

WPI

Improving Truck Unloading/Loading in Downtown Nantucket

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December 13th, 2022

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

Abstract

Nantucket relies heavily on freight from the mainland via the ferry. Due to the limited space and high seasonal tourist traffic, Nantucket's downtown core district faces severe congestion and limited curbside space for freight trucks to distribute their cargo, especially in summer. Our project goal was to analyze the effects trucking has on downtown and propose strategies to alleviate them. Based on our interviews, observations, and research, we recommend that Nantucket consider the following actions to address the issues faced and caused by trucks downtown: (1) Provide clearer information about routes out of the core, (2) Reconfigure some existing loading zones and create some new ones, (3) Improve signage about loading zones, and (4) Increase fines for illegally parking in loading zones.

Acknowledgements

We would like to thank everyone who contributed to our project and helped us throughout the process. We would like to acknowledge:

The Nantucket Yacht Club for housing us and Young's Bicycle shop for providing us with bikes.

Our sponsor Patrick Reed who provided us a place to work, guidance and assistance with our project, and the tools necessary to conduct our research.

Our advisors Dominic Golding and Bruce Bursten who guided us through our project.

We would also like to thank the following people who were willing to meet with us and provided great insight for our project.

- Ray Sylvia (Working Foreman, Department of Public Works)
- Nat Lowell (Longtime NP&EDC Member)
- Arthur Gasbarro (Director, Traffic Safety Work Group)
- Erika Mooney (Operations Administrator, Town of Nantucket)
- Peter Burke (Executive Director, Chamber of Commerce)
- Mark Willett (General Manager, Wannacomet Water Company)
- Bill Hoss (Island Operations Manager, Cape Cod Express)
- Jerry Mack (Neighborhood Police Officer, Nantucket Police Department)
- Matt Peel (Operations Manager, FedEx)
- Sean Driscoll (Communications Director and Records Access Officer, Steamship Authority)

Finally, we would like to thank the town of Nantucket for the warm welcome to this island. Everyone we met was willing to speak with us and happy to provide their perspective on our project.

Executive Summary

Now more than ever, we rely on delivery services to bring goods and products to businesses and homes. In 2020, delivery services carried 24.8 billion parcels in the United States, an increase of 12.6 billion from 2015 (UPU, 2021). In commercial and population centers, however, the last leg of freight transportation can become a problem. Large numbers of trucks are required to meet the high demand, and they become major causes of congestion and pollution in places like downtown Nantucket.

The town of Nantucket finds itself in a unique position as an island, tourist destination, and a national historic landmark. At the peak of the tourist season, the town's daytime population can increase to over 60,000 people, all of which are primarily supported by freight delivered by trucks that must first be ferried to the island. Relying on ferries means that instead of arriving throughout the day, trucks are offloaded in groups that drive off the ferry straight onto the narrow streets of Nantucket's historic core. As a result, they compete for space with residents and tourists alike, contributing to congestion on the already packed roads. The spike in demand for curbside space can also overwhelm the available supply, which leads to trucks disrupting traffic by stopping in travel lanes to unload. Even trucks that find curbside space to load or unload can obstruct visibility for pedestrians, and others are forced to pull up over the curb onto the sidewalk by the narrow streets, reducing its effective width for the high volumes of foot traffic.

To that end, the goal of our project was to propose strategies to alleviate the problems associated with truck loading/unloading in downtown Nantucket. We accomplished this goal through the following four project objectives:

1. Identify current practices and lessons learned in the management of truck loading/unloading in selected towns that face similar problems and constraints to Nantucket.
2. Determine the periods and locations of peak demand for loading/unloading in downtown Nantucket and identify contributing factors to curbside inefficiencies.
3. Solicit stakeholder perspectives on the causes, consequences, and solutions to the loading/unloading problems in downtown Nantucket.

4. Review and evaluate potential strategies to address truck loading and unloading problems in downtown Nantucket in consultation with the selected stakeholders.

To achieve this goal and accomplish our objectives, we researched strategies for transportation management in several other locations and spoke with transportation officials. We also used existing data, interviews with stakeholders, and our own observations to determine when, where, and why trucks cause problems while loading and unloading in downtown Nantucket and what issues arise.

Conclusions and Recommendations

Through our research, we have developed several conclusions regarding truck loading/unloading and freight movement in downtown Nantucket that each have at least one accompanying recommendation. Our conclusions and recommendations address both the identified core issues and seasonal challenges.

Conclusion 1: Tourists and new truck drivers lack the knowledge required to navigate Nantucket. Experienced truck drivers have a solid understanding of the layout of Nantucket, but the newer ones have trouble navigating downtown. Tourists also have trouble navigating downtown, and sometimes park in loading zones, which creates many issues for truck drivers.

Recommendation 1: The Town should consider developing an online guide or graphic for navigation in downtown Nantucket. This guide will make it easier to navigate downtown, and reduce the amount of tourists who unknowingly park illegally.

Conclusion 2: The loading zones in downtown Nantucket are not used to full capacity. Limited zone size, absence of crosswalks, and limited room to maneuver deter truck drivers from using the loading zones as intended and can lead trucks to park illegally, block traffic, and exacerbate congestion.

Recommendation 2: Nantucket should consider reconfiguring three of its existing loading zones to increase their utility to truck drivers and alleviate related issues, such as trucks blocking pedestrian crosswalks.

Conclusion 3: Current number of loading zones do not provide enough capacity to meet demand. Even with the full utilization of every loading zone in downtown Nantucket, the demand for space to stop and unload can still overwhelm the available supply.

Recommendation 3: Nantucket should consider creating some new loading zones to expand coverage in underserved areas and add capacity elsewhere, while also creating some new spaces for passenger vehicle parking.

Conclusion 4: The current signage for loading zones in downtown is unclear. Signs marking loading zones blend into the background and the instructions are confusing for truckers and tourists; some signs are missing or poorly placed.

Recommendation 4: Nantucket should consider clarifying the signage used for loading zones so fewer people overlook them.

Conclusion 5: Current fines are not sufficient enough to deter illegal parking. Fines for parking illegally in loading zones in Nantucket are very low compared with other jurisdictions. Other jurisdictions have found raising fines to be an effective policy to ease congestion.

Recommendation 5: Nantucket should consider increasing the fine for illegal parking in loading zones.

Authorship

Section	Primary Writer	Primary Editor
Abstract	CR	MW
Acknowledgements	MW	CR
Executive Summary	All	All
Authorship	CR	All
1.0 Introduction	DC	All
2.0 Background	AV,MW	CR
2.1	AV,MW	CR
2.2	MW	All
2.3	AV	All
2.4	DC	AV
3.0 Methods	AV	CR
3.1	MW	CR
3.2	AV	CR
3.3	CR	AV
3.4	DC	AV
4.0 Findings	MW	All
4.1	DC	All
4.2	MW,AV	All
4.3	CR	All
5.0 Conclusions and Recommendations	All	All
References	All	DC
Appendix A	CR	All
Appendix B	CR	All
Appendix C	CR	All
Appendix D	MW	All
Appendix E	AV	All
Appendix F	CR	All
Appendix G	MW	All

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1.0 Introduction

Now more than ever, we rely on delivery services to bring goods and products to businesses and homes. In 2020, delivery services carried 24.8 billion parcels in the United States, more than double what was shipped in 2015 (UPU, 2021). In commercial and population centers, however, the last leg of freight transportation can become a problem. Large numbers of trucks are required to meet the high demand, and they become major causes of congestion and pollution.

The town of Nantucket finds itself in a unique position as an island, tourist destination, and a national historic landmark. At the peak of the tourist season, the town's daytime population can increase to over 60,000 people, all of which are primarily supported by freight delivered by trucks that must first be ferried to the island. Relying on ferries means that instead of arriving throughout the day, trucks are offloaded in groups that drive off the ferry straight onto the narrow streets of Nantucket's historic core. As a result, they compete for space with residents and tourists alike, contributing to congestion on the already packed roads. The spike in demand for curbside space can also overwhelm the available supply, which leads to trucks disrupting traffic by stopping in travel lanes to unload. Even trucks that find curbside space to load or unload can obstruct visibility for pedestrians, and others are forced to pull up over the curb onto the sidewalk by the narrow streets, reducing its effective width for the high volumes of foot traffic.

To that end, the goal of our project was to propose strategies to alleviate the problems associated with truck loading/unloading in downtown Nantucket. We accomplished this goal through the following four project objectives:

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3. Solicit stakeholder perspectives on the causes, consequences, and solutions to the loading/unloading problems in downtown Nantucket.

4. Review and evaluate potential strategies to address truck loading and unloading problems in downtown Nantucket in consultation with the selected stakeholders.

To achieve this goal and accomplish our objectives, we researched strategies for transportation management and reached out to transportation officials in several other locations. We also used existing data, interviews with stakeholders, and our own observations to determine when, where, and why trucks cause problems while loading and unloading in downtown Nantucket, and the types of issues truck drivers encounter. With this information and feedback from our stakeholders, we developed potential strategies, most of which were simple but specific, such as enlarging a loading zone by five feet and adjusting signage for loading zones.

2.0 Background

This section will provide an overview of truck transportation and the challenges it poses especially with regard to loading and unloading. Topics covered include an overview of freight management in the United States, how freight reaches and is moved on Nantucket, regulations around trucking, and space constraints to trucking on Nantucket.

2.1 Overview of Trucking Management

Trucks play a key role in freight delivery, moving 71.6% of goods in the United States (U.S. Census Bureau, 2021). However, there are problems that come with our reliance on trucking, especially during the final stretch of a delivery. Most of these problems are related to traffic congestion, but trucks can also be disruptive and harmful to people nearby due to noise, safety concerns, and pollution (usually diesel fumes). Fortunately, there are many methods to manage these issues.

2.1.1 Issues Caused by Trucking

There are two main factors that create problems and inefficiencies during the final stretch of a delivery. First, there are many establishments, such as homes or businesses, that individually receive multiple deliveries a day. This makes truck routing much more complicated, as it requires managing many small deliveries from multiple trucking companies. Second, deliveries are often restricted to certain time periods based on when the receiver is available and certain routes decided by the jurisdiction's trucking policies.

When completing a delivery, truck drivers are not always able to find parking, which wastes fuel, exacerbates pollution, and adds to traffic congestion. Each year in the U.S., \$160 billion are lost in traffic congestion, \$28 billion of which is due to truck congestion (U.S. Department of Transportation, p. 17). Other times, truck drivers will park on the curb or double park, which partially blocks the road and reduces the line of sight for other drivers (Figure 1). These actions contribute to traffic congestion and present safety issues for both other drivers and pedestrians (Dey et al., 2019, p. 322). In

addition to impacting traffic, trucks can simply be disruptive. They are big, loud, and a significant source of pollution, including diesel fumes and other greenhouse gasses (GHGs). Indeed, in the U.S., trucks are responsible for two-thirds of GHG emissions from freight sources (Dablanc et al., 2013, p. 30). Recent studies have also shown that truck emissions, especially in highly congested locations, have a noticeable impact on children's health, which causes many communities to prioritize the reduction of truck emissions (Dablanc et al., 2013, p. 30).



Figure 1: Truck double-parked on the side of the road (Dey et al., 2019, p. 322)

2.1.2 Potential Solutions

Given that traffic congestion creates a lot of noise and pollution, it is the most prioritized problem caused by trucking, and as a result, jurisdictions have developed many methods to address it. A common method is to designate which streets are accessible to trucks, and when they can drive on them (Portland Bureau of Transportation, 2017, p. 3). This method can reduce congestion in residential areas and the disturbance that trucks can cause. That said, parking is still a significant issue for trucks, so most communities have designated loading zones. When executed effectively, loading zones reduce traffic congestion by reserving space for trucks to park

without blocking traffic flow, but the creation and management of such zones can be difficult. Many jurisdictions lack a standard method to determine the size, number and location of loading zones and they are often trying to balance competing demands for space. Consequently, loading zones are not always placed in the most suitable locations for freight delivery (Muñuzuri et al., 2017, p. 1). To make matters worse, some jurisdictions lack consistent signage, which confuses truck drivers. For example, Portland, OR had 44 different types of signs designating loading zones and the rules governing their use, such as time of day (Portland Bureau of Transportation, 2017, p. 1). Weak enforcement of parking violations is another common issue that leads to cars parking in loading zones and trucks parking for longer than necessary. Portland used improved signage to try to tackle these problems and had some success limiting car parking in loading zones. Washington, D.C. raised the parking violation fines for cars but not trucks. This strategy deterred cars from encroaching on parking zones without hindering trucking companies.

Aside from improving enforcement, many jurisdictions use pricing mechanisms to encourage high turnover rates in loading zones, which means trucks spend less time in loading zones so more trucks can use them in a given period. For example, New York City set its prices for parking in loading zones at \$2 for one hour, \$5 for two hours, and \$9 for three hours. When implemented and enforced properly, New York City found this strategy reduced the average parking duration from 160 to 45 minutes (Bomar et al., 2009, p. 9). With the reduced parking duration, more than three times as many vehicles can use loading zones.

Another strategy to reduce truck congestion is to simplify the final stretch of a delivery. To achieve this goal, some jurisdictions consolidate deliveries between vendors by delivering goods to one spot for people to pick up on their time. Although some people do drive to collect their packages, they can do that outside of peak hours and have easier access to parking. This consolidation simplifies truck routes by reducing the number of stops on a trip. It also simplifies the jurisdiction's parking policy, as it can prioritize a few stops where most packages are delivered. In Europe, some jurisdictions, such as London, use cargo bikes to complete deliveries, instead of relying on people to pick up their packages (Ralston, 2022). This practice has the advantage of

consolidating truck deliveries without requiring further action from the receiver. When done well, it can even make deliveries faster.

Adjusting planning standards is a more long-term freight management strategy. Local jurisdictions can “set policies and guidelines for the incorporation of freight deliveries into new developments, the design of loading docks, and parking and loading practices” (Dabanc et al., 2013, p. 32). Many different types of policies have been implemented. New York City, for example, developed loading/unloading requirements for commercial buildings over 8,000 square feet. The effects of these planning standards are not immediate, however, because they are limited by a city’s rate of development and redevelopment and can raise development costs, but they promote long-term change in the city’s infrastructure by making it more accommodating to trucks.

Because truck emissions are determined by the distance trucks travel and the time they are idling, strategies that reduce congestion and speed up delivery times tend to reduce truck emissions. That said, many jurisdictions go further and use strategies that specifically target truck emissions. Alternative fuel vehicles have been widely promoted across America and even subsidized in Europe, but such vehicles are still a small proportion of the truck fleet. Until a much larger share of the truck fleet switches to alternative fuels, such as electricity or hydrogen, fuel efficiency and emissions standards are significantly more effective strategies. These methods do not eliminate diesel as a fuel source, but they require truck engines to burn cleaner and more efficiently. This approach is a much more manageable requirement for trucking companies, so unlike alternative fuel vehicles, it has achieved widespread adoption (Dabanc et al., 2013, p. 33).

2.2 Trucking and Traffic Congestion in Other Communities

All jurisdictions have different trucking needs and limitations based on many factors, such as population, historical factors, transportation infrastructure, local and state legislation, and budgets. That said, many jurisdictions have implemented similar solutions (Table 1) that can be used elsewhere. These approaches, however, must be tailored to local conditions. In this section, we discuss some of the approaches taken by different jurisdictions.

Table 1: Methods used by different jurisdictions to improve truck loading/unloading

City Name	Adjust loading zone prices	Clarify signs	Improve enforcement	Direct truck traffic	Encourage off-peak delivery
Washington D.C.	✓		✓	✓	
Portland, OR		✓	✓	✓	
New Orleans, LA (French Quarter)		✓		✓	
Martha's Vineyard, MA				✓	✓

2.2.1 Washington, D.C.

Washington, D.C. is much larger than Nantucket, with a daytime population of over 1,300,000, but it still faces some similar problems (Dey et al., 2019, p. 312). It lacks sufficient street-side parking, which often forces trucks to park on the side of the road, which leads to both traffic and safety concerns. There have been many attempts to manage these issues, which include increasing the number of loading zones, adjusting the pricing of loading zones, simplifying truck parking rules, and incentivizing nighttime delivery, but these approaches had limited success (Dey et al., 2019, p. 313).

The District Department of Transportation (DDOT) found that double parking was the most common infraction in loading zones, not unauthorized parking or payment violations (Figure 2). That said, all three infractions were still significant. After analyzing the data, DDOT adjusted the prices for loading zone parking and for parking violations. DDOT doubled the fee from \$50 to \$100 for unauthorized parking of cars but did not alter the fee for trucks, which only discouraged cars from using loading zones (Dey et al., 2019, p. 318). DDOT also raised the cost of using loading zones to encourage trucks to move in and out quickly. These changes reduced the amount of time spent double parking by 43%. Although these changes were effective in increasing the efficiency of loading zones, they did not entirely solve the city's truck loading/unloading problems (Dey et al., 2019, p. 323).

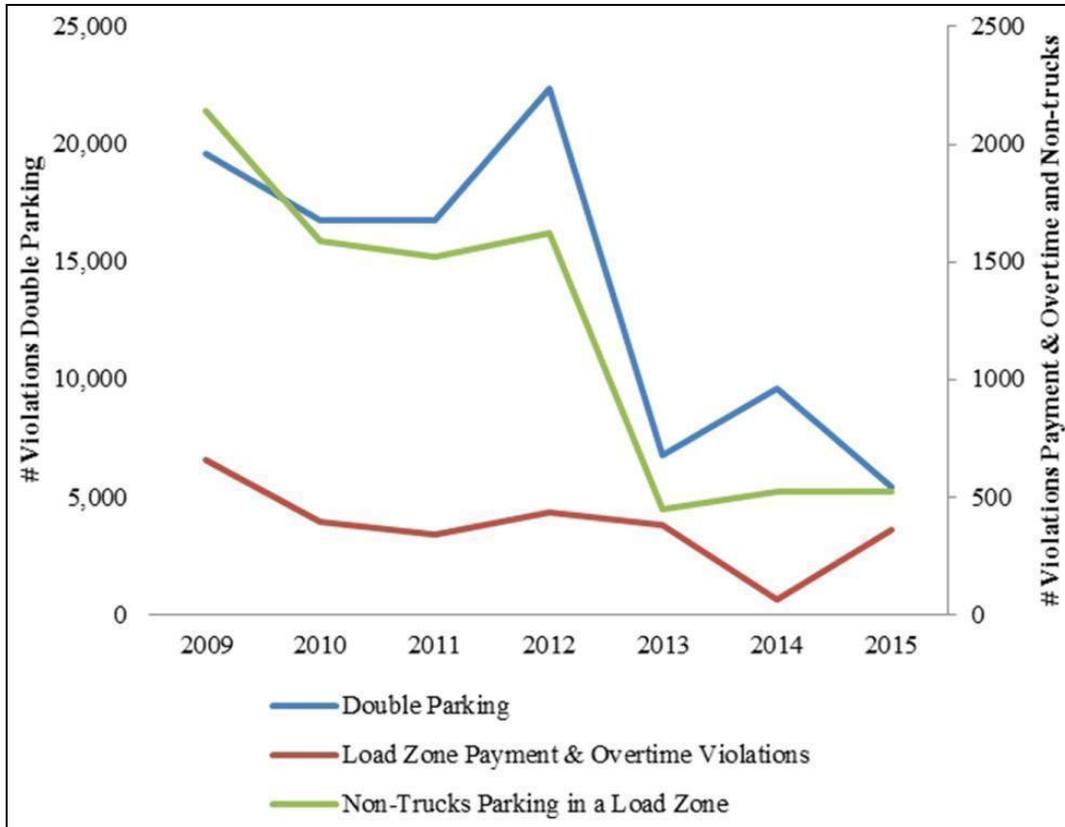


Figure 2: 2009 to 2015 Aggregate annual parking violations in Washington, D.C. (Dey et al., 2019, p. 320)

2.2.2 Portland, OR

Like Washington, D.C., Portland is considerably larger than Nantucket, but faces similar trucking issues. Also, like D.C., Portland focused on loading zones to improve its trucking system. The problem with Portland’s current system is that there is no set of standards for loading zones. They lack any official means to determine where or how to place them, and they have 44 different signage designations (Portland Bureau of Transportation, 2017, p. 1). To improve its loading zones, Portland developed six strategies (Portland Bureau of Transportation, 2017, p. 3):

1. Establish three to five standard loading zone signs to reduce confusion among drivers.
2. Maximize the use of combination zones, which provide paid parking to visitors as well as delivery vehicles. These allow Portland to add loading zones without completely removing parking.

3. Clarify loading zone signage to prevent confusion. This clarification will involve making signs less reliant on text, as shown in Figure 3 and implementing a color coded curb (Portland Truck parking and Loading Plan, 2016, p. 23).
4. Implement a 30-minute time limit in loading zones to encourage greater turnover and throughput.
5. Prevent the placement of loading zones on residential streets to reduce truck traffic in residential areas.
6. Develop an annual review process to determine the efficacy and efficiency of loading zones, and to identify where new zones may need to be placed.

Together, these six strategies are expected to significantly improve the efficiency of loading zones, which will reduce traffic congestion and safety concerns in Portland.

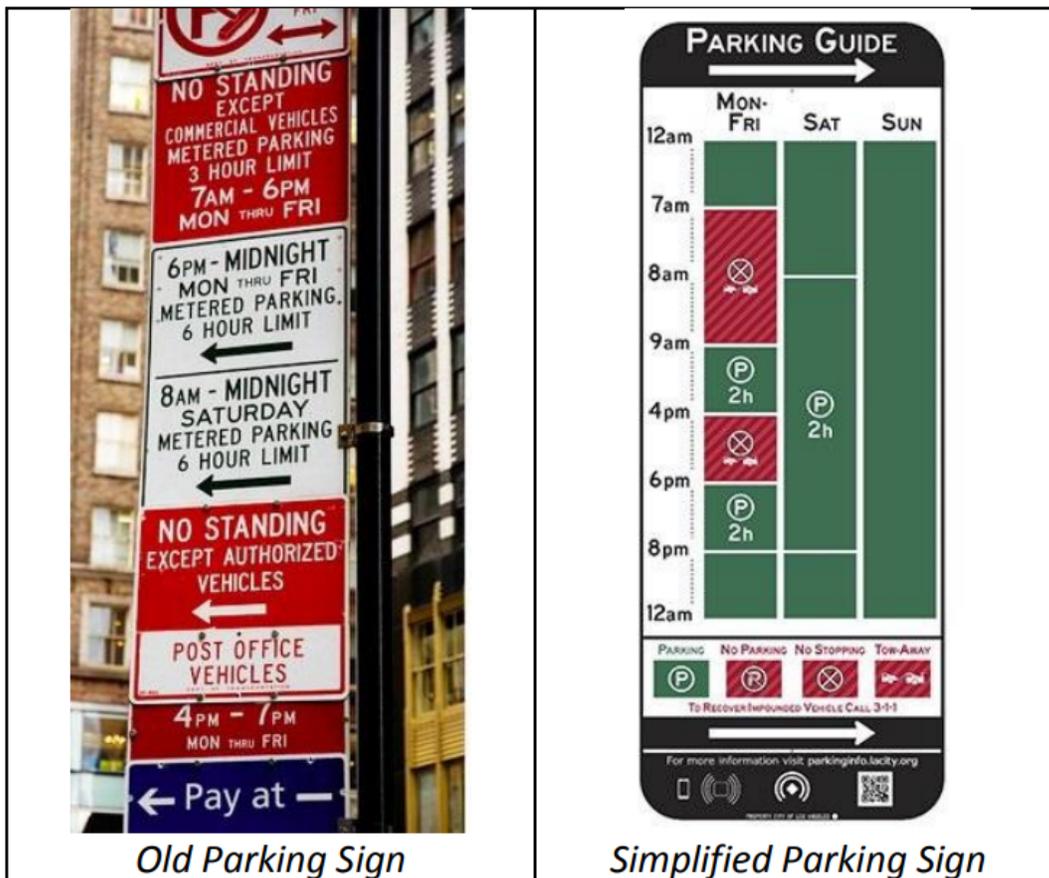


Figure 3: Old vs Simplified Parking Signs (Portland Truck Parking and Loading Plan, 2016, p.

2.2.3 The French Quarter, New Orleans, LA

The Downtown Development District of New Orleans commissioned Nelson\Nygaard and others to develop a road classification system for the French Quarter, as shown in Figure 4, to better manage truck and other traffic (Nelson\Nygaard, 2009 p. 6). This classification is based on an assessment of the number of motor vehicle lanes, on-street parking, access to major highways, and many other aspects. Each road is given one of three main classifications: travel street, community street, or a living street (Figure 5). Using this classification, New Orleans can better understand the needs and limitations of different streets, and determine where to direct traffic, including truck traffic (Nelson\Nygaard, 2009, p. 6). Like Portland, New Orleans also plans to simplify its signage by reducing text and relying more on symbols (Nelson\Nygaard, 2009, p. 23). The Mobility Study proposes improving bike lanes, sidewalks, and crosswalks to better manage pedestrian traffic that can otherwise impair the flow of vehicular traffic. The city plans to install guidance plaques to direct pedestrians to popular destinations (Nelson\Nygaard, 2009, p. 22).

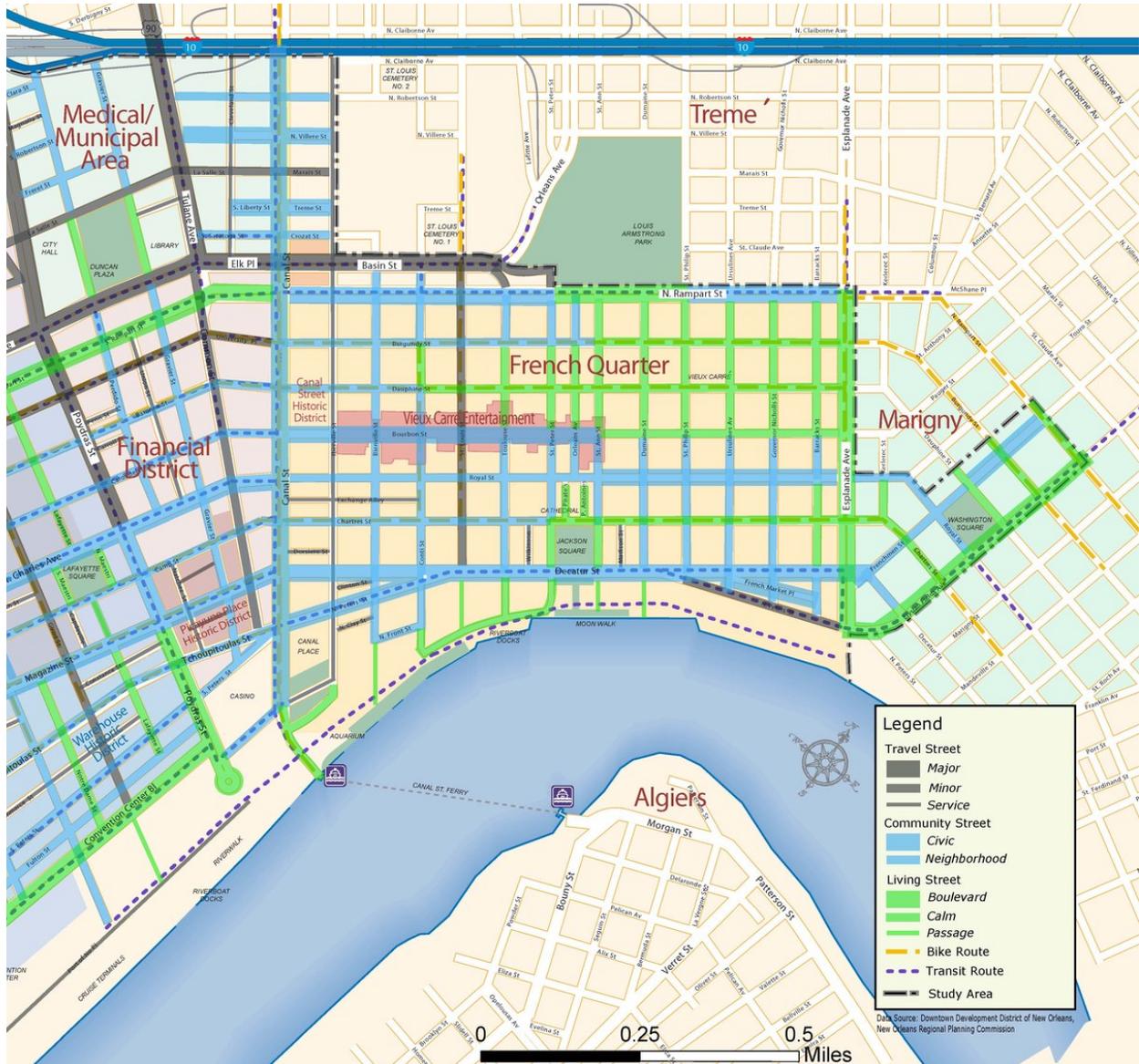


Figure 4: French Quarter road classifications (New Orleans Mobility and Parking Study Final Report, 2009, p. 6)

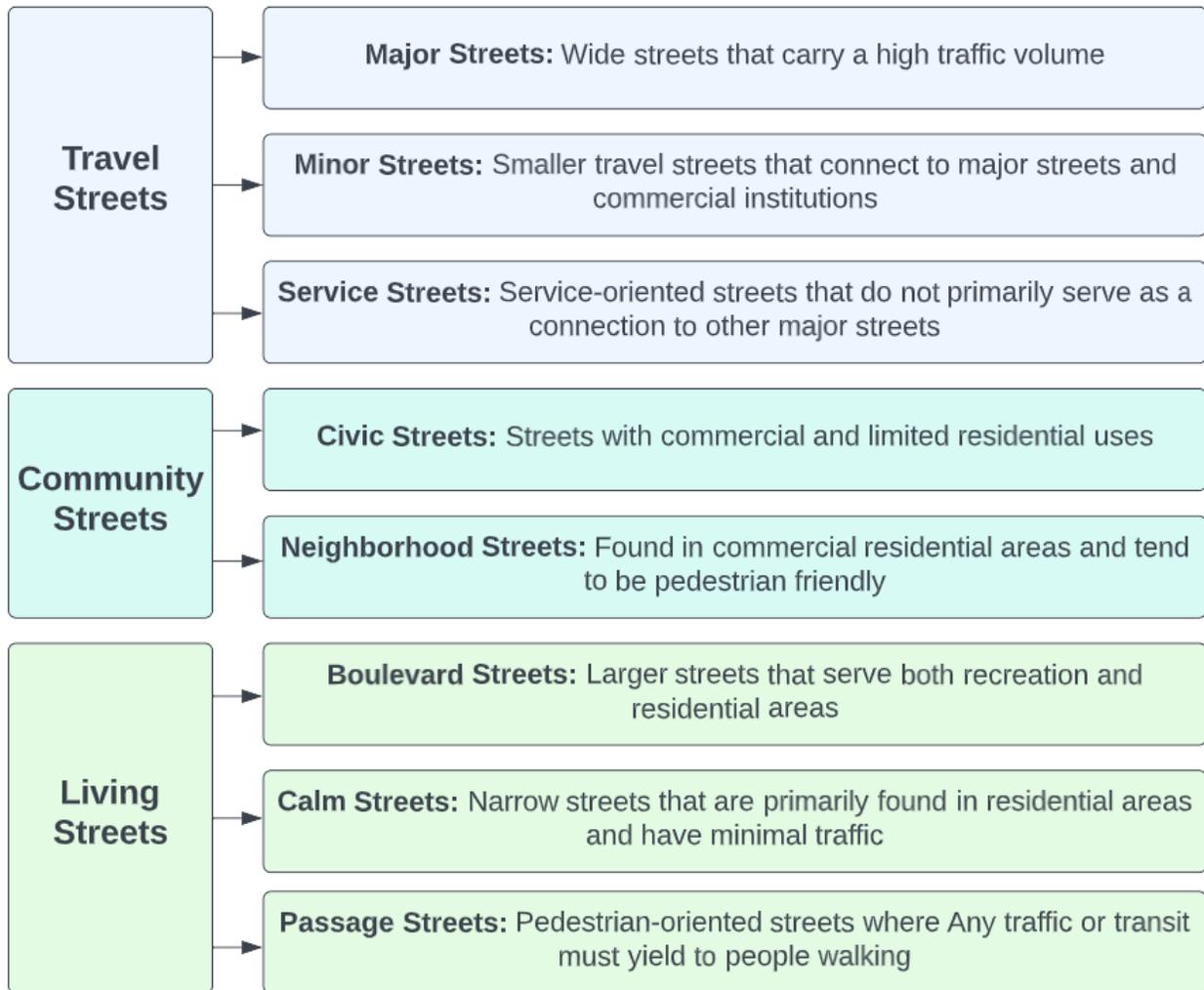


Figure 5: New Orleans French Quarter street classifications

2.2.4 Martha's Vineyard, MA

As an island resort in Massachusetts, Martha's Vineyard has many similarities to Nantucket. Like Nantucket, it is one of the 13 planning regions in Massachusetts, so it works with the same legal restrictions as Nantucket (Martha's Vineyard Commission, n.d.). Naturally, Martha's Vineyard also faces difficulties with truck loading/unloading. In addition to traffic congestion, Martha's Vineyard receives complaints about the disruption trucks cause, especially the ones that arrive on the 5:30 a.m. ferry. To address this issue, Martha's Vineyard eliminated the 5:30 a.m. freight ferry during winter and spring. That said, it could not eliminate that ferry during the summer as trucking

demand increases with the rise in population. During summer when traffic congestion is at its worst, Martha's Vineyard aims to shift the truck schedule so that it has less of an impact on prime traffic hours. Doing this encourages more trucks to arrive early in the day by offering discounts for off-peak travel and is considering adding more ferry runs (Martha's Vineyard Commission, 2019, p. 55). By increasing the number of ferry runs, fewer trucks will arrive at once, which can reduce the surge in truck traffic that occurs when a ferry arrives.

2.3 Overview of Nantucket's Unique Circumstances

While the previous case studies offered some possible solutions to the problems associated with truck loading/unloading, Nantucket has distinct circumstances to consider when devising new transportation policies. For example, Nantucket is an island, so all freight arrives and departs via ferries (or to a limited extent by air) and, while it has 300 miles of roads, only 90 miles are paved. As an island, Nantucket has limited access points to send freight year-round and changing levels of activity in the downtown and mid-island regions from season to season. In addition, efforts to preserve historic areas and improve upon multimodal transportation have created various space constrictions on roads in Nantucket.

2.3.1 Accessing Nantucket

There are two primary ways in which people and goods reach Nantucket: the Nantucket Memorial Airport and the Steamship Authority ferries. Nantucket's airport is the second busiest in Massachusetts by number of flights (Nantucket Memorial Airport, n.d.). The flights it serves, though, are regional jets, and small private and cargo planes, meaning a relatively small amount of freight moves through the airport. In June of 2022 when the volume of air freight reached its peak for the year, the airport received 173,765 pounds of freight. (Nantucket Memorial Airport, n.d.). This is about half as much freight as one of the Steamship Authority's dedicated freight ferries can carry in a single trip when fully laden, of which three are made per day; thus, the Steamship Authority delivers upwards of 200 times as much freight as is received at the Airport over the course of a year. As such, the island relies on regular trips by these ferries for

the bulk of its material needs. The Steamship Authority services the island with a fleet of high-speed passenger ferries, combined passenger and vehicle ferries, and dedicated freight ferries. Relying on vehicle ferries to deliver freight, however, means that trucks arrive in downtown Nantucket in large groups. The Steamship Authority's freight ferries, like the *M/V Katama*, carried as many as 16 trucks in one trip during the 2019 tourist season, and the passenger ferries like the *M/V Woods Hole* can carry as many as 55 vehicles of varying sizes at a time (The Steamship Authority, 2022). This means that every ferry arrival stresses the road capacity in downtown Nantucket and can sometimes even overwhelm it. At the peak of the tourist season, nine ferries arrive on the island every day, three of which are dedicated to freight (The Steamship Authority, n.d.).

2.3.2 Moving Freight on Nantucket

The trucks rolling off the ferries with destinations beyond downtown Nantucket are meant to follow the designated truck routes shown in Figure 6 to minimize the number of cargo trucks traveling on local streets. Most of the truck traffic coming to the island will follow this route, bound for the mid-island, where, as seen in Figure 7, there is a concentration of commercial activity and on-island distribution centers (Nantucket Planning & Economic Development Commission, 2019, p. 35).

For the trucks that remain in town or come from distribution centers, there are eleven loading zones to support the considerable number of deliveries required downtown. Otherwise, trucks must compete for parking space with general traffic. Trucks will also sometimes stop in travel lanes to make deliveries, as seen in Figure 8, obstructing traffic and potentially violating town regulations, such as being within one foot of the curb when stopped, being within a vehicle's width of the curb when stopped, or leaving ten feet of space unobstructed for each direction of travel (Municipal Code § 375-4).

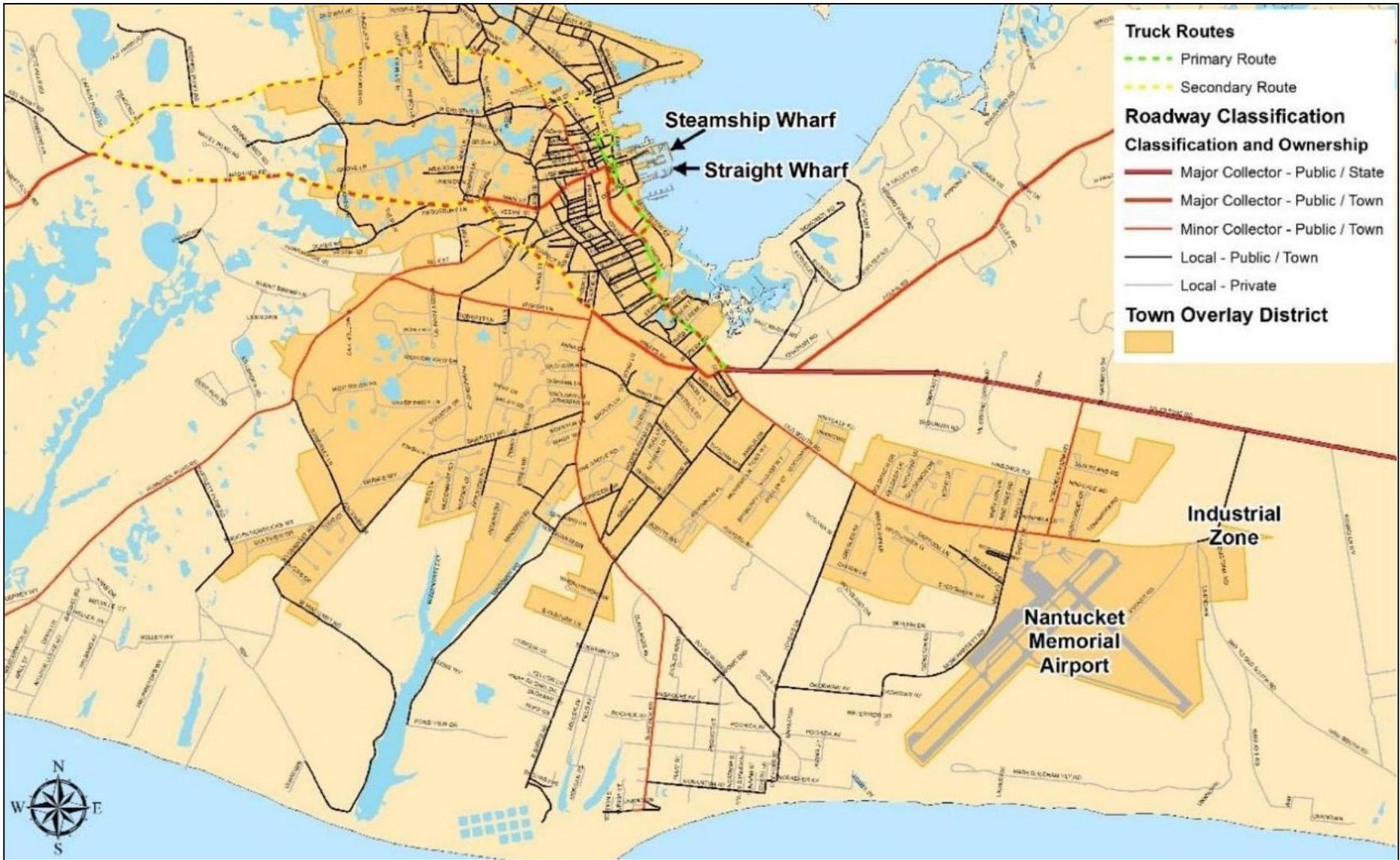


Figure 6: Designated truck routes (Nantucket Planning & Economic Development Commission, 2019, p. 47)

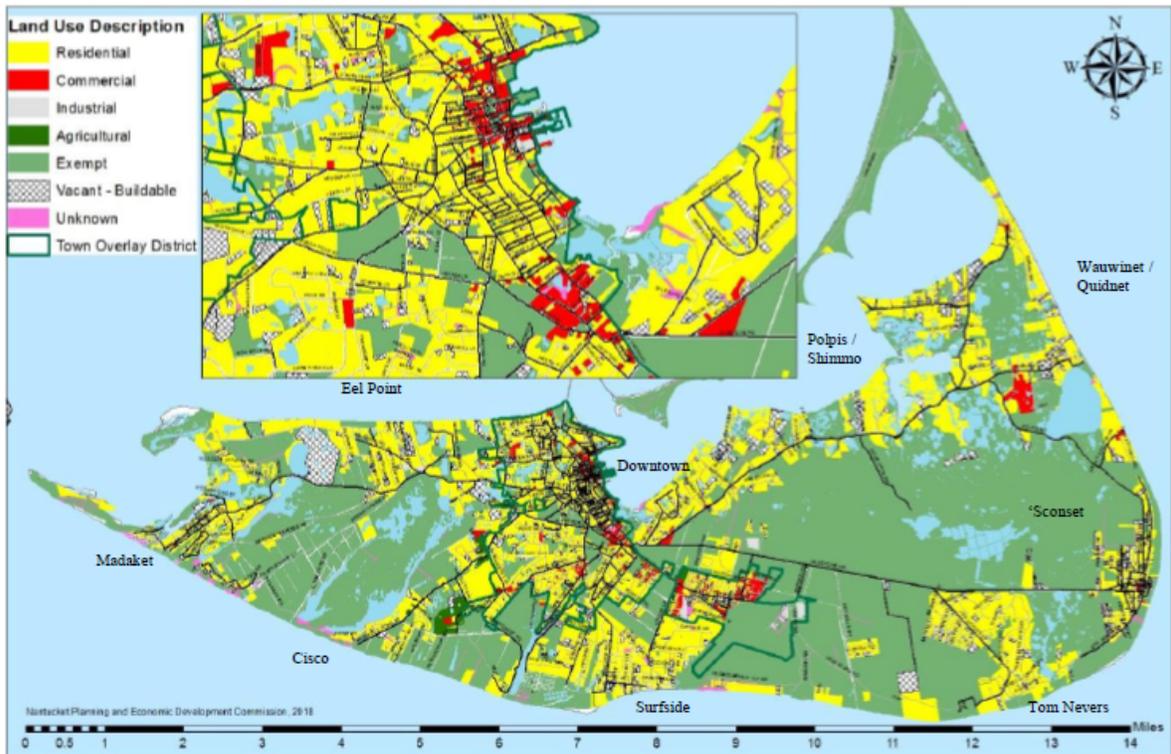


Figure 7: Land use on Nantucket (Nantucket Planning & Economic Development Commission, 2019, p. 33)



Figure 8: Truck stopped in the middle of South Water Street (Google Maps)

2.3.3 Seasonal Changes in Population and Economic Activity

As a resort community, the population and vehicular traffic in Nantucket vary enormously from winter to summer, with two “shoulder” seasons in spring and fall. According to the 2020 U.S. Census Data, Nantucket has a permanent population of 14,255, but estimates of the island’s population year-round shows that it grows from around 15,000 in the winter to more than 50,000 on peak weekends in the summer (Figure 9). This population spike during the summer overwhelms the town’s limited parking supply and fills the downtown section of Nantucket with vehicles and pedestrians. Because the ferry is the most common way for trucks to access Nantucket, a traffic jam is created when all the trucks come off the ferry. After the initial traffic jam, truck drivers face difficulties in navigating through streets filled with vehicles and pedestrians, making their task of finding a place to unload more difficult.

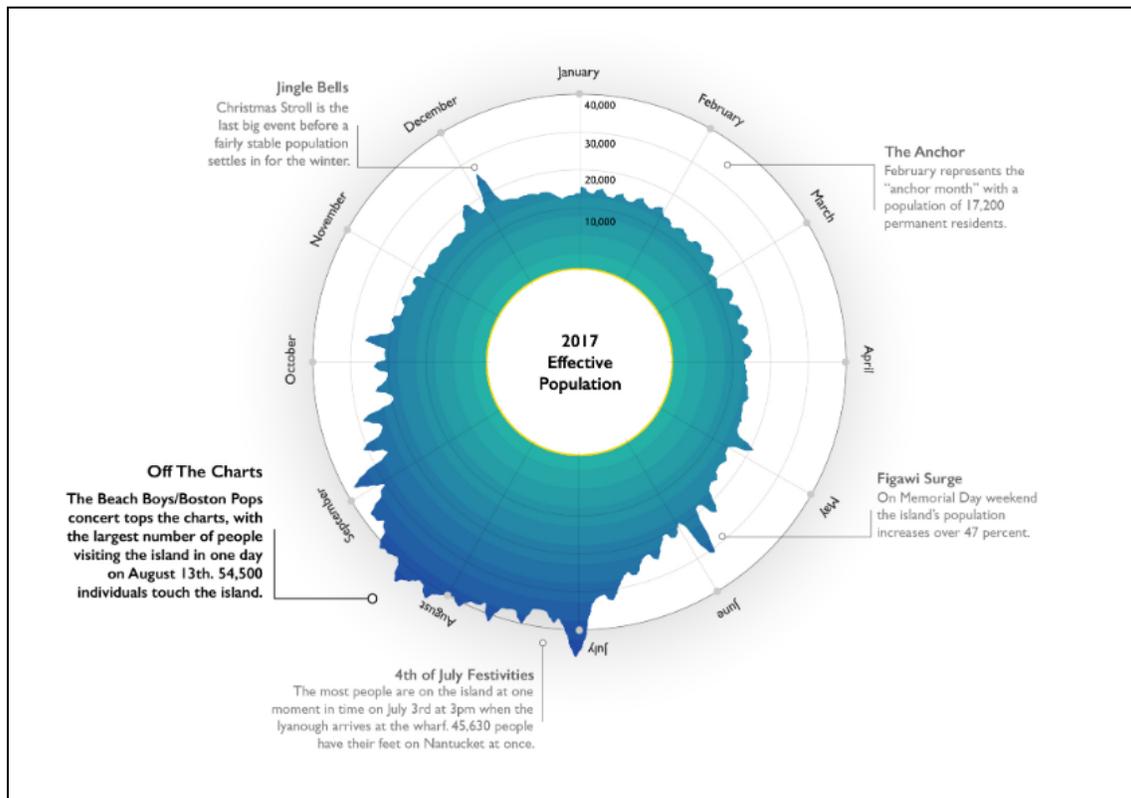


Figure 9: Year round population in Nantucket (Bremer & Armstrong, 2017)

Correlating with fluctuating populations, the economic activity of businesses on Nantucket also changes according to the season (Figure 10). There are an estimated 1,176 active businesses on the island, and a large portion of them, especially construction, retail, and restaurants (Figure 11), rely on frequent and regular deliveries from the mainland (Jasmin, Palmieri, & Tanaka, 2021, p. 27). As economic activity and demand for freight increases over the summer, an increasing number of trucks are transported to Nantucket and they exacerbate the situation described above.

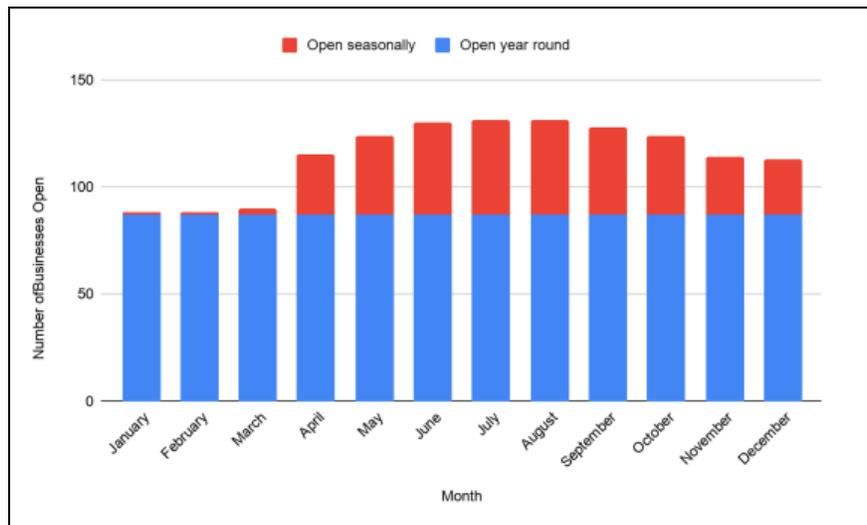


Figure 10: Number of businesses open by month (Raymond, Gold, Keklik, & Gehly, 2019, p. 22)

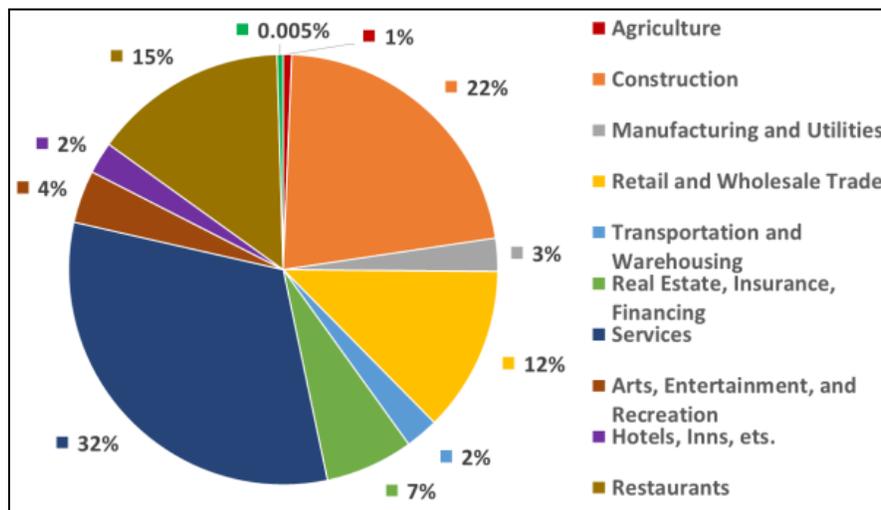


Figure 11: Breakdown of the estimated 1,176 businesses on Nantucket (Jasmin, Palmieri, & Tanaka, 2021, p. 27)

2.3.4 Other Limitations

About half a square mile (342 acres) of land on Nantucket is “utilized for commercial activities”, and most of this activity is centered on the downtown and mid-island areas (Nantucket Planning & Economic Development Commission, 2019, p. 35). The proximity of these two areas to the ferry terminal means the majority of freight movements are limited to a relatively small number of streets. With the influx of visitors and seasonal residents in the summer, streets are often overwhelmed with parked vehicles, leaving little space for trucks or other vehicles to load or unload goods, which leads trucks to stop on sidewalks, double park, and block side streets. Such practices may impede traffic flow and pose risks to other vehicles and pedestrians. The narrow streets and irregular street pattern in Nantucket’s core downtown area exacerbate these problems.

Many jurisdictions deal with spatial limitations by encouraging quick turnover of space and building more parking and loading facilities, but Nantucket is a special case due to its historic architecture and streetscapes. Many of the streets are narrow and some are preserved as cobblestone streets (Figure 12). This culture of preservation also affects the policy regarding modifications to the layout of the downtown area; there is an emphasis in “preserv[ing] the historic character of the old town of Nantucket as a whole, including its pedestrian scale as well as its close and complementary pattern” (Lang & Stout, 1992, p. 9). As a result, Nantucket transportation policy makers must devise solutions for truck loading/unloading without modifying streets to the degree that it harms the historic assets and aesthetics of the downtown area.



Figure 12: Cobblestones on India Street (Google Maps)

Another variable in existing space limitations are future projects aimed at “expand[ing] and maintain[ing] an island wide system of shared-use paths, recreational trails, and sidewalks... [in] the following areas: ferry terminals, downtown public and cultural areas, NRTA bus stops, bike paths adjacent to the downtown area, the hospital, schools, and mid-island commercial areas” (Nantucket Planning & Economic Development Commission, 2019, p. 39). Because these projects are aimed at expanding multimodal transportation, there will be an increase in shared road space and possibly further narrowing of streets; an example of this can be seen in the Easy Street sidewalk widening project (Figure 13). As a result, these future projects must also be taken into account when devising solutions for truck loading/unloading.



Figure 13: Easy Street before and after sidewalk widening (Nantucket Planning & Economic Development Commission, 2019, p. 106)

Besides spatial limitations, Nantucket also encounters limitations in internet connectivity throughout the year. In a 2016 IT assessment report, it is mentioned that the “[island’s] internet connection is supplied by Comcast via its fiber optic cable that is run under the ocean” (IT Assessment, page 12). As a result, the internet connection can be unreliable due to internet outages caused from “single points of failure” within the fiber optic cable. Because there is no secondary connection to the island for the internet, these outages affect the entire island. This constraint must be kept in mind when devising a loading/unloading solution utilizing cloud based software since the service could be down for prolonged periods of time.

2.4 Summary

Transportation policies in urban areas and historic towns provide effective ways of managing freight hauling and deliveries, especially during the final stretch of a delivery. However, the constraints on formulating transportation policy in Nantucket create difficulties in addressing issues during this stretch. Potential solutions must effectively handle congestion in the downtown area while retaining the historic character of the island. In our project, we will conduct a study on the efficiency of loading/unloading policies in Nantucket and provide recommendations for improving them.

3.0 Methods

The goal of this project was to propose strategies to alleviate the problems associated with truck loading/unloading in downtown Nantucket. We accomplished this goal through the following four project objectives:

1. Identify current practices and lessons learned in the management of truck loading/unloading in selected towns that face similar problems and constraints to Nantucket.
2. Determine the periods and locations of peak demand for loading/unloading in downtown Nantucket and identify contributing factors to curbside inefficiencies.
3. Solicit stakeholder perspectives on the causes, consequences, and solutions to the loading/unloading problems in downtown Nantucket.
4. Review and evaluate potential strategies to address truck loading and unloading problems in downtown Nantucket in consultation with the selected stakeholders

We used a mixed-methods approach that included interviews, observations, literature reviews, and analysis of existing data. As seen in Figure 14, we collected as much data as possible from a variety of sources to develop potential strategies to improve Nantucket's management of truck loading/unloading and methods to evaluate the efficacy of the strategies we recommended. We then solicited stakeholder feedback on those strategies and methods in order to refine our recommendations.

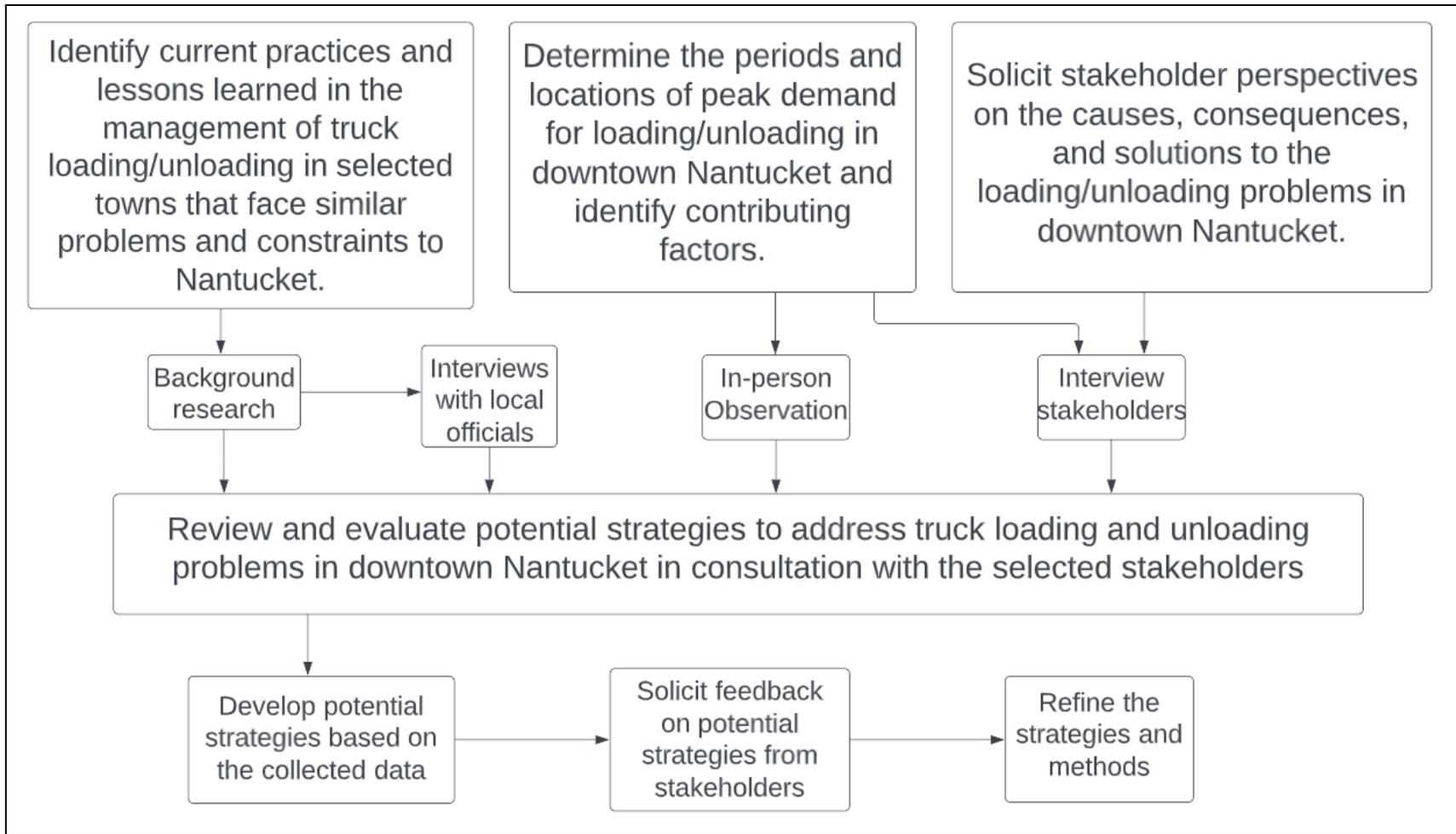


Figure 14: Project outline

3.1 Identifying Current Practices and Lessons Learned in the Management of Truck Loading/Unloading

We conducted research on freight management programs and policies, with a special emphasis on towns that either had a robust freight management program, such as Washington, D.C, or faced similar constraints to Nantucket, such as Martha's Vineyard, MA, and the French Quarter of New Orleans, LA. This background research included examining government documents and other published studies from reputable sources with the goal of finding similar truck loading/unloading problems to those found in Nantucket and the steps taken to mitigate them.

We then planned to supplement our review of the published material and 'gray literature' with interviews of local officials from other jurisdictions. We identified potential interviewees from our background research of the academic and policy literature. Five officials were contacted and we received responses from three, but only one official, from the town of Plymouth, was available for an interview. This interview was conducted virtually using a standardized list of questions (Appendix B) that we developed based on the information we learned from our background research, and in consultation with our advisors and sponsor. We adapted these questions as needed to match the expertise and experience of the interviewee. We recorded it with the permission of the interviewee and used the preamble and consent form found in Appendix A. With this interview, we gathered further information about common trucking related issues, and potential methods to address them.

3.2 Determining Periods and Areas of Peak Demand and Identify Contributing Factors

Our second objective was to determine the time periods and locations of high demand for loading/unloading trucks in the downtown area of Nantucket. We identified three main tasks for this objective: analyze existing data, conduct interviews with stakeholders knowledgeable in truck movements downtown, and make in-field observations. For our data analysis, we had access to several data sets, including maps of loading zones from the Nantucket GIS datasets, data on truck traffic on the

Steamship ferries, and maps of sign placement on the island. Analyzing these data sets helped us to develop our interview questions and to refine our observation strategies. These two tasks further refined each other through new information we learned from aforesaid stakeholders and in-field observations.

3.2.1 Data Analysis

Our first step in determining contributing factors to the timing and location of peak demand was to analyze databases on truck loading/unloading and their movement. We used ArcGIS to map out loading zones in the downtown district, and reviewed past data from the Steamship Authority on ferry trips to the island. Our primary focus in analyzing these resources was to become familiar with loading zones and time periods with high volumes of freight traffic.

3.2.2 Interviews

To obtain additional information about peak periods and locations, we conducted interviews with local individuals who have knowledge of where and when trucks park to load/unload material. The interview process was similar to the one outlined in section 3.1. We interviewed representatives of the following groups and organizations:

- Freight carriers;
- Business owners and managers;
- The Nantucket Police Department;
- The Steamship Authority; and,
- The Nantucket Traffic Safety Work Group.

Interview questions are presented in Appendix C. Our interviews with the Police Department focused on the period and location of trucks loading and unloading in the downtown area. For businesses, we created a questionnaire for collecting information on freight delivery times and the number of deliveries they receive per week. We visited businesses in the core downtown district and distributed this questionnaire while collecting anecdotes about peak-season activity and frustrations. Some of the business employees and managers also indicated certain areas on the curbside that could be used as loading zones. For the Steamship Authority, we concentrated our interview on

clarifying our key for interpreting the ferry data, the impact of the recently purchased vessels, and the reservation system for all vehicles.

3.2.3 Observations

In addition to the interviews, we carried out systematic observations of current curbside utilization, including loading zones, in the downtown area. These observations were conducted in three stages: defining the study area, creating a database of loading zones, and noting potential areas for change. Initially, our third stage was focused on monitoring freight movements and loading/unloading hotspots using a camera drone; however, we learned through our interviews that many of the problems associated with freight movement and loading/unloading hotspots are apparent only during the peak season. In addition, the weather conditions on the island made drone observations difficult and the data provided from the drone was not substantial enough to warrant continuing drone flights. We tried to remedy this through recording the video feed of the Nantucket Harbor Camera on top of the whaling museum, but the feed did not add any additional useful data.

In our first stage of observations, we determined the geographic boundaries for our study area and updated our information on loading zones in Nantucket to create our own database and map. We used the commercial parking area from the parking district map (Appendix D) as our initial study area, but after consulting our sponsor and reviewing the data we collected from existing databases, preliminary interviews, and town documents (such as studies and freight routes), we adjusted the area to only include the core district outlined in yellow in Appendix D. After defining our study area, we compiled a list and map of loading zones from the town GIS database and systematically surveyed our study area to corroborate the location of loading zones. We anticipated that some loading zones were missing from the town database while others appeared in the town GIS records but are no longer present. Each loading zone was photographed and information about the loading zone size, surface material, general condition, type of street (e.g., cobbled, single lane, two-lane, etc.), and any obstacles hindering access were recorded. We used an observation form (Appendix E) to organize our observations. Based on these observations, we created the most

up-to-date loading-zone database for our study area, which was later visualized as a map. Finally, we observed how the rest of the curbside is utilized in the downtown district and noted changes that might alleviate congestion and/or enhance truck loading and unloading. This action was prompted after talking to businesses and other interviewees who noted areas that typically are problematic and the improvements they would recommend.

3.3 Soliciting Stakeholder Opinions

Our third objective was to solicit stakeholder perspectives on the causes, consequences, and potential solutions to the loading/unloading problems in downtown Nantucket. The primary way we achieved this objective was to interview stakeholders, such as the Nantucket Police Department, the Nantucket Island Chamber of Commerce, members from the Traffic Safety Work Group, local business owners and managers, and the truck drivers themselves. When looking for the initial set of potential stakeholders, we used information we found from reports on similar issues in Nantucket, a list of people suggested by our sponsor, and individuals identified from other research we conducted on the island. Part of that research examined issues facing businesses in close proximity to loading zones. Many business owners have a keen sense of the effects of truck congestion over time and have given first-hand accounts of how truck loading/unloading affects the surrounding space. Using a version of the GIS map that was created by the town and updated by us, we conducted in-person interviews with owners and managers of these nearby businesses. For truck drivers, the approach was more *ad hoc*: we talked to any driver who was waiting to load their truck at Steamboat Wharf and who was willing to be interviewed.

We chose these stakeholders as they either have personal experience and opinions about the congestion caused by trucks, or are directly affected by that congestion in the downtown area. The patrol officer for the downtown area works for the Nantucket Police Department and is in charge of enforcing illegal parking and considers the safety concerns that truck congestion poses. Business owners rely on deliveries to keep their business stocked, but also want parking and road space available for customers. Members from the Traffic Safety Work Group focus on improving the streets

in Nantucket through addressing traffic safety related issues, so they have insight into which areas receive the most complaints and what requests come in from locals. These interviews were conducted both in person and virtually using Zoom or on the phone. The questions for each interview have a section that was asked to the interviewee regardless of their position, as well as a section that had specific questions that directly relate to their work (Appendix B) . These questions were asked to gauge the opinions and frustrations of truck loading/unloading in downtown Nantucket. In addition to talking to business owners in person, we worked with the Nantucket Island Chamber of Commerce to create a short questionnaire for business owners that was aimed at reaching more people in a shorter time frame. This questionnaire is presented in Appendix F. The responses from both the interviews and the questionnaire were added to a database of common answers from which they were coded, sorted, and weighed by the frequency of each answer. The data also allowed us to determine commonly viewed problems of truck loading/unloading and shift our focus to looking at how to reduce those specific areas of the loading/unloading process that a truck driver typically does during a delivery.

3.4 Propose Strategies to Address Problems in Truck Loading and Unloading

Using the findings we gathered through objectives 1-3, we developed several potential strategies to reduce the negative effects that loading and unloading trucks have on downtown Nantucket. We began by drawing conclusions based on the data we collected to determine the sources of issues faced by truck drivers, as well as the issues that they cause. We then developed one or more recommendations to address each conclusion based on suggestions from stakeholders and on our own findings. Finally, our key stakeholders (Patrick Reed, Nat Lowell, Ray Sylvia, and Officer Jerry Mack) reviewed these recommendations, and, using their feedback, we refined them to bring forward to the town of Nantucket.

4.0 Findings

In this chapter, we present the findings from our interviews, observations, and review of archival data. We begin by summarizing the general flow of trucks on the island, before examining the locations and limitations of existing loading zones in the downtown commercial district. The final section highlights the major factors that inhibit efficient truck loading and unloading in downtown Nantucket.

4.1 Truck Traffic Flow to and from Downtown Nantucket

At the peak of Nantucket's tourist season in July and August, the Steamship Authority makes three dedicated freight trips to the island per day, arriving at 7:45 a.m., 1:00 p.m., and 6:30 p.m. Trucks carrying hazardous materials, such as tankers, can only travel on the first two freight trips of the day (The Steamship Authority, n.d.). In a typical trip, a freight ferry will carry eight tractor-trailers and three box trucks. In addition to the designated freight trips, a significant number of cargo trucks also cross to Nantucket on passenger vehicle ferries. Across all ferry trips, an average of 68 trucks come to the island in a day at the height of tourist season in July, peaking at as many as 88 trucks. Even in February, the ferries average 51 trucks every day (The Steamship Authority, 2022). The intense demand for freight on the island year-round means freight carriers, such as Cape Cod Express, make their reservations for a place on the ferry up to six months in advance and pay a 10% deposit up front (Bill Hoss, Cape Cod Express, 11/16/2022). By necessity, tanker trucks arrive on the first ferry of the day, which forces most of the remaining trucks onto the later ferries (The Steamship Authority, 2021). Thus, most of the 'ordinary' delivery trucks arrive when the streets are already packed with cars and pedestrians.

The trucks on the ferries can be placed in three general groups: those with freight that have destinations out of downtown, those bound for on-island distribution centers, and those that deliver to businesses downtown straight off the ferry.

Trucks headed to businesses or distribution centers out of town follow the designated truck route to the best of their ability (Figure 15). This is normally a smooth process, but drivers new to Nantucket have, on rare occasions, missed the turn onto

South Water Street and instead driven the wrong way up Broad Street, causing significant disruption while correcting their mistake (Harvey Young, Young's Bicycle Shop, 11/17/2022).

Those hauling goods like fuel or landscaping supplies destined for delivery to businesses outside downtown (such as the airport, Stop & Shop, Marine Home Center, Island Lumber) typically spend very little time on roads downtown. Most of their time is spent waiting in the truck alley at Steamboat Wharf or outside of downtown making deliveries, and as such, they contribute little to traffic congestion. Landscaping materials, lumber supplies, and oversize shipments (e.g., prefabricated trailer homes), however, often come on large highway trucks which emphasize endurance over maneuverability, and may require special guidance through the downtown (Harvey Young, Young's Bicycle Shop, 11/17/2022).

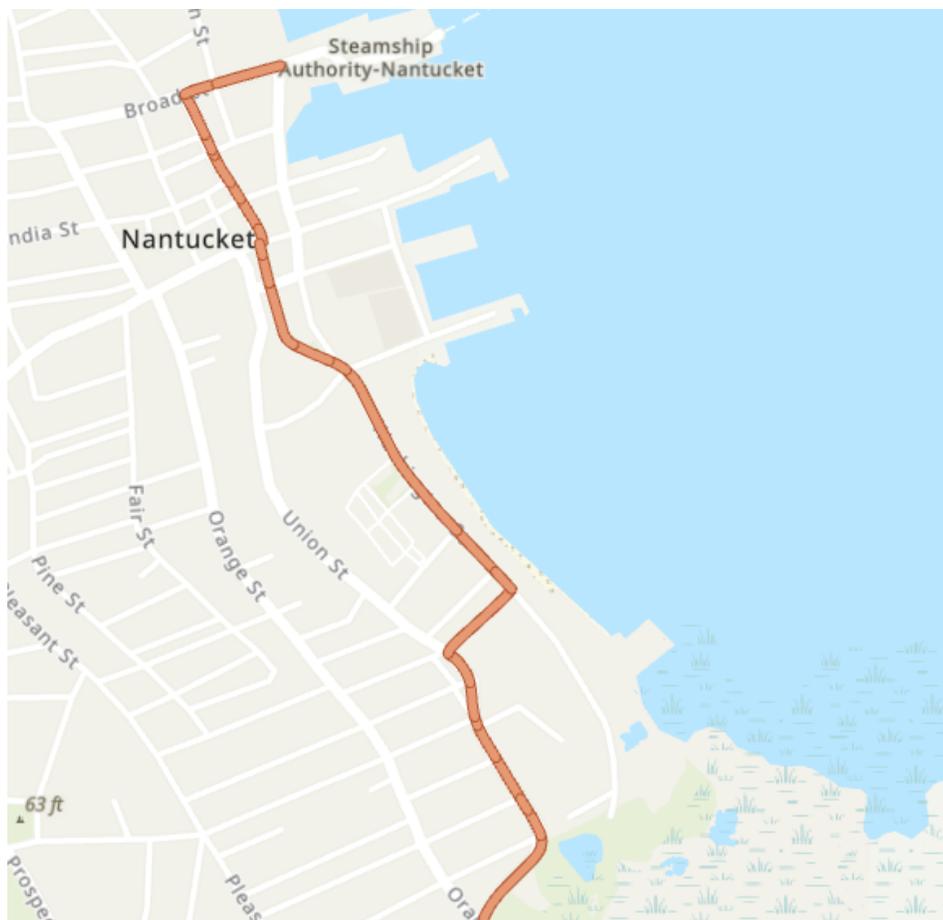


Figure 15: Truck route out of downtown

The other group of trucks that must make their way out of town from the ferry are those belonging to companies like Cape Cod Express, UPS, and FedEx, with distribution warehouses in mid-island, typically near the airport. These companies will put large box trucks and semi-trucks with 53-foot trailers on the ferry. The freight on these trucks will be unloaded at the distribution centers and reloaded onto smaller box trucks along with the small amount of freight that comes through the airport for delivery across the island, including downtown. During the peak summer season, most truck drivers prepare for a 45 minute drive just to reach downtown from the mid-island distribution centers and consider 30 minutes the fastest they can expect. Cape Cod Express is the largest freight distributor to downtown Nantucket. The company usually brings sixteen 53-foot trailers to the island every day during the peak of the tourist season, and uses a fleet of box trucks to deliver locally. Cape Cod Express typically sends eight box trucks downtown over the course of the day in summer, with up to four trucks making deliveries downtown simultaneously (Bill Hoss, Cape Cod Express, 11/16/2022).

The final group of trucks carried by the ferry includes those belonging to companies like US Foods and Sysco, which make deliveries downtown without an on-island distribution center, instead delivering directly from the trucks that arrive on the ferry. These companies typically use larger box trucks or semis with smaller “pup” trailers of less than 30 feet in length, which can be maneuvered in confined spaces like Nantucket’s downtown when combined with a short tractor to make a “pup truck” (Heavy Equipment Transport, n.d.).

4.2 Delivering in Downtown Nantucket

Although trucks face difficulties getting from mid-island distribution centers to downtown, especially in the summer, most of their problems begin once they reach the core downtown district. When making deliveries, truck drivers must budget time spent dealing with traffic congestion, searching for an open loading zone, and unloading and making deliveries by foot to the final destination. Time spent on these three tasks can be greatly increased if personal vehicles are illegally parked in loading zones or if trucks park in loading zones when not actually making deliveries. As a result, truck drivers

often struggle to find loading zones from which to make their deliveries, leading them to double park, which blocks traffic and adds to congestion.

Through our survey for businesses, we found that 84% of businesses receive deliveries in the 9:00 - 11:30 a.m. time periods (Figure 16). Many businesses also received deliveries between 11:30 a.m. and 5:30 p.m., but only 6 out of 49 businesses received deliveries before 9:00 a.m. and none of them received deliveries after 5:30 p.m. These data imply that the demand for freight delivery is highest from 9:00 to 11:00 a.m. and that by 5:30 p.m., most businesses stop receiving deliveries. We also observed that 17 out of 49 businesses closed in the winter, and the rest had a significant drop in deliveries, as shown in Figure 17, which corresponds with the reduction in trucks arriving on the ferries during winter. It is important to note, however, that only businesses that were still open after Thanksgiving answered our survey, so there are likely more businesses that close for the winter than we observed.

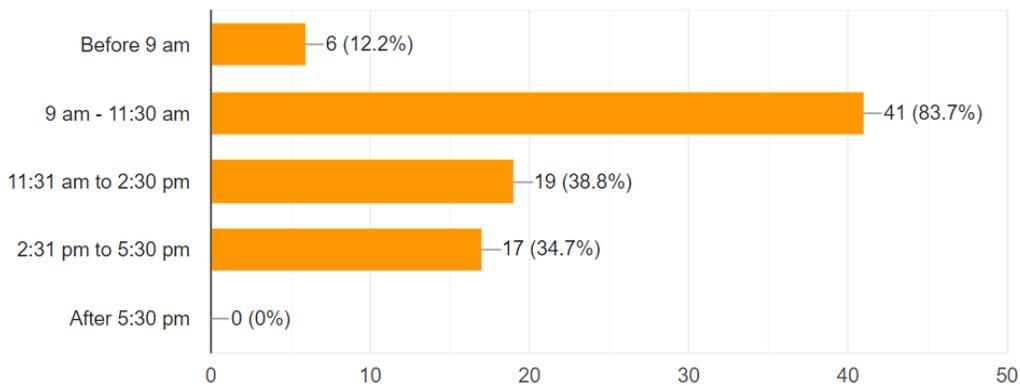


Figure 16: Times when businesses receive deliveries (n = 49)

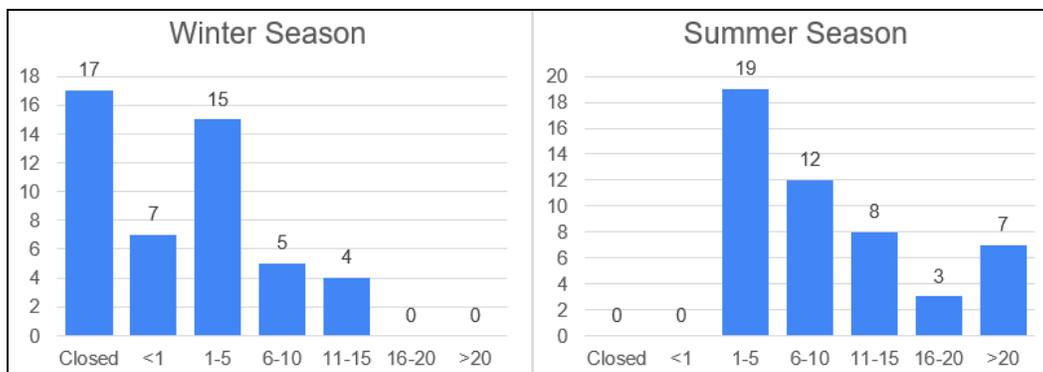


Figure 17: Number of deliveries businesses receive per week in a given season (n = 49)

4.2.1 Loading Zones

We reviewed the existing loading-zone layer from the Town GIS map and updated it based on our observations of the current layout of loading zones (Figure 18). We also collected additional information on each zone, including substrate, size, and signage (Table 2).

Downtown Nantucket has 11 loading zones, each of which has a designated period for loading and unloading; outside that period each zone can be used for general parking. Most loading periods are 8:00 a.m. to 4:00 p.m. or 8:00 a.m. to 12:00 p.m., but there are exceptions. Nat Lowell, a longtime NP&EDC Member, calls the 8:00 a.m. to 12:00 p.m. loading zones 'short-term' loading zones. They are designed to provide parking to trucks in the morning but change to regular parking spots in the afternoon when people are getting lunch and demand for passenger vehicle parking rises. Six of the 11 loading zones switch to parking at 4:00 p.m., but truckers from Cape Cod Express indicated that this is too early and that they need loading zones until 6:00 p.m. to complete their deliveries. Truckers also explained that the time they spend in a loading zone varies greatly depending on the size of their delivery. It can be just a few minutes, but if they have a large delivery and a long walk to the delivery location, they can spend as much as an hour in a loading zone. When making these deliveries, truckers typically have a dolly to cart freight to its delivery location. Seven of the loading zones are on asphalt, which is easy for truckers to cart freight over, but the remaining four are on cobblestone. In these loading zones, truckers try to lower their ramp on the brick crosswalk, which provides a smooth surface over the cobblestone road and allows truck drivers to cart freight comfortably.

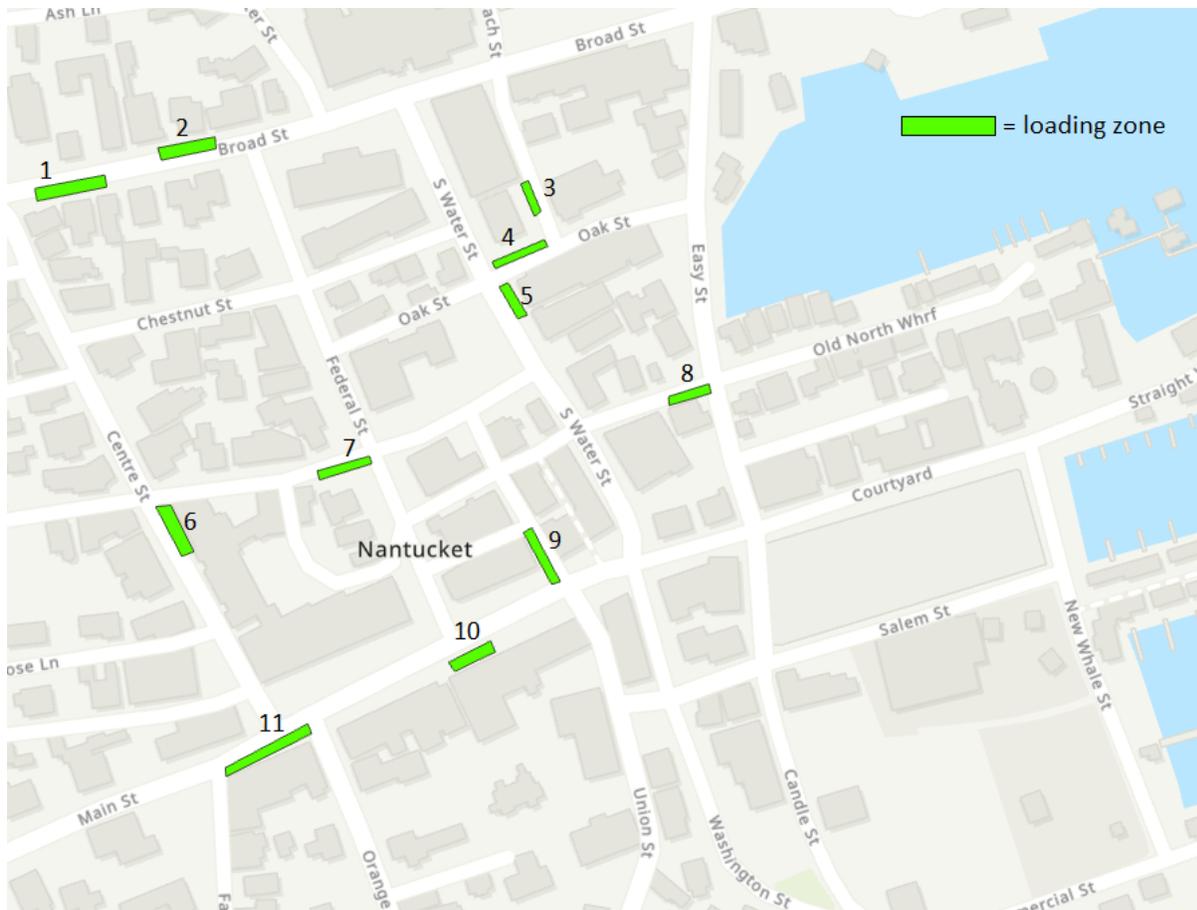


Figure 18: Loading zones in the downtown area of Nantucket

Table 2: Loading zone characteristics

Loading Zone	Road Surface	Start Time	End Time	Loading Zone on Sundays	Length
1	Asphalt	8:00 AM	4:00 PM	No	35 ft
2	Asphalt	8:00 AM	12:00 PM	No	40 ft
3	Asphalt	8:00 AM	4:00 PM	No	32 ft
4	Asphalt	8:00 AM	2:00 PM	Yes	44 ft
5	Asphalt	8:00 AM	5:00 PM	No	45 ft
6	Asphalt	8:00 AM	4:00 PM	Yes	38 ft
7	Cobblestone	8:00 AM	4:00 PM	No	61 ft
8	Asphalt	8:00 AM	4:00 PM	No	42 ft
9	Cobblestone	8:00 AM	4:00 PM	No	50 ft
10	Cobblestone	6:00 AM	11:00 AM	No	44 ft
11	Cobblestone	N/A	N/A	Yes	55 ft

4.2.2 Issues with Loading Zones

Box trucks come in a range of sizes and can use all of the available loading zones. The largest trucks, the so-called pup trucks, require 48 ft of space to unload with their ramp down. Unfortunately, most of the loading zones are not long enough to accommodate these large trucks. Most loading zones are designated by two signs, one at each end. Additionally, the loading zones that are on asphalt have a white outline on the road to designate their boundaries. Zones 7, 9, 10, and 11 are on cobblestones, however, and lack markings on the ground. Furthermore, Zones 9 and 11 are each marked by a single sign, which makes their boundaries very unclear. Their actual boundaries extend to the end of the block that they are located on, but there is no way for truck drivers and other drivers to know that. Compounding these issues, the sign at Zone 11 does not designate times for loading versus parking, which means that even after business hours, this zone cannot be legally used for parking.

Zone 8 on Cambridge Street is often blocked in by the curbing at Easy Street and vehicles parked behind it (Figure 19). This blockage forces trucks to drive onto the curb to park which discourages truck drivers from using this loading zone and makes the sidewalk unsafe for pedestrians. Cambridge Street has sidewalks and parking on both sides and the junction with Easy Street is especially busy since Easy Street is the main truck route to the Steamship ferries. These factors make it even more difficult for trucks to maneuver into the loading zone. Zone 7 on the corner of India and Federal Street is positioned near many businesses, and long enough for the largest trucks that deliver downtown. Unfortunately, this section of India Street is cobbled and there is no brick crosswalk to ease offloading with dollies or hand trucks. Consequently, some truckers back in at an angle to lower their ramp partly on the sidewalk, so it is easier to offload deliveries. This practice has placed tire marks on the sidewalk as shown in Figure 20. Additionally, we heard that occasionally, when trucks use this loading zone, they do not pull all the way into it and block Independence Lane. Zone 5 on the corner of South Water and Oak Street is positioned well for easy unloading, but at 45 feet it is too short. When the largest (i.e., 48') trucks use it, they either block the crosswalk when they lower their ramp, or they take up part of the ADA accessible parking space in front of it (Figure 21). Zone 4 is also positioned near many businesses, but Jerry Mack

(Nantucket Police Department, 11/14/2022) reported that personal vehicles often park in that spot, which forces truck drivers to double park. The truck drivers we interviewed indicated that New Whale Street between Main Street and Commercial Street needs a loading zone since it is a very busy part of the commercial district being near numerous retailers and restaurants on Straight Wharf. Currently truckers just park in the street and get ticketed there, but they have no convenient alternative parking spot, so they treat the tickets as simply the cost of doing business. They claim that a loading zone would significantly reduce such illegal parking.

Because of these various issues, the current loading zones are not used to their full extent. From our survey, only 30% of businesses reported that trucks typically use a loading zone while 45% of businesses reported that trucks typically park on the street. That said, many businesses said that truck drivers make sure to park out of the way to impede traffic as little as possible. These businesses also confirmed that vehicles often park illegally in loading zones and take these spaces away from trucks.



Figure 19: Zone 8



Figure 20: Marks on India St.



Figure 21: Truck parked in both zone 5 and ADA accessible parking

4.2.3 Factors that Lead to Inefficiencies in Loading/Unloading

From our interviews with our stakeholders, we have determined several factors that contribute to freight delivery inefficiencies in the downtown area. First, there is an issue with personal vehicles illegally parked in loading zones. Usually, noncommercial vehicles are fined \$50 for parking in loading zones (Officer Jerry Mack, Nantucket

Police Department, 11/14/2022). Such fines do not sufficiently deter tourists and residents from parking in loading zones (Figure 22) since the cost of a ticket is a fraction of the cost of a typical restaurant meal which is less than the parking fees in most metropolitan areas (Table 3) (Bill Hoss, Cape Cod Express, 11/16/2022).

In addition to people who intentionally park illegally in loading zones, there are also ways in which drivers inadvertently park illegally. NPD Officer Mack believes that the combined loading zone and parking signs are often misinterpreted by noncommercial drivers who read the word ‘parking’ but ignore the time designations (Figure 23). Currently, the town does not hire a towing company to remove vehicles from loading zones so the space remains occupied until the owner returns for their vehicle. Several of our interviewees noted that a lot of space in the core district would have higher turnover rates if the fine for exceeding the parking time limit was increased.

Table 3: Parking in loading zone fines

Jurisdiction	Fine Amount
Nantucket, MA	\$50 ¹
Boston, MA	\$90 (\$120 if paid after 21 days) ²
New Orleans, LA	\$40 ³
Portland, OR	\$95 ⁴
Washington, D.C.	\$100 ⁵

¹ Officer Jerry Mack

² City of Boston, (2016)

³ City of New Orleans, (n.d)

⁴ Portland.gov, (n.d)

⁵ District of Columbia, (n.d)



Figure 22: Illegally parked vehicle in a loading zone



Figure 23: Combined loading zone and parking sign

Traffic congestion during the peak season is another factor that inhibits truck deliveries. All of our interviewees agreed that the traffic in the core district of downtown almost creates a gridlock, which frustrates most truck drivers. This frustration is made worse by the fact that Nantucket is an island, so truck drivers need to complete their deliveries on time to return to the ferry. Because these truck drivers have to deliver their cargo quickly, they do not have a lot of time to search for open loading zones. As a result, some truck drivers lose their patience and start unloading from the middle of the street, which creates more congestion for other drivers (Figure 24). In their defense, drivers will often cite the Interstate Commerce Commission to support their claim that they have 15 minutes to stop their vehicle in the public way to unload goods. The provision for this practice, however, is granted by the vaguely worded section B(2) of chapter 375-6 in Nantucket's Municipal Code, which reads:

B. No driver shall park any vehicle on any public way, or parts thereof, on any day, during the hours or days indicated, where parking is restricted or prohibited, provided that these rules and regulations shall not apply to:

(2) Commercial vehicles, as defined in § 375-1 of these rules and regulations, stopped for no more than 15 minutes, unless otherwise posted, for the loading or unloading of materials.

The police interpret this section of the code to mean that truckers can stop their vehicles for 15 minutes to unload their goods provided they are not blocking traffic as defined in chapter 375-4. Unfortunately, as seen in Figure 24, trucks often block traffic while they unload.



Figure 24: Truck blocking Oak Street (Officer Jerry Mack, Nantucket Police Department)

The last factor contributing to inefficiencies in truck deliveries is how curbside space is managed in some parts of downtown. In the past few years, the traffic patterns in the core district have been changing to better accommodate car traffic; however, the placement of curbside markings and structures were not reconsidered to maximize the amount of space for parking and freight delivery. Nat Lowell pointed us to several areas where fire hydrants and yellow lines block spaces that could be used as loading zones, such as the one on Federal Street (Figure 25). He mentioned that moving hydrants to nearby spots on the curbside where parking is already prohibited and shortening some of the extended yellow lines would open up more space for new loading zones.



Figure 25: Example of a movable fire hydrant and yellow line on Federal Street

While researching these inefficiencies, we found that the town of Nantucket has no dedicated liaison for the trucking companies to contact. Currently, the operations administrator, Erika Mooney, sends out communications to them via email to notify them about road closures and shifts in the traffic pattern. Although these trucking companies

receive these emails, we found that they do not know who to contact in the town administration to voice their concerns or requests.

4.3 Issues Caused by Trucking

When trucks need to deliver to the downtown area, they will (depending on the patience of the driver) circle around downtown several times to find a loading zone before the truck driver decides that they need to deliver the goods by any means necessary. This practice often results in truck drivers parking in a spot that blocks part of the road, reducing traffic flow (Figure 26).



Figure 26: A pup truck parked in a space reserved for official town vehicles only

It is technically legal to park this way as long as traffic can get around the truck, and the truck does not stay for more than 15 minutes, but it still impedes traffic. Some truckers however block the entire road when they are unable to find a better spot. Blocking the

road is illegal and trucks will get tickets, but most companies consider this ticket part of the cost of doing business on Nantucket. Individuals from the Nantucket Police Department mentioned that the truck drivers who have been delivering to Nantucket for a long time are more patient when waiting for a loading zone, and the newer ones are less patient and more likely to park illegally. Some of these younger drivers even argue with the police when they get ticketed. This behavior is problematic for the traffic and pedestrian flow in the downtown area, whether it is because the truck prevents other vehicles from passing (Figure 27), the truck covers a crosswalk, or even the truck narrows a turn by parking too close to a corner of the sidewalk (Figure 26).



Figure 27: A truck parked the middle federal street, blocking traffic

One primary example where illegal truck parking occurs frequently is Independence Lane. While there is a loading zone on India Street (zone 7 on Figure 28), long freight trucks park close to the entrance of Independence Lane from Federal Street (zone 13 on Figure 28) to make a lot of deliveries despite signs denoting that it is a fire lane and the slightly less visible yellow lines painted on both sides of the road (Figure 29).

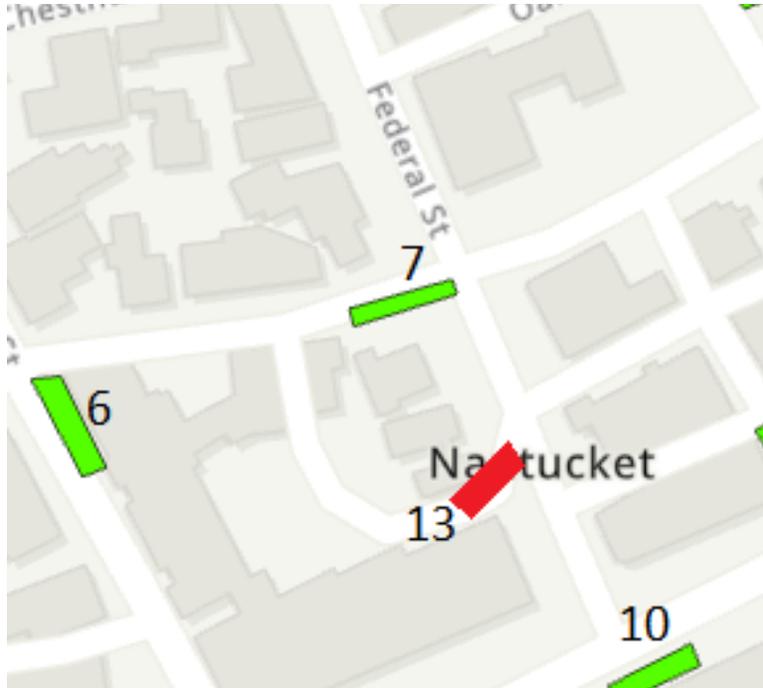


Figure 28: Map of downtown Nantucket with loading zones and points of interest



Figure 29: A refrigerated box truck parked in Independence Lane

Trucks that park in Independence Lane to deliver goods block access to and from the employee parking area in the rear of the buildings. During the tourist season, this problem becomes worse as the freight trucks that park there are sometimes unable to leave for long periods of time due to passenger vehicles parked on Federal Street and India Street.

Although numerous drivers do park legally in loading zones, the loading zone itself can cause additional challenges. For example, in Figure 21, a truck is parked in a loading zone, but to be able to extend the loading ramp, they must park the cab of the truck inside the adjacent ADA accessible parking space.

5.0 Conclusions & Recommendations

Through our research, we have identified several core issues regarding truck loading/unloading and freight movement in downtown Nantucket. Our conclusions and recommendations address both the identified core issues and seasonal challenges. In Table 4 shown below, we organize our recommendations related to each of our conclusions and have ranked them by ease of implementation (i.e., Tranche 1, 2, and 3). Following the table, we discuss in more detail each conclusion and the associated recommendation(s)

Table 4: Main conclusions and recommendations

	Conclusion 1: Tourists and new truck drivers lack the knowledge required to navigate Nantucket	Conclusion 2: The loading zones in downtown Nantucket are not used to full capacity	Conclusion 3: Current loading zones do not provide enough capacity to meet demand	Conclusion 4: The current signage in downtown is unclear	Conclusion 5: Current fines are insufficient to deter illegal parking
Tranche 1	Recommendation 1.1 Create a visual guide for helping tourists and new drivers navigate downtown	Recommendations 2.1, 2.2, and 2.3 Adjust loading zones 5, 7, and 8	Recommendation 3.3 and 3.4 Move fire hydrants to open up more space for parking and loading zones	Recommendation 4.2 clarify the signage on zones 9 and 11	
Tranche 2			Recommendation 3.1 and 3.2 Create new loading zones where demand for deliveries is highest		Recommendation 3.2 Increase the fines for parking in loading zone violations and over time parking
Tranche 3				Recommendation 4.1 Create new loading zone and parking signs that are visually distinct	

Conclusion 1: Tourists and new truck drivers lack the knowledge required to navigate Nantucket. Experienced truck drivers have a solid understanding of the layout of Nantucket, but the newer ones have trouble navigating downtown, making them more likely to get frustrated when looking for a loading zone and instead park in the street. Additionally, there have been some rare occasions when new truck drivers miss the turn onto South Water St. and have to block cars and back up to get back on the truck route. Tourists can also have trouble navigating downtown, and sometimes park in loading zones, which creates many issues for truck drivers. To address this confusion, the town of Nantucket should consider the following:

Recommendation 1.1: The Town should consider developing an online guide or graphic for navigation in downtown Nantucket. This guide would take the form of an interactive map where users can turn the layers on and off. It would be similar to Nantucket's GIS map, but only contains data that is relevant to navigating downtown, which will make it much more user friendly. This guide would also include a printable version, a prototype of which can be found in Appendix G. It would contain a route out of downtown that truck drivers and tourists alike can follow. It would also show the parking spaces downtown, sorted by their time limits, loading zones, and ADA accessible parking spaces. In addition to the map, we recommend that the guide contains the signs that Nantucket uses to mark parking and loading zones so drivers know what to look for. This map could be a resource that can be distributed by the Steamship Authority and car rental companies on the island.

Conclusion 2: The loading zones in downtown Nantucket are not used to full capacity. Downtown Nantucket has a high demand for freight delivery, but its loading zones are not able to handle that demand. Limited zone size, absence of crosswalks, and limited room to maneuver deter truck drivers from using the loading zones as intended and can lead trucks to park illegally, block traffic, and exacerbate congestion. To increase use of these loading zones, the town of Nantucket should consider the following:

Recommendation 2.1: The Town should consider extending zone 5 (Figure 30) to 50 ft and moving the ADA accessible parking spaces in front of it forward 5 ft to compensate. This size increase would allow larger trucks to use this loading zone without illegally blocking an accessible parking space or crosswalk.

Recommendation 2.2: Because zone 7 (Figure 30) is on a cobblestone road, we recommend that the Town consider installing a crosswalk at the western end of the loading zone. This crosswalk would give truck drivers a smooth surface on which to lower their ramps and move dollies. It would also enhance pedestrian access. This change may encourage trucks to use this loading zone instead of parking and blocking Independence Lane and pull forward all the way into the loading zone.

Recommendation 2.3: Zone 8 (Figure 30) is boxed in by the bump-out in the sidewalk, so we recommend that the Town considers flattening the curb in front of this loading zone. This would allow more truck drivers to back into zone 8, encouraging a more frequent use of this loading zone.

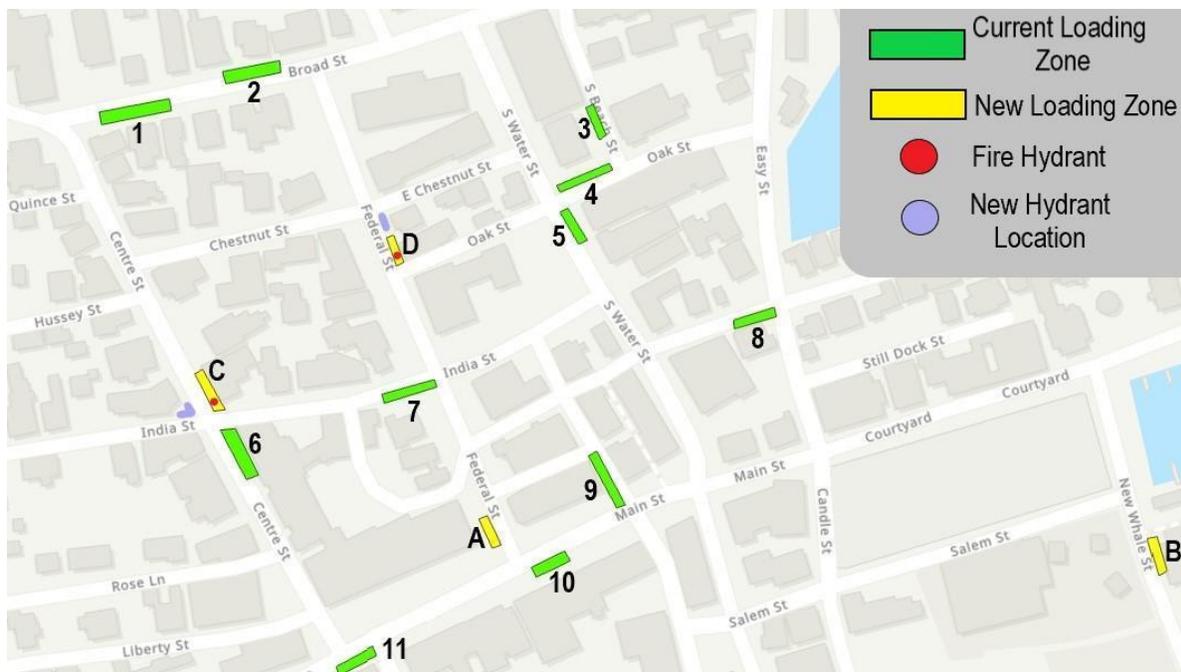


Figure 30: Map of new loading zones and required modifications

Conclusion 3: Current loading zones do not provide enough capacity to meet demand. Even with the full utilization of every loading zone in downtown Nantucket, the demand for space to stop and unload can still overwhelm the available supply, as some areas of downtown are underserved, and others have underutilized curbside space. To improve coverage and make more space for trucks to unload without blocking the street, the town of Nantucket should consider adding loading zones in the four locations marked in Figure 30.

Recommendation 3.1: New Loading Zone A, on the corner of Federal Street and Main Street, provides an alternative for trucks that would otherwise park in the no standing zone in front of the Hub or in the entrance to Independence Lane. A loading zone in this location would replace space for street parking, but it would also give trucks an option that does not obstruct the turn from Main Street onto Federal Street or block Independence Lane to emergency vehicles. The town could additionally consider swapping the current Main Street loading zone in front of Federal Street with this new loading zone in order to compensate for the lost parking spaces.

Recommendation 3.2: New Loading Zone B services the large cluster of businesses on Old South Wharf. When the area is packed with tourists during the summer months, there is no clear space for trucks to stop to unload, leading to frequent illegal parking, most often in the handicap space in front of the Angler's Club. Designating a loading zone here would give trucks a consistent place to stop for loading and unloading during the summer, and make the bounds of enforcement clearer.

Recommendation 3.3: New Loading Zone C, on the corner of Center Street and India Street, is already approved by the town. This would be a "short term" loading zone, active from 8:00 a.m. to 12:00 p.m., to supplement the nearby zone 6. The adjacent fire hydrant currently precludes this section of curb from being utilized. Relocating it to the opposite side of the street where there is no parking, as shown in Figure 30, would open up space for this loading zone and additional parking outside the marked hours.

Recommendation 3.4: New Loading Zone D, on the corner of Federal Street and Oak Street, is similarly occupied by a fire hydrant. This fire hydrant could be moved to the opposite end of the block to make space for another short-term loading zone that can serve Federal, Oak, and Chestnut Street and also become additional parking after 12:00 p.m.

Conclusion 4: The current signage for loading zones in downtown is unclear. The Town of Nantucket has gone to great lengths to preserve the historical and aesthetic integrity of its architecture and streetscapes. This means that signage indicating loading zones and parking hours can blend into the background and may not be readily apparent to truck drivers or tourists. As shown in Figure 23, the content of the signs can also be ambiguous and confusing. Several people we interviewed indicated that tourists often do not see the signs marking loading zones when trying to find a parking space. There are currently metal non-regulatory retroreflective signs in downtown (Figure 31), which stand out to truck drivers and tourists, but the signs for parking and loading zones are non-retroreflective and wooden (Figure 32).



Figure 31: Existing metal signs in downtown



Figure 32: Split signage for when a space is a loading zone or parking space

Recommendation 4.1: We recommend that the town re-evaluates the loading zone signs and looks at different approaches to clarify them. The first step would be dividing the combined parking and loading zone signs (Figure 23) into separate signs like the arrangement in front of the Dreamland theater (Figure 32). Combined signs overwhelm drivers with information, and often cause drivers to skim the signs for the word ‘parking’ and ignore the rest, leading to them parking in loading zones. Separating the signs makes it clearer to drivers that these locations are more than just parking spaces.

Furthermore, separating the signs affords the opportunity to make the loading zone signage visually distinct. The red and white metal signs commonplace elsewhere are the simplest solution to implement. Standardized metal signs already exist downtown where they are necessary for communicating to drivers, even sharing posts with the wooden parking signs (Figure 31).



Figure 33: New Bedford, MA Loading Zone Sign (Google Maps)

These are not the only options, however. The signage in New Bedford, MA, provides a good example here, utilizing a color palette that is unobtrusive in its historic surroundings, while being visually distinct from the current gray parking signs (Figure

33). An alternative color palette like New Bedford's could be implemented on metal signs, as New Bedford has, or wooden signs like the ones currently in use.

Recommendation 4.2: We recommend that the town considers clarifying the signage on zones 9 and 11. Both of these loading zones are designated by only one sign, which makes their boundaries very unclear. By adding a sign so both ends of the loading zones are marked, Nantucket can reduce the number of drivers who unknowingly park illegally in these loading zones.

Conclusion 5: Current fines are not sufficient to deter illegal parking. When a ticket is issued to a vehicle for parking illegally, the current cost of the ticket does not effectively deter an individual or company from continuing this behavior. This observation was confirmed after talking to individuals who were more than willing to pay the \$25 or \$50 parking ticket so they could park all day downtown. Furthermore, after looking at the tickets issued by other towns and cities for illegal parking in a loading zone, there are numerous cities where the cost of the ticket is close to (or at) \$100 (Table 3). One specific example where increasing the cost of a ticket reduced illegal parking is in Washington, D.C., where the DDOT increased the fine for parking illegally in a loading zone from \$50 to \$100 for personal vehicles. Once the fine increased, cars were more likely to be discouraged from parking in loading zones (Dey et al., 2019, p. 318). With this said, we recommend that the town of Nantucket considers the following:

Recommendation 5.1: Currently, the fine for parking inside of a loading zone is \$50. We believe that if the town were to consider increasing this fine, it would serve as a more effective deterrent to illegal parking, and especially in loading zones.

Additional Recommendations

Recommendation 6.1: Town liaison for trucking companies

We suggest that the Town of Nantucket consider creating a dedicated liaison for the trucking companies as a mechanism to allow them to voice their concerns. From our findings, we believe the trucking companies do not know who to contact in the town administration. The town would benefit from having a dedicated liaison or contact who would be available to hear concerns from the trucking companies.

Recommendation 6.2: Summer loading zone study

Because we were not here during the summer, we were unable to observe downtown Nantucket at peak demand. We recommend that the Town of Nantucket consider observing its loading zones during July when freight demand is at its peak. The town should record how often each loading zone is used, how often a vehicle illegally parks in it, and how often trucks compete for the loading zone. This study will help the town evaluate the efficacy of its loading zones and determine which ones do not get used often and which ones cannot accommodate all of the trucks that need it. The study will also help determine what times the loading zones are used and when they can become parking.

Recommendation 6.3: On-street markings

After interviewing some of our key informants and walking around downtown, we have found that there is a lack of on street markings to guide vehicles into parking spaces. We recommend that the Town of Nantucket consider adding on-street markings to help other vehicles park efficiently on the curbside so that they avoid encroaching on loading zones. Curbside space is very limited in the core district and if a car encroaches on a loading zone, then truck drivers most likely will not use it. These on-street markings can be as simple as painting the corners of the parking space. In addition to creating these on-street markings, we also recommend that the Town of Nantucket also considers reevaluating the length of the yellow lines in the core district. In our

observations and interviews, it has been noted that the length of some yellow lines could be shortened to provide more space for parking and loading zones.

Recommendation 6.4: Town Bylaw

Currently, there exists two sections in the municipal code of Nantucket governing the ability of vehicles, commercial or otherwise, to park in a public way. The two sections, 375-4(k) and 375-6(b), do not reference each other and leave a gray area regarding truck loading activities in travel lanes. We recommend that the Town of Nantucket consider revisiting these two bylaws and reconciling this gray area so that trucks following the 15 minute loading rule in 375-6(b) are also under the provisions of 375-4(k) which states that there needs to be sufficient space for traffic to flow.

Collectively, these recommendations may help to alleviate some of the problems of loading and unloading in downtown Nantucket, but they will not solve the larger problem of congestion in the summer due to excessive pedestrian and vehicular traffic. That said, truck unloading in downtown will become a much smoother process through these recommendations, so trucks will have less of an impact on congestion downtown.

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Appendices

Appendix A: Interview Preamble

We are a group of four students from Worcester Polytechnic Institute (WPI) conducting a research project in collaboration with the Nantucket Planning Office to evaluate the issues of freight loading/unloading in downtown Nantucket.

We would be delighted if you would take some time to answer a couple of questions about truck loading/unloading in Nantucket. Your participation in this interview is completely voluntary and you may stop at any time. We shall be taking notes during our conversation and may wish to quote you in our final report. Do you mind if we quote you by name, or would you prefer we anonymize your responses? We will, of course, give you an opportunity to review any quotations prior to publication. We will also be happy to provide you with a copy of our report when it is completed. Thank you for your support in this research.

Do you have any questions before we begin? If you have any concerns or questions after the interview, you can contact us at gr-ACK22-trucks@wpi.edu or our faculty advisors, Dominic Golding (golding@wpi.edu) or Bruce Bursten (bbursten@wpi.edu).

Do you mind if we record this interview or would you prefer we just take notes?

Appendix B: Interview Script for Officials in Other Jurisdictions

General Interview Script

- Topic 1: Background
 - *Tell us about your time with [jurisdiction] and how freight issues may/may not be relevant to your position?*
- Topic 2: Noticed Issues
 - *What problems have you noticed that commercial trucks create in [jurisdiction]?*
 - *How have those problems affected the overall traffic flow in a given area?*
 - *How have trucks posed a noticeable negative impact to the roads, sidewalks, and/or environment?*
 - *Are there any policies in [your jurisdiction] that contribute to any issues with truck loading/unloading?*
- Topic 3: Tested Solutions
 - *What methods has [jurisdiction] used to try to mitigate the issues regarding truck loading/unloading?*
 - *How successful has each method been?*
 - *Have any seemingly unrelated policies or programs had unintended effects on trucking?*
 - *Which methods have shown to be the best long term solution to the problem?*
- Topic 4: Wrapping Up
 - *What changes would you make to your current system to further help mitigate the current issues that you have noticed?*
 - *What are some documents that you think that we should look at in regards to the problem?*
 - *Are there any other groups or individuals that you believe could help us expand the conversation?*

- *Would you be fine if we ask follow-up questions at a later date as more information is learned?*

Appendix C: Nantucket Interview Script

General Interview Script

- Topic 1: Noticed Issues
 - If any, what problems have you noticed that trucks create in the downtown area?
 - In your view, what are the most common problems caused by trucks in the downtown area
 - At what time(s) of day do you notice trucks to be the most problematic?
 - Are there specific times of the year that you would say trucks become substantially more problematic?
 - Are there any locations around downtown where trucks and/or other personal vehicles cause problems?
 - In your experience, what do you believe to be the causes of the problems you mentioned with trucks downtown?
- *Topic 2: Personal Experience*
 - How does truck traffic/loading/unloading affect your daily tasks?
 - In what instances has truck loading/unloading created an issue for you?
- Topic 3: Wrapping Up
 - What changes would you like to see, in the short or long term, to address the current problems with trucks on Nantucket?
 - Are there any specific issues that you think that we should look at in regards to challenges trucks cause?
 - articles, past surveys, town meetings
 - Are there any other groups or individuals that you recommend we should contact for an interview?
 - Would you be okay if we ask follow-up questions at a later date as more information is learned?

Interview Questions for Businesses

- Topic 1: Background
 - How long have you been in business?

- How often do you receive deliveries?
- In the tourist season?
- In the off season?
- Are there any services that you offer in the tourist season that are not offered in the off season?
- **Topic 2: Issues for Business**
 - Where does your business load/unload? (if relevant)
 - In what way, if any, does truck loading/unloading impact your business?
 - When does truck loading/unloading impact your business the most?
 - How often is a truck parked close to or in front of your business (other than for deliveries to your business)? Do you think that trucks parked near your business have an impact on your business?
 - Is there anything related to loading or freight that would improve your business operations?

Interview Questions for Traffic Enforcement Officers

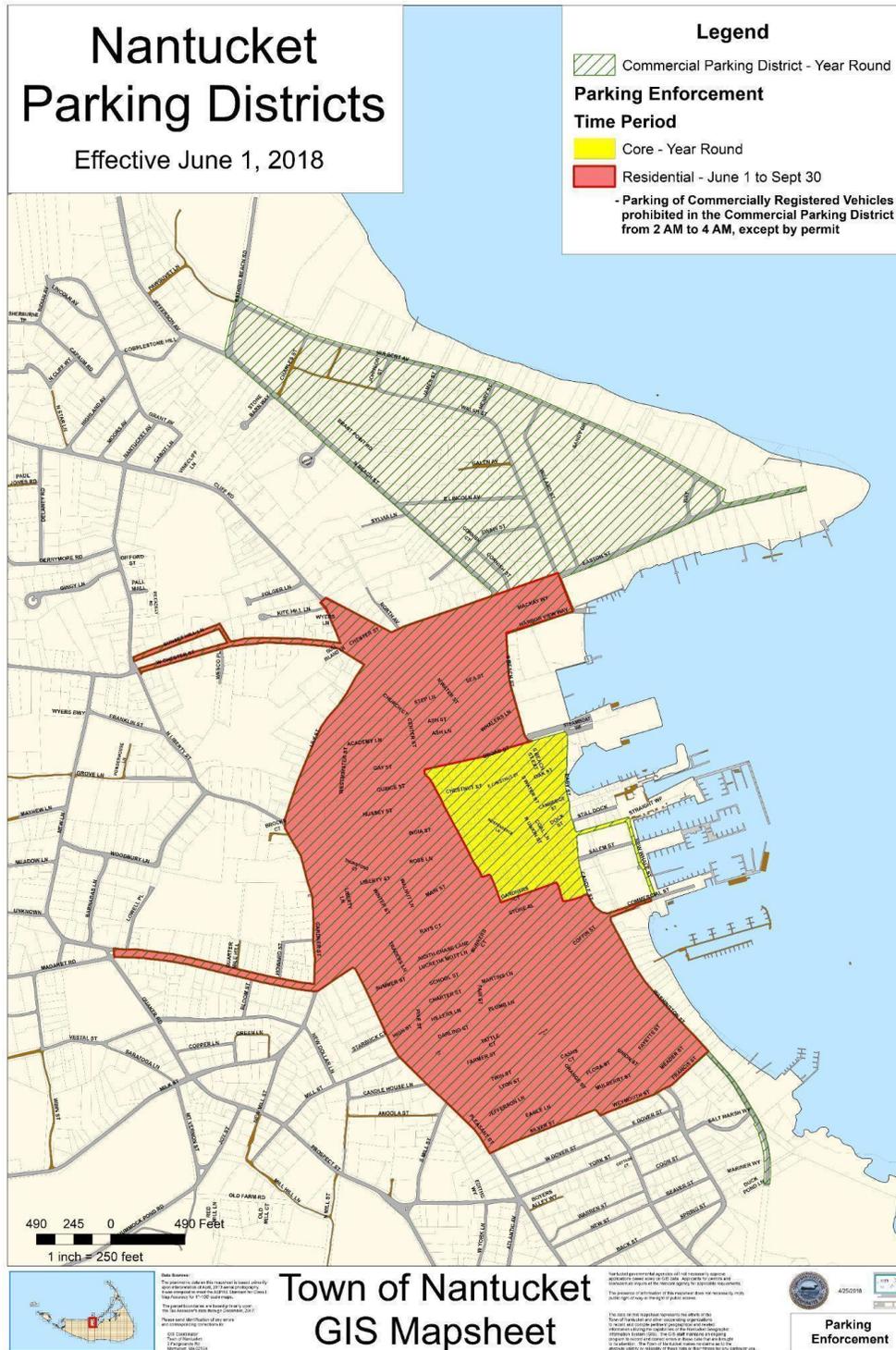
- **Topic 1: Current Procedures**
 - How are loading zones enforced?
 - On average, how many violations on commercial vehicles are recorded in a given day during the peak season?
 - Has this number increased since the pandemic?
 - Are there certain sizes of trucks that get more infractions than others? I.e smaller vans vs large box trucks?
 - How many violations are against personal vehicles inhibiting commercial business?
 - How many of those would you estimate are violations against a commercial truck?
 - How many violations would you estimate go unnoticed?
- **Topic 2: Specific Opinions**
 - In your estimation, what percentage of the time do truck drivers follow designated signage for truck routes and loading zones?
 - Does this percentage change with respect to the peak-season and the off-season?

- From your observations, what are some of the factors that contribute to truck-induced traffic congestion?
- Do you have any suggestions to reduce loading/unloading related issues like congestion and sidewalk blockages?

Interview Questions for Truckers

- **Topic 1: Background**
 - How long have you been trucking?
 - How long have you, and how often do you deliver to Nantucket?
 - How much time do you spend completing deliveries vs waiting for the ferry?
- **Topic 2: Loading Zones**
 - How difficult is it to find a nearby loading zone for most of your deliveries?
 - What percentage of the time do you find a loading zone you want to use already occupied?
 - What percentage of the time is it obstructed?
 - What do you do if you're unable to find a useful loading zone?
 - What is a reasonable distance for a loading zone to be from the destination for most of your deliveries?
 - When does the distance become impractical?
 - How often do you make deliveries to locations without a loading zone within a practical distance?
 - Is the current signage at loading zones clear?
 - What are the main factors that interfere with your deliveries on the island?
 - How do you think Nantucket's loading zones could be improved?
 - Is Nantucket different from other locations that you have operated freight OR is it different for loading/unloading as compared to your impressions of other places?

Appendix D: Initial Study Area (Current Parking Area in Downtown District)



Appendix E: Loading Zone Condition Form

Loading Zone Condition Form

Date: _____ Time of Day: _____

Loading zone address: _____

Is this loading zone on GIS? Y ___ N ___

Surface material of the loading zone: Cobblestone ___ Asphalt ___ Brick ___

Dirt ___ Other ___

If selected "other", what type of surface material is it? _____

Dimensions (in feet): Length _____ Width _____

Is the loading zone area painted on the ground? Y ___ N ___

Is there a curb cut nearby? Y ___ N ___

Obstructions in the loading zone

None Tree Planter Outdoor Seating Personal Vehicle Other

Explain:

Description of the location of the loading zone on side of the street:

Direction of traffic flow: One way ___ Two way ___

Is this loading zone time based? Y ___ N ___

- If yes, what period of the day is the space a loading zone? _____

Is a parking space within 10 feet from the loading zone? Y ___ N ___

Number of businesses in proximity to loading zone: _____

Appendix F: Business Owner Questionnaire

Business Owner Questionnaire

Preamble:

We are a group of four students from Worcester Polytechnic Institute (WPI) conducting a research project in collaboration with the Nantucket Planning Office to evaluate the issues of freight loading/unloading in downtown Nantucket.

We are particularly interested to know what business owners think about these issues and would be grateful if you would take a few minutes to answer some brief questions. Your participation in this questionnaire is completely voluntary and you may choose to skip any questions. It will be useful in our analysis to know the location of your business, but your responses will remain anonymous in our reports and we will not reveal any identifying information.

Thank you for your support in this research.

If you have any concerns or questions about this questionnaire, you can contact us at gr-ACK22-trucks@wpi.edu or our faculty advisors, Dominic Golding (golding@wpi.edu) or Bruce Bursten (bbursten@wpi.edu).

Question 1:

What is the name of your business?

Question 2:

What is the address of your business?

Question 3:

How long have you been in business at this location?

- <1 Year
- 1 - 5 Years
- 6 - 10 Years

- 11 - 15 Years
- 16 - 20 Years
- 20+ Years

Question 4:

Per week, how many trucks typically deliver to your business during

	Closed	<1	1-5	6-10	11-15	16-20	>20
Summer season (June 15 to September 15)	<input type="radio"/>						
Shoulder seasons (April 1 to June 14 and September 16 to December 31)	<input type="radio"/>						
Winter (January 1 to March 31)	<input type="radio"/>						

Question 5:

What times of day do you typically receive deliveries? (Check all that apply)

- Before 9 am
- 9 am to 11:30 am
- 11:31 am to 2:30 pm
- 2:31 pm to 5:30 pm
- After 5:30 pm

Question 6:

Where do trucks typically park to load and unload for your business?

- Nearby loading zone
- On Street
- Other _____

Question 7:

Please indicate which, if any, of the following problems delivery trucks encounter in trying to deliver to your business? (Check all that apply)

- None
- Loading zone occupied by other delivery trucks
- Loading zone blocked by other parked vehicles
- Loading zone excessive distance away
- Other _____

Question 8:

What might the town and/or trucking companies do to make freight deliveries easier for your business?

Question 9:

Are there any additional comments you would like to make?

Question 10:

If you would be willing to participate in a short (15 minute) interview, either in person or what is most convenient for you, please provide your contact information below.

Name (First, Last) _____ Email Address _____

Conclusion:

Thank you for your time in completing this questionnaire. Your responses will be useful in helping us get a better understanding of the freight management in downtown Nantucket.

Appendix G: Sample Downtown Parking Graphic

