

Assessing and Communicating Flood Risk in Currituck County, North Carolina

by

Amber Halstead

Dr. Lisa Campbell, Advisor

April 25, 2018

Masters project submitted in partial fulfillment of the
requirements for the Master of Environmental Management degree in
the Nicholas School of the Environment of
Duke University

Table of Contents

Executive Summary	1
Introduction.....	3
Section 1: Online Survey Findings:	8
Online Survey Synopsis	15
Section 2: Community Mapping Meeting Findings.....	16
Section 3: Flood Risk Communication	22
Priority Areas and Audiences	22
Priority Messages, Outreach Projects, and Other Public Information Initiatives	24
Bibliography	27
Appendix A: Methods.....	29
Appendix B: Full Results of Community Mapping Meeting.....	30
Appendix C: Examples of Federal Emergency Management Agency Flood Communication Materials	40

Executive Summary

Flooding is a major threat to communities along the North Carolina coast. The region is prone to hurricanes, tropical storms, and nor'easters; all of which bring serious flooding that destroys property and endangers lives. Currituck County, North Carolina, the focus of this study, is one of the more vulnerable counties with a developed barrier island. Flooding is one of the main hazards affecting Currituck with over 58.7% of the county currently located in a flood zone.

The purpose of this project is to collect data on past flooding in Currituck County, residents' perceived risk of flooding, and their opinions on flood insurance. These data was then be used to develop a communication plan to address knowledge gaps and misconceptions about flooding in the county. This study utilized an online survey and a series of community mapping meetings to assess public opinion on flood risk. The data collected were then used to inform a flood risk communications plan for Currituck County.

The first two sections of this report provide an overview of the data collected. The results of the online survey, detailed in section one, were coded and analyzed using a chi squared test for independence. The maps created during the community mapping meetings were digitized and discussed in section two of the report.

Section three of this report makes several key points and recommendations for Currituck County's flood risk communication plan:

- Target flood risk communications in the communities of Corolla and Moyock in Currituck, County. These communities are at high risk of flooding and were identified as having large areas of past flooding outside of the preliminary Special Flood Hazard Areas.
- Direct flood risk communications toward residents that are new to the county. The data suggested that people draw most heavily on past experiences when making decisions about their flood risk. Without past flood experiences, new residents will be more likely to underestimate their flood risk, especially if they are outside a special flood hazard area.

- Reach out to property owners removed from the special flood hazard area. The results showed a correlation between living outside the flood zone and a perceived lower risk of flooding.
- Communicate the affordability of flood insurance. The results showed that the cost of flood insurance was a major reason that people chose not to have insurance or would choose to drop their coverage if possible. By communicating the benefits of investing in flood insurance, property owners may be more inclined to retain their coverage.

Introduction

The purpose of this project is to collect data on past flooding in Currituck County, residents' perceptions of risk of flooding, and their opinions on flood insurance. These data will then be used to develop a communication plan to address knowledge gaps and misconceptions about flooding in the county.

Flooding is a major threat to communities along the North Carolina coast. The region is prone to hurricanes, tropical storms, and nor'easters; all of which bring serious flooding that destroys property and endangers lives. The most recent example of a catastrophic flood event along the coast is Hurricane Matthew. This storm deposited 15 inches of rain across coastal North Carolina on October 8th and 9th of 2016. The resulting flood waters claimed 28 lives and caused billions of dollars of damage to the state (Stradling, 2016).

Currituck County, North Carolina, is the focus of this study, and is one of these more vulnerable counties with a developed barrier island. Flooding is one of the main hazards affecting Currituck with over 58.7% of the county currently located in a flood zone (Currituck County, 2017). The County has had several major flooding events in recent history including hurricanes Isabel (2003) and Ernesto (2006) as well as two severe storms in 2009 bringing six and thirteen inches of rain respectively (Currituck County, 2017). Hurricane Matthew, in 2016, also brought heavy flooding to the area, damaging 84 buildings and causing the loss of 15-20% of the soybean crop in the county (Langston, 2016).

The continual impact flooding has had on the social well-being and human livelihoods within Currituck County may point to the limitations of solely using expert flood knowledge to mitigate flood risk. McEwen *et al.* (2017) discuss the importance of integrating lay knowledge into flood risk management and studies the power that this integration of knowledge has in highlighting 'knowledge controversies'. 'Knowledge controversies' are discrepancies between local knowledge and scientific assessment. Identifying these knowledge controversies will allow local officials to locate both institutional knowledge gaps as well as misinformation. Locating institutional knowledge gaps can also allow the county to combine local knowledge with scientific studies to identify previously unknown management concerns. Additionally, identifying

misinformation about flooding hazards can help the County to uncover where past risk communication plans have been inadequate and give them the ability to tailor future flood risk communications to the needs of the community.

1.1. How do people understand flood risk?

There has been little research on the relationship between flood risk assessments and individuals' risk perceptions. A study from Switzerland indicated that people's flood risk perceptions are strongly influenced by their own experiences and found that recent nearby flood events were crucial for a perceived risk of flooding (Siegrist & Gutscher, 2006). This study also found a significant correlation between household perceptions of flood risk and flood probabilities on governmental flood hazard maps. However, there were still many residents that reported a perceived low risk of flooding that lived in a high-risk area and many residents living outside flood hazard areas that reported a perceived high risk of flooding.

Wachinger et al.'s (2013) paper on risk perceptions focused on natural hazards and found that risk factors, or the scientific characteristics of risk, are not a major driver of risk perception. In other words, the likelihood that a disaster will occur is not a significant factor for people when they make judgements on their level of risk. Their study also found confounding reports on the impact of direct experience with natural disaster on risk perceptions, sometimes reinforcing precautionary behavior and sometimes producing a false sense of security.

These opposing reactions to direct exposure to natural disasters can likely be explained with the literature on decision-making and the difference between the availability bias and the gambler's fallacy. Availability bias leads individuals to underestimate the likelihood of low probability events that they have not experienced and to overestimate the likelihood of those that they have experienced (Hertwig, Barron, Weber, & Erev, 2004; Fox & Hadar, 2006; Brilly & Polic, 2005; Ruin, Gaillard, & Lutoff, 2007). For example, someone whose home has recently flooded may easily imagine it will happen again and perceive a greater risk of flooding. The gambler's fallacy, on the other hand, says that people who have just experienced flooding will assume they are less likely to experience flooding again because it just happened (Camerer & Kunreuther, 1989).

Currituck County is particularly interested in perceptions of flood risk because the North Carolina Department of Public Safety has released updated flood maps, which the County is currently in the process of adopting. These new maps will result in a net decrease of 64% of buildings currently in the 100-year floodplain, also known as the special flood hazard area (SFHA) (North Carolina Emergency Management, n.d.) The maps depict a reduction in flood risk (probability of the base flood) with a smaller base floodplain extent consequently reducing the SFHA or regulatory floodplain.

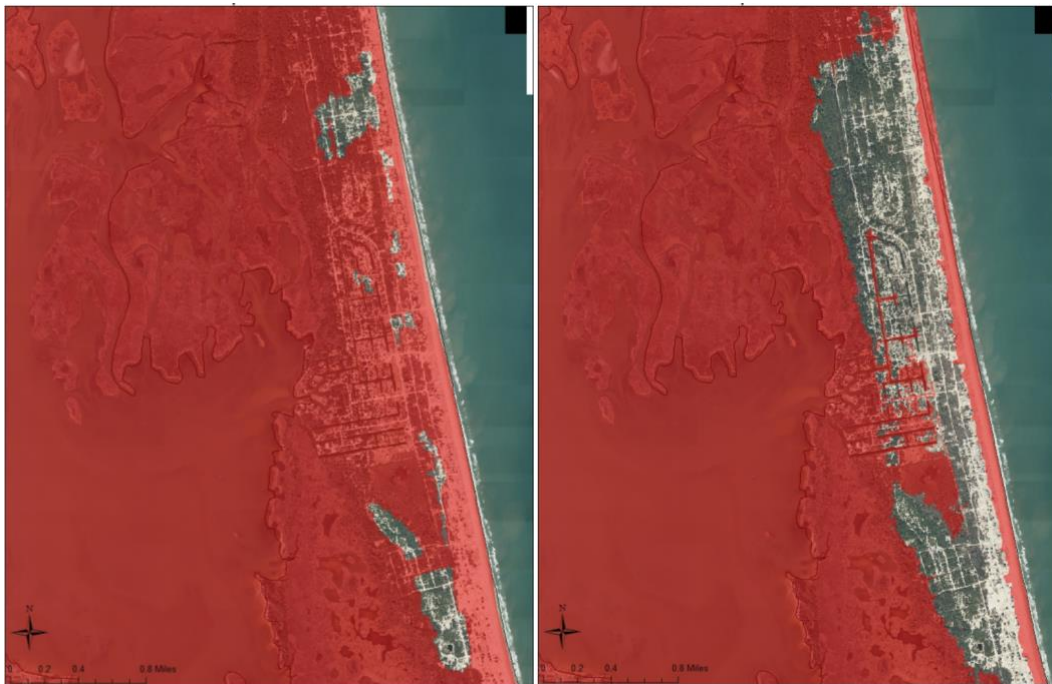


Figure 1 Corolla, North Carolina under the Current Special Flood Hazard Area (left) and Preliminary Special Flood Hazard Area (right) Source?

The current and preliminary flood maps for the town of Corolla, shown above, depict the drastic changes in coverage. This area of the county currently has 2,323 buildings within their SFHA. The new preliminary maps will reduce this to just 178 buildings. County officials want to ensure that citizens are aware of their flood risk and identify the impact that these map changes may have on citizens' perceived flood risk.

Areas within the high-risk floodplain have a 26% chance of experiencing a flood during a 30-year mortgage (Currituck County, 2017). Areas outside this floodplain are not removed from all flood risk. In fact, 20-25% of all flood insurance claims are outside of high risk flood zones (Currituck

County, 2017). Ideally, people in flood prone communities would be aware of these risks and take appropriate action to mitigate the flood risk to their homes. However, several studies have found that individuals often underestimate their risk of flooding and thus choose not to implement loss reduction measures prior to a disaster (Camerer & Kunreuther, 1989; Chivers & Flores, 2002; Kunreuther, 2006). A study done by Wallace *et al.* (2016) found that individuals outside of SFHAs have greatly reduced perceived risks of flooding. Thus, the danger in removing property from the special flood hazard area is an increased community perception of little to no flood risk in a low-lying coastal environment.

1.2 Flood risk and flood insurance

Property owners with federally backed mortgages within the SFHA are required to obtain a flood insurance policy through the National Flood Insurance Program (NFIP). Established in 1968, the NFIP was designed to insure property owners against flood losses after private insurers deemed flood insurance too risky and ended coverage (Federal Emergency Management Agency, 2002). Most properties outside of the SFHA are not required to carry flood insurance and this change in flood risk mapping will result in a 52% decrease in the required NFIP policies for the County (North Carolina Emergency Management, n.d.). These property owners will still be able to obtain a flood insurance policy, but it will become optional. If these updated maps reduce the public perception of flood risk in the area, it is possible that these property owners may choose not to renew their flood insurance, despite continued risk of flooding. If property owners stop carrying flood insurance and the maps change again with their property back into a flood zone, they may pay more to get back into the program.

This study, which took place from October 2017 to March 2018, consisted of an online survey and public participatory mapping, described in Appendix A. The goal of this study was to collect data from Currituck County residents on their perceived risk of flooding, thoughts on flood insurance, and past flood events in the County. This research will form a record of areas impacted by flooding within Currituck County to help future planning, management and monitoring of flood hazards. Additionally, the research provides insight on the community's perception of flood risk to inform outreach campaigns on flood risk and flood insurance and to improve community knowledge of risk and preparedness. This study will help the County tailor flood risk communication and

outreach, the maps produced during the community mapping meetings can be used along with a communication plan that explains flood risk through the lens of the community's interests.

Section 1: Online Survey Findings:

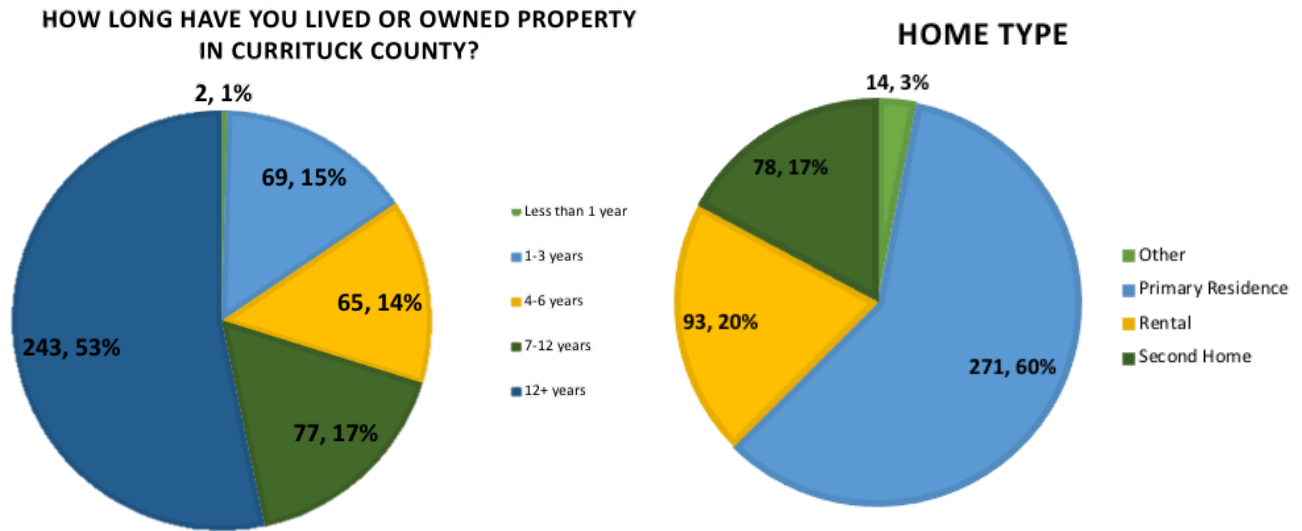


Figure 2 Responses from the 2018 online flood risk survey

1.1. Survey Respondents' Residency

506 people completed the on-line survey. The majority of survey respondents had their primary residence in Currituck County (60%) and had lived in the County for more than 12 years (53%). Only 2 respondents (1%) had lived in the county for less than a year at the time of completing the survey. Roughly 1/6th of survey responses came from residents in each of the remaining time groups, 1-3 years, 4-6 years, and 7-12 years. 20% of respondents were part time renters and 17% owned a second home in the county.

The spatial distribution of the survey respondents was somewhat proportional to the population distribution within the county with roughly 1/3 of responses coming from both Corolla and the Northern Mainland. These results slightly over-represent the Corolla neighborhood, which has a large percentage of the houses in Currituck County, but less than one third of the residents. The remaining third of the responses came from the Lower Mainland (16%), Knott's Island and Gibbs Woods (15%), and the Off-Road Area (3%).

1.2 Perceived Risk of Flooding.

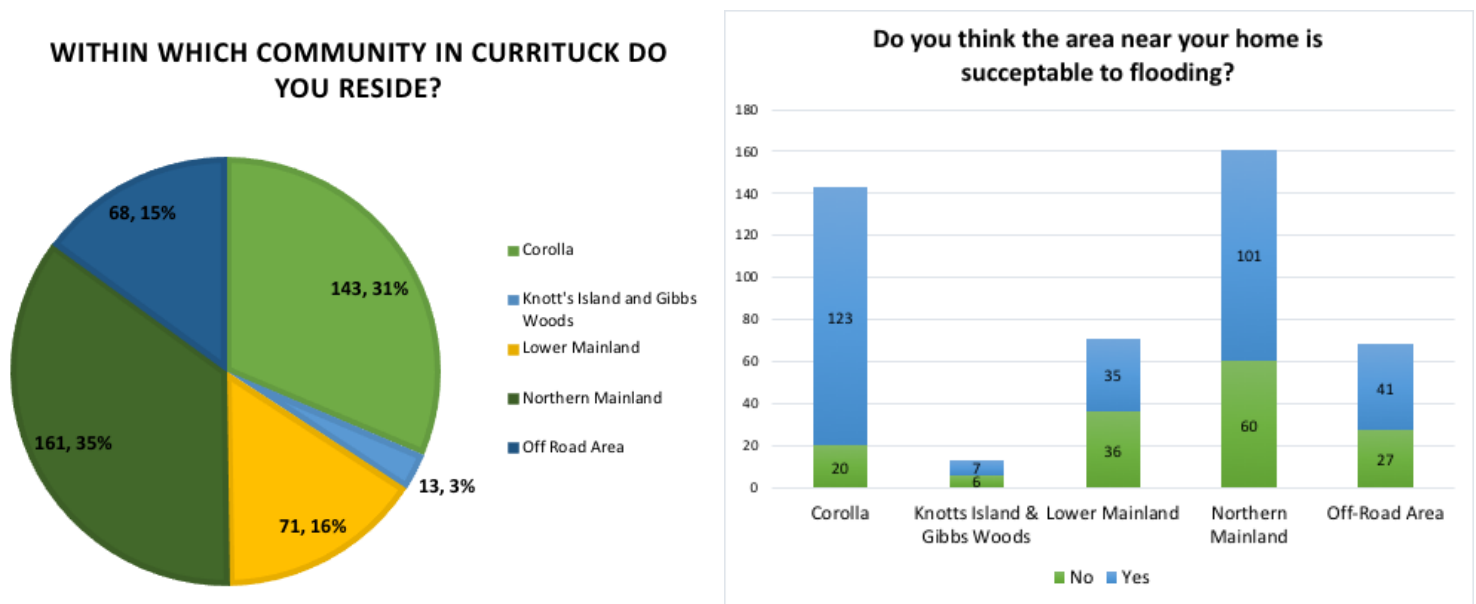


Figure 3 Responses from the 2018 online flood risk survey

Respondents from Corolla were far more likely than the other communities to believe that the area near their home was susceptible to flooding, with 86% of Corolla respondents saying that they were at risk. Responses from the Northern Mainland were also more likely to perceive a high risk of flooding near their homes (63%). Chi Square analysis showed a significant relationship between responses from Corolla and the Northern Mainland and perceived likelihood of flooding with a p-values of less than 0.0001 and 0.0458 respectively. Respondents from the Off-Road Area (60%), the Lower Mainland (49%), and Knott's Island and Gibbs Woods (54%) were slightly less likely to perceive a risk of flooding near their homes, with closer to half of the respondents from these areas feeling as if their homes were safe from flooding.

After respondents indicated whether or not they felt they believed the area near their homes were susceptible to flooding, they were asked why they held that belief. Both groups, those who felt their home was susceptible to flooding and those who felt it was not, drew on their past experiences when forming their opinion on flood risk. Often respondents stated that they had experienced flood damage before, they mentioned seeing the sound outside of their house, or that they have lived in their home for years and never experienced flooding. One main difference between the two groups

of respondents, those who think the area near their homes is susceptible to flooding and those who do not, is that respondents who do not believe they are at risk of flooding are far more likely to mention their flood zone and use the fact that they are not in a SFHA as justification of reduced flood risk (Chi square, $p < 0.001$).

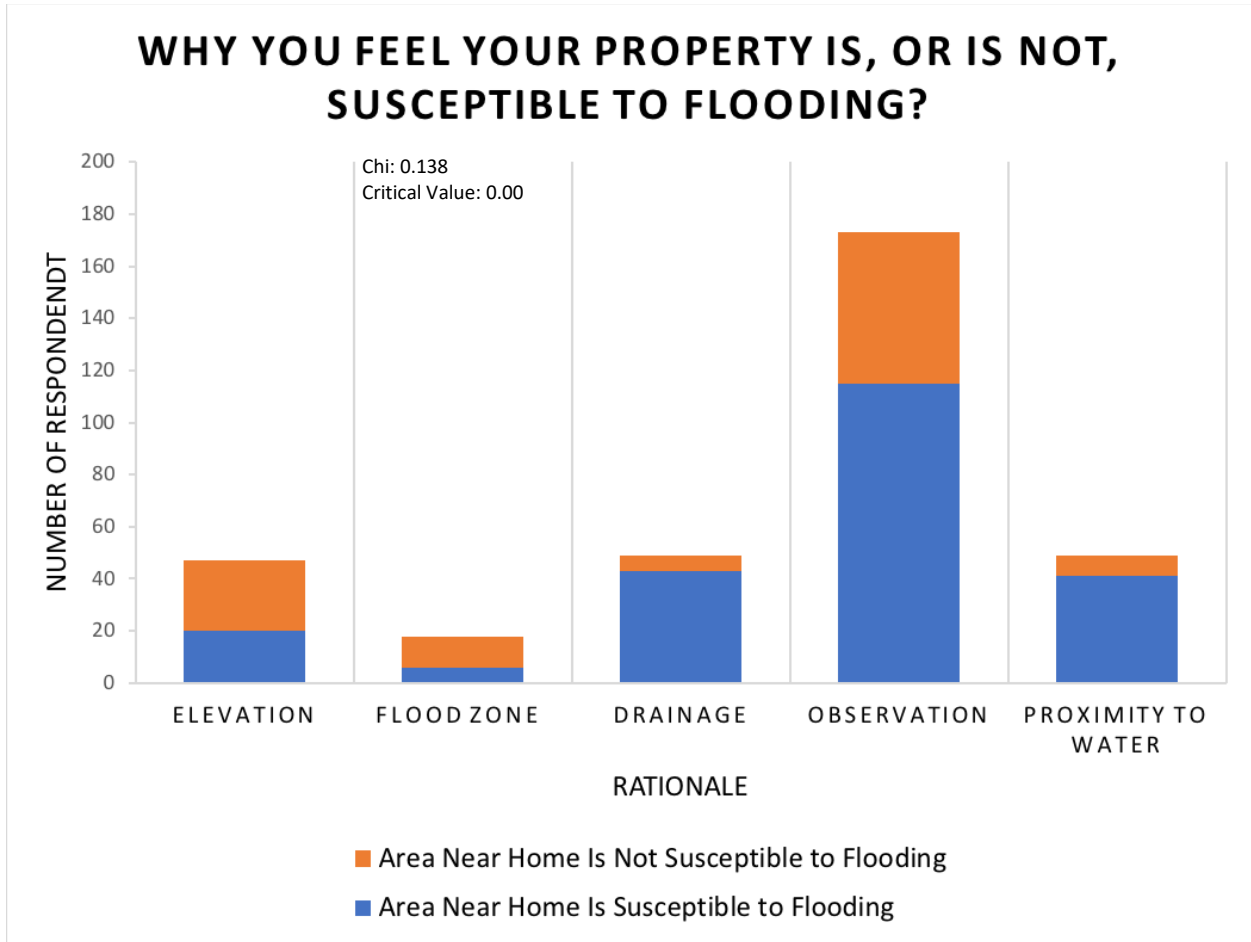


Figure 5 Results from 2018 Flood Perception Survey

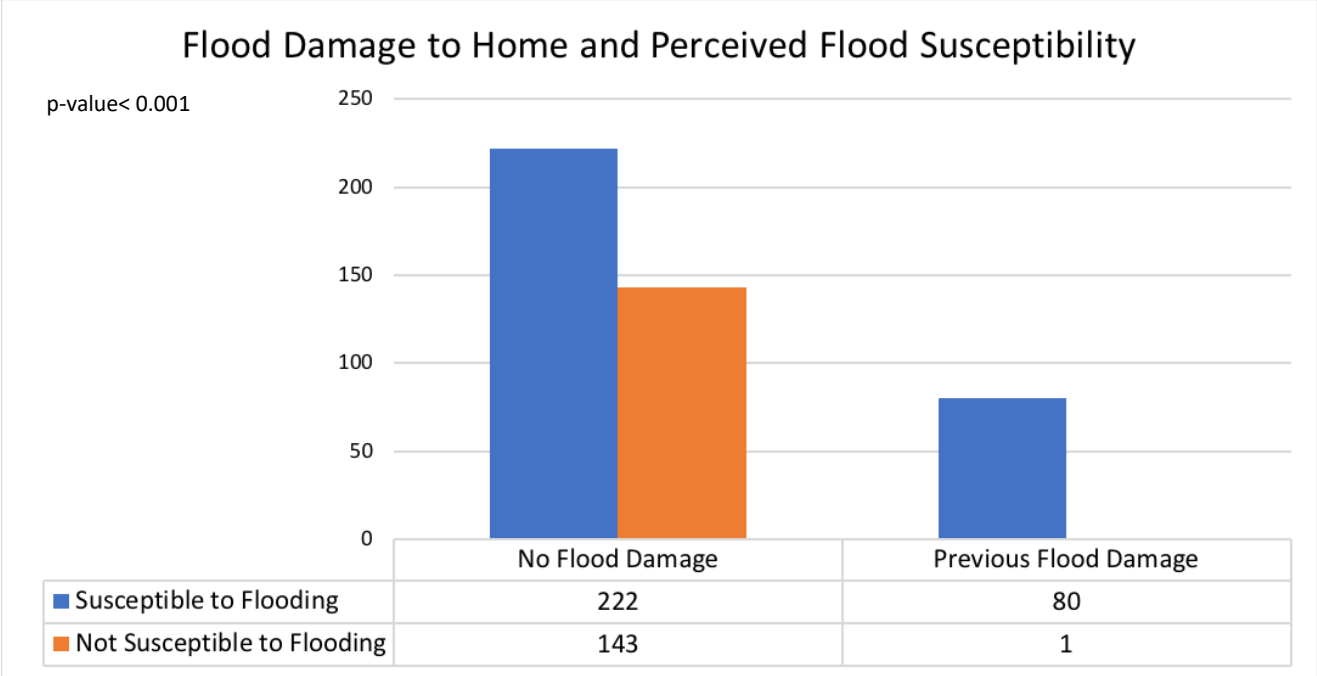


Figure 6 Results from 2018 Flood Perception Survey

Figure 6 above helps to show the impact that past experiences with flood events have had on respondent’s perception of flood risk. 99% of the respondents who had suffered damages from flooding in the past believed that they were susceptible to flooding. There is also a large percentage of individuals, 61%, who have never suffered damages from flooding but still think that they are at risk of flooding in the future. Chi square analysis showed a significant correlation between perceived risk of flooding and past flood damage ($p < 0.001$). Many of these individuals are still drawing from their experiences with flooding in the past, just not a flood that destroyed their property. These respondents discuss seeing water come up to their homes or remember neighbors’ yards flooding, many of them even naming specific storms that stuck in their memory.

Respondents Not in Flood Zone

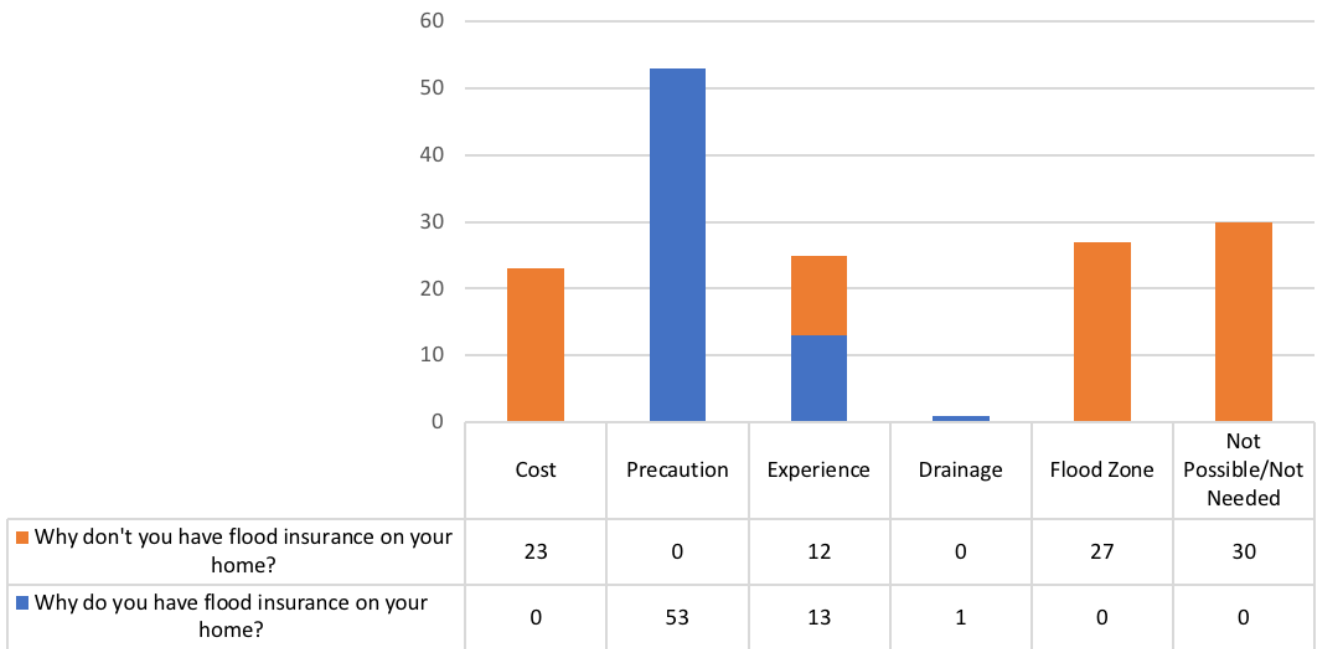


Figure 7 Rationale of residents outside of a SFHA for either obtaining or not obtaining a flood insurance policy.

Respondents in Flood Zone

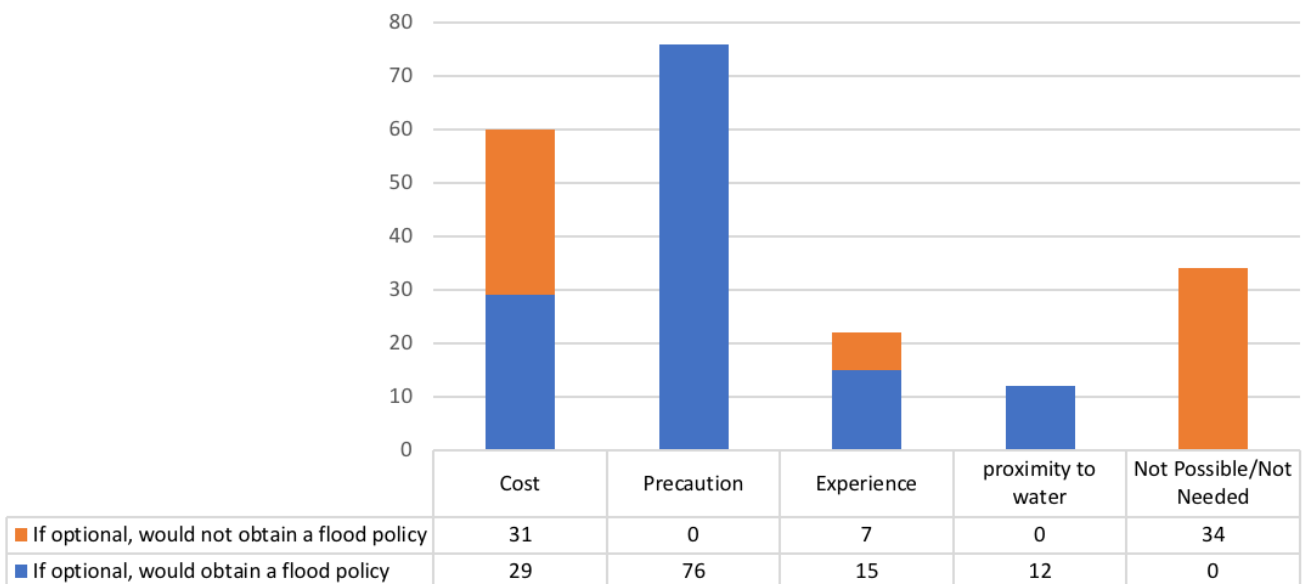


Figure 8 Rationale of residents within a SFHA for either obtaining or not obtaining a flood insurance policy, if it were optional.

1.3 Flood Insurance

Figures 7 and 8 show the rationale of survey respondents when deciding whether or not to purchase flood insurance. Since homeowners within the SFHA are often required to obtain flood insurance (i.e. if they have a federally backed mortgage), they were asked if it were optional, would they still purchase flood insurance. Residents outside the SFHA already have the option of not purchasing insurance, so they were simply asked if they have flood insurance and why. The answers given by both groups were coded into the categories shown in figures 7 and 8.

The most common reason people choose to get flood insurance, regardless of their flood zone, is that they are being precautionary, that they just want the ‘peace of mind’ flood insurance provides or that they want to protect against ‘unforeseen possibilities’. No one mentioned their flood zone as a reason why they felt at risk of flooding and chose to purchase flood insurance. In contrast, flood zone was only mentioned by respondents who choose not to have insurance. Often these respondents stated their flood zone as the only rationale for not having flood insurance. Cost was also a factor preventing respondents from purchasing flood insurance. Many respondents said that they ‘just can’t afford’ flood insurance and or that they had flood insurance but dropped it when their premiums increased substantially. While over half of the respondents in the flood zone who mentioned the price of flood insurance said that it was ‘worth the cost’ or a ‘good value’, no one outside the flood zone mentioned that they felt their flood insurance was affordable or worth the investment.

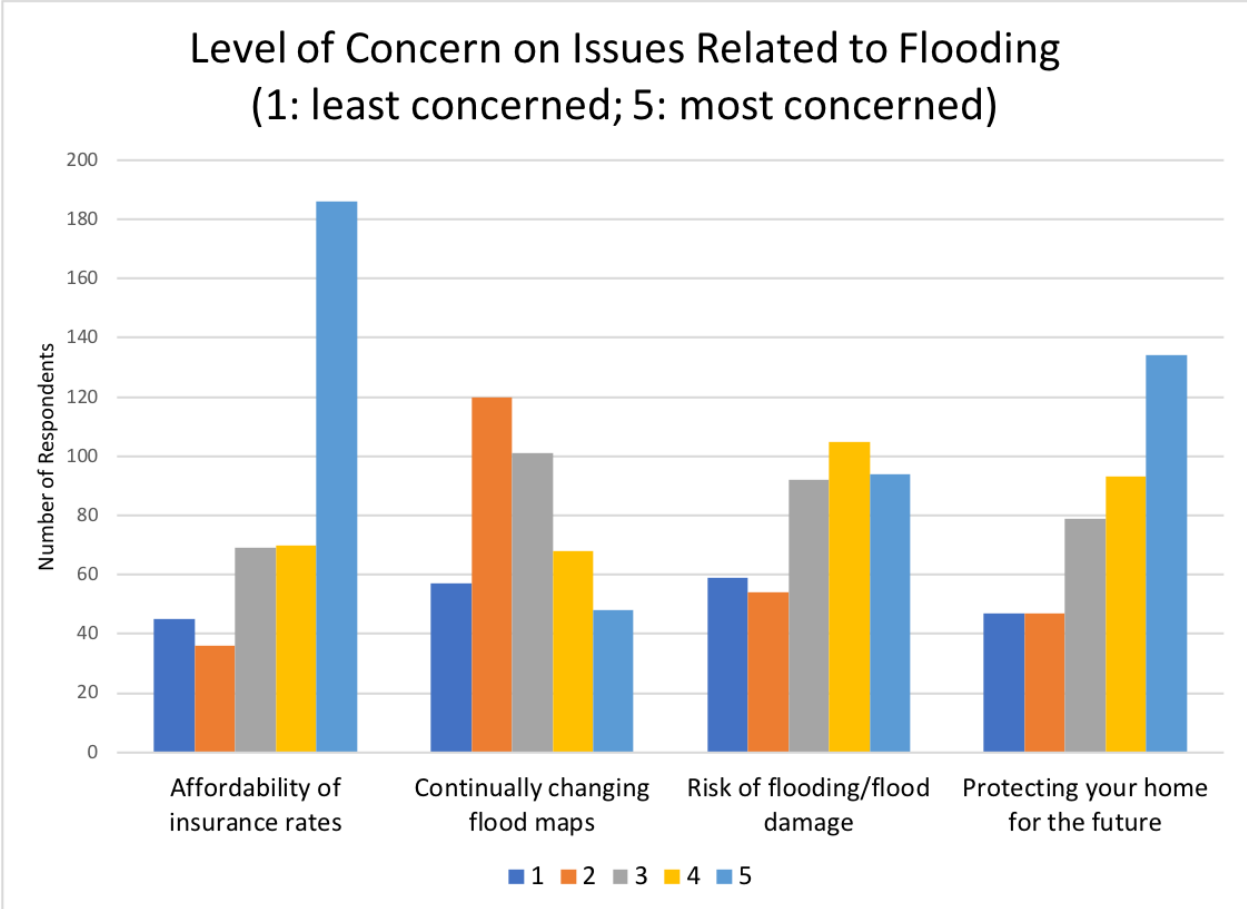


Figure 9 Results from 2018 Flood Perception Survey

1.4 Concerns about Flooding

Figure 9 shows the average level of concern for several flood related issues. Affordability of insurance rates is the most concerning issue for respondents, with the majority of respondents rating it 5. Protecting their home for the future was important to respondents as well, with responses skewed toward 4 and 5. Continually changing flood maps had the lowest levels of concern, with the majority of respondents listing it as either a 2 or 3.

Online Survey Synopsis

- Past experiences drive flood risk perception.
 - People who had flooded in the past were aware that they were at risk of flooding again. No one mentioned flooding in the past as a reason they won't flood again.
 - People who had witnessed flooding in their neighborhoods that did not impact their homes believed that they were unlikely to flood in the future.
- Being in the Special Flood Hazard Area does not seem an important influence on why people feel at risk; however, being outside of the special flood zone is often mentioned as a reason people feel that they are not at risk.
- Cost of insurance was a concern for people regardless of their flood zone. Many people choose not to have insurance, even though they feel they need it, because they feel it is too expensive.
- Respondents rated protection of their home as a major flood related concern.
- Continually changing flood maps are not a major concern.

Section 2: Community Mapping Meeting Findings

2.1 Meeting Survey Results.

Figures 10 through 13 detail the results of a survey given to participants after the community mapping meetings. With just 13 respondents, these data are not meant to represent the opinions of the entire county. However, data can be used to help county officials understand where residents are getting their information from and how much they trust it. In the future, county officials can expand on this survey by sending it to a wider audience.

Where do you get your information about flooding?	
Source	Number of Responses
Internet	7
Newspapers	4
T.V.	4
Informational Letters	2
Other	2
Radio	0
Other:	visible flooding and word of mouth

Figure 10 Survey responses from the 2018 Community Flood Mapping Meetings

Which source of information do you trust the most?	
Source	Number of Responses
Informational Letters	6
Internet	4
Other	3
Newspapers	0
T.V.	0
Radio	0
Other:	weather, word of mouth, and County government or representatives

Figure 11 Survey responses from the 2018 Community Flood Mapping Meetings

Who do you believe is responsible for mitigating flood risk at your home?	
Responsible Party	Number of Responses
Private Property Owners	9
Local authorities	7
Federal authorities	4
Other	1

Figure 12 Survey responses from the 2018 Community Flood Mapping Meetings

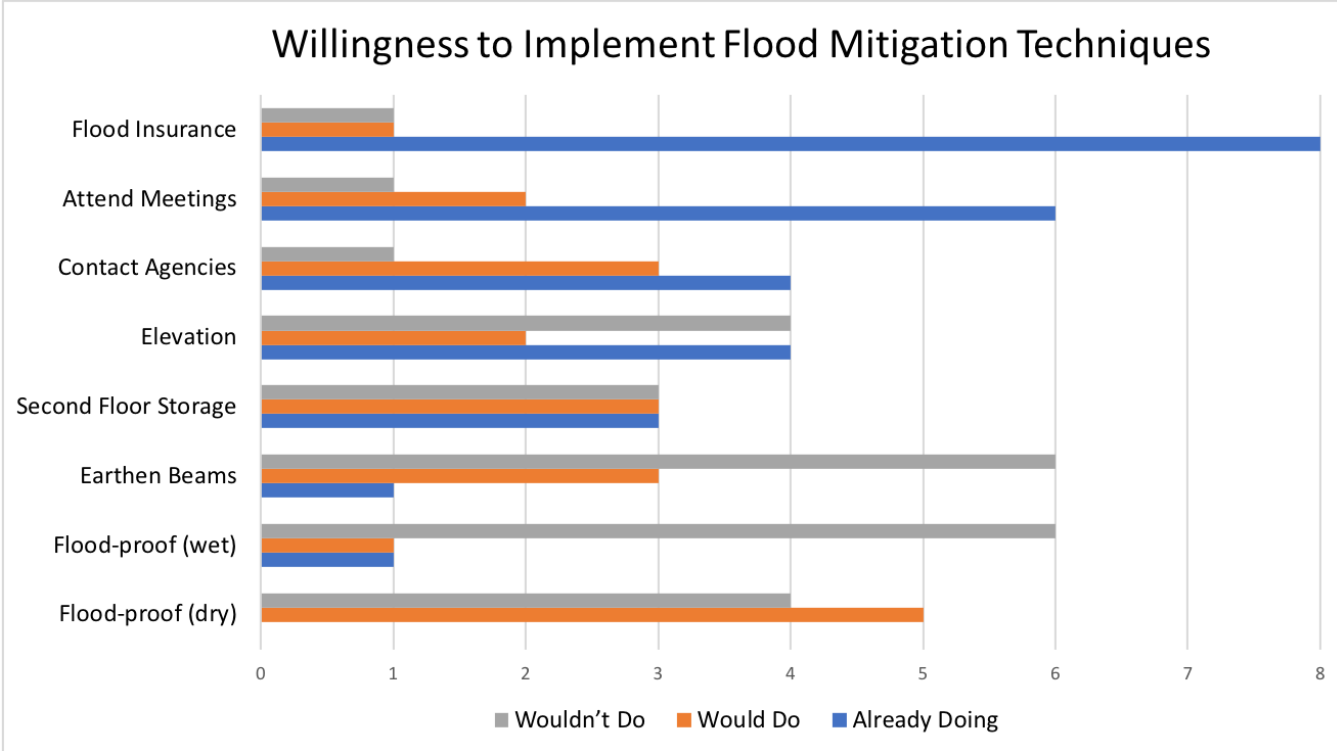


Figure 13 Survey responses from the 2018 Community Flood Mapping Meetings

2.1 Community Mapping Data

The following section explores the digitized maps produced from community mapping meeting. This section specifically looks at Corolla and the Northern Mainland because they both stood out in the online survey as having a significantly higher perceived risk of flooding. These two areas also had the greatest area delineated as ‘flooding areas’ during the community mapping meetings. The rest of the maps produced during the community mapping meetings can be found in Appendix B.

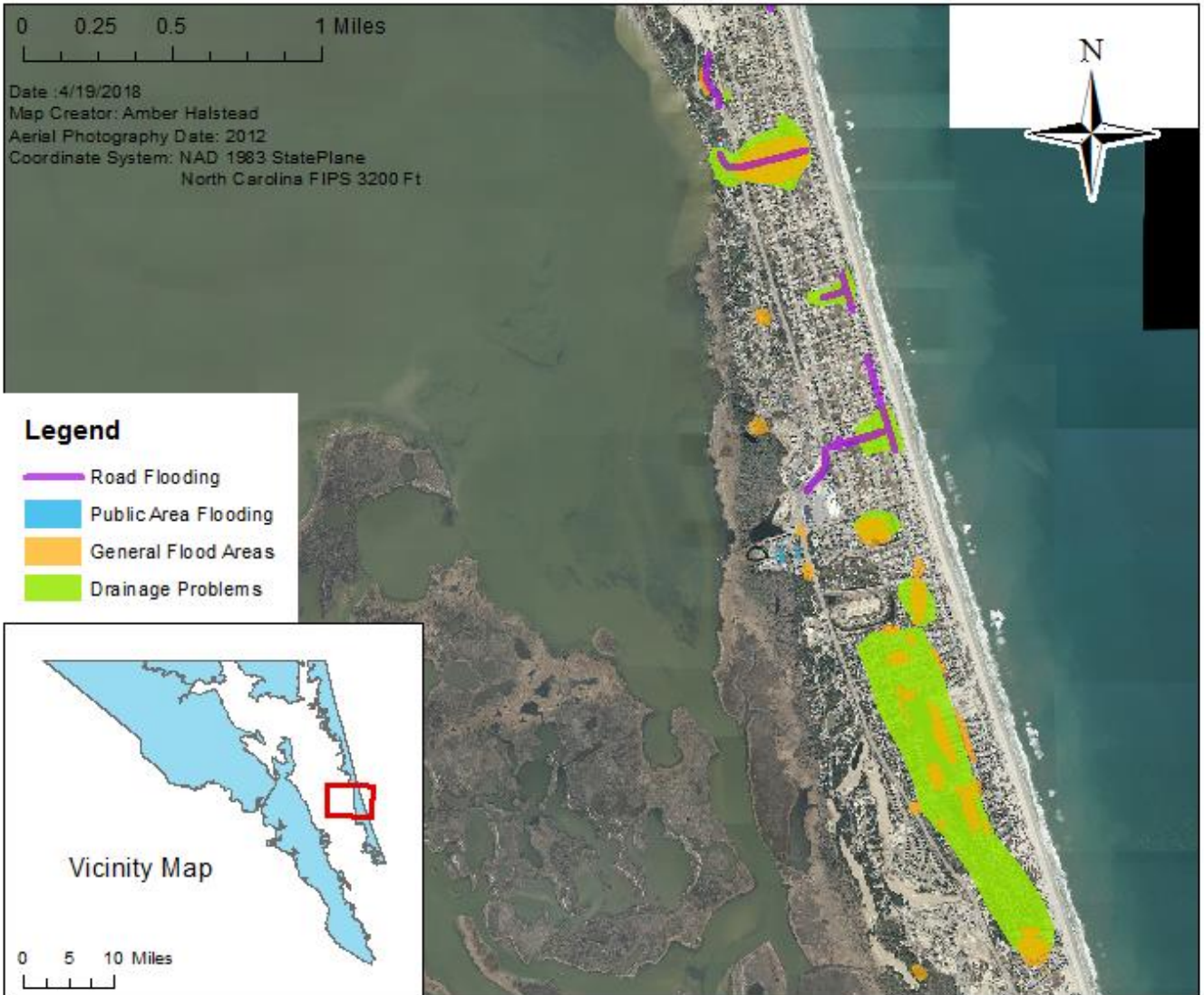


Figure 14 Digitized data from the 2018 Community Mapping Meetings

Figure 14 shows Corolla, NC with the digitized results of the community mapping meetings overlain on the aerial image. The flooding identified in the meeting originated, primarily, from

drainage issues across the county. On the barrier island specifically, these drainage problems are due, in large part, to the high water table. Figure 15, below, shows the same region with the preliminary special flood hazard area included on the map in red. As shown, the majority of areas delineated during the mapping meetings as areas of frequent flooding are not included in the updated flood zone. Residents discussed development as a driver of their drainage issues, citing the poor storm water engineering that they believe accompanies the newer developments.

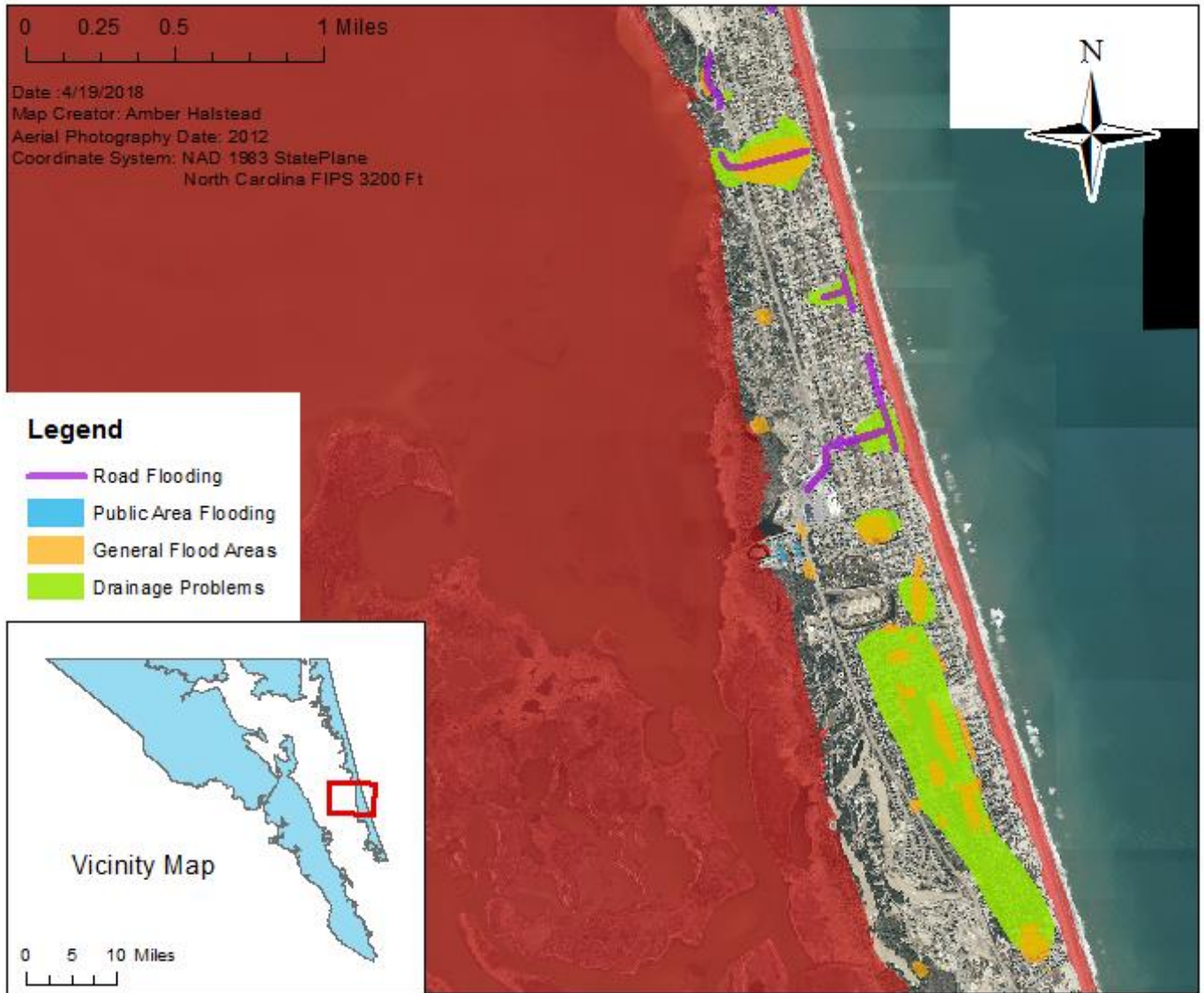


Figure 15 Digitized data from the 2018 Community Mapping Meetings with the SFHA shown in red.

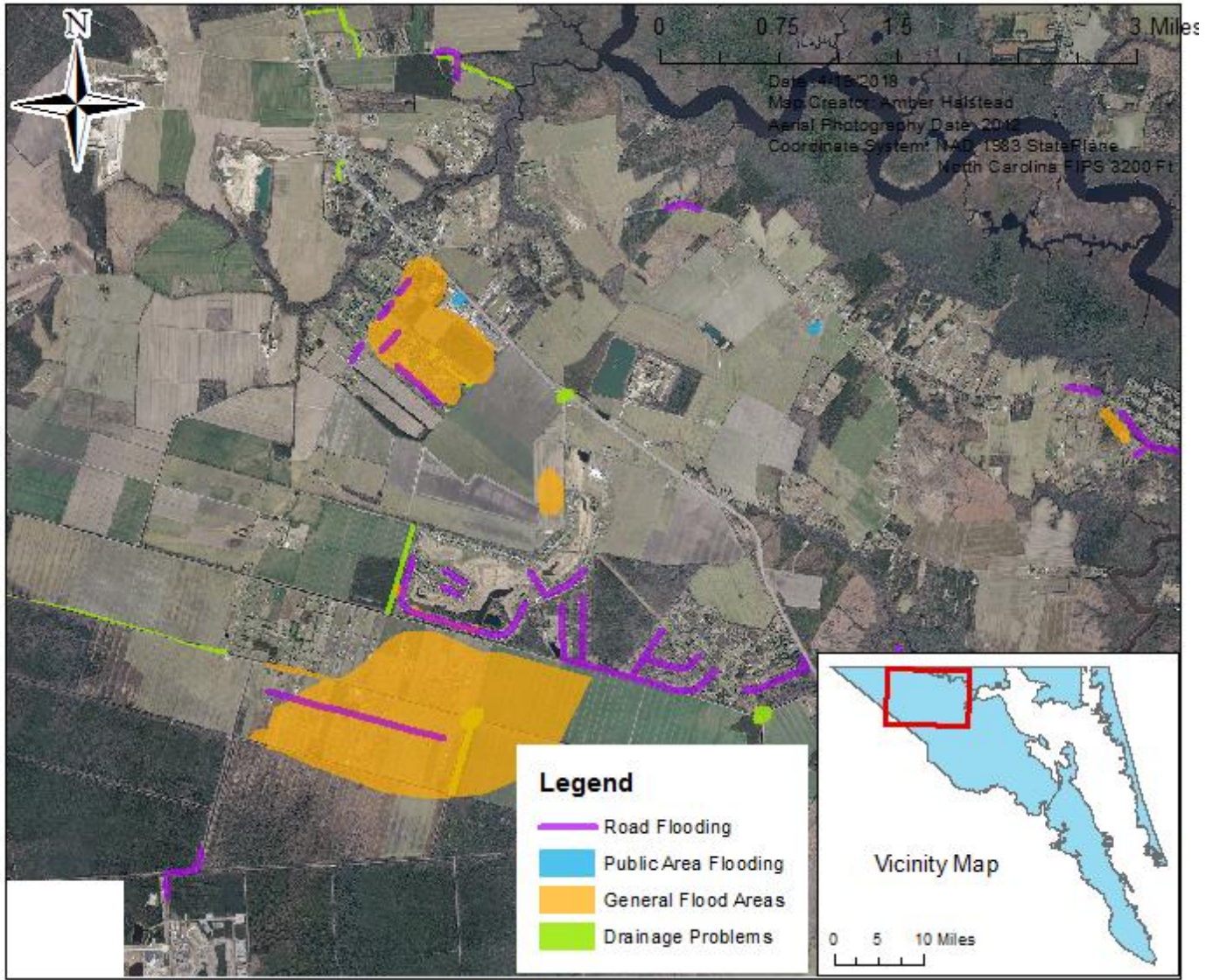


Figure 16 Digitized data from the 2018 Community Mapping Meetings.

Figure 16, above, shows the results of the community mapping meetings for Moyock, North Carolina. Participants indicated that this flooding occurs during periods of prolonged rain and during major storm events. Meeting participants discussed inadequate drainage as major cause of flooding. Figure 16, below, shows the same area in Moyock, North Carolina with the preliminary Special Flood Hazard Areas overlain in red. Much like Corolla, most of the areas identified during the mapping meetings as ‘flooding areas’ are not within the preliminary flood zone. The meeting attendees said that in this area, flooding occurs with fewer inches of rain and the flood waters take longer to recede than they had in the past. The attendees cite blocked culverts and canals as main drivers of the Moyock flooding.

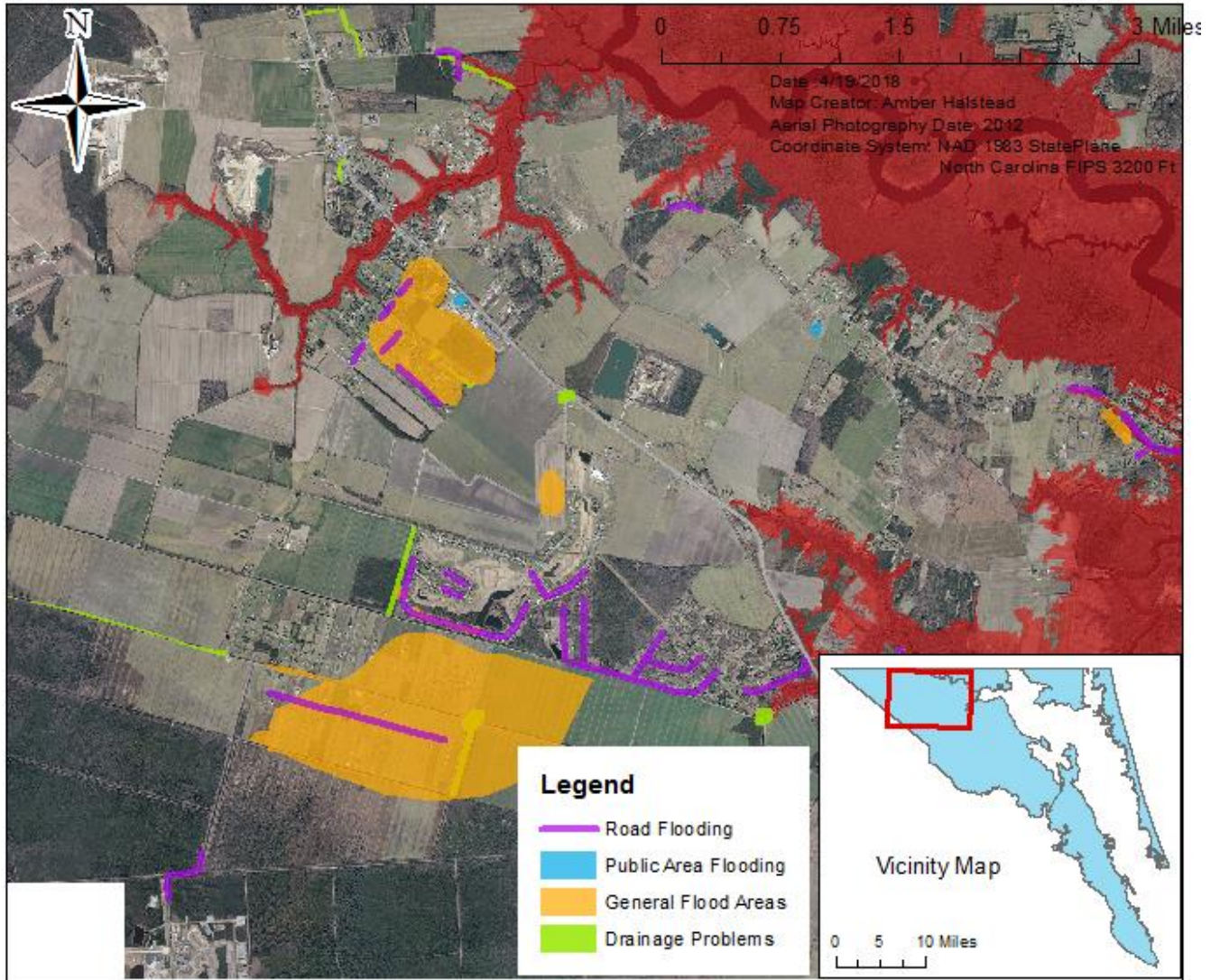


Figure 17 Digitized data from the 2018 Community Mapping Meetings with the SFHA shown in red.

Section 3: Flood Risk Communication

Priority Areas and Audiences

- Corolla:

Corolla's flooding is driven by the high water table that limits the absorption of water into the sediment. This is not something that was factored into the FEMA flood maps, which delineate flood zones as areas of lower elevation or areas exposed to wave action. Because of this disconnect between the cause of flooding on the barrier island and the method used to delineate SFHAs, many areas that have historically flooded in Corolla are being removed from the flood zone. Increased development in Corolla exacerbates flooding in the area by decreasing permeable surfaces and increasing runoff. Trees absorb water from the soil and allow for greater absorption of rainwater. So, removing trees for development also reduces the soil's ability to absorb water.

- Moyock:

Moyock is a very flat low-lying community. This community was historically agricultural with a network of drainage canals throughout Moyock. Residents identified inadequate drainage infrastructure as major issue in the community. There are already several drainage districts within the community however they are not all active. There were several participants in the community meetings that were unaware of their local drainage districts or unaware of the possibility of establishing a drainage district. Messaging to Moyock residents should include information on how to get involved with or establish a drainage district in their area. Like Corolla, development in the Moyock area has exacerbated flooding. Increases in impervious surfaces and alterations to the natural drainage patterns have increased flooding in the area.

- New Residents:

The most common reason people believed that they were at risk of flooding was because they had experienced flooding in the past. New residents often do not have memories of past flood events in the area, so they are likely to underestimate their risk of flooding.

- Individuals removed from the SFHA:

The survey results showed that there was a strong link between individuals outside of the flood zone and a reduced perception of flood risk. However, the results also indicated that the majority of people were drawing on availability bias, which would lead those who have experienced flooding to perceive a higher flood risk and those who have not experienced flooding to perceive a lower risk. Some of the individuals removed from the SFHA may have experienced flooding in the past and be drawing on those memories causing them to perceive a higher risk of flooding even with the removal from the SFHA. The individuals who have not experienced flooding, however, are not likely to feel at risk of flooding when removed from the flood zone. Even if individuals feel they are at risk of flooding, they may still choose to drop their flood insurance coverage due to the high cost of coverage. The high cost of flood insurance was reported to be one of the major concerns of survey respondents and may cause individuals to drop their coverage, even if they have lower premiums when removed from the SFHA. Changing flood maps were not reported as a major concern for most survey respondents. Because of this, when citizens are contemplating flood coverage, they will likely not consider future map changes. This is important because it means they will likely not consider the financial benefits of retaining their coverage now to receive a reduced premium in the future if and when they are moved back into a SFHA.

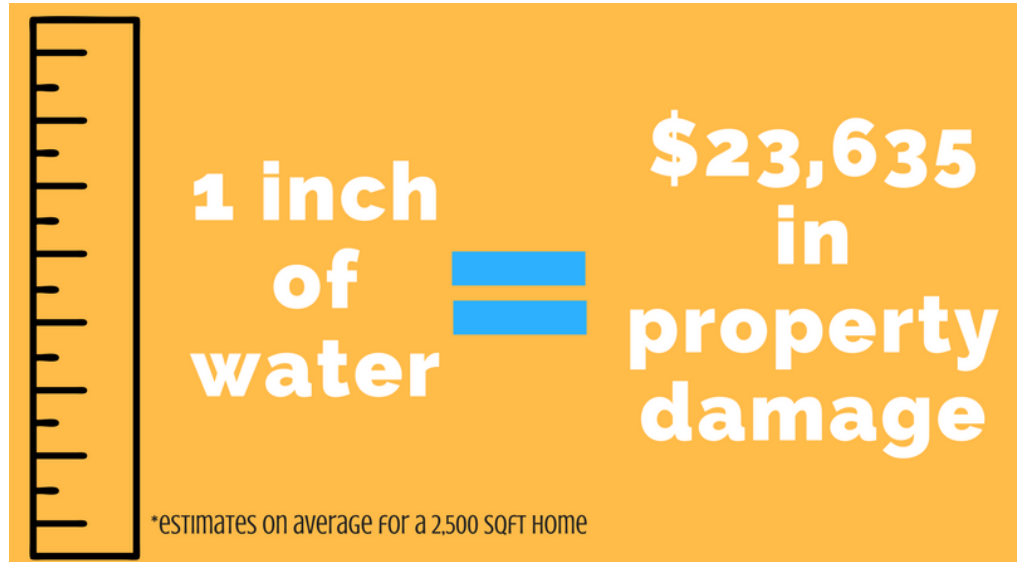


Figure 18 Graphic on flood damage using data from FEMA (National Flood Services, 2017)

- Communicate the affordability of flood insurance.
 - Quantify the impacts of flood damage
 - Many respondents said that they felt the insurance premiums just “aren’t worth it” or that it is “cost prohibitive”. An online survey respondent said that their insurance would cost \$450 per year. By placing a monetary value on flood damage, advertisements like figure 18 can help residents see the value of flood insurance and justify the investment to protect their home.
 - Communicate nonmonetary benefits
 - The number one reason people chose to have flood insurance was because it gave them peace of mind. Communicate to residents that buying flood insurance is the best thing they can do to protect their home, business, and their family’s financial security in the face of flood damage.

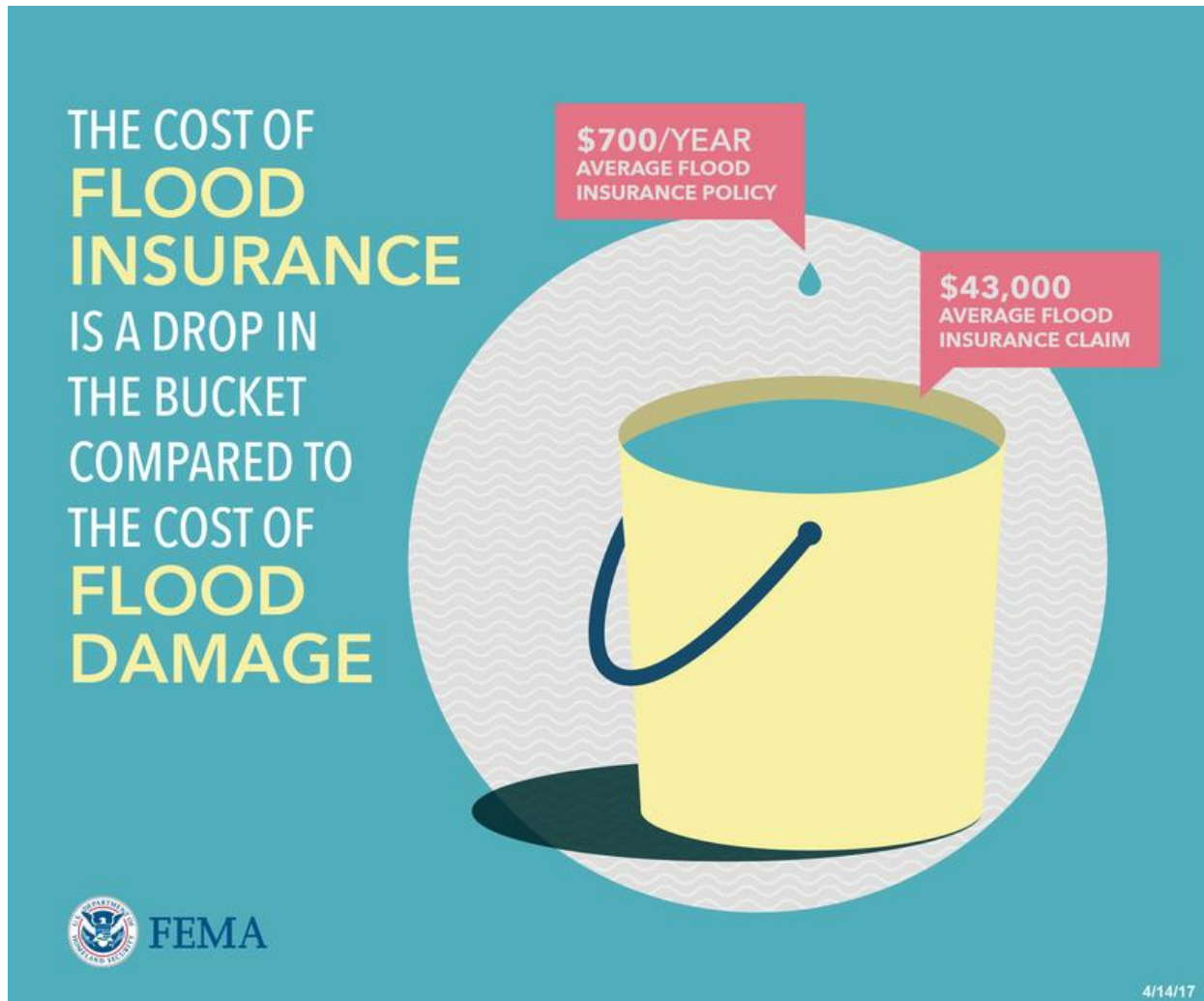


Figure 19 FEMA Flood Insurance Advertisement

- Utilize FEMA communications materials
 - FEMA provides free communication materials, like figure 19, for local governments to communicate flood risk. These materials are available for use on their website.
 - Create graphics like figure 18 from FEMA flood damage estimates or from your own data on flood losses in the county
 - Examples of FEMA advertisements in Appendix C



Figure 20 Dare County communication material used to advertise flood risk (Vision Internet, n.d.).

- Communicate that there is still a risk of flooding outside the SFHA
 - Use images like figure 15 and 17 to compare SFHA with the extent of previous flood events
 - Pair these maps with images of flooding to help residents recall their flood memories

Bibliography

- Brilly, M., & Polic, M. (2005). Public perception of flood risks, flood forecasting and mitigation. *Natural Hazards and Earth System Sciences*, 5, 345–355.
- Burton, C. G. (2010). Social Vulnerability and Hurricane Impact Modeling. *Natural Hazards Review*, 11(2), 58-68.
- Camerer, C. F., & Kunreuther, H. (1989). Decision processes for low probability events: Policy implications. *Journal of Policy Analysis and Management*, 8(4), 565.
- Camerer, C., & Kunreuther, H. (1989). Experimental markets for insurance. *Journal of Risk and Uncertainty*, 2(3), 265–299.
- Chivers, J., & Flores, N. E. (2002, November). Market Failure in Information: The National Flood Insurance Program. *Land Economics*, 78(4), 515– 21.
- Currituck County. (2017, May 07). *Currituck County Flood Outreach: Do You Know Your Risk?* Retrieved from Currituck County : <http://www.co.currituck.nc.us/pdf/form-planning/brochures-flood-information.pdf>.
- Fox, C. R., & Hadar, L. (2006). Decisions from experience" = sampling error + prospect theory: Reconsidering Hertwig, Barron, Weber & Erev (2004). *Judgment and Decision Making*, 1(2), 159-161.
- Hertwig, R., Barron, G., Weber, E. U., & Erev, I. (2004). Decisions From Experience and the Effect of Rare Events in Risky Choice. *PSYCHOLOGICAL SCIENCE*, 15(8), 534–539.
- Kunreuther, H. (2006, March 1). Disaster Mitigation and Insurance: Learning from Katrina. *ANNALS of the American Academy of Political and Social Science*, 604(1), 208-227.
- Langston, D. (n.d.). "Matthew's destruction hits some Currituck families hard.". *The Outer Banks Voice*, 2016.
- McEwen, L., Garde-Hansen, J., Holmes, A., Jones, O., & Krause, F. (2017). Sustainable flood memories, lay knowledges and the development of community resilience to future flood risk. *Transactions of the Institute of British Geographers*, 14-28.
- North Carolina Emergency Management. (n.d.). *Flood Study Update: Currituck County*. Department of Public Safety.
- Petrolia, D. R., Landry, C. E., & Coble, K. H. (2013, May). Risk Preferences, Risk Perceptions, and Flood Insurance. *Land Economics*, 89(2), 227-245.

- Ruin, I., Gaillard, J.-C., & Lutoff, C. (2007). How to get there? Assessing motorists' flash flood risk perception on daily itineraries. *Environmental Hazards*, 7(3), 235-244.
- Siegrist, M., & Gutscher, H. (2006, August). Flooding risks: A comparison of lay people's perceptions and expert's assessments in Switzerland. *Risk Analysis*, 26(4), 971-979.
- Stradling, R. (2016, October 27). Hurricane Matthew death toll in NC rises to 28. *News & Observer*.
- Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The Risk Perception Paradox—Implications for Governance and Communication of Natural Hazards. *Risk Analysis*, 33(6), 1049-1065.
- Wallace, J. W., Poole, C., & Horney, J. A. (2016). The association between actual and perceived flood risk and evacuation from Hurricane Irene, Beaufort County, North Carolina. *Journal of Flood Risk Management*, 9(124-135).

Appendix A: Methods

The focus of this study is people's perception of flood risk in Currituck County, North Carolina. To assess public perception, this study utilized an online survey and series of community mapping meetings. The online survey was distributed to a list of about 800 people that had signed up receive information from Currituck County. The survey was also advertised on the Currituck County Facebook page and on a local radio station. The survey remained open for one month and received 506 responses. The final question on the online survey asked respondents if they would be interested in participating in an in-person community mapping meeting and asked for their contact information, if interested. Interested respondents were then contacted to participate in the community mapping meetings. These meetings were also advertised on the Currituck County Facebook page. There was a series of four meetings held in different neighborhoods across Currituck County. There were twenty-one community meeting attendees in total, the majority of which attended the meetings in Moyock, 13, and Corolla, 5. During the community mapping meetings, attendees were asked to draw on paper maps to demarcate areas of flooding within the county. While drawing on the map, participants were asked questions about flood depth, cause, and duration for each flooding area identified. These conversations were recorded using a voice memo recorder. The results of the community mapping meetings were digitized using ArcGIS to create a shape file for each of the four types of flooding asked about during the meeting; road flooding, public area flooding, general flooding, and drainage problems.

Appendix B: Full Results of Community Mapping Meeting

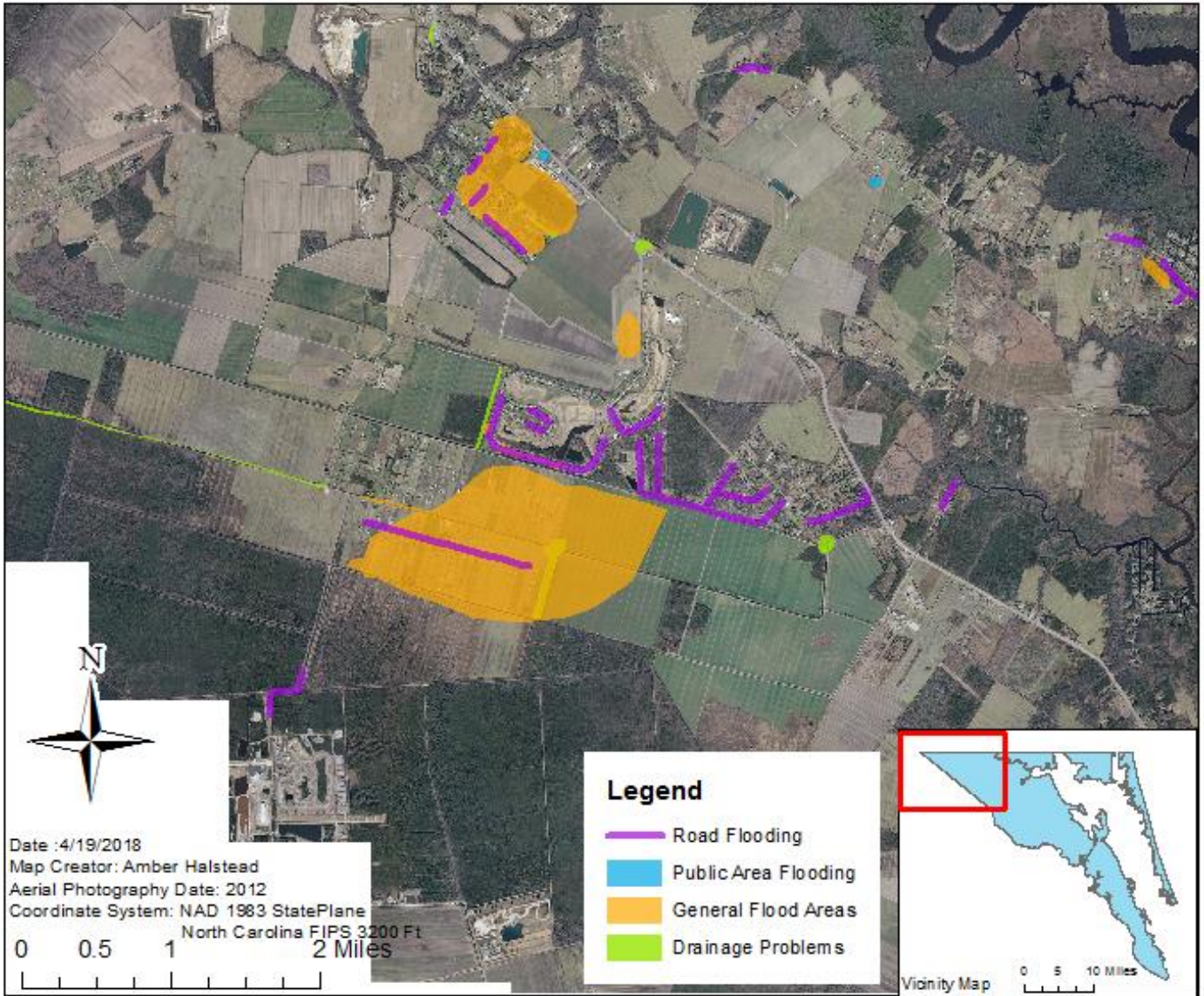


Figure 21 Areas of flood concern in the Guinea Mill Run and Lateral A Canal areas identified during the Community Mapping Meetings.

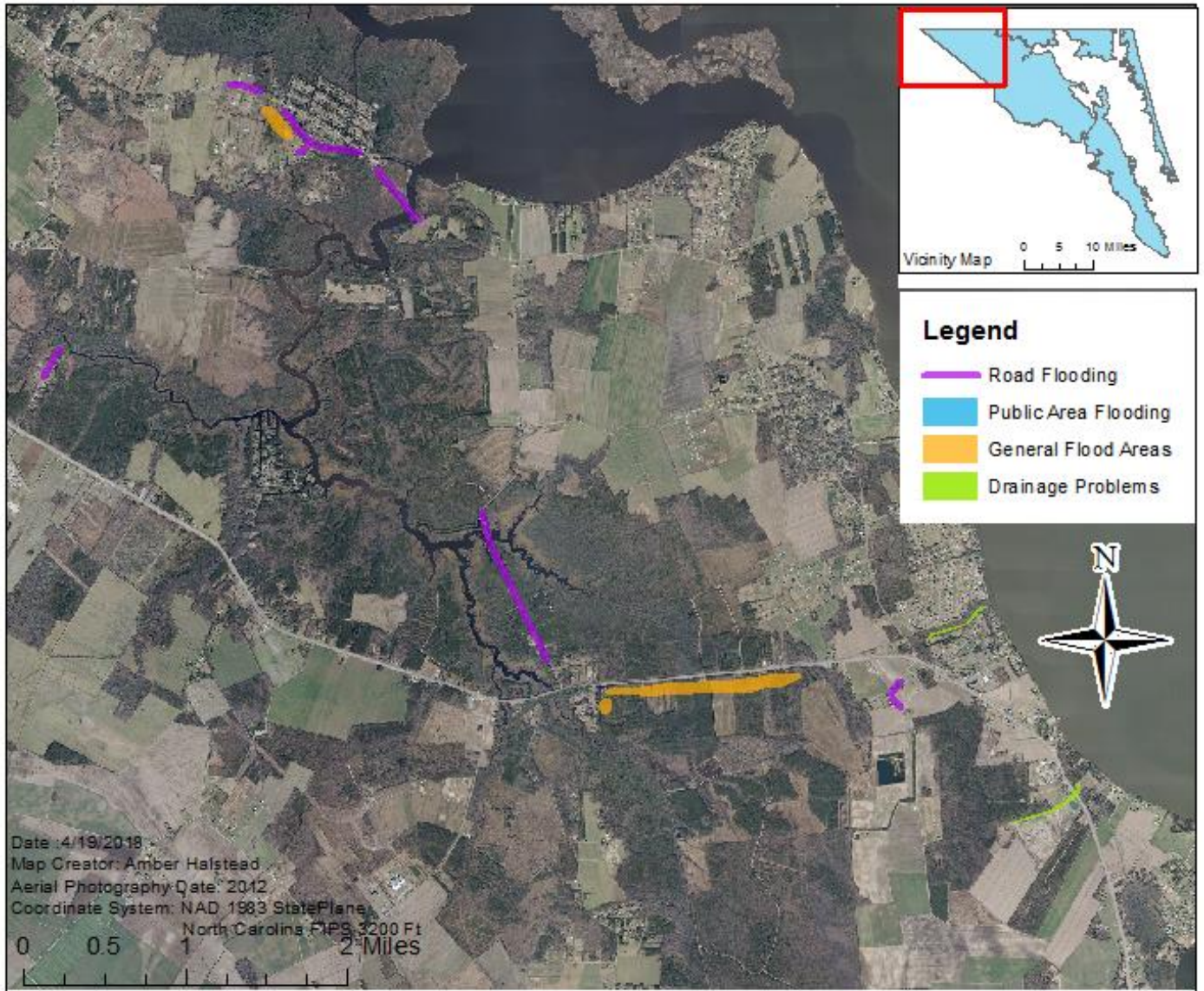


Figure 22 Areas of flood concern in Currituck area identified during the Community Mapping Meetings

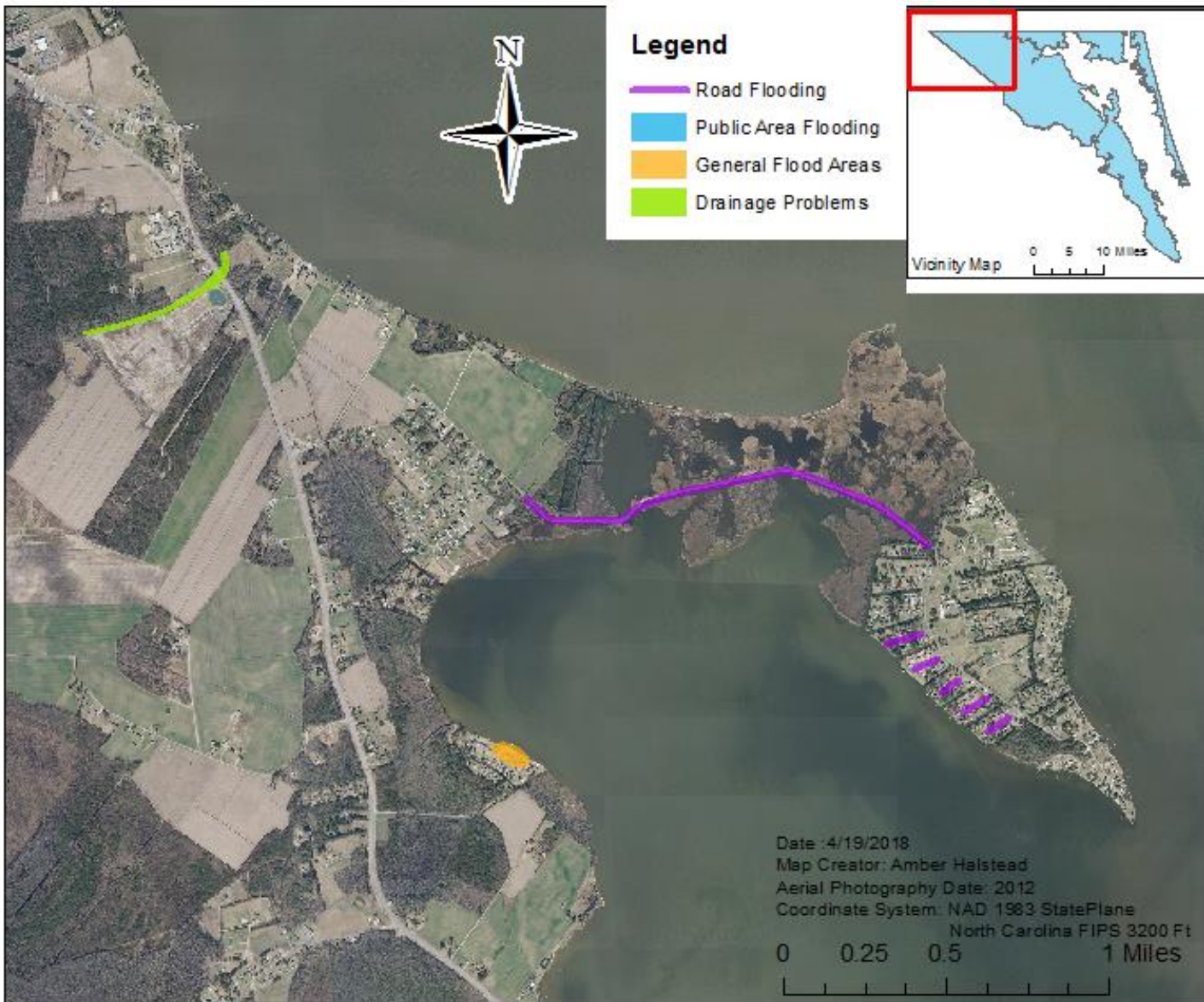


Figure 23 Areas of flood concern in Bell Island identified during the Community Mapping Meetings



Figure 24 Areas of flood concern in Jarvisburg identified during the Community Mapping Meetings

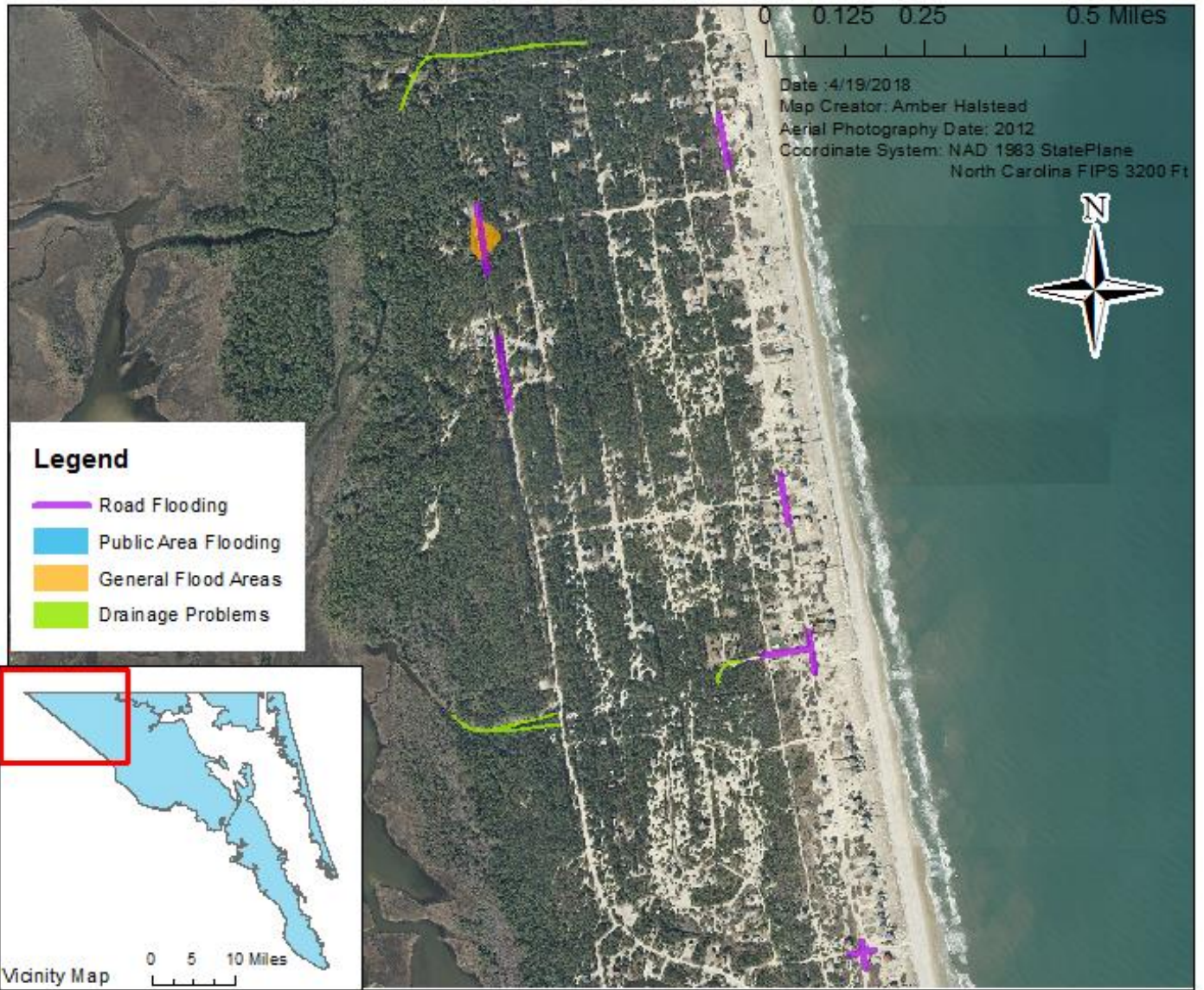


Figure 25 Areas of flood concern near the North Carolina/Virginia boarder identified during the Community Mapping Meetings

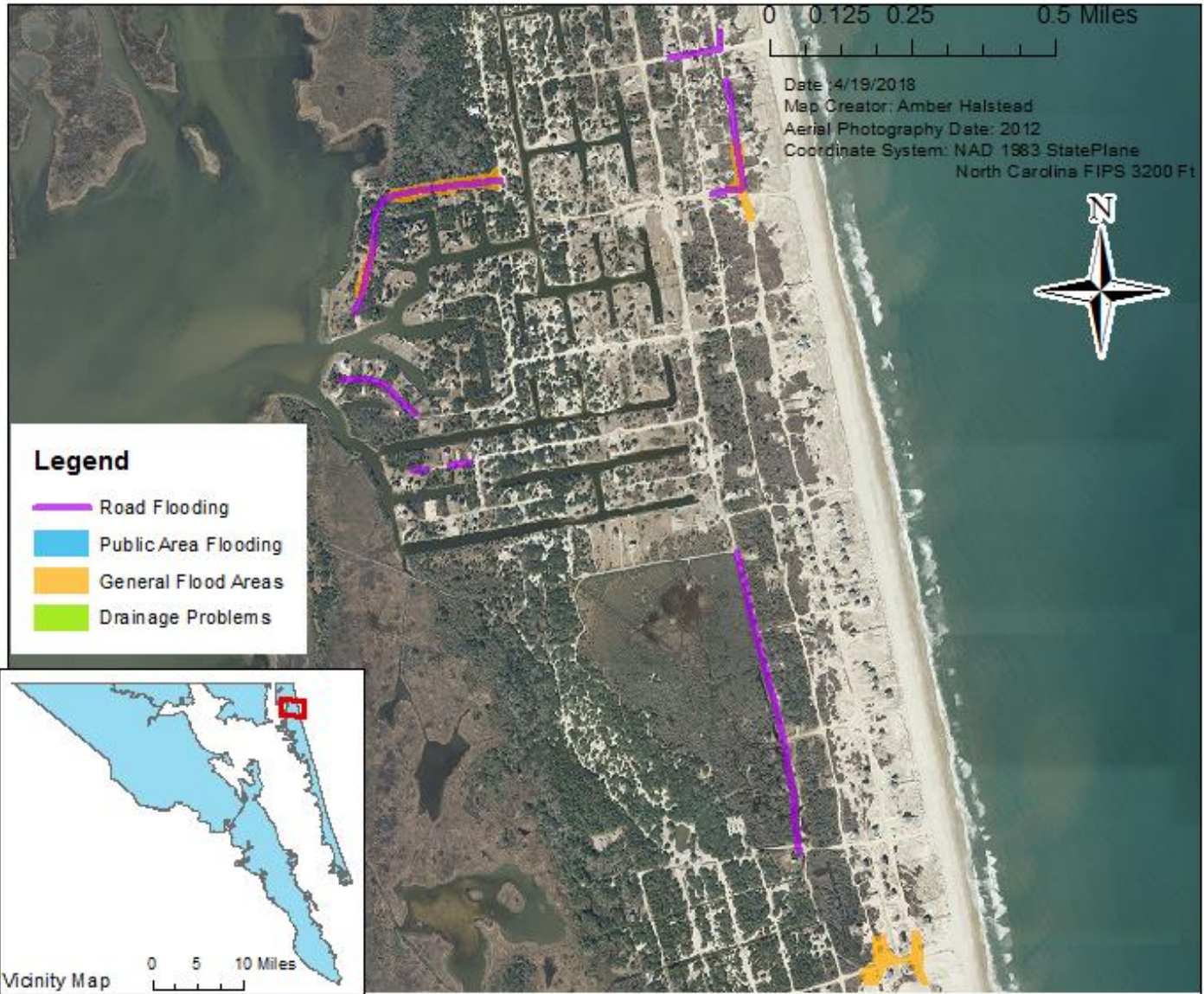


Figure 26 Areas of flood concern near the Off-Road Area identified during the Community Mapping Meetings

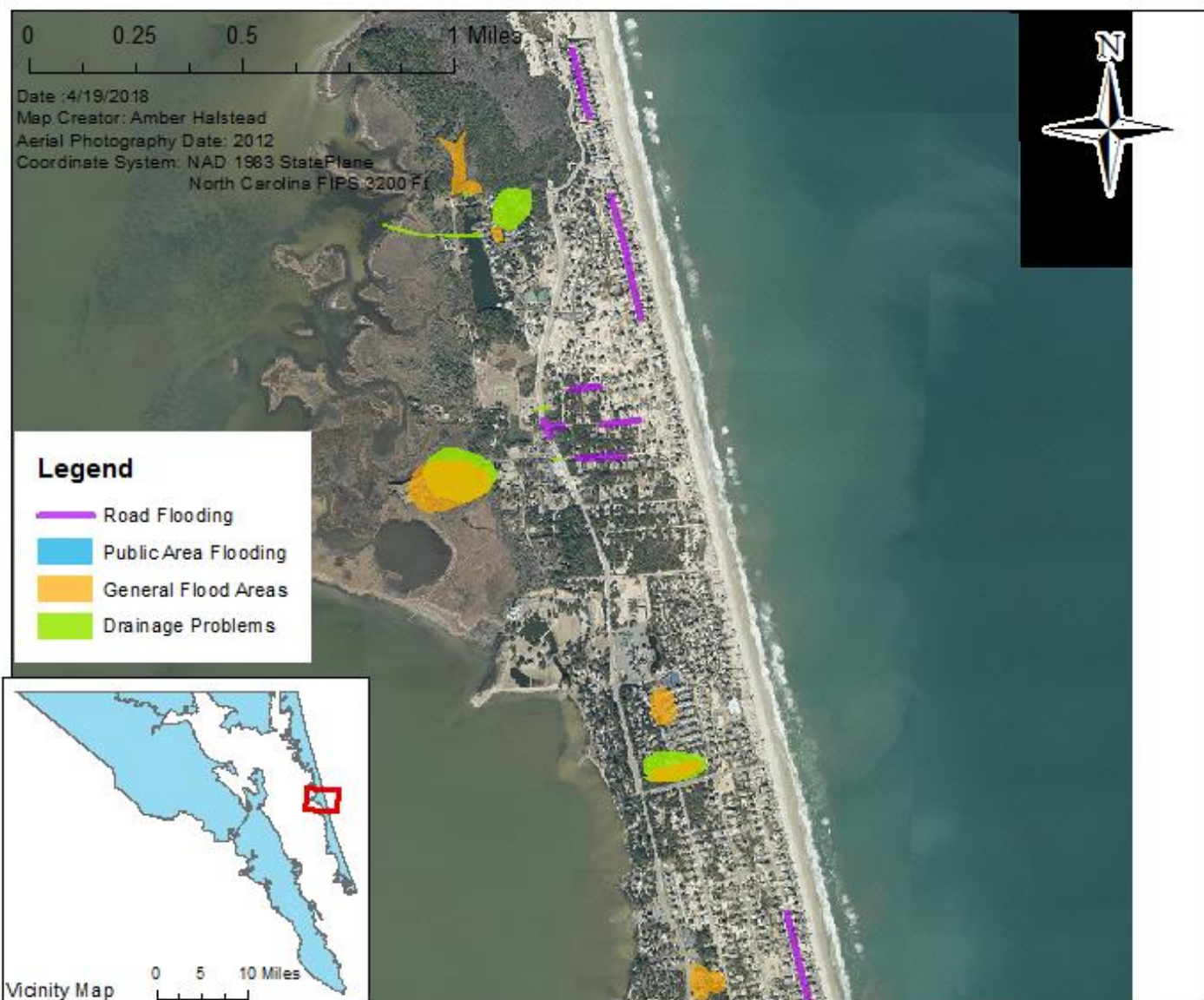


Figure 27 Areas of flood concern in the Villages at Ocean Hill identified during the Community Mapping Meetings

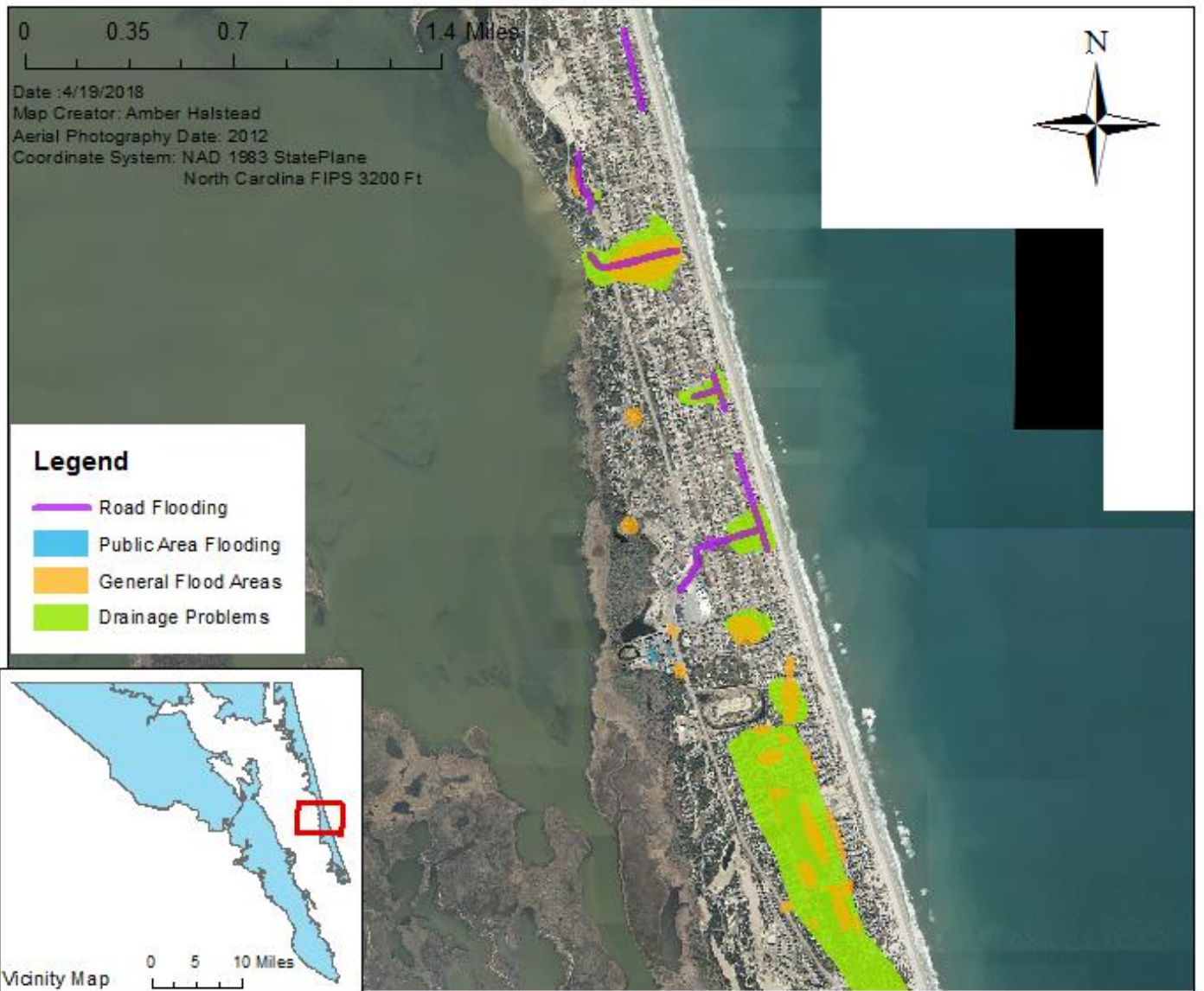


Figure 28 Areas of flood concern near Buck Island identified during the Community Mapping Meetings

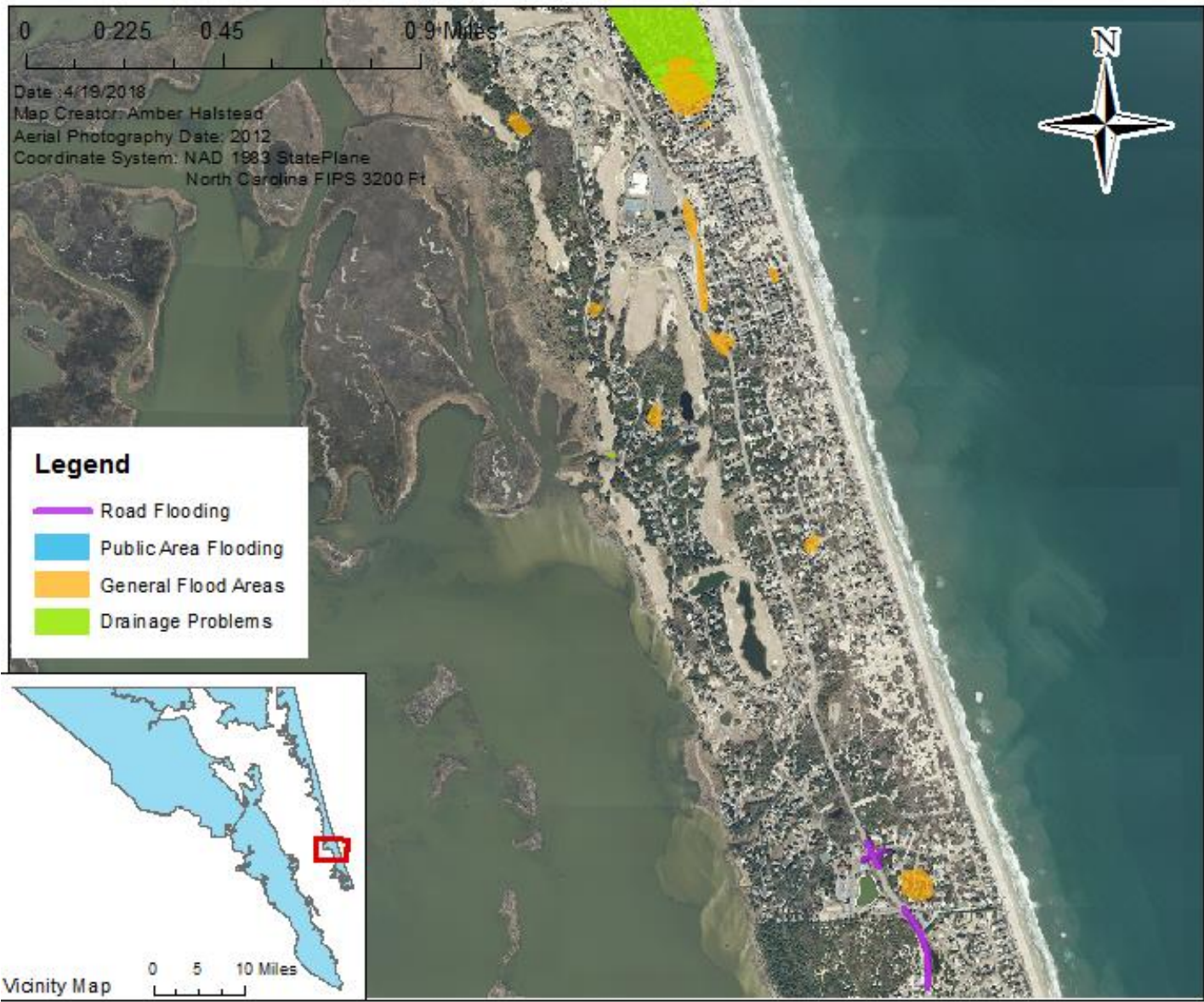


Figure 29 Areas of flood concern near Ocean Sands identified during the Community Mapping Meetings

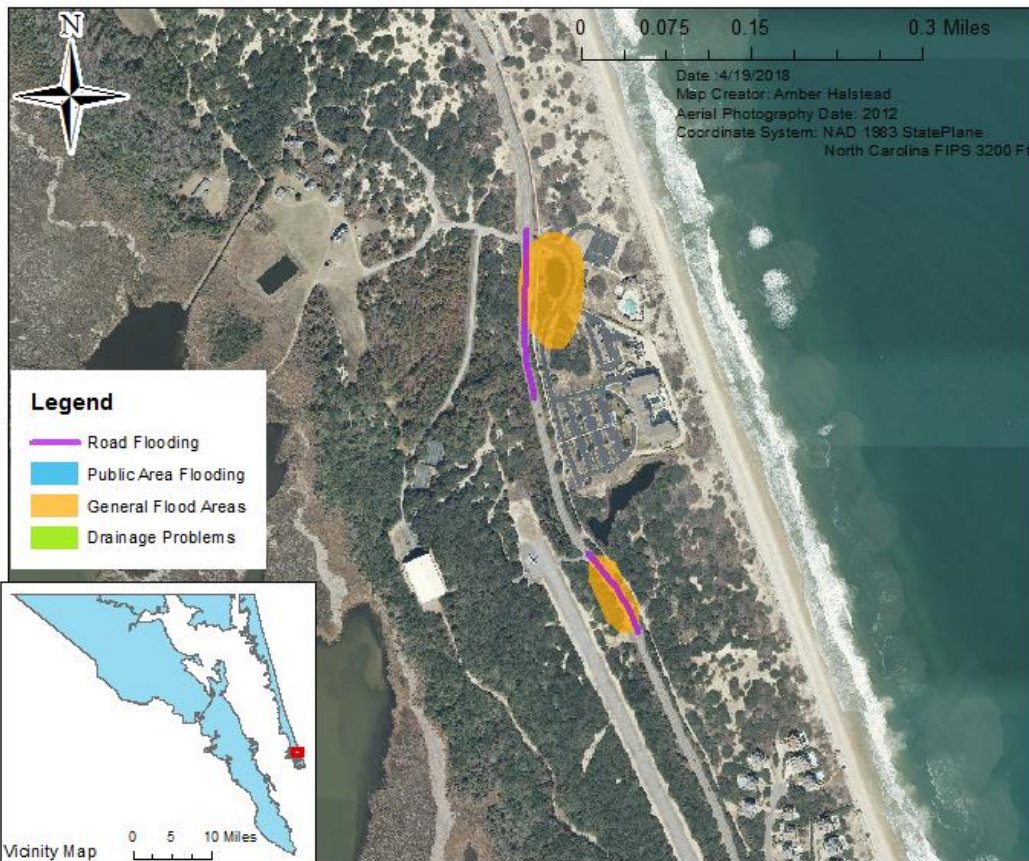



Figure 30 Areas of flood concern near Pine Island identified during the Community Mapping Meetings

Appendix C: Examples of Federal Emergency Management Agency Flood Communication Materials

**THE COST OF
FLOOD
INSURANCE
IS A DROP
IN THE BUCKET
COMPARED TO THE
COST OF
FLOOD
DAMAGE**

4/14/17

**\$700/YEAR
AVERAGE FLOOD
INSURANCE POLICY** | **\$43,000
AVERAGE FLOOD
INSURANCE CLAIM**

 **FEMA**