300		1300	
1305	CONS REST M01	R	1305		1305		1305	
1306	CON REST N M00	R	1306		1306		1306	
1307	LTD REST	R	1307		1307		1307	
1308	VAC HOST	R	1308		1308		1308	
130B	VAC 40B LOT	R	1306		1306		1306	
130R	RES ACLNDV M01	R	1300		1300		1300	
130V	DO NOT USE	R	1305		1305		1305	
1310	POTENTIALLY BDB	R	1310		1310		1310	
1313	POT BDBL WF	R	1300		1300		1300	
131R	RES ACLNPO M01	R	1310		1310		1310	
1320	UNBUILDABLE	R	1320		1320		1320	
1321	UNB WETLAND	R	1320		1320		1320	
1323	UNB WF	R	1300		1300		1300	
1325	GREENBELT	R	1325		1325		1325	
1328	UNBLD HOST	R	1328		1328		1328	
132R	UNBLD LLOCKED	R	1320		1320		1320	
1333	UNB WF PF WET	R	1320		1320		1320	
1400	CHILDCARE	R	1400		1400		1400	
2010	OPEN SPACE	O	2010		2010		2010	
2013	OP SP WF	O	2013		2013		2013	
2020	WET RES PV	O	2020		2020		2020	
2100	NONPROD AH	O	2100		2100		2100	
2110	NONPROD VC	O	2110		2110		2110	
2200		O	2200		2200		2200	
2210		O	2210		2210		2210	
2300		O	2300		2300		2300	
2310		O	2310		2310		2310	
3000	HOTELS M94	C	3000		3000		3000	
3000	HOTELS M06	C	3000		3000		3000	
300R	HOTELS M01	C	3000		3000		3000	
3010	MOTELS M94	C	3010		3010		3010	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
3010	MOTLCNDO M06	C	3010		3010		3010	
301R	MOTELS M01	C	3010		3010		3010	
301U	MOTELS M05	C	3010		3010		3010	
3020	INNS M94	C	3020		3020		3020	
3028	INN HOST M01	C	3028		3028		3028	
302C	INN CNDO M06	C	302C		302C		302C	
302I	INNS M96	C	3020		3020		3020	
302K	INN HOST M96	C	3028		3028		3028	
302R	INN/B+B M01	C	3020		3020		3020	
3030	INTERVAL N	C	3030		3030		3030	
3040	NURSING HM	C	3040		3040		3040	
3050	HOSP PVT	C	3050		3050		3050	
3060	TRANS RES	C	3060		3060		3060	
3100	RTL OIL ST	C	3100		3100		3100	
3110	RTL GAS ST	C	3110		3110		3110	
3120	GRAIN ELEV	C	3120		3120		3120	
3130	LUMBER YRD M96	C	3130		3130		3130	
313V	LUMBER YRD M00	C	3130		3130		3130	
3140	TRK TERM	C	3140		3140		3140	
3150	DOCKYARD M96	C	3150		3150		3150	
315C	DOCKYARD M94	C	3150		3150		3150	
315V	DOCKYARD M00	C	3150		3150		3150	
3160	COMM WHS M94	C	3160		3160		3160	
316I	COMM WHS M96	C	3160		3160		3160	
316V	COMM WHS M00	C	3160		3160		3160	
3170	FARM BLDGS	C	3170		3170		3170	
3180	COM GRN HS	C	3180		3180		3180	
318C	COM GRN HS M94	C	318C		318C		318C	
3210	HRDWARE ST	C	3210		3210		3210	
3220	STORE/SHP M94	C	3220		3220		3220	
3221	RET CNDO M06	C	3221		3221		3221	
3222	COMM BLD NO LND	C	3222		3222		3222	
3223	RET/OFFCNDO M06	C	3223		3223		3223	
3228	STORE HOST	C	3228		3228		3228	
322I	STORE/SHP M96	C	3220		3220		3220	
322O	RET CNDO M06	C	3221		3221		3221	
322R	STORE/SHP M01	C	3220		3220		3220	
322U	RETCONDOPS M05	C	3223		3223		3223	
3230	SHOPNGMALL	C	3230		3230		3230	
3240	SUPERMKT M94	C	3240		3240		3240	
324I	SUPERMKT M96	C	3240		3240		3240	
3250	STORE/SHP M94	C	3250		3250		3250	
3260	REST/CLUBS M94	C	3260		3260		3260	
3268	REST HOST	C	3268		3268		3268	
326A	CONDO RESTRNT	C	326A		326A		326A	
326I	REST/CLUBS M96	C	3260		3260		3260	
327C	JUNKYARD M94	C	3270		3270		3270	
327R	JUNKYARD M01	C	3270		3270		3270	
327V	JUNKYARD M00	C	3270		3270		3270	
3280	PRIV CLUB	C	3280		3280		3280	
3290	HEALTH CLU	C	3290		3290		3290	
3300	AUTO V S&S	C	3300		3300		3300	
3310	AUTO S S&S M94	C	3310		3310		3310	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
331I	AUTO S S&S M96	C	3310		3310		3310	
3320	AUTO REPR	C	3320		3320		3320	
332C	GAR CNDO M06	C	332C		332C		332C	
3330	FUEL SV/PR	C	3330		3330		3330	
3340	GAS ST SRV M95	C	3340		3340		3340	
334C	GAS ST SRV M94	C	3340		3340		3340	
334I	GAS ST SRV M96	C	3340		3340		3340	
334V	GAS ST SRV M00	C	3340		3340		3340	
3350	CAR WASH	C	3350		3350		3350	
3360	PARK GAR	C	3360		3360		3360	
3370	PARK LOT M94	C	3370		3370		3370	
337V	PARK LOT M00	C	3370		3370		3370	
3380	OTH MTR SS	C	3380		3380		3380	
3400	OFFICE BLD M94	C	3400		3400		3400	
3401	OFF CNDO M06	C	3401		3401		3401	
3408	OFF HOST	C	3408		3408		3408	
340I	OFFICE BLD M96	C	3400		3400		3400	
3410	BANK BLDG	C	3410		3410		3410	
3420	PROF BLDG	C	3420		3420		3420	
3421	PROF CONDO	C	3421		3421		3421	
3500	POST OFF	C	3500		3500		3500	
3510	EDUC BLDG	C	3510		3510		3510	
3520	NOT USED	C	3520		3520		3520	
3530	FRATNL ORG	C	3530		3530		3530	
3540	TRANSPORT	C	3540		3540		3540	
3541	AIRPORT	C	3541		3541		3541	
3542	BUS STATN	C	3542		3542		3542	
3543	TRAIN STA	C	3543		3543		3543	
3544	TAXI STAND	C	3544		3544		3544	
3550	FUNERAL HM	C	3550		3550		3550	
3560	PROF ASSOC	C	3560		3560		3560	
3600	MUSEUMS	C	3600		3600		3600	
3610	ART GAL	C	3610		3610		3610	
3620	MOVIE THTR M94	C	3620		3620		3620	
3620	MOVIE THTR M06	C	3620		3620		3620	
3630	DRIVEINTHT	C	3630		3630		3630	
3640	THEATER	C	3640		3640		3640	
3650	STADIUMS	C	3650		3650		3650	
3660	ARENAS	C	3660		3660		3660	
3670	RACETRACK	C	3670		3670		3670	
3680	AMUSE PARK	C	3680		3680		3680	
3690	OTHER CULT	C	3690		3690		3690	
3700	BOWLING	C	3700		3700		3700	
3710	ICE SKATE	C	3710		3710		3710	
3720	ROLLER SKT	C	3720		3720		3720	
3730	SWIM POOL	C	3730		3730		3730	
3740	HEALTH SPA	C	3740		3740		3740	
3750	TENNIS CLB M94	C	3750		3750		3750	
3751	TEN CLB RE	C	3751		3751		3751	
375R	TENNIS CLB M01	C	3750		3750		3750	
3760	GYMS	C	3760		3760		3760	
3770	OTH IN REC	C	3770		3770		3770	
3772	AGRIC P RE	C	3772		3772		3772	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
3800	GOLF CRSE M94	C	3800	3800	3800	3800	3800	
3801	GO CRSE RE	C	3801	3801	3801	3801	3801	
380I	GOLF CRSE M96	C	3800	3800	3800	3800	3800	
3810	TENNIS ODR M94	C	3810	3810	3810	3810	3810	
381R	TENNIS ODR M01	C	3810	3810	3810	3810	3810	
381V	TENNIS ODR M00	C	3810	3810	3810	3810	3810	
3820	RIDING STB	C	3820	3820	3820	3820	3820	
3830	BEACHES	C	3830	3830	3830	3830	3830	
3831	BE CLB RES M94	C	3831	3831	3831	3831	3831	
383V	BE CLB RES M00	C	3831	3831	3831	3831	3831	
3840	MARINAS M94	C	3840	3840	3840	3840	3840	
3841	YACHT CLUB	C	3841	3841	3841	3841	3841	
3842	YACHT CLB M94	C	3842	3842	3842	3842	3842	
3843	YACHT CLB M96	C	3843	3843	3843	3843	3843	
384I	MARINAS M96	C	3840	3840	3840	3840	3840	
384R	MARINAS M01	C	3840	3840	3840	3840	3840	
384V	MARINA M00	C	384V	384V	384V	384V	384V	
3850	FISH&GAME	C	3850	3850	3850	3850	3850	
3860	CAMPGROUND	C	3860	3860	3860	3860	3860	
3870	YTH CAMPS	C	3870	3870	3870	3870	3870	
3880	OTHR OUTDR	C	3880	3880	3880	3880	3880	
3890	STRUCT-61B	C	3890	3890	3890	3890	3890	
3900	DEVEL LAND	C	3900	3900	3900	3900	3900	
3910	POT DEVEL	C	3910	3910	3910	3910	3910	
3920	UNDEV LAND	C	3920	3920	3920	3920	3920	
3930	AH-NOT 61A	C	3930	3930	3930	3930	3930	
4000	MANUFRNG	I	4000	4000	4000	4000	4000	
4010	IND WHSES	I	4010	4010	4010	4010	4010	
4020	IND OFFICE	I	4020	4020	4020	4020	4020	
4021	IND CNDO M06	I	4021	4021	4021	4021	4021	
4022	IND BLDG	I	4022	4022	4022	4022	4022	
4030	ACCLND MFG	I	4030	4030	4030	4030	4030	
4040	R-D FACIL	I	4040	4040	4040	4040	4040	
4100	SAND&GRAVL M94	I	4100	4100	4100	4100	4100	
410I	SAND&GRAVL M96	I	4100	4100	4100	4100	4100	
410V	SAND&GRAVL M00	I	4100	4100	4100	4100	4100	
4110	GYPSSUMMINE	I	4110	4110	4110	4110	4110	
4120	ROCK MINE	I	4120	4120	4120	4120	4120	
4130	OTH MINES	I	4130	4130	4130	4130	4130	
4200	PUB TANKS	I	4200	4200	4200	4200	4200	
4210	TANKS LNG M94	I	4210	4210	4210	4210	4210	
421I	TANKS LNG M96	I	4210	4210	4210	4210	4210	
421V	TANKS LNG M00	I	4210	4210	4210	4210	4210	
4220	ELEC PLANT	I	4220	4220	4220	4220	4220	
4230	ELEC ROW	I	4230	4230	4230	4230	4230	
4240	ELECSUBSTA	I	4240	4240	4240	4240	4240	
4250	GAS PLANT	I	4250	4250	4250	4250	4250	
4260	GAS ROW	I	4260	4260	4260	4260	4260	
4270	GAS STG	I	4270	4270	4270	4270	4270	
4280	GAS SUBSTA	I	4280	4280	4280	4280	4280	
4300	TEL X STA	I	4300	4300	4300	4300	4300	
4310	TEL REL TW M96	I	4310	4310	4310	4310	4310	
431C	TEL REL TW M94	I	4310	4310	4310	4310	4310	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
431V	TEL REL TW M00	I	4310	4310	4310	4310	4310	
4320	CBL-TV TR	I	4320	4320	4320	4320	4320	
4330	RAD/TV TR	I	4330	4330	4330	4330	4330	
4400	IND LD DV	I	4400	4400	4400	4400	4400	
4410	IND LD PO	I	4410	4410	4410	4410	4410	
4420	IND LD UD	I	4420	4420	4420	4420	4420	
4500	ELEC GEN PLANT	I	4500	4500	4500	4500	4500	
4510	ELEC GEN PLANT	I	4510	4510	4510	4510	4510	
4520	ELEC GEN AGRMNT	I	4520	4520	4520	4520	4520	
5010	IND ASC TR	P	5010	5010	5010	5010	5010	
5020	DOM/FOR CP	P	5020	5020	5020	5020	5020	
5030	DOM/FOR ME	P	5030	5030	5030	5030	5030	
5040	PUB UTIL	P	5040	5040	5040	5040	5040	
5050	MCH PL/WR	P	5050	5050	5050	5050	5050	
5060	PIPE LINES	P	5060	5060	5060	5060	5060	
6010	C61 TEN YR	S	6010	6010	6010	6010	6010	
6020	C61 5 YEAR	S	6020	6020	6020	6020	6020	
6100	FOREST C61	S	6100	6100	6100	6100	6100	
7100	CRANBERRY	S	7100	7100	7100	7100	7100	
7110	TOBACCO SD	S	7110	7110	7110	7110	7110	
7120	TR CRP VEG	S	7120	7120	7120	7120	7120	
7130	FIELD CRPS	S	7130	7130	7130	7130	7130	
7140	ORCHARDS	S	7140	7140	7140	7140	7140	
7150	VINEYARDS	S	7150	7150	7150	7150	7150	
7160	TILL FORAG	S	7160	7160	7160	7160	7160	
7170	PROD WOOD	S	7170	7170	7170	7170	7170	
7180	PASTURE M01	S	7180	7180	7180	7180	7180	
718V	PASTURE M00	S	7180	7180	7180	7180	7180	
7190	NURSERIES	S	7190	7190	7190	7190	7190	
7200	NON PROD M00	S	7200	7200	7200	7200	7200	
720V	NONPRNECLD M00	S	7200	7200	7200	7200	7200	
7220	DO NOT USE	S	7220	7220	7220	7220	7220	
8000	RECREATION	S	8000	8000	8000	8000	8000	
8010	61B HIKE	S	8010	8010	8010	8010	8010	
8020	61B CAMP	S	8020	8020	8020	8020	8020	
8030	61B NATURE	S	8030	8030	8030	8030	8030	
8040	61B BOAT	S	8040	8040	8040	8040	8040	
8050	61B GOLF	S	8050	8050	8050	8050	8050	
805C	61B GOLF M94	S	8050	8050	8050	8050	8050	
805I	61B GOLF M96	S	8050	8050	8050	8050	8050	
805R	61B GOLF M01	S	8050	8050	8050	8050	8050	
8060	61B HORSE	S	8060	8060	8060	8060	8060	
8070	61B HUNT	S	8070	8070	8070	8070	8070	
8080	61B FISH	S	8080	8080	8080	8080	8080	
8090	61B AL-SKI	S	8090	8090	8090	8090	8090	
8100	61B NR-SKI	S	8100	8100	8100	8100	8100	
8110	61B SWIM	S	8110	8110	8110	8110	8110	
8120	61B PICNIC	S	8120	8120	8120	8120	8120	
8130	61B GLIDE	S	8130	8130	8130	8130	8130	
8140	61B TARGET	S	8140	8140	8140	8140	8140	
9000	US GOVT VACANT	E	9000	9000	9000	9000	9000	
9001	US GOVT MDL 01	E	9001	9001	9001	9001	9001	
9002	US GOVT MDL 94	E	9002	9002	9002	9002	9002	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
9020	DO NOT USE	E	9020		9020		9020	
9030	DO NOT USE	E	9030		9030		9030	
9032	DO NOT USE	E	9032		9032		9032	
9033	DO NOT USE	E	9033		9033		9033	
9034	DO NOT USE	E	9034		9034		9034	
9035	DO NOT USE	E	9035		9035		9035	
9037	DO NOT USE	E	9037		9037		9037	
9038	DO NOT USE	E	9038		9038		9038	
903A	DO NOT USE	E	9035		9035		9035	
903B	DO NOT USE	E	9035		9035		9035	
903C	DO NOT USE	E	9034		9034		9034	
9040	DO NOT USE	E	9040		9040		9040	
9041	DO NOT USE	E	9041		9041		9041	
9046	DO NOT USE	E	9046		9046		9046	
9047	DO NOT USE	E	9047		9047		9047	
9050	DO NOT USE	E	9050		9050		9050	
9051	DO NOT USE	E	9051		9051		9051	
9053	DO NOT USE	E	9053		9053		9053	
9054	DO NOT USE	E	9054		9054		9054	
9055	DO NOT USE	E	9055		9055		9055	
9056	DO NOT USE	E	9056		9056		9056	
9057	DO NOT USE	E	9057		9057		9057	
9058	DO NOT USE	E	9058		9058		9058	
9059	DO NOT USE	E	9059		9059		9059	
9060	DO NOT USE	E	9060		9060		9060	
9061	DO NOT USE	E	9061		9061		9061	
9062	DO NOT USE	E	9062		9062		9062	
9070	DO NOT USE	E	9070		9070		9070	
9080	DO NOT USE	E	9080		9080		9080	
9081	DO NOT USE	E	9081		9081		9081	
9090	DO NOT USE	E	9090		9090		9090	
9093	DO NOT USE	E	9093		9093		9093	
9096	DO NOT USE	E	9096		9096		9096	
9100	SOL DEPT CONS &	E	9100		9100		9100	
9110	SOL DIV OF FISH	E	9110		9110		9110	
9140	SOL DEPT OF MEN	E	9140		9140		9140	
9170	SOL EDUCATION	E	9170		9170		9170	
9200	STATE DEPT CONS	E	9200		9200		9200	
9210	STATE DIV OF FI	E	9210		9210		9210	
9220	STATE POLICE	E	9220		9220		9220	
9230	STATE DEPT PUBL	E	9230		9230		9230	
9270	STATE UMASS	E	9270		9270		9270	
9290	STATE OTHER	E	9290		9290		9290	
9300	MUNICIPAL OR CO	E	9300		9300		9300	
9301	MUNICIPAL CEMET	E	9301		9301		9301	
9302	MUNICIPAL VACAN	E	9302		9302		9302	
9310	MUNICIPAL IMPRO	E	9310		9310		9310	
9311	MUNICIPAL MDL01	E	9030		9030		9030	
9320	MUNICIPAL CONSE	E	9320		9320		9320	
9340	MUNICIPAL EDUCA	E	9340		9340		9340	
9350	MUNICIPAL PUBLI	E	9350		9350		9350	
9351	MUN PUB SAFETY	E	9351		9351		9351	
9360	MUNICIPAL TAX T	E	9360		9360		9360	

**Land Use Codes
NANTUCKET, MA**

Use Code	Use Desc	Land Class	Assess Lnd	Sum Ln 1	Assess Lnd	Sum Ln 2	Assess Bldgs	Sum Obldgs
9380	ENTERPRISE VACA	E	9380		9380		9380	
9390	ENTERPRISE IMPR	E	9390		9390		9390	
9391	ENTERPRISE MDL	E	9391		9391		9391	
9400	EDUCATIONAL PRI	E	9400		9400		9400	
9430	EDUCATIONAL IMP	E	9430		9430		9430	
9460	EDUCATIONAL VAC	E	9460		9460		9460	
9461	EDUCATIONAL MDL	E	9461		9461		9461	
9462	EDUCATIONAL CON	E	9462		9462		9462	
9500	CHARITABLE VACA	E	9500		9500		9500	
9510	CHARITABLE IMPR	E	9510		9510		9510	
9530	CHARITABLE CEME	E	9530		9530		9530	
9540	CHARITABLE FRAT	E	9540		9540		9540	
9550	CHARITABLE HOSP	E	9550		9550		9550	
9551	CHARITABLE HOSP	E	9551		9551		9551	
9560	CHARITABLE LIBR	E	9560		9560		9560	
9561	CHARITABLE MUSE	E	9561		9561		9561	
9570	CHARITABLE SERV	E	9570		9570		9570	
9571	CHARITABLE SERV	E	9571		9571		9571	
9580	CHARITABLE RECR	E	9580		9580		9580	
9590	CHARITABLE HOUS	E	9590		9590		9590	
9600	RELIGIOUS CHURC	E	9600		9600		9600	
9610	RELIGIOUS RECTO	E	9610		9610		9610	
9620	RELIGIOUS OTHER	E	9620		9620		9620	
9700	HOUSING AUTHORI	E	9700		9700		9700	
9701	HOUSING AUTH MD	E	9701		9701		9701	
9720	TRANSPORTATION	E	9720		9720		9720	
9721	TRANS AUTH VACA	E	9721		9721		9721	
9730	HOUSING AUTH VA	E	9730		9730		9730	
9910	LANDBANK VACANT	E	9910		9910		9910	
9920	LANDBANK MDL 94	E	9910		9910		9910	
9921	LANDBANK MDL 01	E	9910		9910		9910	
995	CONDO MAIN	R	995		995		995	
TON	FIXED ASSETS	E	995		995		995	

Appendix F: G.L. 139-8: Residential Development Options

Excerpt from Nantucket Zoning Bylaw
Prepared as part of WPI IQP: Nantucket Buildout Analysis, 2018

§ 139-8. Residential development options. [Amended 11-13-1990 STM by Art. 19, AG approval 3-19-1991; 4-12-1994 ATM by Art. 48, AG approval 4-29-1994; 4-10-1995 ATM by Arts. 42 and 43, AG approval 5-22-1995; 4-9-2001 ATM by Art. 36, AG approval 8-2-2001; 4-15-2003 ATM by Art. 28, AG approval 8-27-2003; 4-12-2004 ATM by Arts. 35 and 36, AG approval 9-3-2004; 4-8-2008 ATM by Arts. 58, 59 and 64, AG approval 8-18-2008; 4-6-2009 ATM by Art. 27, AG approval 8-10-2009¹; 4-6-2011 ATM by Arts. 63 and 64, AG approval 9-15-2011; 3-31-2012 ATM by Art. 54, AG approval 7-12-2012]

A. Flex development and open space residential development options shall become effective on January 1, 2013, and may be allowed as an alternative to a conventional subdivision. Flex development may be allowed in the Town Overlay District (TOD) through the issuance of a special permit by the Planning Board. Open space residential development is allowed by-right in the Country Overlay District (COD). The primary purposes of these development options are as follows:

- (a) To allow for greater flexibility and creativity in the design of residential developments.
- (b) To encourage a more efficient form of development that consumes less open land.
- (c) To reduce infrastructure and site disturbance through the creation of compact development.
- (d) To encourage the permanent preservation of open space.

(1) Requirements.

(a) The following requirements shall apply to flex development and open space residential development:

[1] All plans shall conform to the requirements of MGL c. 41, §§ 81K through 81GG and the "Rules and Regulations Governing the Subdivision of Land," as may be amended by the Planning Board from time to time.

[2] Building lots shall not be subject to the regularity formula in § 139-16D.

1. Editor's Note: This enactment also repealed former § 139-8, Residential Districts R-1, R-10, SR-2 and ROH and Residential Commercial Districts RC, RC-2, CDT, CN, CTEC and LC, as amended.

- [3] Building lots shall be restricted from any further lot division that results in additional building lots.
 - [4] To ensure that all common open space and common facilities within the development will be properly maintained, a homeowners' association shall be established in the form of a corporation, nonprofit organization, or trust. The homeowners' association legal documents shall be subject to approval by the Planning Board and shall be filed at the Nantucket County Registry of Deeds or the Registry District of the Land Court.
 - [5] The maximum number of building lots, excluding any bonuses, shall not exceed the number which may otherwise have been created on a conventional subdivision plan meeting all dimensional and upland requirements of the Zoning Bylaw and in full conformance with (and requiring no waivers from) the "Rules and Regulations Governing the Subdivision of Land," as may be amended by the Planning Board from time to time, as demonstrated by the submission of a dimensioned lotting plan.
- (b) Preservation of open space shall be required, with the amount based on the total tract size pursuant to Subsections A(3) and (4) below.
- [1] A restriction defining the protection of the open space shall be enforceable by the Town or County of Nantucket and recorded at the Nantucket County Registry of Deeds or the Registry District of the Land Court. In addition, open space shall be:
 - [a] Owned by the Town of County of Nantucket; or
 - [b] Owned by the Nantucket Islands Land Bank; or
 - [c] Conveyed to an established nonprofit organization, a principal purpose of which is the conservation of open land; or
 - [d] Subject to a permanent conservation restriction, as provided in MGL c. 184, §§ 31 through 33, and owned in common by a corporation or trust composed of the owners of lots within the development.

- [2] Open space shall be restricted to one or more of the following uses, subject to approval of the Planning Board, in accordance with MGL c. 184, §§ 31 and 32:
- [a] Preservation of important natural features on a lot.
 - [b] Passive recreation, including, but not limited to, nature study, boating, fishing, hunting, picnicking, and horseback riding.
 - [c] Active recreation.
 - [d] Bicycle paths and walking trails.
 - [e] Agriculture.
 - [f] Structures accessory to the use of the open space which may include, but are not limited to: boathouses, duck walks, landings, barns, gazebos.
 - [g] Water features consistent with the purposes described above.
 - [h] Individual underground septic systems or wells that provide service to the lots within the development.
- [3] Subject to Subsections A(3) and (4), a maximum of 50% of the required open space may be located on noncontiguous parcels of land in common ownership with the tract to be developed. The Planning Board shall determine the development potential of the noncontiguous parcel(s) and consider the open space value subject to the following criteria:
- [a] Preservation of scenic views or vistas.
 - [b] Common border to existing open space.
 - [c] Existence of a fragile ecological environment.
 - [d] Agricultural importance.
 - [e] Importance to the community for recreation, water supply, cultural or historic municipal use.
 - [f] Importance to the community as determined by the Planning Board.

(2) Bonus lots.

(a) Flex developments and open space residential developments shall be entitled to bonus lots, subject to the requirements below. Bonus lots shall be based on the number of building lots which could have been created through a conventional subdivision plan, as set forth in § 139-8A(1)(a)[5]. For all density calculations that result in a fractional number, only fractions equal to or greater than 0.51 should be rounded to the next highest whole number.

[1] A 10% increase in the number of building lots that could have been created through the submission of a conventional subdivision plan.

[2] A 10% increase if the open space remains open to the public through a permanent access easement or conveyance to the Town or County of Nantucket or the Nantucket Islands Land Bank.

[3] A 1% increase for each 10% of the cluster lots restricted to a single dwelling unit, provided that the restricted lots would otherwise be permitted a second dwelling pursuant to Board of Health regulations.

[4] The total increase in building lots shall not exceed 30% of the number of building lots which could have been created through a conventional subdivision plan.

(3) Flex development.

(a) Flex development may be allowed in the Town Overlay District (TOD) through the issuance of a special permit subject to the following:

[1] The Planning Board shall be the sole special permit granting authority for relief pursuant to any provision of this chapter.

[2] Planning Board approval of a special permit shall not substitute for approval of a definitive subdivision or approval not required (ANR) plan.

[3] Flex Development shall be permitted in the R-40, R-20, R-10, R-5, and ROH Districts only and shall conform to the following dimensional requirements:

	R-40	R-20	R-10	R-5	ROH
Minimum tract area (acres)	5	3	2	1	1
Open land required (total tract)	70%	50%	40%	30%	25%
Minimum lot size (square feet)	10,000	7,500	4,000	3,000	3,000
Maximum lot ground cover ratio	35%	30%	50%	60%	65%
Minimum frontage	20	20	20	0	0
Front setback	5	5	5	5	0
Side/Rear setback	5	5	5	5	0

- [4] The Planning Board may reduce, by up to 100%, the setbacks, provided that the Planning Board finds that such a change will not have an adverse impact on the neighborhood and that it will promote the purposes and intent of this section.
- [5] The Planning Board may reduce, by up to 100%, the required frontage, provided that the lot has sufficient access through an easement.
- [6] The Planning Board may waive the required minimum tract area, provided that the Planning Board finds that the proposed flex development is more in keeping with the surrounding area, promotes a more efficient use of land, and that it will promote the purposes and intent of this section.
- [7] Noncontiguous open space parcels, subject to Subsection A(1)(b)[3], may be located in the Town Overlay District (TOD) or the Country Overlay District (COD).

(b) The following development and design criteria will be considered by the Planning Board during its review of an application for flex development:

- [1] Landscaping features utilizing natural or man-made materials are encouraged and may include effective screening, planting of street trees, and preservation of existing mature vegetation.
- [2] Sidewalks and walking paths which encourage pedestrian activity are encouraged, including connections to adjacent neighborhoods and bordering open spaces.
- [3] Vehicular access should be consolidated in a small number of widely spaced access points where practicable.
- [4] Common driveways and shared parking areas are encouraged.

(c) The following performance criteria shall be reviewed by the Planning Board. Mitigation measures proposed by the developer shall be considered:

- [1] Traffic flow and safety in the proposed development, the neighborhood, and adjacent public and private ways will not be significantly impacted in comparison with other development options;
- [2] Quality of site design, building design (if applicable), and landscaping enhances the area in comparison with other development options;
- [3] The provision of open land and any associated landscaping is appropriate for the scale and location of the development as determined by the Planning Board;
- [4] That utilities and services, such as water and sewer, are adequate for the proposed development.

(4) Open space development.

(a) Open space development shall be allowed by-right within the Country Overlay District (COD), subject to the following:

- [1] For parcels of land within an open space development, the Planning Board shall be the sole special permit granting authority for relief pursuant to any provision of this chapter.
- [2] Open space development shall be permitted in the LUG-1, LUG-2, LUG-3, and VR Districts only and shall conform to the following dimensional requirements:

	LUG-3	LUG-2	LUG-1	VR
Minimum tract area (acres)	10	10	5	3
Open land required (total tract)	80%	75%	65%	60%
Minimum lot size (square feet)	10,000	10,000	10,000	10,000
Maximum lot ground cover ratio	20%	20%	20%	20%
Minimum frontage	20	20	20	20
Front setback	15	15	15	15
Side/Rear setback	10	10	10	10

- [3] The Planning Board may issue a special permit to reduce, by up to 100%, the setbacks, provided that the Planning Board finds that such a change will not have an adverse impact on the neighborhood and that it will promote the purposes and intent of this section.
- [4] Noncontiguous open space parcels, subject to Subsection A(1)(b)[3], may be located in the Country Overlay District (COD) only.
- [5] In any LUG Zone, a minimum buffer of 50 feet of permanently restricted and undisturbed open space (excluding walking paths and fire access easements) shall be required between the proposed lot line of any open space residential development lot and the

outside boundary of the subdivision tract. The Planning Board, through the issuance of a special permit, may reduce or waive this requirement if it finds that:

- (b) Such reduction or waiver is necessitated by the shape or topography of the tract of land; or
- (c) Natural resources will be better protected by an alternative location; or
- (d) Equivalent protection against inconsistency with the existing pattern of development has been provided.

B. Nantucket Housing Needs Program.

- (1) Purpose. To create, make available and maintain housing that is affordable to people who earn less than 150% of the Nantucket County median household income; to maintain Nantucket's diversity and unique sense of community; to encourage moderate-income families to continue to reside on Nantucket; and to generate a supply of housing that will remain affordable.
- (2) Definitions. The following definitions only apply to this § 139-8C:

HOUSING AUTHORITY — The Nantucket Housing Authority (NHA) or its designee.

MAXIMUM RENTAL PRICE — Shall be no more than the fair market rent established for Nantucket County as published by the U.S. Department of Housing and Urban Development in Federal Register, Vol. 65 No. 185 (September 25, 2000) and as may hereafter be amended from time to time.

MAXIMUM RESALE PRICE — The greater of the maximum sales price or price the current Nantucket Housing Needs Covenant unit owner paid for the Nantucket Housing Needs Covenant unit.

MAXIMUM SALES PRICE — Shall be calculated by assuming a ten-percent down payment and an annual debt service (at prevailing thirty-year fixed interest rates) that is equal to 30% of the gross annual income of a household earning up to 125% of median income.

MEDIAN INCOME — Median family income for Nantucket County as published from time to time by the U.S. Department of Housing and Urban Development.

NANTUCKET HOUSING NEEDS COVENANT — A covenant placed on housing, which property owners choose to execute and which shall be enforceable by the NHA, to be recorded in the Registry of Deeds or the Land Court Registry District.

PRINCIPAL RESIDENCE — The locality where a person resides with the present intent to make it the person's fixed and permanent home. The person's physical presence alone will not establish a principal residence. In ascertaining one's intent, the Housing Authority shall consider, among other things, the person's employment status, voter registration, driver's license, motor vehicle registration, real property ownership, income tax returns, or the filing with the Housing Authority of a written declaration to establish or maintain a principal residence.

QUALIFIED FAMILY MEMBER — The owner of the lot at the time the lot was subdivided into primary and secondary lots and the owner's spouse, and their parents, grandparents, children, brothers and sisters, or as otherwise defined within the Nantucket Housing Needs Program regulations or guidelines. **[Added 4-2-2016 ATM by Art. 55, AG approval 7-12-2016]**

QUALIFIED PURCHASER HOUSEHOLD — A household whose gross annual income is less than 150% of median income.

QUALIFIED RENTER HOUSEHOLD — A household whose gross annual income is not more than 100% of median income.

(3) General requirements.

(a) Housing subject to the Nantucket Housing Needs Covenant shall be:

[1] Occupied by a qualified renter or qualified purchaser household.

[2] The principal residence of the qualified renter or qualified purchaser household.

[3] Enforceable for the greater of 99 years or the maximum time period allowable by law.

[4] The price of the unit shall not exceed the maximum sales price, or, in the case of resale, the maximum resale price.

[5] The unit rent shall not exceed the maximum rental price.

[6] The owner of a unit being rented shall provide the Housing Authority with an annual certification of compliance with the terms of the covenant.

(4) Monitoring and administration.

(a) The Housing Authority shall monitor and administer the Nantucket Housing Needs Program and may promulgate rules and regulations to implement it. Prior to promulgating such rules and regulations and prior to completing a model Nantucket Housing Needs Covenant, the Housing Authority shall hold a public hearing or hearings to solicit advice from the public. The Housing Authority shall publish notice of these hearings prominently in a newspaper of general circulation on Nantucket for two successive weeks.

(b) All legal documentation shall be submitted to the Housing Authority for review and approval.

C. Special permit to create secondary residential lots for year-round residents. **[Amended 4-5-2014 ATM by Art. 63, AG approval 5-7-2014; 4-2-2016 ATM by Arts. 54, 55, AG approval 7-12-2016]**

(1) Purpose: to create, make available and maintain housing that is affordable to those who earn at or below 150% of the Nantucket County median household income; to help those people or households to continue to reside on Nantucket; to generate and preserve affordable housing in the Town of Nantucket in perpetuity, all in order to maintain Nantucket's diversity and unique sense of community.

(2) Secondary lots may be permitted in the following zoning districts: ROH, R-5, R-10, R-20, R-40, VR, LUG-1, LUG-2, and LUG-3.

(3) As authorized by MGL c. 40A, § 9, Paragraph 2, the Planning Board, acting as the special permit granting authority, may issue a special permit authorizing the division of a lot into two lots, provided the following requirements and/or conditions shall apply:

(a) The original lot shall not be subject to any covenants, restrictions or similar encumbrances, whether appearing

in a deed, easement, land-use permit or any other instrument, pertaining to the prohibition of more than one dwelling unit on the original lot.

- (b) One of the two lots shall be subject to an NHNC-Ownership Form, which shall provide, without limitation, that the owner of that lot shall earn at or below 150% of the Nantucket County median household income. Secondary lots sold to qualified family members shall not be subject to the income and asset limits for eligible households. Upon resale, transfer, or gift of the secondary lot to a nonqualified family member, the lot shall be subject to an NHNC-Ownership Form, and all requirements set forth therein, including income and asset limits for eligible households.
- (c) The lots shall not be subject to the secondary dwelling requirements contained within § 139-2 of this chapter. **[Amended 4-1-2017 ATM by Art. 74, AG approval 5-31-2017]**
- (d) One of the two lots shall be allowed to have a second dwelling unit, subject to the requirements of the tertiary dwelling definition contained within § 139-2 of this chapter. **[Added 4-1-2017 ATM by Art. 74, AG approval 5-31-2017]**
- (e) Except for pre-existing nonconforming lots, in which case the Planning Board may issue a special permit defining the lot areas, the lot area for the smaller of the two lots shall be at least 40% of the minimum lot size for the district in which the lot is located, except in the LUG-2 and LUG-3 Districts, where the secondary lot may be reduced to 20,000 square feet.
- (f) The lots shall comply with the ground cover ratio, front setback, and side and rear setback requirements of the underlying zoning district, including any provisions of this chapter for pre-existing nonconforming lots, except as follows:
 - [1] The Planning Board may waive by the issuance of a special permit the setback requirements only as they apply to the lot line(s) between the secondary lots;
 - [2] The Planning Board may waive by the issuance of a special permit the ground cover ratio requirement

for the secondary lots, provided that the total ground cover, ratio does not exceed the amount that would have been allowed for the original lot;

- (g) The lots each must have a minimum of 20 feet of frontage or an easement of sufficient width and grade to provide access.
 - (h) The lots shall share a single driveway access. The Planning Board must be provided with an instrument, in recordable form, evidencing the common access rights to said access in accordance with this subsection. The Planning Board may grant a special permit to waive the requirement for shared driveway access based upon a finding that separate driveway access would not have a significant and adverse effect on the scenic or historic integrity of the neighborhood and is not contrary to sound traffic or safety considerations.
- (4) This § 139-8C shall not apply to major commercial developments (§ 139-11); flex development and open space residential development options (§ 139-8A); and are not permitted in the following zoning districts: Commercial Downtown (CDT); Moorlands Management (MMD).
 - (5) The Planning Board may grant a special permit for the division of a duplex into two attached single-family dwellings, provided that one of the dwellings is subject to a NHNC-Ownership Form. Subsection C(3)(e) and (f) above shall not apply and the Planning Board shall establish minimum lot size, ground cover ratio, and setbacks during the special permit review. Ground cover ratios for the primary and secondary lot combined shall not exceed the maximum allowed in the underlying zoning district.
 - (6) Section 139-16D, Regularity formula, shall not apply to this § 139-8C.
- D. Special permit issued by the Planning Board to create workforce homeownership housing in the R-5 Zoning District through a workforce homeownership housing bonus lots allowance and in the CN and CMI Zoning Districts through a workforce rental community. The purpose of this provision is to incentivize the creation of workforce and affordable rental and ownership housing opportunities; to promote consistency, quality, and flexibility in the site layout and design; to mitigate traffic congestion by encouraging the creation of compact

neighborhoods proximate to compatible adjacent commercial uses that reduce the need for vehicle trips to already congested areas; and to promote economic vitality and a greater diversity of housing opportunities in compliance with objectives contained within plans adopted or accepted by the Town of Nantucket, Nantucket Planning and Economic Development Commission, or the Nantucket Housing Authority. This bylaw, which sets a minimum size lot area, is intended to allow for aggregation of buildings, parking spaces, and open areas to improve design quality. Consistent design quality shall be applied to all dwelling units, and affordable units shall be distributed evenly throughout the development. **[Added 11-9-2015 STM by Art. 2, AG approval 12-29-2015; amended 4-2-2016 ATM by Art. 36, AG approval 7-12-2016]**

(1) Requirements.

- (a) The following requirements shall apply to workforce homeownership housing bonus lots in the R-5 Zoning District and to a workforce housing rental community in the CN and CMI Zoning Districts.

- [1] Minimum lot requirement of 60,000 square feet in the CN District and 32,000 square feet in the CMI District;
- [2] The term of affordability shall be in perpetuity or the longest term allowed by law;
- [3] The application shall be subject to major site plan review;
- [4] The Planning Board shall be the sole special permit granting authority for any relief pursuant to any provision of this chapter;
- [5] Planning Board approval of a special permit shall not substitute for approval of a definitive subdivision or approval not required (ANR) plan;
- [6] Project must be eligible for approval as local action units (LAU) through the Local Initiative Program (LIP) or otherwise included on the Town's Subsidized Housing Inventory. It shall be the responsibility of the applicant to take all reasonable steps necessary to ensure the units are included, including, without limitation, preparation and execution of a regulatory

agreement in a form to be approved by the Town of Nantucket, through its Board of Selectmen, and by the Department of Housing and Community Development (DHCD) and provision of any other documents requested by DHCD.

- (2) Workforce homeownership housing bonus lots.
- (a) Bonus lots, subject to the requirements below, shall be based on the number of building lots which could have been created through a conventional subdivision plan. The maximum number of building lots, excluding any bonuses, shall not exceed the number which may have otherwise been created on a conventional subdivision plan meeting all dimensional and upland requirements of the Zoning Bylaw and in full conformance with (and requiring no waivers from) the Rules and Regulations Governing the Subdivision of Land, as may be amended by the Planning Board from time to time, as demonstrated by the submission of a dimensioned lotting plan. For all density calculations that result in a fractional number, only fractions equal to or greater than 0.51 should be rounded to the next highest whole number.
- [1] The total number of lots shall be calculated by multiplying the number of lots allowed by-right, as described above, by a factor of 1.33.
- [2] 25% of the total number of lots allowed, using the bonus provision, must be allocated and restricted to ownership by households earning at or below the area median income limits set forth in the definition of "workforce homeownership housing," as defined in § 139-2, or the rental dwelling units located on the lots achieved through the bonus provision must be restricted to households earning at or below 80% of area median income. Said lots shall be subject to a Nantucket Housing Needs Covenant-Ownership Form or other instrument restricting sale or rental to households earning at or below the area median income limits set forth in the definition of workforce homeownership housing, as defined in § 139-2.
- (b) The Planning Board may reduce, by up to 100%: the front yard setback (but not the side or rear yard setbacks applied to the perimeter of the project area), internal

side or rear yard setbacks (meaning setbacks between lots which are the subject of the application), side or rear yard setbacks between the lots which are the subject of the application and other land in common ownership or control of the applicant, and the required frontage, provided that the lot has sufficient vehicular access through an easement.

- (c) The Planning Board may allow an increase in the ground cover ratio up to 50%.
 - (d) A minimum buffer area of at least 20 feet shall be established between the workforce homeownership housing bonus lots and residentially zoned abutting properties. The Planning Board may require the buffer area to include plantings, fencing, walls, or other improvements to mitigate impacts to abutting properties.
- (3) Workforce rental community.

- (a) Rental dwelling units in one or more structures, shall be subject to the following requirements:

[1] The maximum number of dwelling units shall not exceed 32, at least eight of which must (25% of which) be restricted to occupancy by households earning at or below 80% of area median income. An instrument, in a form approved by the Planning Board, restricting rental of at least eight of the dwelling units to households earning at or below 80% of area median income must encumber the subject lot(s);

[2] The maximum number of bedrooms contained within the workforce rental community lot shall not exceed 57;

[3] At least 10% of the total dwelling units within the workforce housing rental community must contain at least three bedrooms, unless such requirement is reduced by a future binding directive from the Commonwealth of Massachusetts Department of Housing and Community Development which confirms that fewer than 10% three-bedroom units may be included in the workforce rental community while still confirming that all of the units in the workforce rental community shall be eligible for

inclusion on the Town's Subsidized Housing Inventory. In such an instance, the Planning Board shall have the discretion to approve fewer three-bedroom units within the workforce rental community, in conjunction with the issuance of the special permit, as long as the requirement described above with respect to confirmation of the eligibility of all of the units in the workforce rental community relative to inclusion on the Town's Subsidized Housing Inventory has been met.

- (b) A minimum buffer area of at least 20 feet shall be established between the workforce rental community and residentially zoned abutting properties. The Planning Board may require the buffer area to include plantings, fencing, walls, or other improvements to mitigate impacts to abutting properties.
 - (c) The Planning Board may, in addition to those requirements included in § 139-23, require submission of additional documentation, including, without limitation, detailed floor plans, operation and management plan for the project, including maintenance of the structure(s) and the site.
 - (d) The Planning Board may reduce, by up to 100%, the side and rear yard setbacks where two or more workforce rental community lot projects are adjacent to each other.
- (4) The Planning Board may allow a workforce rental community as part of a larger project, as allowed in the CN and CMI Districts, provided that the project, comprised of one or more parcels of land in the same ownership or control, could be divided into multiple lots meeting the lot requirement of § 139-8D(1)(a)[1] on a conventional subdivision plan meeting all dimensional and upland requirements of the bylaw and consistent with the Rules and Regulations Governing the Subdivision of Land, as may be amended by the Planning Board from time to time, as demonstrated by the submission of a dimensioned lotting plan. **[Added 11-6-2017 STM by Art. 20, AG approval 2-26-2018]**
- E. Special permit to create rear lot subdivisions. **[Added 4-1-2017 ATM by Art. 72, AG approval 5-31-2017]**
- (1) Purpose: to provide a residential infill development option that allows for the same density that could be created by

a conventional subdivision, but that does not create unnecessary un-taxed roadway lots.

- (2) Rear lots may be permitted in the following zoning districts: R-5, R-10, R-20, R-40, and LUG-1.
- (3) As authorized by MGL c. 40A, § 9, Paragraph 2, the Planning Board, acting as the special permit granting authority, may issue a special permit authorizing the division of a lot into two or more lots, provided the following requirements and/or conditions shall apply:
 - (a) A minimum frontage of 20 feet shall apply to each lot;
 - (b) The ground cover ratio, front setback, and side and rear setback requirements of the underlying zoning district shall apply to each lot;
 - (c) The regularity formula prescribed in § 139-16D shall not apply to lots created pursuant to this subsection;
 - (d) The number of buildings lots shall not exceed the number which may have otherwise been created on a conventional subdivision plan meeting all dimensional and upland requirements of the Zoning Bylaw and the requirements contained within the "Rules and Regulations Governing the Subdivision of Land," as may be amended from time to time, as demonstrated by the submission of a dimensioned lotting plan.

Appendix G: Maximum Buildout Charts

Master Charts of Maximum Buildout on Nantucket, MA
Prepared as part of WPI IQP: Nantucket Buildout Analysis, 2018

Max Buildout, by District

District	Present Day: 2018					Hypothetical Max Buildout Scenario			2030 Low Scenario		2030 High Scenario	
	Residential Parcels	Total Dwellings	% of Total Dwellings	Parcels with 1 Dwelling	Parcels with 2+ Dwellings	New Dwellings	% New Dwellings	% Potential Growth	New Dwellings	% Potential Growth	New Dwellings	% Potential Growth
Grand Total	10697	10456	100%	6821	1760	5461	100%	52.2%	1260	12.1%	2484	23.8%
Town	4166	4276	40.90%	2933	661	2610	47.80%	61.0%	602	14.1%	1187	27.8%
Scon	963	554	5.30%	355	97	598	11.00%	107.9%	138	24.9%	272	49.1%
Airport	377	335	3.20%	221	54	368	6.70%	109.9%	85	25.4%	167	49.9%
Surf	595	719	6.90%	349	167	289	5.30%	40.2%	67	9.3%	131	18.2%
Brant	318	330	3.20%	215	55	239	4.40%	72.4%	55	16.7%	109	33.0%
Quid	169	156	1.50%	82	36	124	2.30%	79.5%	29	18.6%	56	35.9%
Tom	612	522	5.00%	354	83	116	2.10%	22.2%	27	5.2%	53	10.2%
Dionis	273	336	3.20%	124	104	115	2.10%	34.2%	27	8.0%	52	15.5%
Mad	325	284	2.70%	242	21	101	1.80%	35.6%	23	8.1%	46	16.2%
Polpis	147	178	1.70%	62	55	98	1.80%	55.1%	23	12.9%	45	25.3%
Harbor	255	300	2.90%	124	84	91	1.70%	30.3%	21	7.0%	41	13.7%
Pine	84	84	0.80%	80	2	77	1.40%	91.7%	18	21.4%	35	41.7%
Wauw	98	94	0.90%	52	21	72	1.30%	76.6%	17	18.1%	33	35.1%
Farm	104	98	0.90%	70	13	69	1.30%	70.4%	16	16.3%	31	31.6%
MadCon	170	184	1.80%	107	38	68	1.20%	37.0%	16	8.7%	31	16.8%
Huss	91	107	1.00%	65	21	57	1.00%	53.3%	13	12.1%	26	24.3%
Mono	135	163	1.60%	78	41	50	0.90%	30.7%	12	7.4%	23	14.1%
HumPond	70	63	0.60%	47	8	41	0.80%	65.1%	9	14.3%	19	30.2%
Unspecified	694	631	6.00%	614	7	39	0.70%	6.2%	9	1.4%	18	2.9%
Naus	195	187	1.80%	183	2	35	0.60%	18.7%	8	4.3%	16	8.6%
Poco	99	91	0.90%	42	24	34	0.60%	37.4%	8	8.8%	15	16.5%
Moors	29	29	0.30%	13	8	33	0.60%	113.8%	8	27.6%	15	51.7%
Mia	63	57	0.50%	27	15	26	0.50%	45.6%	6	10.5%	12	21.1%
Eel	61	76	0.70%	21	25	21	0.40%	27.6%	5	6.6%	10	13.2%
Hinck	59	71	0.70%	24	23	20	0.40%	28.2%	5	7.0%	9	12.7%
Mile	94	94	0.90%	71	11	15	0.30%	16.0%	3	3.2%	7	7.4%
Shimmo	63	87	0.80%	15	35	14	0.30%	16.1%	3	3.4%	6	6.9%
Bogs	8	10	0.10%	0	5	10	0.20%	100.0%	2	20.0%	5	50.0%
Smith	86	57	0.50%	46	5	10	0.20%	17.5%	2	3.5%	5	8.8%
Fish	95	101	1.00%	59	21	7	0.10%	6.9%	2	2.0%	3	3.0%
State	10	12	0.10%	6	3	7	0.10%	58.3%	2	16.7%	3	25.0%
Cisco	73	73	0.70%	59	7	5	0.10%	6.8%	1	1.4%	2	2.7%
WMia	17	18	0.20%	12	3	2	0.00%	11.1%	0	0.0%	1	5.6%
GP	6	5	0.00%	5	0	0	0.00%	0.0%	0	0.0%	0	0.0%
HumNan	36	40	0.40%	32	4	0	0.00%	0.0%	0	0.0%	0	0.0%
Musk	1	1	0.00%	1	0	0	0.00%	0.0%	0	0.0%	0	0.0%
Tuck	56	33	0.30%	31	1	0	0.00%	0.0%	0	0.0%	0	0.0%

Max Buildout, District by Dwelling Source

District	Subdividable		Second Dwelling	Undeveloped		Total
	Total Affected	Total New Dwellings	Total New	Total Affected	Total New Dwellings	
Grand Total	539	1932	2066	846	1463	5461
Town	285	986	1005	315	619	2610
Scon	52	190	188	146	220	598
Airport	31	226	60	46	82	368
Surf	28	45	155	57	89	289
Brant	39	137	56	24	46	239
Quid	19	51	25	27	48	124
Dionis	10	25	47	29	43	115
Tom	1	1	65	41	50	116
Mad	3	8	86	6	7	101
Polpis	6	57	32	7	9	98
Harbor	7	13	20	26	58	91
Wauw	6	32	14	4	26	72
Pine	1	1	75	1	1	77
Farm	11	34	20	11	15	69
MadCon	7	25	37	5	6	68
Huss	7	19	30	4	8	57
Mono	5	15	18	10	17	50
HumPond	7	21	16	0	4	41
Unspecified	3	7	32	0	0	39
Naus	0	0	28	6	7	35
Poco	0	0	10	17	24	34
Moors	4	23	3	5	7	33
Mia	0	0	6	17	20	26
Eel	1	8	9	4	4	21
Hinck	4	6	4	6	10	20
Mile	0	0	5	9	10	15
Shimmo	2	2	4	7	8	14
Bogs	0	0	0	3	10	10
Smith	0	0	8	2	2	10
Fish	0	0	0	6	7	7
State	0	0	6	1	1	7
Cisco	0	0	1	3	4	5
WMia	0	0	1	1	1	2
GP	0	0	0	0	0	0
HumNan	0	0	0	0	0	0
Musk	0	0	0	0	0	0
Tuck	0	0	0	0	0	0

Max Buildout and Scenarios, by Zone

Zone	Present Day: 2018					Hypothetical Max Buildout Scenario			2030 Low Scenario		2030 High Scenario	
	Residential Parcels	Total Dwellings	% of Total Dwellings	Parcels with 1 Dwelling	Parcels with 2+ Dwellings	New Dwellings	% New Dwellings	% Potential Growth	New Dwellings	% Potential Growth	New Dwellings	% Potential Growth
Grand Total	10697	10456	100%	6821	1761	5478	100%	52.4%	1260	12.0%	2484	24.0%
R20	1412	1508	14.4%	913	290	820	15.0%	54.4%	189	12.5%	372	24.7%
R1	978	1043	10.0%	669	185	740	13.5%	70.9%	170	16.3%	336	32.2%
R10	1015	1031	9.9%	810	110	615	11.2%	59.7%	141	13.7%	279	27.1%
ROH	1298	1408	13.5%	1040	180	498	9.1%	35.4%	115	8.2%	226	16.1%
LUG3	1511	1375	13.2%	763	295	487	8.9%	35.4%	112	8.1%	221	16.1%
R5	671	614	5.9%	537	37	416	7.6%	67.8%	96	15.6%	189	30.8%
RC2	211	182	1.7%	136	22	373	6.8%	204.9%	86	47.3%	169	92.9%
LUG2	958	1072	10.3%	556	250	330	6.0%	30.8%	76	7.1%	150	14.0%
LUG1	682	810	7.7%	377	212	298	5.4%	36.8%	69	8.5%	135	16.7%
SR20	396	267	2.6%	166	50	254	4.6%	95.1%	58	21.7%	115	43.1%
SOH	215	54	0.5%	44	5	152	2.8%	281.5%	35	64.8%	69	127.8%
VR	498	461	4.4%	362	48	146	2.7%	31.7%	34	7.4%	66	14.3%
SR1	155	84	0.8%	70	7	75	1.4%	89.3%	17	20.2%	34	40.5%
SR10	104	78	0.7%	55	11	69	1.3%	88.5%	16	20.5%	31	39.7%
RC	61	68	0.7%	50	7	42	0.8%	61.8%	10	14.7%	19	27.9%
R40	70	63	0.6%	36	13	36	0.7%	57.1%	8	12.7%	16	25.4%
CTEC	80	59	0.6%	45	7	35	0.6%	59.3%	8	13.6%	16	27.1%
CMI	72	67	0.6%	53	7	26	0.5%	38.8%	6	9.0%	12	17.9%
CDT	45	34	0.3%	30	2	22	0.4%	64.7%	5	14.7%	10	29.4%
R2	18	0	0.0%	0	0	21	0.4%	0.0%	5	0.0%	10	0.0%
CN	114	111	1.1%	79	15	19	0.3%	17.1%	4	3.6%	9	8.1%
RC2M	10	7	0.1%	7	0	3	0.1%	42.9%	1	14.3%	1	14.3%
MMD	29	24	0.2%	14	5	1	0.0%	4.2%	0	0.0%	0	0.0%
ALC	1	23	0.2%	0	1	0	0.0%	0.0%	0	0.0%	0	0.0%
CI	3	2	0.0%	2	0	0	0.0%	0.0%	0	0.0%	0	0.0%
LC	2	3	0.0%	1	1	0	0.0%	0.0%	0	0.0%	0	0.0%
OIH	0	0	0.0%	0	0	0	0.0%	0.0%	0	0.0%	0	0.0%
RCDT	2	2	0.0%	2	0	0	0.0%	0.0%	0	0.0%	0	0.0%
VN	5	1	0.0%	1	0	0	0.0%	0.0%	0	0.0%	0	0.0%
VTEC	8	5	0.0%	3	1	0	0.0%	0.0%	0	0.0%	0	0.0%
(blank)	73	0	0.0%	0	0	0	0.0%	0.0%	0	0.0%	0	0.0%

Max Buildout, Zone by Dwelling Source

Zone	Subdividable		Second Dwelling	Undeveloped		Total
	Total Affected	Total New Dwellings	Total New	Total Affected	Total New Dwellings	
Grand Total	564	1933	2066	851	1479	5478
R20	98	261	343	9	216	820
R1	114	440	131	55	169	740
R10	42	116	414	16	85	615
ROH	58	172	274	11	52	498
LUG3	25	128	150	1	209	487
R5	45	225	118	0	73	416
RC2	44	206	36	1	131	373
LUG2	18	45	126	132	159	330
LUG1	27	63	143	102	92	298
SR20	14	57	40	0	157	254
SOH	20	55	80	8	17	152
VR	13	24	109	0	13	146
SR1	13	35	25	9	15	75
SR10	7	21	36	102	12	69
RC	8	29	13	28	0	42
R40	1	1	22	49	13	36
CTEC	5	12	0	0	23	35
CMI	5	15	0	7	11	26
CDT	2	17	5	0	0	22
R2	0	0	1	123	20	21
CN	4	9	0	19	10	19
RC2M	1	2	0	0	1	3
MMD	0	0	0	0	1	1
ALC	0	0	0	0	0	0
CI	0	0	0	6	0	0
LC	0	0	0	56	0	0
OIH	0	0	0	72	0	0
RCDT	0	0	0	35	0	0
VN	0	0	0	10	0	0
VTEC	0	0	0	0	0	0
(blank)	0	0	0	0	0	0