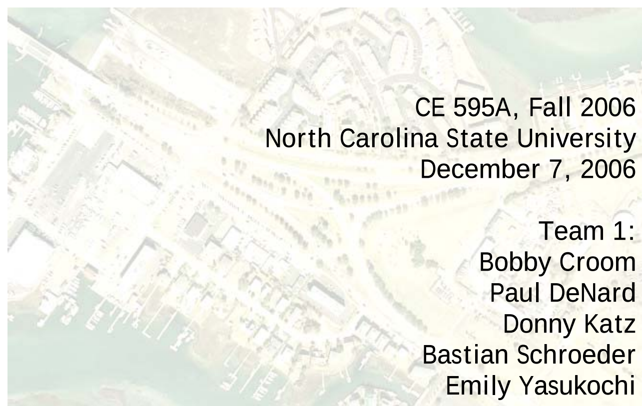
US 74/76 Intersection, Wrightsville Beach, NC

A Case Study in Context Sensitive Solutions

Final Report



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Executive Summary

This report summarizes a case study in the NCSU ‘Context Sensitive Solutions’ class. The small beach community of Wrightsville Beach, NC in New Hanover County has a year-round population of under 3,000 people, but like most of North Carolina’s barrier islands attracts tens of thousands of vacation goers over the summer months. The only access point to this community is across a four-lane undivided draw bridge facility. While the bridge capacity is theoretically sufficient to process the peak demand in excess if 50,000 vehicle per day, the configuration of the intersection just east of the bridge causes frequent traffic congestion during peak demands. The unsignalized US 74/76 split on the gateway Harbor Island channels most incoming traffic through designated one-way road segments to process drivers to different parts of the island.

Through meetings with town staff and the use of an online survey, the team gathered stakeholder input about existing problems and solution ideas. Among others, the results suggested that the current configuration has residents and visitors concerned about turning movement queues backing up into the main travel lanes, drivers coming up with shortcuts to avoid the hassle of the intersection, and the lack of access for non-motorized road users.

This report proposes further study of a system of signalized intersections, referred to as the ‘Candy Corn,’ forming a coordinated cluster of intersections at the gateway to the town. Preliminary analyses show that with proper timing and signal progression, traffic delays and the number of stops can be minimized under peak demand, while improving access for local traffic, and creating opportunity for signalized pedestrian crossings.

In a study area highly constrained by wetlands, areas of low-elevation, and adjacent commercial and residential development, the ‘Candy Corn’ offers the potential for a demand-responsive system that can be timed to optimize the unique traffic operations on the island. Even the frequent opening of the draw bridge could be addressed through the creation of special bridge clearance phases.

In addition to the predicted operational benefits, the suggested reconfiguration of the intersection frees up approximately two acres of land to be used for open space or public use. This puts the tourism-based community of Wrightsville Beach in the unique position to transform pavement into a true landscaped gateway to their town.

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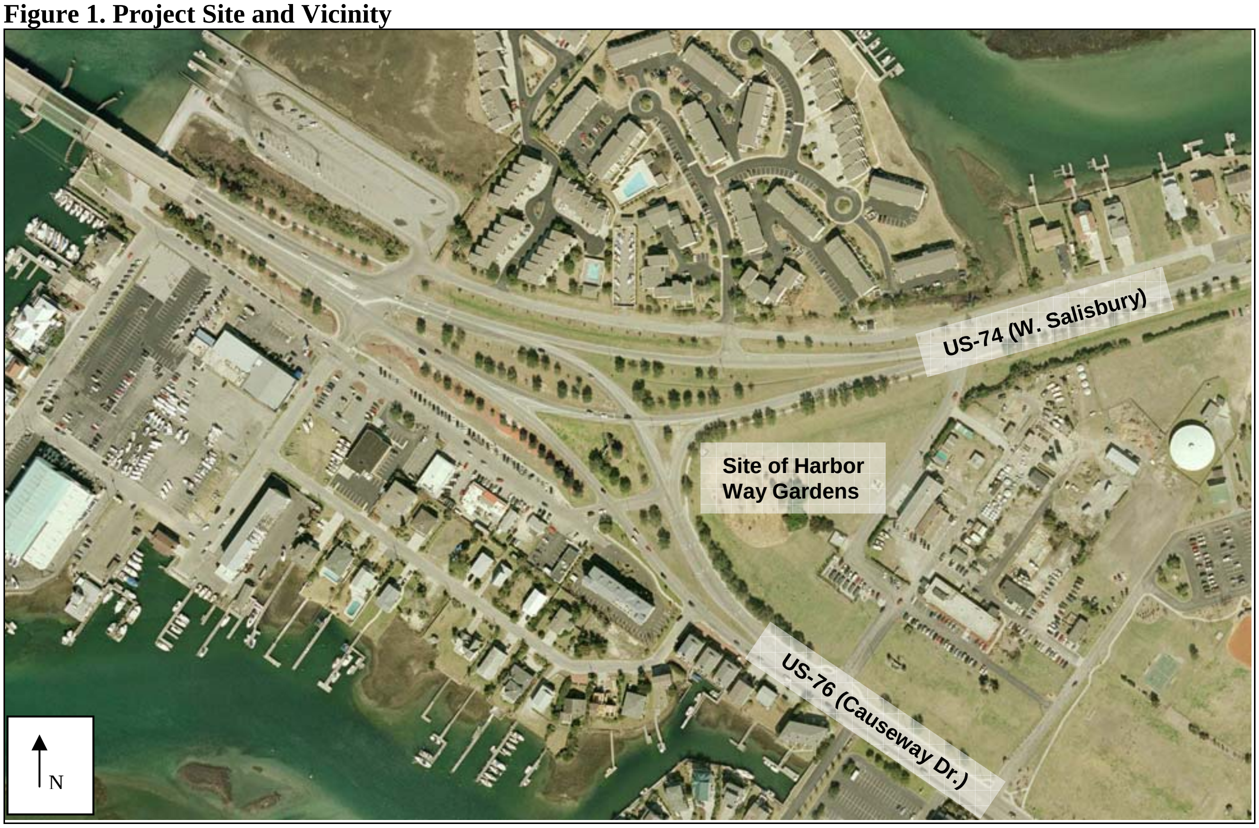
1 Introduction

Wrightsville Beach, North Carolina is a popular destination for tourists due to its five mile stretch of sandy beach. Being a beach destination causes a spike in visitors and traffic during the summer months, attracting people from within and outside of the state of North Carolina. Wrightsville Beach is also a popular destination for tourists seeking some solitude during the off-peak months.

The main access point into Wrightsville Beach is the intersection of US 74 and US 76. This intersection was designed in the 1950s and consequently displays some of the standard design elements associated with that time period. Eastbound US 74 and 76 meet prior to a drawbridge located west of Wrightsville beach, cross over the drawbridge, and split again on Harbor Island, the man-made island that connects Wilmington to the west with the barrier island of Wrigtsville Beach to the east. On this island, which is part of the incorporated Town of Wrightsville Beach, directional travel lanes are split from each other, which leave several inaccessible medians and an aesthetically displeasing and large footprint. The current design does not place a high priority on pedestrians, bicyclists or the general context of the area and surrounding community. Refer to Figure 1 for an aerial view of the site.

Figure 1. Project Site and Vicinity



Source: New Hanover County GIS

Through the years since construction, this intersection has seen an increase in seasonal traffic and congestion. A permanent count station on the bridge measured the peak daily traffic in 2002 in excess of 40,000 AADT across the US 74/76 bridge during the summer months, with as much as 50,000 on holiday weekends. (Appendix L)

Some attempts have been made to accommodate non-vehicular transportation modes in the area. For instance, a pedestrian path has been installed along with a commendable garden/park area directly to the east of the intersection. However, the main intersection remains largely inaccessible to bicycles and pedestrians.

Requests have been placed with NCDOT and its Division Engineer to produce an alternative design. Because of the unique characteristics of both the intersection and the town of Wrightsville Beach, it was suggested that this project be used as a case study in Context Sensitive Solutions (CSS). Thus, this report describes the processes and results of the CSS process as it applies to the US 74/76 intersection in Wrightsville Beach, North Carolina.

1.1 Purpose and Objectives

The purpose of the CSS process is to provide a transportation solution that is both an asset to the community and that fits within the human and natural environments of its setting. The design of the intersection alternatives will thus attempt to address the following issues:

- Create a design that will accommodate and enhance the area and surrounding community
- Create a design with an acceptable level of service for the various users (pedestrians, bicyclists, vehicular) of this area
- Allow a higher level of service during the seasonal peak periods to relieve congestion and reduce air pollution
- Be an asset to the community, whether tourist or resident
- Allow an acceptable level safety for all users, including non-vehicular users

In order to address these issues, we identified the following objectives:

1. Identify and thoroughly understand the principles of Context Sensitive Solutions/Design in accordance with the National Cooperative Highway Research Program practices as it relates to a highway design project.
2. Effectively identify the context and important stakeholders of the US 74/76 interchange gateway into Wrightsville Beach.
3. Form a cooperative CSS personnel structure including a multidisciplinary team to work through the project process internally, as well as forming an efficient stakeholder partnership to include those outside the transportation engineering "circle."
4. Create several design alternatives based on balancing the transportation needs and human and natural environmental factors researched and revealed through the stakeholder involvement process.
5. Analyze each alternative based on the CSS evaluation criteria from, highway design standards from the NCDOT and FHWA, and other forms of stakeholder involvement.
6. Select and optimize several accepted alternatives that will address state natural environment regulations and blend into the Wrightsville Beach community environment limiting undesired human (business, residential, etc) impacts.
7. Present final recommendations and qualitative review of CSS process to stakeholders and highway officials at NCDOT.

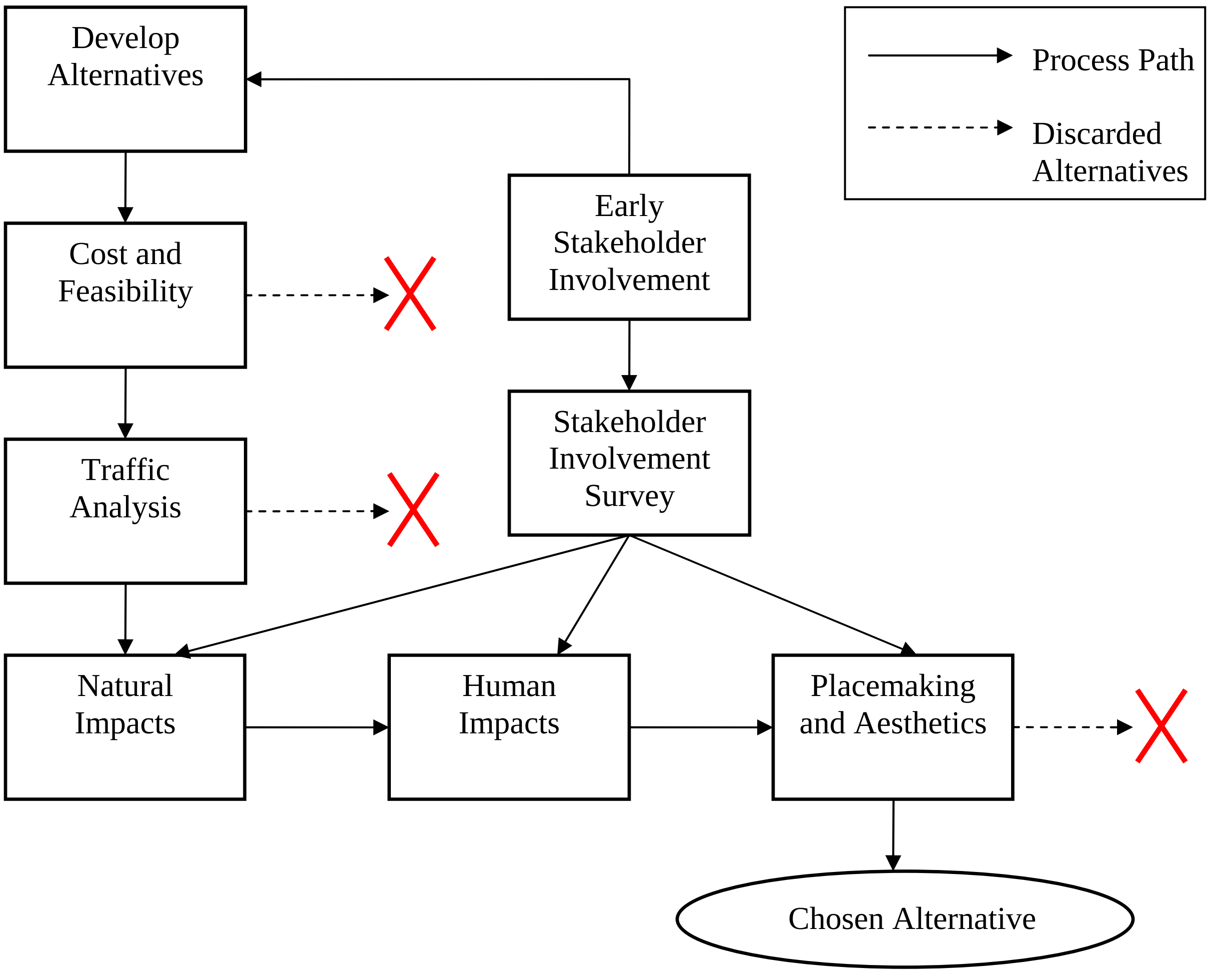
1.2 Scope

The team will analyze the impacts of several transportation alternatives with respect to cost, traffic, the human and natural environments, and aesthetics and placemaking. Our primary focus for impacts to the natural environment will center on storm water, drainage, reduction of pervious surfaces, and loss of existing plantings. Our analysis of impacts to the human environment will focus on economic benefits to the community, stakeholder acceptance, and preservation of cultural amenities. The team will place additional emphasis on assuring multimodal accessibility of the proposed design. We will use public involvement, as discussed in Section 2.4 below, to gauge public opinion on what aspects of the project are most important and which alternatives are most desirable.

1.3 Approach

A project plan was established to guide our analysis. Our goal was to reduce the number of alternatives as the analysis progressed. We considered what steps of our decision-making process should occur earlier or later in order to accomplish this. Guiding us in this were the CSS checklists that we gathered from NCHRP Report. From these checklists, a final plan was established. It was determined that spending time on poor alternatives was to be avoided. For example, analyzing a costly alternative for its pedestrian safety would be wasteful, since it is unlikely to be built. Efforts in responding to human and environmental context are better spent on alternatives that meet more tangible goals, such as reducing traffic congestion and keeping costs manageable. We developed a flow chart as seen in Figure 2.

Figure 2. CSS Process Flow Chart



This analysis guide we felt was more conducive to CSS studies than a decision matrix. Although we originally proposed to use a decision matrix to choose our final alternative, we felt it impractical due to time constraints, and the depth of the problem, to do so. A study that flowed from step to step would allow us to pay attention to each detail of the problem, with the most constraining aspects studied first.

The stakeholder involvement survey was designed from comments gathered during early stakeholder involvement. It was intended to get input on the perceived safety and operations of the intersection from a larger constituency. In the process of narrowing down alternatives it aids in assessing natural and human impacts and tailoring our recommendations to the expressed needs from the community.

2 Context

2.1 Human Environment

The most prevalent aspect of context in the Town of Wrightsville Beach is its beach community identity. Fewer than 3,000 people inhabit the island year-round, but town officials estimate peak weekend populations at greater than 30,000 people. In accord with its beach identity, property values in Wrightsville are well above the state average and those of nearby Wilmington, NC.

The human component of Wrightsville Beach is composed mainly of long-time residents, second-home owners, and beach-going visitors. Developers, rental property owners, and business owners are also important stakeholders in the community. In the immediate vicinity of the study intersection, the predominant uses are single family residential to the north, commercial and residential to the south, utilities and transportation to the southwest, and office and institutional uses to the east. Figure 3 shows the land uses in the project vicinity.

Figure 3. Wrightsville Beach Land Use Map

During the town's Master Plan Revitalization Charette, held in February 2005, the area immediately south of the intersection was identified as a focus area for revitalization. Citizens were asked to express their vision of the area with respect to land use, aesthetics, and traffic and parking over the next twenty years. Community members identified that business, commercial, office, and residential uses are desired for the area. Aesthetically, citizens expressed interest in a more pedestrian-friendly environment, more landscaping, public restrooms, and underground utility lines. With respect to traffic and parking, citizens were in favor of a modern roundabout at the study intersection. One of the justifications of the roundabout was that "a significant amount of publicly owned land will become vacant with the potential for development," (NC Department of Commerce, 2005). With such high property values, freeing real estate for development could be a significant boost to the local economy.

Though the roundabout enjoyed public support in the master planning process, there is some degree of skepticism to the idea with town officials and police staff questioning the expected operational performance of a roundabout during peak travel days. This political opposition to a roundabout is an important aspect of the human environmental context of this case.

Another important aspect of human context in the vicinity of the study intersection is the "Loop", a 2.5-mile sidewalk that creates a continuous path along Lumina Avenue, US 74, and US 76. The Loop is a popular destination for pedestrians and joggers throughout the year and is an important cultural amenity of the town (see **Error! Reference source not found.**). There is some bicycle traffic in the area, although many cyclists are discouraged from having to cross over the US 74/76 bridge, a facility with very narrow lanes and sidewalks.

Figure 4. A Jogger on the Loop

It is important to emphasize the character of the intersection as a "gateway" to the Wrightsville Beach community. Residents and visitors alike ought to associate the US 74/76 split with a friendly welcome to the town. The geometric configuration of the intersection and the environmental context are therefore equally important to an acceptable level of service of traffic flow.

Finally, in order to gain an understanding of the commercial atmosphere of the intersection, our group compiled a list of businesses established in the vicinity. The list, attached in Appendix A, provides contact information and locations of all these businesses. These stakeholders are important to involve when discussing access and parking effects any construction or improvements may cause.

2.2 Natural Environment

The natural environment in the study intersection vicinity is made up primarily of grassy medians planted with heritage live oak trees (*Quercus virginiana*). A cultural and natural amenity of Wrightsville Beach, the live oak trees add both sense of place and natural shade to the area. With the elevation of most of the town just a few feet above sea level, drainage in the grassy medians may be an issue. Figure 5 shows the topography in the study area. As shown in the figure, the medians in the central and northeastern portions of the intersection are at a lower elevation than the road surface. During our site visit, which occurred after a few days of heavy rain, we observed pooled water in some of the medians (see Figure 6).

Figure 5. Project Area Topography

Figure 6. Heritage Live Oaks and Pooled Water in Median

Also related to the geological characteristics of Wrightsville Beach and the Carolina coastline in general is the presence of wetlands. Figure 7 shows wetlands in the general vicinity of the project, of which there are two types: estuarine shrub/scrub and salt/brackish marsh. Although no wetlands lie within the immediate project area, care should be taken to avoid affecting the wetlands located to the north and east of the study intersection on Harbor Island. The coastal wetlands of the Carolinas are also known to attract many bird species year-round. While a detailed study of birds in Wrightsville Beach wetlands was beyond the scope of this project, any major changes in stormwater runoff to the Intercoastal waterway could have consequences for bird habitat and should therefore be carefully studied.

Figure 7. Wrightsville Beach Wetlands

Map created by E. Yasukochi
Data Source: New Hanover County GIS

Because this project is centered on an auto-oriented intersection, air pollution is another important natural environmental consideration. Aside from starting a cold engine, the largest volumes of air pollutants are released from automobiles during acceleration from a stopped position, which implies that any improvements involving full or partial control (e.g. signals) of the intersection are likely to increase air pollution in the intersection vicinity. This must be weighed with benefits to traffic flow brought about by intersection control.

A final important natural amenity in the vicinity of the study area is Harbor Way Gardens, a community park and garden located inside the Loop, just east of the study intersection. Both a cultural and natural amenity, the garden comprises landscaped plots with mature plantings, paved paths, benches, and water fountains (see

Figure 8).

Figure 8. Harbor Way Gardens Entrance

2.3 Traffic Context

The vehicular context is a significant part of the study area. It would not be correct to assume that traffic in the study intersection behaves like similar intersections located elsewhere. The primary reasons for the uniqueness of the intersection are the aspects of the drawbridge over the Intercoastal Waterway, the majority of vehicles during the summer being tourists, and the seasonal peaking of congestion.

The drawbridge has the most significant impact on the problem. No traffic model can be considered unless the drawbridge is included. The bridge is only required to open once per hour, on the hour, however it may open more frequently for commercial vessels (Rufe, 1998). This creates situations where the bridge may open more often in an hour, causing additional traffic to build up. The bridge will not open off schedule for pleasure vessels; however, more pleasure vessels passing under when it is open causes it stay open longer, creating longer queues along the roadways. This problem only worsens during the summer months, when both boat and vehicle traffic increase. When the bridge is up, all roadway operations cease heading onto or off the island. Once down, it takes time for the surrounding roadways to return to pre-opening operation levels.

Since the beach is the most significant attraction in the area, the intersection tends to serve mostly tourists during the peak season. The summer season has much higher volumes than the colder months. During the off-season, the intersection flows without problems, verified by the responses received from the stakeholder survey. However, come the weekends of summer, traffic is approximately 250% higher than the winter, causing severe congestion experienced by both residents and tourists. Most travelers aim only to pass through the intersection as quickly as possible on their way to the beach, their final destination. Thus, the desire of drivers is to pass through unobstructed. Although tourists are prevalent, the needs of local residents must still be met, as they may be more likely to access the businesses and homes around the intersection.

2.4 Community Involvement

One of the most important aspects in determining the context of the study area was to include the community by making their values important guideposts throughout the design process. For an engineer or project team designing new features in an existing, unfamiliar corridor, meeting with area officials and those who will be affected by the project is essential to setting up a working relationship and avoid any dictatorial planning. In addition, it helps transform the observations about intersection features to invaluable feedback incorporated into the decision-making process.

There were two major encounters with the Wrightsville Beach community to gather feedback on context and solutions. The first major contact was at an initial scoping meeting in Wrightsville Beach in early September, 2006, where we discussed the intersection study with community leaders and NCDOT officials. This meeting set the stage for the project, giving us an idea that this intersection is a key part of the community business, tourist, and resident life. We were also able to establish contact with the local media, the Lumina Newspaper, to broaden our outreach potential to the general public. Many of the natural and human environmental factors were ascertained as a result of the discussion.

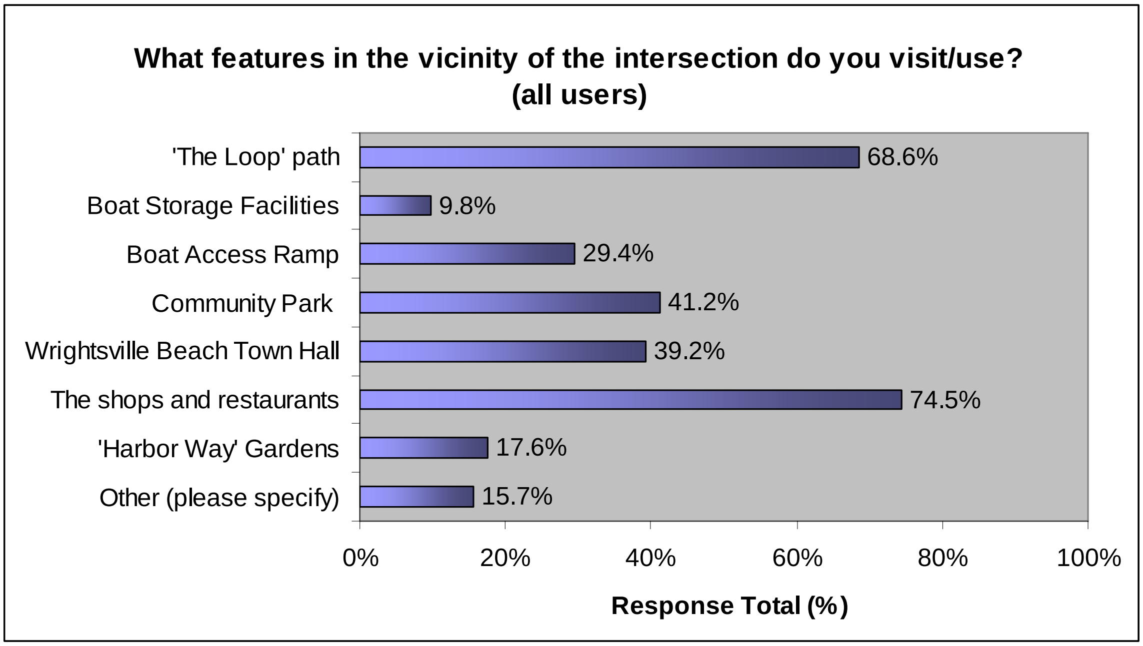
The second major contact was a project update and online survey reaching a broader audience including town officials and the general public. This more direct approach of gathering opinions helped us to categorize and formally organize the values of the community. We sent an e-mail including a link to an online survey to our town contacts from the initial meeting and the Lumina newspaper, allowing a three week response period. The survey consisted of questions about the modal and surrounding activity usage; the safety, congestion, and subjective rating of transportation facilities; and general comments on intersection improvements. The purpose of the survey was to:

- Get a profile of intersection users in the community
- Determine the main use of the intersection in regards to travel type and destination
- Determine the gateway intersection's affect on its vicinity
- Gather community ratings on multimodal congestion and safety
- Receive direct input on intersection improvements

The survey was brief to generate an adequate amount of responses, but also detailed enough to gather a context. Refer to Appendix B for a copy of the survey.

The online survey allowed the team to go beyond the initial meeting and quantify the values to the community for concrete decision making. Detailed survey results can be found in Appendix C. We received 52 valid surveys, of which nearly 50% were employees/residents and 50% were visitors that each had some connection to the intersection. We believe the survey response represents an even balance of the tourist (visitor) and residents/workers concerns. We were able to profile homeowners (23%), town workers and business owners (28.8%), boat access users/owners (27%), pedestrians and cyclists (54% and 51% respectively), and island visitors (36.5%) and aggregated responses from the whole group. From the survey we can draw that a significant part of the Wrightsville Beach community walk and bike in this beach area. Many homeowners and a few visitors use the Loop pedestrian path which is located right beside the intersection. According to the survey, 68% of all respondents use the Loop, which indicates that this facility is a key aspect of the community environment for both tourists and residents. In addition, the most used features in the vicinity are the shops and restaurants at 74%, which have direct access to the gateway intersection (see Figure 9).

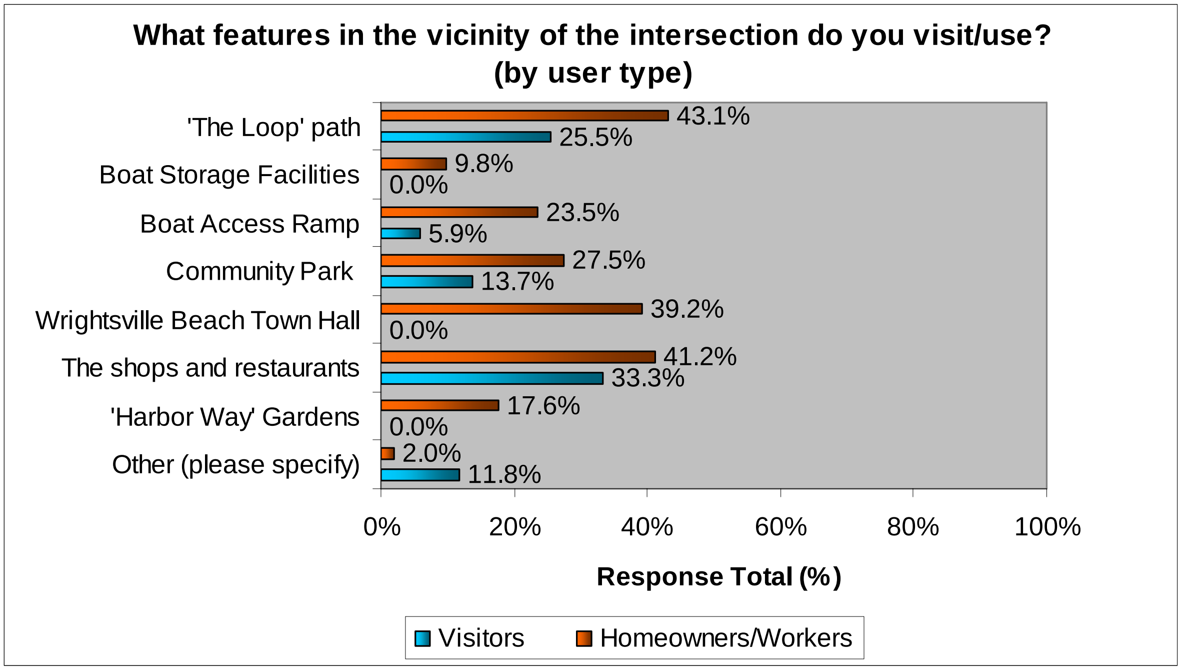
Figure 9. Use of Project Vicinity Features



*Other: The most common answer was the beach or beach access.

As shown in Figure 10, the most used feature in the vicinity among local residents, which in this survey are classified as homeowners and town employees, is the Loop. It is assumed that many of those residents who use the loop also visit or work in the nearby Town Hall. Among the residents, the boat facilities and access ramp are key features accessed from the gateway intersection as well. In addition, only residents and employees said that they visit the 'Harbor Way' Gardens, showing it is a well-known centerpiece for the community. Among visitors, the shops and restaurants, the Loop, and the community park were the most commonly visited features near the intersection. This helps us see that any improvements to this intersection would need to address access to these local businesses and the recreational facilities to serve the needs of residents and to continue attracting visitors.

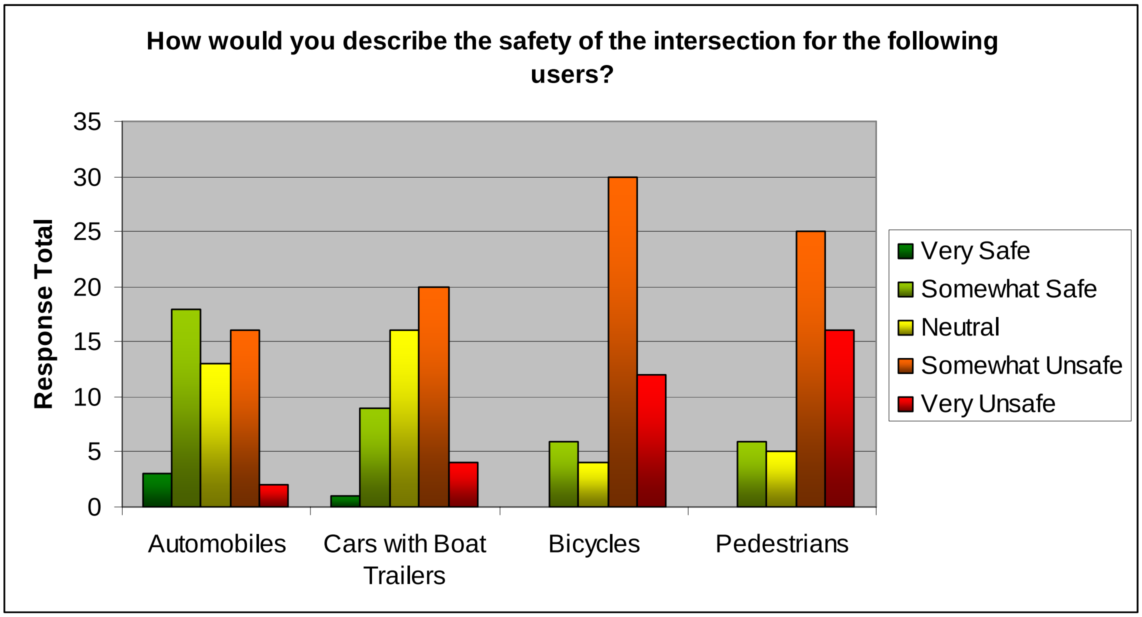
Figure 10. Feature Use by User Type



*Other: The most common answer was the beach or beach access.

When asked about safety and congestion issues, the intersection was rated more unsafe for all of the modes except autos and highly congested during the tourist season on weekends. Concerning safety, the automobile was the perceived as the safest mode of transportation through the intersection with 35% of the respondents saying it was somewhat safe. On the other hand, 40%, 58%, 48% of respondents said the intersection was somewhat unsafe for vehicles traveling with a boat on a trailer, bicycles, and pedestrians, respectively (see Figure 11). The high safety concerns for bicycle traffic most likely exist because of the restrictions for bikes on town sidewalks combined with lack of on-road bicycle facilities. One resident suggested that better facilities for bikes and pedestrians could solve congestion problems by encouraging multimodal travel on the island.

Figure 11. Perceived Intersection Safety by Mode

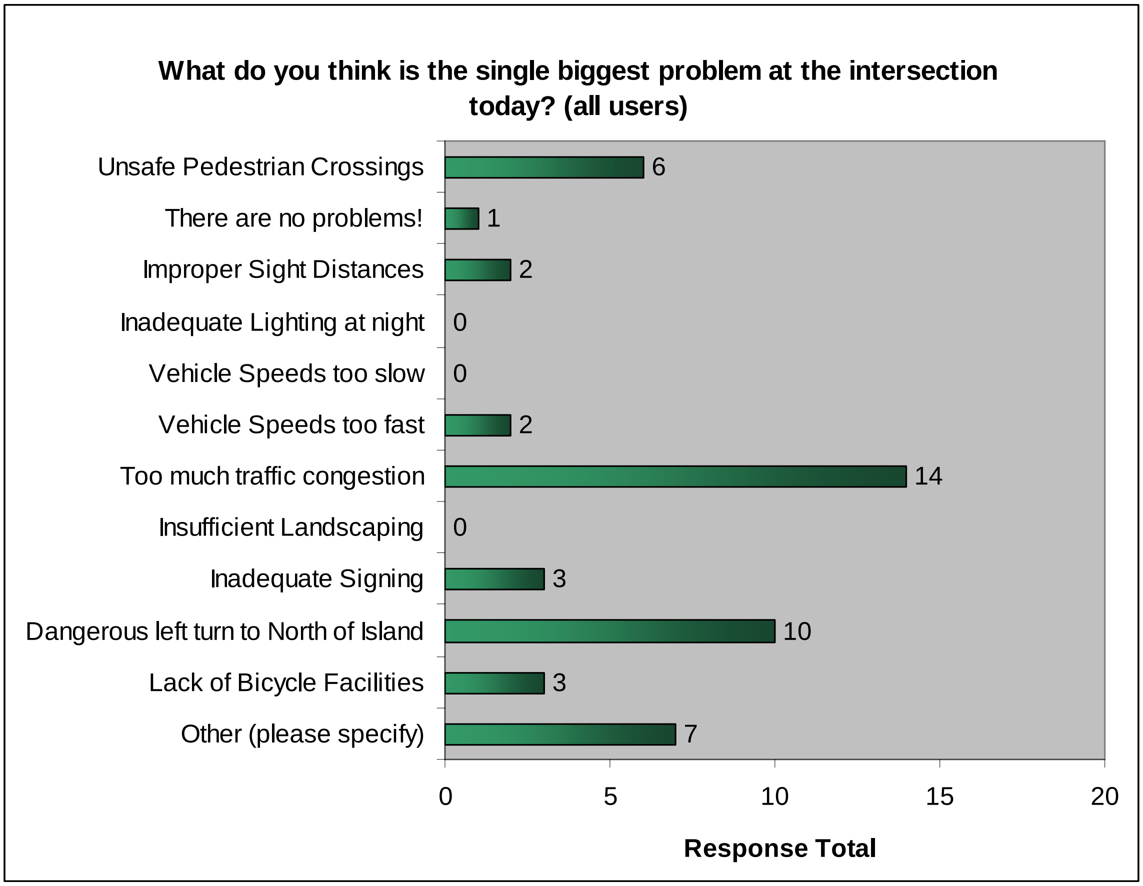


Regarding congestion, it was expected and observed in the survey (94% of respondents) that the worst congestion occurs during the summer tourist season on weekends because of the peak beach traffic. According to the survey, the tourist-season weekday AM/PM peaks also rated highly congested (49%), while many residents and local visitors rated the off-season weekends as somewhat congested and off-season weekday AM/PM peaks as not congested.

Another portion of the survey looked into the community's values on the surrounding human and natural environmental factors. The features that were rated poorly were the crossing opportunities for the pedestrians (54%) and the facilities for bicycles (44%). Many of the residents and tourists who walk on the Loop are limited to that pathway because the existing geometry is a free-flow intersection intended for moving vehicles. One homeowner even commented of the intersection that "pedestrian and bike access in the intersection is nonexistent," and according to the intersection configuration it is not. Another homeowner and avid cyclist commented that bike traffic interacting with boat access traffic is a problem and the creation of an island bike system should be considered. The general community as well as the boat owners specifically (7 of 11) rated access to the boat ramp average. In addition, the remaining features, including parking and access for the shops and restaurants, the intersection landscaping, and directional signs were rated average by most respondents (see Appendix C for chart). In particular, one resident of the community suggested that the landscape be improved by adding native trees such as live oak or palmetto instead of the palm trees added in the past. One visitor commented that the directional signs were confusing and worn, writing, "At night, you pray for the best."

A significant portion of the survey was the question about whether improvements should be made and identifying the most significant problem in the intersection. According to those surveyed, 84% of respondents answered yes to whether improvements should be made, while 16% said no. The biggest problems with the intersection were the congestion issues and the illegal left turn heading northeast on Salisbury Street (see Figure 12).

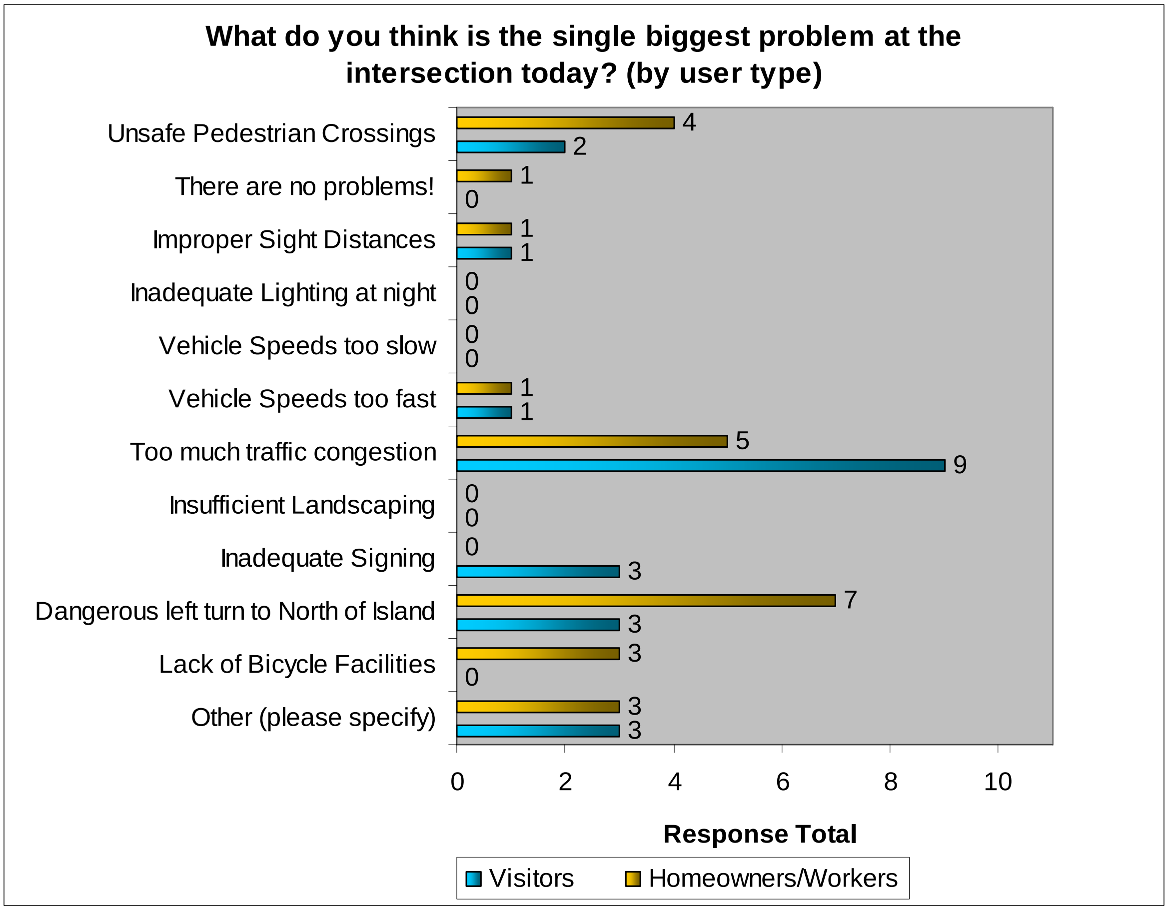
Figure 12. Significant Intersection Problems



*The other category includes general concerns such as "confusing" to more detailed concerns such as "backups at the US 76 left turn closest to the drawbridge." (See Appendix D for other concerns.)

According to the survey, the biggest problem at the intersection according to visitors was congestion. However, for residents and workers of the town, other issues in addition to congestion were important, including the dangerous second left turn onto Salisbury. Town officials and the Police Chief confirmed this perception during our September meeting. Residents and town workers were also concerned about unsafe pedestrian crossings (see Figure 13).

Figure 13. Intersection Problems by User Type



*The other category includes general concerns such as "confusing" to more detailed concerns such as "backups at the US 76 left turn closest to the drawbridge." (See Appendix D for other concerns.)

Public involvement with the Wrightsville Beach community in the form of the survey and the initial meeting with town officials was an invaluable resource to the design process. The initial meeting allowed us set the context of the human and natural environment, while the survey allowed us to specifically quantify the values of residents and visitors in a small yet meaningful sample. The key conclusion drawn from the survey was that traffic congestion relief and pedestrian and bicycle safety were expected to be incorporated into the design solution for an improved intersection.

3 Alternatives

3.1 Description of Preliminary Alternatives

The team brainstormed several improvement alternatives for the US 74/76 intersection keeping in mind the context of the project location. While developing the alternatives, the focus remained on what a community values: the meeting of transportation needs within the context of the human and natural environment. The safety and functionality of the facility were kept in highest consideration, but not at the expense of the natural surroundings or nearby land uses. The following alternatives were considered:

- grade separated intersection consisting of a single flyover
- system of signals
- roundabout
- low cost (unsignalized and no build)
- single signalized intersection

The following descriptions of each category discuss some of the positive and negative aspects the designers saw in the ideas prior to detailed analysis.

3.1.1 Flyover

Given the separation of movements at the existing intersection, a 'flyover' may in this case be one of the solutions with the lowest impacts to experienced users of the intersection. A short single-lane one-way bridge at the main conflict point would alleviate congestion issues while maintaining the flow at all remaining legs. The experienced user would still recognize the layout and paths within the intersection and levels of service would be maximized.

3.1.2 System of Signals

The current intersection geometry does not lend itself to a system of signals, but with some minor realignment of movements, a signal system alternative becomes attractive. Current traffic paths can be somewhat maintained. This option also has the benefit that traffic signals are familiar to drivers, and thus they should have few problems navigating the changes. This option could also create signalized crossings for pedestrians. It is expected, however, that any signal will add delay to the intersection as a whole.

3.1.3 Roundabout

A modern roundabout may present a safe solution for traffic problems. Research has shown significant safety benefits of roundabouts as compared to signalized intersections. Short of a grade-separated alternative, a roundabout may well represent the safest of all the alternatives for vehicles, and if designed correctly, can be safe for pedestrians as well. The roundabout accomplishes the goal of reducing traffic speed and shares the delay of movement between all traffic paths.

3.1.4 Demand Management and Low Cost

Options such as restriping, adding signage, and adding bike lanes are all methods of improving the intersection without much investment. It is also an option to close the second left turn on Causeway, as it is a safety problem. Lastly, a shuttle bus running from a park-and-ride facility west of the Intercoastal Waterway to the beach could reduce the volume passing through the intersection. All of these improvements can be done instead of new construction, or added to a construction project to improve its effectiveness.

3.1.5 Signalized Intersection

There exists the option of converting the current flashing beacon for the left-turn movements at the intersection (eastbound US 74 and westbound US 76) into a full signal. This would maintain the current geometry of the intersection, and change only the interaction between the crossing lanes. This option has the benefits that traffic signals are familiar to drivers and people familiar with the intersection will not have to relearn how to navigate it.

3.2 Eliminated Alternatives

Several preliminary design ideas were eliminated early in the process, because they were deemed infeasible or inappropriate for the scale of this intersection. Among the eliminated alternatives is the general concept of a grade-separated intersection, including the idea of creating a 'flyover' of the existing eastbound movement destined for Salisbury Street. Due to structural constraints in the beach region, the high anticipated project cost, and the visual obstruction of an elevated structure, the team decided to not perform a detailed analysis of this potential intersection treatment.

Related to cost constraints, the group also ruled out any alternatives that would require a widening or re-construction of the existing US74/75 drawbridge. Certainly a higher structure would relieve the impact of scheduled bridge openings on traffic operations, but was deemed infeasible in the scope of this project.

The bridge constraint also rules out an early idea of converting the existing dual left-turn bay intersection at the eastern end of the bridge into a full signalized intersection. Traffic operations theory suggests an ideal saturation flow rate of 1,900 passenger cars per hour per lane. Even under such ideal conditions (ignoring grade, heavy vehicles, etc.) the two-lane intersection approach would be able to process a maximum of 3,800 vehicles per hour in each direction. At given eastbound flows exceeding 2,100 vehicles per hour, the resulting 'volume to capacity' ratio for this direction exceeds 0.55; in other words, this movement alone would require a green indication 55% of the hour. Considering that several other phases would need to be serviced through the intersection, including cycle lost time, and given the widening constraint, the team concluded that this form of intersection treatment is also infeasible.

The related idea of creating a signalized intersection further east from the bridge was also ruled out, because it was reasoned that the high number of lanes and long turn bays required to process all the traffic would be out of context for this beach community. In order to adequately service peak demands, the cross-section would have to be widened to three or potentially even four lanes, plus any turn lanes. Given the very high right-of-way cost in Wrightsville Beach and the cultural importance of the historic oak trees along the corridor, such widening would not be appropriate.

Finally, the team briefly considered increasing the capacity of the existing stop-controlled intersection of eastbound Salisbury Street and westbound Causeway Drive. This could be achieved by widening one or both of the approaches to two lanes, while maintaining stop-controlled operations. The team ruled out this alternative for safety concerns. A two-lane stop-controlled approach would introduce sight-distance constraints and create the potential for severe crashes at the intersection.

After eliminating these options because of high costs, negative community impacts, or infeasibility of traffic operations, the options that remained for detailed traffic analysis were various low-cost scenarios, a system of signals, and a roundabout.

4 Traffic Analysis

4.1 Analysis Methodology

After eliminating some early alternative ideas because of high cost and resource constraints, the team moved into the traffic analysis portion of the project. Following our outlined approach, the team wanted to screen the alternatives for feasibility from a traffic operations perspective before moving into an assessment of human and natural impacts.

4.1.1 Traffic Volumes

In the traffic analysis portion of this project, the team had to work with very limited data. The team never obtained current counts at the intersection and therefore has no real estimate of volume levels or turning percentages through the fairly complicated existing intersections. The team did have access to data from a permanent NCDOT traffic count station just west of the island on the US 74 /76 corridor. Unfortunately, the station malfunctioned in 2002 and has yet to be repaired, but the data did give the team a general idea of traffic intensities at the intersection.

The team decided to use as base volumes a daily volume count from Memorial Day 2002, the day with the heaviest traffic across the bridge for that year. That day a total AADT of 50,328 vehicles was observed, with 25,419 vehicles entering the island (eastbound) and 24,909 vehicles leaving (westbound). The count further indicated that the noon peak hour (12:00–1:00 p.m.) showed very heavy traffic volumes with eastbound and westbound flows of 2,022 veh/hour and 1,636 veh/hour in eastbound and westbound directions, respectively. This corresponds to a directional split of 55/45. A second busy hour of that day was the 5:00 to 6:00 p.m. hour with eastbound and westbound flows of 1,445 veh/hour and 2,375 veh/hour, respectively—a directional split of 40/60.

The team decided to focus all further analysis on the noon peak hour, because current traffic operations indicate congestion issues for traffic entering the island; mainly at the stop-controlled intersection for eastbound Salisbury Street traffic. In the PM peak hour, the heaviest flow is outgoing (westbound) and operates under free-flow operations; indicating that traffic operations are expected to be better than during the noon peak. The team further assumed a 1% background growth rate and a design year of 2010. While the town of Wrightsville Beach is fairly built out at the present time, there is an ongoing trend of converting single-family homes to multi-family condominiums. The team reasoned that this trend, combined with the possibility of future parking additions justifies the moderate, yet positive growth rate. The design year 2010 is justified because the team expects any improvements to take several years to implement, related to a current funding shortage in the NCDOT TIP budget. The team believes that by 2010, town officials and residents may procure funding sources to finance intersection improvements.

Due to the lack of turning movement data, the team had to make further assumptions about the directional distribution of incoming and outgoing traffic. Appendix E shows the assumed percentages of incoming and outgoing bridge traffic to and from the various exit and entry points for our study areas. The general assumptions were that the majority of traffic would be 'through traffic' between the bridge and the main part of the island, but that small percentages would turn into the various access points (including the boat ramp, the townhouses north of the intersections, and the shops and restaurants to the south). The split for the remaining through traffic was assumed to be slightly heavier along Causeway Drive, because it is wider than Salisbury Street. For the traffic destined for Salisbury Street, it was assumed that some percentage of drivers will choose the 'second left' turn—a common driver behavior pattern that was suggested to us repeatedly by town representatives both at our meeting and in the survey results.

The resulting flows (in vehicles per hour) for each intersection are shown in Appendix F. The figure shows the projected future volumes, as well as volumes that have been decreased by 25%. The team assumed that these 75% flows may be more representative of 'typical' conditions at the intersection as they would be observed on a non-peak weekend or during the week. All future analyses were done at both volume levels to explore the operational sensitivity of the alternatives.

Conceptually, the 75% volume cases can also be interpreted as an intersection treatment in itself. The town may be successful in reducing the peak-day traffic demand through the introduction of shuttle services from the main land or even the creation of a permanent transit route. In this sense, the 75% flows could represent a goal for future traffic reduction programs.

4.1.2 Analysis Approach

Due to the unconventional configuration of the intersection, the team decided early on to use the microsimulation model VISSIM for most of the analysis. VISSIM's link-connector structure allows for a very detailed representation of intersection geometry and allowed the team to model the existing conditions, as well as improvements, very accurately. The team believes that results obtained through this form of microscopic modeling will be much more representative of the unique character of the intersection than what could be achieved through conventional Highway Capacity Manual (HCM) methods. Another argument in favor of VISSIM is the fact that under congested operations, queues are expected to spill back from oversaturated intersection approaches into other parts of the network, something that cannot be analyzed by the deterministic equations given in the HCM. Finally, the use of VISSIM allowed the team to model the impact of scheduled openings of the drawbridge on vehicular operations.

Due to a lack of data, it was beyond the scope of this effort to fully calibrate the model accurately, other than by visual inspection of vehicle operations. The team therefore used the roundabout model aaSIDRA to assess some of the results obtained with VISSIM. Also, because VISSIM does not contain any built-in optimization algorithms, the team first coded any signalized alternative in SYNCHRO and optimized network cycle lengths, offsets, and intersection splits using its built-in algorithms. The resulting timings were coded into VISSIM and were slightly adjusted using manual inspection (for example, some of the offsets were adjusted to improve progression).

Our analysis focused on performance measures aggregated to the level of the entire intersection, but also included some assessment of individual approaches. The measures were all obtained from a VISSIM node analysis, which utilizes a cordon line drawn around the entire study area. The measures of effectiveness in our analysis include average delay per vehicle, average number of stops per vehicle, average vehicle queues on the worst approach and average fuel consumption for the entire intersection, a proxy measure for vehicle emissions and environmental impacts of different alternatives.

4.1.3 Traffic Analysis Results

The team modeled a total of five different scenarios in VISSIM and tested each at two volume levels. Three model replications with varying random number seeds were completed to account for stochastic variation in the model, resulting in a total of 30 VISSIM runs. Each analysis was done for a simulation time of one hour.

A total of five scenarios were modeled in VISSIM, each at two volume levels. The first three deal with the existing conditions and minor changes, while the last two are different improvement alternatives. Appendix G shows screenshots of all VISSIM models.

- *Existing conditions*; this represents current traffic operations with assumed directional distributions and ignoring the effect of bridge openings.
- *Existing, with bridge opening*; this scenario is the same as the previous scenarios, but with two 5-minute bridge openings occurring during the analysis hour (one representing the scheduled hourly opening and the other the arrival of an unscheduled commercial vessel)
- *Block second left turn;* this scenario is generally the same as the existing conditions, but it was assumed that all eastbound traffic with destination on Salisbury Street would take the appropriate route – i.e. there would be no 'shortcuts' using the crossover opportunity along Causeway Drive. To actually achieve this behavior in the field, directional signage and police enforcement may be necessary. Under this alternative, traffic leaving the commercial area south of the intersection would likely still be allowed to use the crossover for Salisbury Street as intended.
- *Signal System ('Candy Corn');* this alternative is discussed in detail in a later section. It generally represents the concept of replacing current unsignalized operations with a system of four signalized intersections, coordinated for optimal progression through the network.
- *Roundabout;* this alternative tests the feasibility of creating a single-lane roundabout in the center of the current intersection. The team assumed that existing through traffic on Causeway Dr. and Salisbury St. would be able to bypass the intersection as is the case today.

The alternatives were analyzed on the aggregate intersection node level, representing a cordon line drawn around the entire study area. Table 1 shows the resulting operational parameters for all alternatives for the overall node evaluations, as well as for the 'worst movement' in each scenario. Note that these are not necessarily the same for all cases. Appendix H contains the individual outputs of all 30 VISSIM runs.

Table 1. Operational Parameters for Alternatives

		Overall Node Evaluation*			Worst Movement*			
Alternative	Volume Level	Avg. Delay per vehicle (sec)	Avg. Number Stops/Veh.	Avg. Fuel Consump. (gal/hr)	Worst Movement	Avg. Delay per vehicle (sec)	Avg. Number Stops/Veh.	Avg. Queue (feet)
Existing Conditions	100%	63.9	1.4	140.2	NW-E	67.0	2.1	827.8
	75%	5.7	0.3	128.1	NW-E	12.9	0.6	8.0
Existing with Bridge Opening	100%	77.3	1.3	217.8	NW-E	153.6	3.8	245.6
	75%	38.8	0.5	151.0	NW-E	60.1	1.3	99.4
Block 2nd Left Turn	100%	74.3	1.9	203.3	NW-E	223.4	6.2	1061.1
	75%	5.2	0.2	132.4	NW-E	16.0	0.4	0.0
Signal System ('Candy Corn')	100%	26.0	0.7	189.5	NW-E	49.2	1.0	11.4
	75%	23.0	0.6	140.8	NW-E	43.5	0.9	6.0
Roundabout	100%	62.9	2.1	164.0	SE-NW	618.2	20.8	1034.8
	75%	59.9	2.2	136.3	SE-NW	312.1	11.2	939.7

* All data are averages of 3 VISSIM runs at different random number seeds

The analysis results suggest very high intersection delays for existing conditions with an average delay of 63.9 seconds per vehicle. As expected, the worst movement is the northwest-to-east (NW-E) movement, which represents traffic having to yield the right-of-way to Causeway Drive traffic leaving the island. This approach shows delays of 67.0 seconds per vehicle and average queues of nearly 830 feet, which well exceeds the available storage of approximately 500 feet.

Interestingly, the existing configuration seems to operate well in the 75% volume case, at volume levels that may be more representative of average conditions on the island. Overall intersection delays are a mere 5.7 seconds per vehicle and only 12.9 seconds per vehicle for the NW-E movement, with average queues of only 8.0 feet.

An analysis of bridge openings suggest that overall delays worsen even in the 75% case to 38.8 seconds per vehicle. The team assumed that the bridge opened twice during the analysis hour (once scheduled and once for a commercial vessel) for a duration of 5 minutes (300 seconds) each. While delay for the worst movement increases as expected, it is interesting to note that the average queue actually decreases to a little under 250 feet. This is explained because very long queues on the NW-E movement have a chance to clear with all other traffic being stopped as a result of the bridge.

When analyzing the effect of blocking the second left turn, overall intersection delays increase compared to the existing conditions, and delays for the worst movement almost quadruple to 223.4 seconds per vehicle. Under 75% flows, the intersection still appears to operate satisfactorily, suggesting that this treatment may be effective if peak-day traffic can be reduced through other means.

The analysis of the ‘candy corn’ intersection shows very promising results. Even at 100% flows (shown in Appendix I), the overall intersection delays are only 26.0 seconds per vehicle and, more importantly, delays for the worst movement are only 43.5 seconds; still a satisfactory levels of service according to HCM standards. All queues are maintained well within the allocated storage space. In assessing the results for this alternative, it should be noted that the delays in the

75% volume case are worse than in existing conditions. While the system of signalized intersections can adequately handle even high demands, it comes with the downside of some delays for most vehicles even at lower flow conditions.

Finally, the roundabout alternative shows extraordinarily high delays for traffic leaving the island on causeway drive (SE-NW). This is explained because upon entry in the circle, this movement has to yield to the fairly heavy eastbound flow destined for Salisbury Street (which was actually the 'worst movement' in all other alternatives). Given the very high delays and long queues, the team does not think that a roundabout in any configuration will be able to support the traffic demands at this intersection. This claim is further supported by capacity figures given in the FHWA roundabout operational guide and results of a separate analysis in the aaSIDRA package (see Appendix J).

4.1.4 Traffic Analysis Summary

The traffic analysis showed that from an operational perspective, the existing intersection operates fairly well in the 75% volume case. Leaving aside concerns for safety, all movements are free-flowing and the single stop-controlled approach shows acceptable levels of queuing. Under this low-volume scenario it also appears possible to enforce the intended traffic operations by blocking off the second left turn for eastbound vehicles destined for Salisbury Street. This would only slightly increase the delay for that particular movement without queues spilling into the eastbound travel lane.

However, under high-volume conditions, the existing intersection configuration is expected to be over capacity, with the eastbound Salisbury Drive movement frequently spilling into the main travel way. It is therefore suggested that if it is desired to maintain the existing geometry or even block of the second left turn, that the town look into means of reducing the peak-day traffic demand. Possibilities include park-and-ride service from mainland parking lots or a scheduled transit or trolley service to the island.

If the town wishes to increase intersection capacity to improve flow of traffic on peak days, then a system of signalized intersections may be a way to do so. Through optimal signal progression, it is assured that vehicle stops are kept at a minimum and that the majority of traffic can still flow freely through the study area. While expensive, the cost would be marginal compared to a grade-separated improvement—in our view the only other alternative that would indeed offer a higher capacity. The analysis showed that a roundabout at the intersection is not feasible.

The list of alternatives was thus reduced to two primary options for improvement: 1) demand management and low cost improvements and 2) a system of signals. The next section describes these alternatives in detail, and the following three sections discuss how these alternatives would affect the human and natural environments of Wrightsville Beach, as well as the aesthetics and sense of place on Harbor Island in the vicinity of the intersection.

4.2 Selected Alternatives Description

4.2.1 Demand Management and Low Cost Alternative

Combining options that do not involve major construction are the basis for the demand management and low cost alternative. After ruling out that closing the second left turn from Causeway to Salisbury Street would cause immense queues during peak periods, the group turned to other low cost ideas that could improve the intersection.

On the top of the list was to explore new multimodal transportation options. These have the ability to reduce congestion, while meeting the wants of the community. Since better access for pedestrianism and bicycling was important to the stakeholders, improvements in these areas need to be made on this project. These have the chance to shift the way people access the island, but can only happen once safety is improved for these users. This would include sidewalk safety features, perhaps including a widening. Pedestrian crosswalks may be installed with the current geometry, but would be excellent with new geometry that is safer for pedestrians to traverse, such as in the Candy Corn alternative, described below.

Bicycle lanes are also an improvement that the town desired. Although the bridge is not wide enough currently to add these, the intersection could benefit with the lanes now. Increased bicyclists numbers may also reduce the number of vehicle drivers. Also, since bicyclists cannot use the Loop path, a designated place on the road will fill this gap in multimodalism. In the future, if the bridge is ever replaced, bike lanes could be added there as well, connecting a continuous bike system to Wilmington and points west of the island.

Another feature that could be incorporated is a shuttle bus during the peak traffic days of the year. The goal here is to transport tourists from west of the intersection, the other side of the intercoastal waterway, to the beach. This would reduce congestion by providing an alternative to paying for parking on the streets and lots of Wrightsville Beach. Visitors would be able to park at a facility off the island. Although a park-and-ride lot could be constructed, it may be just as well accomplished by having visitors park in excess parking at a shopping center (if there is any during summer season.) This improvement has the possibility to reduce congestion in the intersection and all roads of Wrightsville Beach.

With the fairly recent addition of parking meters on the island, the demand for free parking could fuel this option. Buses could do routine pickups at several stops along the beach, transporting the passengers to and from the parking lot(s). An agreement with the City of Wilmington would be necessary to make this option a reality, but could be a boon for the Wilmington tourism industry, as hotels, restaurants, and shops would benefit because people may be more likely to stay in Wilmington if they know a shuttle to Wrightsville Beach is available.

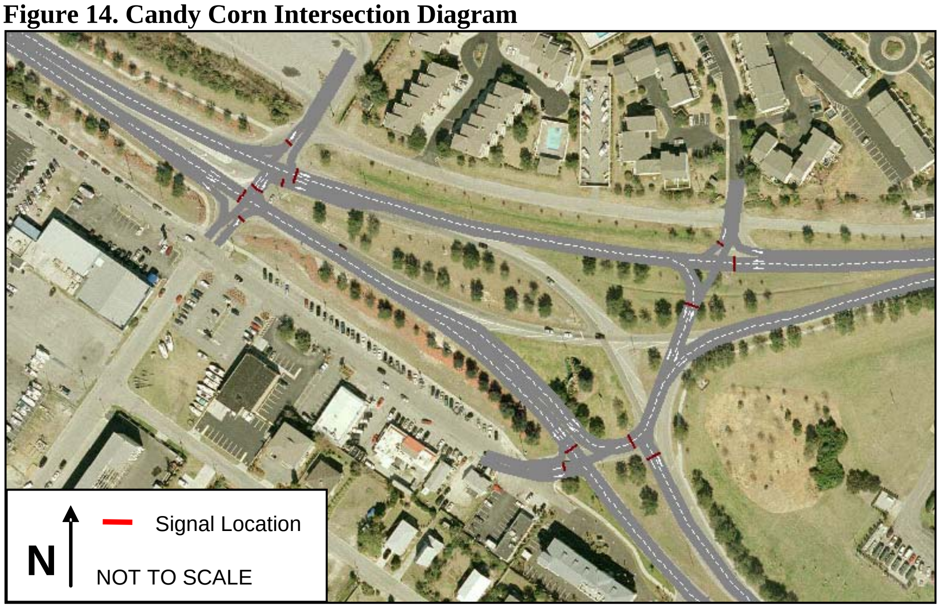
Very low cost options are to repaint and resign the intersection. With complaints from experienced users that the intersection is difficult to navigate at night, repainting could reinforce the travel ways that are to be taken. The use of signs to ensure visitors and users know where to go will help to reduce the confusion of the intersection.

All of the demand management and low-cost options are methods that could be implemented as separate improvements. In conjunction with options requiring major construction, however, they could be complementary improvements that make an alternative even more effective. The significant feature is that these options are relatively inexpensive compared to major construction and funds are thus easier to secure. However, the transportation need may not be as effectively met with these options.

4.2.2 System of Signals ("Candy Corn")

The Candy Corn alternative is named for the similarity of the shape of the intersection to that of the popular Halloween candy. Refer to Figure 14 for a schematic of the intersection layout. It operates with traffic flowing in one direction on each leg of a triangle, in a counterclockwise fashion. The primary inputs of traffic occur at all three corners of the candy corn, with two inputs at each corner. The convergence of two inputs is signalized so that only one input at a corner operates at a time. While driving on a particular leg of the candy corn, you may either exit the candy corn, or bear left and stay in it to travel the next leg. The signals are timed so that you should only have to stop at most once upon entering the candy corn. The design also guarantees that there are no weaving sections.

Figure 14. Candy Corn Intersection Diagram



At Wrightsville Beach, the eastern leg of the candy corn could be built either along the current eastern edge of the intersection as shown in the figure, or past the Municipal Center farther to the east. The larger candy corn with the leg constructed farther to the east would operate similarly to the smaller one. It would also create a large center which has more options for development in its interior.

The candy corn design allows pedestrians to cross at the signals. Pathways would be built across the center to provide routes to guide their movement to the next safe crosswalk.

5 Natural Impacts

5.1 Demand Management and Low-Cost Alternative

The demand management and low cost alternative would have the fewest impacts on the natural environment of Wrightsville Beach and the study area. The heritage oaks would be preserved in their existing locations. No new impervious area would be constructed, so stormwater runoff and drainage would not change from existing conditions. Wetlands would not be affected, nor would the Harbor Way Gardens.

Barring growth in auto volumes, air pollution in the project vicinity may decrease due to both demand management via beach shuttles from off-island sites and increases in the pedestrian and bicycle mode shares, which may result from adding amenities for these users. Considering that stakeholders expressed a desire for better pedestrian and bicycle facilities, it is reasonable to assume that those mode shares would increase given better facilities. Although reductions in air pollution from these changes may be minimal, they are still worthwhile considering that vehicular traffic is expected to increase at a moderate rate regardless of whether or not bicycle and pedestrian amenities are improved. More people using non-vehicular modes of travel may offset increases in air pollution due to increases in vehicle traffic.

5.2 System of Signals

The system of signals or Candy Corn alternative would have greater impacts on the natural environment than the demand management/low cost alternative. While large sections of the existing pavement could be used in this alternative, GIS measurements suggest that approximately 20,000 square feet of new pavement surface would be needed. However, the pavement that makes up the existing “X” configuration in the center of the intersection would no longer be needed and could be converted to permeable surface. About the same amount of existing pavement could be removed as added, thus balancing out the loss of permeable surface from new pavement needed by the candy corn configuration.

The northern portion of the candy corn’s eastern leg would bisect an existing median that has an elevation about two feet below that of the roadway surface. This median may be part of the stormwater management system for the roadway, and thus the stormwater runoff previously stored in this median must be handled elsewhere. While extensive calculations of stormwater volumes were beyond the scope of this project, this is an important aspect to consider in the next stages should the candy corn alternative be selected for further development.

The new pavement surface required by the candy corn alternative would also require the removal of at least three heritage live oaks currently located in the median discussed above. While the community expressed a strong desire to preserve all of the trees in the intersection vicinity, replacement trees and other landscaping could be planted in the area freed by the removal of the pavement in the center of the intersection, should such a use be desired by the town.

In both the small and large candy corn designs, Harbor Island wetlands would not be affected. Intercoastal wetlands are not likely to be affected by the small candy corn design because the total impervious surface would remain about the same before and after construction. Depending on the amount of land that could be converted to other uses in the larger candy corn design, additional loss of pervious surfaces may impact nearby wetlands due to added runoff that would presumably discharge to the intercoastal waterway or the low-lying Harbor Island wetlands.

As this alternative generally adds to existing pavement and does not require removal of existing pavement until the new intersections are operational, construction could be completed for the most part with the intersection open to all traffic. Brief periods of closure may of course be expected, however, the outer lanes of eastbound Causeway Drive and westbound Salisbury Street should remain open for all but the briefest periods, thus allowing a detour route via Lumina Avenue.

The largest environmental consideration for the candy corn alternative is its implications for air quality. Because it involves multiple signals, most cars that pass through the intersection will have to come to a stop and accelerate again at some point in the intersection. Although signal progression and timing are critical to minimizing the number of stops, the design still implies a large increase in air pollutants being released into the atmosphere in the vicinity of the intersection when compared to existing conditions. Table 2 compares pollutant levels of three major air pollutants, carbon monoxide (CO), oxides of nitrogen (NO_x), and volatile organic compounds (VOC), as well as total fuel consumption by all vehicles during the peak hour analyzed.

Table 2. Emissions and Fuel Consumption during Peak Hour

Alternative	Volume Level	CO (g)	NO_x (g)	VOC (g)	Fuel Consumption (gal)
Existing Conditions	100%	9,798	1,906	2,271	140.2
	75%	8,954	1,742	2,075	128.1
Existing with Bridge Opening	100%	15,221	2,961	3,528	217.8
	75%	10,554	2,053	2,446	151.0
Signal System ('Candy Corn')	100%	13,247	2,577	3,070	189.5
	75%	9,840	1,915	2,281	140.8

While these emissions figures are useful for relative comparison of the alternatives, they should not be thought of in absolute terms, as built-in VISSIM emission models have not been calibrated as a part of this report. As shown in the table, the candy corn alternative has higher levels of total pollutants and fuel consumption than existing conditions, but lower emissions and fuel consumption than the existing conditions with the bridge open. While we did not model the candy corn alternative with bridge openings, we would expect the emissions and fuel consumption to be higher than the candy corn during normal operations. We would recommend providing extra time during post-bridge-opening cycles to both relieve congestion and minimize emissions. Additionally, the timing of the signals could be further optimized to reduce the number of stops and thus reduce total emissions. These issues should be investigated if the candy corn alternative is chosen for further review.

Finally, Harbor Way Gardens would not be negatively affected by this alternative. The garden area may actually benefit from improved pedestrian safety and access via marked crosswalks at the signals, which may increase the number of visitors to the gardens year round. In the larger candy corn design, the gardens would be the centerpiece of the interior space freed by the design. The gardens could even be expanded in this scenario to cover a much larger area.

6 Human Impacts

6.1 Demand Management and Low-Cost Alternative

The demand management and low-cost alternative, which minimizes geometric design and construction to the intersection, results in few new human impacts. Most of the current negative impacts on the human environment are remedied by small-scale additions, which would add to the quality of the current intersection. If minor improvements such as a bike lane addition or pedestrian crosswalks were implemented, many of the concerns from the community involvement process would be solved. Regarding the effect on surrounding facilities such as businesses, apartments, the boat access ramp, and the municipal center and park, keeping the low-cost alternative would maintain the current points of access. There would be no drawback or restricted access put into place during the construction process and with new designated flow areas for pedestrians and bicycles, many more people would have access. A limitation of this design would be the higher free flow speeds of traffic which would cause difficulty between normal traffic and bicycles and cars with boat trailers who need to make more difficult turns for access.

The free flow design of the intersection plays a major part in the safety rating of this intersection. Although there are no formal methods of testing the safety, in the scope of this project, even if a bike lane is added, striping is done, and crosswalks are made, there will have to be a change in speed that is enforced. The pedestrians will not be able to make a smooth flow across the street, but dart across because there is no existing signal. In addition, cyclists using the left turn lane to go northbound on Salisbury Street would have a challenge finding a wide enough gap to cross over westbound US 74 comfortably. As a result of this feature in the intersection, the bike route would most likely have to be rerouted to a safer place in the vicinity of the intersection.

6.2 System of Signals

The system of signals, also known as the candy corn alternative, is the preferred alternative, and yields many human impacts, most of which are positive. The signals serve to calm the traffic that approach and enter Wrightsville Beach from the bridge, creating a slower flow of traffic through the vicinity. Residents will be able to appreciate a slower pace for the town gateway; however town visitors and tourists will most likely care about how to get to the beach quicker. The slower speeds work in the favor of safety, which is important to residents, and improves overall intersection flow because of designated phases for each movement.

This new intersection configuration ensures improved access to the surrounding developments. The access to the businesses south of the intersection is not controlled, allowing an even flow of passenger cars in and out of the lots without considering cross traffic. Also, there is new access to a residential complex north of the intersection. One drawback is the potential for traffic to queue and block the movements from functioning correctly. As far as pedestrians and bicyclists, the crosswalk network that is inside and outside the intersection improves the conditions for this mode of transportation (see Human Use Plan, Appendix K). The traffic signals, which will include pedestrian phases, will allow pedestrians to move to and from nearby facilities without worrying about fast moving traffic. Bicycles will have an improved lane area to ride on in addition to a shoulder lane, which will encourage more bicycle traffic throughout town. The safety of the intersection is expected to improve; however, there is a risk of more crashes because of the stop-go conditions that are likely to come about with a traffic signal. Many of the neighboring businesses will be affected by the construction of the realignment. Although more access will be granted after construction has been completed, brief delays from construction may arise.

7 Placemaking and Aesthetics

Context Sensitive Solutions provides a new format for how transportation facilities are designed and implemented. The key to this new format is for the whole process to become more "community-centric." Rather than retroactively fitting the community and its assets around the transportation facility, CSS focuses on the facility being molded to the existing or desired ideals of the community and its stakeholders. Two factors that make the CSS method successful are proper placemaking and aesthetics.

Placemaking allows the individual stakeholder identities to be properly recognized as a collective and communal identity. This idea places emphasis on the proper management of all the relationships involved in making an effective 'place.' The goal of proper placemaking involves building a sense of community in an inviting setting.

The aesthetic resource elements are obvious considerations for a successful place. The FHWA's Visual Impact Assessment for Highway Projects (1981) qualifies three types of aesthetics. The first is Internal Aesthetics which focuses directly on the roadway facility removed from its surroundings. The second is Relational Aesthetics. This considers the relationship between the roadway facility and the surrounding elements. The last examines the entire context of the affected environment.

Evaluating projects on how well the placemaking and aesthetic resources foster the various relationships that comprise the community environment is essential in successful CSS projects. Below are our evaluations for the respective alternatives.

7.1 Demand Management and Low-Cost Alternative

The low cost alternative takes advantage of the current facility by making adjustments to the current lane configurations. This alternative includes re-striping and signing the existing facilities, adding bike lanes, improving and/or adding pedestrian access, and providing a park and ride facility during the peak season.

This alternative attempts to serve a greater number of stakeholders than does the current facility. The addition of the bike lanes attempts to remove current bicyclists that use the pedestrian sidewalk and therefore reduces the negative interaction between these two groups. By creating a new and separate space for bicyclists, a place has been created for both bicyclists and pedestrians.

One of the drawbacks of the current design is the lack of a destination for the pedestrian "loop." With the new design, pedestrian crosswalks can be safely accommodated so that pedestrians can choose to traverse the Loop or continue to a business destination, allowing greater options for this mode of travel.

A unique aspect of this alternative is the possibility of incorporating a park-and-ride shuttle. If this can be effectively accomplished, then this alternative has created an improved place for bicyclists, pedestrians, residents, business owners, and tourists.

Due to the minimal costs involved in re-striping, more budgeted money could be utilized to improve the aesthetics of the study area. For example, the community garden could be enlarged, landscaping could be incorporated, and/or streetscape improvements could be provided to the homes and businesses that would now also be accessible to pedestrians.

7.2 System of Signals

The system of signals or candy corn alternative condenses and somewhat coordinates the vehicular traffic. Items to note about this intersection include the possibility of gaining additional parcels from the loss of frontage streets and that the interior area can be adjusted to suit the final stakeholder recommendation. Both of these items are conducive to expanding the current multimodal network and creating a central place.

The pedestrian network that includes the Loop could be expanded to allow access from this network to the interior area and the existing homes and businesses or any new development obtained by freeing up parcels currently used as right of way. Further, the addition of bike lanes would relieve some of the stress on the sidewalks.

The interior area of the design would allow numerous possibilities for attempts at obtaining "good place" status. This area would allow pedestrians, bicyclists, passenger vehicles and even transit vehicles if necessary. Due to this flexibility, the options could come in the form of an open space, a meeting area, or even be converted to a single or mixed use development.

Aesthetically, the current garden on the east side of the intersection would remain untouched and available. Depending on the decided stakeholder use in the interior area, there would be many options for aesthetically pleasing elements. These could range from median/shoulder trees and landscaping to limitless possibilities of local and possibly historical art. Figure 15 shows an artist's rendering looking north at Causeway Drive from the southeast corner of the candy corn.

[Placeholder for Figure 15]

8 Discussion and Recommendations

The intersection of US 74 and 76 in Wrightsville Beach presents a complex and interesting problem statement for transportation engineers, residents and visitors of Wrightsville beach, and the natural environment. Because of its unique character as a beach community, context is especially important to any proposed solution that addresses the transportation need at hand.

While the on-line stakeholder survey that we conducted as a part of the CSS process had a relatively small number of responses (52), the input we received was nonetheless extremely valuable in gauging public opinion about the intersection and learning about intersection elements that the community feels need improvement. Consistent themes of survey responses indicated that peak season traffic congestion, the second eastbound left turn onto Salisbury, pedestrian and bicycle safety and local access were the most important aspects of improving the study intersection.

Using travel data from 2002, we determined that the highest single daily volume traversing the causeway bridge was in excess of 50,000 vehicles. The existing conditions at the intersection were modeled to have an average delay in excess of one minute during the peak periods, with queues on the worst approach extending more than 800 feet from the intersection. The situation is exacerbated upon the opening of the drawbridge, which occurs regularly throughout the day, with a tendency toward longer openings in the summer season when there are more pleasure craft in the water. While no traffic solution on the island can overcome the limitations of the drawbridge, a solution that reduces overall vehicle delay throughout the busy summer season would have benefits for the entire community if built with human, natural, and aesthetic impacts in mind.

It is with these interests in mind that we recommend the candy corn alternative for the study intersection. In concert with the system of signals, we also recommend a host of elements from the demand management and low cost alternative to improve multimodal transportation options in the project vicinity. First, we recommend adding bicycle lanes throughout the design of the candy corn intersection. Although improvements have not been identified for points beyond the intersection of US 74 and 76, we strongly recommend that the town continue these facilities along eastbound Causeway Drive and Westbound Salisbury Street as well as along Lumina Avenue to create a comprehensive network of dedicated bicycle facilities in Wrightsville Beach.

Because pedestrian and bicycle safety is a concern for intersection users, especially town residents, the candy corn alternative provides some significant improvements over the existing intersection configuration. In addition to enhanced bicycle safety from the improvements described above, pedestrian safety and access would be improved with this design as well. Signalized pedestrian crossings would allow safe passage from the Loop to the commercial area to the south and to the residential area to the north of the intersection. This may encourage a higher mode share for pedestrians and bicyclists, as people may take trips on foot that they previously drove because of the perception of the intersection as unsafe.

A second multimodal improvement is a shuttle system from points west of the drawbridge to beach locations along the barrier island of Wrightsville Beach. While this would involve close collaboration and cooperation between the town of Wrightsville Beach and the City of Wilmington, the project team feels that both municipalities could benefit from such a shuttle system. Wrightsville Beach would benefit from reduced traffic and parking demand during peak visitor season and Wilmington would benefit from additional tourist revenue from beach-going visitors staying in Wilmington.

The environmental impacts of the intersection warrant further study, but initial research suggests that there would be no net loss in permeable surfaces or impacts to wetlands caused by the candy corn alternative. The one significant environmental aspect is the proposed intersection’s impact on air quality. This should be further studied, optimizing signal progression and timing and calibrating the models more precisely for the study intersection.

Because the candy corn alternative frees space in the center of the intersection, the town would have a host of options for the center island’s uses. The options are even further expanded in the larger candy corn scenario, which has its eastern leg along Seawater Lane near the municipal complex. Options such as expanding the Harbor Way Gardens, adding public art, and even moving and updating the municipal complex could be considered in the larger candy corn alternative. In both the smaller and larger candy corn alternatives, improved landscaping and a system of paths would enhance the aesthetics and sense of place at the intersection, providing more of a “gateway feel” to this intersection.

In addition to the enhancements listed above that would improve multimodal access, safety, and aesthetics, the candy corn alternative reduces the average delay of the intersection from the existing 64 seconds to 26 seconds during the peak summer times. This represents a significant improvement in operations. While non-peak delay is slightly increased with this option, it still performs well and has the added benefits of improved safety and access for bicycle and pedestrian users. Overall, this alternative has benefits for all users, and thus it is recommended that NCDOT and the Town of Wrightsville Beach move forward with procuring funding for this project.

Finally, we recommend continuing with the context sensitive approach to this project. We found that it gave us the insight needed to come up with a truly creative solution that meets a transportation need, is an asset to the community, and fits within the human and natural context of its setting. Major obstacles one might find in selling this project to the community lie primarily in the fact that people resist change. Although this alternative does involve a somewhat significant change, the benefits of improved access and safety for all modes, larger plots of open space, and improved aesthetics and traffic flow are all points on which this project can be sold to the community. It is important that a multi-disciplinary team be assembled for further review of each aspect of the project. We recommend that this team be composed of, but not limited to the following people: traffic and transportation design engineers, a transportation planner, a landscape architect, a coastal environment/wetlands scientist, various community members, elected officials, business owners, public relations/information coordinator, and pedestrian/bicycle advocacy or community groups. With this team of individuals, we believe it is possible to create an effective, attractive, safe gateway to one of North Carolina's most beautiful beach communities.

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Appendices

Appendix A: Area Business Listings

Appendix B: Online Stakeholder Survey Questions

Appendix C: Online Stakeholder Survey Results

Appendix D: Online Stakeholder Survey “OTHER” Responses

Appendix E: Assumed Traffic Assignments (Percentages)

Appendix F: Traffic Flows Using Assumed Assignments

Appendix G: VISSIM Model Screenshots

Appendix H: VISSIM Outputs

Appendix I: Candy Corn Flows

Appendix J: aaSIDRA Output

Appendix K: Human Use Plan

Appendix L: Raw Traffic Data