



City of Norfolk Bicycle and Pedestrian Strategic Plan

September 2015

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Chapter 1: Introduction

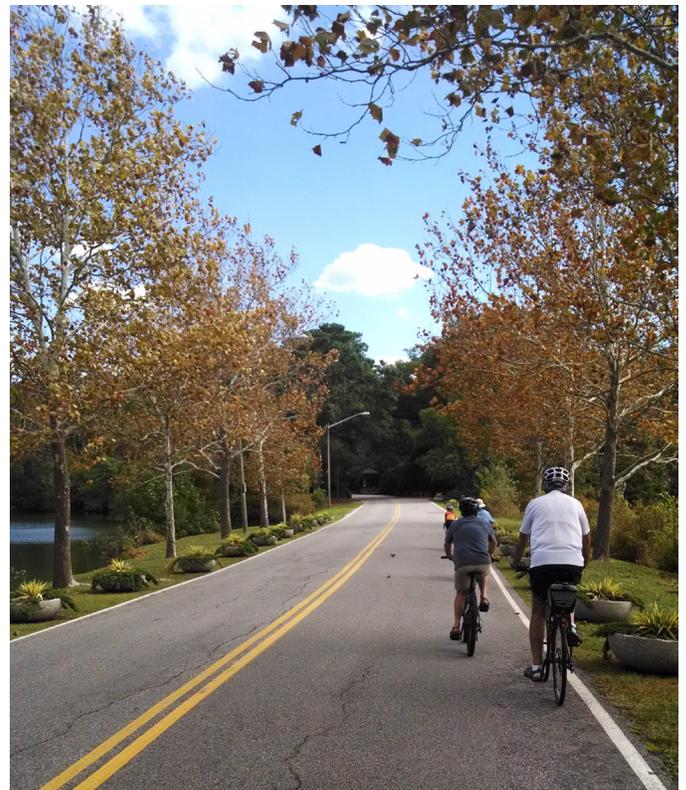
City leaders and residents are seeking to make Norfolk a great place for bicycling and walking. Many residents and visitors already ride bicycles in the city, both for recreation and transportation, and all residents and visitors are pedestrians at one time or another, even if they make most of their trip via transit, automobile or bicycle. This Strategic Plan equips the City with recommendations to improve 12 key corridors identified by stakeholders as critical to kick-starting a comprehensive and connected bicycle network. Recommended improvements also benefit pedestrians through improved crossings at major streets and provision of bicycle facilities that will help residents avoid sidewalk riding. Implementation of the Plan recommendations will result in a solid foundation upon which Norfolk can continue building the premier bicycle and pedestrian friendly city in Virginia.

Bicycling and Walking in Norfolk

Overall, most trips in Norfolk today are taken by automobile. While commute trips only account for a portion of overall trip types in the city, over 80 percent of commutes are taken in passenger cars and trucks. Just four percent are taken using public transit; slightly more than five percent by walking, and less than one percent is taken by bicycle.¹

These figures do not account for the many non-work trips that occur on a daily basis: errands, social or family visits, school drop-off and pick-up, and others. It is possible that a greater percentage of these trips are taken by bicycling and walking as Norfolk is a compact city and commercial land uses are dispersed throughout. In addition to dispersed commercial land uses, Norfolk has a number of other important assets that can be key to building strong bicycle and walking mode shares for daily transportation, including the following:

- A strong share of the regions jobs and accessible employment sites
- A traditional downtown that is strengthening its mix of commercial and residential land uses
- Recreation and entertainment destinations such as the Virginia Zoo, Elizabeth River and Chesapeake Bay waterfronts, Norfolk Botanical Garden, performing arts centers and sports venues
- A compact shape (it is only eight miles east to west and north to south)
- A fairly well connected street grid
- Large universities and other public institutions



The Norfolk Botanical Garden is a popular destination for bicyclists.

¹ American Community Survey 5-Year Estimates, 2014.

- Flat terrain
- Neighborhood based school boundaries

While Norfolk may not currently have large volumes of commuting cyclists, it does have thousands of bicycle enthusiasts that like to recreate regularly. Many of these cyclists use major city streets for morning or afternoon rides when traffic volumes are low. Norfolk also has many walkers, including those that stroll the waterfronts, walk their dogs in local parks and city-owned cemeteries, and exercise on the Elizabeth River Trail. Another important bicycling and walking constituency consists of non-drivers, including children and seniors, and people without access to vehicles.

Norfolk, like cities across the U.S., is experiencing an influx of young residents who want to live in a city, but not spend exorbitant time in their car. Due to the strong mix of employment, commercial activities, public institutions and residential population, the downtown, greater Ghent and Old Dominion University (ODU) areas of the city are experiencing a dramatic increase in people bicycling and walking. Other parts of the city generate bicycle and pedestrian activity as an affordable means of daily transportation, to jobs, school and shopping. While hard numbers are currently not available, it is easily noticed when observing street life in these areas.

Though many features of the city mentioned earlier bode well for bicycling and walking, current conditions for these modes are not exemplary. This was underscored by the comments residents provided in the public outreach meetings conducted during the planning process. Though destinations are nearby, conditions make it difficult to walk or bike to them. As a result, many bicyclists are observed riding on sidewalks, and walking trips are made less safe by necessary crossing of large auto-oriented streets. Additionally, bicyclists are often found riding in the street against traffic or in other unpredictable ways, which are not uncommon in communities with minimal bicycle infrastructure.

There are a number of groups within Norfolk, in addition to the City, who are working to make it a better place for bicycling and walking. The Tidewater Bicycle Association (TBA) is a regional advocacy group with members in Norfolk, Chesapeake, Portsmouth, Newport News and Virginia Beach. Many members of TBA were involved in this Planning process, and TBA will continue to work to improve the region's bicycle environment. The Bicycling and Pedestrian Trails Commission, a citizen representative body appointed by City Council, serves to advise the City on pedestrian and bicycle matters.

The Downtown Norfolk Council (DNC) was also an involved stakeholder in developing this Plan. The DNC



Some intersection locations in the city present challenges to through movements because of large, complex design and high traffic volumes.

has promoted and funded bicycle improvements in the downtown area, including shared lane markings on Granby Street and installation of bike racks. The DNC also seeks an improved pedestrian environment for downtown residents and business owners. Old Dominion University is a major presence in the city that is also making improvements for pedestrians and bicyclists. The university installed pedestrian crossing safety improvements along its periphery in the last few years, and the Outdoor Adventure Program office has started a bike share program for students, faculty and staff affiliated with the university. ODU was recently recognized as a Bronze Bicycle Friendly University by the League of American Bicyclists. Other Norfolk colleges and universities are recognizing a growing interest among staff and students in bicycling as well. Bike Norfolk, a local advocacy group, also participated in the planning process.

Recent Changes in Bicycling and Walking

A number of infrastructure improvements for bicycling and walking have been implemented by the City in the last decade. The Elizabeth River Trail was developed in 1994 and has been continually improved with new sections, including one under construction currently (summer 2015) along Weyanoke Street. Bike lanes and shared lane markings have been added to a number of streets throughout the city – Church Street and East and West Ocean View Avenues among others. These facilities create space for bicyclists on the street and make all roadway users aware of bicycle traffic. Bicycle parking has been added downtown and in commercial corridors such as Colley Avenue, Colonial Avenue and Chelsea. Additionally, the Parking Chapter of the *City of Norfolk Zoning Ordinance*, 1992 as amended, now requires most new development to provide bicycle parking.

Investments have also been made in pedestrian infrastructure, most notably in redeveloping parts of the city. For instance, a portion of the 21st Street commercial strip received new sidewalks in 2009 that feature a planter strip, and planted curb extensions were installed on the portion near Llewellyn Avenue. Sidewalk and crossing improvements have also been installed near Tide stations to improve access to and from the light rail.

All of these efforts form a promising start for improved bicycling and walking in Norfolk.

Plan Organization

The Norfolk Bicycle and Pedestrian Strategic Plan contains the following elements:

Chapter 2: Plan Development Process

Summarizes the process used to develop the Plan's infrastructure, policy and program recommendations, including public and stakeholder outreach

Chapter 3: Implementation

Presents overarching strategies, cost estimates, funding mechanisms and policy recommendations for implementation of the Plan

Chapter 4: Corridor Facility Recommendations

Details the recommended facility improvements and existing conditions for each of the 12 Plan corridors, including facility types, implementation actions and cost estimates

Appendices

A: Public Involvement Process

B: Level of Traffic Stress Analysis and Maps

C: Cost Estimate Details

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Chapter 2: Plan Development Process

Development of this Plan was a collaborative effort among City staff, stakeholders, interested citizens and the consultant team. This chapter outlines the process that led to recommendations presented for 12 corridors in Chapter 4.

Stakeholder Goals

A set of goals laid out by City staff and stakeholders early in the planning process drove the development of this Plan.

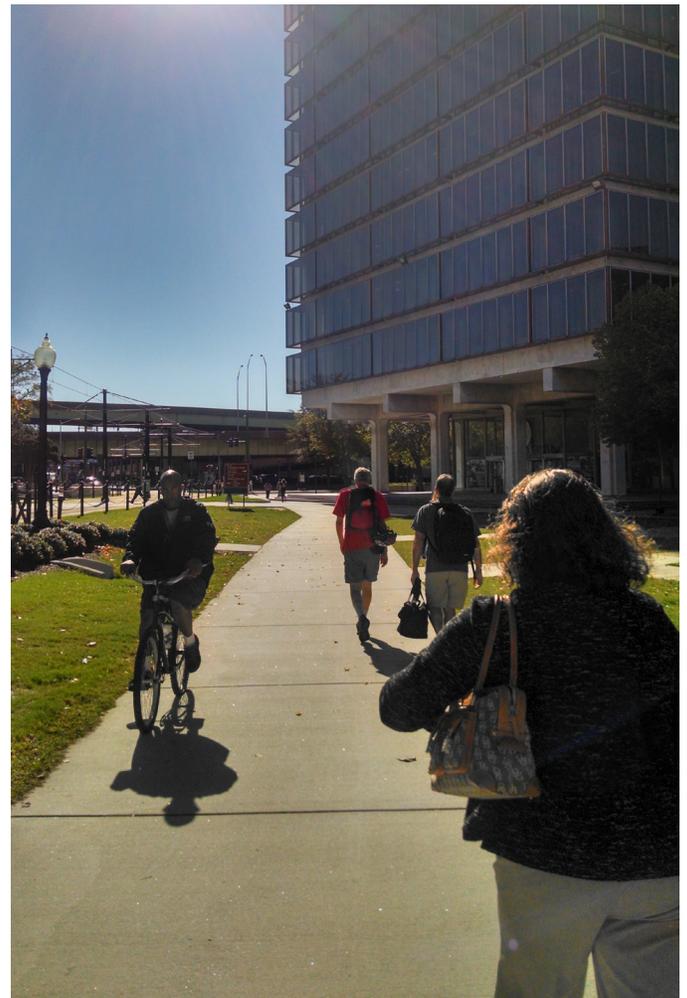
Goal: Improve the environment for bicycling and walking in Norfolk

City staff and stakeholders recognize that while elements are lacking in the pedestrian environment currently, the experience for bicyclists is in greater need of improvement. Residents are bicycling throughout Norfolk today, but they are doing so on infrastructure constructed solely for automobile and pedestrian travel.

In environments like this, bicyclists create their own spaces and ways of adapting to the infrastructure, which often leads to bicyclist behavior that is inconsistent or in conflict with expected vehicular movements on the street network. This Plan provides recommendations that will give bicyclists their own space on many streets, creating safer routes and encouraging more predictable riding habits which are directed by signage, markings and other elements. These marked bikeways will also alert drivers to bicyclists' presence on streets and help explain where they need to share the travel lane with bicyclists.

The recommendations in this Plan will also create better pedestrian environments, and do so in a variety of ways. First, by providing defined on-street facilities for bicyclists that increase comfort and safety, they will be less likely to use sidewalks, lessening potential conflicts with pedestrians. Secondly, most of the on-street bikeways will be accomplished by moving

the traffic further from the curb and sidewalk; the bike lanes, buffered bike lanes and protected bike lanes will create more space between pedestrians and fast-moving traffic. Finally, many of the proposed bicycling upgrades involve creation of safer crossings of major streets. These improvements—crosswalks, rectangular rapid flashing beacons, medians, High-Intensity Activated Crosswalk (HAWK) signals—will also make it safer and more comfortable for pedestrians to cross busy roads.



Safe interactions between bicyclists and pedestrians are part of the goal to improve the bicycling and walking environment in Norfolk.

Goal: Move quickly toward implementation

Rather than identifying a comprehensive network that might take 20 to 30 years to develop, this Plan focuses on a detailed list of implementable projects.. To achieve this goal, the project team identified bikeway improvements for a set of corridors that were selected based on the following criteria:

Corridor Selection Criteria

- *Provide at least one corridor in every part of the city*
- *Ensure all corridors connect to each other*
- *Avoid arterials with the largest amounts of traffic and those requiring major reconstruction and land use changes to be made bicycle and pedestrian friendly*
- *Include alternatives to the arterial corridors that are avoided for reasons stated above*
- *Include corridors where staff knowledge suggests improvements can be made with relatively little impact to motor vehicle traffic*
- *Include corridors where people already ride and that connect destinations which bicyclists want to access*
- *Connect to key destinations including downtown, beaches, rivers, the Elizabeth River Trail, employment and activity centers, and other cities*

Goal: Ensure corridor selection reflects public interest

A map and draft list of potential study corridors was developed by the Bicycling and Pedestrian Trails Commission and the project working group. Stakeholder and general public input were sought and used to refine the initial list and identify any important connections that were missing. Stakeholder meetings were held in October 2014, with the following targeted groups:

- Universities
- Bicycling and Pedestrian Trails Commission
- Downtown Norfolk Council

Three public meetings were held in different locations throughout the city to provide the opportunity for varied groups of residents to give input. Attendees were asked to identify important destinations and areas of concern for walking and bicycling. A full account of these meetings and their results is provided in Appendix A.

Residents also had the opportunity to give input online via an interactive map, called a WikiMap. The destinations, barriers and routes identified on this map helped inform the selection of study corridors. The results of this tool are also summarized in Appendix A.

The project team used input gathered from all of these sources to select the final set of 13 study corridors. They conducted field visits to the corridors during three trips in October and December 2014 and February 2015. The final corridors selected are shown in the map on the following page.

Corridor Recommendations Development

Data was gathered about the streets in each corridor from a variety of sources, including field work. Data used in the study process included Virginia Department of Transportation (VDOT) Average Daily Traffic counts, the width and configuration of travel lanes, shoulders and other road space, the presence of bicycle facilities, the speed limit, the presence of crossing treatments and intersection signalization. Team members also noted locations that would present particular challenges to bicyclists or pedestrians, many of which were large, complex intersections or high-volume, high-speed cross streets at unsignalized locations. The team also studied off-street alignments for the potential to improve directness, decrease exposure to heavy traffic, or circumvent a barrier.

Through this process, one corridor was eliminated from consideration because a reasonable solution was deemed infeasible at this time. This corridor would create an important connection between Wards Corner and Hampton Boulevard. Study of the



Final Study Corridors Map. Dashed lines indicate City-planned facilities with likely short-term implementation.

area reveals a disconnected street network, water barriers and lack of opportunity along Little Creek Road for an on- or off-street bicycle facility. This led the project team to confirm the importance of an alternative route which City staff are currently developing to provide an off-street trail parallel to Terminal Boulevard on the south side of the adjacent railroad line. Due to the large amount of open and unused space parallel to the railroad, it appears to be the best and possibly least costly option.

For the remaining 12 corridors, baseline data was used to develop facility recommendations. Facility types and their bicycling attributes are explained in the following section. In general, recommended facilities fit within the existing curb-to-curb width and are accommodated through road diets and lane diets.² Some recommendations require widening of road pavements, but these only occur in locations without curb and gutter. There are also a handful of recommendations for shared use paths that will be constructed outside of the street right-of-way.

In addition to physical constraints, speed limit and traffic volumes were considered in identifying the appropriate facility type. Where streets have higher speeds and volumes, greater separation from automobile traffic is provided. Many of the largest streets in the network have low enough traffic volumes that road diets are likely to be feasible with minimal impact to motor vehicle traffic. On Granby Street and Chesapeake Boulevard, for instance, removal of a travel lane in each direction is recommended for much of their length, and this provides space for wide buffered bike lanes with horizontal separation between bicyclists and adjacent automobiles.

Cost estimates were developed for each corridor based upon the set of recommended improvements needed to make it an effective bikeway, including the features such as crossing signals that would serve both pedestrians and bicyclists. Costs for additional pedestrian-specific improvements (e.g., high-visibility crosswalks) were not included in the cost estimates because a complete assessment of pedestrian needs was not conducted. However, a table of costs for typical pedestrian features is included in the cost estimate appendix.

² A road diet eliminates one or more travel lanes to free up roadway space for other uses. A lane diet narrows lanes but maintains the same number of lanes.

Facility Toolkit

The bicycle and pedestrian recommendations in this Strategic Plan will not only further connect different neighborhoods and areas of Norfolk together, but will also improve the quality of active transportation by using facilities that increase the safety, comfort, and convenience for pedestrians and bicyclists.

This toolkit provides a description of the different elements that are part of the recommendations and classifies them into three categories: bicycle facilities, pedestrian facilities, and spot improvements. All recommendations should adhere to the latest edition of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), as well as other standards such as the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide, as appropriate.

Most, if not all of the proposed bicycle and pedestrian improvements in this Plan will have minimal or no negative impacts on motor vehicle travel. However, many of the on-street bicycle facilities described on the following pages will require a reallocation of space from automobile travel lanes to bicycle lanes. In these cases, the following on-street implementation actions will be needed.

On-Street Implementation Actions

Road Diet

- Removal of one or more travel lanes to repurpose roadway space for other uses
- Rules of thumb applied in Norfolk included the following traffic volumes for final cross sections:
 - Four-to-three lane conversion: 15,000 or fewer vehicles per day
 - Four-to-three lane conversion: 20,000 vehicles per day, traffic study suggested
 - Six-to-five lane conversion: 35,000 vehicles per day possible, traffic study suggested

Lane Diet

- Narrowing of one or more travel lanes to repurpose roadway space for other uses
- Rule of thumb for recommendations in Norfolk was a minimum lane width of 10 feet with an 11-foot minimum width where transit vehicles would be present

Bicycle Facilities



Shared-Use Path

- Fully separated, two-way path
- Open to pedestrians, bicyclists and most other non-motorized users
- Typically paved and marked with a center line
- May be parallel to a roadway or along a separate alignment
- Best used on streets with high motor vehicle traffic speeds or volumes



Separated Bike Lane

- On-road, bicyclist-only facility, physically separated from automobile travel lane and sidewalk by curbs, bollards, parked cars, or other vertical elements
- May be one-way on both sides of the street, or two-way on one side of the street
- May be located at roadway level or raised to, or just below sidewalk level
- Best used on streets with medium and high traffic volumes and fewer intersections or driveways



Bike Lane

- On-road bicyclist facility with roadway space dedicated to bicyclists designated by bike lane pavement markings
- Generally located to the right of and in the same direction of the motor vehicle travel lane
- May be placed on one-way streets
- Best used on streets with low to medium motor vehicle traffic volumes



Buffered Bike Lane

- On-road bicyclist-only facility with roadway space dedicated to bicyclists
- Hashed pavement markings create additional space between bicyclists and motor vehicle traffic
 - Buffer may be located between bike lane and automobile travel lane, between bike lane and parking lane, or both
 - Both sides are buffered when total lane width exceeds nine feet
- Best used on streets with medium to high motor vehicle traffic volumes



Shared Lane Marking

- On-road pavement marking indicating that bicyclists and motorists must share the roadway
- Indicates where bicyclists should position themselves to avoid open car doors when on-street parking is present
- Reinforces motorist caution and expectation that bicyclists are present
- Best used on roads with low motor vehicle traffic volumes and speeds limits under 35 mph



Priority Shared Lane Marking

- Similar to Shared Lane Markings but underlaid with a bright green painted (or thermoplastic) box
- Spaced more frequently than Shared Lane Markings
- Typically used in locations with higher volumes of traffic and/or complex traffic patterns such as those with higher turnover on-street parking
- Best used on roads with low motor vehicle traffic volumes and speed limits under 35 mph



Contraflow Bike Lane or Shared Lane

- On-road pavement marking on a street that is one-way for automobile traffic
- Indicates bicyclists ride in opposite direction of automobile traffic either in bike lane separated from adjacent lane by a double yellow line or shared lane marking if enough space for bike lane is not available
- Accompanied by signage indicating two-way bicycle traffic for drivers on and crossing the street



Paved Shoulder

- Paved roadway outside of the edge line available for bicyclist or pedestrian travel
- Lack of bicycle markings differentiates it from a bike lane
- Best used on roads with medium motor vehicle traffic volumes where sidewalks are not present

Pedestrian Facilities



High-Visibility Crosswalk

- On-road pavement marking to indicate appropriate location to cross a street
- Connects to sidewalks at intersection or mid-block locations
- Bold, reflective striping improves visibility of crosswalk for pedestrians and drivers



Raised Crosswalk

- High visibility crosswalk raised from street level to sidewalk level
- Increases visibility of pedestrians crossing street
- Raised crossing acts as speed table to reduce vehicle speeds
- May be placed mid-block or at an intersection



Curb Ramps

- ADA-compliant curb ramps provide ramped access to sidewalks
- Detectable warning surface on curb ramp provides warning for physically impaired
- Should be located to place users in line with crosswalk across intersection leg



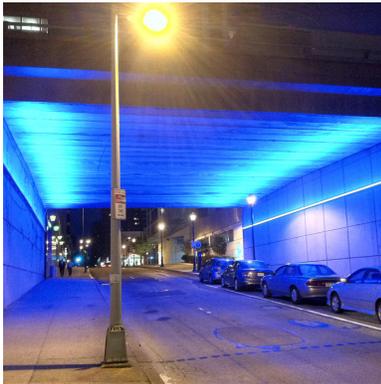
Curb Extension

- Sidewalk and curb space extended into roadway to reduce roadway width
- Slows motor vehicle turning speed
- Visually narrows roadway to help reduce vehicle speeds
- Reduces crossing distance for pedestrians
- Provides more space for pedestrians waiting to cross the street



Median Island

- Curb separated space for pedestrians in center of roadway
- Allows pedestrians to cross wide streets in two stages
- Visually narrows roadway to help reduce vehicle speeds
- Best used on multi-lane roadways with high motor vehicle traffic volumes



Pedestrian-Scale Lighting

- Street lighting that use shorter lamp posts and is directed toward the sidewalk instead of the roadway
- Improves pedestrian visibility and safety
- Special lighting treatments can be used to improve specific locations such as underpasses

Spot Improvements



Leading Pedestrian Interval (LPI)

- Intersection signalization programmed to provide pedestrians additional time to cross the intersection before the "green" signal for motor vehicles
- Pedestrians crossing at an intersection have a head start and are more visible to turning motorists



Rectangular Rapid Flashing Beacon (RRFB)

- On demand pedestrian or bicyclist activated signal with push button
- Bright LED flashing beacons increase motorist awareness of pedestrians or bicyclists crossing
- May be used in conjunction with median islands or high visibility crossings
- May be used at mid-block crossings or intersections



HAWK Signal

- On demand pedestrian or bicyclist activated signal with push button
- Red signal requires motor vehicles to stop while pedestrian crosses the road
- Generally used at mid-block crossings
- Best used on multi-lane roadways or roads with higher motor vehicle traffic speeds



Bike Box

- Space for bicyclists to wait at intersection in front of waiting motor vehicles
- Designated bike box space indicated with pavement markings
- Give bicyclists a head start by positioning them in front of motor vehicles



Intersection Striping

- Bicycle lane striping continues through intersection
- Improves visibility of bicyclist
- May include green pavement, shared lane markings and/or bicycle lane lines



Bicycle Parking

- Bicycle parking provides bicyclists with secure location to store a bicycle
- Conveniently located, covered, and well-designed bike parking can increase bicycle security
- Abundant bicycle parking will reduce instances of bicycles being locked to sign posts, gates, and trees
- Variety of types include sidewalk racks, on-street bike corrals, and bicycle lockers

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Chapter 3: Implementation

Infrastructure Strategies

Norfolk has one advantage over communities that began implementing their bicycle and pedestrian improvements in the 1990s and 2000s: Lessons can be learned from their past experiences and implementation challenges. While most, if not all of the bicycle and pedestrian improvements proposed for these corridors will have minimal or no negative impacts on motor vehicle travel, in the public review process, during construction and after implementation, some motorists or adjacent residents may have concerns or raise objections. Some residents may challenge the necessity of projects when they do not see an existing high volume of pedestrians and bicyclists, and some projects may be challenging for other reasons. In this regard there are four things that Norfolk can learn from those who have gone before:

Conduct demonstration and open streets events.

Norfolk is already familiar with these community events that create a temporary demonstration of what may seem to be dramatic proposals for change in the design and use of public space or streets. Norfolk has successfully conducted a number of these events with the organizers from Better Block, Inc. which have helped residents realize the advantages of these designs. There are any number of components of this Plan that can be implemented temporarily as a way to show the community how proposed changes would work, look and feel.

Taking this a step further, the city may find success from instituting a "Cyclovia"-type open streets event, which is a weekend dedication of lanes and/or whole streets for mass use by people on foot or bike rather than those in cars. Begun in Bogota, Colombia, these events not only demonstrate the joy people feel by having streets free of automobile traffic, but provide social cohesion, health education opportunities and any number of other community-wide benefits. Norfolk's flat topography makes it a perfect city for

open streets; people of all ages and abilities can travel more easily, under their own power.

Develop and nurture key partnerships.

Cooperation and support from partners and coordinating agencies is often essential for successful project development. Each of the corridors in this Plan typically has three to five key partners that need to be engaged in implementation. (See table on the following page for details.)

This table will be useful for City staff, elected officials, Bicycling and Pedestrian Trails Commission members, and other advocates. Typically, the City has established contacts with these partners, with whom they work regularly, however, at times advocates or elected officials can play an important role developing key contacts, educating representatives or orchestrating engagement.

Implement high-quality designs.

Bicycle and pedestrian improvements should be well designed and carefully considered. When done right, cities find that bicycle and pedestrian improvements often result in improved travel for motorists and sometimes a reduction in motor vehicle crashes. Bicycle facilities that include a reduction of travel lane widths typically help calm traffic which residents and pedestrians appreciate. In some cases, slower moving traffic will flow more easily, resulting in less overall delay.

Get the word out about roadway changes.

It is important to inform local residents and commuters of planned changes to a roadway including the purpose and desired outcomes of the project. This can include signs along the corridor prior to construction, informational meetings for neighborhood groups, media attention in print, on the radio (traffic report stations) and television, and a social media campaign. On-the-ground outreach to pedestrians and bicyclists can also help orient them to a new facility once it is implemented.

Corridor												
PARTNERS:	1	2	3	4	5	6	7	8	9	10	11	12
Developers		•						•	•	•		
Downtown Norfolk Council	•	•										
ERT Group				•	•							
Hampton Roads Transit			•									•
Civic Leagues	•	•	•	•	•	•	•	•	•	•	•	•
Norfolk Public Schools	•	•		•			•					
Norfolk Southern RR							•	•				
ODU, NSU, TCC	•			•	•							
Norfolk Redevelopment and Housing Authority	•			•								
US Navy			•		•					•		
VDOT			•	•	•	•	•	•	•	•	•	•
Virginia Beach, Chesapeake, or Portsmouth						•		•	•	•		

Table 2: Key Partners, by Study Corridor

Utilize pilot projects.

The initial set of improvements emerging out of this Plan will take Norfolk to the next level. This Plan recommends infrastructure changes throughout the city, but the projects with the quickest impact are likely to be those located where bicyclists already ride for both transportation and recreation. Creating a short loop that can be ridden for recreation is also likely to attract more riders. Placing these new facilities in a mixed-use area may enable more residents to take short trips by bike. Identifying these projects as a “pilot” may make the changes seem less intimidating to skeptical residents.

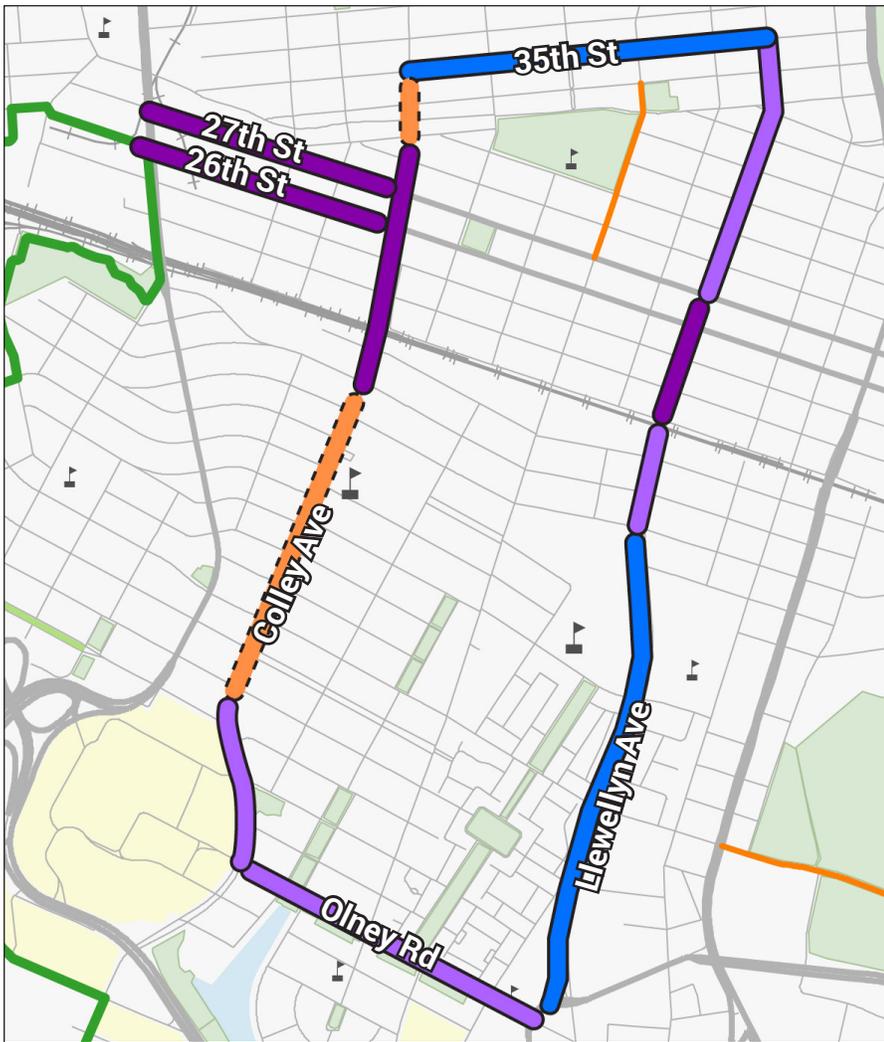
Considering these factors, it is recommended that the City pursue early implementation of the facilities identified in the map on the following page. This loop links major facilities on Colley Avenue and Llewellyn Avenue to one another and to the Elizabeth River Trail to the west. There is already a higher volume of bicyclists in this area of the city. The projects serve a major employment destination at the hospitals

complex and reaches the growing destination of the Arts District. Colley Avenue is a destination in itself for shopping and dining as well. The facility recommendations for this loop are outlined in the descriptions of Corridors 1, 2 and 5. A bike lane project is already planned and funded on 35th Street.

High-impact project implementation.

In corridors where traffic studies or other factors suggest that implementation of recommended facilities may have a negative impact on motor vehicle traffic, it may be wise to begin with a low cost investment that can be modified or removed if the project is not a success. For example, if a road diet is needed to provide a protected bicycle lane, changing a four-lane median divided road to a two-lane median divided road, by converting the right hand lane into the protected bicycle lane, the following approach may be taken:

- Step 1: Stripe the right hand lane as a buffered bicycle lane, which is accomplished by



Proposed Pilot Projects

restriping the existing pavement, only using paint (the lowest cost investment). Study the impacts to traffic and the levels of bicycle use that it attracts. Monitor the feedback from motorists, bicyclists, local residents and businesses and other stakeholders.

- Step 2: Install flexible post bollards in the buffer area, to provide a vertical element of protection, and reapply paint where needed.
- Step 3: If all has gone well and the road surface needs repaving, then resurface and apply long lasting highly-reflective thermoplastic striping and bollards, add planters, portions of curb or other permanent vertical features, signage and crosswalks to provide a full-featured separated bike lane.
- If for some reason the project needs to be reversed after Step 1 or Step 2, the paint or

paint and bollards can easily be removed (at relatively low cost) and a priority shared lane marking installed, which restores the right lane for motor vehicle traffic and provides a modest improvement for cyclists to share the space with cars.

Once the city has significant experience assessing the potential for road diets, designing and implementing them, and confirming that they lead to more bicycling, this step by step process may not be needed. The Llewellyn Avenue pilot project will not be implemented in this manner, but rather it will provide a good test case for future separated bike lane projects.

There are other creative ways to phase in new designs that can be used depending on the existing status of the road. For example, a road with six 12-foot lanes (36'/36') could be adjusted first to have

an 11-foot inner lane, 10-foot middle and right lanes and a five-foot bike lane, in each direction. The lane diet can be tested first for safety and traffic impacts, and then a full road diet (reducing six lanes to four) with protected bicycle lanes can be implemented as a second step at a later date, as the level of bicycle usage rises.

Designate citywide recreational loop.

Development of a citywide recreational loop is a key concept that emerged from the public meetings and received continued support throughout the planning process. The loop could be formed by the following corridors, beginning in Downtown and moving clockwise:

- North on Corridor 2: Lower Granby, Llewellyn, Granby
- North on Corridor 3: Upper Granby
- East on Corridor 10: Ocean View
- South on Corridor 11: Azalea Garden
- West on Corridor 8: Cape Henry
- South on Corridor 4: Maltby and Park
- Elizabeth River Trail along the waterfront to Granby

With the improvements recommended by this Plan, these linked corridor segments will create an attractive recreational loop ride that can become a signature facility for the City. It can provide a relatively high level of protection from traffic throughout, and thus serve both experienced and less experienced cyclists. It will be popular among Norfolk residents as a way to traverse a variety of city-neighborhoods and visit a number of attractive locations including the downtown waterfront, two Lafayette River crossings, the beach, the Botanical Garden and revitalizing neighborhoods near Norfolk State University. It will also be attractive for cyclists from neighboring Hampton Roads communities and visitors from outside the region.

Implementing the improvements along the entire loop will take some time and a substantial investment. As a whole, it may not be the most important component of this Plan on which to focus all efforts in the near term since the City already provides some recreational bicycling opportunity via

the Elizabeth River Trail, and experienced recreational bicyclists already ride these streets. However, there are certainly components of this loop that are likely to emerge as near-term, high-priority projects. As a 7 to 10 year goal, completion of improvements along the entire loop may provide the City and its residents a singular unifying vision, achievement of which would be a strong motivating force to sustain steady implementation of this Plan.

Non-Infrastructure Strategies

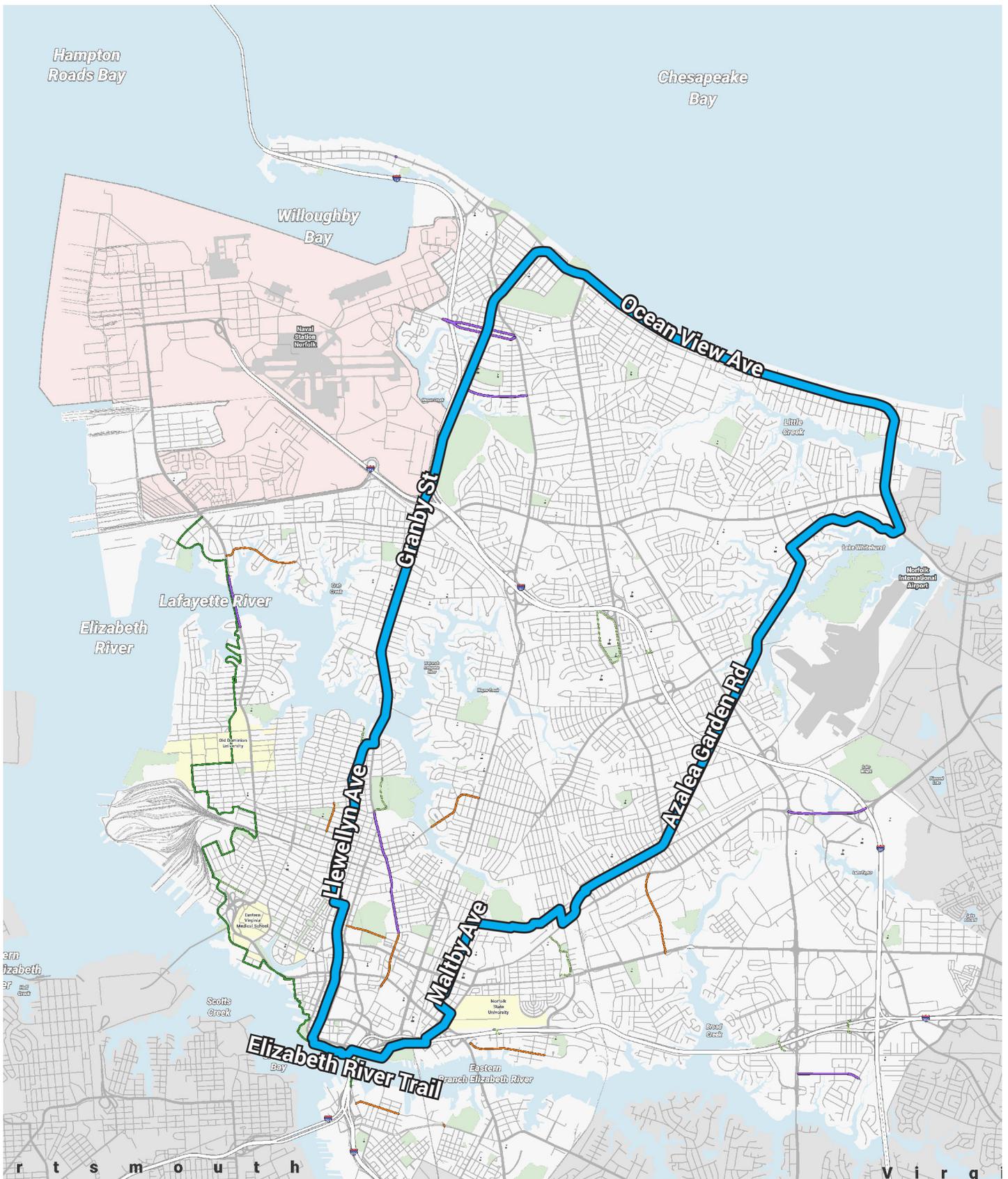
During the planning process a number of important issues were raised that were beyond the scope of this Strategic Plan which focused on infrastructure development. These issues are typically addressed through educational programming, communication, training and policy based approaches, which are designed to support the infrastructure changes proposed in this Plan.

These issues are noted here with a general recommendation that the City and its citizens take each of them up in a future planning effort. Most of these issues are common to U.S. cities that are engaging in improving bicycling and walking conditions, and the recommendations presented are based on what is becoming common practice across the country.

Pedestrian and Bicyclist Safety

Bicyclists expressed frustration with a general lack of respect accorded to them by drivers. Norfolk has many road users who come to the city daily from the surrounding communities for jobs, school, shopping and entertainment. Driver frustration from congestion tends to be high even though many arterials have been designed to move these vehicles through the city as fast as possible. As a result, motor vehicle speeds tend to be high. And some actual arterial speed limits tend to be higher than in other cities. Bicycle-automobile and pedestrian-automobile crashes are not uncommon; there was an average of 54 police-reported bicycle-vehicle crashes per year from 2009 to 2012. Finally, erratic and against traffic biking by some bicyclists compounds the poor relationship between these two road user groups.

To respond to these issues it is recommended that the City intensify its efforts to change disrespectful



A possible future citywide loop comprising sections of six Plan corridors and the Elizabeth River Trail would provide a 22.5-mile option for bicyclists to link many parts of the city on a recreational ride.

Funding Strategies

Making Norfolk Competitive

The City of Norfolk is beginning to transform itself to attract the educated, skilled entrepreneurs and workforce that are the key drivers of innovation and economic growth. As described in the Greater Norfolk Corporation's (GNC) 2014 President's report, a new urban model is now emerging: the "innovation district," a compact geographic area where leading-edge anchor institutions and growing companies cluster and connect with each other. Bruce Katz from the Brookings Institution describes innovation districts as the "ultimate mash-up of entrepreneurs and educational institutions, start-ups and schools. They are walkable, bikeable and connected by transit. They are urban, mixed-use and authentic." Norfolk seeks to take advantage of this timely convergence of what communities want and what corporations are now seeking – quality places that are competitive, cool and connected.

City leaders, Downtown Norfolk Council, GNC and many others understand that making Norfolk more walking and biking friendly will greatly advance efforts to create a quality place. Implementation of the Bicycle and Pedestrian Strategic Plan will establish the framework for this change. To move the corridor recommendations forward faster the City should aggressively engage the private sector. There is growing interest with corporations like Google, Coca-Cola Co., and Walmart who have funded projects ranging from bike shares to multi-use trails. National health funders like Kaiser Permanente and the Robert Wood Johnson Foundation are investing in research and activation programs. Other private sources include developers who may be required to contribute to infrastructure development as a permitting condition or hospitals and universities who increasingly see the connection between their mission and creating healthier places. A home-grown relationship could be cultivated with Norfolk Southern, who has financial and physical assets that would be of great benefit to an emerging trail and greenway system.

The opportunities outlined above are recognized by government and community leaders. The city should now use this Plan to leverage a wide-range of partnerships including the funding sources listed below to help build this important piece of their competitive future.

behavior and attitudes through region-wide and city-based media campaigns, school-based traffic safety education, bicyclist skills courses and use of social media communication channels. The "We Roll Together" campaign has been a solid start to this type of effort and should be expanded. These efforts should be informed by analysis of bicycle and pedestrian crash trends over the past five years, and supported by targeted police enforcement strategies.

Bike Sharing Programs

The idea of installing a citywide bike sharing system was raised in the planning process. Old Dominion University already runs a successful bike sharing system for its affiliates. These programs are popular and successful in cities all around the U.S. Many cities have begun to study and implement public bicycle sharing programs as bicycling increases in response to better infrastructure. It is recommended that Norfolk study implementation of a public bicycle sharing program once interest in bicycling grows.

Signed Bike Routes and Wayfinding

Wayfinding needs were strongly voiced by citizens who participated in the public meetings, especially with regard to the Elizabeth River Trail. As the infrastructure recommendations of this Plan are installed and constructed, development of a citywide system of signed bike routes is recommended. In the near term, improvement for the wayfinding system along the Elizabeth River Trail can be studied and implemented now given adequate community buy-in.

Bicycle Parking and Other Encouragement Programs

Bicycle and pedestrian safety campaigns, bike sharing and wayfinding systems should be supported by continued expansion of bicycle parking, especially in commercial areas and at employment locations. The current Bike to Work Day efforts by the City are a positive step in the direction of bicycling encouragement. Other bicycling and walking encouragement programs and bike culture activities should be spearheaded by public health institutions, bicycle advocacy groups, and other civic organizations, and supported by the City and the Bicycling and Pedestrian Trails Commission.

Funding Sources

To implement all of the improvements recommended in this Plan, the City will need to allocate funds on an annual basis over a multi-year period. In addition to City funds, there are a variety of other sources that the City can leverage, utilizing both traditional and innovative funding sources. The City should pursue multiple strategies to secure funds not only for a complete and comprehensive walking and bicycling network, but also for active transportation policies and programs that may require an ongoing commitment of resources. Strategies can include:

- Dovetailing with VDOT and City planned roadway improvements or other major capital projects. It is important to inform the lead agency on such projects very early on of the City's desire to incorporate relevant and proximate bicycle and pedestrian improvements in the larger project. In many cases, the cost of adding bicycle and pedestrian facilities to a road reconstruction or repaving project will be a small share of the overall project budget.
- Identifying competitive projects for the State and Federal grant funds discussed below.
- Partnering with major employers and Norfolk-based businesses, the U.S. Navy, large corporations and hospitals in the health care industry, the Norfolk Redevelopment and Housing Authority, Norfolk's universities, and private developers, to fund and support bicycle and pedestrian projects and programs.

There are a variety of potential funding sources at various levels for active transportation projects and programs. It is recommended that the City apply for several of these sources to implement the Bicycle-Pedestrian Strategic Plan. Possible funding sources include:

Federal

- **Transportation Alternatives Program (TAP)**
This program was authorized under "Moving Ahead for Progress in the 21st Century" (MAP-21), which combines several programs that were previously stand-alone programs, including Transportation Enhancement (TE), Recreational Trails, and Safe Routes to School (SRTS)

programs.³ In Virginia, projects that also qualify as Safe Routes to School Projects can receive TAP funds.

Funds are disbursed through VDOT and the Hampton Roads Metropolitan Planning Organization (MPO). The funding is designated for non-motorized transportation projects, such as trails, bicycle facilities, sidewalks, and other pedestrian improvements. Recreational Trails Program funding gets taken off the top, then remaining TAP funding is divided into two equal pots: VDOT distributes 50 percent of TAP funds statewide through a competitive grant process, and the other 50 percent is allocated to metropolitan areas based on population.⁴ TAP requires a 20 percent local match. The VDOT website on the TAP program (<http://www.virginiadot.org/business/prehancegrants.asp>) is a great source for additional information about this program.

The Hampton Roads MPO was allocated \$3.14 million of TAP funds for FY 2016, and Norfolk was allocated \$352k of that for the Elizabeth River Trail.⁵ The MPO will allocate somewhere between \$1.7 and \$2.7 million for FY 2017.⁶

- **Surface Transportation Program (STP)**
The Hampton Roads MPO can use its sub-allocated portion of this flexible funding for roads, bridges, and transit projects. Funds can go towards construction of bicycle and pedestrian facilities, or non-construction projects (such as maps, brochures, and public service announcements) related to bicycling and walking.⁷ The program's flexibility makes it a popular funding source, so it is very competitive.

3 Funding for these previous stand-alone programs expire three years after they were apportioned—2015 is the last possible year that these funds could be utilized—with the exception of Safe Routes to School.

4 http://www.advocacyadvance.org/site_images/content/Navigating_MAP-21_Workshop_Funding_Profile_Chesapeake.pdf

5 http://www.virginiadot.org/business/resources/transportation_enhancement/FY16_Transportation_Alternatives_Program_Allocations.pdf

6 Personal communication with George Homewood, Director of City Planning for the City of Norfolk

7 http://www.advocacyadvance.org/site_images/content/Navigating_MAP-21_Workshop_Funding_Profile_Chesapeake.pdf

The Hampton Roads MPO is currently allocated \$160.54 million in this program (amount includes Federal and local match) (FY 2015-2020).⁸

- **Congestion Mitigation and Air Quality (CMAQ)**
This program supports projects in non-attainment areas that improve air quality and reduce traffic congestion. The City of Norfolk is a non-attainment area. The Hampton Roads MPO is currently allocated \$84.88 million of Federal and matching funds (FY 2015-2020).⁹ In the past, 1993-2018, only 8 percent of all CMAQ funds for the Hampton Roads MPO went towards active transportation projects.¹⁰
- **Highway Safety Improvement Program (HSIP)**
HSIP funds may be used for safety projects aiming to reduce traffic fatalities and serious injuries. Bicycle and pedestrian safety projects on public roads are eligible for HSIP funding. Bike lanes, roadway shoulders, crosswalks, other intersection improvements, and signage are some examples of eligible projects. The State of Virginia requires that HSIP funds be allocated to bicycle and pedestrian safety in proportion to fatalities. In other words, roughly 10 percent of HSIP funds should go towards bicycle and pedestrian safety since there are roughly 10 to 12 percent bicycle/pedestrian deaths each year.¹¹ Funds are distributed through VDOT. For additional information on this program, see the VDOT website (http://www.virginiadot.org/business/tes_app_pro.asp) and the *Framework for Selection and Evaluation of Bicycle and Pedestrian Safety Projects in Virginia* report (http://www.virginiadot.org/vtrc/main/online_reports/pdf/08-r8.pdf).

Projects that might be best suited for this program include the following:

- Those that improve underpasses of the Interstate-Highways that pass through the City (such as Granby/Interstate 64 and Newtown

Road)

- Those that are located along corridors with a concentration of bicycle and/or pedestrian crashes
- Those that improve bicycle and pedestrian crossing safety at complex intersections
- Those that provide off-road accommodations along high speed roadways where bicyclists and pedestrians have no other travel route options
- **Section 402, State and Community Highway Safety Grants Program**
This program funds education, enforcement, and research programs intended to reduce traffic crashes, deaths, injuries, and property damage.
- **National Highway Performance Program (NHPP)**
This program funds pedestrian projects that benefit National Highway System corridors. Funds are disbursed through VDOT and MPOs and have previously been used to fund construction of new and retrofit crosswalks. In order to qualify for NHPP funds, projects must be identified in a Statewide or MPO long range plan.
- **Community Development Block Grant Program (CDBG)**
This U.S. Department of Housing and Urban Development (HUD) program, under the "Entitlement Communities" program area, provides annual grants to larger cities and urban counties to develop viable communities by providing decent housing, a suitable living environment, and opportunities to expand economic opportunities, primarily for low- and moderate-income people. Examples include commercial district streetscape improvements, sidewalk improvements, safe routes to school, and neighborhood-based bicycling and walking facilities that improve local transportation options or help revitalize neighborhoods.¹²

The City of Norfolk receives CDBG money; a portion of it could be allocated to bicycle and pedestrian updates in lower income areas and revitalization zones. This would include improvements along portions of corridors 4, 12,

8 http://www.virginiadot.org/projects/resources/SYIP/05_MPO_Coordination_Meeting_March_2014_CMAQ-RSTP_Final2.3.pdf

9 http://www.virginiadot.org/projects/resources/SYIP/05_MPO_Coordination_Meeting_March_2014_CMAQ-RSTP_Final2.3.pdf

10 http://www.advocacyadvance.org/site_images/content/Navigating_MAP-21_Workshop_Funding_Profile_Chesapeake.pdf

11 http://www.advocacyadvance.org/site_images/content/Navigating_MAP-21_Workshop_Funding_Profile_Chesapeake.pdf

12 Pedestrian & Bicycle Information Center

11, and 8, such as the segment near Walmart in Corridor 8. That said, historically CDBG funding has been allocated to social service-oriented nonprofits, such as daycare and elderly providers, and in recent years, funding has decreased.

- **Transportation Investment Generating Economic Recovery Discretionary Grant Program (TIGER)**

TIGER grants fund a broad array of road, rail, transit, and bicycle and pedestrian projects that have a significant impact on the nation, a region, or a metropolitan area. The program focuses on capital projects that generate economic development and improve access to reliable, safe, and affordable transportation. These competitive grants fund multi-modal, multi-jurisdictional projects that may be more difficult to fund through traditional DOT programs.¹³

The program is a good fit for bicycle and pedestrian projects given its emphasis on non-automotive modes of transportation and the availability of small grants. TIGER is one of the only avenues for cities, metro regions, and transit agencies to directly apply for federal funds, bypassing state DOTs.¹⁴ That said, the demand for TIGER grants far surpasses supply, and the program is extremely competitive. None-the-less, it may be worthwhile to go through the TIGER application process, as it could help generate a package of corridors that could be pitched to other funding sources.

- **U.S. Department of Defense (DoD)** – The Department of Defense funds transportation projects to improve access to its bases and mitigate impacts from oversized or overweight military vehicles, increased personnel, or other defense activities. Further, Navy facility planners were given new mandates in a May 2013 Memorandum to include transportation alternatives in Installation Master Plans and “provide for pedestrian, bicycle, and transit-friendly communities that allow residents opportunities for regular physical activity and, consequently healthier lifestyles while decreasing dependence on automobiles.” However, it is at

13 US Department of Transportation

14 <http://usa.streetsblog.org/2014/09/12/us-dot-awards-72-tiger-grants-but-the-program-remains-in-jeopardy/>

the Commander’s discretion whether or not to comply with this mandate.

The City of Norfolk can coordinate with the Norfolk Naval Station to incorporate bicycle and pedestrian improvements into any project proposals to better enable military employees to walk and bike.

For more information on the application and selection process for Hampton Roads, Virginia, the following document is a helpful resource:

http://www.advocacyadvance.org/site_images/content/Navigating_MAP-21_Workshop_Funding_Profile_Chesapeake.pdf.

State and Regional

- **State or Regional Programs**

The State of Virginia and Hampton Roads MPO have different pots of money for a variety of transportation programs, such as the Statewide Transportation Improvement Program (STIP). The City of Norfolk can tie projects outlined in this Plan to these funding sources and apply for funding: 12.7 percent of all STIP projects included bicycle and pedestrian facilities, and 10.2 percent were bicycle and/or pedestrian-only projects (a total of 278 projects) with an average project cost of \$1 million.¹⁵

- **Revenue Sharing**

This state-funded program allows localities (Counties, Cities, or Towns) to earmark state gas-tax revenue to specific projects. This funding can be applied to a wide variety of projects, including new roadways, expansion/widening of existing roadways, improvements to existing pedestrian/bicycle facilities, or construction of new bicycling/walking facilities. Revenue Sharing projects typically require “local match”, with the locality providing up to 50 percent of the project costs and the state providing the remainder.

- **Additional Revenue Sources**

Other State revenue sources that have funded bicycling and walking projects in the State of Virginia include bond proceeds, general fund, license plates, severance fees, toll roads, vehicle and truck tax, vehicle registration fees, and

15 http://www.advocacyadvance.org/docs/LiftingTheVeil_Virginia.pdf

vehicle transfer fees.¹⁶ The City of Norfolk can lobby for funding from these sources to finance projects.

- **House Bill 2 (HB-2)**

House Bill 2 was signed into law in 2014 and directs the Commonwealth Transportation Board (CTB) to use a new scoring process, which is currently being developed and will be finalized by July 2016, to objectively select projects for funding statewide. Currently, projects will be evaluated and scored based on "congestion mitigation, economic development, accessibility, safety, environmental quality and land use, and transportation coordination (in areas over 200,000 in population). Projects that reduce congestion would rise to the top in traffic-clogged regions like Northern Virginia and Hampton Roads."¹⁷ The City of Norfolk could apply for funding for large bicycle/pedestrian projects (e.g. over \$2 million) if they meet this criteria, though bicycle and pedestrian projects may be too small by comparison to compete.

Local

- **Bicycle/Pedestrian Accommodations Dovetailed with Other Projects**

The most cost-effective way to build bicycle and pedestrian infrastructure is to adopt a policy of including bicycle and pedestrian accommodations into other planned roadway improvements projects. This could include capital projects, other major roadway projects, and potentially military projects, as well as incorporating bicycle lanes and road diets, where appropriate, when restriping/repaving projects are scheduled. This approach is most successful if discussed in the very early stages of a project.

- **General Fund/Capital Improvement Programs**

Since the City of Norfolk maintains its own roads¹⁸, projects can be funded with money from the City's Capital Improvements budget. Pedestrian and bicycle infrastructure can be constructed and maintained annually via municipal CIPs. For the 2017-2020 CIP, \$750,000 has been set aside to "Develop Bicycle, Pedestrian Greenways, Sharrows, and Complete Streets."

- **Developer proffers¹⁹**

The State of Virginia uses a system of cash-proffer payments to finance roads since it is illegal to finance roads and other public facilities with impact fees in the State. However, the City of Norfolk has different regulations than the rest of Virginia—any proffers that are offered must be on-site and non-cash proffers, and they are more tightly regulated than those in other cities. Examples of proffers in Norfolk include agreements on landscaping, parking, driveways, hours of operation, and allowable uses.

- **Bond Referendums**

Many cities use general obligation bonds to pay for their capital improvements, such as roadway and bridge projects. These are approved by a vote of citizens within the municipality.

Other

- **Healthy Community Action Team (HCAT) Grants**

HCAT grants are offered by the Virginia Foundation for a Healthy Youth and are used to hire a HCAT coordinator who works to promote healthy living for children. Safe Routes to School activities are an eligible activity for HCAT coordinators.

16 <http://www.advocacyadvance.org/statefunding/>

17 http://virginiahb2.com/docs/HB2_FactSheet_041315.pdf

18 <http://www.virginiadot.org/about/districts.asp#4>

19 "A 'proffer' is a voluntary offer by a developer to abide by certain development conditions. The best-known type of proffer is a 'cash proffer'. Cash proffers are funds offered by developers at the time of rezoning to help defray capital facilities costs associated with the development." <http://www.chesterfield.gov/smartdata.aspx?id=9911>

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Chapter 4: Corridor Recommendations

This chapter presents facility recommendations for the 12 selected corridors. An overview of each corridor is provided including a facility map on the first two pages of each corridor section. This overview provides:

- Corridor statistics
- Purpose of improvements
- Key challenges
- Estimated total corridor cost
- Summary public input received

It should be noted that the cost totals include planning-level estimates of linear facility implementation for the corridor. They do not include: intersection improvements such as crosswalks and signals, signal timing modifications or re-designed intersections.

Following the overview, each corridor is broken into multiple segments based upon changes in roadway characteristics (width, lane configuration, etc.) and recommended facility type. A sample page is provided below for orientation to this section.

Segment statistics

Existing conditions photo documentation

Potential design challenges highlight intersections that will need greater design detail

Corridor 1: Olney Road

Segment 2: Colonial Avenue to Boush Street

Length: 0.3 miles
AADT: 2,400 - 8,600
Speed limit: 25 mph

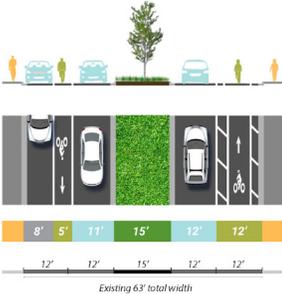
Facility: EB Buffered bike lanes and WB bike lane
Major Action: Road diet





• Townhouse residential buildings line the north side of Olney Road between Botetourt Gardens and Mowbray Arch, whereas the south side is fronted by a park.

• Ghent Montessori School and the Chrysler Museum are located at the intersection with Mowbray Arch.



Existing 63' total width

Potential Design Challenges

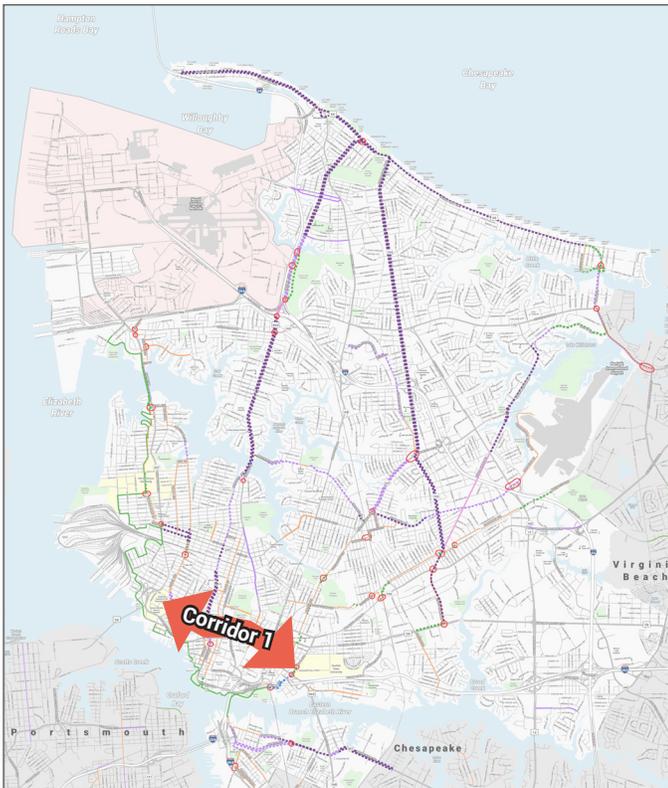
- On-street parking is maintained on the north side of Olney in the proposed cross section to provide visitors access to the townhomes there. If parking is not necessary here, a buffered bike lane could be accommodated on both sides of the street.
- The intersection of Olney Road, Duke Street, Boush Street and Llewellyn Avenue is proposed for a substantial redesign that is discussed as part of Corridor 2 later in this plan.

Segment key map

Cross sections included for segments with more complex roadway configuration changes

Aerial diagrams included for segments with complex routing

Corridor 1: Olney Road - Hospitals Complex to Norfolk State University



Length: 2.1 miles

Speed Limit: 15-25 mph

Curb-to-Curb Width:
30 to 62'

AADT: <2,400 - 8,600

Land Use:

Hospitals at western end; medium density residential; Downtown Arts and Design District

Key Bicycle Facilities:

Bike lanes, priority shared lane markings, shared lane markings

Key Pedestrian Improvements:

Improved crossings at Monticello Avenue, Tidewater Drive, and Church Street

Purpose of Improvements

- Provides a priority bicycle corridor that will function as an effective alternative to the major automobile corridors of Virginia Beach Boulevard and Brambleton Avenue.
- Connects, via crosstown route, two other key north-south corridors in this plan: Colley Avenue and Granby Street / Llewellyn Avenue.
- Improves bicycle conditions through the Arts District, a high-priority area undergoing revitalization.
- Provides access to/from major employment sites including the hospital complex, NSU and downtown.

Estimated Project Cost

\$400,000

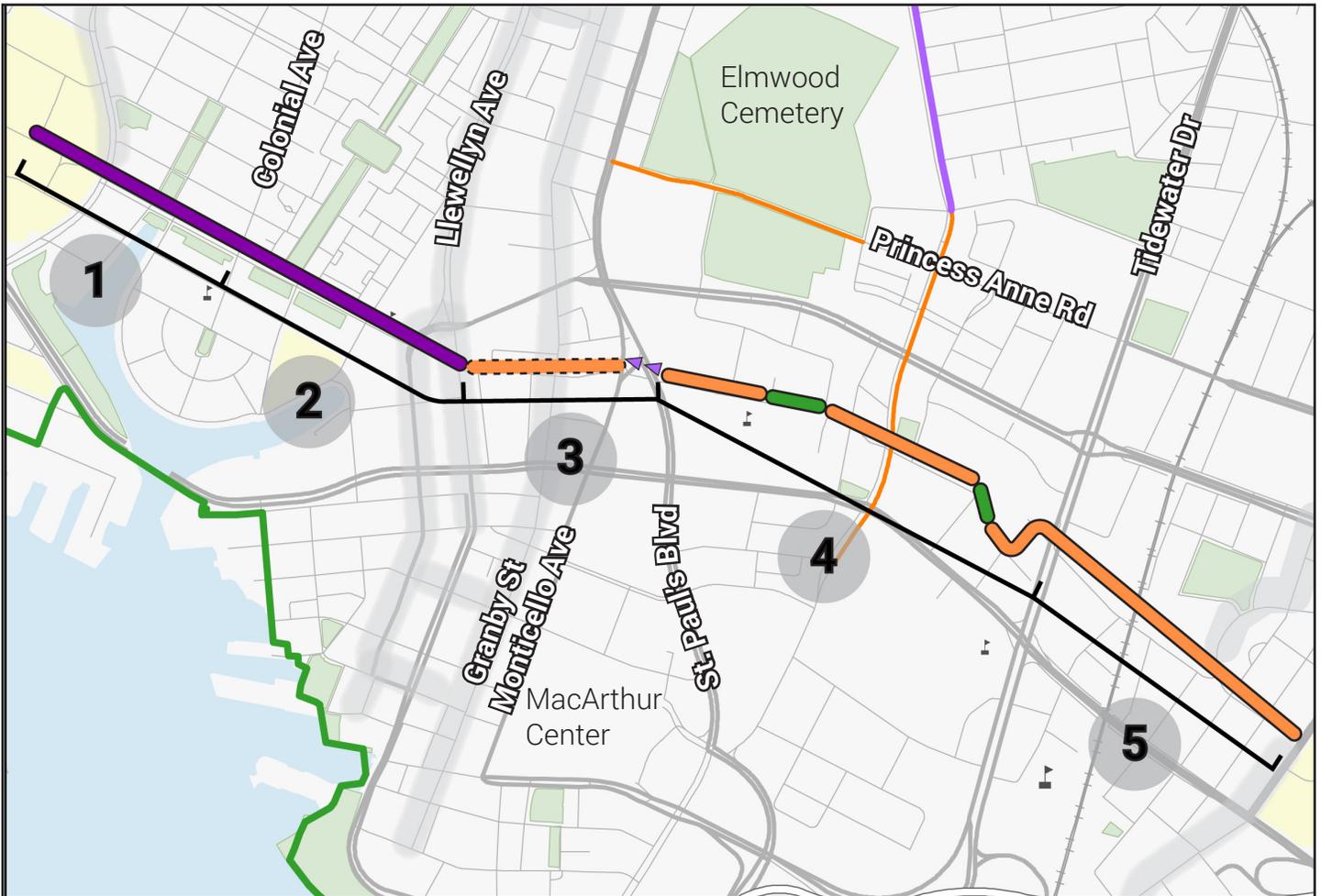
Key Challenges

- The intersection at Monticello Avenue, St. Pauls Boulevard and Olney Road will require its own design effort to deal with crossings of major arterials and complex traffic movements.
- Crossings of Church Street and Tidewater Drive will require geometric and striping improvements to be made safe and comfortable.
- The St. Paul's area is slated for redevelopment, so the facilities recommended there must be designed in coordination with that effort.

Public Input

- Improved bicycle access and general streetscape improvements were called for in the Arts and Design District Revitalization Strategy.
- Many WikiMap users indicated that Olney Road is part of their regular biking route; many use it between Colley Avenue to Granby Street.

Corridor 1: Recommendations Overview Map



Legend

Existing Facilities

-  Corridor Segment
-  Bike Lane
-  Sharrows
-  Shared Use Path

Proposed Facilities

-  Buffered Bike Lane
-  Sharrows
-  Priority Shared Lane
-  Shared Use Path
-  Contraflow Bike Lane

Corridor 1: Olney Road

Segment 1: Children's Lane to Colonial Avenue

Length: 0.3 miles

AADT: 8,600

Speed limit: 15 to 25 mph

Facility: Bike lanes

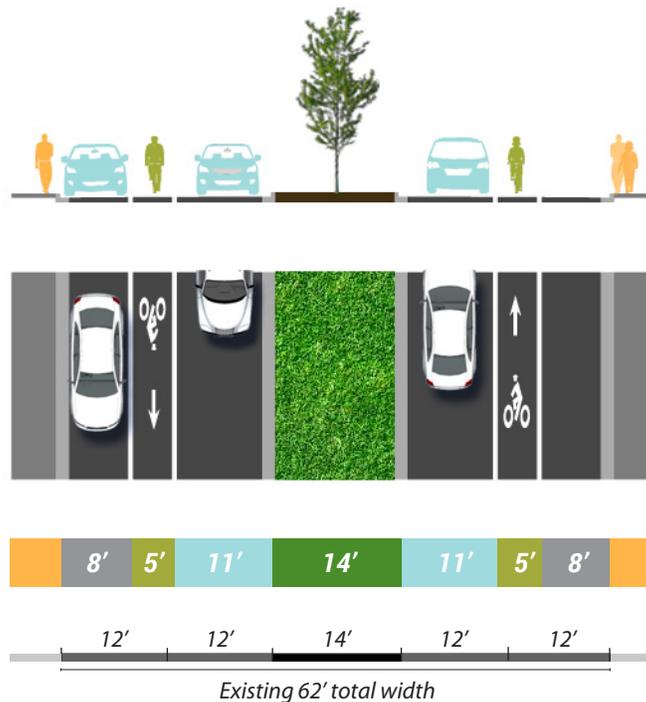
Major Action: Lane diet



- Olney Road through the hospital area is a two lane street with wide, 15-foot lanes



- Wide lanes continue to the east of Colley Avenue where a planted median separates travel lanes



Potential Design Challenges

- Accommodating turn lanes and bike lanes on the block from Wagner Road to Colley Avenue will require reconfiguring the striping and may warrant a traffic study to determine whether turning queues can be accommodated with a new design that better accommodates bicyclists.

Corridor 1: Olney Road

Segment 2: Colonial Avenue to Boush Street

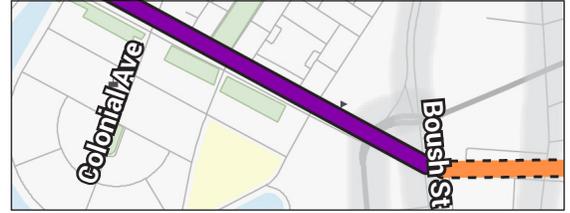
Length: 0.3 miles

AADT: 2,400 - 8,600

Speed limit: 25 mph

Facility: Buffered bike lanes

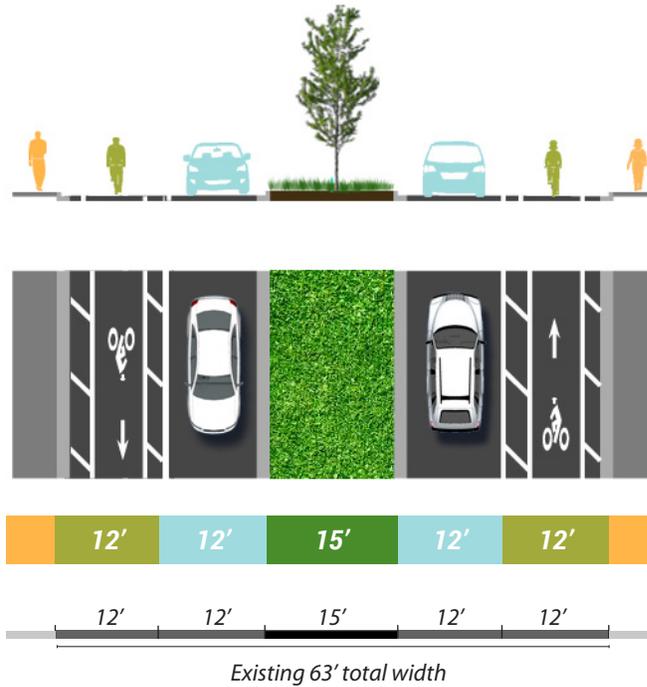
Major Action: Road diet; parking removal



- Townhouse residential buildings line the north side of Olney Road between Botetourt Gardens and Mowbray Arch, whereas the south side is fronted by a park.



- Ghent Montessori School and the Chrysler Museum are located at the intersection with Mowbray Arch.



Potential Design Challenges

- The intersection of Olney Road, Duke Street, Boush Street and Llewellyn Avenue is proposed for a substantial redesign that is discussed as part of Corridor 2 later in this plan.

Corridor 1: Olney Road

Segment 3: Boush Street to Monticello Avenue

Length: 0.2 miles

AADT: 2,400

Speed limit: 25 mph

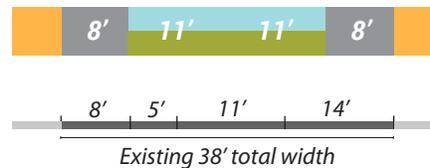
Facility: Priority shared lane markings

Major Action: Eradicate and restripe



- A bike lane currently exists in the eastbound direction in this segment, with a shared lane marking in the westbound travel lane.

- A number of businesses front on Olney Road in this segment, and more are expected to locate here as the Arts District develops further.



Potential Design Challenges

- Removal of the existing eastbound bike lane may be perceived as a downgrade in facility type through this segment.
- Priority shared lane markings will be a new facility type for the City here, but they are an optimal facility type in a commercial area with high parking turnover and relatively low traffic speeds.

Corridor 1: Olney Road

Segment 4: Monticello Ave to Tidewater Drive

Length: 0.7 miles

AADT: unknown

Speed limit: 15 to 25 mph

Facility: Shared lane markings and shared use path

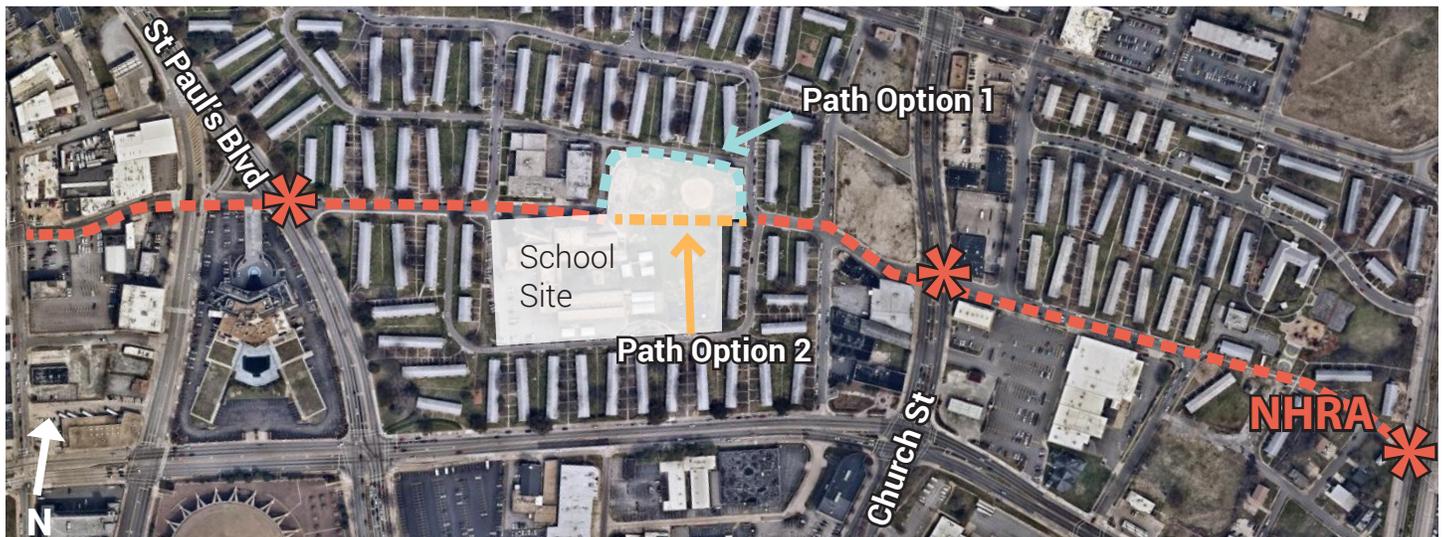
Major Action: Install; Construct



- Olney Road through this area is a low-volume local street that includes a 15 mph school zone.



- This sidewalk through Norfolk Housing Authority property provides a connection between two cul de sac portions of Olney Road.



Potential Design Challenges

- Intersections at Monticello Ave/St. Paul's Boulevard, Church Street and Tidewater Drive will all need particular design attention to safely and comfortably accommodate bicycle travel.
- Construction of an off-street trail through the park next to PB Young Elementary School is more desirable than routing around the park to the north but will be more costly.
- Routing bicyclists across Norfolk Redevelopment Housing Authority property by widening the sidewalk at the east end of the corridor marked with "NRHA" may spark adjacent tenants to raise concerns.
- Path 2 would require new construction whereas Path 1 has an existing narrow pathway adjacent to the street that would need to be resurfaced and widened.

Corridor 1: Olney Road

Segment 5: Tidewater Drive to Maltby Crescent

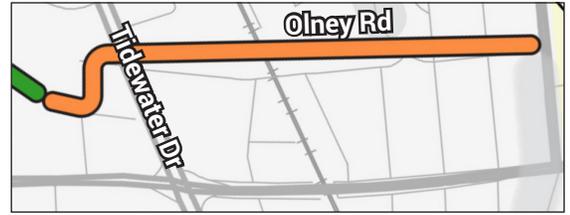
Length: 0.5 miles

AADT: >2,400

Speed limit: 25 mph

Facility: Shared lane markings

Major Action: Install



- The crossing at Tidewater Drive is nearly 150' wide with six lanes of traffic. One marked crosswalk exists today.

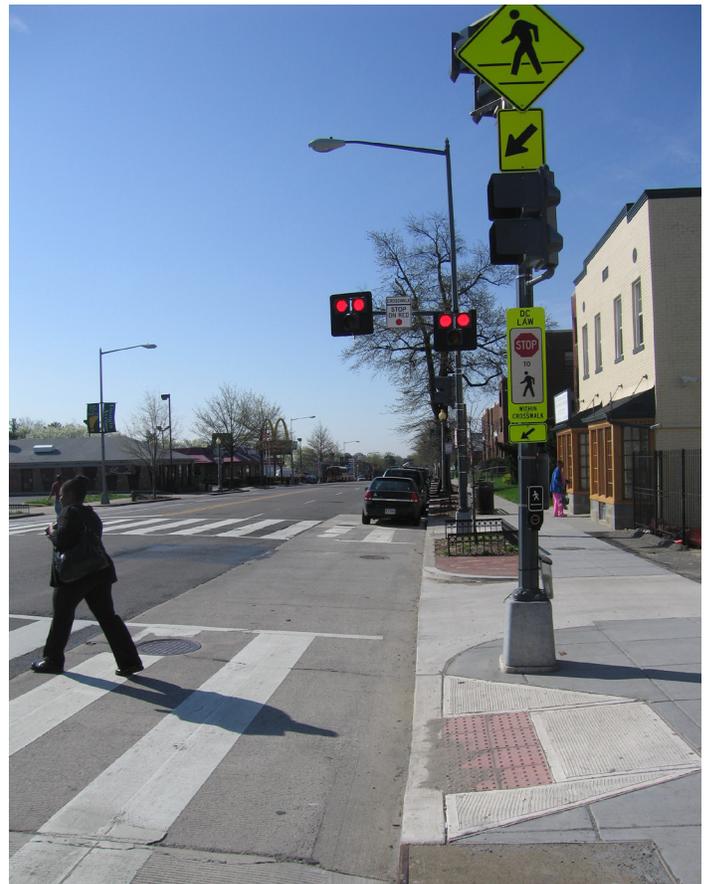


- Streets through this segment are low-volume with residential and industrial uses.



Potential Design Challenges

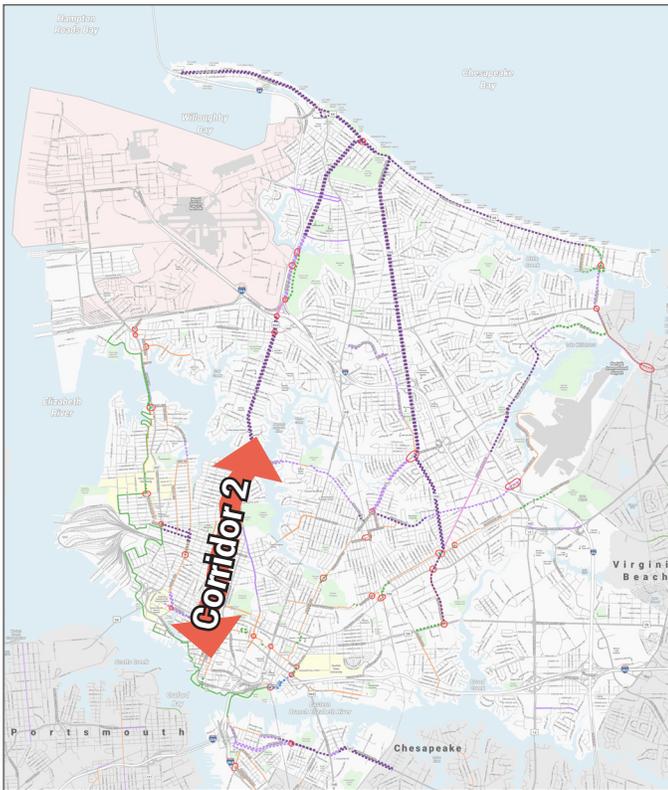
- The Tidewater Drive intersection shown above presents a challenge to moving along this segment of Olney Road.
- Industrial businesses along this segment will need to be notified of an increase in bicycle traffic and make truck drivers aware of safe practices for travel around bicyclists.



- A HAWK (High-Intensity Activated CrossWalk beacon) would facilitate pedestrian and bicyclist crossing with minimal automobile traffic interruption on Tidewater Drive.

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Corridor 2: Llewellyn Avenue and lower Granby Street, and Boush Street Alternatives



Length: 2.9 miles

Speed Limit: 15-30 mph

Curb-to-Curb Width:

34 to 66'

AADT: 2,100 - 23,000

Land Use:

Downtown core commercial at south end; neighborhood commercial and medium density residential through mid-section

Key Bicycle Facilities:

Separated bike lane on Llewellyn Avenue; priority shared lane markings on Granby Street

Key Pedestrian Improvements:

Traffic calming and crossing improvements along Llewellyn Avenue through implementation of separated bike lanes

Estimated Project Cost

\$570,000*

Key Challenges

- Phasing will be critical to their success as the parallel parts of the corridor interact with one another.
- The road diet on Llewellyn Avenue appears feasible based on its low traffic counts.
- Wayfinding signage south of Brambleton Avenue on Duke and Granby Streets will be key to helping bicyclists navigate to their destinations while avoiding travel on high-stress Boush Street.
- The complex intersection at Virginia Beach Boulevard, Olney Road, Duke Street and Llewellyn Avenue will be a design challenge.

Purpose of Improvements

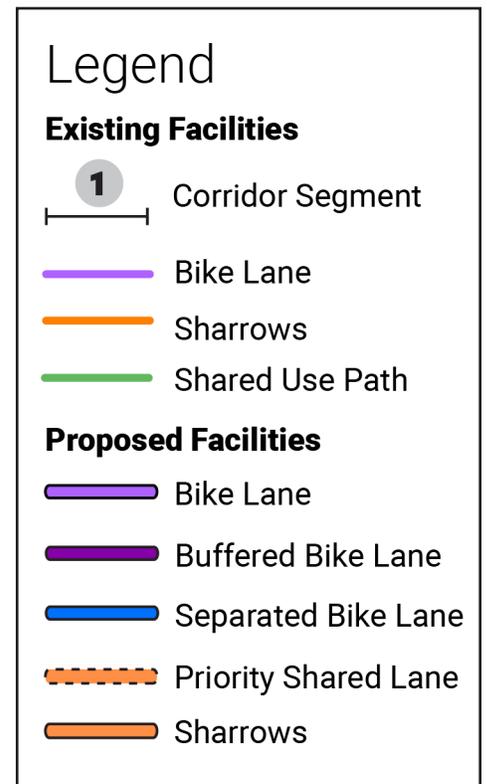
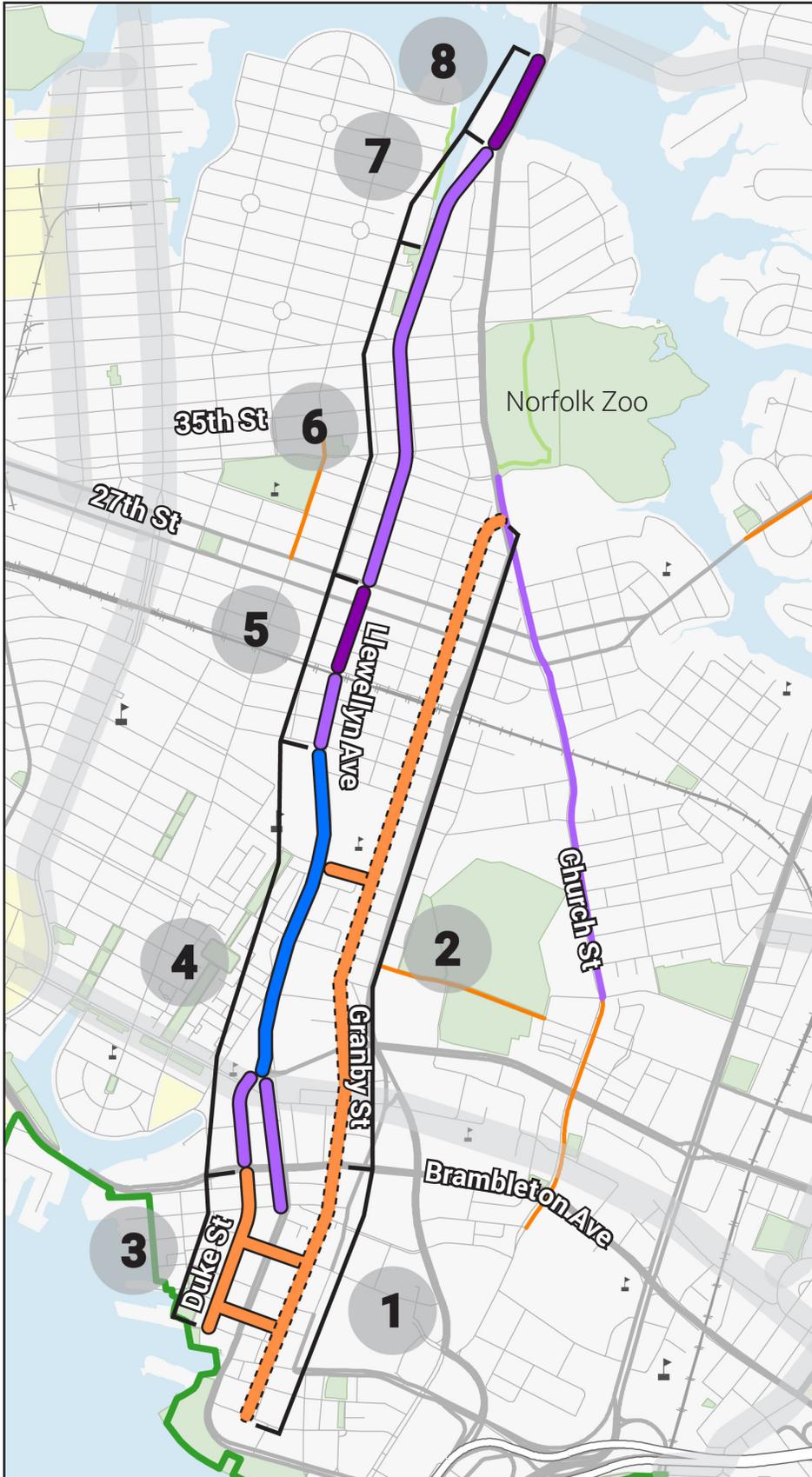
- A strong bicycle connection from downtown to the Arts District and Ghent, Park Place and Colonial Place is needed.
- Traffic calming on Llewellyn Avenue through a road diet would make this street more pedestrian friendly in residential segments.
- Bicycle improvements on mid-Granby (Brambleton Avenue to Church Street) will further support a revitalizing commercial area.

Public Input

- Improved bicycle accommodation south of Brambleton Avenue in the core of downtown is a priority for residents and the Downtown Norfolk Council.

**Note: Cost estimate does not include reconfiguration of intersection at Llewellyn, Virginia Beach and Olney.*

Corridor 2: Recommendations Overview Map



Corridor 2: Granby Street

Segment 1: Waterside Drive to Brambleton Avenue

Length: 0.7 miles

AADT: 4,500

Speed limit: 15 mph

Facility: Trail; Priority shared lane markings and street parking

Major Action: Install and sign



- This segment has existing shared lane markings in narrow travel lanes south of Charlotte Street.



- Travel lanes widen north of Charlotte Street.



Potential Design Challenges

- Better wayfinding signage is needed to identify the walkway at the southern end of this segment.
- Operations of the street here will not change, but educational outreach efforts to drivers should take place with installation of the new priority shared lane markings.

Segment 2: Granby Street -- Brambleton Avenue to Church Street

Length: 1.4 miles

AADT: 4,500 - 8,800

Speed limit: 25 mph

Facility: Priority shared lane markings and traffic calming

Major Action: Install and construct



Granby Street facing south at Olney Road

Why Granby

Granby Street is the main corridor through Norfolk's growing Arts and Design District. The Revitalization Strategy for this area identified a preferred shared lane bicycle treatment between Brambleton Avenue and Virginia Beach Boulevard as depicted in the rendering above. Maintaining on-street spaces will make parking easier and create space for in-street parklet construction.

Corridor 2: Granby Street

Segment 2: Brambleton Avenue to Church Street



- Near Princess Anne Road, the street is 38' wide with parking on both sides including one commercial loading zone.



- The area near Ghent Elementary School and new residential development would benefit from traffic calming.



Cross section for Olney to Shirley sub-segment



Existing 38' total width

Potential Design Challenges

- The necessity of maintaining parking on both sides of the street through this segment prevents installation of a higher protected bike lane. On-street parking is heavily used in the commercial areas of the Arts District and north of 15th Street.
- In areas of lower utilization, curb extensions should be considered at intersections to prevent drivers from using the parking lane as a passing lane around bicyclists. Curb extensions will also benefit pedestrians by shortening crossing distances.

Corridor 2: Duke Street

Segment 3: Tazewell Street to Olney Road

Length: 0.3 miles

AADT: 2,100 - 9,000

Speed limit: 25 mph

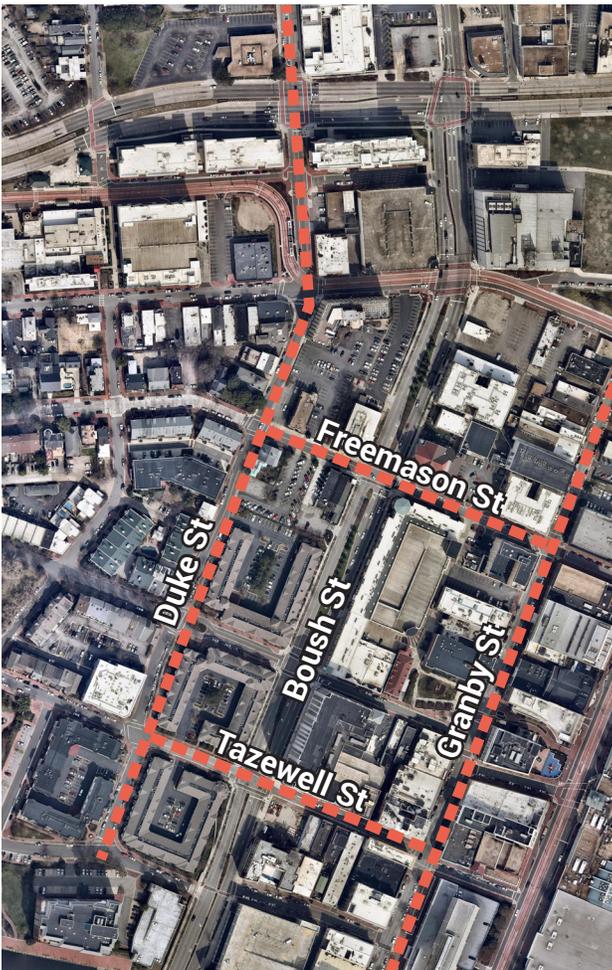
Facility: Bike lanes and shared lane markings

Major Action: Road diet and install



- South of Brambleton Avenue, Duke is a low-volume, low-traffic residential street parallel to the heavily traveled Boush Street.

- The four-lane area of Duke Street is recommended for a road diet based on its low traffic volume of 9,000 AADT.



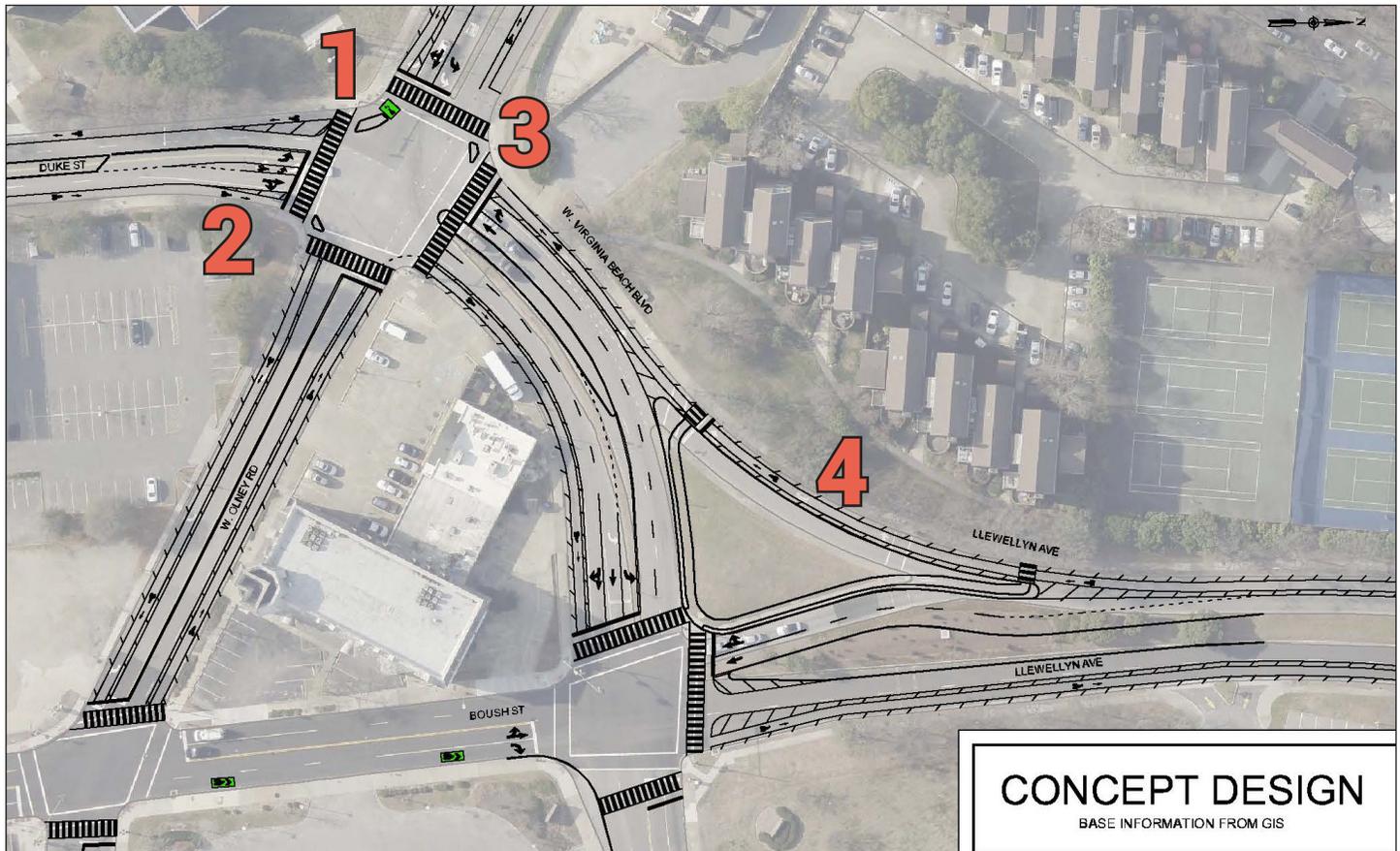
Potential Design Challenges

- Special pavement markings should be used to direct bicyclists cross the light rail tracks at a 90-degree angle at Charlotte Street.
- Wayfinding will be necessary to direct bicyclists to routes on Tazewell Street and Freemason Street to access downtown.
- Bike lanes on Boush Street may be implemented in the long term to add another option for riders with a destination along this street. Today, with no option for accommodating bicyclists south of Charlotte Street, these bike lanes would be a disconnected part of the network.
- In the future, the City should explore implementation of bike lanes on Boush Street from Virginia Beach Boulevard south to Charlotte Street.

Corridor 2: Key Intersection

Intersection: Duke Street at Virginia Beach Boulevard

This intersection is a key location for both Corridor 2 and Corridor 1 which crosses through on an east-west alignment along Olney Road. The intersection was called out for a full reconstruction in the Arts and Design District Plan. That plan and the proposed configuration below call for closing the southbound right turn slip lane from Llewellyn Avenue onto Olney Road. Additional bicycle facility striping and curb alignment changes are shown in the graphic below.



1 Difficult left turns through this intersection are accommodated with curb islands that provide bicyclists space to wait while making a two-stage left turn.

2 The left turn from Duke Street onto Olney Street is accommodated with a pocket bike lane to the left of the through and right turn lane.

3 Right turns on red should be restricted with this design. Bicycle-specific signals or phasing will also be necessary to allow riders to enter the intersection before right-turning automobiles.

4 Southbound bicyclists are routed to the west of this island along the alignment of the former right turn slip lane.

Potential Design Challenges

- Implementation of this design will require major reconstruction of the Llewellyn Ave and Virginia Beach Blvd intersection including changes to automobile traffic patterns. A traffic study is recommended to be conducted before finalization of this design. It is possible that some turn lanes preserved in this concept design will not be necessary and may allow for greater space devoted to bicyclists or pedestrians.

Corridor 2: Llewellyn Avenue

Segment 4: Virginia Beach Boulevard to 20th Street

Length: 0.7 miles

AADT: 8,300

Speed limit: 25 mph

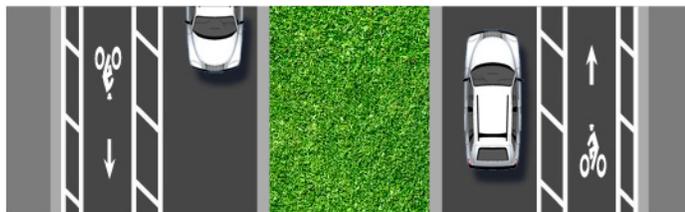
Facility: Separated bike lane

Major Action: Road diet



- Dual travel lanes and a 2-foot bermed median encourages higher speeds here.

- A road diet would shorten pedestrian crossing distances in this area near an elementary school and library.



Existing 66' total width

Potential Design Challenges

- The four-to-two lane road diet may be seen as reducing levels of services for automobiles, but turn lanes are present for four of seven left turn movements.
- Initial installation of this facility can be done with plastic flex posts. Long term, reconstruction of the road edge is preferable.

Corridor 2: Llewellyn Avenue

Segment 5: 20th Street to 27th Street

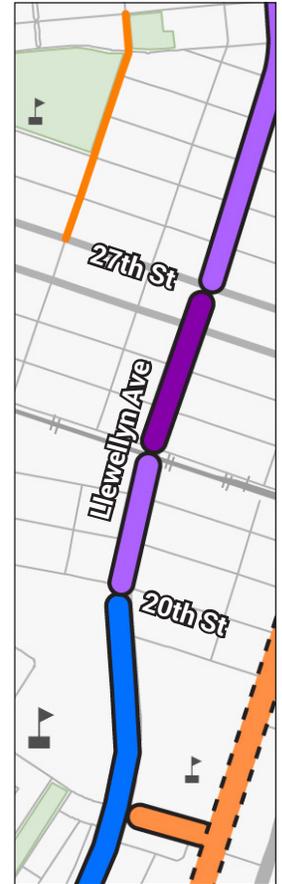
Length: 0.4 miles

AADT: 6,900 - 8,000

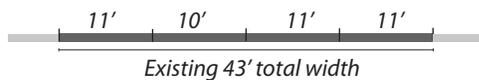
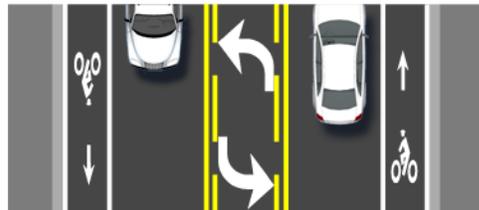
Speed limit: 25 to 30 mph

Facility: Bike lanes and buffered bike lanes

Major Action: Road diet



- This segment currently has four travel lanes.



Potential Design Challenges

- The four-to-two lane road diet may be seen as reducing levels of services for automobiles, but turn lanes are present for many left turn movements.

Corridor 2: Llewellyn Avenue

Segment 6: 27th Street to Delaware Avenue

Length: 0.8 miles

AADT: 6,000 - 11,000

Speed limit: 25 to 30 mph

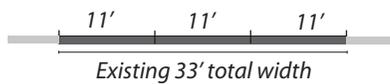
Facility: Bike lanes

Major Action: Road diet



- The three-lane section has shared lane markings today.

- There are gaps in the sidewalk network along this segment of Llewellyn that should be filled.



Potential Design Challenges

- Eradication of existing recently-installed pavement markings may not be desirable.
- Additional study of daily trips to ensure compatibility with designated bike facility may be necessary.

Corridor 2: Llewellyn Avenue

Segment 7: Delaware Avenue to Granby Street

Length: 0.1 miles

AADT: 7,200

Speed limit: 25 to 30 mph

Facility: Buffered bike lane; bike lane

Major Action: Install



- The existing northbound contraflow bike lane allows two-way bicycle travel and should be retained.
- The wide travel lane exiting the Granby Street Bridge encourages high speeds. A buffered bike lane may be a better way to narrow width.

Potential Design Challenges

- Routing northbound bicyclists onto Connecticut Avenue to access the Granby Street Bridge will require bicycle detection and potentially other improvements at Connecticut and Granby to facilitate the bicyclists' left turn.

Segment 8: Granby Street Bridge

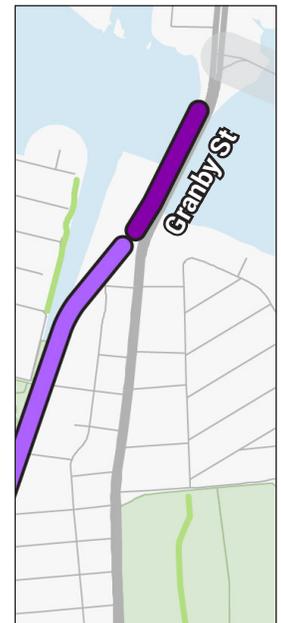
Length: 0.3 miles

AADT: 37,000

Speed limit: 30 mph

Facility: Buffered bike lanes

Major Action: Lane diet



- This is one of only three bridges over the Lafayette River, connecting the north and south sides of the city.
- Bicyclists ride on the sidewalk today for comfort and safety even though it is only 5 feet wide.

Potential Design Challenges

- Though buffered bike lanes will be a more comfortable facility than sharing the road with automobile traffic, bicyclists will still be near high-volume, higher-speed traffic. Long term, it would be ideal to provide either vertical or horizontal separation for the bicycle facility here.

Corridor 2: Comparison Study

Based upon public input from bicyclists and an analysis of the city's street grid south of the Lafayette River, it became apparent that a comparison study of two key north-south routes into downtown should be conducted as a part of the overall bikeway planning effort.

From the bridge over the Lafayette River to downtown, Llewellyn Avenue and Granby Street are a few blocks apart, and run parallel to each other. However, at the north and south ends of these streets, their character and connectivity with other streets vary. In downtown especially, they serve different destinations: Granby becomes the traditional retail commercial center of Norfolk and Llewellyn becomes Duke Street in Freemason, a historic, residential, waterfront neighborhood.

The Table 1, below, illustrates a number of the differences between these two potential bikeway corridors.

Study Assumptions

North of 30th Street, use Llewellyn: For the following reasons, it was determined that from 30th Street to the Lafayette River, at the north end of the study area, the route should use Llewellyn Avenue.

- Despite the existence of a short stretch of bike lanes near the zoo, Granby from 30th Street/ Church Street to the north, does not present a near term opportunity for a bikeway that could be adequately separated from motor vehicle traffic. It was determined that removing parking in the commercial section was not an option.
- Moreover, Llewellyn has safer transitions between the bridge and surface streets in both the northbound and southbound directions.

South of Olney Road, Use Granby Street: South of Olney Road, Llewellyn transitions to Boush and Duke Streets.

ATTRIBUTES	ROUTE OPTION 1	ROUTE OPTION 2
	Llewellyn (30th Street to Olney)	Granby (30th Street to Olney)
Range of Average Daily Traffic	9,000 to 11,000	2,100 to 9,000
Range of Speed Limits	15 to 30	25 to 30
Range of Overall Street Width	34' to 66'	
Number of Travel Lanes	4 lanes divided south of 20th Street. 3 lanes north of 21st Street (2 northbound)	2 travel lanes with on-street parking on both sides in most blocks
Median	25-foot vegetated median with mature shade trees, to the south of 20th Street	None
Residential Areas	Olney Road to Shirley; 25th Street to 38th Street	No exclusive residential areas
Mixed Use Areas	Shirley to 25th Street; 38th Street to Granby Street	Virginia Beach Blvd to 30th Street
Retail/Commercial Areas	Near intersection of 21st Street	Main Street to Virginia Beach Blvd
Unique Destinations Served	Residential areas of Ghent near Botetourt Gardens; Freemason	Mixed use areas north of Shirley Avenue
Potential for and impacts of introducing dedicated bicycle facilities	Great potential, including almost a mile of separated bike lanes	Bicycle lanes only possible by eliminating parking on one side

Table 1: Comparison of Two Primary Corridors

Corridor 2: Comparison Study

- Granby is preferred as the priority bikeway street through downtown, because of its centrality, proximity to many popular destinations, existing traffic calming (15 mph speed limit) and direct access to the waterfront at Town Point Park.

Given these assumptions, to have a continuous route, one or two linkages between Granby and Llewellyn are needed. It was assumed that Olney Road would function as a good cut-over to Granby for both southbound and northbound bicycle movements. However, it was also determined that some northbound cyclists on Granby will be inclined to remain on Granby and may desire to cut-over to Llewellyn at a point north of Olney Road. Moreover, the new YMCA at 29th Street and the Norfolk Zoo are important destinations. So the study looked at establishing one or two additional east-west route links between Olney Road in the south and approximately 30th Street in the north. Specifically, the study examined the potential for east-west linkages using West 28th, 29th, 30th or 31st Streets; West 20th Street; and Shirley Avenue.

Conclusions

Conclusion One: Olney Road and Shirley Avenue were found to be the two best connector streets for both north and southbound bicycle traffic, and both should be signed and marked accordingly. The intersections at Shirley and Llewellyn and Shirley and Granby can receive additional treatments to facilitate the left turn movements required. It is also assumed that the complex intersection of Llewellyn/Olney/Duke/Boush/Virginia Beach Boulevard will be addressed as part of the overall project on Llewellyn to make turning and transition movements at that location, efficient, clear and safe.

- Because 28th and 30th are one way eastbound, to accommodate the northbound link to Llewellyn, operations for bicyclists would have to be regulated to allow contra flow cyclists. The streets are very narrow, and while likely very low in traffic volume, other streets provided options that did not require a change in traffic operations that residents of the street may find confusing.

- 29th Street was ruled out because it does not go through to Granby, due to construction of the new YMCA.
- Making a northbound left turn on 31st Street would be challenging without special treatments due to its close proximity to the Church Street intersection.
- Making a southbound left turn on 20th Street was also found to be a potentially unsafe location.

Conclusion Two: Both Llewellyn Avenue and Granby Streets between Olney Road and Shirley Avenue should be improved as part of the primary route.

- Llewellyn Avenue between Olney Road and 20th Street has low traffic volumes, high aesthetic qualities due to the median and shade trees, and potential for providing a highly separated facility (separated bike lane) at relatively low cost.
- Between Olney Road and Shirley Avenue, Granby Street should be retrofitted with priority shared lane markings to improve this route option. The curb-to-curb width of Granby Street would require elimination of parking on one side in order to install standard bike lanes or elimination of parking on both sides to install separated bike lanes to provide an experience similar to Llewellyn. Because reducing parking was not an option in the near term, the less impactful improvement is recommended in the near term.

Underlying this conclusion is the recognition that by providing separated bike lanes for almost a mile on Llewellyn Avenue, the City can best serve the population of "interested but concerned" bicyclists for whom perceived lack of safety in traffic is a notable barrier to bicycling. Due to observed revitalization of both residential and commercial properties along Granby, the study concluded that priority shared lane markings should be installed on Granby in concert with the improvements made along Llewellyn. Making a minimal impact and lower cost improvement to this stretch of Granby in the near term will help create a positive climate for consideration of higher quality improvements in

Corridor 2: Comparison Study

the future; improvements that may include parking reductions, traffic calming, pedestrian crossing enhancements, and separated bike lanes.

Conclusion Three: North of 21st Street, Llewellyn narrows significantly, but can support bike lanes by eliminating one of the three existing travel lanes (two northbound and one southbound). The extra motor vehicle capacity is not needed in the northbound direction, and pedestrians and residents along this segment will benefit from the traffic calming effect that will accompany the road diet and addition of bike lanes. There are some modest but important design challenges in this section, including the following:

- A few blocks of concrete roadway, upon which the thermoplastic lane striping and bicycle symbols tend to wear-off much faster
- The need for turn lanes at 38th Street
- The recently repaved and marked (with shared lane markings) section from 38th Street to the north would need to be redone.
- The need to address the potential for bicycle detection at the signal at Connecticut and Granby for northbound cyclists.
- Additional eradication of existing striping in order to change/add bicycle lane striping on the transitions to and from the bridge between the bridge and Connecticut (there are no space limitations in this area)
- Design consideration needed on the block north and south of 21st Street to address right turning motor vehicle movements.

Recommendations

Recommendation One: As shown in the following map, this routing study comparison recommends that bikeway facilities and associated improvements on lower Granby, upper Llewellyn, the overlapping segments of Granby and Llewellyn, a block of Shirley Avenue, two blocks of Olney Road, and at the complex intersection at Llewellyn, Duke, Olney, Boush and Virginia Beach Blvd, be designed and implemented as a single phase of work.

Recommendation Two: In a second phase of work, priority shared lane markings should be installed on Granby Street between Shirley and the Zoo. It is clear from observing the current changes taking place on Granby Street north of Shirley, that it is becoming its own origin and destination as a mixed use neighborhood. It is an easily bikeable distance to/from many key destinations throughout the city. Because its parallel neighboring street, Monticello Avenue, is much less bicycle friendly and more difficult to make so, Granby is likely to begin generating a significant number of bicycle trips sooner rather than later.

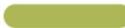
Also in the second phase of work, implementation of additional bikeway links to downtown should be implemented on Duke Street in Freemason, parts of Boush Street and other downtown crossing links between Duke and Granby Streets.

Recommendation Three: Due to the existence of bicycle lanes on Church Street south of the Zoo, and the importance of the Zoo as a bicycle destination, a future study should look at Granby adjacent to and north of the Zoo, as well as Columbus Avenue. This study should determine if improvements can be made to improve the bicycling conditions and routing between the Zoo and the Lafayette River Bridge. If feasible a dedicated bikeway will improve bicycle safety and access in this corridor and become a well-used addition to the City's overall bikeway network.

Corridor 2: Comparison Study

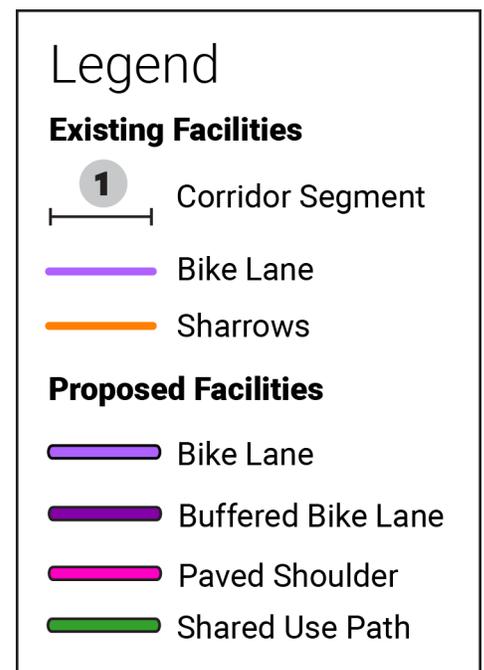
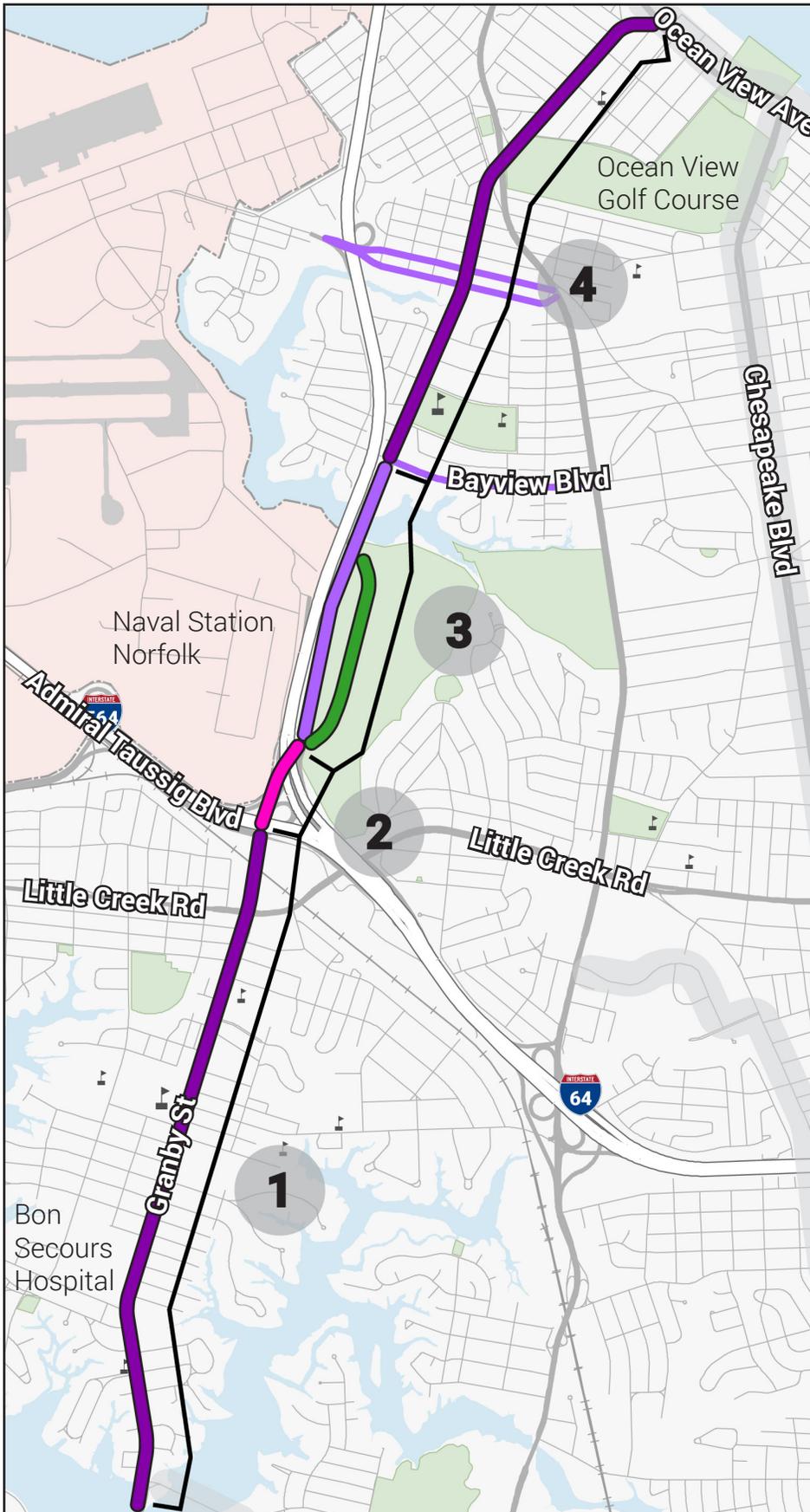


Legend

-  Recommendation One
-  Recommendation Two
-  Recommendation Three

Corridor Two Recommended Phasing

Corridor 3: Recommendations Overview Map



Corridor 3: Granby Street

Segment 1: Willow Wood Drive to Admiral Taussig Boulevard

Length: 2.0 miles

AADT: 32,000 - 34,000

Speed limit: 35 mph

Facility: Buffered bike lanes

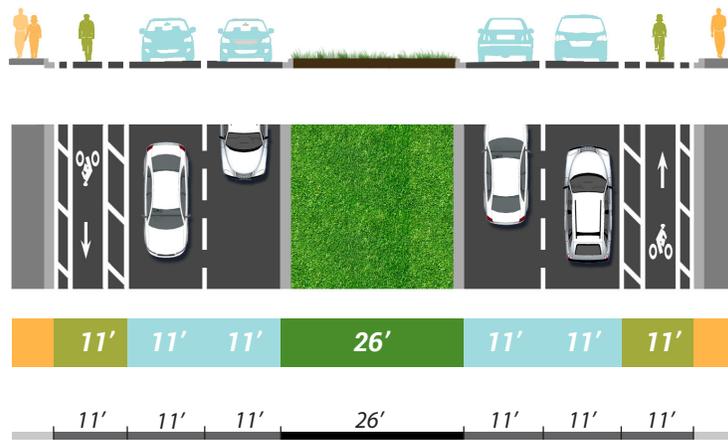
Major Action: Road diet



- The outside lane of this segment is concrete and has three bus lines that operate with headways between 10 and 30 minutes over the course of the day.



- A wide planted median divides the north and southbound travel lanes.



Potential Design Challenges

- Enforcement of buffered bike lane for exclusive bicycle use will be important after initial implementation.
- Interaction of Hampton Roads Transit buses and the buffered bike lane will need to be taken into consideration in final design of facility.
- The intersection at Kingsley Lane may require some left turn accommodation for northbound bicyclists to access the Bon Secours hospital.
- Special permitted parking on Granby Street for Temple Israel services may need to be adjusted to accommodate a continuous facility throughout this entire segment.

Corridor 3: Key Intersection

Intersection: Granby Street at Little Creek Road

Length: N/A

AADT: 32,000

Speed limit: 35 mph

Facility: Buffered bike lanes

Major Action: Traffic study and intersection redesign



- This intersection includes five lanes in both the north and southbound directions.
- Two dedicated right turn lanes move traffic onto Little Creek Road. Bicyclists currently travel through the intersection sharing a lane with automobiles.
- Bicyclists currently travel through the intersection sharing a lane with automobiles.

Potential Design Challenges

- Continuing the buffered bike lanes through this intersection will require removal of some lanes, continuing the road diet that occurs north and south of the intersection. Removal could be of through travel lanes or turn lanes.
- A traffic study of the impact of lane removal and full right turn on red restriction should be completed before implementing these design changes.

Corridor 3: Granby Street

Segment 2: Interstate 64/564 Interchange Underpass

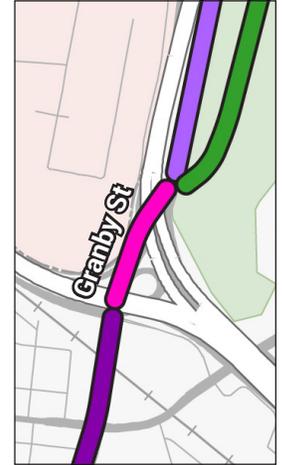
Length: 0.3 miles

AADT: 22,000

Speed limit: 35 mph

Facility: Paved shoulder, shared by bicyclists and pedestrians

Major Action: Lane diet and barrier construction



- Pedestrians travel along a dirt path on the inside of the guardrail through this segment.



- Sight lines at the on- and off-ramps are challenging, especially at the southbound off-ramp from I-64.



- Shared lane markings currently exist in this segment, but sharing the lanes in this high-speed area is uncomfortable for all and a deterrent to most bicyclists.



- Currently a protected pedestrian pathway does not exist on the west side of the street. Pedestrians are forced to walk in the minimal on-road shoulder.

Potential Design Challenges

- Reducing speed of vehicles exiting I-64 and I-564 will be challenging. Geometric changes to the off-ramps would be the most effective means of decreasing speed but is likely cost-prohibitive. Removal of the southbound lane for traffic exiting I-64 toward Admiral Taussig Boulevard would force traffic to yield and help slow speeds.
- Construction of the paved shoulder will require replacing the existing guard rail with a one-sided Jersey barrier.
- Lighting should be added to the underpass to increase pedestrian and bicyclist safety and comfort.

Corridor 3: Granby Street

Segment 2: Interstate 64/564 Interchange Underpass



1 A retaining wall may be necessary here to allow for construction of the shoulder next to a significant grade

2 Drivers exiting I-64 here will need advance warning of ped/bike crossing on ramp
A waiting space for pedestrians and bicyclists is needed
The crossing should be located to provide the best possible sight lines

3 Drivers exiting I-64 here will need advance warning of ped/bike crossing on ramp
Presence of through lane to the south means drivers do not need to slow exiting highway -- consider rumble strips on approach

4 A waiting space for northbound bicyclists and pedestrians will need to be provided for safe crossing of the I-564 on-ramp

Corridor 3: Granby Street

Segment 3: I-64 Interchange to Bayview Boulevard

Length: 0.9 miles

AADT: 24,000

Speed limit: 35 mph

Facility: Bike lanes

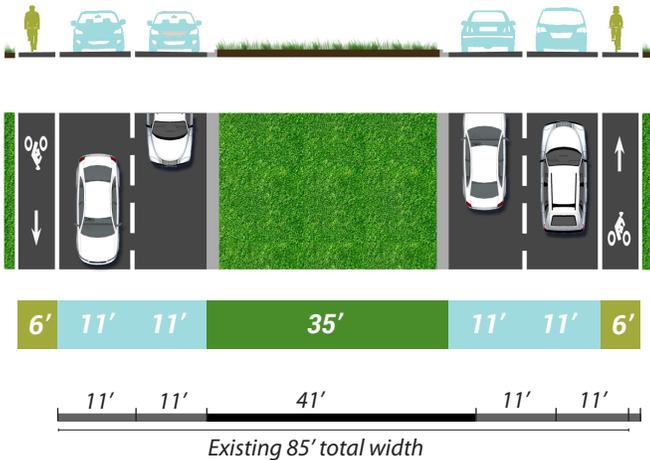
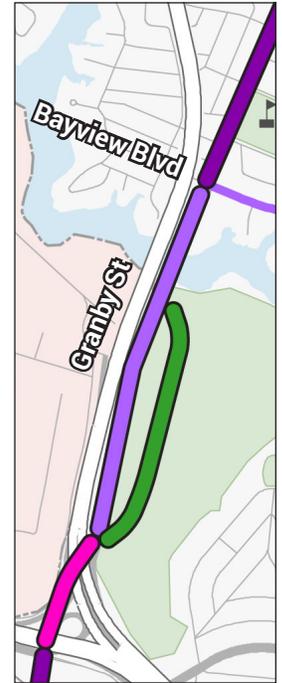
Major Action: Road widening



- Current shared lane markings do not provide separate space for bicyclists on this high-volume segment.

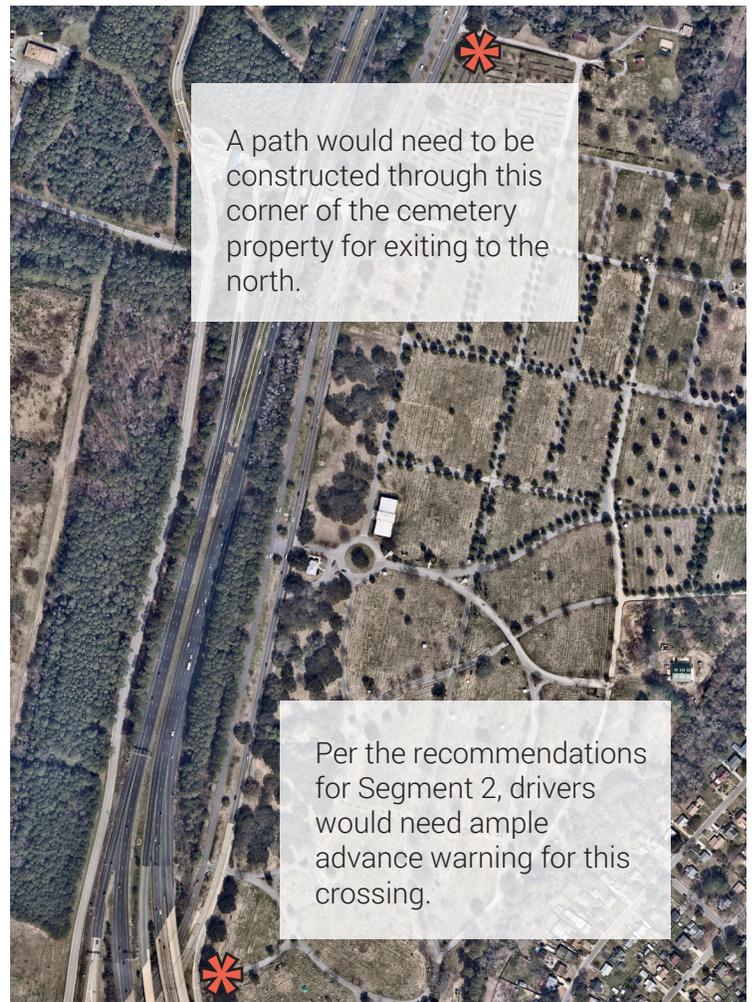


- Using the edge of the wide median to shift the northbound lanes will create enough space for bike lanes on the west side of the street.



Potential Design Challenges

- Accommodations for bicyclist left turns at NSN Gate 22 will need to be made.
- Potential conflicts between drivers entering I-64 and southbound bicyclists will need to be considered in the design of this segment.
- Forest Lawn Cemetery is closed for access from 7pm to 6am daily, so if a route through the cemetery is desired, it should also be supplemented by an improved on-street facility.



Corridor 3: Granby Street

Segment 4: Bayview Boulevard to Ocean View Avenue

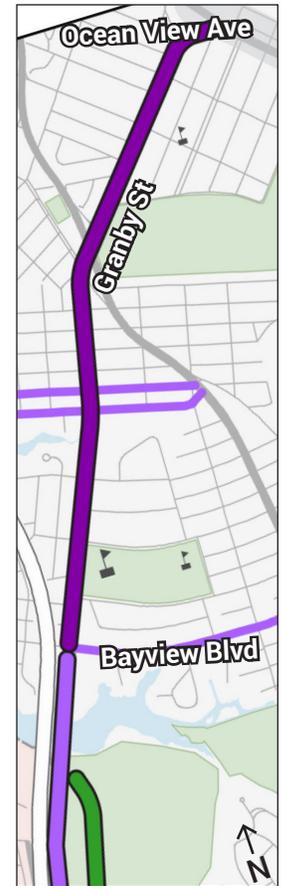
Length: 1.6 miles

AADT: 12,000

Speed limit: 35 mph

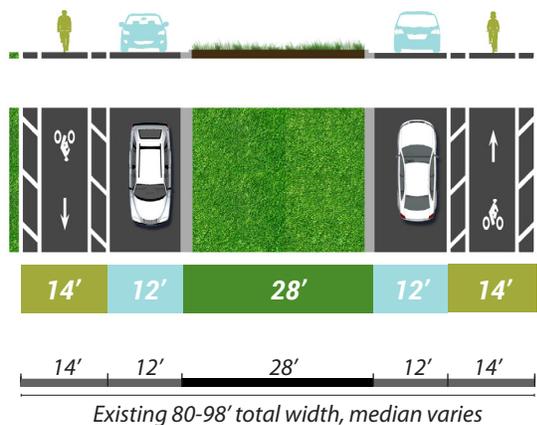
Facility: Buffered bike lanes

Major Action: Road diet - 4 lanes to 2 lanes



- This segment currently has shared lane markings, but traffic volumes are low enough to enable a road diet.

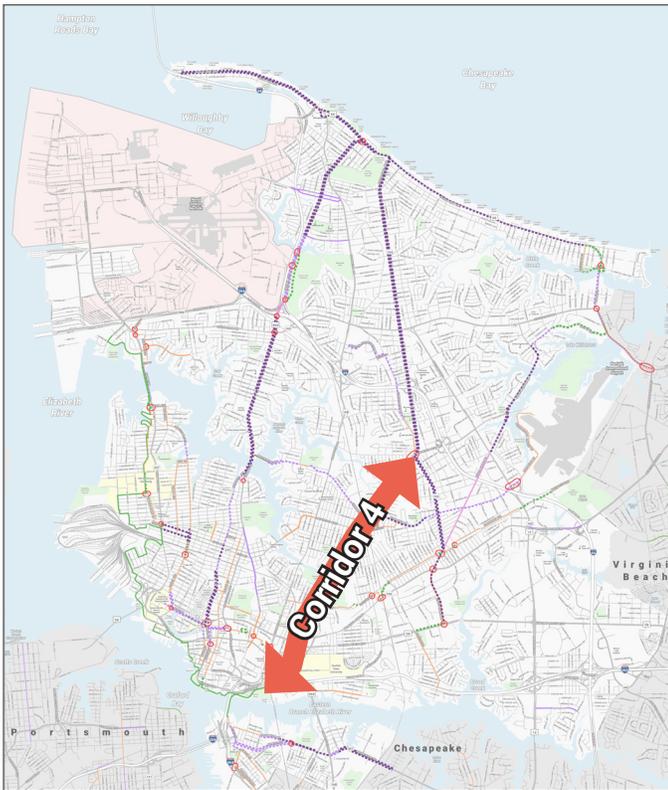
- A portion of this segment has already been operating with one lane southbound in 2015 due to major stormwater infrastructure work.



Potential Design Challenges

- A reduction in number of travel lanes may be viewed as decreasing motor vehicle level of service.
- The grade separated intersection with Tidewater Drive would need to highlight the conflict area between through bicycle traffic and automobile traffic accessing the on- and off-ramps to Tidewater Drive.
- The intersection at Ocean View Avenue will need to be designed in coordination with the implementation of recommendations for Corridor 10 along Ocean View.
- Enforcement of buffered bike lane for exclusive bicycle use will be important after initial implementation.
- Parking restrictions will need to be enforced along this segment to ensure parked cars do not block the bike lane. Little parking was observed on street as all homes have driveways.

Corridor 4: Harbor Park and Tide Station to Five Points



Length: 4.2 miles
Speed Limit: 25-0 mph
Curb-to-Curb Width: 21 - 86'
AADT: 1,300 - 17,000

Land Use:
Mix of residential and industrial land uses including older and new neighborhoods; NSU

Key Bicycle Facilities:
Buffered bike lanes

Key Pedestrian Improvement:
Improved intersection design at Five Points

Purpose of Improvements

- Connects the Five Points Area with major destinations such as the Harbor Park, Norfolk State University, Amtrak Station and the Elizabeth River Trail.
- Linking existing low-volume, low-speed local streets will help bicyclists avoid difficult and dangerous intersections that could be encountered along a different alignment that makes the same connection.
- Combined with Corridor 12, this route provides a north-south link between Ocean View and downtown that is an alternative to Tidewater Drive.

Estimated Project Cost

\$3,520,000

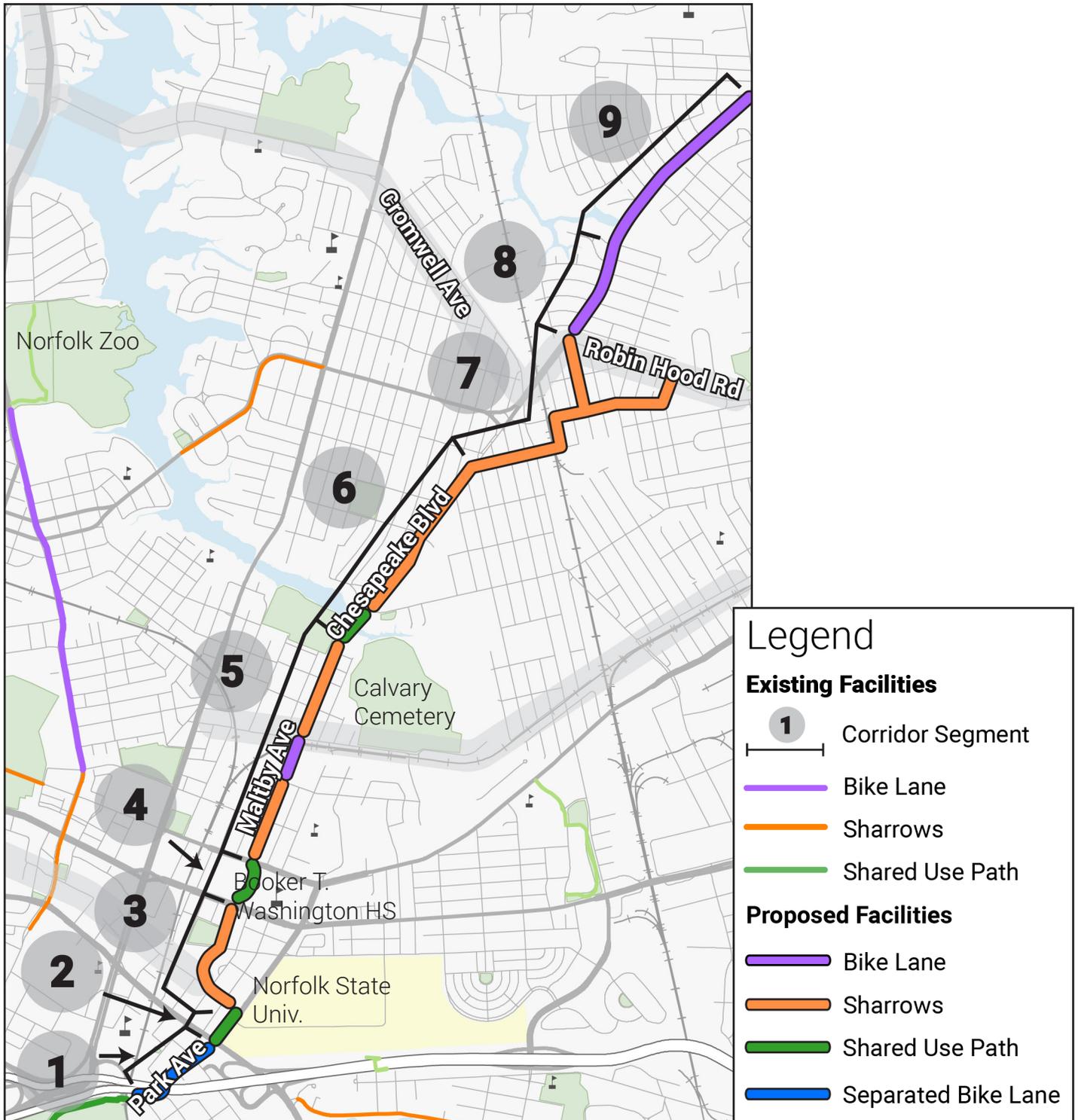
Key Challenges

- A bicycle/pedestrian bridge over the Lafayette River at the location of a former trolley bridge is necessary to complete this corridor.
- Cooperation from Norfolk State University will be needed to complete the shared use path in Segment 2 on their property along Park Avenue.
- The northern end of this corridor is dependent upon the design of the Five Points intersection. This corridor's interaction with Corridor 12 will need to be facilitated through this design.

Public Input

- Many commenters on the online WikiMap noted that the Lafayette River is a barrier to the otherwise comfortable and convenient bike route along Maltby Avenue and Chesapeake Boulevard.
- Some residents raised concerns about personal security in the neighborhoods between the ballpark and Lafayette River, including the Booker T. Washington High School campus.

Corridor 4: Recommendations Overview Map



Corridor 4: Park Avenue

Segment 1: Holt Street to Brambleton Avenue

Length: 0.4 miles

AADT: unknown

Speed limit: 25 mph

Facility: Two-way separated bike lane

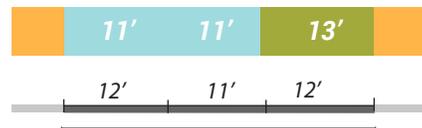
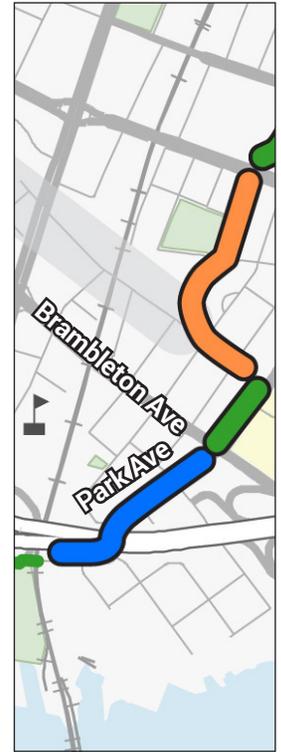
Major Action: 3 to 2 Road diet



- The Elizabeth River Trail is on the south side of the street here and ends at Holt Street.



- Park Avenue has three lanes in this segment.



Potential Design Challenges

- The interaction of bicycle traffic with motor vehicle traffic at Brambleton Avenue may be complicated by formalizing two-way bicycle traffic on one leg of the intersection. Special attention to crossing design will be needed because of the overall large volumes of traffic, dual turning lanes and multiple turning movements that have been integrated into the signal phasing.

Corridor 4: Park Avenue and Maltby Crescent

Segment 2: Park Avenue from Brambleton Avenue to Olney Road

Length: 0.1 miles

AADT: 15,000

Speed limit: 25 mph

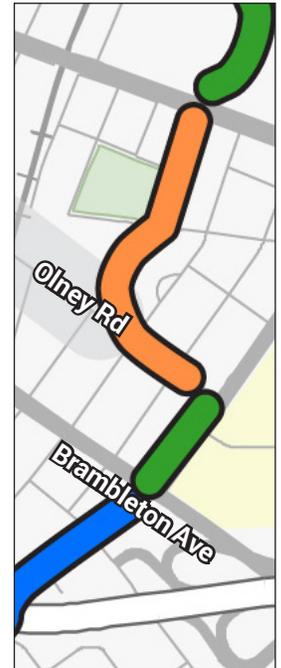
Facility: Shared use path

Major Action: Construct



Potential Design Challenges

- Unless a travel lane can be removed from Park Avenue, construction of a 1-block path from Brambleton to Olney Road will require use of Norfolk State University property in addition to the sidewalk.
- Some small trees will need to be removed to widen the existing sidewalk to at least 10'.
- The crossing at Olney Road will need special signage and markings to indicate two-way bicycle travel.



Segment 3: Park Avenue to Virginia Beach Boulevard

Length: 0.4 miles

AADT: unknown

Speed limit: 25 mph

Facility: Shared lane markings

Major Action: Install



- Maltby Crescent and other streets in this segment are low-volume local streets.

- Parking is allowed on both sides of the street in front of single-family residential development.



Potential Design Challenges

- There are no major design challenges to implementation of this recommendation.

Corridor 4: Booker T. Washington High School

Segment 4: Virginia Beach Boulevard to Princess Anne Road

Length: 0.1 miles

AADT: N/A

Speed limit: N/A

Facility: Shared use path

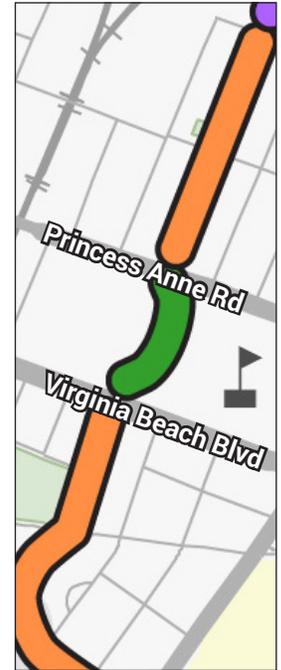
Major Action: Construct



- The existing crosswalk on this alignment is not high visibility, and the northern end lacks a curb ramp.



- The northern end of the path should align with Maltby Avenue which currently has no marked crosswalk.



Potential Design Challenges

- Creation of a path through the athletic fields of Booker T.. Washington High School will require cooperation from the Norfolk Public Schools. It appears that a relatively direct path can be created by aligning it between existing fields. An alternative, less direct routing can be aligned along existing sidewalks.
- The crosswalks at Virginia Beach Boulevard and Princess Anne Road will need to be upgraded to include curb ramps, high visibility crosswalks, median islands and potentially HAWK, or another signal type, if crossing safety becomes an issue.

Corridor 4: Maltby Avenue and Chesapeake Boulevard

Segment 5: Princess Anne Road to Lafayette River

Length: 0.7 miles

AADT: 903 - 3,600

Speed limit: 25 mph

Facility: Shared lane markings; bike lanes

Major Action: Install; Lane diet



- The block of Maltby Avenue between Cary Avenue and Street Julian Avenue is wide enough to accommodate bike lanes



- The majority of this segment is a very low-volume local street that dead ends at the Lafayette River.



Potential Design Challenges

- There are no major design challenges to implementation of this recommendation.

Segment 6: Lafayette River to Hanbury Street

Length: 0.6 miles

AADT: 1,300

Speed limit: 25 mph

Facility: Bike/ped bridge; Shared lane markings

Major Action: Construct; Install



- Embankments from the former trolley bridge connecting Maltby Avenue to Chesapeake Boulevard still exist.



- This segment of Chesapeake Boulevard is a very low-volume local street.



Potential Design Challenges

- The crossing of the Lafayette River may be too wide for a prefabricated pedestrian and bicycle bridge, so it will need to be custom designed and constructed.

Corridor 4: Signed connector route

Segment 7: Chesapeake Boulevard to Robin Hood Road

Length: 0.7 miles

AADT: unknown

Speed limit: 25 mph

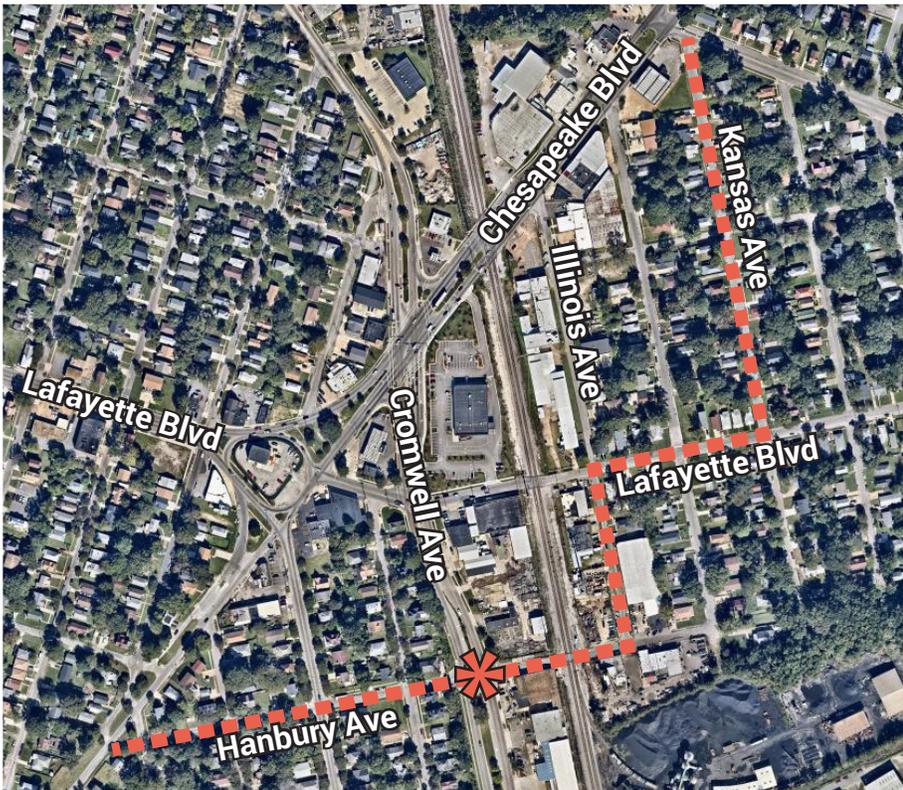
Facility: Shared lane markings

Major Action: Install



- Hanbury Avenue, Lafayette Boulevard, Arizona Avenue, and Kansas Avenue are low-volume, comfortable local streets.

- The crossing on Hanbury Avenue of Cromwell Avenue today is wide and uncontrolled.



- This routing helps bicyclists avoid the complex, dangerous and potentially confusing quasi-circle intersection of Chesapeake Boulevard and Lafayette Boulevard, and the major intersection of Chesapeake Boulevard and Cromwell Avenue.

Potential Design Challenges

- The intersection at Cromwell Avenue would benefit from improved crossing treatments like high-visibility crosswalks and likely a HAWK signal to stop cross traffic on demand for bicyclists and pedestrians. New median refuge islands or adjustment of existing islands would also benefit pedestrians and bicyclists but may be difficult to place and accommodate left turn movements.

Corridor 4: Chesapeake Boulevard

Segment 8: Robin Hood Road to Montgomery Street

Length: 0.3 miles

AADT: 17,000

Speed limit: 30 mph

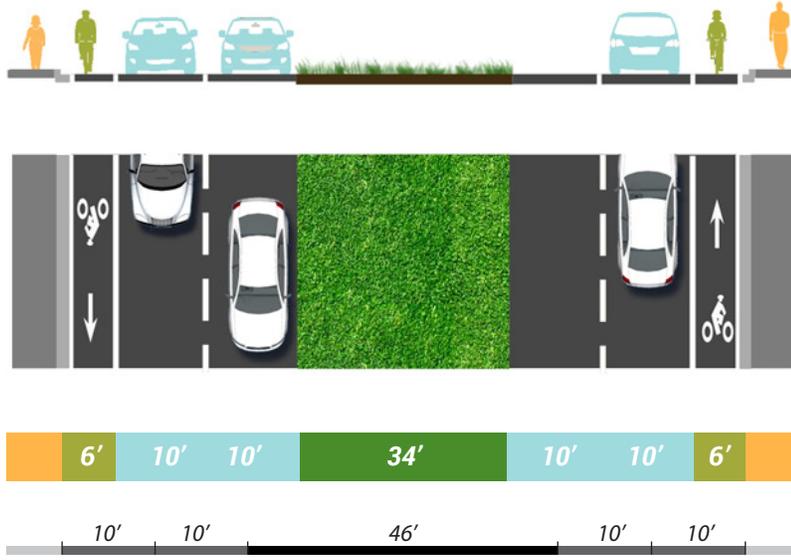
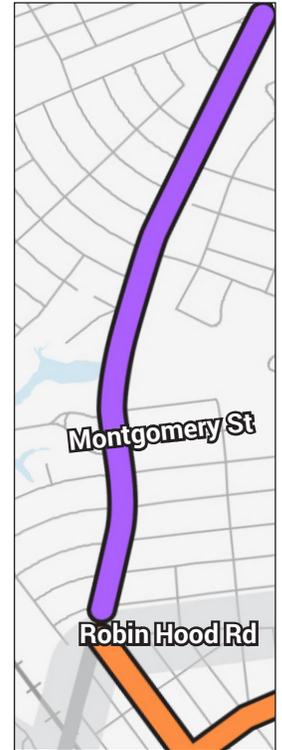
Facility: Bike lanes

Major Action: Widen road



- There is a wide 46' planted median in this segment with no curbs.

- Plantings are far enough to the interior to not be disturbed by widening the roadway into the median.



Potential Design Challenges

- The intersection at Robin Hood Road and Chesapeake Boulevard will need some additional crossing treatment for southwestbound bicyclists to make the left turn onto Robin Hood Road.

Corridor 4: Chesapeake Boulevard

Segment 9: Montgomery Street to Norview Avenue

Length: 0.6 miles

AADT: 17,000

Speed limit: 30 mph

Facility: Bike lanes

Major Action: Lane diet



- There is a planted median in this segment that has curbs.



- A 11' to 14' shoulder exists on both sides of the street from Montgomery Street to Wayne Circle and continues on the east side of the street north of Wayne.



Existing 86' total width

Recommended cross section for lane diet section, Wayne Circle to Hyde Circle

Potential Design Challenges

- The design of the northern end of this segment from Hyde Circle to Norview Avenue will need to be coordinated with the redesign of the Five Points intersection. There are constraints to routing bicyclists onto a wide sidewalk in this area (utility poles and boxes), so an on-street facility may be the best choice. Accommodating the northbound bicyclists' movement onto Chesapeake Boulevard (Corridor 12) will be challenging given the double right turn lanes present on the south leg of Chesapeake Boulevard.

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Corridor 5: Downtown-Old Dominion University-Naval Station Connector



Length: 4.2 miles

Speed Limit: 25-35 mph

Curb-to-Curb Width:
20 - 88'

AADT: low - 34,000

Land Use:

Majority neighborhood commercial; Old Dominion University; medium-density residential

Key Bicycle Facilities:

Priority shared lane markings on Colley Ave; Widened sidewalk for Elizabeth River Trail on Hampton Boulevard Bridge

Key Pedestrian Improvement:

Widened sidewalk for Elizabeth River Trail on Hampton Boulevard Bridge

Purpose of Improvements

- This corridor connects a number of major destinations within Norfolk and provides an alternative to bicycle travel on most of Hampton Boulevard.
- Key upgrades to the Elizabeth River Trail are recommended in this corridor.
- There is a significant amount of existing bicycle traffic on Colley Avenue to access neighborhood commercial establishments.
- Retaining existing and increasing future bicycle travel on the north end of Colley Avenue will support neighborhood revitalization.

Estimated Project Cost

\$690,000

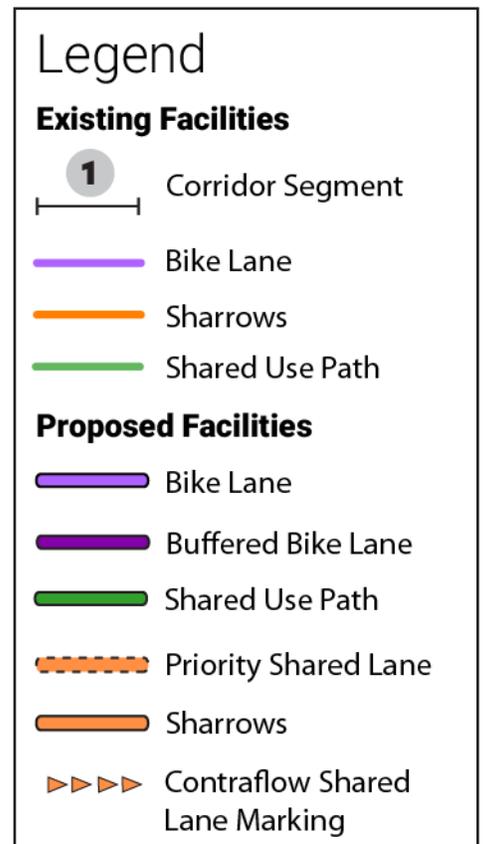
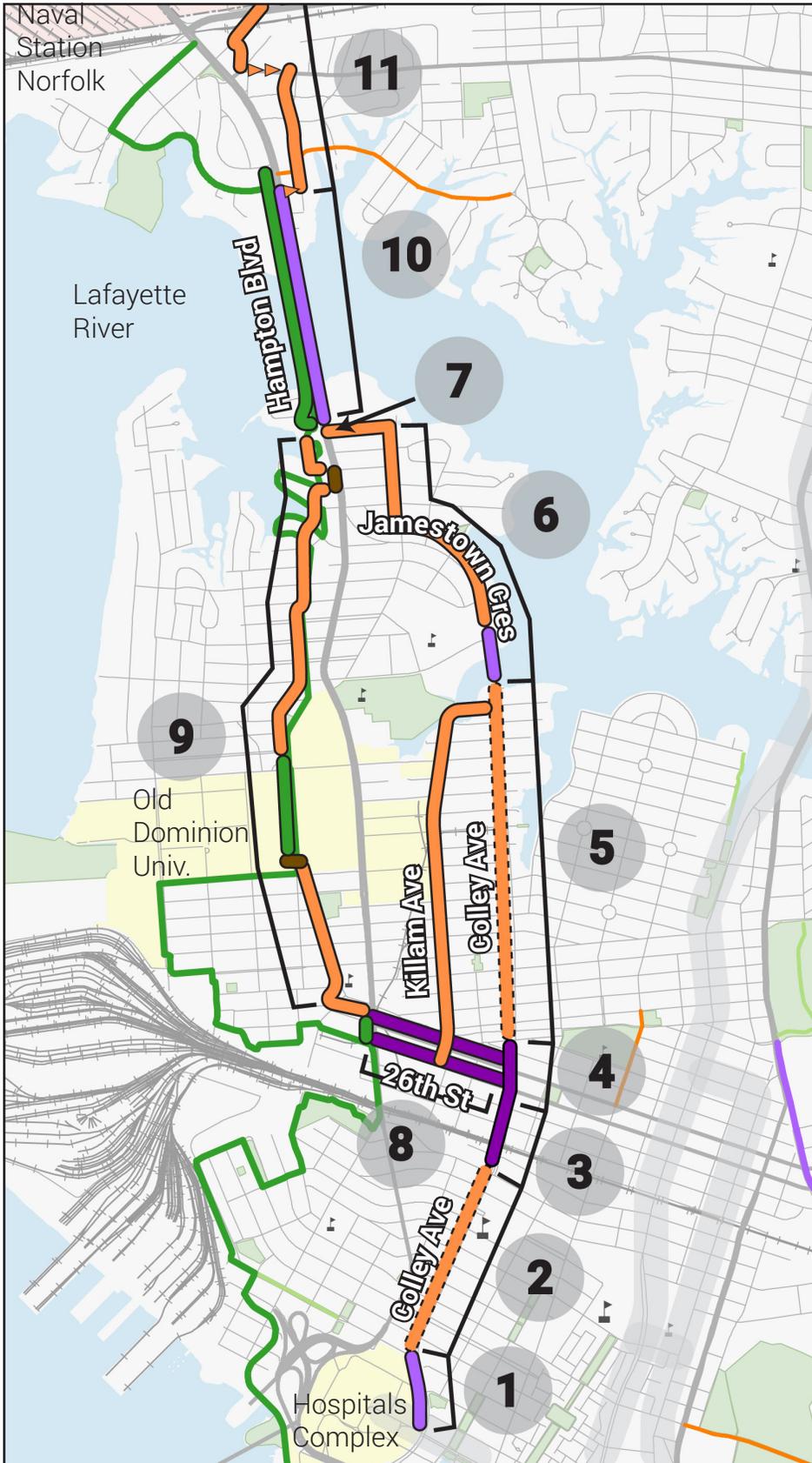
Key Challenges

- The sidewalk on the west side of the Hampton Boulevard Bridge across the Lafayette River is designated as the Elizabeth River Trail. As a shared use path, this sidewalk is severely sub-standard.
- The City will need to prioritize phasing of the east and west routes presented here that parallel Hampton Boulevard. Both are needed and serve different purposes.
- The underpass on Colley Avenue will need to be reconstructed at some future point to provide a better bicycle accommodation than routing on the narrow sidewalk.

Public Input

- Student and staff stakeholders from Old Dominion University expressed a desire for a route to connect to downtown more directly than the Elizabeth River Trail.
- The Colley Avenue commercial zones were noted as important bicycle destinations for people who live in the area.

Corridor 5: Recommendations Overview Map



Corridor 5: Colley Avenue

Segment 1: Olney Road to Redgate Avenue

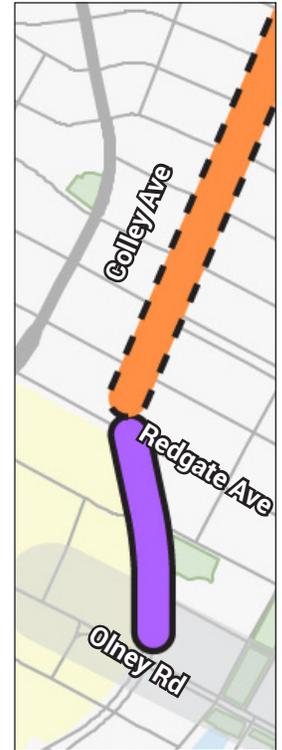
Length: 0.2 miles

AADT: 14,000

Speed limit: 25 mph

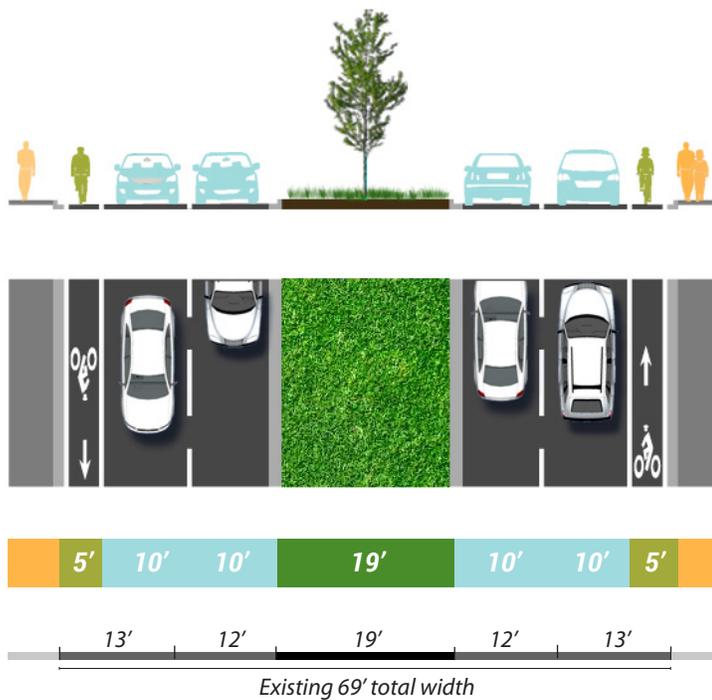
Facility: Bike lanes

Major Action: Lane diet



- Left turn pockets exist at all of the intersections along this segment.

- This segment serves the hospitals complex which is a major traffic generator.



Potential Design Challenges

- There are no major design challenges to implementation of this recommendation.

Corridor 5: Colley Avenue

Segment 2: Redgate Avenue to 21st Street

Length: 0.5 miles

AADT: 15,000

Speed limit: 15 to 25 mph

Facility: Priority shared lane markings

Major Action: Install



- Small retail and restaurant destinations line this segment of Colley Avenue and patrons keep on-street parking heavily occupied.



- James Blair Middle School is located in this segment of Colley Avenue and creates a 15 mph school zone.



- Priority shared lane markings include a green backing and are spaced more closely than traditional shared lane markings to reinforce the message that bicyclists will be sharing the road with drivers.

Potential Design Challenges

- This will be one of the first installations of priority shared lane markings in Norfolk, so outreach to adjacent businesses, residents and visitors to the corridor is recommended.

Corridor 5: Colley Avenue

Segment 3: 21st Street to 25th Street

Length: 0.2 miles

AADT: 16,000

Speed limit: 25 mph

Facility: Buffered bike lane

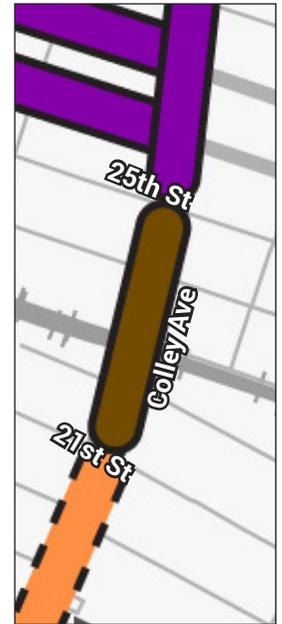
Major Action: 4 to 2 road diet



- The sidewalk is narrow through the underpass and obstructed.



- The street widens to four lanes at 21st Street. This segment is the only four-lane one for the length of Colley Avenue.



Potential Design Challenges

- Traffic volumes appear to accommodate a road diet in this segment, but an additional traffic study may be desirable to confirm.

Segment 4: 25th Street to 28th Street

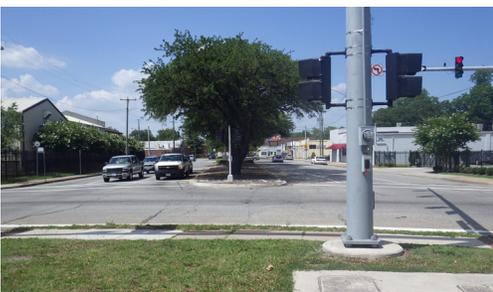
Length: 0.1 miles

AADT: 16,000

Speed limit: 25 mph

Facility: Buffered bike lanes

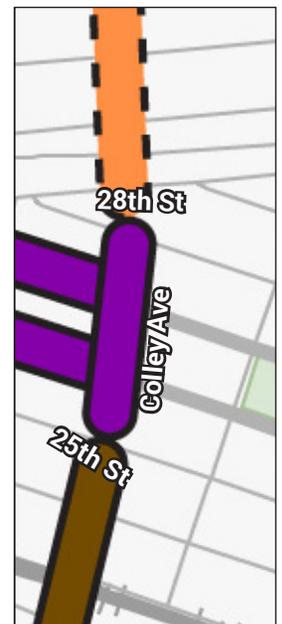
Major Action: 4 to 2 Road diet



- The street width and configuration changes a number of times throughout this segment.



- Left turn movements onto 27th Street will need to be accommodated.



Potential Design Challenges

- The shifting roadway dimensions and configurations will necessitate a detailed and careful striping plan.

Corridor 5: Colley Avenue and Jamestown Crescent

Segment 5: 28th Street to 52nd Street

Length: 1.0 miles

AADT: 14,000

Speed limit: 25 mph

Facility: Priority shared lane markings

Major Action: Install



- Parking lanes are striped on both sides of the street in this segment.



- Shared lane markings exist from 38th Street to 51st Street.



Potential Design Challenges

- There are no major challenges to implementing this recommendation.

Segment 6: 52nd Street to Hampton Boulevard

Length: 1.0 miles

AADT: low to 7,200

Speed limit: 25 mph

Facility: Bike lanes; Shared lane markings

Major Action: Install



- Shared lane markings exist from 52nd Street to Magnolia Avenue.



- Streets in this segment are narrow with parking allowed on both sides.



Potential Design Challenges

- Recently striped parking just north of the bridge could be removed to continue the bike lanes from the southern end of the segment through Magnolia Avenue.

Corridor 5: Elizabeth River Trail

Segment 7: Lexan Avenue to Hampton Boulevard Bridge

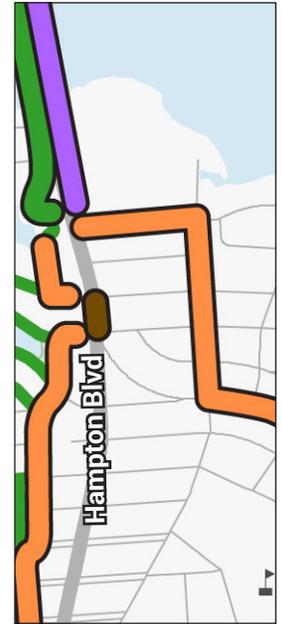
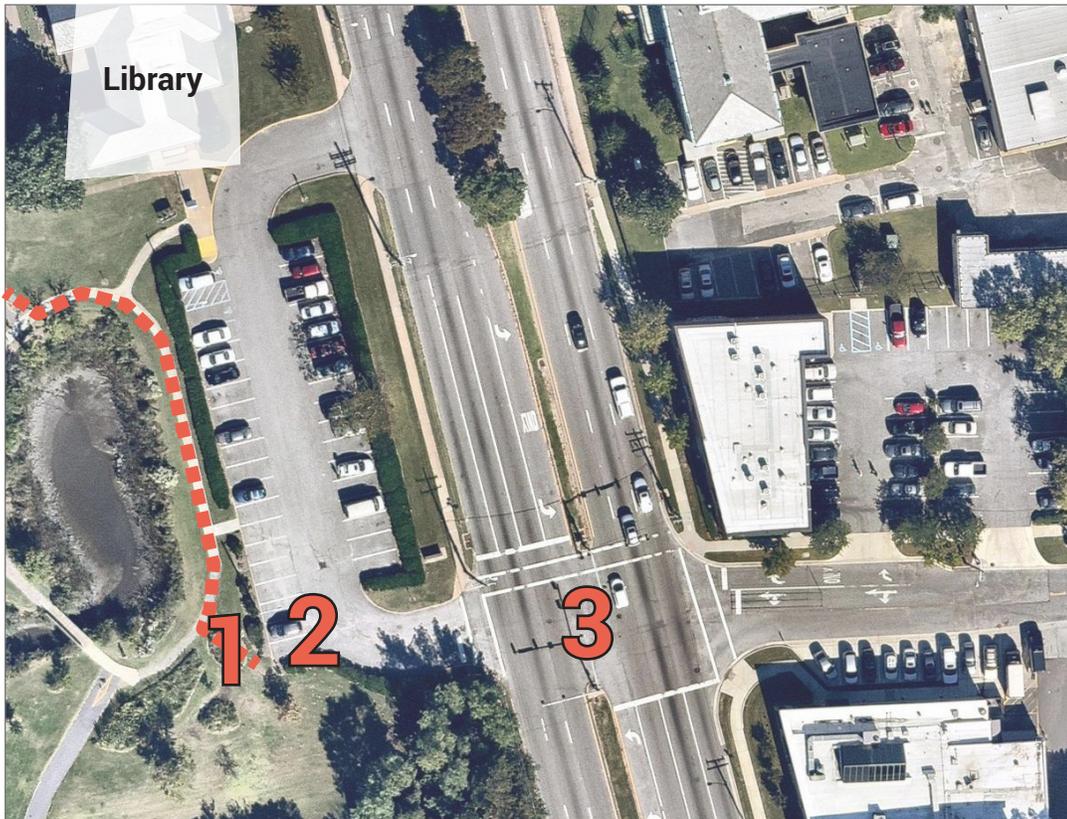
Length: 0.2 miles

AADT: N/A

Speed limit: N/A

Facility: Intersection improvements; Shared use path spur

Major Action: Install



- 1** A short spur of shared use path will need to be constructed to connect to the library parking lot in this location
- 2** The southernmost parking space should be removed to provide access to the new trail spur.
- 3** A crosswalk and green bike crossing across should be added to the south leg and a green bike crossing to north leg. Pedestrian signal heads and actuators should be upgraded to alert bicyclists to crossing time

Potential Design Challenges

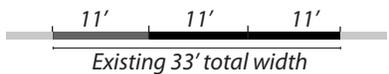
- There are no major design challenges to implementation of this recommendation.

Corridor 5: 26th Street and 27th Street

Segment 8: Colley Avenue to Hampton Blvd

Length: 0.4 miles
 AADT: 4,200 - 8,300
 Speed limit: 30 mph

Facility: Buffered bike lanes;
 Shared use path
 Major Action: Road diet;
 Construct



A one-way pair of buffered bike lanes should be constructed on 27th and 26th Streets. A dialog with adjacent land and business owners along the segment should be initiated to discuss the necessity of on-street parking. Parking is currently allowed on one side of each of these streets, and to maintain two travel lanes at all times, it will need to be removed.

A short segment of shared use path should be constructed along Hampton Boulevard between 26th and 27th Streets (at asterisk) to allow for eastbound access to 26th Street from the crossing at 27th Street.

Potential Design Challenges

- Parking or lane removal on both streets may be met with resistance from neighboring land owners and tenants.

Corridor 5: Hampton Boulevard western alternate

Segment 9: Hampton Boulevard to Elizabeth River Trail

Length: 1.9 miles

AADT: unknown

Speed limit: 25 mph

Facility: Shared lane markings

Major Action: Install



- There is currently no curb ramp at the corner of Richmond Crescent and Hampton Boulevard to access the sidewalk bikeway.



- Bluestone Avenue and other streets in this segment are low-volume local streets.



Potential Design Challenges

- This route, for the most part, follows the existing Elizabeth River Trail on-road route which requires more obvious wayfinding signage.

Corridor 5: Hampton Boulevard

Segment 10: Hampton Boulevard Bridge

Length: 0.3 miles

AADT: 34,000

Speed limit: 35 mph

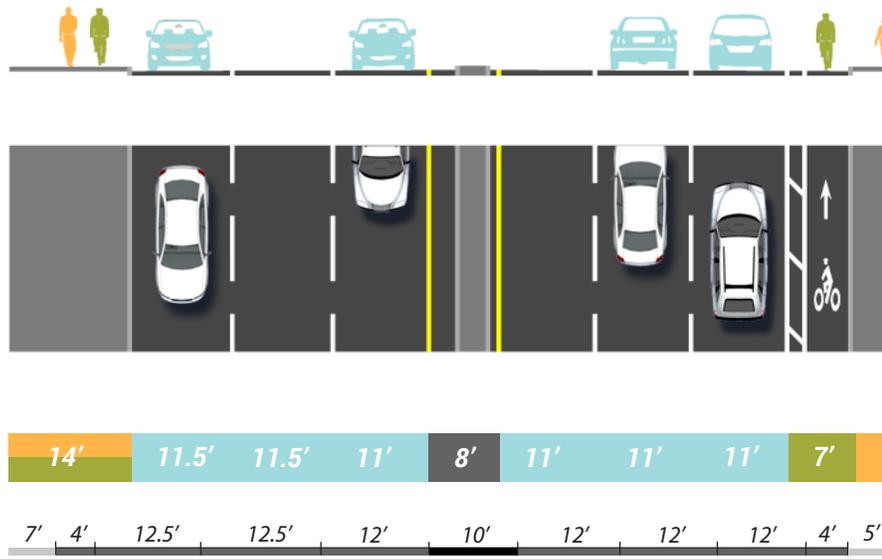
Facility: Wide sidewalk; bike lane

Major Action: Reconstruct; lane diet



- The current sidewalk is 7' wide which is not wide enough for two bicyclists to pass one another on this facility that is intended as a two-way trail.

- The existing lanes on the northbound side of the bridge are 12' wide, and a 4' shoulder is present.



Potential Design Challenges

- Widening the sidewalk will be a significant investment.

Corridor 5: Hampton Boulevard Alternate

Segment 11: Hampton Boulevard Bridge to Harrison Road

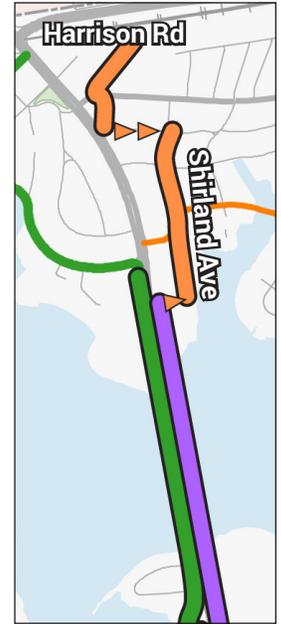
Length: 0.7 miles

AADT: unknown

Speed limit: 25 mph

Facility: Shared lane markings

Major Action: Install



- The diverter island at Baylor Place and Hampton Boulevard prevents automobile traffic from turning left onto Hampton Boulevard.

1 Crossing Little Creek Road to access Harrison Road will require some detailed design attention

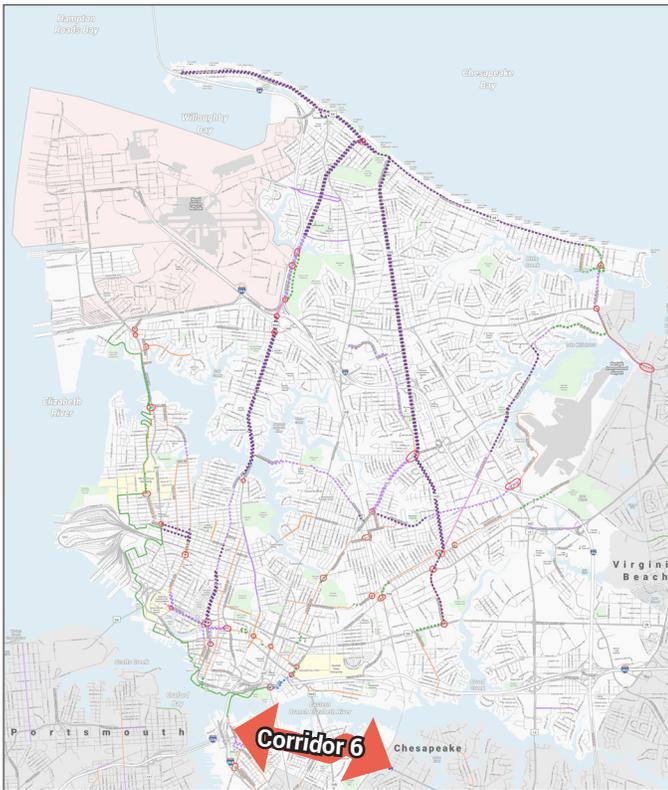
2 The transition between Baylor Place and Trouville Avenue will need special design and passage for southbound bikes through a diverter island.

Potential Design Challenges

- This segment only serves a purpose when the potential trail south of the rail corridor along the Naval Station boundary is constructed.
- For the contraflow sections, signage will be necessary to alert drivers to two-way bicycle travel, especially at intersections.

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Corridor 6: Indian River Road -- South Norfolk Connector



Length: 2.2 miles
Speed Limit: 30 mph
Curb-to-Curb Width: 20 - 92'
AADT: 1,200 - 19,000

Land Use:
Single-family residential at east end and center; majority industrial uses

Key Bicycle Facilities:
Bike lanes and buffered bike lanes

Key Pedestrian Improvement:
Traffic calming on Indian River Road with road diet through residential areas

Purpose of Improvements

- Provide a continuous bikeway linking South Norfolk to downtown, using the existing I-264 bicycle/pedestrian bridge crossing of the Elizabeth River.
- Provide a continuous bikeway link from Norfolk to Chesapeake.

Estimated Project Cost

\$300,000

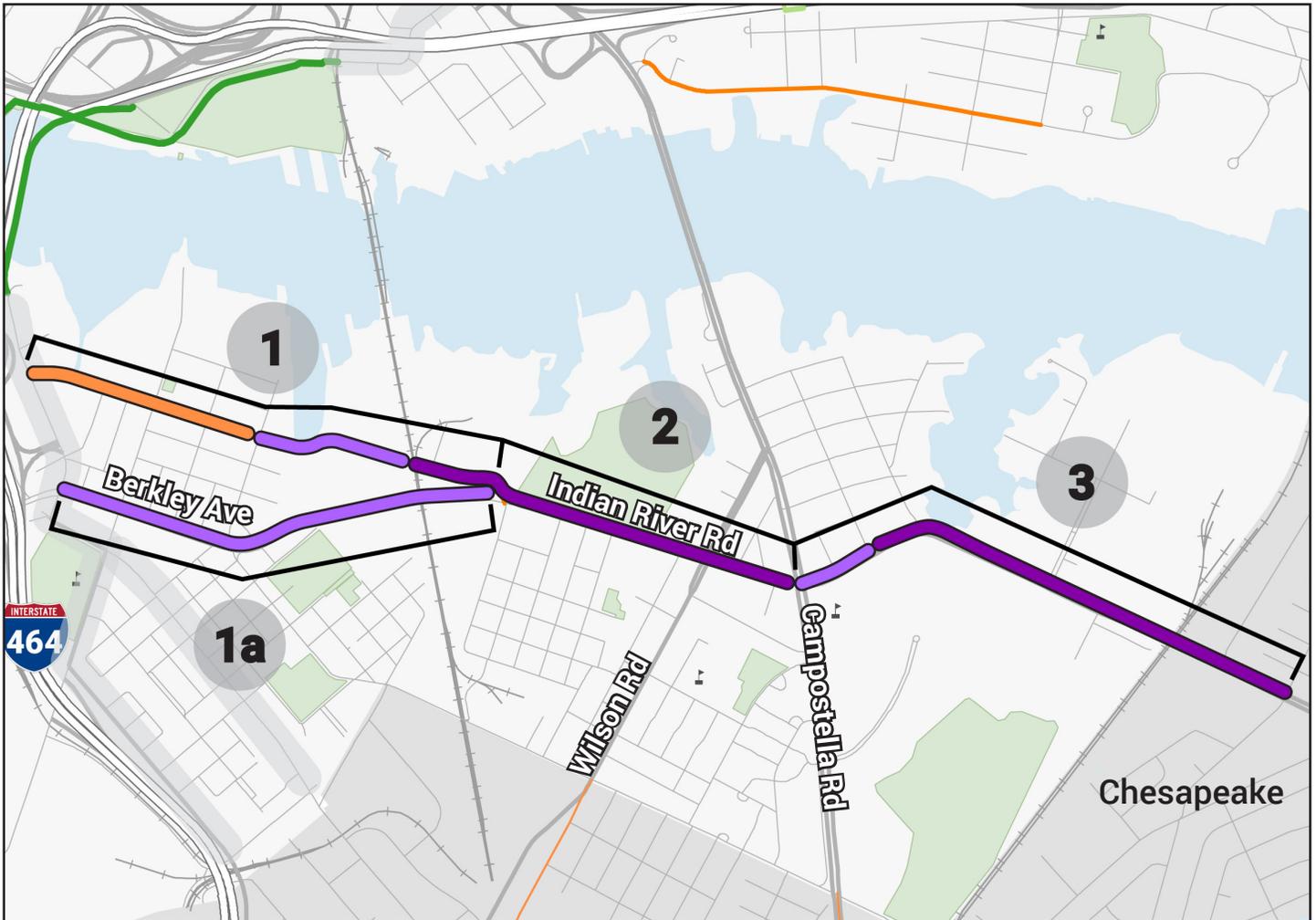
Key Challenges

- Indian River Road transitions to a 45 mph speed limit in Chesapeake to the east of this corridor.
- Accommodating bike lanes through the complex turn lane configurations at Campostella Road will necessitate some detailed design work.

Public Input

- An east-west connector through South Norfolk that reaches Chesapeake was noted as important by residents in this neighborhood.

Corridor 6: Recommendations Overview Map



Legend

Existing Facilities

- ① Corridor Segment
- Sharrows
- Shared Use Path

Proposed Facilities

- Bike Lane
- Sharrows
- Buffered Bike Lane

Corridor 6: Indian River Road

Segment 1: State Road to Berkley Avenue

Length: 0.9 miles

AADT: 1,200 to 2,700

Speed limit: 30 mph

Facility: Buffered bike lane and bike lanes

Major Action: Remove parking



- Existing shared lane markings should be maintained.



- On-street parking is little used in this area as businesses provide parking for their employees.



Existing 34' total width

Recommended cross section for parking removal section, Fauquier Street to Railroad tracks

Potential Design Challenges

- Adjacent businesses may object to prohibiting on-street parking, but there is parking provided at these establishments already.

Corridor 6: Berkley Avenue

Segment 1a: State Street to Indian River Road

Length: 0.9 miles

AADT: 12,000

Speed limit: 35 mph

Facility: Bike lanes

Major Action: Lane diet



- Existing travel lanes are wide (12-13') on Berkley Avenue.



- Adjacent residential properties would benefit from traffic calming effect of narrower lanes.



Potential Design Challenges

- Making left turns across the two lanes of traffic may be difficult for less experienced bicyclists. It may be desirable to facilitate some left turns off Berkley Avenue into the neighborhood to the north and the business district to the south with two-stage turn boxes.

Corridor 6: Indian River Road

Segment 2: Berkley Ave to Campostella Road

Length: 0.6 miles

AADT: 13,000

Speed limit: 30 mph

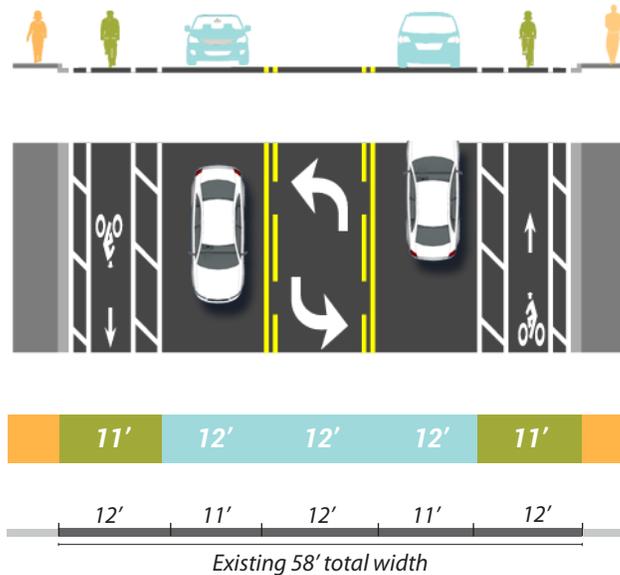
Facility: Buffered bike lanes

Major Action: 5 to 3 Road diet



- The 23' curb-to-curb width on either side of the median requires a road diet to accommodate bicycles.

- Left turn pockets are available at major locations such as Riverside Memorial Park cemetery.



Potential Design Challenges

- The intersection at the east end of this segment with Campostella Road will need detailed design work to address the conflict zone created by right-turning vehicles accessing the right turn lane across the buffered bike lane.

Corridor 6: Indian River Road

Segment 3: Campostella Road to City Limits

Length: 0.7 miles

AADT: 16,000 - 19,000

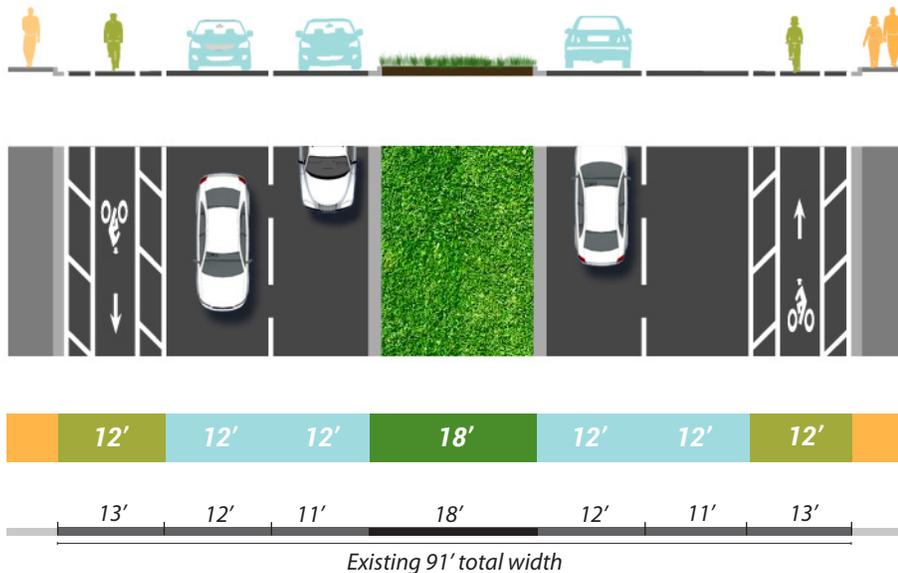
Speed limit: 30 mph

Facility: Buffered bike lanes

Major Action: 6 to 4 Road diet



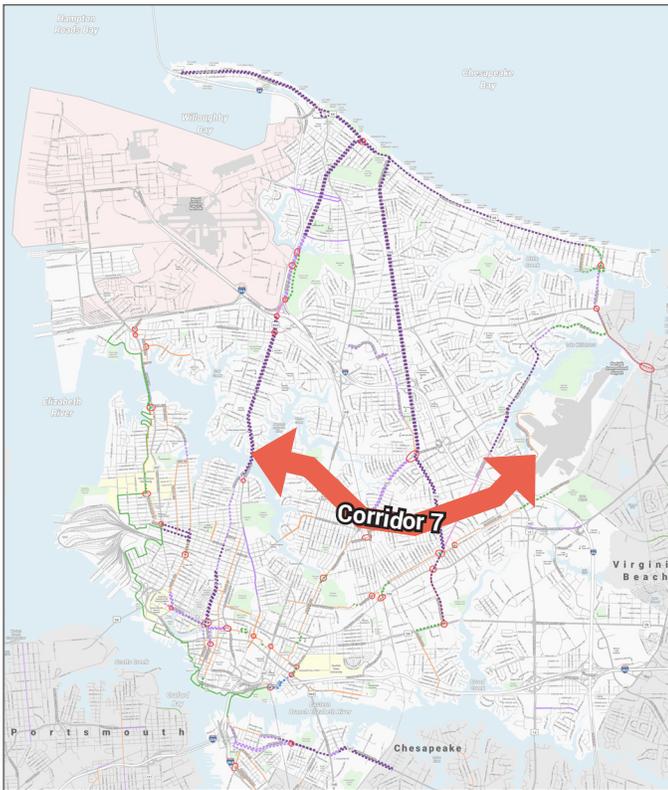
- The existing six-lane section is larger than needed for traffic volumes and promotes higher speeds than the posted limit of 30 mph.



Potential Design Challenges

- There are no major challenges to implementing this recommendation.
- In the future, adding flexible bollards to the buffer area would provide a greater degree of separation for bicyclists on this segment that tends to be fairly high speed in spite of the 30 mph speed limit.

Corridor 7: Cromwell Drive and Robin Hood Road Cross-City Connector



Length: 4.7 miles

Speed Limit: 25-35 mph

Curb-to-Curb Width:
24-50'

AADT: 4,200 - 11,000

Land Use:

Majority single family residential; two elementary schools; some light industrial

Key Bicycle Facilities:

Bike lanes, buffered bike lanes and connector trail

Key Pedestrian Improvement:

Connector trail and crossings from Cromwell Avenue to Robin Hood Road

Purpose of Improvements

- An east-west corridor is needed to connect across the city. This corridor links three of the north-south corridors recommended in this plan on Granby, Chesapeake and Azalea Garden.
- Providing a connection from the city to a popular recreational bicycling route that uses Miller Store Road.

Estimated Project Cost

\$840,000

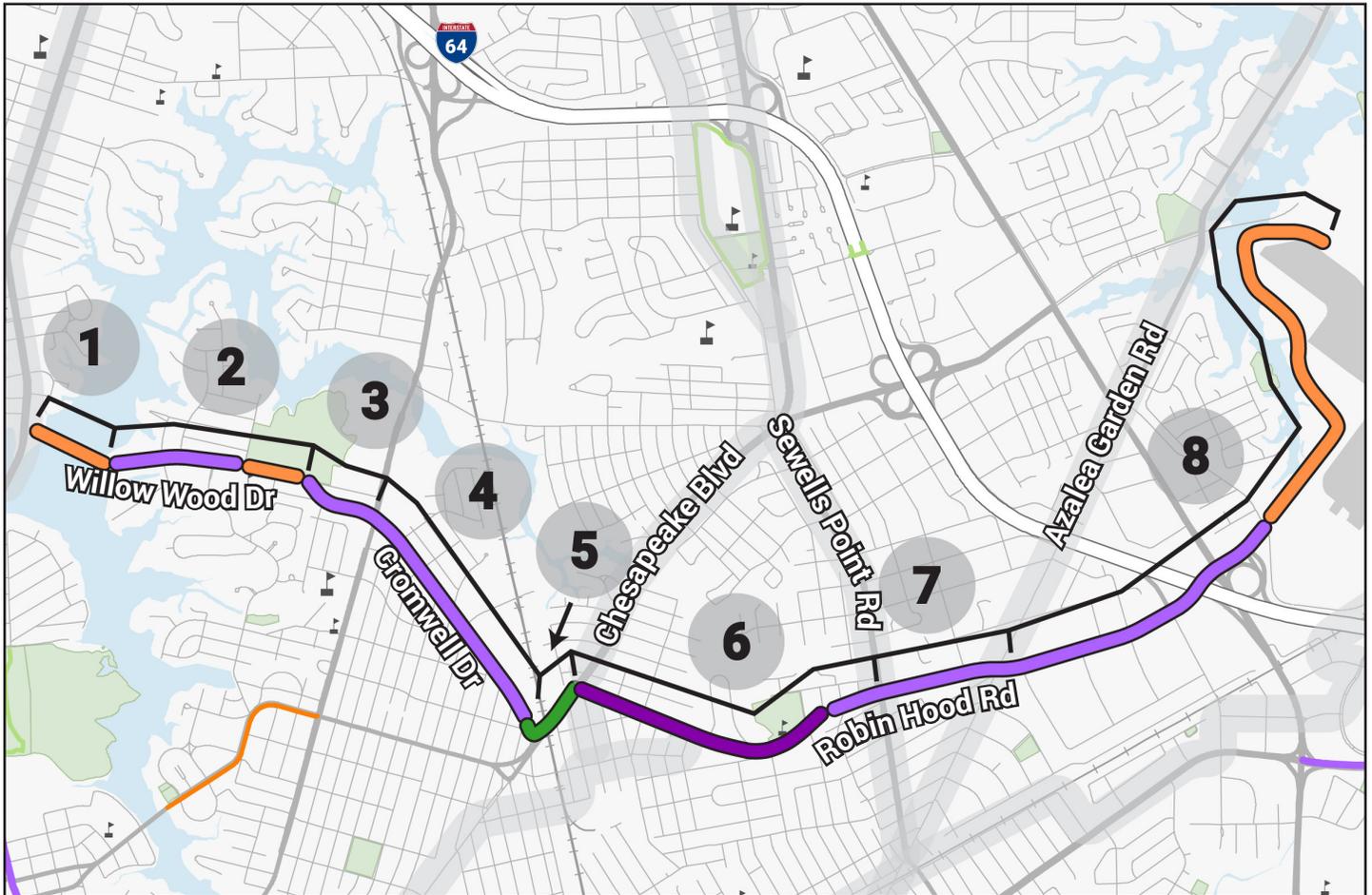
Key Challenges

- Navigating the intersection of Cromwell Drive and Chesapeake Boulevard will require construction of a short trail section that avoids this complex and dangerous intersection. However, this is a key connection between the east and west ends of this corridor.
- This is a long corridor with many different facility types, and implementing the entire set of projects at once may be challenging.

Public Input

- Many bicyclists already ride the western end of this corridor to connect from Granby Street into neighborhoods and to employment destinations at Norfolk Commerce Park.
- Robin Hood Road was noted as a location that is already fairly good for bicycling but has great opportunity for a dedicated bikeway due to wide lanes.

Corridor 7: Recommendations Overview Map



Legend

Existing Facilities

- ① Corridor Segment
- Sharrows
- Bike Lane

Proposed Facilities

- Bike Lane
- Sharrows
- Buffered Bike Lane
- Shared Use Path

Corridor 7: Willow Wood Drive

Segment 1: Bridge

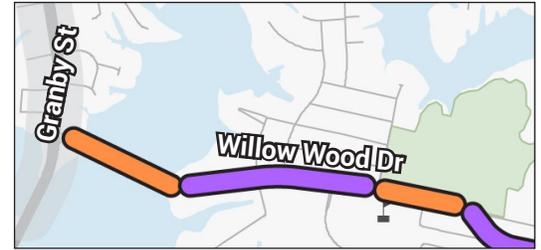
Length: 0.3 miles

AADT: 11,000

Speed limit: 25 mph

Facility: Shared lane markings and signage

Major Action: Install



- Bicyclists today ride on the sidewalk on the bridge, even though it is uncomfortably narrow.



- Sightlines for drivers are compromised by the grade of the bridge.



- The MUTCD R 4-11 sign "BIKES MAY USE FULL LANE" should be incorporated on the bridge to alert drivers to the fact that bicyclists will be in the lane ahead though they may not see them.

Potential Design Challenges

- There are no major design challenges to implementing these recommendations.

Corridor 7: Willow Wood Drive

Segment 2: Bridge to Elmore Place

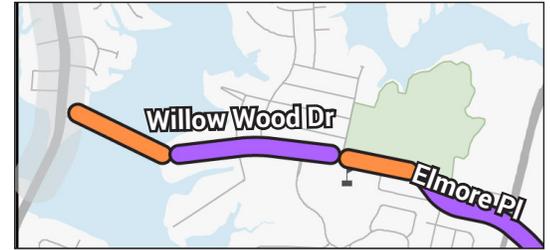
Length: 0.6 miles

AADT: 11,000

Speed limit: 25 to 30 mph

Facility: Bike lanes; shared lane markings

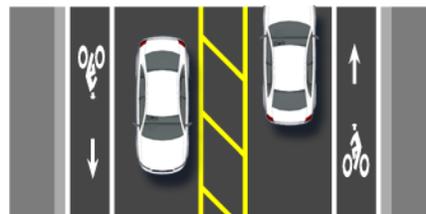
Major Action: Lane diet; install



- The western end of this segment has a large planted median with cartways wide enough to accommodate bike lanes.



- There is a 10' striped median throughout this segment except where left turn lanes exist.



Existing 37' total width

Potential Design Challenges

- Maintaining the left turn lane into the school property precludes keeping a continuous bike lane facility through this segment.
- The left turn lanes at Norway Place and Huntington Place will need to be removed to accommodate bike lanes, but these are low-volume residential streets.
- Lowering the speed limit to 25 mph through this entire segment is recommended. The residential character and presence of a park and elementary school justify slower speeds for bicyclist and pedestrian safety.

Corridor 7: Cromwell Drive

Segment 3: Willow Wood Dr to Tidewater Dr

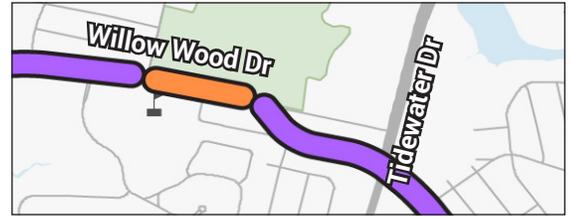
Length: 0.3 miles

AADT: 11,000

Speed limit: 30 mph

Facility: Bike lanes

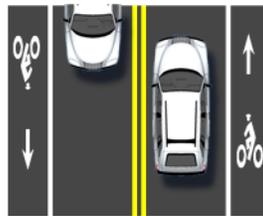
Major Action: Lane diet



- Elmore Place currently has two wide travel lanes where parking is allowed next to two destinations that have their own parking lots.



- This portion of Cromwell Drive is 29' wide where parking is not prohibited, though it is narrow.



4.5' 10' 10' 4.5'

14.5' 14.5'

Existing 29' total width

Potential Design Challenges

- For bicycle lanes to be installed in the 29-foot section pictured (or described) above, a) the two bicycle lanes will be slightly substandard (4.5' instead of 5'), or b) the two travel lanes will be substandard (9.5' instead of 10').
- Parking will need to be prohibited on Cromwell Drive in this segment, and on the south side of Elmore Place.
- The westbound bike lane should be striped through the intersection of Willow Wood Drive and Elmore Place to alert westbound drivers on Willow Wood Drive that they are crossing bicyclists' path of travel.

Corridor 7: Cromwell Drive

Segment 4: Tidewater Drive to Lyons Avenue

Length: 0.7 miles

AADT: 12,000

Speed limit: 30 mph

Facility: Bike lanes

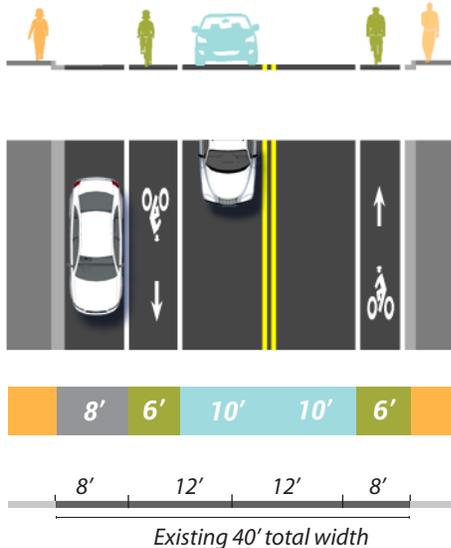
Major Action: Parking consolidation; lane diet



- Between Tidewater Drive and Brest Avenue, parking is little-used. It could be striped on alternating sides of the street to provide traffic calming.



- The center turn lane and travel lanes in this segment are wider than needed.



Potential Design Challenges

- Consolidation of parking on one side of the street may be viewed unfavorably by some residents, however, a chicane configuration will further calm/slow traffic, which typically finds strong local support.

Corridor 7: Connector Trail

Segment 5: Cromwell Drive to Robin Hood Road

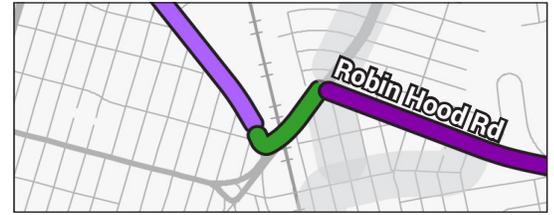
Length: 0.2 miles

AADT: N/A

Speed limit: N/A

Facility: Trail and enhanced crossings

Major Action: Construct; close medians



Due to the unusual geometry, the intersection of Cromwell Road and Chesapeake Boulevard would be difficult and costly to retrofit for safe bicycle travel. Segment 5 recommends an alternative routing that would appear to be feasible. In heavy traffic it will enable cyclists to cross each street in two stages if necessary, rather than waiting for a gap in traffic from both directions.

- 1** Bicyclist queuing space will be located at the southwest corner of Cromwell Road and Flanders Avenue. Curb will be extended to provide waiting space and narrow this wide crossing.
- 2** Crosswalks will be striped at both crossings to and from the median on Cromwell Road to facilitate the movement of southeastbound bicyclists. The southern crosswalk aligns with an existing, unused driveway cut that accesses the 7-11 parcel.
- 3** An easement from the owner of the 7-11 parcel will be needed to route a trail behind the store. Grading issues need to be addressed at the southeastern side where there is a steep ditch next to the railroad tracks.
- 4** This two-way crossing will have a marked crosswalk, signage and an activated RRFB to facilitate crossing to a trail located in the median along Chesapeake Boulevard.
- 5** The median openings can be narrowed or closed to reduce or eliminate potential conflicts with motor vehicles.

Potential Design Challenges

- Designing the two stage crossing of Cromwell to adequately address high speed traffic on that street. Speed enforcement may be needed.
- Determining if any of the median breaks on Chesapeake can be closed, and/or designing crossings that protect bicyclists and pedestrians but still accommodate truck turning movements, if needed.

Corridor 7: Robin Hood Road

Segment 6: Chesapeake Blvd to Sewells Point Rd

Length: 1.0 miles

AADT: 5,600

Speed limit: 25 to 30 mph

Facility: Buffered bike lanes; bike lanes

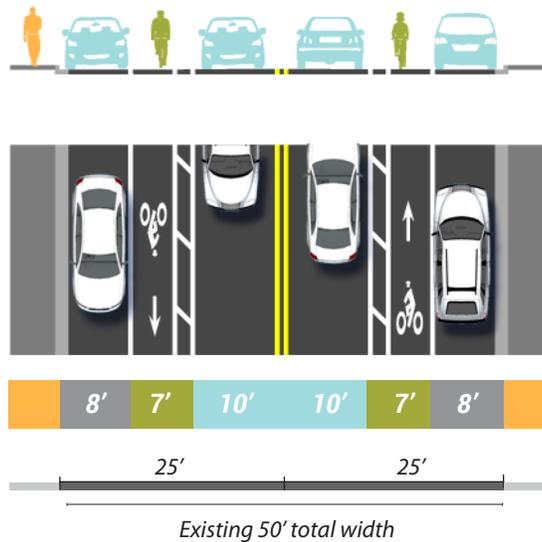
Major Action: Lane diet



- The street is 44 to 50' wide at the western end with little utilized parking on both sides of the street.



- The street narrows to 30' at Tillman Road, and parking is prohibited on both sides of the street.



Potential Design Challenges

- There is an existing problem with drivers passing on the right in the unoccupied parking lane near the western end of this segment. Striping buffered bike lanes will not prevent this, but the City could consider adding curb extensions at some intersections and switching the parking lane from one side to the other midway through the segment.
- The street narrows incrementally from Chesapeake Boulevard to Tillman Road. Design of bike lane striping will need to take that into account. It is recommended to drop parking from one side of the street and subtract 1' from the bike lanes when the street narrows to 44'.

Corridor 7: Robin Hood Road

Segment 7: Sewells Point Road to Azalea Garden Drive

Length: 0.4 miles

AADT: 4,200

Speed limit: 25 mph

Facility: Bike lanes

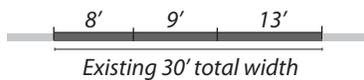
Major Action: Parking removal



- Speed humps are present in this segment for traffic calming.



- Parking is striped on the north side of the street and prohibited on the south side.



Potential Design Challenges

- On-street parking will have to be completely prohibited in order to provide bicycle lanes on this 30-foot wide road; however replacing parking with two bike lanes and a narrower eastbound travel lanes will support traffic calming efforts instituted in the form of speed humps.
- If residents prefer retention of parking on one side, it can be flipped half way down the street by installing a chicane for the travel lanes. Priority shared lane markings can be installed instead of bike lanes, however this treatment may result in increased motorist frustration as they will be forced to use the opposing travel lane to pass slower cyclists.

Corridor 7: Robin Hood Road

Segment 8: Azalea Garden Drive to Airport Entrance

Length: 2.2 miles

AADT: 9,300

Speed limit: 30 to 35 mph

Facility: Bike lanes; Shared lane markings

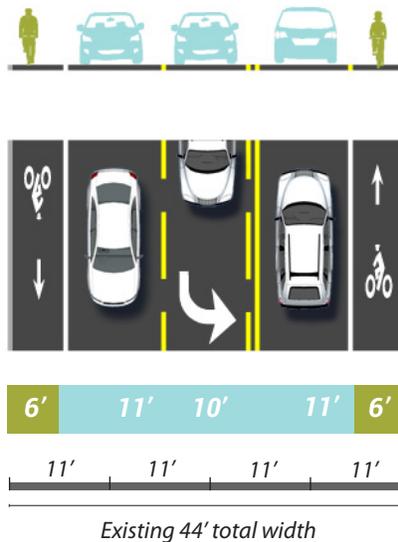
Major Action: Road diet; Install



- This section through the Norfolk Commerce Park has four travel lanes and lacks sidewalks on both sides of the street.



- This two-lane section east of Miller Store Road has narrow shoulders.



Potential Design Challenges

- Providing safe bicycle and pedestrian accommodations under the I-64 bridge will require thoughtful design. It is likely that bicyclists and pedestrians will need to be accommodated off of the roadway as a sidepath or "wide sidewalk." Issues that need to be addressed in the design include: a) providing shared bicycle and pedestrian space on both sides of the road, b) providing a wide enough facility to safely accommodate both bicyclists and pedestrians, c) designing safe and easy transitions for the bicyclists to enter the sidepath and re-enter the road at appropriate locations; d) providing lighting that addresses glare during the day and darkness at night, and e) addressing crossing conflicts with motor vehicles at the right turn slip lanes.
- The priority shared lane marking, or a green bike lane, is recommended for the road segment immediately east of Military Highway where a pair of entrance and exit ramps intersect the road on its south edge; through bicyclists must contend with four separate motor vehicle movements potentially crossing their path.

Corridor 8: Cape Henry Trail Interim Route



Length: 5.1 miles

Speed Limit: 25-35 mph

Curb-to-Curb Width:
20 - 64'

AADT: Low

Land Use:

Majority medium density residential; Walmart Neighborhood Market; Small commercial; Business park at east end

Key Bicycle Facilities:

Shared lane markings; improved crossings; connector trails

Key Pedestrian Improvement:

Improved crossings at Ingleside Road, Azalea Garden Road, Chesapeake Boulevard, and Military Highway

Unique Corridor Opportunity

- The Cape Henry Trail can serve as Norfolk's portion of the cross-state Beaches to Bluegrass Trail.
- Recommendations proposed here provide on-road improvements and short path linkages to create an interim alternative to the ultimate shared use path construction.
- In the interim, the corridor should be improved and opened to pedestrian and bicycle travel while planning for a rail to trail conversion continues.

Estimated Project Cost

Northern Route: \$1,030,000

Southern Route: \$1,000,000

Key Challenges

- Coordination with Norfolk Southern and VDOT to address needed at-grade railroad crossing and arterial road crossings.
- Development of a segment of trail adjacent to a minimally active rail line at the I-64 underpass.
- Acquisition of easements or right-of-way across a small number of private properties.

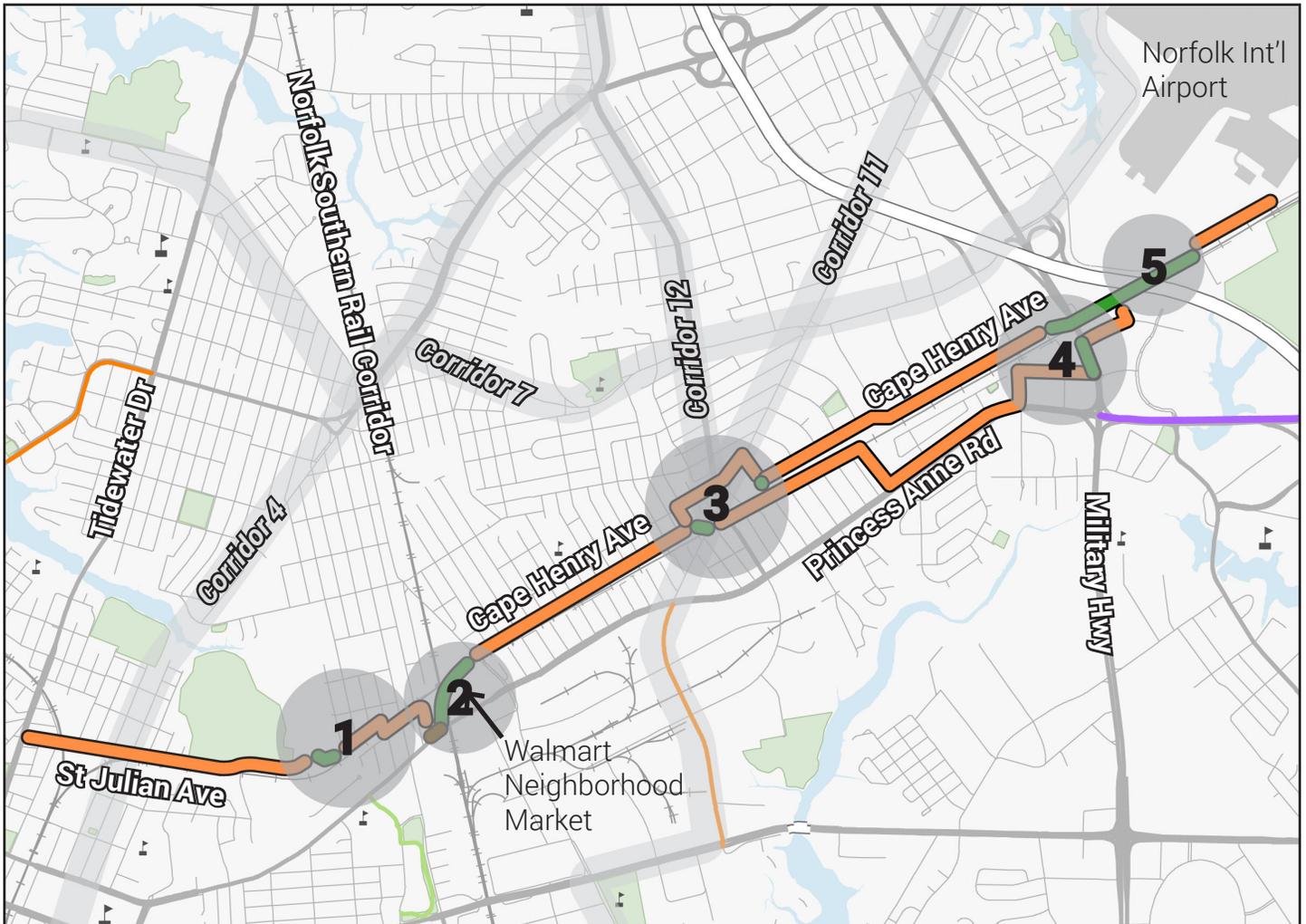
Purpose of Improvements

- Provide a low-stress route in east Norfolk that links to downtown via Corridor 4, as well as employment centers near the airport.
- Connect Norfolk to planned bicycle infrastructure in Virginia Beach.

Public Input

- An east-west connection across the middle of the city was desired by numerous stakeholders.
- Improved connection to Virginia Beach via a low-stress route was called for.

Corridor 8: Recommendations Overview Map



Legend

Existing Facilities

1 Improvement Area

Shared Lane Markings

Bike Lane

Proposed Facilities

Shared Lane Markings

Sidewalk Bikeway

Shared Use Path

Corridor Approach

Due to the unique nature of this corridor, the format used to present it in this report has been modified. The following pages address the numbered areas defined in the map above.

The improvement areas are centered around critical crossings or short segments of shared use path that are needed to link the existing low-stress local streets that form the majority of the corridor's route.

Shared lane markings are recommended for all of the low-volume local roads included in this corridor.

On the east end of this corridor, two alignment options are shown, one north of the Norfolk Southern rail line, and one south of it.

Corridor 8: St. Julian Avenue and Cape Henry Avenue

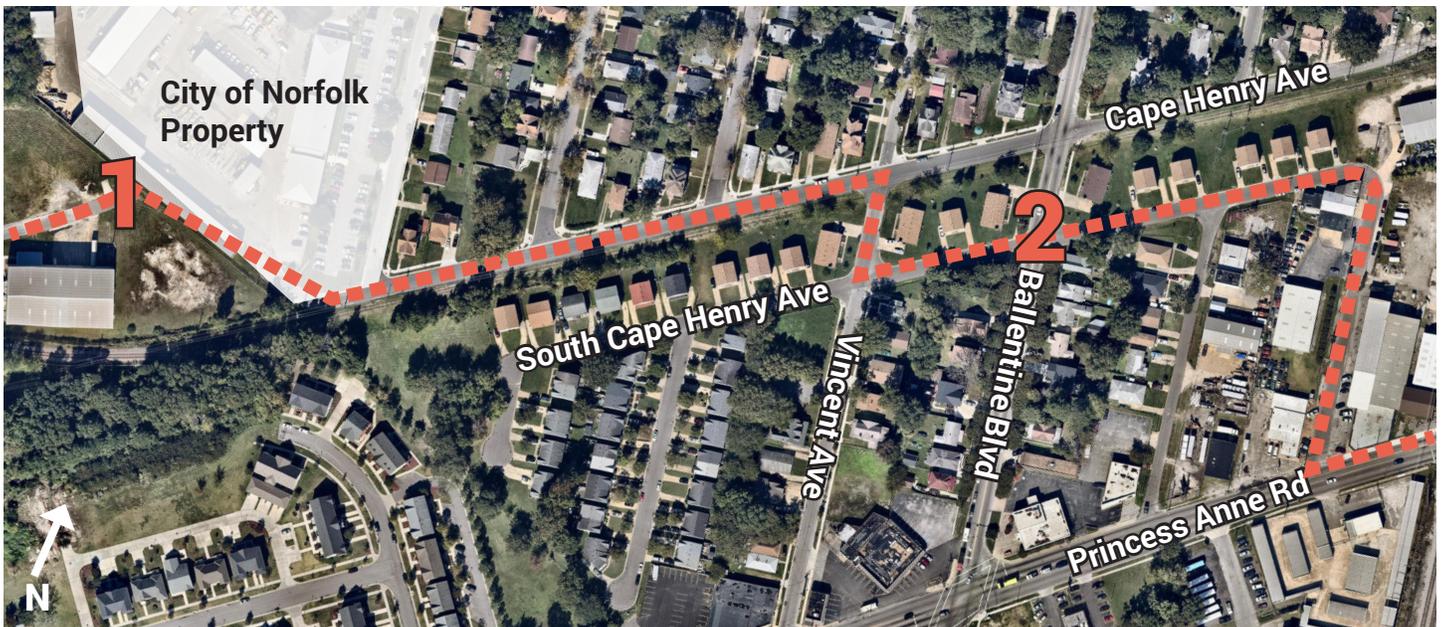
Area 1: St. Julian Avenue to Princess Anne Road

Facilities: Shared use path;
Crosswalks; Rectangular rapid
flashing beacon

Major Issues: Private property;
crossing minor arterial



From Tidewater Drive to its dead end near the Public Works Department property, St. Julian is a very low volume neighborhood street. The lack of connection between the end of St. Julian Avenue and Cape Henry Avenue is a barrier to creating a route through this area. The intersection at Ballentine Boulevard, a higher volume street, also needs additional improvements to make crossing safe and convenient.



1 St. Julian Avenue dead ends near City of Norfolk DPW/Streets property. A shared use path should be constructed from the end of the street utilizing City property to connect to Cape Henry Avenue.

Depending on the location of property boundaries, the City may need to acquire an easement across the edge of private land to connect from the end of St. Julian Avenue to City-owned property.

2 The crossing of Ballentine Avenue should have high-visibility crosswalks and an actuated rectangular rapid flashing beacon to alert drivers to increased volumes of bicyclists and pedestrians crossing.

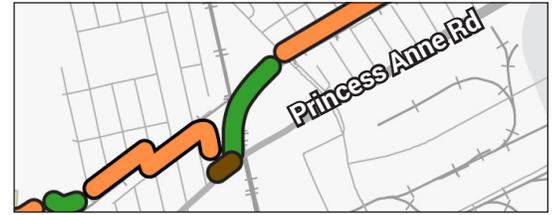
The route will need wayfinding to direct bicyclists through the zig-zag turns at Vincent Avenue and South Cape Henry Avenue.

Corridor 8: Railroad and Ingleside Road Crossings

Area 2: Princess Anne Road to Cape Henry Ave

Facilities: Wide sidewalk; Shared use path; Crosswalk; Median island

Major Issues: Crossing NS Railroad track and Ingleside Road



Norfolk Southern's north-south rail corridor forms a barrier to a continuous facility through this area. An alternative routing is needed that crosses the rail line at an existing crossing located at Princess Anne Road.



1 The existing sidewalk is used by bicyclists and pedestrians today. Pavement across the railroad tracks will need to be widened.

2 Wayfinding signage and a route delineated in the Longshoreman's Association parking lot can direct bicyclists.

3 Routing bicyclists on existing parking lot and service road is a low-cost alternative to constructing a shared use path. It will require cooperation from the property owner and Walmart operations.

4 Bicyclists will be routed onto the sidewalk along Ingleside Road. This sidewalk requires maintenance and additional paving next to the railroad tracks.

5 The crossing of Ingleside Road should have a median island for bicyclists and pedestrians to cross in two stages. A curb ramp will need to be added on the west side of Ingleside.

Corridor 8: Azalea Garden Road and Railroad Crossings

Area 3: Juniper Street to Norcovia Avenue

Facilities: Shared use path;
Crossing treatments;

Major Issues: Crossings of
Azalea Garden Road and rail
corridor; Routing choices



The complex intersection of Azalea Garden Road, Sewells Point Road, Cape Henry and S Cape Henry Avenues presents a barrier to bicycle travel through this area. The need to cross the rail line further complicates routing. Two railroad crossing options should be studied: Option 1, use the existing at-grade crossing at Azalea Garden Road, or Option 2, created a new crossing at Norcovia Avenue.



1 The sidewalk along the south side of this parcel needs to be widened to accommodate two-way bicycle travel.

2 Crossing improvements are needed at Azalea Garden Road here. A median island is recommended to provide a refuge area and enable two-stage crossing, but this may impact access to adjacent businesses.

 The alternative routing along Cape Henry Avenue avoids the rail crossing described in Option 2. Use of this route is dependent on the items described in Area 4, Option 2 on the following page.

1 Improvements are needed at this unsignalized crossing of Sewells Point Road.

2 Wayfinding signage is needed at these intersections.

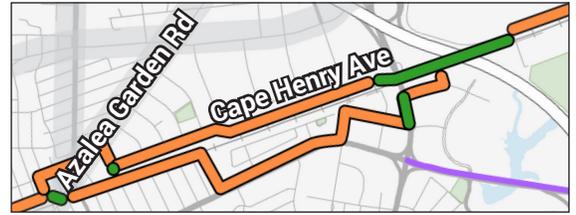
3 The recommendation for this segment of Azalea Garden Road in Corridor 11 is paved shoulders. This segment will need to be improved to create this route.

4 Extensive use of this informal crossing of the rail tracks at the end of Norcovia Avenue is evident. Pedestrian safety and convenience will be enhanced by formalizing this crossing of the little-used rail line.

Corridor 8: Military Highway Crossing

Area 4: Princess Anne Road to Rail corridor

Facilities: New signal timing and signal heads; Shared use path; Bike/pedestrian bridge
Major Issues: Crossing major arterial; Private property



Military Highway is a major barrier to connecting to the eastern end of this corridor. Two options for crossing are presented below. Option 1 continues from the S Cape Henry Avenue alignment, whereas Option 2 stays north of the railroad tracks and uses Cape Henry Avenue indicated in the Alternative Route in Area 3 on the facing page.



- 1** A connection is needed between the end of the Princess Anne Road service drive and the sidewalk.
- 2** The intersection at Elizabeth Road and Military Highway currently does not allow cross traffic. Signal timing and phasing will need to be revised to accommodate cross traffic from bicyclists. Bicyclists and pedestrians should cross the north leg of Military Highway.
- 3** A two-way sidepath is needed in the wide grass shoulder along the east side of Military Highway to help bicyclists avoid the many turn conflicts at the intersection with Elizabeth Road.

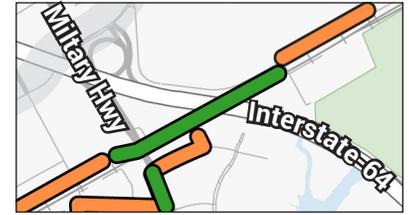
- 1** City of Norfolk land is available on both sides of Military Highway to use for ramped bridge approaches to connect the end of Cape Henry Avenue to a crossing of Military Highway.
- 2** Military Highway is a major arterial with an ADT of 43,000 at this location. A new pedestrian/bicycle bridge is recommended to provide a safe crossing.
An at-grade crossing would require a new actuated signal such as a HAWK. An existing controlled at-grade rail crossing periodically stops traffic in this location already with a rail crossing warning system.

Corridor 8: Norfolk Southern Rail Corridor

Area 5: Academy Drive to Pritchard Street

Facility: Shared use path

Major Issue: Construction of trail in little-used but active rail corridor



This is the only segment of the Cape Henry Trail alternative where it is necessary to use the rail corridor in the short term. Other nearby options for crossing under Interstate-64 will require major infrastructure changes to be made comfortable for bicyclists.

This shared use path along the rail corridor will provide a critical link between a proposed new development at Lake Wright and the City of Norfolk. Without this trail, pedestrian and bicyclist access to the development will not be possible.



- The existing rail bed and corridor are wide enough to accommodate a trail on the north side of the tracks.



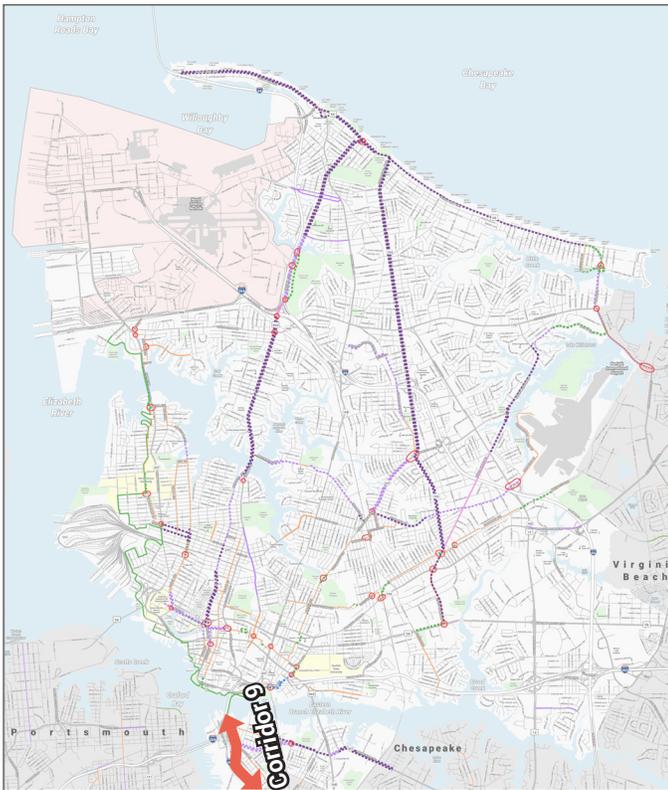
- There is ample space between the tracks and bridge abutments to accommodate a trail.

Potential Design Challenges

- The major challenge of this segment will be working with Norfolk Southern to receive approval to design and construct a trail along this minimally active rail corridor.

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Corridor 9: Southside Bikeways



Length: 1.2 miles

Speed Limit: 25-30 mph

Curb-to-Curb Width:
24 - 48'

AADT: 1,400 - 8,300

Land Use:

Multifamily residential;
elementary school;
industrial

Key Bicycle Facilities:

Bike lanes, shared lane markings

Key Pedestrian Improvement:

Road diet on portion of Liberty Street narrows
pedestrian crossing

Purpose of Improvements

- Provide a continuous bikeway connection between Southside, Chesapeake and downtown.
- Improve access to the Jordan Bridge for recreational cyclists who use it to cross the Southern Branch of the Elizabeth River.

Estimated Project Cost

\$110,000

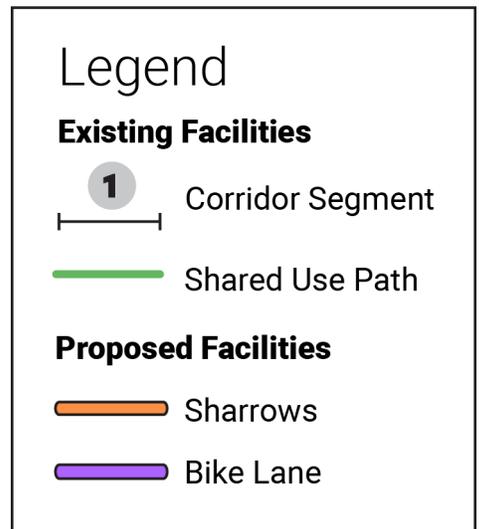
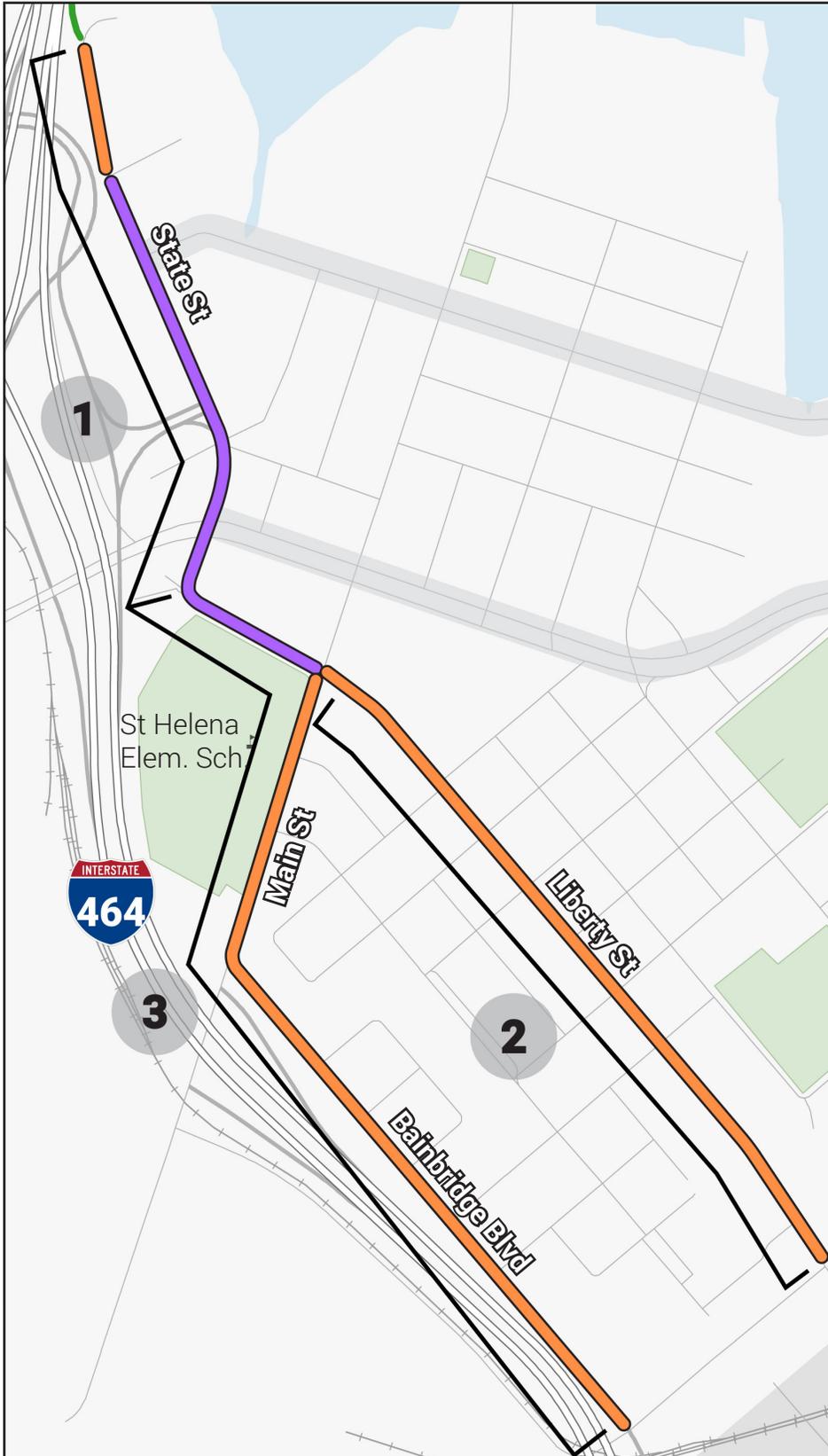
Key Challenges

- The intersection of South Main Street and Bainbridge Boulevard has a vast expanse of pavement uninterrupted by median islands or striping. Signage and markings will be needed to alert drivers to bicyclists' presence as it is 125' from an exit ramp off Interstate 464.
- Southbound bicyclists on South Main Street making a left turn onto Bainbridge have to watch for traffic coming from three different directions and it is easy for the drivers to miss seeing a cyclist making this maneuver.

Public Input

- Many recreational riders noted that the Jordan Bridge is a major destination.

Corridor 9: Recommendations Overview Map



Corridor 9: State Street

Segment 1: I-264 Bridge to Liberty Street

Length: 0.5 miles

AADT: < 2,400

Speed limit: 25 mph

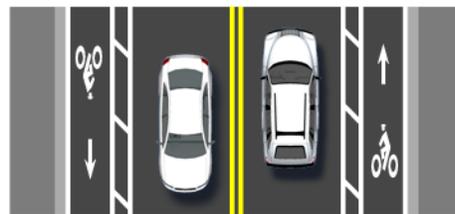
Facility: Shared lane markings; bike lanes

Major Action: Install



- The shared use path on the I-264 bridge exits onto the narrow end of State Street.

- State Street widens to 48' with parking on both sides.



Existing 40' total width

Potential Design Challenges

- There are no major design challenges to implementation of this recommendation.

Corridor 9: Liberty Street

Segment 2: State Street to Halifax Street

Length: 0.1 miles

AADT: 3,800

Speed limit: 25 mph

Facility: Bike lanes; shared lane markings

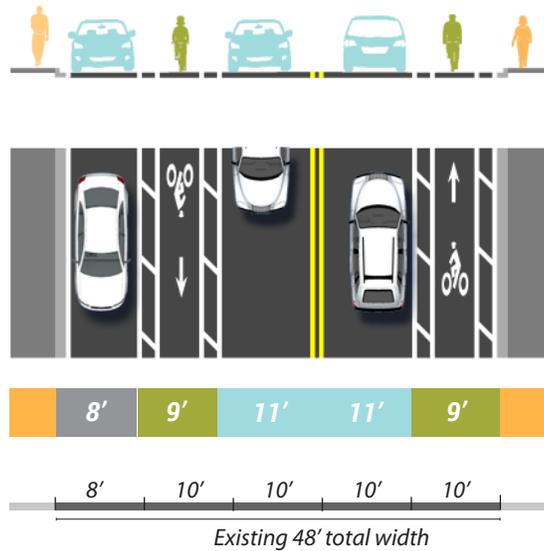
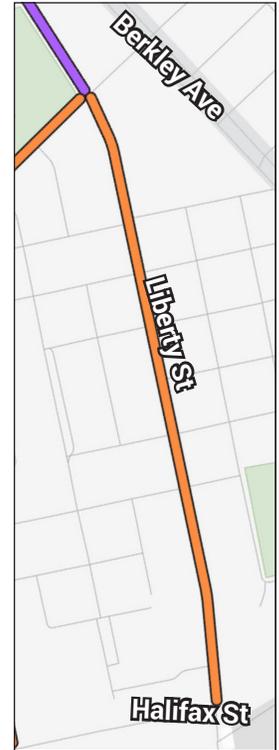
Major Action: Lane diet; Install



- A new development on the north side of Liberty Street may desire on-street parking.



- Liberty Street from South Main Street to Halifax Street is a low-volume residential street with a few small retail businesses.



Potential Design Challenges

- There are no major design challenges to implementation of this recommendation.

Corridor 9: South Main Street and Bainbridge Boulevard

Segment 3: Liberty Street to Norfolk City Line

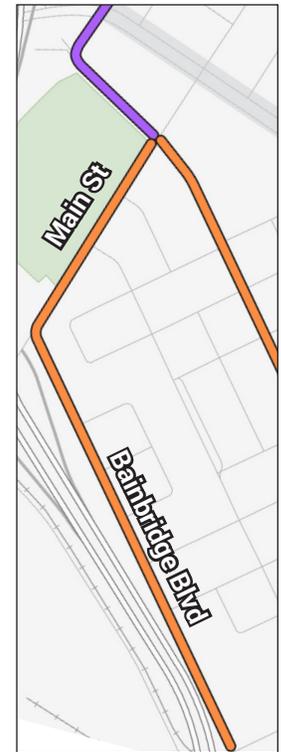
Length: 0.7 miles

AADT: 8,300 (Main); 1,400 (Bainbridge)

Speed limit: 25 to 30 mph

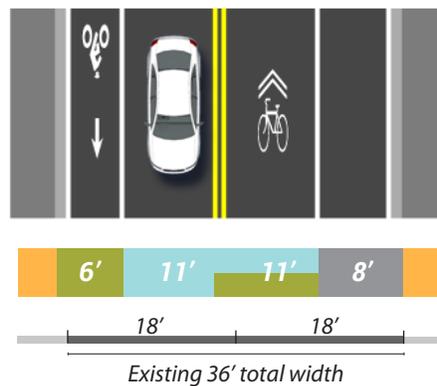
Facility: One-way bike lane; shared lane markings

Major Action: Parking removal; install



- South Main Street has parking allowed on both sides of the street, but it appears to be predominantly used by school employees and for drop off/pick up.

- A bicycle jughandle could provide a waiting space for riders making the lefthand turn onto Bainbridge Boulevard.



Potential Design Challenges

- If parking and/or a drop-off zone is not really needed in front of St. Helena Elementary School, a bicycle lane can be installed in the southbound direction of South Main Street, and a priority shared lane marking in the northbound lane. If parking/drop-off/pick-up is needed, priority shared lane markings should be used in both travel lanes.
- The intersection of Bainbridge Boulevard/South Main Street/and the northbound off ramp from I-264 needs to have striping and signing applied to clarify stop controls, lanes for turning movements, merge areas and areas of pavement that should not be used by motorists. Cyclists making a southbound left from South Main to Bainbridge should have a highly visible, but protected area in which to wait for a gap to make the left turn.

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Corridor 10: Ocean View Avenue and Shore Drive East-West Connector



Length: 8.4 miles
Speed Limit: 30-45 mph
Curb-to-Curb Width: 48 - 78'
AADT: 6,200 - 32,000

Land Use: Oceanfront residential with pockets of restaurant and retail; JEB Little Creek-Fort Story at eastern end

Key Bicycle Facilities: Buffered bike lanes; East Ocean View shared use paths

Key Pedestrian Improvement: Traffic calming through road diet; Improved sidewalk maintenance on Shore Drive

Purpose of Improvements

- Maximize the level of comfort for this beachfront route, which is a popular recreational ride for cyclists of all abilities, and expand the market for commercial bike rental businesses that serve beach visitors and tourists.
- Provide a continuous Ocean View bikeway improvement that will enable local residents and seasonal visitors to make short local trips by bicycle, instead of motor vehicle.
- Provide a connection for Ocean View area residents to access the Granby, Chesapeake and Azalea Garden routes that connect northern Norfolk to the core and south sides of the city.
- Upgrade a high priority segment of a proposed citywide recreational bicycle loop that also includes Azalea Garden and Granby.

Estimated Project Cost

\$3,000,000

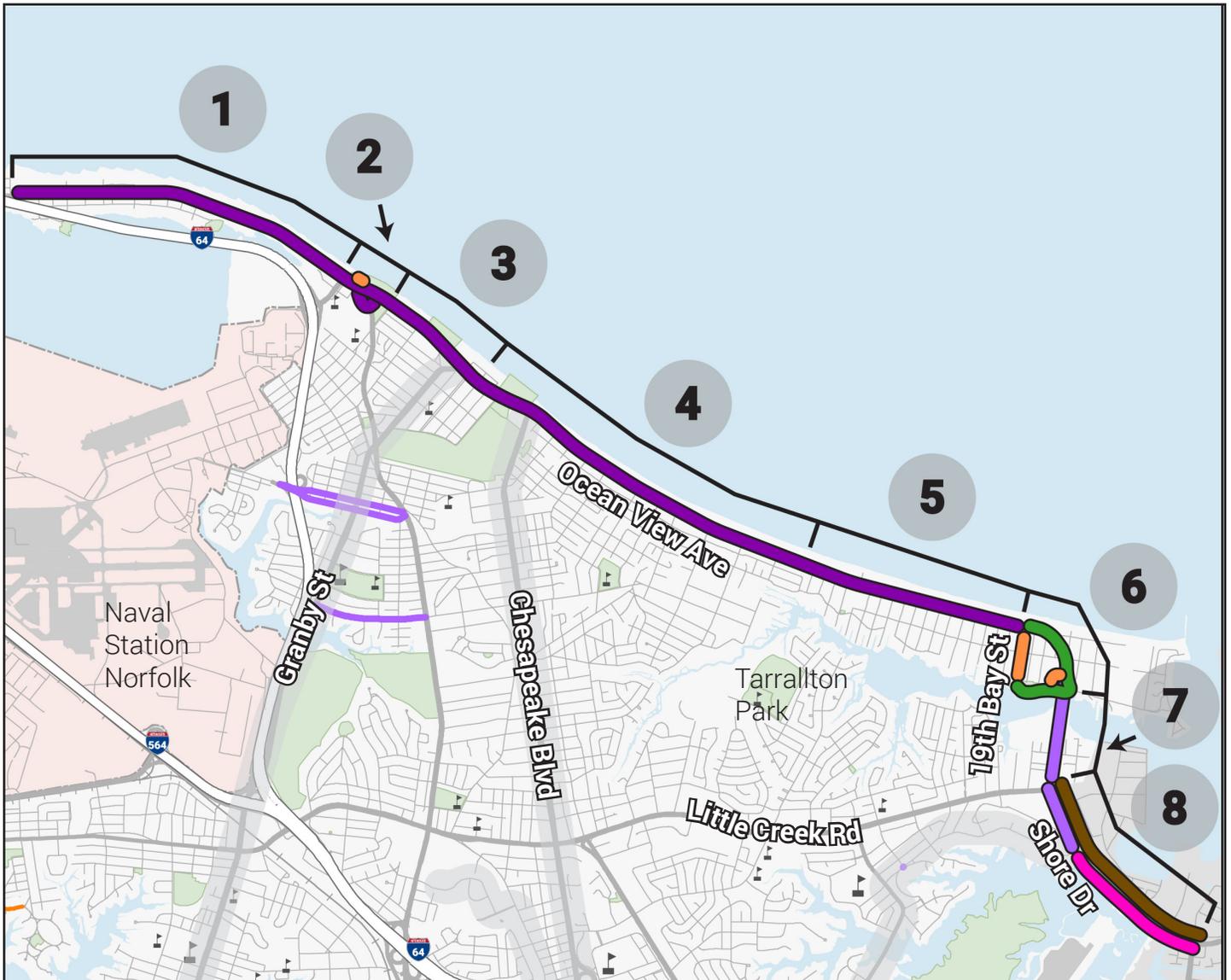
Key Challenges

- The road diet that is recommended for much of this corridor is based upon available traffic volume data, however additional counts or a traffic study may be needed to confirm feasibility and guide final design.
- The unique split traffic pattern where Tidewater Drive merges with Ocean View will require special design considerations.
- Shore Drive from Little Creek to the city boundary does not have a consistent cross section, with varying ROW and constraints present. Special attention will be needed to address transitions between facility types, and bicyclist safety in a high speed roadway environment.

Public Input

- The bike lanes on Willoughby Spit were noted as one of the nicest places to ride in Norfolk at public meetings, even though they are a substandard width. This route will extend that enjoyable, oceanfront riding experience.
- Experienced bicyclists already use this corridor to access Virginia Beach, but safer, more comfortable facilities are needed.

Corridor 10: Recommendations Overview Map



Legend

Existing Facilities

- ① Corridor Segment
- Bike Lane
- Sharrows

Proposed Facilities

- Bike Lane
- Buffered Bike Lane
- Paved Shoulder
- Sidewalk Bikeway
- Sharrows
- Shared Use Path

Corridor 10: Ocean View Avenue

Segment 1: I-64 Access to 4th View Street

Length: 1.9 miles

AADT: 6,200

Speed limit: 30 mph

Facility: Buffered bike lanes

Major Action: 4 to 2 Road diet



- Existing bike lanes are substandard width at 4' wide.



- The bike lane ends on the approach to 4th View Street without shared lane markings in the right turn lane.

Potential Design Challenges

- Though the existing bike lanes are substandard, implementation of this segment may be a lower priority, given the low traffic volumes and comfortable riding environment.
- The western end of this segment provides access to the I-64 bridge/tunnel which may cause periods of traffic volume higher than counts indicate. This may present a challenge to the road diet recommendation.

Segment 2: 4th View Street to First View Street

Length: 0.5 miles

AADT: 13,000

Speed limit: 30 to 35 mph

Facility: Buffered Bike Lanes

Major Action: Road diet; Install



- The single westbound lane (on left of photo) will need to be shared by bicycle and automobile traffic at the 4th View intersection.



- The existing shoulder on the eastbound flyover ramp is sufficient for bicycle travel but needs to be extended to the end of the ramp.

Potential Design Challenges

- The recommendations presented here should be viewed as interim solutions. To truly address the issues presented by complex traffic pattern in this area of the Tidewater Drive interchange, a full intersection redesign is recommended.

Corridor 10: Ocean View Avenue

Segment 2: 4th View Street to First View Street



- 1** Bicyclists will share the westbound lane with automobile traffic here. Shared lane markings and signage should be added to alert drivers.
- 2** The eastbound section from 4th View Street to the off ramp should be restriped to add a bike lane. The 14' left turn lane will need to be narrowed as will both of the 12' travel lanes.
- 3** The existing wide shoulder on the eastbound ramp should be striped and marked as a buffered bike lane.
- 4** The striped median in the westbound direction should be narrowed to accommodate a 7' buffered bike lane through this section.
- 5** Consider eliminating the left turn lane to allow the wide shoulder/buffered bike lane to continue on the right side of the travel lane through to Mason Creek Road.
- 6** Shared lane markings and signage should be added to the westbound lane between the grass median and curb. In the future, the median should be narrowed to accommodate a bike lane.

Corridor 10: Ocean View Avenue

Segment 3: First View Street to Sherwood Place

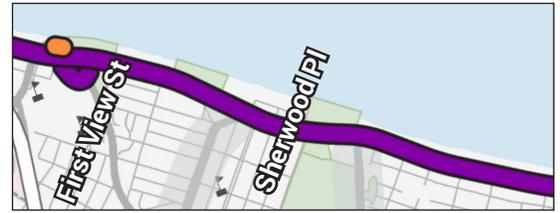
Length: 0.7 miles

AADT: 17,000

Speed limit: 35 mph

Facility: Buffered bike lanes

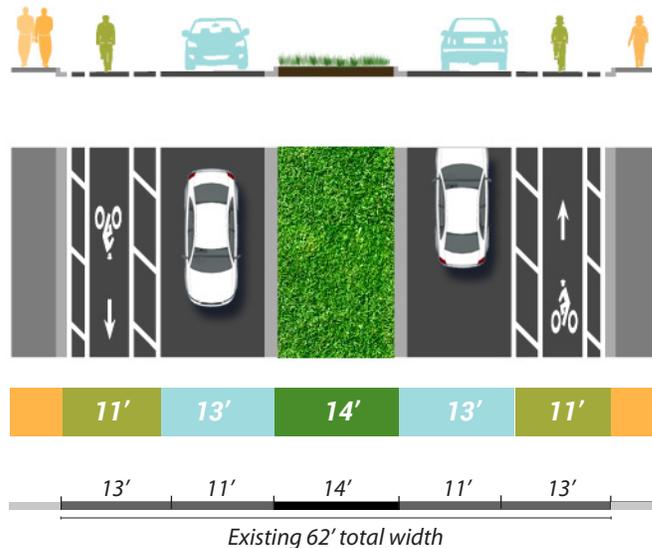
Major Action: 4 to 2 Road diet



- The City has made improvements in this area of high pedestrian traffic area near Ocean View Beach Park.



- Left turn pockets are available for most intersections throughout this segment, making a road diet less likely to cause traffic congestion.



Potential Design Challenges

- A traffic study will be necessary to assess the feasibility of a 4-lane to 2-lane road diet through this segment. The given estimate is 17,000 vehicles per day which is likely feasible but needs to be confirmed.
- A sidepath on the north side through this segment would be desirable, especially to access the waterfront, but there does not appear to be enough right-of-way to accommodate widening the existing sidewalk.
- The intersection at Ocean View Avenue and Granby Street is complex and will need further study in the design process.

Corridor 10: Ocean View Avenue

Segment 4: Sherwood Place to 1st Bay Street

Length: 2.1 miles

AADT: 14,000

Speed limit: 35 mph

Facility: Buffered bike lanes

Major Action: 5 to 3 Road diet



- Shared lane markings exist today from Chesapeake Boulevard to Willow Terrace but do not provide a comfortable bicycling experience.



- East of Beaumont Street, parking boxes are striped on the south side of the street. They shift to the north side after Cape View Avenue.

Segment 5: 1st Bay Street to 19th Bay Street

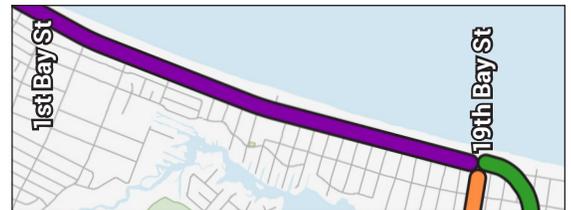
Length: 1.2 miles

AADT: 16,000

Speed limit: 35 mph

Facility: Buffered bike lanes

Major Action: 4 to 3 Road diet



- The many turning movements into residential and commercial driveways are not accommodated in the four-lane section today.



Existing 48' total width

Potential Design Challenges

- There are no major challenges to implementation of this recommendation.

Corridor 10: Ocean View Avenue Alternate Route

Segment 6: Ocean View Avenue to Shore Drive

Length: 0.6 miles

AADT: < 2,400

Speed limit: 25 mph

Facility: Shared lane markings;
trail

Major Action: Install; construct



An alternate route is needed in this section because traffic volumes may be too high on Ocean View Avenue to accommodate a road diet.

The alternative routing also connects to a community park and will provide a pedestrian and bicycle route from East Beach to the park that avoids the large intersection at Ocean View Avenue and Pretty Lake Avenue.

1 The intersection at 19th Bay Street and Ocean View Avenue needs an improved crossing to facilitate left turns by north/westbound bicyclists. A high visibility crosswalk and actuated rectangular rapid flashing beacon are recommended.

2 A shared use path should be constructed along the existing public right-of-way (paper street) through East Ocean View Community Park to connect 19th Bay Street to 21st Bay Street.

3 Eastbound bicyclists will be directed to turn right onto Shore Drive from Pretty Lake Avenue. Westbound bicyclists will make a right turn from Shore Drive onto Pretty Lake Avenue.

4 A shared use path should be constructed along the existing paper street that would go underneath the Shore Drive bridge and connect to Pretty Lake Drive west of the bridge.

Corridor 10: Shore Drive

Segment 7: Pretty Lake Ave to Little Creek Rd

Length: 0.6 miles

AADT: 22,000 - 32,000

Speed limit: 35 mph

Facility: Bike lanes

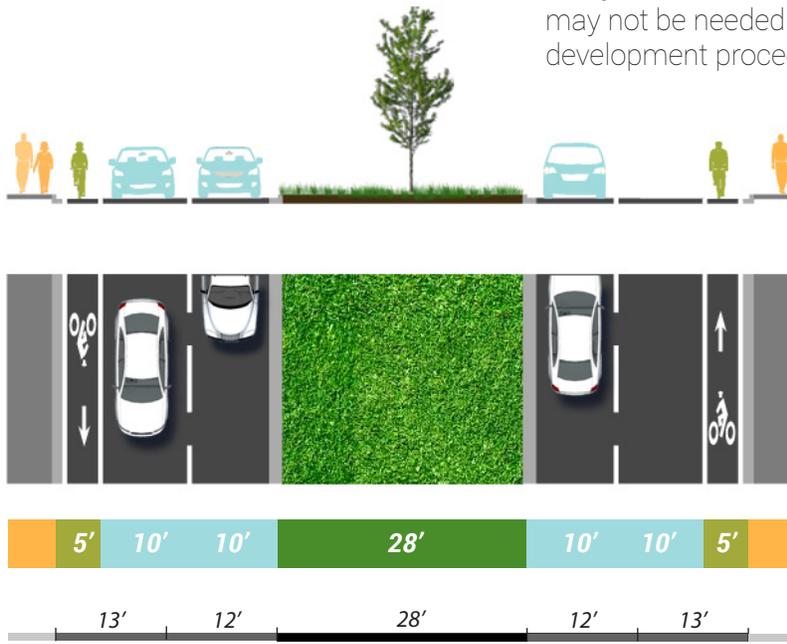
Major Action: Lane diet; redesign



- The existing lanes are 12' and 13' wide in this segment.



- The southbound bike lane currently ends to accommodate a left turn lane just south of the bridge that may not be needed unless future development proceeds.



Potential Design Challenges

- The left turn lane pictured above will need to be removed to provide enough space to add a bike lane in this area. It appears to be in preparation for planned development. If and when this development continues on the east side of Shore Drive and a left turn lane is actually needed, the developer should be required to move the west curb line to continue to provide enough space for the bike facility.
- The intersection at Little Creek Road is complex with a long right turn lane which will present an extended conflict zone for bicyclists and drivers. Design treatments will need to be added to alert both modes to this conflict.

Corridor 10: Shore Drive

Segment 8: Little Creek Road to Diamond Springs Road

Length: 1.2 miles

AADT: 32,000

Speed limit: 45 mph

Facility: Sidewalk bikeway; shoulders

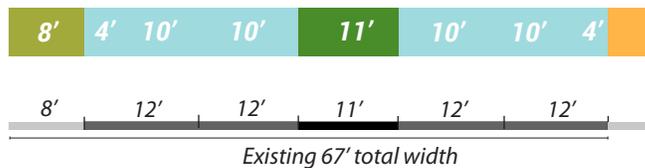
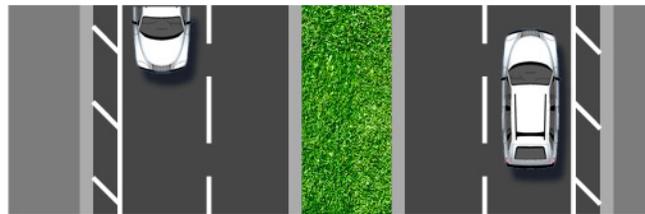
Major Action: Maintain; pave



- The existing sidewalk on the north side is 8' wide but half covered with tree debris and sand. Regular maintenance is needed.



- There are no curb ramps, crosswalks or bike/pedestrian warning signs for drivers at the driveway access to JEB Little Creek-Fort Story.

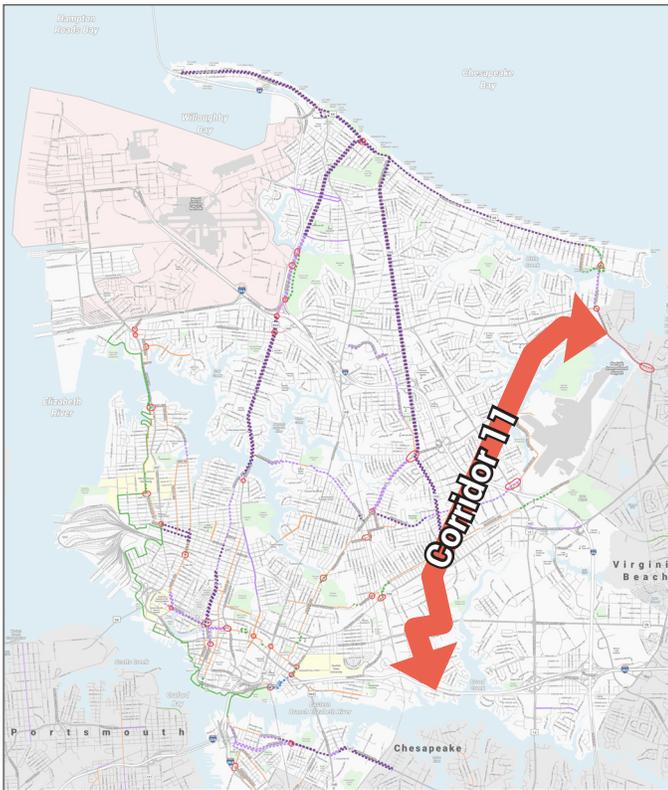


Potential Design Challenges

- While not ideal for all bicyclists, making the existing 8' sidewalk fully functional for two-way bicycling will provide a linkage to Virginia Beach that serves "interested but concerned" riders.
- The intersection at Little Creek Road needs to accommodate bicyclist transitions to and from the sidewalk, likely with a two-stage left turn for southbound bicyclists. Wayfinding will be needed.
- For the sidewalk bikeway, curb ramps should be installed where they do not exist and existing ramps will need to be maintained and repaired.
- It may be necessary to move the guard rail along the south side of the street east of Huetite Drive to pave a contiguous 4' shoulder to accommodate those bicyclists who prefer not to use the sidewalk route.

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Corridor 11: Ingleside Road Tide Station to Airport via Azalea Garden Road



Length: 6.7 miles

Speed Limit: 25-35 mph

Curb-to-Curb Width:
24 - 55'

AADT: 2,400 - 30,000

Land Use:

Mostly low-density residential; Tide station and industrial district at southern end; Botanical Garden at northern end

Key Bicycle Facilities:

Shared use path along Virginia Beach Boulevard; Buffered bike lanes

Key Pedestrian Improvement:

Shared use path along Virginia Beach Boulevard; Paved shoulder along Azalea Garden Road

Purpose of Improvements

- Provide the eastern segment of a citywide recreational loop route.
- Connect east side neighborhoods to popular destinations on the east side of Norfolk, including the ocean beaches, Botanical Garden, the Airport and the Ingleside Road station.
- Connect east side neighborhoods to east-west routes on Corridors 7 and 8 which lead the heart of the city and to Virginia Beach.
- Improve a route that crosses I-264 at a location without an interchange, thus avoiding the conflicts created by at-grade on- and off-ramp crossings.

Estimated Project Cost

\$3,000,000

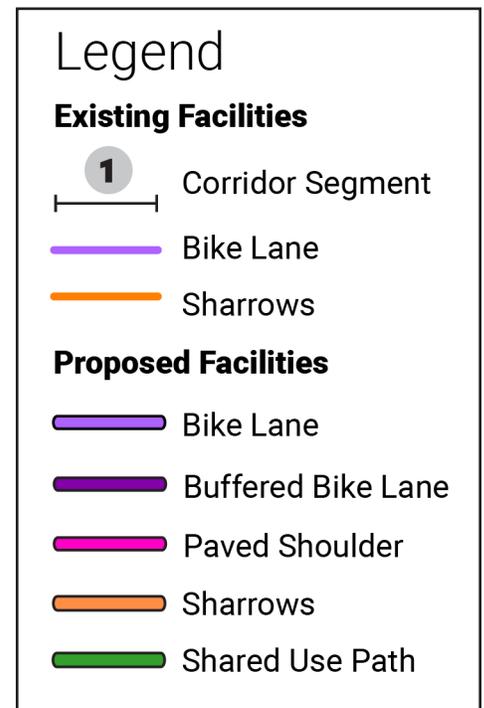
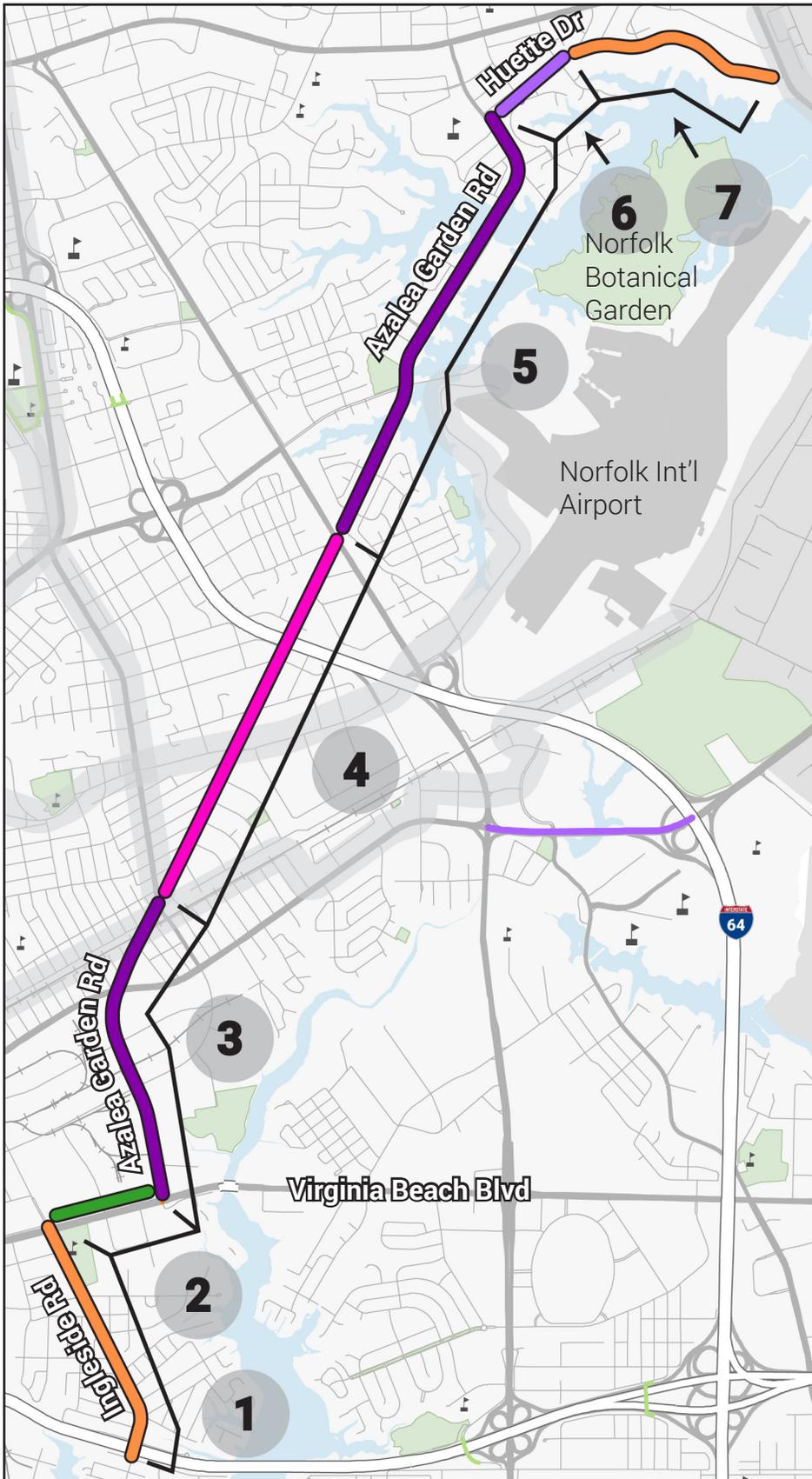
Key Challenges

- Bicyclist movements onto and off of the trail along Virginia Beach Boulevard will require a high level of design attention. There will be complex movements across busy arterial streets.
- Additional complex intersections with traffic volumes, truck traffic, large volumes of turning traffic and high speeds will present design challenges. These also include Huette Drive at Shore Drive and Azalea Garden Road at Military Highway and at Princess Anne Road.

Public Input

- Residents noted that a portion of this corridor is part of a popular recreational riding loop.
- The Botanical Garden received the highest number of mentions on the WikiMap as an important bicycle destination.

Corridor 11: Recommendations Overview Map



Corridor 11: Ingleside Road and Virginia Beach Boulevard

Segment 1: Mississippi Avenue to Virginia Beach Boulevard

Length: 0.9 miles

AADT: 3,100

Speed limit: 25 mph

Facility: Shared lane markings

Major Action: Install



- Lighting of the I-264 underpass is minimal and should be improved.



- Ingleside is a narrow neighborhood street that will provide a comfortable riding environment



Potential Design Challenges

- There are no major design challenges to implementation of this recommendation.

Segment 2: Ingleside Road to Azalea Garden Road

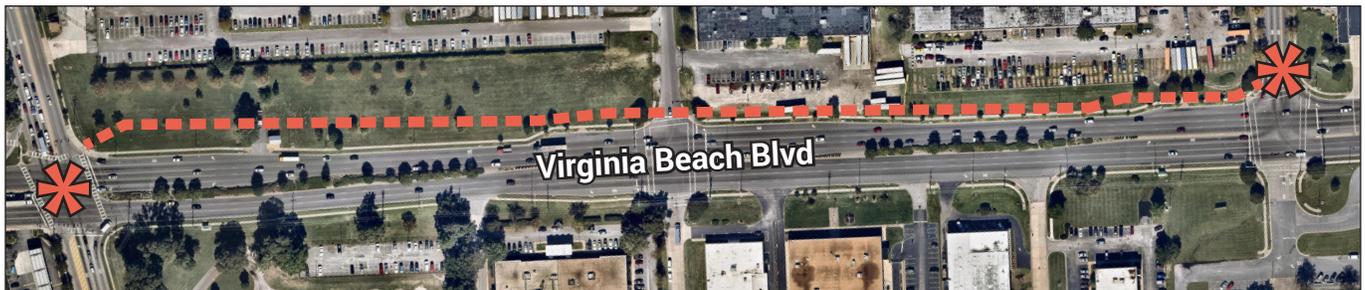
Length: 0.4 miles

AADT: 30,000

Speed limit: 35 mph

Facility: Shared use path

Major Action: Construct



Potential Design Challenges

- At Ingleside and Virginia Beach Boulevard (VBB), bicyclists should be accommodated using a two-stage crossing of the east leg of VBB and the south leg of Ingleside. Signing, striping and potentially signal modifications at these crossings should make it clear to motorists making northbound right turns from Ingleside and eastbound rights from VBB that they are crossing a two-way bikeway and a pedestrian crosswalk.
- The same approach should be taken at Azalea Garden Road and VBB, where northbound cyclists using the route will need to cross the northern leg of Azalea Garden Road prior to turning left up AGR and potentially subject to conflicts with a variety of motor vehicle turning movements, depending on how signalization is designed.

Corridor 11: Azalea Garden Road

Segment 3: Virginia Beach Boulevard to Sewells Point Road

Length: 1.1 miles

AADT: 9,300 - 13,000

Speed limit: 35 mph

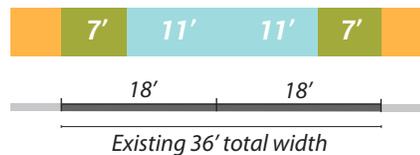
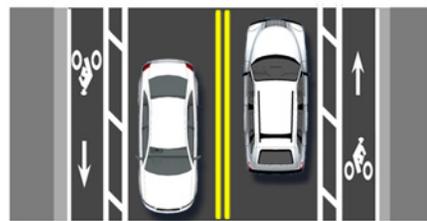
Facility: Buffered bike lane

Major Action: Lane diet; 5 to 3 Road diet



- A 150' two-way left turn lane anomaly exists north of Patent Road for movements onto Patent and into one of the commercial properties.

- From Princess Anne Road to Sewells Point Road, there are currently four travel lanes and a center turn lane. Buffered bike lanes will be accommodated through a road diet.



Recommended cross section for lane diet section, Virginia Beach Boulevard to Princess Anne Road

Potential Design Challenges

- This design does not accommodate the existing pocket two-way left turn lane north of Patent Road.
- The intersection at Princess Anne Road will need to be evaluated for the potential removal of one or more turn lanes to accommodate a continuous bicycle facility.
- The northbound right turn slip lane at Sewells Point Road will create a conflict with the buffered bike lane facility and should be removed.
- Making the northbound left turn connection to Corridor 12 at Sewells Point Road is difficult today and will require some special design.

Corridor 11: Azalea Garden Road

Segment 4: Sewells Point Road to Military Highway

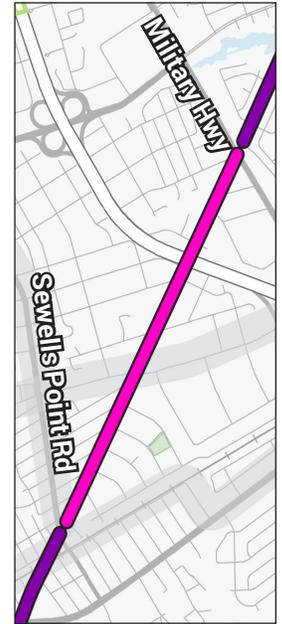
Length: 1.4 miles

AADT: 7,900 - 8,200

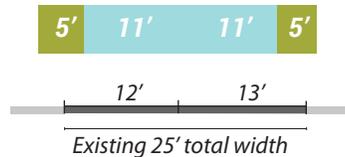
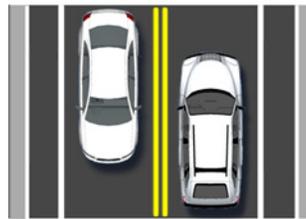
Speed limit: 35 mph

Facility: Paved shoulder

Major Action: Widen road



- The current gravel shoulder appears well-built and is suitable for paving to provide a 5' to 6' paved shoulder.
- There are no sidewalks on either side of the street for the majority of this segment.



Potential Design Challenges

- The intersection at Robin Hood Road may require some re-striping to accommodate a new bicycle facility in the roadway.
- There is a 1000' section north of Robin Hood Road that has curb and gutter on the east side of the street. This area may need reconstruction of the roadway edge to provide a continuous shoulder.
- Crosswalks will need to be added to sidestreets indicating the pedestrian path of travel.
- Additional lighting is needed under the I-64 overpass.

Corridor 11: Azalea Garden Road & Huette Drive

Segment 5: Military Highway to Huette Drive

Length: 1.7 miles

AADT: 11,000

Speed limit: 30 mph

Facility: Buffered bike lanes

Major Action: 4 to 2 Road diet



- The existing four-lane roadway and low traffic volumes lead to higher than posted travel speeds.
- This segment contains access to the Norfolk Botanical Gardens.

Potential Design Challenges

- The intersections of Azalea Garden with Military Highway and Norview Avenue will need some detailed design efforts to deal with turn lane configurations.

Segment 6: Azalea Garden Road to Cameilla Drive

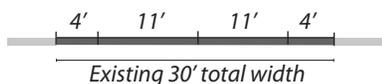
Length: 0.5 miles

AADT: 2,400

Speed limit: 25 mph

Facility: Bike lanes

Major Action:
Restripe to widen
bike lane



Implementation Issue

- There are no particular design challenges to implementation of this segment, however this is a low-priority improvement as bike lanes already exist on this low-volume street.

Corridor 11: Huette Drive

Segment 7: Cameilla Road to Shore Drive

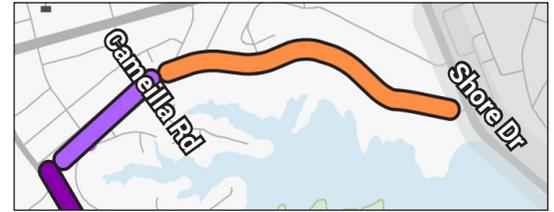
Length: 0.7 miles

AADT: 2,400

Speed limit: 25 mph

Facility: Bicycle Boulevard

Major Action: Install



- Some traffic calming already exists in this segment in the form of speed humps.



- This segment has a narrow 22' roadway



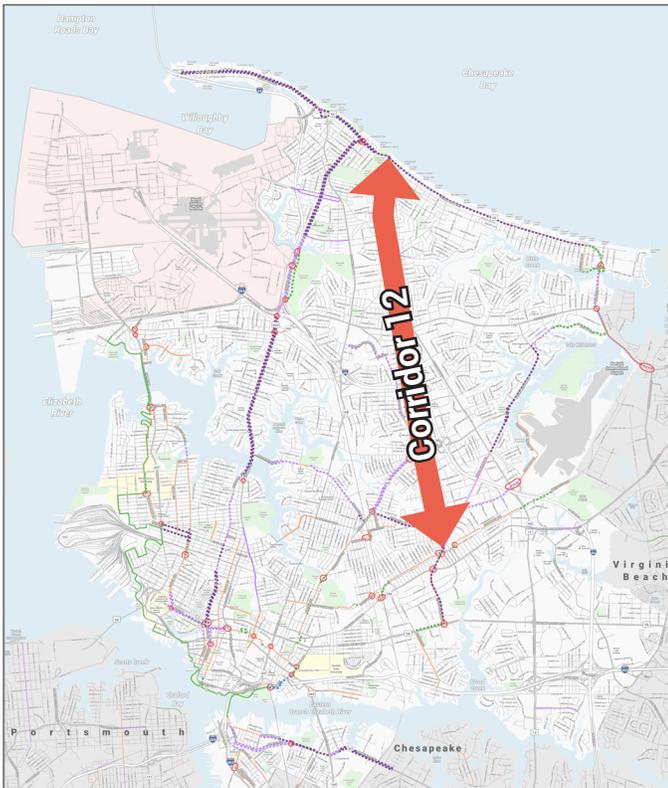
- A BIKES MAY USE FULL LANE sign would alert drivers to expect bicyclists in the roadway especially at the blind curve locations along this Huette Drive.

Potential Design Challenges

- It will be necessary to do outreach to adjacent residents about implementation of additional traffic calming measures which will further slow traffic on the street.
- Facilitating the left turn to travel northbound on Shore Drive (Corridor 10) at the end of this corridor will require some detailed design work.

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Corridor 12: Sewells Point Road and Chesapeake Boulevard Bikeway



Length: 5.5 miles
Speed Limit: 25-40 mph
Curb-to-Curb Width: 21 - 90'
AADT: 7,600 - 26,000

Land Use: Single and multi-family residential; Major commercial center at Five Points; Norview High School

Key Bicycle Facilities:

Buffered bike lanes

Key Pedestrian Improvement:

Improved intersection design at Five Points

Purpose of Improvements

- Connect the core of eastern Norfolk to Ocean View
- Improve bicyclist access to Five Points and Norview High School
- A spur route along Sewells Point Road connects to the Walmart Supercenter near Little Creek Road and Tidewater Drive

Alternatives Evaluation

- From Five Points north, Chesapeake Boulevard and an alternative route along Sewells Point Road and Old Ocean View Road were investigated. The alternative was found to be less direct and require more crossing improvements than desirable. The road diet option on Chesapeake Boulevard will provide additional benefits of traffic calming that extend to other road users aside from bicyclists.

Estimated Project Cost

\$900,000*

**Note: Does not include cost of alternative route on segments 3, 4 and 5*

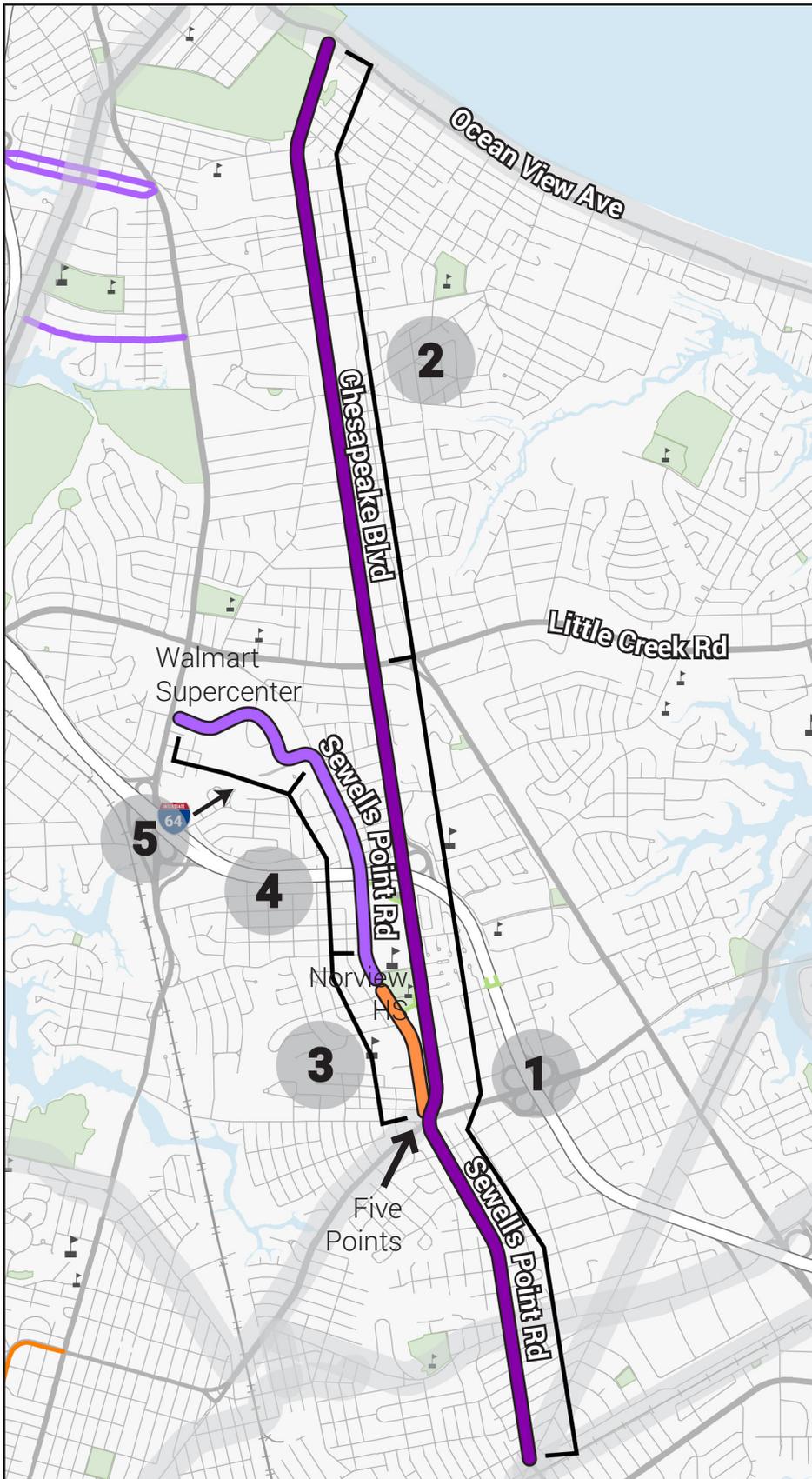
Key Challenges

- Development of safe bikeway crossings of the on- and off-ramps at the I-64 interchange.
- Design of bicycle accommodations at Five Points, a complex intersection
- Potential need for a traffic study to confirm feasibility of recommendations and support the facility design process

Public Input

- Chesapeake Boulevard was identified as an opportunity to provide a longer distance north-south connection.
- The Walmart was identified as a major destination.

Corridor 12: Recommendations Overview Map



Legend

Existing Facilities

- ① Corridor Segment
- Bike Lane
- Sharrows

Proposed Facilities

- Bike Lane
- Buffered Bike Lane
- Sharrows

Corridor 12: Sewells Point Road and Chesapeake Boulevard

Segment 1: Azalea Garden Road to Little Creek Road

Length: 3.1 miles

AADT: 12,000 - 26,000

Speed limit: 35 to 40 mph

Facility: Buffered bike lanes

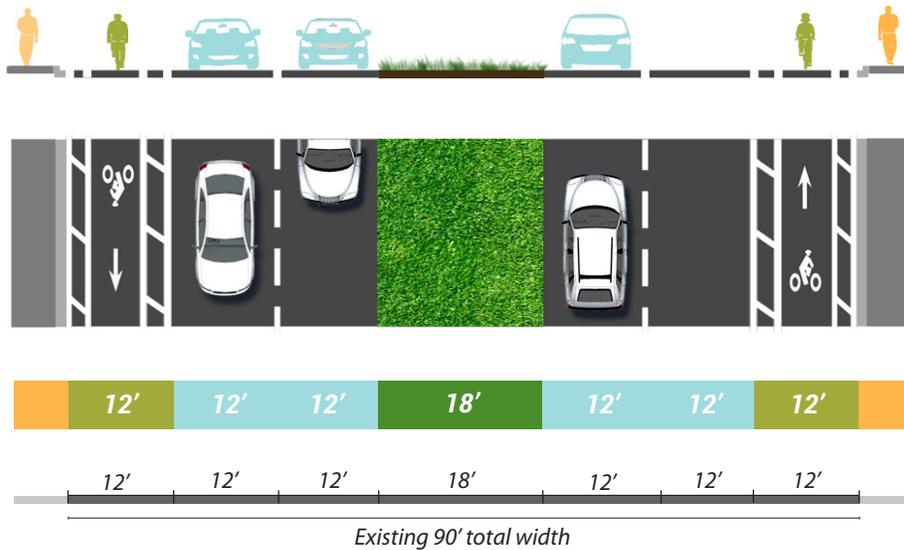
Major Action: 5 to 3 Road diet; 6 to 4 Road diet



- The five-lane section of Sewells Point Road stretches from Azalea Garden Road to Norview Avenue.



- The six-lane divided section of Chesapeake Boulevard stretches from Norview Avenue to Little Creek Road.



Recommended cross section for Chesapeake Boulevard from Norview Avenue to Little Creek Road.

Potential Design Challenges

- Similar to Corridor 3 on Granby Street, the design of buffered bike lanes will need to accommodate mixing/crossing zones where bus stops are located. Bus routes occur on both Sewells Point Road and Chesapeake Boulevard.

Corridor 12: Key Intersection

Segment 1-INT: Chesapeake Boulevard and I-64 Interchange



1 The rightmost lane converts to a right-turn only lane onto I-64 at these locations and continues through the underpass. It may be advisable to route bicyclists onto a wide sidewalk through these segments.

2 On-ramp crossings present conflicts with high-speed motor vehicle movements. Highly visible crossing treatments will be needed.

3 A lane is added at the end of both off-ramps, so drivers are not forced to yield to traffic on Chesapeake Boulevard and may maintain higher speeds as they enter the city street. This conflict area requires detailed design to ensure bicyclists' safe crossing.

Corridor 12: Chesapeake Boulevard

Segment 2: Little Creek Road to Ocean View Avenue

Length: 2.4 miles

AADT: 7,600 - 12,000

Speed limit: 35 mph

Facility: Buffered bike lanes

Major Action: 4 to 2 Road diet

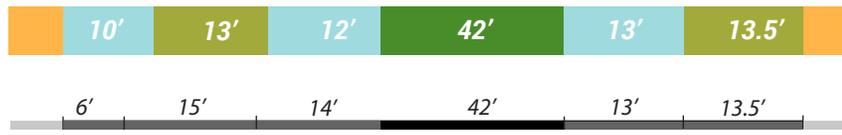


- The entire length of this segment has a wide grass median with no curbs.

- Portions of this segment near the northern end around Liecster Avenue have a wide shoulder that is used for parking.



Recommended cross section for Euwanee Place to Liecster Avenue



Potential Design Challenges

- The southernmost portion of this segment may have higher AADT than indicated by current counts. An updated count and possible traffic study may be necessary to implement this road diet recommendation.

Corridor 12: Sewells Point Road

Segment 3: Norview Avenue to Quail Street

Length: 0.5 miles

AADT: 7,600

Speed limit: 25 mph

Facility: Shared lane markings

Major Action: Install



- Parking is allowed on the east side of the street from Norview Avenue to Strand Street.



- The street narrows to 21' north of Strand Street and parking is removed.



Potential Design Challenges

- Shared lane markings will indicate that drivers are likely to encounter bicyclists, but some drivers were observed exceeding the 25 mph speed limit. Unless traffic calming measures or enforcement activity changes, the facility will not be comfortable for the full range of bicyclists.

Segment 4: Quail Street to Philpotts Road

Length: 0.1 miles

AADT: 7,600

Speed limit: 25 mph

Facility: Bike lanes

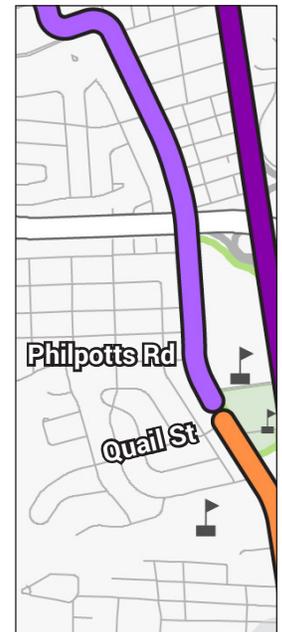
Major Action: Lane diet



- An off-street asphalt path is located on the east side of the street.



- Wide lanes (15' to 18.5') can encourage illegal passing in this area and higher speeds adjacent to a school site.



Potential Design Challenges

- There are no major design challenges to implementation of this recommendation.

Corridor 12: Sewells Point Road

Segment 5: Philpotts Road to Denison Avenue

Length: 0.8 miles

AADT: 7,600

Speed limit: 25 to 30 mph

Facility: Bike lanes

Major Action: 3 to 2 Road diet; 4 to 3

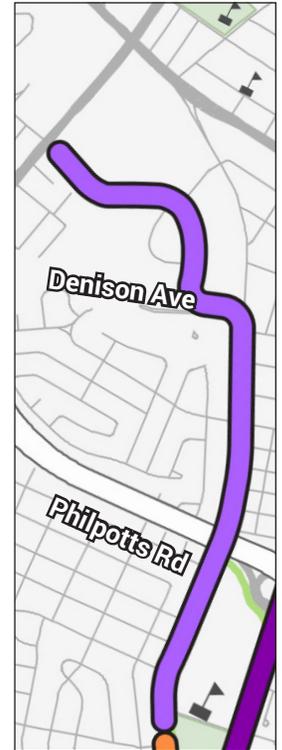
Road diet



- There are currently two northbound lanes and one southbound in the first half of this segment.



- The northern section of this segment has four lanes with turn lanes designated at Philpotts Road and Johnstons Road.



Existing 44' total width

Recommended cross section for road diet segment from Widgeon Road to Denison Avenue.

Potential Design Challenges

- The northbound turn lane distinctions at Widgeon Road will need to be eliminated to accommodate bike lanes through the entire segment. It is unlikely that they are necessary. A left turn lane in the southbound direction can be maintained.

Corridor 12: Denison Ave and Central Business Park Dr

Segment 6: Sewells Point Road to Walmart entrance

Length: 0.5 miles

AADT: < 2,400

Speed limit: 25 mph

Facility: Bike lanes

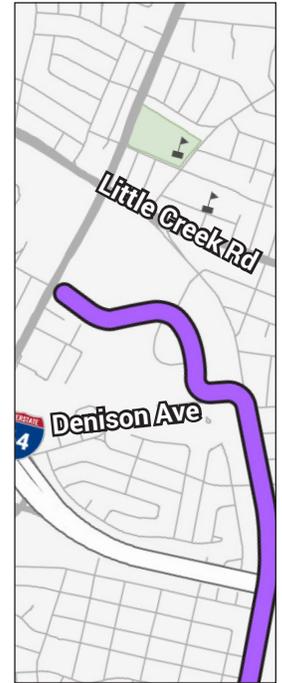
Major Action: Lane diet



- Denison Avenue currently has wide, 15' lanes on either side of a grass median.



- Central Business Park Drive provides access to the side entrance of the Walmart Supercenter shopping plaza.



Potential Design Challenges

- There are no major design challenges to implementation of this recommendation.

Appendix A: Public Engagement

The 2015 Norfolk Bicycle & Pedestrian Strategic Plan (Plan) project included high-level collaboration with the public and stakeholder engagement focused on the following groups:

- **Technical Committee:** Representatives from key City agencies. The committee met six times during the course of the Plan. Additionally, members of the technical committee and citizen activists hosted two guided bicycle tours for the project team.
- **Stakeholders/Focus Groups:** Advocates, other City departments, universities, and the business community. Interest areas for the focus groups included economics, safety, health, and education.
- **Norfolk Bicycling and Pedestrian Trails Commission:** Citizen advocates interested in making Norfolk more bike and walk friendly.
- **City Council:** Regular updates and information were provided to the council via the project manager and Deputy City Manager.
- **General Public:** Emphasizing outreach to non-traditional constituents through news articles; open house meetings, online engagement and survey.

The project engaged the aforementioned groups in a variety of ways throughout the course of the project: project web site, formal and informal meetings, focused stakeholder meetings, public open houses, and participation in key citywide events. Since the Plan process officially began, the City has reached out to the public in a variety of ways, which are summarized in this memorandum. The City staff has also participated in regular Bicycle and Pedestrian Advisory Committee meetings, ADA Advisory Committee meetings, neighborhood meetings, and attended citywide events with information about the Plan Update.

Technical Committee Meetings

The Technical Committee was made up of key City staff from departments integral to bicycle and pedestrian planning, design and implementation. The group provided valuable feedback and ideas for planning documents, analyses, and outreach activities. The technical committee coordinated information dissemination and facilitated feedback from the non-profit, public and private sectors. The meetings indicated below represent key touch points throughout the planning process. Several other organized meetings took place related to corridor selection, facility recommendations review and draft plan development.

Committee meetings occurred in June 2014 (Kick-off); September 2014 (Corridor selection/public meeting preparation, bike tour); October 2014 (public meetings and corridor selection, bike tour); December 2014 (Fieldwork); and April 2015 (Plan review).

Project Technical Committee	
Susan Pollock	Department of Planning
Paul Forehand	Department of Parks & Recreation
Ben Kane	Department of Parks & Recreation
Paul Fillion	Department of Public Works
John Ward	Department of Public Works
Lori Crouch	Public Relations Manager
Greg Reck	Downtown Norfolk Council
John Stevenson	Department of Public Works
Travis Davidson	Tidewater Bicycle Association
Rob Brown	Department of Public Works
Jason Baines	Department of Parks and Recreation
Rachel McCall	Downtown Norfolk Council
Jeff Raliski	Department of Planning
Matt Hales	City Planning Commission
Markus Wegener	Norfolk Bicycling and Pedestrian Trails Commission

Technical Committee Kick-Off

Date: June 5, 2014

This meeting oriented technical committee members to the planning process and relevant expectations in supporting the project. The major components of the meeting included:

- Project Overview: scope, schedule, and management
- Project Issues: Opportunities and challenges, study priorities, formation and role of committee
- Project Tasks: review Formal plan approval, format of Final Plan Report
- Action items and next steps
- Milestones, deliverables and management meetings

Committee priorities identified at the meeting included: regional trail connections, innovative facility recommendations, naval base coordination, options for rail corridor use, corridor connectivity, ERT wayfinding, development requirements, tourism, CEPTED, implementation.

Norfolk Bicycling and Pedestrian Trails Commission Kick-Off

Date: June 5, 2014

This meeting had a similar purpose as the technical committee meeting and was intended to engage the Commission as ambassadors of the planning process and final Plan.

Commission priorities identified at the meeting included: connectivity throughout the city, regional connections, Shore Drive facilities, usable loops for bike transportation, Blue Grass to Beaches, ODU and NSU, Norfolk Police Academy, access to bridges.

Technical Committee – Corridor Selection and Preparation for Public Outreach

Date: September 11, 2014

The focus of this meeting was to begin identifying

priority corridors and to prepare for upcoming public outreach and focus group meetings.

Highlights: Discuss data collection for base map and corridor analysis, prepare for public and stakeholder involvement, review proposed corridor maps in preparation for final selection.

Technical Committee Meeting – Field Work

Date: December 15, 2014

This TC meeting occurred at the beginning of our week long site visit and served to inform the committee of the field work process and priorities. Additionally, the project team reviewed the approach and objectives for several focus group meetings that took place that week.

Highlights: Described map books, field forms, and approach to field work. Coordinated with committee on approach to facility recommendations during site visit. Coordinated with committee on focus group meetings.

Technical Committee Meeting – Corridor Recommendations Review

Date: April 24, 2015

Highlights: In-depth review of facility recommendations spreadsheet. The group discussed the consultant team's recommendation process, methodology and analysis. The team received and documented committee comments and questions.

Bicycle Tours

The technical committee with assistance from the Bicycling and Pedestrian Trails Commission hosted two bicycle tours of the city. Members of the consultant team visited key corridors throughout the city becoming familiar with challenges and barriers to making the city more biking and walking friendly. The tours focused on key bicycle/pedestrian corridors and identified desirable characteristics of future bicycle/pedestrian facilities.

During both tours the groups made several programmed stops to discuss the pros and cons of different street environments. Photographs and notes were taken at specific locations to document concerns of the members. Some key findings from

the rides include:

- Developed a keen sense of the physical barriers (highways, bridges, railroads and waterways) in Norfolk.
- Learned about the wayfinding challenges of the Elizabeth River Trail.
- Gained insight into the “local” routes that bicyclists take to navigate the city.
- Observed local biking and walking behaviors.
- Built excellent rapport with the technical committee and members of the Bicycling and Pedestrian Trails Commission as we entered into the recommendations phase of the project.



Committee members toured a number of parts of the city to assess bicycling conditions first-hand.

Public Outreach

Public Open Houses – Project Kick-Off

Dates: October 15th, 16th and 22nd, 2014

In coordination with City staff, Technical Committee members, and the Bicycling, Pedestrian and Trails Commission, the TDG Team with City staff facilitated three public open houses to provide information and gather input from any and all interested area citizens. The format for the first set of meetings was a combination “open house” and public workshop to

introduce the project, capture input on existing needs and motivate future involvement in the planning process

The meetings featured activities and interactive tools that provided a variety of ways for attendees to provide comments and ideas. The TDG Team and City staff employed various techniques to encourage participation from groups that are typically not active participants in bicycle plans such as University Students, non-bicyclists, low-income residents, and visitors to the city.

Each meeting included “stations” for public review and comment to identify barriers to biking and walking, as well as desired routes. Participants provided input through comments at designated map stations and they were invited to use an online interactive map. Comments from participants were documented and incorporated into the corridor analysis phase of the planning process.

Public Open House – Final Plan

Scheduled date: October 6, 2015

The final meeting will be an open house and presentation to report on the final corridor network, recommended facilities, and strategies for implementation. The meeting is intended to offer citizens an opportunity see and hear about the final plan and to garner public support for plan adoption by City officials.

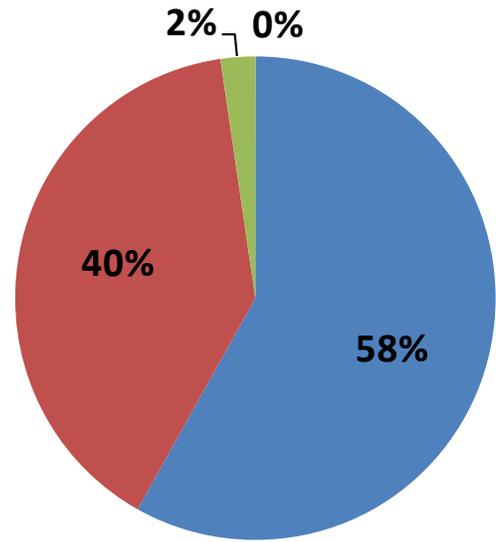
Public Meeting Survey

A series of questions were handed out at each public meeting. These questions enabled the project team to better understand current walking and bicycling behaviors and guide where improvements should be located to have the biggest impact on improving biking and walking in Norfolk. The questions and responses are outlined on the following pages from 44 completed surveys.

What is your home zip code?

ZIP Code	# of attendees
23508	18
23507	9
23503	2
23504	1
23529	1
23505	4
23517	1
23518	1
23510	2
23509	2
23505	1
23502	1
23322	1

How often do you walk for 10 minutes or more in Norfolk?

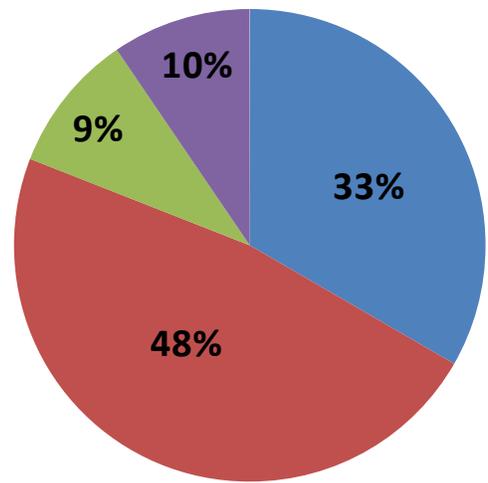


What is your school/work zip code?

ZIP Code	# of attendees
23504	3
23455	1
23507	4
23503	2
23510	11
23460	1
23511	1
23508	6
23320	2
23517	1
23502	1
23529	2
23703	1
23456	1
23513	1
23185	1
Navy Base	1

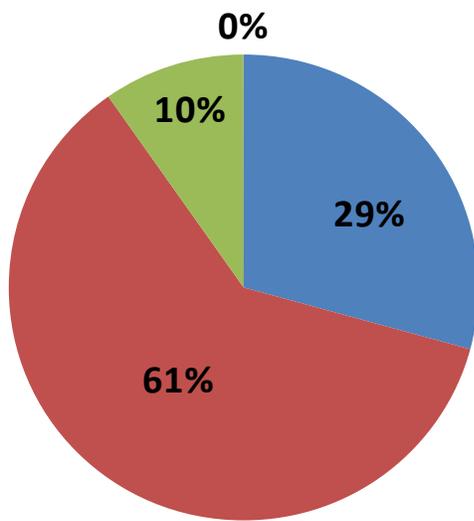
- Daily
- A few times a week
- A few times a month
- A few times a year

How often do you bike for 10 minutes or more in Norfolk?



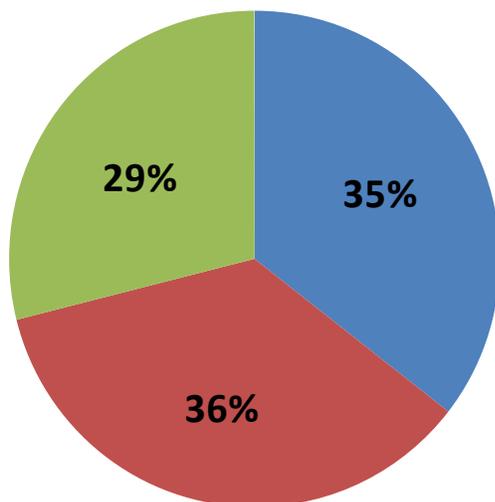
- Daily
- A few times a week
- A few times a month
- A few times a year

How would you classify yourself as a bike rider?



- Strong and Fearless
- Enthused and Confident
- Interested but Concerned
- No way, no how

Why do you ride a bike? (Instructed to check all that apply.)



- Fun
- Transportation
- Exercise

Focus Group Meetings

In addition to public outreach through citizen committees, public meetings, surveys and the on-line interactive map the project team conducted two focus group meetings. These meetings served to enhance the information and perspectives gained through the various outreach venues.

The purpose of the stakeholder focus groups was two-fold: one, to receive practical feedback and guidance from various user perspectives; and two, to foster buy-in and consensus among partners and organizations that play an active role in implementing the plan policies and recommendations.

The meetings conducted are indicated below. An additional meeting was organized for Naval Station Norfolk but was not attended.

Focus Group - Universities
 October 15, 2014 from 2:00 PM – 3:00 PM
 Attendance: 11

Focus Group - Downtown Complete Streets Committee
 October 16, 2014 from 8:00 AM – 9:00 AM
 Attendance: 15

On-line interactive map / WikiMap

A WikiMap was developed to help identify which corridors in Norfolk would be included in the City's strategic bicycle and pedestrian plan. A WikiMap is an online interactive map that interested residents can use to make comments and suggestions that help inform the final plan. In Norfolk, the WikiMap was open to the public from 10/30/2014 to 12/4/2014 and was available as a link from the City's bikeways and trails website. The public was encouraged to go online and contribute to the WikiMap during community meetings, through social media blasts, and through the local news. Over 750 individual comments were made by 142 different users. The results of this public effort helped determine the corridors included in this Strategic Plan. The tables below show a breakdown of WikiMap contributors by age, gender, motor vehicle ownership, and their self-described bicycling habits and level of comfort riding a bicycle.

Age	
Under 19	3
20-29	28
30-39	35
40-49	23
50-59	35
60 and older	17
Prefer not to say	1

Gender	
Female	46
Male	94
Prefer not to say	2

Motor Vehicle Ownership	
Own a motor vehicle	137
Do not own a motor vehicle	5

Self-described level of comfort riding a bicycle	
I am willing to ride in mixed traffic with automobiles on almost any type of street.	39
I am willing to ride in traffic, but I prefer dedicated bicycle lanes and routes.	67
I would like to bicycle more, but I prefer not to ride in traffic.	34
I do not ride a bicycle and am unlikely to ever do so.	2

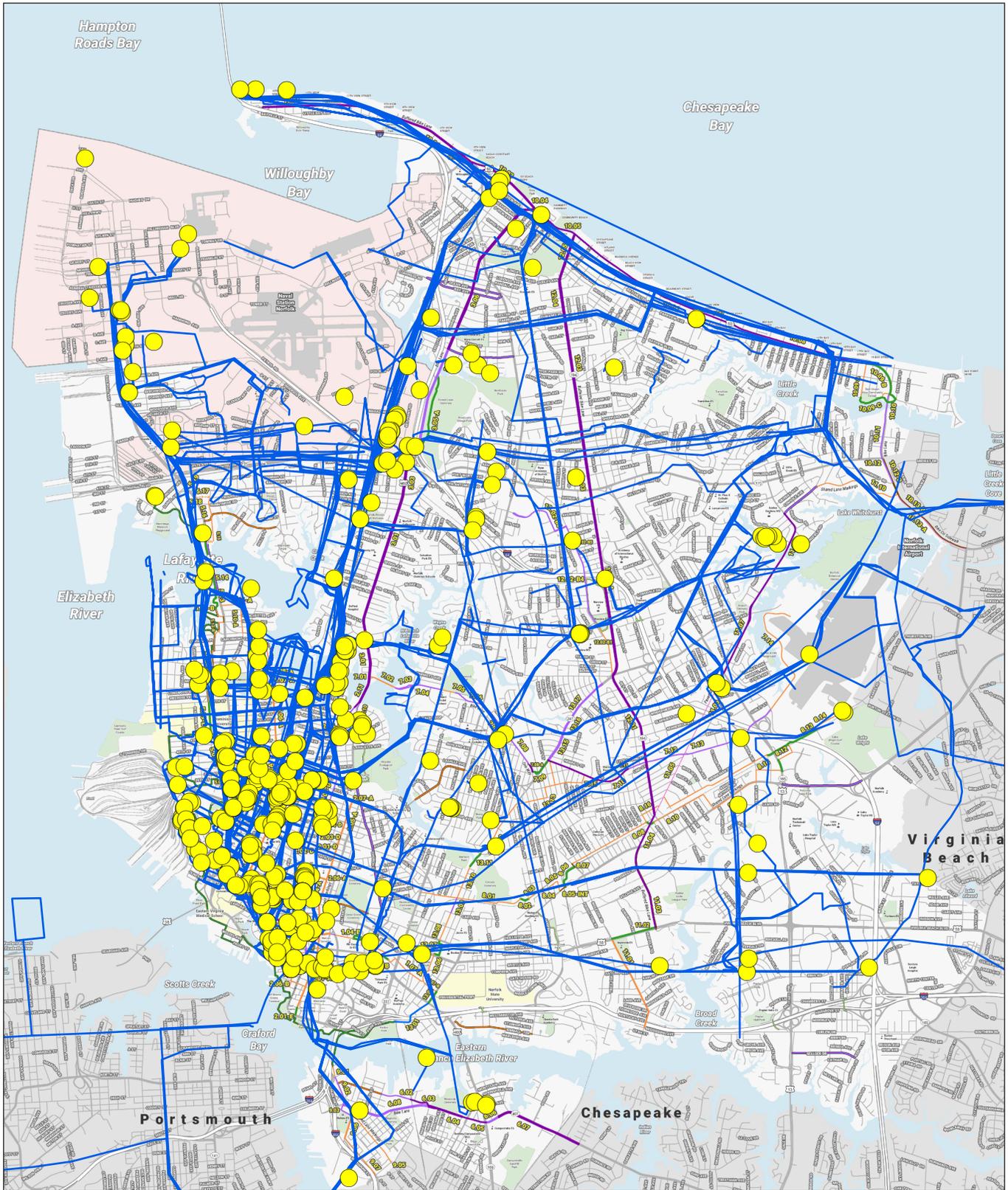
The WikiMap requested users to identify bicycle and pedestrian routes they currently use and would like to use, road segments that need improvement, barriers to bicycling and walking, and destinations they reach by walking or bicycling. The following table summarizes the number of contributed comments:

Point/Line Type Added	# Comments
Barriers to walking and bicycling	154
Road segments that need improvement	81
Needed trails	143
Walking destinations	29
Bicycling destinations	180
Currently used bicycling routes	170

WikiMap contributors were requested to identify the routes that they currently use for bicycling, those that need improvement, and locations that need trails to improve bicycle and pedestrian connectivity. Many of the bicycling routes used today are along Ocean Avenue, and in the downtown area near the Elizabeth River. WikiMap users also identified needed trails that also follow along Ocean Avenue and downtown, suggesting that many existing routes can be improved with additional facilities. Also, WikiMap contributors identified needed trails that provide additional east-west connectivity into the city.

In addition to providing the location of walking and bicycling destinations, WikiMap contributors also identified the type of destination: a link to adjacent communities (Virginia Beach, Chesapeake), dining or entertainment, park, recreation, school, shop, trail access, transportation link, work, or other destination. WikiMap users identified dining or entertainment destinations more often than any other destination type. Shops were the second most common destination added by WikiMap contributors. The following tables summarize the types of walking and bicycling destinations added to the WikiMap.

Bicycling Destination	# Comments
Link to adjacent community	9
Dining or entertainment	52
Recreation	33
School	4
Shop	40
Transportation link	8
Work	14
Other or no response	20



WikiMap comments clustered along a number of streets and informed the selection of Plan corridors.

Walking Destination	# Comments
Dining or entertainment	13
Park	2
Shop	6
Trail access	4
Transportation link	2
Other	2

The WikiMap users identified where barriers to walking and bicycling exist within the City of Norfolk as well as the type of barrier. Options for barriers included physical barriers such as highways, water, or railroad tracks; infrastructure issues such as missing sidewalks, missing connections, no bicycle detection, or poor lighting; and traffic barriers such as difficult intersection crossings or road segments having traffic that is too busy. WikiMap users could also list the barrier as “other” if it did not fit into a specific category. Difficult intersections, followed by traffic that is too busy were identified as the most common barriers to walking and bicycling by the WikiMap respondents.

Barrier to Walking or Bicycling	# Comments
Difficult intersections	66
Highway	15
Lighting	29
No connection	30
No detection	16
No sidewalks	18
Railroad	4
Too busy	44
Other	46

Lastly, the WikiMap users provided the location of individual road segments that could be improved for pedestrian and bicycle transportation as well as what could be improved. The options included traffic issues such as high speed or high volumes of traffic; road issues such as roads that are too narrow or roads without any bicycling facilities; and bicycling facilities that are too narrow for comfortable use.

Users also had the opportunity to choose “other,” if the issue was not addressed by the listed options. The most common reason for a road segment to need improvement was because it was lacking facilities, followed by high speed traffic.

Road Segment Needs Improvement	# Comments
Bike lane too narrow	20
High speed traffic	39
High volume traffic	34
No facility	44
Narrow road segment	26
Other	32

The information collected through the public WikiMap was used to select corridors that are included in the Plan network. The study corridors represent a convergence of the data collected. They cover both barriers to walking and bicycling and road segments that need to be improved as an approach to increase the amount, safety, and convenience of walking and bicycling. The corridors also represent opportunities to further connect Norfolk along routes people are currently using and trails that they would like to use in order to reach walking and bicycling destinations within the city. Use of WikiMap input benefits the final Plan by incorporating local knowledge and insight in order to ensure that the Plan’s final recommendations address the public’s concerns and garner their support.

Appendix B: Level of Traffic Stress Analysis

A Bicycle Level of Traffic Stress (LTS) analysis evaluates the conditions of the roadway network in regard to the relative level of comfort a bicyclist experiences while riding on a specific road segment. Data about automobile speeds and volume, as well as the cross section of the roadway and type of bicycle facility are evaluated to determine a final stress level assessment.

The low stress bicycling concept is premised on the experience of the Dutch who have focused on building a connected bicycle network that minimize bicyclists interaction with motorized traffic. The approach targets mainstream adult bicyclists (Interested but Concerned population) by providing the following types of facilities:

- Shared lanes on low-volume, low-speed, local streets
- Bicycle lanes on moderate-volume, moderate-speed streets
- Separated bike lanes on high-volume or high-speed streets

The Bicycle LTS analysis classifies the segments of each priority corridor into four levels of traffic stress, with "LTS 1" being the least stressful and "LTS 4" being the most stressful. The classifications correspond to the upper limit of a type of bicyclist's comfort zone:

- LTS 1 – Suitable for nearly all riders: trails, separated bike lanes, low-volume streets
- LTS 2 – Interested but concerned adults: moderate-volume streets at 30 mph or less with shared lane or minimum width bike lanes
- LTS 3 – Enthused and confident adults: higher-volume streets at 30 mph with a minimum width bike lane
- LTS 4 – Strong and fearless adults: high-volume streets at 35 mph or more with a minimum width bike lane

In the simplified LTS analysis method used for Norfolk, streets were assigned a level of traffic stress 1 through 4 using the following data:

- Streets where bicyclists share the road with automobiles are assessed based on speed limit and traffic volume
- Streets with bike lanes or buffered bike lanes are evaluated based upon the width of the bike lane and speed limit
- Bicycle facilities fully separated from automobile traffic such as separated bike lanes, sidepaths and trails are deemed low-stress facilities

Shared lane and bike lane evaluations work on a "weakest link" principle whereby the element rated the most stressful trumps any other. For instance, Chesapeake Avenue is a street with a wide buffered bike lane recommended, but the speed limit is 40 mph. The speed of traffic gives Chesapeake an LTS rating of 4, the most stressful, in spite of the new wide bicycle facility. Similarly, the northern section of Colley Avenue has a speed limit of 30 mph which would create a low-stress riding environment, but current traffic counts indicate approximately 14,000 vehicles per day. That traffic volume means that a bicyclist would be passed by at least three automobiles a minute during the peak hours of the day. That leads to a more stressful riding environment, and Colley Avenue is rated LTS 4.

While some sections of the proposed facility network do not result in a low-stress riding environment, it is still important to start to implement facilities. As noted in Chapter 3, some buffered bike lanes may be retrofitted in the future to include vertical separation. This would change the stress level of Chesapeake Boulevard from LTS 4 to LTS 1. Other factors such as speed limits may also be changed to lower the stress level of other streets, though those recommendations are not made in this Plan.

The following map shows the results of the Level of Traffic Stress analysis for recommended facilities on all 12 corridors in Norfolk.



Appendix C: Cost Estimate Details

Planning-level cost estimates for construction of recommendations were developed to complement the Plan. They were developed by identifying pay items and establishing approximate per-mile quantities. Unit costs are based on 2015 dollars and were assigned based on historical cost data from Virginia Department of Transportation average prices and the estimator's experience and judgement. The costs shown reflect only the cost associated with construction of the particular bicycle facility indicated and do not reflect other costs that may be associated with a larger project such as right-of-way acquisition, signal timing assessment and design. Costs include pavement markings and standard signage for the facility type. Where applicable for implementation of a facility, costs also include eradication of existing pavement markings. The costs are intended to be general and used for planning purposes. A 10 to 30 percent contingency is applied to the cost for each item based on the type of project. The component unit costs for each facility type are detailed in the first set of tables in this appendix.

Per-mile costs for each type of bicycle facility were developed and applied to each segment of a corridor. These segment costs were totaled to come up with the corridor costs included in Chapter 4. Individual segment costs are available in a separate spreadsheet provided to the City.

Some corridors include recommendations for intersection improvements, and these costs were not included in the cost estimates. Recommendations such as crosswalks and High-Intensity Activated Crosswalk Beacons (HAWKs) are priced in Table 4 in this appendix. Additional pedestrian improvement types are also included in that table for the City's reference.

Norfolk Bike Plan - Conceptual Cost Estimates

Prepared: Friday, June 26, 2015

Shared Lane Markings

Includes: shared lane pavement marking at 250 foot spacing. No markings on existing roadway require removal.

Item	Unit	Quantity	Unit Cost	Total Cost	Assumptions
Thermoplastic Pavement Marking Symbol	EA	42	\$250.00	\$10,560	1 Symbol every 250 feet per side of the road 1 Sign every 500 feet, each side of road
Sign Panel (Class I)	EA	20	\$250.00	\$5,000	
Steel Sign Post (2x2 Inch Tubing)	EA	20	\$200.00	\$4,000	
Subtotal				\$19,560	
Lump Sum Items					
Maintenance of Traffic (10%)	LS	1.00	\$1,956.00	\$1,956	
				Subtotal	\$21,516
			10% Contingency	\$2,152	
Total Estimated Cost				\$23,700	→ \$4.49 Per Foot

Priority Shared Lane Marking Treatment

Includes: shared lane pavement marking at 125 foot spacing with green color bracketing symbol. No markings on existing roadway require removal.

Item	Unit	Quantity	Unit Cost	Total Cost	Assumptions
Thermoplastic Pavement Marking Symbol	EA	84	\$250.00	\$21,120	1 Symbol every 125 feet per side of the road 6'x10' color at \$325 per gal./100sf per gal. rounded to \$4/sf 1 Sign every 500 feet, each side of road
Green Bike Lane Paint	SF	5,069	\$4.00	\$20,275	
Sign Panel (Class I)	EA	20	\$250.00	\$5,000	
Steel Sign Post (2x2 Inch Tubing)	EA	20	\$200.00	\$4,000	
Subtotal				\$50,395	
Lump Sum Items					
Maintenance of Traffic (10%)	LS	1.00	\$5,040.00	\$5,040	
				Subtotal	\$55,435
			20% Contingency	\$11,087	
Total Estimated Cost				\$66,600	→ \$12.61 Per Foot

Bike Lanes

Includes: bicycle lane markings in both directions with bicycle lane signs. No markings on existing roadway require removal.

Item	Unit	Quantity	Unit Cost	Total Cost	Assumptions
Thermoplastic Pavement Marking Lines (4")	LF	10,560	\$3.00	\$31,680	2 solid lines entire length
Thermoplastic Pavement Marking Symbol	EA	53	\$250.00	\$13,200	
Sign Panel (Class I)	EA	20	\$250.00	\$5,000	1 Symbol every 200 feet, each side of road 1 Sign every 500 feet, each side of road
Steel Sign Post (2x2 Inch Tubing)	EA	20	\$200.00	\$4,000	
Bicycle Safe Grate	EA	18	\$680.00	\$11,968	Every 600', each side of road
Subtotal				\$65,848	
Lump Sum Items					
Maintenance of Traffic (10%)	LS	1.00	\$6,585.00	\$6,585	10% of Subtotal
				Subtotal	\$72,433
			20% Contingency	\$14,487	
Total Estimated Cost				\$87,000	→ \$16.48 Per Linear Foot

Table 3: Bicycle facility costs

Bike Lanes - Requires Roadway Widening (Outside of Existing Footprint)

Includes: bicycle lane markings in both directions with bicycle lane signs. Requires road widening up to 7' each side, 14' total, with 22' pavement overlay of existing roadway. Open drainage with drainage impacts.

Item	Unit	Quantity	Unit Cost	Total Cost	Assumptions
Earthwork, Excavation, Grading	CY	5,476	\$30.00	\$164,267	7 feet width and 2 feet depth, each side of road
Aggregate Base Course	CY	2,738	\$42.00	\$114,987	7 feet width and 1 feet depth, each side of road
Milling	SY	11,733	\$7.00	\$82,133	22 feet width
Asphalt Base Course	TON	2,779	\$91.00	\$252,884	14 feet width and 0.5 feet depth, 13.3 CF in a TON
Asphalt Surface Course	TON	2,387	\$80.00	\$190,938	36 feet width and 0.125 feet depth, 13.3 CF in a TON
Thermoplastic Pavement Marking Lines (4")	LF	10,560	\$3.00	\$31,680	2 solid lines entire length
Thermoplastic Pavement Marking Symbol	EA	53	\$250.00	\$13,250	1 Symbol every 200 feet each side of road (bike lane)
Sign Panel (Class I)	EA	20	\$250.00	\$5,000	1 Sign every 500 feet, each side of road
Steel Sign Post (2x2 Inch Tubing)	EA	20	\$200.00	\$4,000	
Subtotal				\$859,138	
Lump Sum Items					
Landscaping (10%)	LS	1.00	\$85,914.00	\$85,914	
Drainage and E&S (15%)	LS	1.00	\$128,871.00	\$128,871	
Maintenance of Traffic (10%)	LS	1.00	\$85,914.00	\$85,914	
Utility Adjustments (10%)	LS	1.00	\$85,914.00	\$85,914	
			Subtotal	\$1,245,751	
			30% Contingency	\$373,725	
			Total Estimated Cost	\$1,619,500	→ \$306.72 Per Foot

Paved Shoulder one side

Includes: bicycle lane markings in both directions with bicycle lane signs. Requires road widening up to 7' each side, 14' total, with 22' pavement overlay of existing roadway. Major grading required with curb and gutter. Drainage impacts.

Item	Unit	Quantity	Unit Cost	Total Cost	Assumptions
Earthwork, Excavation, Grading	CY	2,738	\$30.00	\$82,140	7 feet width and 2 feet depth, one side of road
Aggregate Base Course	CY	1,369	\$42.00	\$57,498	7 feet width and 1 feet depth, one side of road
Milling	SY	5,867	\$7.00	\$41,069	11 feet width
Asphalt Base Course	TON	1,390	\$91.00	\$126,490	7 feet width and 0.5 feet depth, 13.3 CF in a TON
Asphalt Surface Course	TON	464	\$80.00	\$37,120	18 feet width and 0.125 feet depth, 13.3 CF in a TON
Thermoplastic Pavement Marking Lines (4")	LF	5,280	\$3.00	\$15,840	1 solid lines entire length
Sign Panel (Class I)	EA	10	\$250.00	\$2,500	1 Sign every 500 feet, one side of road
Steel Sign Post (2x2 Inch Tubing)	EA	10	\$200.00	\$2,000	
Curb & Gutter	LF	530	\$25.00	\$13,250	5280' x 10%
Subtotal				\$377,907	
Lump Sum Items					
Landscaping (10%)	LS	1.00	\$37,791.00	\$37,791	
Drainage and E&S (15%)	LS	1.00	\$56,686.00	\$56,686	
Maintenance of Traffic (10%)	LS	1.00	\$37,791.00	\$37,791	
Utility Adjustments (10%)	LS	1.00	\$37,791.00	\$37,791	
			Subtotal	\$547,966	
			30% Contingency	\$164,390	
			Total Estimated Cost	\$712,400	\$134.92 Per Foot

Paved Shoulder

Includes: bicycle lane markings in both directions with bicycle lane signs. Requires road widening up to 7' each side, 14' total, with 22' pavement overlay of existing roadway. Major grading required with open drainage. Drainage impacts.

Item	Unit	Quantity	Unit Cost	Total Cost	Assumptions
Earthwork, Excavation, Grading	CY	5,476	\$30.00	\$164,267	7 feet width and 2 feet depth, each side of road
Aggregate Base Course	CY	2,738	\$42.00	\$114,987	7 feet width and 1 feet depth, each side of road
Milling	SY	11,733	\$7.00	\$82,131	22 feet width
Asphalt Base Course	TON	2,779	\$91.00	\$252,889	14 feet width and 0.5 feet depth, 13.3 CF in a TON
Asphalt Surface Course	TON	928	\$80.00	\$74,240	36 feet width and 0.125 feet depth, 13.3 CF in a TON
Thermoplastic Pavement Marking Lines (4")	LF	10,560	\$3.00	\$31,680	2 solid lines entire length
Sign Panel (Class I)	EA	20	\$250.00	\$5,000	1 Sign every 500 feet, each side of road
Steel Sign Post (2x2 Inch Tubing)	EA	20	\$200.00	\$4,000	
Subtotal				\$729,193	
Lump Sum Items					
Landscaping (10%)	LS	1.00	\$72,919.00	\$72,919	
Drainage and E&S (15%)	LS	1.00	\$109,379.00	\$109,379	
Maintenance of Traffic (10%)	LS	1.00	\$72,919.00	\$72,919	
Utility Adjustments (10%)	LS	1.00	\$72,919.00	\$72,919	
			Subtotal	\$1,057,329	
			30% Contingency	\$317,199	
			Total Estimated Cost	\$1,374,600	\$260.34 Per Foot

Buffered Bike Lane

Includes: add buffer markings to existing roadway in both directions with bicycle lane signs. Eradicate and reinstall lane lines on road.

Item	Unit	Quantity	Unit Cost	Total Cost	Assumptions
Thermoplastic Pavement Marking Lines (4")	LF	25,608	\$3.00	\$76,824	2 solid lines entire length, each side of road, and gore for buffer
Thermoplastic Pavement Marking Buffer Lines (6")	LF	1,056	\$3.50	\$3,696	1 solid line, 4 feet long, every 40 feet
Thermoplastic Pavement Marking Symbol	EA	53	\$250.00	\$13,200	1 Symbol every 200 feet, each side of road
Sign Panel (Class I)	EA	20	\$250.00	\$5,000	1 Sign every 500 feet, each side of road
Steel Sign Post (2x2 Inch Tubing)	EA	20	\$200.00	\$4,000	
Eradication (Skip Lines)	LF	2,640	\$0.50	\$1,320	eradicate 2 skip lines
Replace Skip Lines	LF	2,640	\$2.60	\$6,864	
Bicycle Safe Grate	EA	18	\$680.00	\$11,968	Every 600', each side of road
Subtotal				\$122,872	
Lump Sum Items					
Maintenance of Traffic (10%)	LS	1.00	\$12,287.00	\$12,287	
			Subtotal	\$135,159	
			20% Contingency	\$27,032	
Total Estimated Cost				\$162,200	→ \$30.72 Per Foot

Cycle Track - Retrofit with Flexible Delineators

Includes: Cycle Track with no widening.

Item	Unit	Quantity	Unit Cost	Total Cost	Assumptions
Thermoplastic Pavement Marking Lines (4")	LF	25,608	\$3.00	\$76,824	2 solid lines entire length, each side of road, and gore for buffer
Thermoplastic Pavement Marking Buffer Lines (6")	LF	1,056	\$3.50	\$3,696	1 solid line, 4 feet long, every 40 feet
Thermoplastic Pavement Marking Symbol	EA	53	\$250.00	\$13,200	1 Symbol every 200 feet, each side of road
Sign Panel (Class I)	EA	20	\$250.00	\$5,000	1 Sign every 500 feet, each side of road
Steel Sign Post (2x2 Inch Tubing)	EA	20	\$200.00	\$4,000	
Eradication (Skip Lines)	LF	2,640	\$0.50	\$1,320	eradicate 2 skip lines
Replace Skip Lines	LF	2,640	\$2.60	\$6,864	
Bicycle Safe Grate	EA	18	\$680.00	\$11,968	Every 600', each side of road
Flexible Delineators	EA	528	\$100.00	\$52,800	1 every 20' each side
Subtotal				\$175,672	
Lump Sum Items					
Maintenance of Traffic (10%)	LS	1.00	\$17,567.00	\$17,567	
			Subtotal	\$193,239	
			30% Contingency	\$57,972	
Total Estimated Cost				\$251,300	→ \$47.59 Per Foot

Shared Use Path

Includes: New path with markings and signage

Item	Unit	Quantity	Unit Cost	Total Cost	Assumptions
Thermoplastic Pavement Marking Lines (4")	LF	1,320	\$3.00	\$3,960	1 dashed lines entire length
Sign Panel (Class I)	EA	10	\$250.00	\$2,500	1 Sign every 1000 feet, each side of path
Steel Sign Post (2x2 Inch Tubing)	EA	10	\$200.00	\$2,000	
Earthwork, Excavation, Grading, Fill	CY	7,822	\$35.00	\$273,778	20 wide disturbance / 2 feet depth
Aggregate Base Course	CY	2,347	\$42.00	\$98,560	12 feet width, 1 feet depth
Asphalt Surface Course	TON	704	\$80.00	\$56,320	12 feet width and 2" depth, 1.8 Ton/CY
Asphalt Base Course	TON	2,112	\$91.00	\$192,192	12 feet width and 0.5 feet depth, 1.8 Ton/CY
Geotextile Filter Cloth	SY	7040	\$3.00	\$21,120	
Intersection Treatments	EA	3	\$1,250.00	\$3,750	Assumed 3 every 1-mile segment. Curb ramps & crosswalk markings
Subtotal				\$654,180	
Lump Sum Items					
Landscaping (5%)	LS	1.00	\$32,709.00	\$32,709	
Drainage and E&S (10%)	LS	1.00	\$65,418.00	\$65,418	
Maintenance of Traffic (5%)	LS	1.00	\$32,709.00	\$32,709	
Utility Adjustments (10%)	LS	1.00	\$65,418.00	\$65,418	
			Subtotal	\$850,434	
			30% Contingency	\$255,130	
Total Estimated Cost				\$1,105,600	→ \$209.39 Per Foot

Pedestrian Improvement	Unit Cost	Assumptions	Total Cost
Curb Ramps	\$1,000	Assumes 8 ramps per intersection, or \$8,000 per intersection	\$8,000
High Visibility Crosswalks	\$1,500	Assumes 60' long, 10' wide – should assume 4 crosswalks per intersection, or \$6,000 per intersection	\$6,000
Median Refuge Island	\$15,000	Assumes 50' long x 6' wide. Does not include design costs	\$15,000
Upgrade of existing signal	\$13,500	Per intersection cost. Assumes new pedestrian signals and push buttons are added (8 per intersection)	\$13,500
New HAWK signal	\$105,000	Per installation. Assumes two mast arms, controller cabinet, push buttons, etc. Including design costs	\$105,000
New Standard signal	\$300,000	Per intersection. Assumes four mast arms, controller cabinet, push buttons, etc. Including design costs	\$300,000
Signage	\$250	\$250 per sign installation	\$250
Curb Extensions	\$18,000	Assumed to be 50' long, 8' wide. Includes curb ramps. Does not include design costs	\$18,000
Raised Crosswalks	\$4,500	Assumed to be 30' long, 10' wide. Does not include possible design costs	\$4,500
<i>*Note: Maintenance of traffic is not included in these estimates and could be 5%-10% of the indicated improvement cost.</i>			

Table 4: Selected pedestrian facility costs

