Evaluating Private Roads on Nantucket

An Interactive Qualifying Project Report
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by

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Abstract

The Town of Nantucket has 400 miles of road, of which 313 miles are privately owned. Many of these privately owned roads are poorly maintained which creates conditions that can impair emergency vehicle access. The goal of this project was to evaluate the conditions of a sample of the unpaved private roads on Nantucket, and to make recommendations for the repair and maintenance of the roads in order to ensure the safe passage of emergency vehicles. The team accomplished this goal by developing an evaluation protocol and systematically evaluating a sample of the private roads on Nantucket. The team then used the data to develop cost estimates and priorities for fixing the roads.

Acknowledgements

We would like to thank our sponsor, Kara Buzanoski, for all of her help and support these past few months. She was very invested in our project and helped us whenever we needed, often taking time out of her busy schedule to meet with us. We would also like to thank the staff at the Nantucket DPW and the Fire Department for providing us with the measuring tools we needed for this project. We would like to specifically like to thank Robert Bates from the Fire Department for his part in our project. Robert developed the list of roads we evaluated and took time out of his schedule to show us some of the problem roads and the specific issues concerning emergency vehicle access.

We would also like to thank our advisor, Dominic Golding, for all of his work supporting us during the semester. He spent many hours meeting with us, guiding us and editing our paper. We would like to thank him for his patience and excellent feedback on our paper and the direction of our project.

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Executive Summary

On Nantucket, 78% of the roads are either privately owned or have undetermined ownership, and the lack of requirements for regular maintenance means that many of the private roads are in a substandard state. The Nantucket Department of Public Works and the Fire Department recognize that surface imperfections and height and width restrictions pose substantial problems for emergency vehicle access on the island but, prior to this project, they had not conducted a systematic evaluation of the condition of the private roads.

The goal of the project was to evaluate the condition of a sample of the unpaved private roads on Nantucket and to make recommendations for the repair and maintenance of the roads in order to ensure the safe passage of emergency vehicles. The project team:

1. Clarified the nature of private roads and concerns about their condition and maintenance through background research;
2. Identified the range of methods used to evaluate the conditions of private roads;
3. Developed road evaluation tools and protocols to assess the condition of private roads in Nantucket;
4. Implemented the evaluation protocol developed for the Nantucket private roads;
5. Evaluated the options to bring the private roads into compliance; and,
6. Recommended appropriate strategies and priorities.

Findings

The team surveyed a sample of 38 private roads identified by the Nantucket Fire Department as known trouble spots. Eighteen of the roads surveyed were classified as a three on the team's rating scale in terms of surface condition because they had severe road condition problems that rendered the roads impassable by an emergency vehicle, seven were classified as a two on the priority scale because they had moderate road conditions that would slow down emergency vehicles, ten were classified as a one because they had small surface imperfections and two were classified as a zero, indicating that they had no surface imperfections.

The team also found that all 38 of the roads evaluated would restrict emergency access to some extent due to narrowness and 26 roads were classified as completely impassable due to narrowness. The overhead clearance along the roads was also classified, but this was found to not be a major issue and any branches that were a problem would be easily removed during brush cutting to fix the width problems.

The project team evaluated the priority of the roads based upon the above factors but also by quantifying at the road's importance, total residential volume, and year-round residential volume through the use of a similar rating system used for the surface condition, width and overhead clearance. The importance was determined based upon the following:

- Whether the road was a connector between two major public roads;
- How many side streets were only accessible from that street; and
- Whether the road was an access point for a beach or another point of public interest.

The project team built a database in Microsoft Access to apply rating values and compute an overall priority value for each road, which was then used to develop a prioritized list of roads. The estimated cost to repair the roads was calculated using cost factors provided by the DPW. The priority ranking, ID number, road name, prioritization value, and total cost are seen in the table below.

During the course of the fieldwork, the project team encountered several other issues that hamper effective emergency response. Many properties had inaccurate addresses and many roads have never been completed and exist only as 'paper roads.' The team encountered various areas of the island, especially Tom Nevers, where roads had not been fully developed and thus created address and access issues.

Ranking	ID	Road Name	Prioritization Value	Total Cost of Repairs
1	5	Cato Ln	20.97	$13,460
2	32	Somerset Rd	20.31	$78,820
3	26	Millbrook Rd	19.64	$22,350
4	16	Folger Av	16.32	$13,825
5	36	Wannacomet Rd	16.31	$17,205
6	17	Gardner Rd	15.65	$37,545
7	2	Austine Locke Way	14.65	$19,185
8	19	Hawthorne Lane	13.66	$19,985
9	14	Field Ave	13.32	$18,195
10	10	E. Creek Rd	12.33	$23,754
10	27	Morgan Square	12.33	$10,330
10	6	Columbus Ave	12.33	$5,405
10	3	Burnt Swamp	12.33	$9,440
14	24	Kendrick St	12.32	$22,325
15	15	Fishers Landing Rd	10.99	$4,875
16	37	Westerwyck Way	10.98	$3,005
17	30	Oak Hollow	10.33	$3,420
17	8	Crooked Ln	10.33	$5,835
17	31	Osprey Way	10.33	$24,795
20	33	Tautemo Way	10	$10,365
21	34	Trinity St	9.99	$6,975
22	1	Arkansas Av	9.33	$30,515
23	11	Exeter St	9.32	$12,835
24	20	Kimball Ave	8.66	$6,580
25	13	FarmView Dr	8.33	$1,020
25	21	Hinsdale Rd	8.33	$23,245
25	23	Ipswich St	8.33	$16,830
28	18	Gloucester St	7.99	$18,605
29	9	Devon St	7.33	$5,135
29	25	Marion St	7.33	$3,000
31	12	Fairfield St	6.33	$2,990
31	7	Cornwall St	6.33	$2,990
33	28	North Star Ln	6	$3,360
34	38	Wiltshire Av	5.33	$7,800
34	35	Wall St	5.33	$3,420
36	22	Huntington St	4.33	$3,850
36	29	Norwood St	4.33	$3,900
38	4	Caroline Way	3	$5,985

Conclusions and Recommendations

The evaluation indicated that 29 of the sample of 38 private roads were considered impassable on at least one section due to either narrowness or poor surface condition. By extrapolation, the team concludes that the conditions of many of the other private roads on Nantucket are likely to render them impassable or greatly increase the response time for emergency vehicles. Thus they are a threat to public safety. The conditions of the private roads do not just impact the Fire Department and the DPW; they have a greater impact on the people who live on the roads because in case of an emergency, the emergency response team may be unable to access their house.

The 38 roads the team was able to evaluate during their time on Nantucket is only a fraction of the 580 private roads on Nantucket and thus there are many other roads that need to be evaluated. During their time on the island, the project group observed many private roads that were not on their list. Some of these additional roads were in good conditions and many others were in poor condition.

Through their research and evaluation, the team has concluded that there are many factors that increase emergency response time on the private roads on Nantucket. An increased response time can mean the difference between life and death and thus the roads need to be repaired. With these conclusions, the team recommends:

1. The Town develops a short-term strategy and timeline to fix the roads that are of top priority;
2. The Town reach out to homeowners and Homeowners Associations to ensure they understand their responsibilities for the maintenance and repair of the private roads
3. The Town work with the homeowners associations, the Fire Department and The Roads and Rights of Way committee to ensure they understand their responsibilities for maintenance and upkeep of private roads;

4. The DPW continue to use the protocols and database developed by the project team to evaluate and prioritize other roads on an ongoing basis; and
5. The Town develops a strategy to correct inaccuracies in the address data.

The safety of the general public is at stake because of the current conditions of the private roads. The recommendations above identify the steps the Town of Nantucket should take in order to remedy this situation.

Authorship

The work for this project was shared equally among the group members by focusing on the strengths of each person. All group members contributed equally to the research and fieldwork for the project. Rebekah Cocks led the writing and formatting of the paper with help from both Margaret Corrigan and Aleksandra LaRue. Margaret completed most of the editing of the paper and Aleksandra completed the work on the Microsoft Access database and designed the presentations.

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1.0 Introduction

Adequate maintenance of unpaved private roads is a concern for many communities as responsibility for their maintenance typically falls to landowners. Unpaved roads that are not adequately maintained can often become impassable, creating concerns about emergency access. On Nantucket, 78% of the roads are either privately owned or have undetermined ownership, thus the town is not responsible for their maintenance. The lack of requirements for regular maintenance means that many of the private roads are in a substandard state. The Nantucket Department of Public Works (DPW) and the Nantucket Fire Department recognize that surface imperfections (such as potholes, corrugation, rutting and loose aggregate) and height and width restrictions (due to overgrown vegetation and other obstacles) pose substantial problems for emergency vehicle access. Currently there are evaluation protocols for public paved roads such as pavement management systems. Prior to this project, however, there was no standard evaluation protocol for unpaved private roads. The goal of the project was to evaluate the conditions of a sample of the unpaved private roads on Nantucket and to make recommendations for the repair and maintenance of the roads in order to ensure the safe passage of emergency vehicles.

During their time on Nantucket, the project group conducted interviews to gain a better understanding of the specific needs of Nantucket with regard to the conditions of the private roads. The knowledge gained from these discussions helped the project group to develop their own road evaluation system based on the Road Surface Management System's unpaved road assessment.

After developing the evaluation protocols, the team implemented the protocols at known trouble spots and then analyzed the data in order to make recommendations to the DPW for the repair and maintenance of the selected roads. The project team found that most of the roads had severe width restrictions due to the encroachment of vegetation and other obstacles and the surface conditions of many roads either rendered the road completely impassable or would severely impair emergency response times. Based on their analysis of road conditions, the team identified the type of repairs needed and estimated the associated costs. Finally, they made several

recommendations about how the DPW should proceed in the future. The group recommend that the DPW develop a maintenance plan that uses the evaluation tools the group developed to systematically assess the condition of private roads and they recommend that the Town approach landowners to enforce their responsibility to maintain their roads in the future.

The findings and recommendations presented in the following report will provide the Town with options for bringing those sections of the private roads that are currently in the worst condition into a passable state for the emergency vehicles. The majority of the 400 miles of roads in Nantucket are private roads and thus the project group was only able to evaluate the short list of roads that are known trouble spots provided by the Fire Department. However, the methods outlined in this report can be used by the Nantucket DPW and Fire Department in the future to evaluate and prioritize additional private road segments in order to bring them into compliance.

2.0 Literature Review

In the following literature review, the group provides information regarding the complex hierarchy of the roads in Massachusetts, focusing mainly on unpaved private roads and issues with their maintenance. The team then discusses the various techniques available for the repair of unpaved roads as well as for their evaluation. The Road Surface Management System was found to be the most pertinent evaluation tool for unpaved roads and the group explains briefly how this system works. Finally, the team has synthesized specific information about the island of Nantucket and some of the concerns regarding the current conditions of private roads.

2.1 Massachusetts Roads

The Commonwealth of Massachusetts has a complex hierarchy of roads. There are various types of roads and different people and groups have the responsibility of maintaining and repairing each type of road. In Massachusetts, there are: public ways, which are roads accessible to the public and that the public has the responsibility to maintain and repair; statutory private roads to which the public has access but does not have the responsibility to repair and maintain; and private roads to which the public has access only with the consent of the owner, but has no responsibility to maintain (Smithers 2011). According the to the Massachusetts Department of Transportation (DOT), statutory private roads make up 9%, or 3,268.95 miles, of the total 36,311.2 miles of roads in Massachusetts. The other 33,311.2 miles are publically owned roads, the majority of these being owned by the towns. Due to the fact there are no regulations for the creation and maintenance of private ways, the Massachusetts DOT does not have statistics on the number of mileage of private ways (Massachusetts Department of Transportation, Office of Transportation Planning 2011).

2.1.1 Public Ways

A road can become a public road by way of one of three different processes: the first being by the establishment of the road by a public authority, the second being through prescription and the third being through dedication to the public by the owner prior to 1846. Typically, public roads are established by governing bodies in a town, county, state, or country when the road is created for the benefit of the general public (Smithers 2011).

There are various types of public roads including state highways, county ways, and town ways. The state highways are the responsibility of the Massachusetts Department of Transportation, Division of Highways, to repair and maintain; county ways are the responsibility of the county, with each town responsible for laying out and maintaining the portion of the road that lies within the town boundaries; and town ways are the responsibility of the town. Town ways are laid out by the selectmen or city council and are approved by the public by way of a vote. The town is then responsible for the upkeep of the established road (Smithers 2011).

2.1.2 Private Roads

In addition to public roads, there are also private roads, which complicate the hierarchy of ownership and responsibilities for maintenance and repair. West's Encyclopedia of American Law defines a "private road" as "a street or route that is designated by a public authority to accommodate a person or a group of people" (Phelps 109). A private road is often created to provide access to a piece of private property. There are two main categories of private roads with other classifications within these groups.

2.1.3 Statutory Private Roads

Massachusetts is one of the only states that have "statutory private ways." Statutory private ways are roads that are laid out by a public governing body at the request of a person who will benefit the most from the road. This road may cross other property and is usually to provide access to the requestor's land. The layout, construction and maintenance are the responsibility of the abutters or owners of the road. Statutory private roads are publicly accessible but the public does not have any responsibility for the upkeep of the roads (Smithers 2011).

2.1.4 Private Ways

The other main class of private roads is "private ways." These are ways that are created by an individual on one's own property without the permission of a public governing body. These roads are solely the responsibility of the owner of the land and the public cannot pass on them without the consent of the owner. Private ways can include driveways and can also include roads on which multiple houses are located (Smithers 2011).

2.1.5 Proprietor Roads and Paper Roads

Within the larger classifications of private way and statutory private road, fall other private road classifications. Proprietor roads and paper roads are also roads that fall under private ownership

and depending upon how these roads are established can be either statutory private roads or private ways. A proprietor road is typically a road that was created as a way for the proprietors of a common piece of land to preserve access to this common land or resource. Proprietor roads are the responsibility of the proprietors to maintain and repair. In some instances, the town is a main shareholder of the road and thus the public can utilize the road. Paper roads are roads that were created via a deed or other paper document. These roads sometimes are only on paper and have not yet been constructed, and in other instances, they have not been paved or improved from their original condition, but the deed gives the holder the right to create or improve the road (Atherton et al 2009).

2.1.6 Responsibility of Private Road Owners

The responsibility of the owners and abutters of private roads include the maintenance and repair of the roads. If private roads are not properly maintained, they can fall into a state of disrepair and may result in damages to passing vehicles. Any damages incurred while traveling on private roads that do not meet regulatory standards are the responsibility of the owner of said road. Section 15 of Chapter 84 of the Massachusetts laws states that,

> "if a person sustained bodily injury or damage in his property…and such injury or damage might have been prevented, or such defect or want of repair… might have been remedied by reasonable care and diligence on the part of the county, city, town or person by law obliged to repair the same, he may, if such county, city, town or person had or, by the exercise of proper care and diligence, might have had reasonable notice of the defect…recover damages thereof from such county, city, town or person" (The Commonwealth of Massachusetts C.84, S.15).

In other words, if vehicles are damaged or if bodily harm occurs while traveling on a private road, and it is determined that the conditions of the road were at fault for the damages, then the owner of the private road will be responsible for the costs of the repair of the damages.

2.1.7 Responsibility of the Public in Regards to Public Roads

In Massachusetts, a town does not have any responsibility to maintain or repair any of the types of private roads unless the town is a major shareholder of a proprietor road. The public also generally does not have any jurisdiction over private roads, except in cases of public endangerment (Atherton et al. 2009). Massachusetts general law, Chapter 40, Section 6N gives

each town the right to create bylaws regarding the temporary repair of private roads. This law states:

> "Cities and towns may by ordinance or by-law provide for making temporary repairs on private ways. Such ordinance or by-law shall determine (*a*) the type and extent of repairs; (*b*) if drainage shall be included; (*c*) if the repairs are required by public necessity; (*d*) the number of percentage of abutters who must petition for such repairs; (*e*) if betterment charges shall be assessed; (*f*) the liability limit of the city or town on account of damages caused by such repairs; (*g*) if the ways shall have been opened to public use for a term of years; and (*h*) if a cash deposit shall be required for said repairs" (The Commonwealth of Massachusetts C.40, S.6N)

This law allows the towns to develop their own protocols to determine the extent of the town's involvement in repairing private roads. Many towns in Massachusetts have bylaws that allow petitions to be made to the board of selectmen for minor repairs of private roads. This may include the filling in of potholes or the grading of the surface of the road. Nantucket has similar by-laws that allow the abutters who own at least 50% of the road to petition for repairs of the road. The Nantucket Board of Selectmen will then review the petition to determine if the repairs are a public necessity (Town of Nantucket MA, 2008).

2.2 Maintenance

All roads require regular maintenance and periodic repair, but private roads are particularly susceptible to falling below minimum satisfactory conditions, as the individual owners of the roads are responsible for the maintenance and repair. To prevent problems from arising from surface imperfections and vegetative intrusion, routine maintenance should be done on the roads. The required maintenance for an individual road depends upon the road surface as private roads are composed of many different materials. Some roads are paved while many others are unpaved. The majority of private roads on Nantucket are unpaved and thus the following discussion focuses on the maintenance of unpaved roads.

All roads require basic maintenance such as the removal of debris and snow and ice, but different road surfaces require different methods of maintenance. Paved roads may require cleaning, particularly in the spring after being treated over the winter with salt and sand, while unpaved

roads would not. Unpaved roads must be frequently maintained to ensure large ruts and other imperfections in the road surface do not occur. After major storms in particular, the drainage of the roads should be inspected. Heavy rains can also cause problems such as pooling of water in potholes, which can weaken the structure of the roadway and accelerate the deterioration of the road. The excessive water can also erode the surface of the roadway and the eroded material can begin to fill in the slopes on either side of the roadway placed there for proper drainage. Unpaved roads must also be actively maintained, especially during periods of heavy usage that can lead to excessive and uneven wear on the road surface (Keller 2003).

There are different techniques for the maintenance of unpaved roads depending on the conditions. The following techniques are used to fix imperfections on the road surface and to reshape the surface of the road.

2.2.1 Blading and Dragging

Blading and dragging is a method of maintenance for dirt and gravel roads in which a tilted moldboard is dragged along the surface of the road. This technique pulls any loose material from the road and spreads the material to fill in the irregularities. The purpose of this technique is not to dig deeply into the road but to fill in the imperfections on the surface. While maintenance should not disturb a road surface that does not need maintenance at the moment, the blading and dragging technique is one which should be utilized more frequently to prevent larger imperfections from occurring (Choctawhatchee, Pea and Yellow Rivers Watershed Management Authority 2000).

2.2.2 Reconstructive Grading

If larger imperfections do occur, reconstructive grading is another maintenance technique that could be utilized. This method can be used either when repairing large ruts and imperfections in the road surface or when reshaping the roadway. “Reconstructive grading consists of cutting through, redistributing, and re-compacting the road surface crust, and/or adding new road fill material to obtain the desired roadway shape and profile” (Choctawhatchee, Pea and Yellow Rivers Watershed Management Authority 2000).

2.2.3 Complete Reconstruction

Another option for the repair of a road is to perform a complete reconstruction of the road surface. This option is one with a greater cost but can, if done correctly, yield a road surface that will last longer. Complete reconstruction could include the paving of the road using asphalt or concrete as the road surface, or it could be a complete reconstruction of the unpaved surface.

2.2.4 Paving

The pavement of a road is a very costly option, but is one often chosen in an attempt to lower the cost and frequency of maintenance on the road. However, if the roads are not paved properly, the deterioration of the road may increase at a rapid rate. Gravel roads, if maintained properly, can be a viable alternative to paved roads. The Kentucky Transportation Center published a set of guidelines to follow when determining whether it will be beneficial to pave a gravel road. These guidelines include considering factors such as traffic, cost, drainage, design, safety and commitment of the responsible party to proper management of the roads. If the road does not have a lot of traffic, then paving the road may not be the best option because gravel roads can sustain light traffic equally well as paved ways. Even if there is enough traffic to justify paving, the road must be designed properly to increase the life of the road. If the road is not designed properly, and does not have an adequate base or drainage system, then the road will not last long enough to justify spending the money to pave the road (Kentucky Transportation Center 2000**)**

2.3 Issues with Private Roads

The owners of private roads do not always adequately maintain their roads because there are no requirements to do regular maintenance and the costs of repairs can be substantial. Owners do not have to report on the status of their road nor is there a system in place to ensure routine maintenance is performed. During their background research, the project team was unable to find any towns in Massachusetts that had implemented a standardized system for the evaluation of private roads. Inadequate maintenance of private roads can have serious implications. If not properly maintained, roads may deteriorate to the point at which they become impassable or could damage vehicles that attempt to pass, including emergency vehicles.

2.4 Evaluating Road Conditions

The evaluation of all roads is an important part of any road management system. Knowing the condition of the roads is essential to determine priorities for maintenance and repairs. Most

towns in Massachusetts have a pavement management plan and a system in place for assessing the condition of major public roads. According to the Central Massachusetts Regional Planning Commission (CMRPC), a pavement management system develops a list of the improvements that have to take place and prioritizes the projects based upon the resources available by the responsible party for maintenance **(**Central Massachusetts Regional Planning Commission 2012**)**. One system used by various towns in Massachusetts and other states to evaluate and prioritize the repair of the roads is the Road Surface Management System (RSMS). RSMS is a software package developed by the University of New Hampshire that incorporates standardized criteria for the evaluation of the roads. For example, the Town of Greenfield, New Hampshire conducted an inventory and assessment of road surfaces in 2011 using RSMS. This program was useful to their research because it prioritizes projects based upon a multitude of factors including repair strategy, drainage, traffic, importance, road conditions, and roughness. This study discusses how many towns set their priorities solely based upon the condition of the roads and ignoring the many other important factors (New Hampshire Technology Transfer Center 2011). By placing top priority of repair on the roads in the worst condition, roads that may be more important, such as routes to hospitals and bus routes may not be repaired early in the process, when in reality they should be higher priority. The consideration of many factors when prioritizing, other than just conditions of the roads, leads to more informed prioritization (New Hampshire Technology Transfer Center 2010).

Other towns may use different approaches and/or software to evaluate their roads. For example, Mainetti, Lashmit, and Lashmit (2007) conducted an assessment of roads in Boxborough, Massachusetts. They focused on the condition of the pavement, street signs, guardrails, sidewalks, and storm drains and developed a scale from poor to excellent in order to assess the conditions of the roads. A road classified as excellent was one that did not have any potholes or cracks and a road classified as poor had severe cracks and potholes. The roads that were in poor condition were prioritized for repair.

While it appears the state and many towns systematically evaluate the condition of paved public roads and develop pavement management plans to set priorities and schedules for maintenance and repairs, the group was unable to find any evidence that towns in Massachusetts

systematically evaluate the conditions of unpaved private roads. This may be because the towns have limited budgets and no direct responsibility to maintain or repair unpaved private roads. The RSMS software, however, can be used for the evaluation of either paved or unpaved roads. RSMS contains evaluation matrices and protocols for both road surfaces. The unpaved evaluation protocol evaluates the condition of the road based upon the severity and extent of loose aggregate, dust, corrugations, ruts, potholes, cross section, drainage, traffic count and importance as described below (New Hampshire Technology Transfer Center 2010):

- Loose Aggregate – any excess material on the surface of the road.
- Dust – the amount produced by cars creates issues in terms of visibility.
- Corrugations – perpendicular ridges on the surface of the road.
- Ruts – parallel indents created by tires due to high traffic volume.
- Potholes – holes created due to poor drainage systems and traffic.
- Cross Section – the slope of the road peaking in the center in order to allow runoff.
- Drainage – A poor drainage system does not allow water to leave the road's surface. This is characterized by the above as well as by the quality of the drainage ditches lining the sides of the roads.
- Traffic Count – based off of the number of cars on and homes adjacent to the road.
- Importance – how these roads are used by the town or city.

Nantucket has used RSMS to evaluate the condition of their paved roads. In 2005 The Nantucket Department of Public Works conducted a pavement management study to determine the current condition of their roads and estimate the likely costs of repairs. They have not, however, used RSMS (or any other tools) to systematically evaluate the condition of the unpaved private roads on the island.

2.5 Nantucket Roads

Nantucket Island, also known as "The Faraway Island" is located 30 miles off the south coast of Cape Cod. Although Nantucket is only 14 miles in length and three and a half miles wide, it has several types of roads and bike paths connecting multiple parts of the island (Town and County of Nantucket Massachusetts). In 1908, a special act of the Massachusetts legislature banned the operation of motor vehicles on the island. Only ten years later, in the spring of 1918, the act was

repealed by voters. Among concerns of the voters was a quick response of emergency vehicles and fire trucks to accidents throughout the island (Karttunen 2008). Today, summer and year round residents as well as town officials have similar concerns about the ability of emergency vehicles to safely navigate on private roads.

2.5.1 Private Roads on Nantucket

GIS data show that there are 86.2 miles of public roads (including mostly town roads, but also a stretch of state highway known as Milestone Road), 89.6 miles of private roads, and 223.7 miles of roads with undetermined ownership (Figure 1). Roads are considered to be private when they have not been taken, accepted and recorded by the Town of Nantucket. Roads that have undetermined ownership are likely to be private, unpaved proprietor's ways. These as well as the private roads make up 78% of all the roads on Nantucket (M. Burns, personal communication, August 7, 2012).

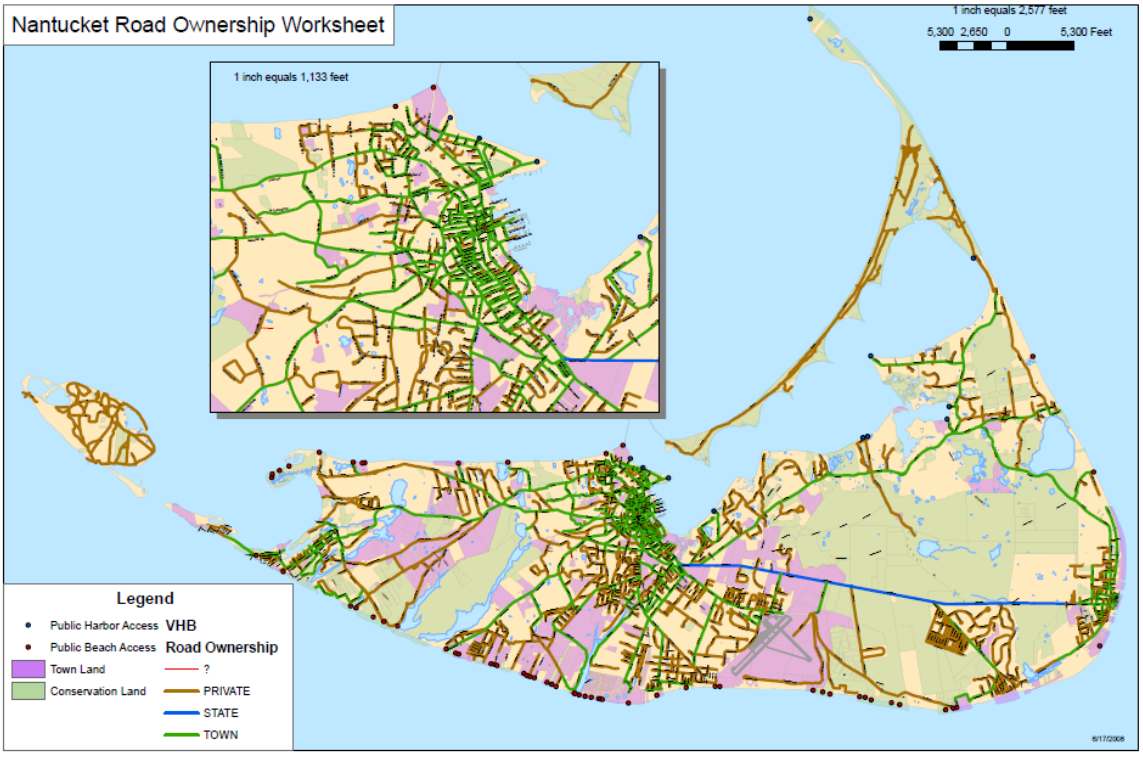

Figure 1: GIS map of Nantucket showing the private and public roads (Atherton et al. 2009)

2.5.2 Legal Aspects of Private Roads on Nantucket

The Nantucket Department of Public Works has primary responsibility for the construction and maintenance of the public ways. It uses town, state, and available federal funding for

maintenance and a pavement management plan to determine priorities. Like most towns throughout Massachusetts, the DPW does not have direct responsibility to maintain and repair the private roads except in cases of public safety or in response to an abutter's request and the Board of Selectmen's (BOS) approval; therefore there is no system in place to evaluate private roads. Instead, the private roads are under control and ownership of private owners or groups such as neighborhood and homeowners' associations. Since the cost of maintaining these private roads is so high, the Town has been reluctant to take over the responsibility of the private roads.

There have, however, been several projects regarding the improved maintenance of private roads on Nantucket. The Roads and Rights of Way Committee has been particular concerned about upgrading and maintaining the condition of private roads between the airport and Surfside. The three major problem roads are Monohansett Road, Okarwaw Way, and Boulevarde, (Figure 2). These are roads often used by the public to cut-through to the airport from Surfside and vice versa. In 2003, the Town planned to spend $17,500 filling potholes (Kinsella, 2003). In order to proceed, the Town needed 50% of the abutters to agree to help fund the repairs. Unfortunately, only a minority of abutters agreed and the Town was unable to complete the project (A. Reinhard, personal communication, October 25, 2012). These roads are still a top priority for the Roads and Rights of Way Committee to date, and they are still trying to find a way to fix them, but it is difficult because of the nature of maintenance of private roads and the lack of landowner interest.

The Town of Nantucket has an *encroachment policy*, which allows the Town to mandate the removal or repair of anything preventing access on public roads, such as vegetation or obstructing fences and wires. If the encroachment does not pose an immediate threat to the public, the policy requires the Town to notify the landowners of the encroachment and then allow the owners to fix the encroachment within 15 days of the notification. After the 15 days, the Town is able to remove or fix the encroachment and then bill the homeowners. If the encroachment poses an immediate threat to the public's safety, the Town has the right to remove the encroachment immediately and then bill the landowner for the cost of removal. This encroachment policy does not currently cover encroachments on private roads specifically, but encroachments blocking public access on private roads may still fall under this policy. The Town

of Nantucket has had difficulty with enforcement of the encroachment policy and thus the Roads and Rights of Way committee is creating a new policy to address this issue (A. Reinhard, personal communication, October 25, 2012).

Figure 2: Google Map of Boulevarde (left), Okarwaw Way (center), and Monohansett Road (right) (Nantucket, MA 2012).

2.5.3 Emergency Vehicle Issues on Nantucket

The ability for emergency vehicles to pass over all roads is of the utmost importance for the safety of the general public. When emergency vehicles are unable to pass or sustain damage from the roads, the owners of said roads are liable for the costs of the damages. These damages could include repairs to the vehicles or loss of life and property due to lack of emergency access. According to the Fire Department, the conditions of the private roads on Nantucket prevent emergency vehicles from getting to accidents in a timely manner. The major problem regarding emergency vehicle access is the width of the roads (Figure 3).

The State of Massachusetts has regulations regarding the width of the roads so that emergency vehicles can pass safely. According to the Pioneer Institute for Public Policy Research, in Massachusetts, the narrowest roads in a typical subdivision are 18 – 20 feet wide. Roads that are wider than 20 feet are better able to accommodate parked cars, two-way traffic, and emergency

vehicles. Typical subdivision roads include courts, lanes, and private roads and are intended to serve 10 – 30 houses or 100-300 vehicle trips per day (Pioneer Institute for Public Policy Research 2004). According to Robert Bates, the fire alarm superintendent on Nantucket, in order to ensure safe passage of emergency vehicles, straight sections of road need 16 feet of width and corners need to be at least 20 feet wide while the overhead clearance must be 14-18 feet. Although the fire department has two off-road fire apparatuses there are still problems with access (R. Bates, personal communication, October, 24 2012).

Figure 3: A Fire Truck Traveling on a Narrow Section of Gardner Road in Nantucket, MA

There are several reasons why private roads are too narrow for safe emergency vehicle access. Since many of the roads are old, there were no width regulations in place when they were constructed and they were often built to accommodate just one car. Even some roads that were constructed to accommodate two cars passing have become much narrower due to lack of maintenance and the encroachment of vegetation and debris.

While overhanging brush and branches can often be brushed aside as emergency vehicles pass, trees that grow close to the side of the road can severely limit effective road width and entirely prevent access by emergency vehicles. Some roads that should be straight, curve around trees and prevent fire trucks and larger vehicles from turning. Banks on the sides of the roads create a similar problem. Many banks found on the Nantucket roads are more than 3 feet tall and make the road too narrow for the passage of two vehicles (see Figure 3). When there are two vehicles on the road, the banks prevent one of the cars from being able to pull off the road so the other vehicle can pass.

The Nantucket private roads pose other issues for emergency vehicles as well. The road surfaces deteriorate over time as maintenance and repairs are not kept up. Imperfections such as potholes and excessive corrugation can lead to bumps and swales so large that emergency vehicles cannot pass without 'bottoming out' and causing vehicle damage. In the summer months, sandy roads become very soft and difficult to travel on without all-wheel drive vehicles. Another significant problem with the Nantucket roads is the lack of street signs and the fact that many of the house addresses do not match the road that the house is accessed from. The lack of street signs may impact emergency vehicle response time because the emergency response personnel may not be able to find the correct road. Incorrect addresses have caused problems in the past where emergency personnel have attempted to access the house from the street indicated in the address only to find the house inaccessible from that road. All of the issues with the Nantucket private roads have hindered the response time of emergency vehicles greatly and will continue to do so if not addressed (R. Bates, personal communication, October, 24 2012).

2.6 Conclusion

The Town of Nantucket has an extensive network of private roads, all of which the Town has no responsibility to maintain. The individual owner of each road has the responsibility to maintain their segment and without regulations for required maintenance, owners often do not adequately maintain the private roads. Anecdotal evidence has suggested that many of the Nantucket private roads are in very poor condition and this has impaired emergency vehicle access. There has been no systematic evaluation of the conditions of the Nantucket private roads to date, but such an evaluation is necessary to determine the extent of repair required as well as the priority of each road. In order to conduct a systematic evaluation of the unpaved private roads, the project team

modified the Road Surface Management System to fit the needs of the Nantucket DPW and Fire Department. The next chapter describes how the team modified and applied the RSMS approach.

3.0 Methods

The goal of this project was to evaluate the conditions of a sample of the unpaved private roads on Nantucket and to make recommendations for the repair and maintenance of the roads in order to ensure the safe passage of emergency vehicles. The team accomplished this goal by completing the following objectives. The group:

1. Clarified the nature of private roads and concerns about their condition and maintenance;
2. Identified the range of methods used to evaluate the conditions of private roads;
3. Developed road evaluation tools and protocols to assess the condition of private roads in Nantucket;
4. Implemented the evaluation protocol developed for the Nantucket private roads;
5. Evaluated the options to bring the private roads on Nantucket into compliance; and,
6. Recommended appropriate strategies and priorities.

The project team completed these objectives through a series of interviews with various people on Nantucket to gain insight into the local needs and identify roadway locations and conditions that present particular difficulties for emergency vehicle access. The team also conducted a systematic evaluation of the road conditions at these locations and used a modified version of the Road Surface Management System (RSMS) to develop a series of recommendations for the repair and maintenance of the roads.

3.1 Objective #1: Clarify the Nature of Private Roads

Prior to going to Nantucket, the project group conducted research on the complex hierarchy of roads in Massachusetts. They focused on how unpaved private roads are repaired and the regulations involved in their maintenance. When looking into the legal responsibilities regarding private roads, it was found that the landowners and homeowners associations carry a majority of the burden as far as maintenance costs are concerned. In cases where the condition of the private road jeopardizes public safety, the board of selectmen has limited jurisdiction over the repair. The selectmen board can force the landowners to pay for the maintenance through betterment fees, or pay to hand over the maintenance responsibilities to the Town.

While on Nantucket, the team built on the literature review to further clarify the nature of private roads through the use of interviews, meetings and additional background research. They conducted three face-to-face interviews. One such interview was with Robert Bates, the

Nantucket Fire Alarm Superintendent, another was an interview with Allen Reinhard, the chairman of the Roads and Right of Way Committee, and Erika Mooney, a member of the Traffic and Safety Work Group, and the final interview was with the Assistant DPW Director, Mohamed Nabulsi. The team also conducted meetings on a weekly basis with their sponsor, Kara Buzanoski. These interviews were semi-structured and the team collected information on the following topics:

- Current conditions of the private roads;
- Problems associated with ensuring the maintenance and repair of the private roads;
- Previous efforts to evaluate unpaved road conditions;
- Past instances of damage to emergency vehicles or problems with emergency vehicle access due to the road conditions;
- Road requirements for the safe passage of emergency vehicles;
- How the current conditions affect daily travel; and,
- Any other concerns they may have with the conditions and evaluation of the unpaved private roads.

The group also reviewed some policy documents and past articles from the *Nantucket Inquirer and Mirror*. They focused on articles from the *Nantucket Inquirer and Mirror* concerning past problems with the private roads and any efforts to resolve the issues. The team was also able to look into a draft of the new Encroachment Policy that the Roads and Rights of Way Committee is writing.

3.2 Objective #2: Identify Methods Used to Evaluate Private Roads

Through their prior research, the team has found that there are very few, if any, towns that conduct systematic evaluations of private unpaved roads. Many towns use pavement management systems to help maintain their infrastructure system. Prior to coming to the island, the RSMS program seemed to be the most appropriate system for evaluating unpaved roads. In the past, Nantucket has used the RSMS program to evaluate the condition of their paved public roads and thus the system was available for the team's use. After meeting with Mohamed Nabulsi, the project team realized that the RSMS software would not be particularly useful in their analysis of private roads. The Nantucket DPW only has one computer with the software

installed and the group members were unable to install the software on other computers. This would have limited the effectiveness of the project because few people would have been able to access the data and the continuation of data collection and entry after the group's time on the island would not have been viable. Instead, at the behest of the sponsor, the group decided to use Microsoft Access and Google Maps to input and organize their data, as these programs are easier to use and would allow a greater spectrum of people to have access to the data. The team did, however, use the RSMS criteria for road evaluation as the starting point for their evaluation protocol.

3.3 Objective #3: Develop Road Evaluation Tools and Protocols

Through meetings and interviews with the DPW staff and emergency response personnel, the team was able to modify the RSMS road condition survey in order to make it applicable to the general concerns associated with the Nantucket private roads. They learned that the width of the road and the overhead clearance were major issues with the Nantucket private roads and that some of the criteria they had thought to be important, such as the drainage and crowning, were no longer as important to their evaluation.

The team's road evaluation included the collection of basic information on a road summary sheet (Appendix 1) such as the name of the road, starting and ending locations, and total length, as well as information about the conditions of the road segments collected on the group's Road Condition Survey Sheet (see Appendix 2) (adapted from: New Hampshire Technology Transfer Center 2010, Walker 2000, Huntington et al 2010, Malcolm et al, Colin et al 2011). The team's protocol called for the measurement of the width of both straight and curved sections of road, the height of the clearance between the road surface and any overhanging branches and wires, and the severity and extent of loose aggregate, potholes, corrugations, and ruts. Another important aspect of their protocol was to evaluate the total residential volume, the year-round residential volume and the importance of each road. The total residential volume is measured by counting the number of houses on the road, the year-round residential volume is measured by counting the number of year round residents versus the number of seasonal residents, and the importance is ranked by giving roads that lead to the beach or other areas of public interest, roads that are connectors between major roads, and roads that have a high number of side streets only accessible from that roads a higher importance. The team used the Nantucket Town GIS map to

count the total number of houses and the number of seasonal residents and thus calculate the total residential volume and year-round residential volume of each road. The total residential volume, year-round residential volume and importance are all factored into the prioritization of the roads so that the conditions of the roads are not the only factor in the prioritization. For example, if the condition of a road renders it virtually impassable by an emergency vehicle, but is a dead end with no side streets and only has two seasonal houses, then it will be of low priority.

The Fire Department on Nantucket developed a priority listing of roads and road segments that needed to be evaluated based on local knowledge concerning the condition of the roads. The group used this list to develop a strategy for their evaluation by grouping them based on their general location on the island. They were then able to plan which roads to evaluate based on their locations. For instance, there were 11 roads in the area of Nantucket known as Tom Nevers and thus the team spent a day in that area evaluating those roads.

After finalizing their evaluation protocol, the group conducted a calibration period of one afternoon where they measured the imperfections in the roads with a measuring tape and a measuring wheel. This process oriented each member of the project team to the use of the protocols to ensure consistency in evaluations among team members and also allowed the team to conduct the evaluations faster and more efficiently without directly measuring the imperfections. During this calibration period, they determined that the best way to segment the roads was by a quick visual analysis of the general condition of the road. For example, a section with no surface issues was evaluated separately from sections with major potholes and corrugations. When the general conditions changed drastically, the team created another segment in order to have consistency with their results. They recorded their data in the field on the matrixes and entered it into Microsoft Access and Google Earth afterwards.

The Access database has three front-end entry forms in which the data collected from the field can be entered. These forms cover the Unpaved Road Condition Survey (Appendix 3) and the Road Summary Sheet (Appendix 4), as well as the equipment cost for repairs (Appendix 5). The data inputted into these forms goes directly into tables in Microsoft Access. As information within the database is changed, queries can be run to update the repair costs and prioritization

values of the roads. Queries can also be run to find specific information on one road and to find out which sections have certain values for corrugations, loose aggregate, potholes, and rutting. This is a simple and effective way for the DPW to collect, update, and keep track of data regarding the private roads on Nantucket.

The project team used Google Earth to map out the roads that Robert Bates identified as problem areas. Before surveying the roads they added a path that outlined each of these roads so they could get an idea of their locations and lengths to use as a resource during their surveys. Once the team collected all of the data, they created surface condition and width maps that identified the problem areas using different colors to represent the type and severity of the problem.

3.4 Objective #4: Implement a Strategy for Evaluating the Roads on Nantucket

To collect the data on the roads, the group biked to the different parts of the island that the Fire Department identified as problem areas. The team implemented their evaluation protocols at each location and afterward, inputted the data they collected along with cost estimates for repairs into Microsoft Access.

In order to evaluate the roads on Nantucket, the group used their modified matrix to survey the current conditions of the private roads. They began evaluating the condition of the road by measuring the road segment's length with a measuring wheel, and then measuring the segment's width and height with a measuring tape and measuring stick. The group members based their width and height requirements for overhead clearance on the requirements provided to them by the fire department. The fire apparatuses require roads to be at least 16 feet wide on straight sections, 20 feet wide on corners, and have a minimum overhead clearance of 14 feet. The group then evaluated the severity and extent of loose aggregate, corrugations, rutting, and potholes on the road and recorded the data in the matrix. To measure the total length of the road, they used Google Maps and to determine the total residential volume and the year-round residential volume, the team used the information available in the Nantucket GIS.

3.5 Objective #5: Evaluate the Options to Bring the Private Roads into Compliance.

After evaluating the roads in the field and collecting all of the data including the cost options for repair of the roads, the project team entered the data into the Microsoft Access database and recorded roads and road segments on maps of Nantucket from Google Earth. This allowed them to organize the data so that the team could prioritize the roads based on the conditions, cost, and importance. The project group used six criteria to determine the priority of each road:

1. Surface Condition;
2. Width;
3. Overhead Clearance;
4. Total Residential Volume;
5. Year-round Residential Volume; and
6. Importance.

The team assigned numbers for each of the above categories for the relevant roads or sections of roads. These numbers were then converted into rating values based on their scale explained below. The group utilized Microsoft Access to convert all of the values into rating values through the use of coding. They coded their systems for rating into Access so that the data based would automatically update when new data was entered.

For surface condition, each segment of road was assigned a number from 0-9 for corrugations, ruts, loose aggregate and potholes based on the team's evaluation matrix (Appendix 1) To classify the rating based on the surface condition, the team used the values given to each road based on their evaluation matrix and reassigned the road a value of zero to three. Table 1 shows the system used to convert the surface condition evaluation value in a rating value and how the team classified each type of road.

Prior to beginning their evaluation, the team was provided with both the actual width of the fire trucks on Nantucket and the preferred width of the road for fastest and safest passage. The fire trucks are just under ten feet wide and thus the group determined that any road that was less than ten feet in width would be impassable for a fire truck. The group members were given 16 feet as the preferred minimum width for safe travel and thus they determined that any road wider than 16 feet would not have an issue with width. Table 2 shows the rating values regarding road width.

Table 1: Surface Condition Rating System

Surface Condition Evaluation Value	Classification	Rating Value
0	No Issue	0
1-3	Passable	1
4-6	Increase Response Time	2
7-9	Impassable	3

Table 2: Width Rating System

Measured Width of Road	Classification	Rating Value
≥16’	No Issue	0
13’-15’11”	Passable	1
10’-12’11”	Increase Response Time	2
<10’	Impassable	3

The team also assigned rating values to the roads based on the width of the corners. Emergency vehicles have a very large turning radius and thus require the corners to be 20 feet in width. If the road is less than 20 feet wide at the corners, then the road will be considered impassable, thus the group assigned any road that had corners of less than 20 feet wide a rating value of three and any road that had no corners under 20 feet wide a rating value of zero.

The project team also assigned rating values to the roads based on the height of the overhead clearance. Through their evaluations, the group found that height was not a very big issue with the roads and determined that most of the height issues would be fixed when other brush cutting was done on the roads. Therefore, they assigned any road that had an issue with overhanging brush being less than 14 feet, the minimum height given by the Fire Department, a one on the rating scale and any road that did not have any overhead issues was assigned a zero.

The group members also rated the roads based on the total residential volume and the year-round residential volume. After determining these volumes through the use of the Nantucket GIS, they utilized the range of houses to develop a scale for each of the categories. The system used for the total residential volume is in Table 3 and the system used for year-round residential volume is in Table 4.

Table 3: Rating System for the Total Residential Volume

Total Number of Houses on Road	Rating Value
0	0
1-16	1
17-32	2
≤33	3

Table 4: Rating System for the Year-Round Residential Volume

Number of Year-Round Residencies	Rating Value
0	0
1-8	1
9-16	2
≤17	3

The final aspect of the group's rating was the importance of each road. They assigned rating values based on the number of side streets only accessible from the road, whether the road is a connector between two major roads, and whether the road accessed the beach or another area of public interest such as a Nantucket Land Bank. Table 5 shows the rating system used for the importance of each road.

After developing all of the scales for the rating, the team determined which criteria should carry more weight. Discussions with both Kara Buzanoski and Robert Bates, helped to determine that

the importance factor should carry the most weight and that the year-round residential volume should carry the second most weight. Therefore, the team multiplied the importance rating values by 1.66 and the year-round residential volume by 1.33 to weight these values.

Table 5: Rating System for Importance

Classification	Rating Value
No beach access, no side streets, not a connector	0
1-2 side street only accessible from the road	1
Beach access/another area of public interest and/or 3-4 side streets only accessible from road	2
Connector between major roads and/or >4 side streets only accessible from road	3

They then used Microsoft Access to add all of the rating values together to develop a priority value for each road. Before determining the priority value for the entire road for surface condition and width, the team assigned the rating values for each section in these categories and then took the maximum value of any section in that particular road and made it the rating value for the whole road. They did this because regardless of which and how many sections have a rating of three for corrugations, the road will still be impassable, even if the rest of the road has a one for corrugations.

3.5.1 Cost Analysis

Once the group had collected all of their data and had all of the priority values, they began their cost estimations for the repairs of the roads. They coded the Microsoft Access database so that the cost values would be calculated by the software based upon the type, extent and severity of surface imperfections as well as the width of the road and the removal of blockades. The group coded Microsoft Access to first calculate the cost of each section and then to add all of the sections together to get the total cost to repair the road. To calculate the costs for repairs, the DPW provided the team cost estimates for the use of equipment and how long each imperfection required for repair. Table 6 shows the costs of labor, equipment rental, and gravel fill.

Table 6: Equipment Prices

Type	Cost	Unit
Brush Hog	$75.00	Per hour
Chain Saw	$35.00	Per hour
Chipper	$75.00	Per hour
Grader	$150.00	Per hour
Gravel Fill	$50.00	Per cubic yard
Skid Steer	$100.00	Per hour

The team was also given the type of labor and the amount of time it would take to fix each type of imperfection and width problem (Table 7).

Table 7: Labor and equipment required for each type of repair.

Type of Repair	Labor and Equipment Required
Blockade removal	Two men labor, no equipment, (one hour)
Filling in potholes	Gravel fill (only for medium and high severity potholes), grader, (one half hour/100 feet)
Small corrugations (1-6 on evaluation scale)	Grader, (one half hour/100 feet)
Large corrugations (7-9 on evaluation scale)	Gravel fill, grader, (one hour/100 feet)
Loose Aggregate	Grader, (one half hour/100 feet)
Rutting	Grader, (one hour/100 feet)
Brush Cutting	Four men labor, brush hog, chipper, skid steer, (one hour/100 feet)

Due to their limited time on the island, the group did not measure the exact size of every pothole and corrugation on the selected roads and thus when calculating the volume of gravel fill needed, they used an estimated average for the different severities. For roads that had potholes of medium severity, the team estimated, based on their evaluation system, that the potholes were

1.5 feet in diameter and three inches in depth. For roads with potholes of high severity, it was estimated the potholes to be 1.5 feet in diameter and five inches in depth. To calculate the extent of potholes per section, the group estimated that there were, on average, four potholes per 100 feet for the sections with a low extent (four or seven on the evaluation), eight potholes per 100 feet for the sections with a medium extent (five or eight on the evaluation), and 12 potholes per 100 feet for the sections with a high extent (six or nine on the evaluation). For high severity corrugations, they estimated that, on average, the corrugations were two feet deep and then they calculated the volume of the corrugations based on this depth and the area of the road based on the length and the width of the road. However, because corrugations consist of a series of swells and holes, the entire road will not require fill, and therefore, the team divided the volume by two for a more accurate estimation because where there is a hole that needs to be filled in, there is also a swell that does not.

After discussions with their sponsor, it was determined that the removal of banks would not be included in the cost estimates. Banks pose great difficulty in estimating the cost of repair because the estimates depend on the height of the banks as well as the width of the road and how far back the banks must be cut. There are also legal issues that can become problematic when cutting into private property to remove the banks. Kara Buzanoski thus decided to leave the estimation for bank removal out of the formula for cost estimate. This, however, does not lessen the need to address the issues of banks creating a narrow road surface.

3.6 Objective #6: Providing Options and Recommendations for the DPW

After evaluating the different options for the prioritization and repair of the roads, the group presented their findings to the DPW. They highlighted the worst roads and road segments, provided them with information on how they should be fixed, and estimated the cost of repairing these roads. Based upon those factors, the team assigned priority to the roads that need to be fixed. The team recommended long term and short-term goals for fixing these private roads and others on the island. The group also recommended that they complete other similar projects in the future based upon the additional issues that were found with these and other roads on the island.

The project team also created a brochure (Appendix 6) to aid in the education of the landowners of their responsibilities to repair and maintain the roads so that emergency vehicles can pass on the roads. This brochure will be for the use of the DPW, fire department, and homeowners associations on the island.

4.0 Findings

The following chapter outlines the results of the findings from the group's work on Nantucket. First, they discuss the results from their evaluation and their subsequent assigning of rating values according to the criteria used in their evaluation. These values were then weighted and added in order to assign a priority value for each road and to develop a prioritized list of roads. The team then calculated estimations for the cost to repair each road. Throughout their work on Nantucket, the team also identified several other issues with the private roads that were not a part of the standardized evaluation, such as the problems that incorrect addresses and 'paper roads' present for emergency response. These issues are discussed in the last section of this chapter.

4.1 Assigning Rating Values

After developing their evaluation protocol and gathering information about the roads, the team began to collect data on the roads by implementing their evaluation protocol. The team evaluated 38 private roads by dividing them into a total of 131 sections for the surface condition, height, and width and evaluating the road as a whole for the residential volume, year-round residential volume and importance. The team then recorded the data into Microsoft Access and Google Earth and assigned rating values for each category as described in their methods. Figure 4 shows a map of all of the roads evaluated.

Figure 4: Map showing the location of the thirty-eight evaluated roads (Nantucket. MA. 2012).

4.1.1 Surface Condition

Figure 5 shows a graph of the number of roads that were classified as a 0-3 on the rating scale based on the severity of the surface condition. To assign these values, the team assigned each road the highest surface condition value of the worst section of road because if one section of road is impassable, it would prevent passage to other parts of the road. Eighteen of the roads were classified as a three on the rating scale in terms of surface condition because they had severe road condition problems that rendered the roads impassable by an emergency vehicle, seven were classified as a two on the rating scale because they had moderate road conditions that would slow down emergency vehicles, ten were classified as a one because they had small surface imperfections and two were classified as a zero, indicating that they had no surface imperfections.

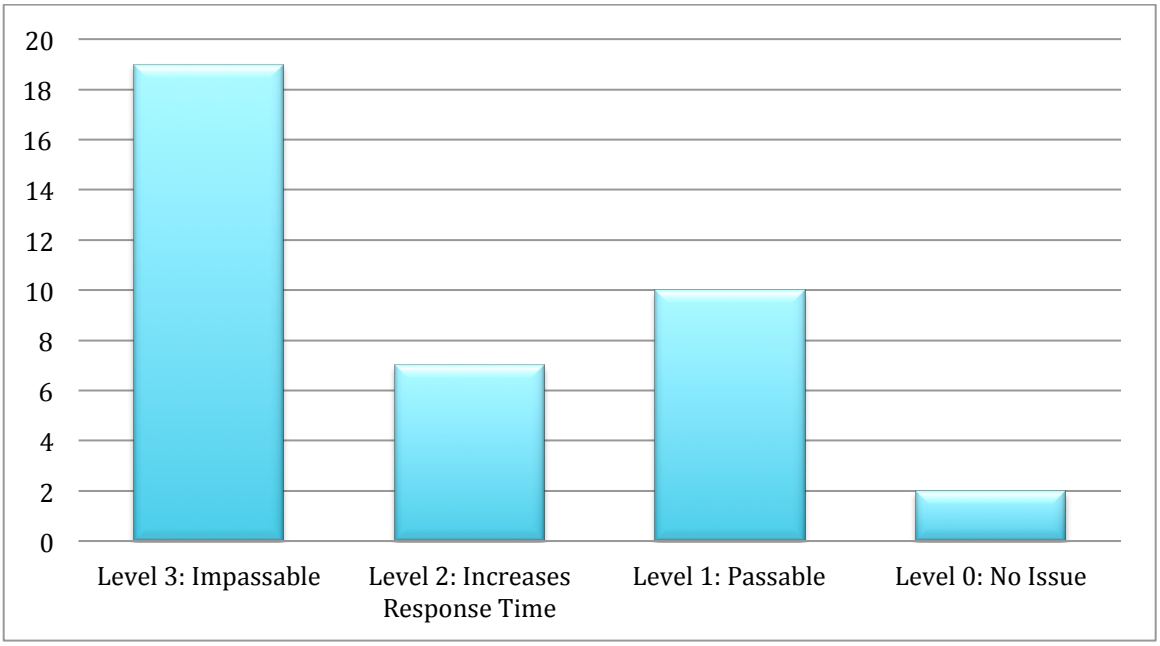

Figure 5: Graph showing the number of roads with each level of surface condition.

Figure 6 shows the location of road segments and their ratings according to surface conditions. Red segments are considered impassable (rated at 3), the yellow segments would result in increased response times (rated at 2), and orange segments are passable but still have some low severity surface condition imperfections (rated at 1).

Figure 6: Map showing road segments rated by surface conditions (Nantucket. MA. 2012).

4.1.2 Width

The team used a similar scale to rate road segments based on width (i.e., (0) good condition (1) passable, (2) would increase response time, (3) impassable). Figure 7 shows 24 roads were rated as a three, meaning the road was less than ten feet wide and thus completely impassable for fire trucks, which are almost ten feet wide. Eight roads were classified as a two, indicating the width of the roads would slow down the emergency vehicles greatly but would not completely stop them, and four roads were classified as a one, indicating that their width allowed passage of emergency vehicles but was still not as wide as the desired 16 foot clearance. All 38 of the roads evaluated would restrict emergency access to some extent due to narrowness. The project group also found the widths of corners on the roads to be a problem. In order for a fire truck to be able to turn a corner, there must be 20 feet of clearance. Seventeen of the roads evaluated had corners less than 20 feet in width and were assigned a value of three. Nineteen roads were rated as zero because they either had no corners or the corners were wider than 20 feet.

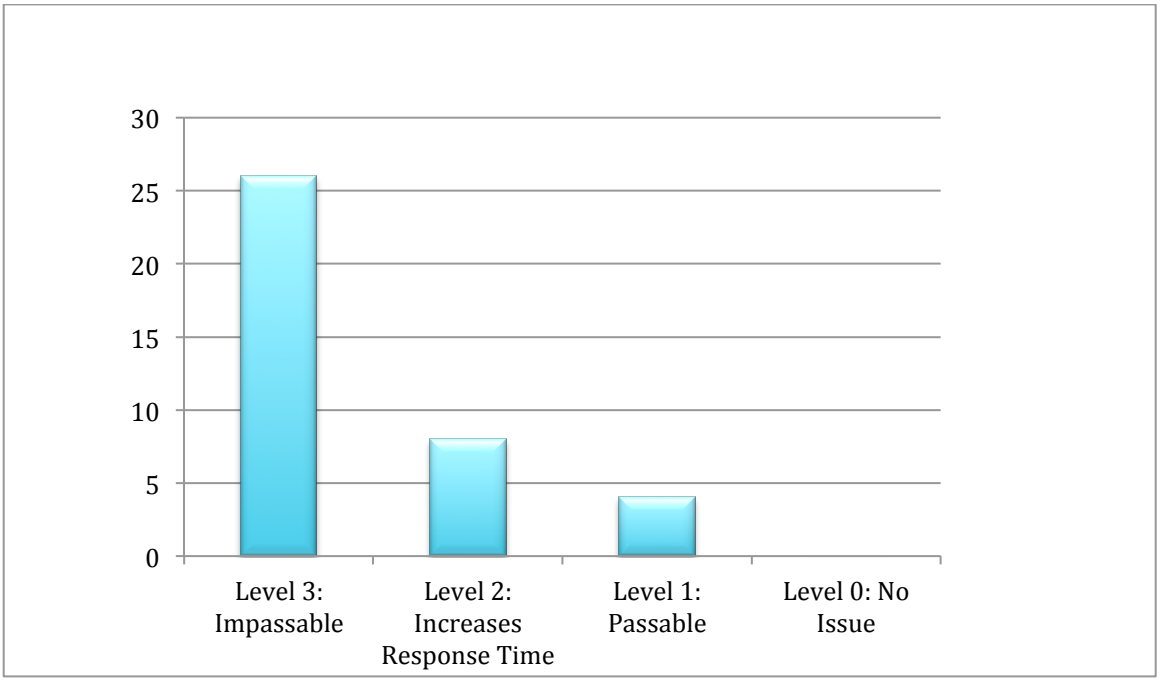

Figure 7: Graph showing the number of roads with different levels of width.

Figure 8 shows the location of the roads rated according to width.

Figure 8: Map showing the width of the evaluated roads (Nantucket. MA. 2012).

4.1.3 Overhead Clearance

The team also evaluated the overhead clearance along the roads. They found that the overhead clearance was not a concern along most of the roads. Nineteen roads had 14 feet of vertical clearance and were assigned a value of zero. Seventeen roads that had a few overhanging branches that restricted clearance to less than 14 vertical feet, but they would easily be removed while cutting brush to widen the road. A rating of one was assigned to each of these roads.

4.1.4 Importance

Another category that was used to determine overall road priority was the importance. The importance was determined based upon the following: whether or not the road was a connector between two major public roads, how many side streets were only accessible from that street and whether the road was an access point for a beach or another point of public interest such as a Nantucket Land Bank (Table 5). Three of the roads evaluated – Cato Lane, Millbrook Road , and Wannacomet Road – were connectors and thus given a three, the highest rating in this category (see Table 8). Cato Lane connects Vesper Lane and Bartlett Road (Figure 9), Millbrook Road connects Madaket Road and Hummock Pond Road (Figure 10), and Wannacomet Road connects Madaket Road and Cliff Road (Figure 11).

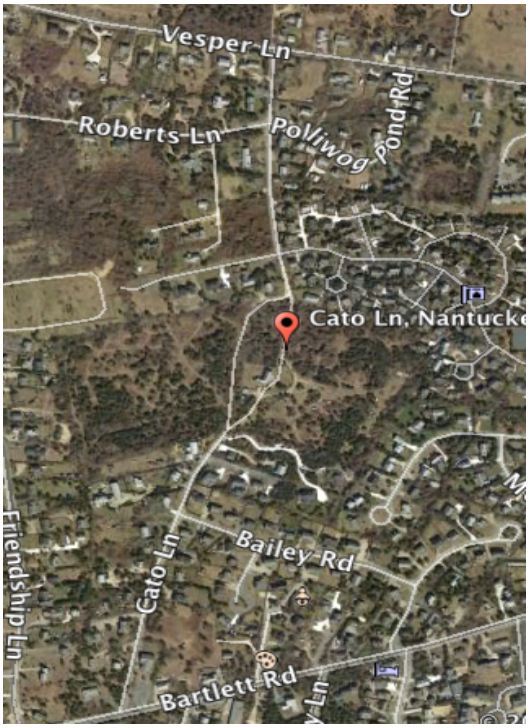

Figure 9: Map of Cato Lane (Nantucket. MA. 2012).

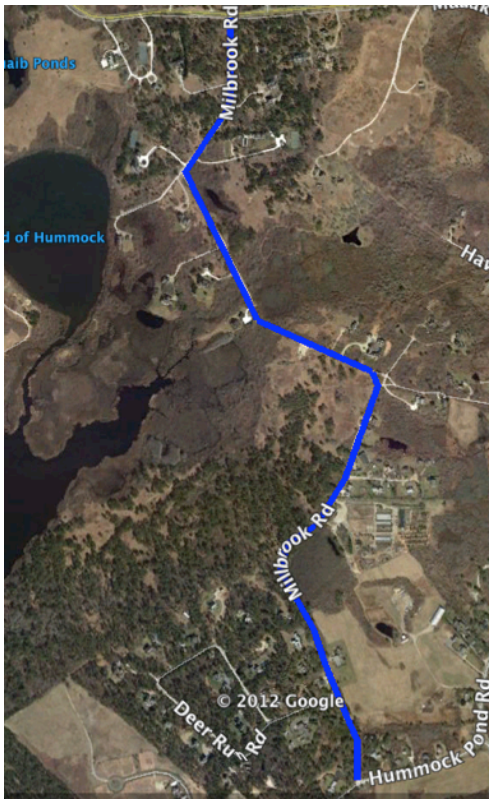

Figure 10: Map of Millbrook Road (Nantucket. MA. 2012).

Figure 11: Map of Wannacomet Road (Nantucket. MA. 2012).

Table 8: Prioritized List of Roads with Rating and Prioritization Values

ID	Road Name	Residential	Use	Importance	Max Surface Condition	Max Straight Width	Max Corner Width	Max Height	Prioritization Value
5	Cato Ln	2	3.99	4.98	3	3	3	1	20.97
32	Somerset Rd	3	3.99	3.32	3	3	3	1	20.31
26	Millbrook Rd	2	2.66	4.98	3	3	3	1	19.64
16	Folger Av	2	2.66	1.66	3	3	3	1	16.32
36	Wannacomet Rd	1	1.33	4.98	3	3	3	0	16.31
17	Gardner Rd	1	1.33	3.32	3	3	3	1	15.65
2	Austine Locke Way	1	1.33	3.32	3	3	3	0	14.65
19	Hawthorne Lane	1	2.66	0	3	3	3	1	13.66
14	Field Ave	2	2.66	1.66	3	3	0	1	13.32
10	E. Creek Rd	1	1.33	0	3	3	3	1	12.33
27	Morgan Square	1	1.33	0	3	3	3	1	12.33
6	Columbus Ave	1	1.33	0	3	3	3	1	12.33
3	Burnt Swamp	1	1.33	0	3	3	3	1	12.33
24	Kendrick St	1	2.66	1.66	2	2	3	0	12.32
15	Fishers Landing Rd	1	1.33	1.66	0	3	3	1	10.99
37	Westerwyck Way	1	0	4.98	2	3	0	0	10.98
30	Oak Hollow	1	1.33	0	1	3	3	1	10.33
8	Crooked Ln	1	1.33	0	1	3	3	1	10.33
31	Osprey Way	1	1.33	0	1	3	3	1	10.33
33	Tautemo Way	1	0	0	3	3	3	0	10
34	Trinity St	1	1.33	1.66	2	1	3	0	9.99
1	Arkansas Av	3	1.33	0	3	1	0	1	9.33
11	Exeter St	1	2.66	1.66	2	2	0	0	9.32
20	Kimball Ave	1	0	1.66	3	3	0	0	8.66
13	Farm View Dr	1	1.33	0	3	2	0	1	8.33
21	Hinsdale Rd	1	1.33	0	3	2	0	1	8.33
23	Ipswich St	1	1.33	0	3	3	0	0	8.33
18	Gloucester St	1	1.33	1.66	2	2	0	0	7.99
9	Devon St	1	1.33	0	2	3	0	0	7.33
25	Marion St	1	1.33	0	2	3	0	0	7.33
12	Fairfield St	1	1.33	0	1	3	0	0	6.33
7	Cornwall St	1	1.33	0	1	3	0	0	6.33
28	North Star Ln	1	0	0	1	3	0	1	6
38	Wiltshire Av	1	1.33	0	1	2	0	0	5.33
35	Wall St	1	1.33	0	1	2	0	0	5.33
22	Huntington St	1	1.33	0	1	1	0	0	4.33
29	Norwood St	1	1.33	0	0	2	0	0	4.33
4	Caroline Way	1	0	0	1	1	0	0	3

Connectors are important for quick access for emergency vehicles to other roads off the main roads. Roads that have a lot of side streets that are only accessible by way of that road were also more 'important' and rated accordingly. Westerwyck Way (Figure 12) had seven side streets only accessible via Westerwyck Way and therefore, if Westerwyck Way is impassable, all of those side streets will be inaccessible. Beach access or access to another place of public interest where there may be large groups of people gathering seasonally, were given second highest priority.

Figure 12: Map of Westerwyck Way (Nantucket. MA. 2012).

4.1.5 Total Residential Volume and Year-Round Residential Volume

'Total residential volume' and 'year-round residential volume' were two other categories used in the evaluation. Year-round residential volume was weighted as the second most important factor in the prioritization because this indicated the number of year-round residents living on the road. On Nantucket, many houses are occupied for only limited periods, typically in the summer months. The owners may live in them during the summer, or rent them out. Therefore, the residential volume, or the total number of houses on the road, is not as important 'year-round

residential volume.' As Robert Bates pointed out, property will be lost if a seasonal house burns down during the off-season, but there will not be a loss of life. Due to the rural and private nature of the roads evaluated, many of the roads had few houses at all and even fewer year-round houses. Of the roads the team evaluated, Somerset Road had the highest year-round volume with 24 year-round houses out of 35 total houses on the road. Arkansas Avenue had the highest residential volume (58 houses) with 50 seasonal residences and only eight year-round residences. In general, the group found that roads closer to downtown Nantucket had a greater percentage of year-round houses while roads closer to the beach or farther off of the main roads tended to have a greater percentage of seasonal residents. There may, of course, be exceptions to this generalization. Figure 13 displays a graph of the residential volume vs. year-round residential volume of the roads evaluated.

4.2 Prioritization

An overall priority was then calculated by combining the ratings of each of the criteria. Through discussions with both Kara Buzanoski and Robert Bates, the team determined that in their priority scale, their category of importance should be weighted the greatest. Connectors and access to side streets are of the utmost importance because they create access to more than just the inhabitants of the single road. Connector roads and roads that lead to other side streets that are not in a passable condition pose a hazard to the inhabitants of the side streets as even if their road were in passable condition, the emergency vehicle would be unable to access their road. Therefore, the team multiplied the assigned rating values for importance by 1.66 and also multiplied the rating value for the year-round residential volume by 1.33 as year-round residential volume was determined to be of second greatest weight.

The team was able to program Microsoft Access to first assign the rating values, weight the values and sum the values to calculate each road's priority value (as seen in the last column of Table 8).

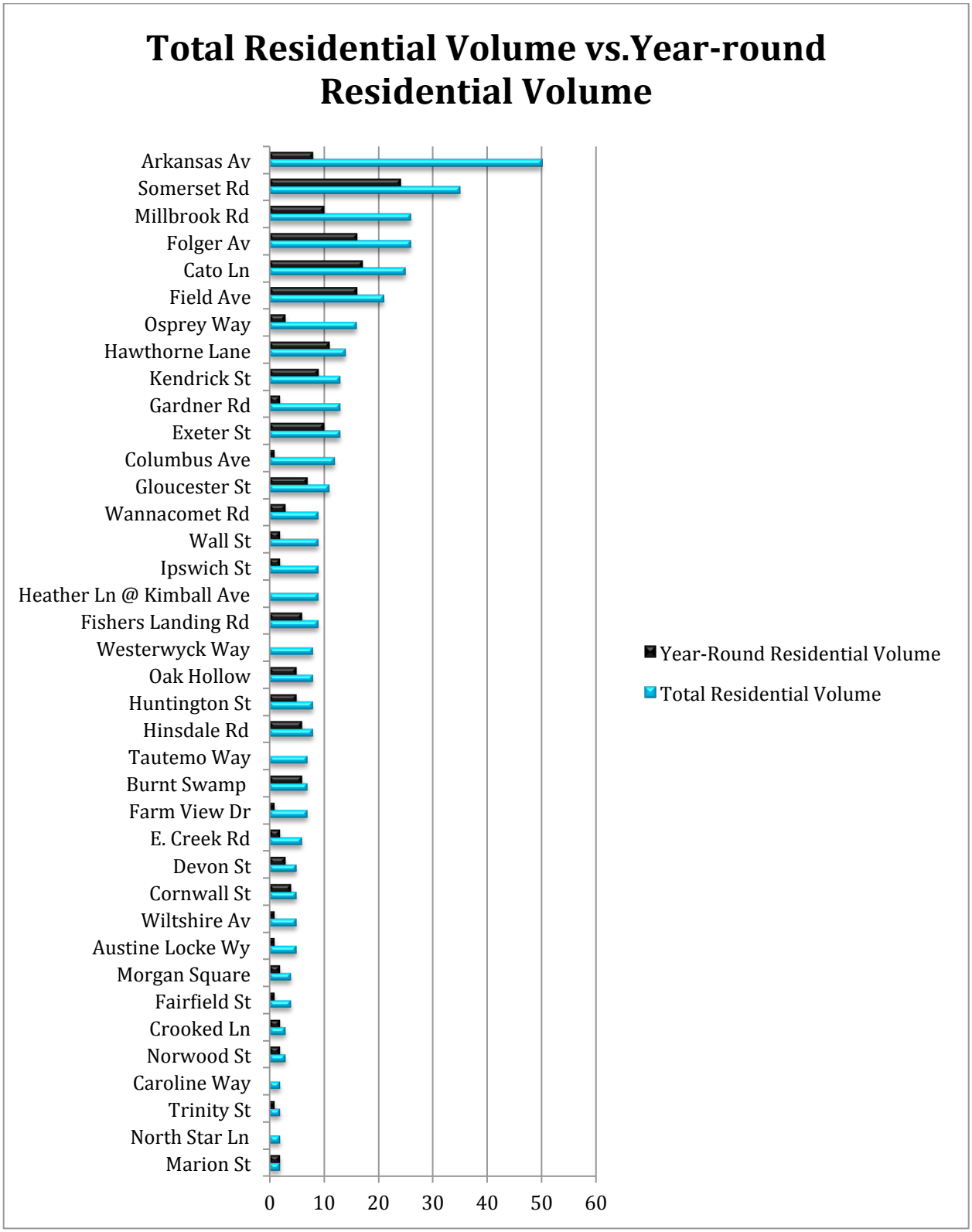

Figure 13: Graph showing total residential volume vs. year-round residential volume.

The project team then created a list of the top ten prioritized roads (Table 9). The maximum priority value that could be given to a road was 21.97 and the minimum value that could be assigned was zero. Cato Lane was given the highest priority rating of 20.97 because it scored high in all of the evaluation categories (see Table 8). One segment of Cato Lane was impassable due to surface conditions, limited width, and overhanging branches. Cato Lane also had one of the highest numbers of year-round residents, was in the second priority category for residential volume and is a connector. The prioritization scored Caroline Way as the road with the lowest priority with a priority value of three. Caroline Way was in a decent condition, scoring only a one for surface condition, a one for width and a one for residential volume in the rating scale (see Table 8). There were also some roads that scored high for the surface conditions, meaning the road was impassable, but the road is of low priority because it scored low on the other categories. For example, Ipswich Street scored a three for both the width and the surface condition on the rating scale, but only scored an 8.33 overall, ranking the road in a three way tie for 24th priority. Despite the poor surface conditions and width, the road did not have many houses and was not of great importance, and thus is not of high priority.

Table 9: Top Ten prioritized roads.

Ranking	ID	Road Name	Prioritization Value
1	5	Cato Ln	20.97
2	32	Somerset Rd	20.31
3	26	Millbrook Rd	19.64
4	16	Folger Av	16.32
5	36	Wannacomet Rd	16.31
6	17	Gardner Rd	15.65
7	2	Austine Locke Wy	14.65
8	19	Hawthorne Lane	13.66
9	14	Field Ave	13.32
10	10	E. Creek Rd	12.33
10	27	Morgan Square	12.33
10	6	Columbus Ave	12.33
10	3	Burnt Swamp	12.33

4.3 Repairs and Cost of Repairs

After collecting all of the information on the roads, the team began to apply the cost units for labor and equipment provided by the DPW for private contractors to the roads to calculate cost estimates for the repair of each road. The team was able to program the cost values into

Microsoft Access along with the labor and equipment necessary to repair each type of imperfections. These values were then added together to calculate the total cost of repair (Table 10).

Table 10: Total Cost of Repair for Each Road in Prioritized Order

ID	Road Name	Total Cost of Repair
5	Cato Ln	$13,460
32	Somerset Rd	$78,820
26	Millbrook Rd	$22,350
16	Folger Av	$13,825
36	Wannacomet Rd	$17,205
17	Gardner Rd	$37,545
2	Austine Locke Wy	$19,185
19	Hawthorne Lane	$19,985
14	Field Ave	$18,195
3	Burnt Swamp	$23,755
6	Columbus Ave	$10,330
10	E. Creek Rd	$5,405
27	Morgan Square	$9,440
24	Kendrick St	$22,325
15	Fishers Landing Rd	$4,875
37	Westerwyck Way	$3,010
8	Crooked Ln	$3,420
30	Oak Hollow	$5,835
31	Osprey Way	$24,795
33	Tautemo Way	$10,365
34	Trinity St	$6,975
1	Arkansas Av	$30,515
11	Exeter St	$12,835
20	Heather Lane @ Kimball Ave	$6,580
13	Farm View Dr	$1,020
21	Hinsdale Rd	$23,245
23	Ipswich St	$16,830
18	Gloucester St	$18,605
9	Devon St	$5,135
25	Marion St	$3,000
7	Cornwall St	$2,995
12	Fairfield St	$2,995
28	North Star Ln	$3,360
35	Wall St	$7,800
38	Wiltshire Av	$3,420
22	Huntington St	$3,850
29	Norwood St	$3,900
4	Caroline Way	$5,985

The total cost for the repair of a single road ranged from $1,020 (Farm View Drive) to $78,820 (Somerset Road). The most expensive repairs were brush cutting, and the repair of high severity corrugations and thus are two of the reasons for the high cost to fix roads such as Somerset Road and Gardner Road. The roads that are more costly to fix are also roads that are longer and thus generally have the greatest number of imperfections and the greatest area that needs fixing. Somerset Road was the longest road to be evaluated and thus had the most area that needed to be fixed. The cost estimates found in Table 10 do not include the cost of bank removal. Due to the different sizes of banks, and the different widths of the roads, coupled with the legal restrictions involved with cutting into private property, the team's sponsor decided against using bank removal in the cost estimates.

4.4 Other Issues of Concern

Based on the team's fieldwork and conversations with Robert Bates and Kara Buzanoski, they discovered that other issues affecting accessibility of private roads include the lack of proper addresses and the existence of 'paper roads' that have never been completed. An example of the issue with paper roads is in Tom Nevers (Figure 14). The area of Tom Nevers the team evaluated was originally planned by the developers to be like a grid, but many of the roads were not completed when the area was developed. Kara Buzanoski informed the team that because the houses could be accessed from another road, the developers did not complete construction of the road (personal communication, November 13, 2012). This has resulted in some roads having two sections that do not connect and thus can create confusion when accessing houses.

Figure 15 shows a section of Tom Nevers where undeveloped paper roads are an issue. The house highlighted in red is "27 Norwood Road" but is accessed from Wiltshire Ave, not Norwood Road. This is a result of Norwood Road not being fully developed; Norwood Road was only developed as far as the blue line shows. Other roads, such as Marion Street and Cornwall Street are show on this map as being undeveloped.

Figure 14: Map of roads in the area of Tom Nevers (Nantucket. MA. 2012).

Figure 15: Map Showing a Sub-section of the Area of Tom Nevers (Nantucket, MA, 2012)

Another example of inaccessible houses from the road is on Morgan Square. There are four houses with addresses on Morgan Square, as seen in Figure 16 below. The group found that it is impossible to access the two houses on the left from Morgan Square, and instead must be accessed from Brooks Road. In this case, these address problems could result in a significantly increased response time because the emergency vehicles would have to turn around on the narrow dirt roads leading to Morgan Square, and return to the main road to access Brooks Road.

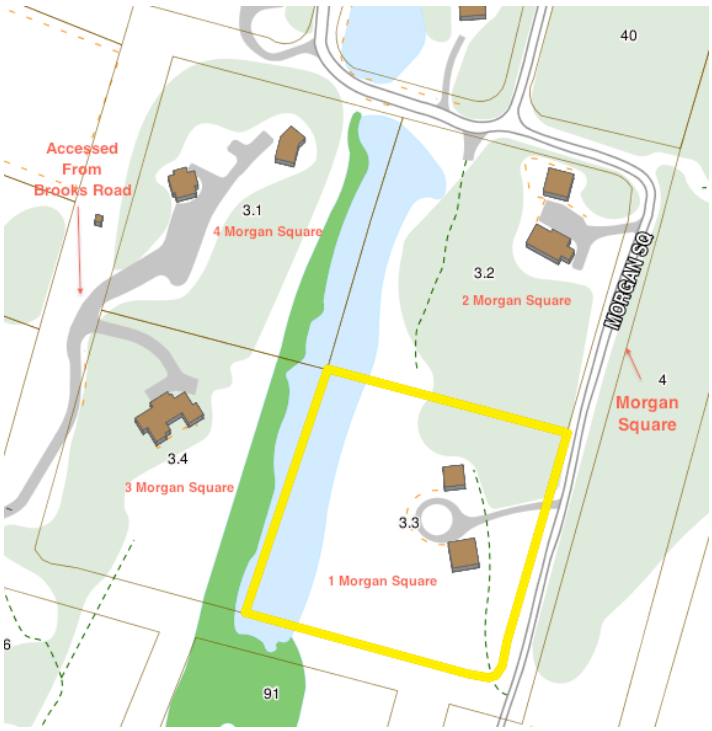

Figure 16: Nantucket Town GIS showing map of Morgan Square (Porter 2011).

The issues found with the addresses of Nantucket homes are a threat to public safety. Even if the surface and width conditions are adequate for safe and fast passage of emergency vehicles, unless the emergency response personnel are already aware of the houses that have incorrect addresses, they will go to the wrong road to access these houses.

A similar issue that was found to be present on many of the streets evaluated was the lack of proper street signs labeling the roads. Some of the roads were completely lacking any form of

identification and others had signs that were difficult to read. A lack of street signs could cause the emergency responders to become lost and lose time.

5.0 Conclusions and Recommendations

5.1 Conclusions

As in other towns in Massachusetts, Nantucket faces many daunting problems with respect to the maintenance and repair of private roads. The maintenance and repair of private roads is the responsibility of the landowners and thus the roads are often not maintained adequately. Seventy-eight percent of all roads on Nantucket are privately owned and many of the older private roads were constructed prior to the establishment of minimum width and other design requirements. The lack of maintenance regulations along with a lack of knowledge concerning their responsibilities has resulted in many owners neglecting their duties to maintain their road and thus the roads are now in substandard conditions. The poor conditions of the private roads on Nantucket inhibit emergency vehicle access. Nantucket Fire Department vehicles have been damaged trying to access the private roads, and the DPW is regularly called in order to extricate Fire Department vehicles that have become stuck on private roads. It may only be a matter of time before a property burns down or a person is harmed due to limited access or extended response times as a result of the poor condition of the private roads. In order to prevent further damages to emergency vehicles and possible future harm to life and property, the roads need to be fixed. However, in order to fix the roads, the DPW needs to know which roads require repair, and prior to this project, there was no standard evaluation protocol for private unpaved roads. Thus, the team created an evaluation protocol specific to the needs of the Nantucket Fire Department and DPW.

Applying the evaluation protocols to of a sample of 38 private roads revealed that 29 were impassable on at least one section due to either narrowness or poor surface condition. By extrapolation, the team expects that the conditions of many of the other private roads on Nantucket are such that they may be impassable or may greatly increase the response time for emergency vehicles. Thus, these roads may be a threat to public safety. The conditions of the private roads do not just impact the Fire Department and the DPW; they have a greater impact on the people who live on the roads because in case of an emergency, the emergency response team may be unable to access their house.

The 38 roads the team was able to evaluate during their time on Nantucket is only a fraction of the 580 private roads on Nantucket and thus there are many other roads that need to be evaluated. While the sample of 38 roads was intended to represent some of the worst private roads on the island based on the local knowledge of the Fire Department and DPW, the team observed other roads that were not in the sample, but were in similarly substandard condition. For example, Golf View Drive was not on the evaluation list, but is an access road for Farm View Drive, which was evaluated. Unfortunately, if Farm View Drive is fixed, the Fire Department will still have difficulty accessing roads on Farm View Drive because of the condition of Golf View Drive. Thus, even if the roads the project group evaluated and deemed impassable are fixed, the condition of other adjoining and connecting roads may still limit emergency access.

Through observation in the field and conversations with Robert Bates and Kara Buzanoski, the team has identified another worrying problem with private roads is the preponderance of incorrect address data. Incorrect addresses result from the existence of paper roads that were never completed and homeowner desires for address listings that belie the actual home location. Incorrect addresses can increase emergency response time because some houses may not actually be accessible from the street indicated in their address. If the emergency response personnel are not aware of specific address issues, they may go to the wrong road, thus wasting time. A similar issue is the lack of proper street signs on the private roads, often creating difficulty when locating the private roads and may cause emergency responders to waste time looking for unlabeled streets.

The team concludes that many factors may increase emergency response time on the private roads on Nantucket. An increased response time can mean the difference between life and death and thus the roads need to be repaired in a systematic and timely fashion.

5.2 Recommendations

Based upon their findings and conclusions the team has developed a list of recommendations for the Town of Nantucket. These recommendations include immediate steps to take to address the problem, as well as long-term steps to fix and prevent future problems. The project team recommends:

1. The Town develops a short-term strategy and timeline to fix the roads that are of top priority;
2. The Town reach out to homeowners and homeowners' associations to ensure they understand their responsibilities for the maintenance and repair of the private roads
3. The Town work with the homeowners' associations, the Fire Department and The Roads and Rights of Way committee to ensure they understand their responsibilities for maintenance and upkeep of private roads;
4. The DPW continue to use the protocols and database developed by the project team to evaluate and prioritize other roads on an ongoing basis; and
5. The Town develops a strategy to correct inaccuracies in the address data.

5.2.1 Recommendation # 1: Fixing Top Priority Roads

The group recommends that the Town facilitate the repair of the private roads to the extent possible by law, beginning with those assigned highest priority based on their evaluation and priority rating. The group's research has indicated that while the Town does not have the responsibility to maintain and repair private roads, they can, in cases of public safety and with the Board of Selectmen's approval, enforce the repair of private roads. The group recommends that the Town use their encroachment policy for public roads as a guide to enforce the repair of the private roads. This would involve warning the homeowners of the problem with their road and allowing them 15 days to begin steps to address the problem. If steps are not taken within 15 days, the Town should then fix the problem and bill the landowners for the cost of repair (Table 10).

Based upon their evaluation and priority rating, the team has arranged the roads into a prioritized list. **The team recommends that the Town focus on the roads of top priority, and as the top**

roads are fixed, moving down the list of roads. This prioritized list is not necessarily complete because the team did not evaluate all of the Nantucket private roads. They evaluated those that were indicated as problem roads by the Fire Department and thus there may be other roads that should be of higher priority. The team members are not certified civil engineers, so the Town may wish to conduct additional evaluation and cost estimation prior to setting final priorities and beginning work.

5.2.2 Recommendation # 2: Educating Homeowners

The team recommends the Town engage in various efforts to educate the landowners located along the private roads of their responsibilities to repair and maintain their roads. To aid in the education of the homeowners, the group members have created a brochure (Appendix 6). The Nantucket DPW often receives requests for the Town to come fix private roads because the owners do not realize that it is their job to maintain their road to a standard that is safe for emergency vehicles. Educating the owners of their responsibilities, the requirements for the safe passage of emergency vehicles and the legal and insurance implications of not adequately maintaining their road, will make the owners more likely to fix their roads without the intervention of the town. The group recommends the Town reach out to the homeowners associations who then can reach out to the individual homeowners, or the Town can send out the brochure created by the team (Appendix 6) when the census or tax bills are sent out. However, reaching out and educating homeowner associations through organizations such as the Civic League may be more practical and more effective because it would allow the Town to reach specific problem areas and would allow them to prioritize which areas to reach out to first. Another way for the Town to reach homeowners is through insurance companies. Insurance companies are likely to raise rates if they are aware that the conditions of the road could impact the accessibility of emergency vehicles. Increased insurance rates create an incentive for homeowners to fix their roads and also show the severity of the situation.

5.2.3 Recommendation # 3: Creating a Maintenance Schedule

The team concluded that there is no set schedule and requirement for the maintenance of the older private roads. These are roads that were created prior to the establishment of the regulations for width, height and other design criteria that are now in place. **The team,**

therefore, recommends that the Town work with the DPW, Fire Department, Homeowners Associations and Road and Rights of Way Committee to establish a strategy for the maintenance of the private roads. The group recommends that after the roads are brought into compliance, that they be maintenance, at minimum, two times a year and more if needed. If done regularly, maintenance of dirt roads can be fairly simple and cost effective, and most often will only require routine blading and dragging and brush cutting with occasional greater repairs.

5.2.4 Recommendation # 4: Evaluating Additional Roads

During the surveying process and through general travel around the island, the team found many other roads that were in poor condition but were not part of the evaluation sample. This observation led them to the conclusion that there are many more private roads on Nantucket that need to be evaluated and prioritized. Based on this conclusion, **the group recommends that the Town continue to evaluate the private roads on an ongoing basis.** This may involve bringing another project group to continue to evaluate the roads or the evaluation may be done by town employees or volunteers. The team has designed both their evaluation protocol and their prioritization system and database to be easily used by the Town in the future. The team, therefore, **recommends that the Town continue to use the evaluation protocols and prioritization system to assess additional private roads in the future.** The database created on Microsoft Access has a form to enter the data collected from the evaluation protocol and once this data is entered, the database will assign priority values and cost estimates to the newly entered data. **The team also recommends that the DPW update the database on an ongoing basis as the roads are fixed and reevaluated**.

5.2.5 Recommendation # 5: Developing a Strategy to Fix Issues with Incorrect Address Data

The team also found incorrect addresses to be an issue regarding timely emergency vehicle responses. It is therefore **recommended that a strategy be developed to fix the issues with addresses**. The team found that some of the roads are not cut through all the way and if they were cut through, then the houses would be easily accessible. Other address problems stem from the houses simply having a different address than the road their house is accessible from. The houses with the incorrect addresses need to change their addresses to reflect the road their house is on. While the team was able to determine some of the problem areas, they were unable to do a

thorough assessment of all of the problems and thus they recommend the Town work with the DPW and the Fire Department to further investigate these address issues. This project could be given to another project group in the future or could be done within the Town. Once the specific issues are identified, the Town should determine the cause of the incorrect address and if the cause is because the road was never fully developed, the Town may decide to finish cutting the road through, if this will rectify the issue with the addresses on the road. If the issue will not be fixed by cutting the road through, then the Town should change the address of the house to reflect the road the house is accessible from.

The team also recommends that proper street signs be required for private roads. During their road evaluation, the group noticed some private roads do not have any sort of sign noting the name of the road and others do not have a standard town street sign marking the road. The team often found it difficult to find some of the roads they were looking for to evaluate and thus the Fire Department might find these roads difficult to find as well. In the case of an emergency, the Fire Department does not have the time to be looking for roads and run the risk of becoming lost due to improper labeling of the roads.

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Appendix 1: Road Summary Sheet

Road Summary Sheet

Name of Road:_____

Location of Road:_____

Starting from road: _____

Ending at road:_____

Importance:_____

Total Residential Volume:_____

Year-round residential Volume:_____

Total Length of Road:_____

Number of Segments:_____

General Issues:_____

Average Height:_____

Average Width:_____
Notes:

Appendix 2: Unpaved Road Condition Survey

Unpaved Road Condition Survey.

Road Name: _____	Section Start Location: _____
Section #: _____	Section End Location: _____

Loose Aggregate

Severity	Extent <10%	Extent 10-30%	Extent >30%
<1”	1	2	3
1-3”	4	5	6
>3”	7	8	9

Potholes

Severity	Extent (#/100 ft) <5	Extent 5-10	Extent >10
<1”	1	2	3
1-3”	4	5	6
>3”	7	8	9

Corrugations

Severity	Extent <10%	Extent 10-30%	Extent >30%
<1”	1	2	3
1-3”	4	5	6
>3”	7	8	9

Ruts

Severity	Extent <10%	Extent 10-30%	Extent >30%
<1”	1	2	3
1-2”	4	5	6
>2”	7	8	9

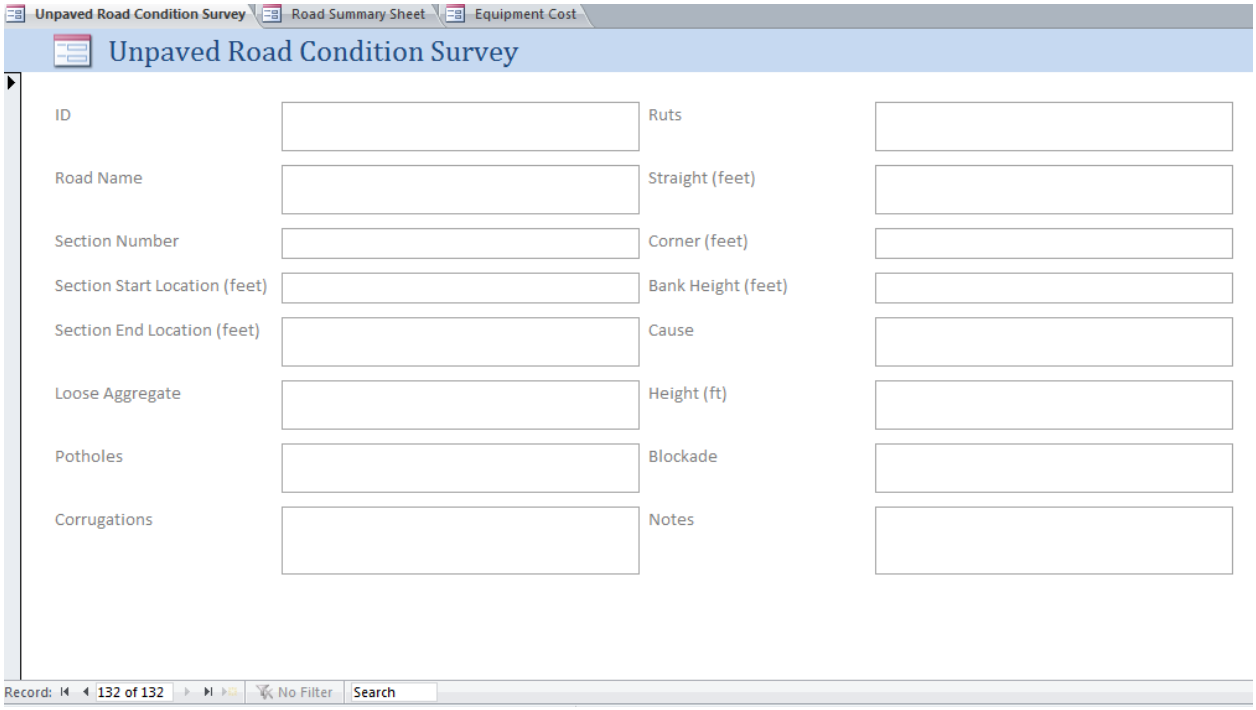
Width
Straight 16’ (y / n)
Actual: _____
Corners 20’ (y / n)
Actual: _____
Cause: (Surface Width, Banks, Overgrowth)
Notes:

Height
Minimum: 14’ (y / n)
Actual:_____

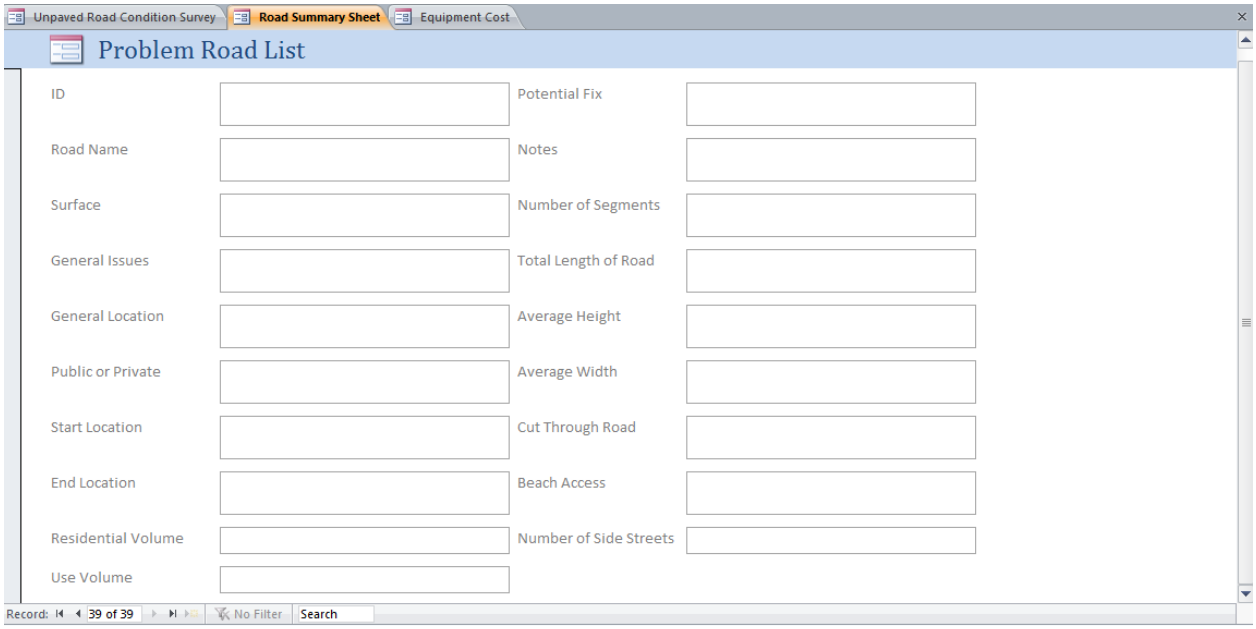
Notes:

Notes:

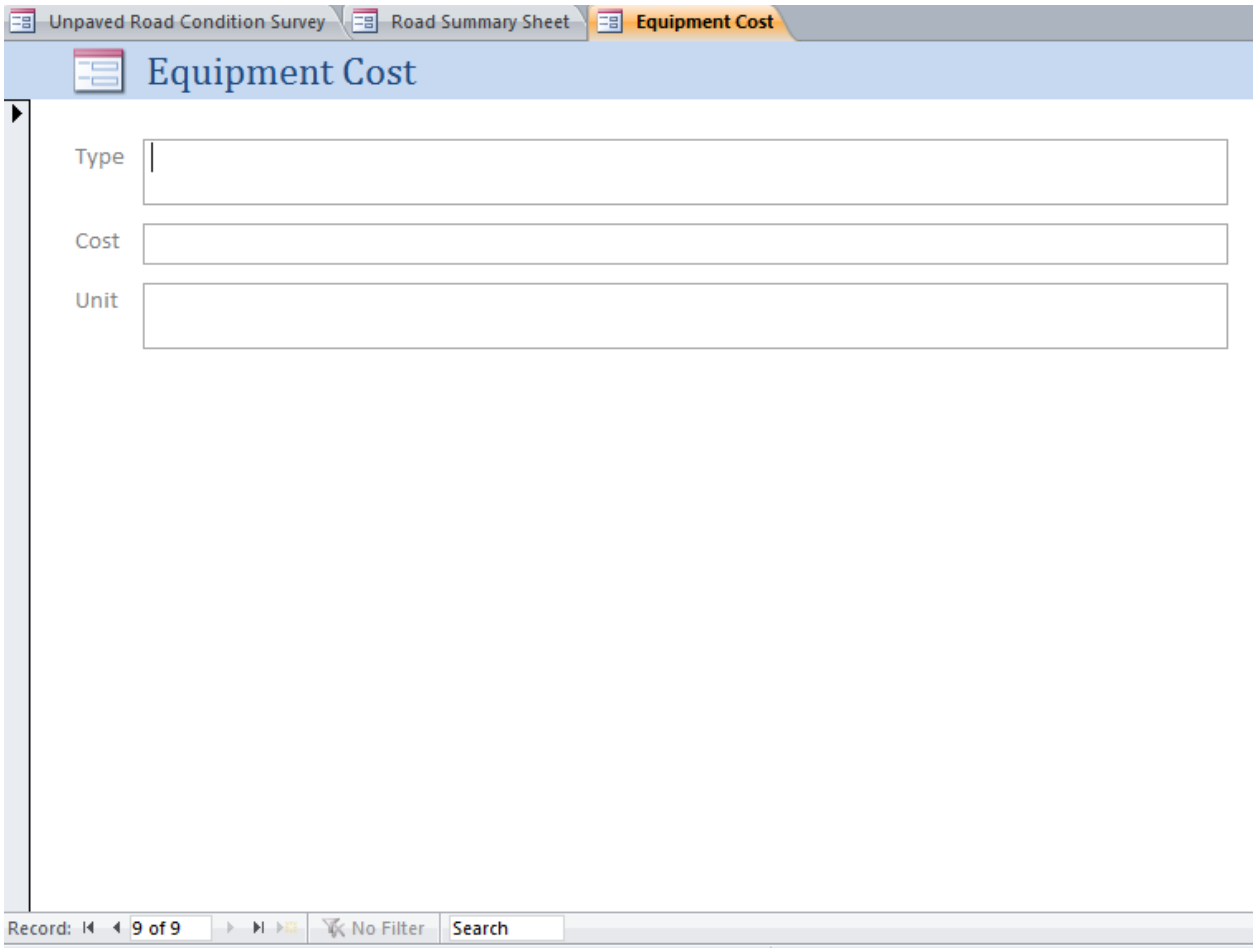
Appendix 3: Unpaved Road Condition Survey Microsoft Access Data Input Sheet



Appendix 4: Road Summary Sheet Microsoft Access Data Input Sheet



Appendix 5: Equipment Cost Microsoft Access Data Input Sheet



Appendix 6: Brochure

Who is responsible for maintaining the private roads?

The responsibility of repair and maintenance falls to the abutters of the road. The town cannot enter private roads to do maintenance.

For questions please contact:

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Private Road Repair and Maintenance

Nantucket DPW
Nantucket Fire Department

Project Group:
Aleksandra LaRue
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Why do they need to be maintained? If I can access my house, why does it matter?

Currently, many of the private roads are in substandard conditions, and even though some smaller, off-road vehicles are able to pass, the roads are impassable for emergency vehicles. Emergency vehicles have been damaged while attempting to pass on some Nantucket private roads and others have gotten stuck. There are some roads on the island that the Fire Department can not travel on. In several instances the DPW has had to use heavy equipment to free stuck and broken emergency equipment.

As property owner your biggest concern should be whether emergency vehicles can navigate your road (and driveway) safely. If not, precious minutes will be lost trying to get the emergency vehicles to your property.

What are the types of maintenance for unpaved roads?

Blading and Dragging - smooth's the road surface and fixes small imperfections, should be done as part of a regular maintenance routine.
Reconstructive Grading - fixes larger imperfections such as larger potholes on the road's surface.
Filling in Potholes - to fix major surface imperfections, large potholes, etc.
Brush Cutting - Necessary to cut back brush to make the road wide enough and the overhead clearance tall enough for fire trucks to pass on the road.
Complete Reconstruction - Necessary when the road surface is in such a bad condition that there is no other option for the repair.

When do they need to be maintained?

Once the roads are fixed to the standards required for emergency vehicle to safely pass, routine maintenance of blading and dragging and any necessary brush cutting should be done on a quarterly basis.

Road Requirements for Emergency Vehicles:

The width on straight sections must be at least 16 feet, on corners it must be at least 20 feet. Any canopy or overgrowth must be cut back to a minimum of 14 feet above the road surface. The surface must be smooth with no potholes, loose material, large swells or ruts as these surface imperfections can cause trucks to become stuck and can greatly impact emergency response time.