

It's Our Future: A Choice City



CITY OF VIRGINIA BEACH COMPREHENSIVE PLAN



Reference Handbook

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FOREWORD

This “Reference Handbook” is designed to be a useful resource covering a number of special and sometimes detailed topics related to the Comprehensive Plan. These include a variety of community design and development guidelines, the titles of stand-alone documents that, by reference, are adopted as part of the Comprehensive Plan and a list of prioritized actions that will help implement the policies of this Plan.

GENERAL COMMUNITY APPEARANCE GUIDELINES

COMMUNITY APPEARANCE AND DESIGN

Establishes a lasting positive impression

Virginia Beach is a mosaic of distinctive places. It is the character, image, and activity of these unique places that, in large measure, define our community. Virginia Beach's identity is composed of places like the oceanfront resort area, a growing year-round destination for those who love beach activities. Our identity also includes the Town Center, which is a major focal point for business and commerce in the city. There are places for those who want a more peaceful, quiet, historic and cultural experience. These include our city and state parks, federal wildlife refuges, and historic landmarks.



Oceanfront Boardwalk



Town Center

The diversity of our places attracts residents and visitors alike and helps foster interaction of people and pride in our community.



Walk in First Landing State Park

Provides open space and protects the environment

Open space and the natural environment are important ingredients that contribute to the overall quality of our physical environment. These areas provide people with places to relax and enjoy the beauty of nature. No two open space areas or natural settings are alike. Indeed, they take on a wide variety of shapes, styles, and uses from active to passive from formal to informal. Active open space fosters social interaction and a sense of place among the residents. Passive open spaces can be enjoyed visually from a road or actively through nature walks or canoe rides.



Actively enjoying city open space



Quality environment designed for people

Creates 'human-scale' environments

It is important for public and private developments to integrate quality design that recognizes the importance of 'human-scale.' The composition and context of community design elements such as pedestrian spaces, streetscapes, landscaping, as well as other design consideration play a critical role in defining quality community appearance.

When designing any development, it is important to remember good design does not interrupt the existing land uses or predominant character of the surrounding area - it complements it. To accomplish this, design elements must include a scale and mass that exhibit a proportional relationship between the built environment and the people who will live, work and play in that setting.

Integrates attractive public facilities and roadways

The City has an obligation to ensure that the design of its public facilities and roadways complement the character of the surrounding community. The size and architectural choice of buildings, orientations of buildings, open spaces, streets, colors, landscape features, sidewalks, lighting, and other design considerations of public improvements must be composed in a manner that is harmonious and consistent with the land use goals of the Comprehensive Plan. For example, within the Strategic Growth Areas, this means adjusting the design of public facilities that will blend in with a higher density urban setting. In other areas, such as established neighborhoods with lower densities, this means composing a more traditional suburban design package. In either case, the design and materials of Capital Improvement Program (CIP) projects should make a positive contribution to the overall quality of the neighborhood within which it is located.



Attractive Resort Area Public Facilities

Creates Quality Community Design

Understanding the physical opportunities and constraints of land and applying good planning and design principles are essential first steps in the process of developing property. The quality of a community's design is influenced by such factors as the existing characteristics of the physical site, the flexibility or lack of flexibility of development regulations, and the value and marketability of the site, which affect investor financing and other decisions. Achieving quality community design begins with an understanding of the larger land planning goals of how the proposed development relates to the other land uses in the area. Once these goals are understood, decisions then focus on implementing more specific elements such as detailed site designs, structural improvements, and other issues.



Part of a Well Planned Neighborhood Design

Quality elements of our city are those elements that accomplish the following:

- 1) In the aggregate respond to the needs of all the community, and not just to the needs of a select few;
- 2) Present a long-range rather than short-range response to the needs of the community, that is, that tend to build a broad and long-lasting base of amenity; and
- 3) Evoke a positive image of Virginia Beach in the minds of our residents and visitors.



Attractive Walkway with Good Visibility

Offers safe, well-planned and attractive pedestrian ways

Virginia Beach encourages good site design, which maximizes safe pedestrian movement to the site and within the site. The City supports community design alternatives that reduce crime, improve the attractiveness of the setting, and promote a sense of comfort and security to its residents and guests.

Promotes a Positive Image and Economic Vitality

Protecting scenic views and vistas, planting trees, landscaping parking lots, integrating amenities and controlling signs not only improve the overall livability of communities, these elements are fundamentally important to their economic health. We must encourage and assist residents and businesses to pursue projects that will improve the environment, image, aesthetic quality and, consequently, marketability of their neighborhoods. There are many other ways to accomplish these objectives. Various examples include street tree planting, trail connections, tot lot and pocket park additions, waterway cleanup, street and alley cleanup, housing rehabilitation, traffic calming and transit-stop enhancements.



Positive Images Help Promote Prosperity

CHALLENGES TO ACHIEVING QUALITY COMMUNITY APPEARANCE

In order to focus on the positive aspects of community appearance, it is useful to touch on certain design elements that pose challenges to improving the quality of our physical environment. The following identifies a few of these challenges.

Sign Clutter

While signs are essential to the success of commerce, a balance must be struck between providing a reasonable opportunity to advertise and the tendency in some places to proliferate such signage. The number, size, placement, and quality of signs can either contribute to or detract from the quality of community appearance. It is the intent of the City of Virginia Beach to reduce the negative community impacts created by poor sign arrangements and design.



Unattractive Sign Clutter

Too Much Light

Outdoor lighting plans should be designed to provide safe, attractive, and appropriate degrees of illumination for the proposed land use. It is important to avoid over-illumination in certain places including residential and rural areas, among others. Other areas may need more lighting for safety and security reasons, such as commercial parking lots and outdoor ATM stations. Nevertheless, every effort should be made to minimize the degree of outdoor lighting, where appropriate, to avoid unwanted glare.



Glare from Excessive Illumination

Landscaping

A typical problem with landscaping is using plant material that, upon maturation, will not be suited to the land use or site. Another problem is the use of plant material that is non-indigenous to the climate of southeastern Virginia. Finally, there is no such thing as a maintenance-free landscape material. Some plants require less attention than others, but all must be maintained to assure long-term health and viability.



Disproportional Landscaping (note sign)

Parking Lots: Excessive Impervious Coverage

We must change the template that is typically used to design and build suburban parking lots. Many times, these facilities are designed exclusively around the automobile and make little or no provisions for safe and orderly pedestrian movement. This often results in the creation of an unattractive 'sea of parking' that is difficult to negotiate on foot and lacks aesthetic appeal. We recognize the need to accommodate the automobile but must also create parking lot designs that address the functional and aesthetic needs of pedestrians.



Vast expanse of asphalt

Vacant and underutilized buildings

Buildings that suffer from long-term vacancies or underutilization do not contribute to a productive economy or attractive community environment. The city must work with owners of such structures to find mutually agreeable solutions to revitalize such properties. These remedies may include reuse and revitalization of the building. They may also include possible redevelopment including a mix of new, marketable uses and site design improvements.



Vacant and Underutilized Buildings

Fences along Roadways

City ordinances allow fences but many have deteriorated leaving a less than desirable view from the road.



Deteriorating fences along roadway

Coordination of Public and Private Infrastructure
Signs should be legible but conform to regulations. Landscaping should be controlled so not blocking signs. Enhance areas that are to be used by pedestrians. Lightings appropriate for the area.



Coordinate Infrastructure

ACHIEVING A POSITIVE COMMUNITY APPEARANCE

Promote quality in design for all developments

All development should incorporate environmentally sensitive design that protects the integrity of existing neighborhoods, complements adjacent land uses, incorporates crime prevention principles, and enhances the overall function and visual quality of the street, neighboring properties and community. Some distinct sections are addressed within this Comprehensive Plan. The creation of design guidelines provides assistance in creating a quality development. Those developments that promote quality design should be recognized.



Positive Neighborhood Design (Concept)

Residential development should enhance the quality of life for residents by incorporating safe, innovative design that integrates planning elements, such as connectivity, visually and functional open space, pedestrian networks and landscaped streetscapes.



Good blend of mixed uses

Non-residential development should incorporate solutions and design principles such as connectivity and consolidation while responding to adjacent residential development, improving the streetscape, and enhancing the experience and perception of employees and customers through appropriate scale and mass.



Complementary Industrial Design

Industrial development should utilize appropriate design elements to avoid intrusive visual, noise, odor and other potential impacts on adjacent uses. Such design should consider the link between function and aesthetic quality and contribute to the planning goal of achieving a quality physical environment.

SPECIAL AREA DEVELOPMENT GUIDELINES

URBAN AREAS

Site Design - Urban Areas

Setbacks and Building Location

- Locate buildings close to the pedestrian street with off- street parking behind or beside buildings.
- If site is located at a street intersection, place the building at the corner. Do not place parking, loading, or service area at the intersection.
- Organize the site so that the buildings frame and reinforce pedestrian circulation. Pedestrians should walk along building fronts rather than along or across parking lots or driveways.



Urban building placement

Access and Circulation

- The goal within the urban environment is more ease and pleasure in walking and less need to use a car. Individual businesses need to be linked to the street, to the sidewalk, to bus stops, to neighborhoods and each other. There should be pedestrian and some vehicular connection. Access must be ADA compliant.
- Pedestrian routes not less than five feet in width should be direct and minimize conflicts with vehicles. Where there are pedestrian pathways from the street to parking areas between buildings ensure, a reasonably safe, and uninterrupted access. Provide a visible crosswalk where pedestrian pathways cross an internal driveway or curb cut.
- Locate bike racks close to main building entrances so they are visible and convenient to use.

Parking Areas (See www.vbgov.com for information on Parking Lots & Structures)

- Wherever possible join parking areas to create an internal circulation network. Minimize or eliminate curb cuts by sharing vehicular access with adjacent properties and or utilizing alleys for access.
- Parking areas should not dominate the frontage of streets. Off street parking areas should be located behind buildings or in the interior of a block whenever possible. Shared parking is strongly encouraged between adjacent or vertically mixed uses whose peak demand is offset from each other.

- Large parking areas should be visually and functionally segmented into several smaller lots.
- Consider the feasibility of providing a parking structure to conserve land and minimize impacts on the environment.
- The building materials of a parking structure should complement surrounding design and be of high quality. Pedestrian entries should be clearly visible. The ground level of a parking structure should include retail, office or some other active use along primary street facades.
- Bicycle rack parking and storage lockers are encouraged inside the parking structure.
- Where appropriate, transit stops (incorporating weather protection) should be included.

Landscaping (See www.vbgov.com for *Landscaping Guide*)

- Quality landscaping is essential to the built urban environment. Where possible retain the existing natural landscape. The corners of significant street intersections, gateways or site entries should be enhanced by special landscape treatments such as pavers, flowering plants, signage or decorative lighting.
- Fences are recommended only where complementary to the building design. Discourage the use of stockade or chain link fence where visible from any public street.
- Urban open space or plazas should have direct access from adjacent streets and allow for multiple points of entry and be located with regard to sun, shade and wind. The open space should be visible from the sidewalk allowing passersby to see directly into the space but buffered from moving cars. Partially enclose the space with building walls, freestanding walls, landscaping, or raised planters to create a relaxing outdoor area.
- The importance of street trees and planters should be recognized and planned into the design.

Natural Features

- Undisturbed natural areas and important natural features should be identified during the design process. Unlike suburban and rural areas where there is greater opportunity to preserve large stands of trees, wetlands or hedgerows, the urban area might find a significant focal point within the development to create a distinct sense of place. An example would be working a significant tree specimen into the design of an urban plaza.

Stormwater Management as Landscaping Features

- Whenever possible, stormwater retention and detention systems are encouraged to be designed as open space or landscape amenities.
- When structural systems are provided, plant material should be used to soften the appearance. The design of the system should blend in with natural site features and become a design element of the overall development.

- Nonstructural systems can be of a variety of landscape plant materials that include groundcover, low to mid-height shrubs or a combination thereof.

Lighting

- Site lighting should be designed to reduce light trespass and glare. Pole standards and fixture design should be of a style and scale that is complementary to the area.
- Lighting for pedestrians should be provided from storefronts using either indirect illumination from the building or direct illumination under canopies or awnings.

Signs

- Signs should primarily serve to identify the name, street number and nature of the business establishment. The color and theme of signs should be consistent with the primary building and the surrounding area. The overall surface area and height must be in compliance with the Zoning Ordinance.

Outdoor Art

- Incorporation of outdoor art and other focal points into the overall design of a project creates a stronger identity and is encouraged.

Building Design – Urban Areas

Urban neighborhoods have a higher density of development and a greater intensity of activities. The area might include some mixed use development that integrates retail, office and residential uses within the same structure either vertically mixed in or horizontally. Drive thru windows and services are discouraged in the core of an urban area.

Building Silhouette

- The pitch and scale of roof lines should be considered in relationship with adjacent structures.

Spacing between building facades

- Design sensitive to the surrounding built and natural conditions. Adjacent buildings should relate in similarity of scale, height, and configuration. The use of retail, cafes or restaurants, and higher density residential around the perimeter of an open space area provide pedestrian traffic and uses for the open space. Public open space should provide as many seating opportunities as possible.

Proportion of the primary façade

- Buildings located on corners shall provide a building entry, additional building mass and distinctive architectural elements at the corner.

Proportion of windows, bays, and doorways

- Windows and door openings should be proportioned so that verticals dominate horizontals except for street level storefront, which may be square.

Location and treatment of entry

- The primary entrance shall be both architecturally and functionally designed on the front façade of the building facing the primary street.
- Retail uses should be placed at street level with office and residential uses placed in the upper levels or in the rear.
- Residential building entrances should be raised above the sidewalk to distinguish them from commercial entries and to reinforce their privacy.

Exterior building materials

- Building exteriors should have a human scale which helps to relate people to the size of the building. Features that promote human scale would be recessed or projecting entries, individual windows with multiple window panes rather than oversized large single panes of glass, balconies, columns or covered walkways, textured or modular building materials.

Building Scale

- Buildings should be considered as being composed of three parts, similar to a column. Each building has a ground floor, upper floors and a roof or parapet.

Shadow patterns

- For taller buildings, recess the upper floors to allow sunlight to pass onto the street.
- Consider the choices of building materials and colors and how they will interplay with the sun and shade.

Street Design – Urban Areas

Streetscapes

- Sidewalks that encourage pedestrian use need to be buffered from cars on both sides. They should not be located directly on the road's edge, since passing traffic can feel dangerous. One simple and inexpensive approach is to allow on-street parking.
- Provisions should be made for wider sidewalks in urban commercial areas (minimum range of 12 to 16 feet wide) to accommodate uses such as vendors, merchandising and outdoor seating.
- Streets should be designed with street trees that complement the activity of the area without hampering street lighting and sight distances. Residential street trees provide an appropriate canopy that shades the street and sidewalk as well as provide a visual buffer between the street and home. Commercial street trees shade the sidewalk without interfering with signs and building facades.
- On-street parking protects pedestrians, benefits merchants, slows traffic, and allows drivers to visit several stores while parking once (instead of having to move from one store's parking lot to the next store's lot). If a sidewalk abuts a parking lot, make sure there are planters or other buffers between the sidewalk and the lot.
- Where on street parking is provided, planting and street furniture should be located so as not to conflict with opening doors or pedestrian access.
- Consolidate the number of fixtures placed within the right of way; consider the location of street lighting, pedestrian lighting, and hanging planters or banners with other streetscape elements.
- Provide for an even distribution of light along sidewalks or pedestrian paths to avoid shadows or dark areas.
- Bus routes and stops are encouraged to be placed within an urban or mixed use center.

SUBURBAN AREAS

The Suburban Area is planned for relatively low density growth which includes residential as well as some commercial and office uses. These design principles are tailored for this area and should be implemented, as appropriate, to improve the quality of our physical environment. These guidelines may be applied to larger-scale developments, infill projects or areas of redevelopment.

Site Design – Suburban Areas

Natural Features

- During the design process, begin by identifying existing natural characteristics of the site that should be conserved. Natural site features and landform should be considered in the early stages of development design prior to building placement. Natural site amenities may consist of a significant stand of trees, unusual topographic conditions, natural drainage patterns, and

similar natural features and should be preserved to the greatest degree possible. Natural characteristics create a sense of place on undeveloped sites that can be expanded upon during the development process.

- Maintain and enhance significant views present within the study area boundaries both on and from a site.

Access and Circulation

- Clearly mark and efficiently place vehicular and non-vehicular access to all new developments during the planning and development process. Vehicular and pedestrian access should be distinct and clearly separated.

- To minimize traffic conflicts, entrances and exits to a development should be consolidated to the greatest extent possible and located a sufficient distance away from street intersections. An internal circulation system should provide safe and convenient access to uses within the development site. Where compatible land uses adjoin one another, access from the internal circulation system to surrounding properties should be provided. Coordinate access with or provide from the secondary street system or by cross-parcel easements whenever possible.



An attractive and accessible pathway

- Entrances and driveways should permit safe and convenient pedestrian crossing where they intersect sidewalk and other pedestrian access ways. A change in paving material to make the driver aware of the crossing is encouraged.
- Where appropriate, pedestrian pathways not necessarily associated with the public roadways fronting the property should be provided in developments. Provide pedestrian access ways between residential development and commercial or office development.
- Pedestrian pathways should be located within a landscaped or natural area that may consist of a significant stand of trees, unusual topographic conditions, natural drainage patterns or other natural features. This pathway should be constructed of a durable, low maintenance material such as asphalt or some surface material that is semi-permeable in nature.

Parking Areas

- The visual appearance of new parking lots is controlled in part by adopted ordinances regarding parking lot landscaping. Location and circulation characteristics can further improve the appearance and function of these lots.
- Parking areas should be located toward the rear of the site while buildings should be generally oriented to the front (see Setbacks and Building Location section for siting of building).

Additionally the parking area should be broken up into separate sub-areas to avoid the 'sea of asphalt' appearance.

- Landscaping for the parking area should be strategically located to provide visual relief, shading of the lot, green areas, and screening while insuring that lines-of-sight are maintained, both at the time of planting and when the plants have matured (see Landscaping section).
- Access between parking areas on separate lots should be accomplished through use of shared-access easements, which join the lots. Individual curb cut for each parking area onto highways is discouraged. Internal circulation roads on a parcel should be designed with stubs to adjoining undeveloped parcels that will provide this future shared access.
- A special area for the parking of bicycles should be provided on site with ready access to the pedestrian/bicycle pathway system.

Landscaping

- Developments that incorporate a carefully designed landscape package are more attractive, safer and retain higher economic value than those that do not. Landscaping can play many roles, both functional and aesthetic, in promoting a quality physical environment.
- Within reason, existing trees and groundcover that are healthy should be preserved and integrated into the overall design of development, especially in high visibility areas of the site. Clearing in these areas should be confined to the absolute minimum to accommodate signage, driveways, and utilities. Pedestrian and bicycle pathways should be designed so as to minimize vegetation loss within these areas. In the absence of existing vegetation, the type, size, and location of new plant material should be added to achieve a high quality physical environment.
- Plans for commercial uses that adjoin areas planned for residential use employ effective landscape design techniques, including the placement of appropriate plant materials to buffer or screening such uses.
- Screening may include fences, walls, berms, hedgerows, and massing of plant material. All enclosures should be designed with durable materials or be from a selection of hardy native plant materials. If walls are used, they should match the dominant material and color used in the building. Design continuity should be maintained between the building, trash enclosure area, and the wall plane used for screening.
- Safe lines-of-sight for motorists that meet or exceed development standards should always be considered when selecting the type, size, and location of landscaping at critical areas such as intersections, parking lot crossways, and driveways. The size of the plants at planting and at maturity should be considered. In addition an inspection and maintenance schedule should be developed to insure that lines-of-sight are adequate at all times.

Stormwater Management as Landscape Features

- Whenever possible, stormwater retention and detention systems are encouraged to be designed as open space or landscape amenities.

- When structural systems are provided, plant material should be used to soften the appearance. The design of the system should blend in with the natural site features and become a design element of the overall development.
- Nonstructural systems can be of a variety of landscape plant materials that include groundcover, low to mid-height shrubs or a combination thereof.

Lighting

- All outdoor lighting should be of a design that accentuates the site and provides sufficient illumination for the development without projecting light and glare onto adjacent properties or into the sky.
- Pole standards and fixture design should be of a style and scale that is complementary to the area. Lighting poles should be of minimum height, possessing a pedestrian scale, but provide adequate illumination.
- Lighting of non-residential buildings should be designed as an integral part of the building's architecture to be as unobtrusive as possible. Lighting especially on the rear of buildings that face residential areas should be designed and placed so that it does not direct or reflect any illumination into residential areas.

Signs

- All signs should be consistent in color and theme with the primary building. The overall surface area and height must be in compliance with the Zoning Ordinance.
- Signs for residential development should be compatible with the style and theme of the community and complementary to any significant natural site features.
- Signs in all nonresidential areas should be clearly legible to both motorists and pedestrians. Oversized or overly elaborate signs competing for attention or which create visual clutter are discouraged.
- Signs should primarily serve to identify the name and nature of the business establishment.
- In non-residential developments, one sign identifying the complex and some of the major tenants should be installed. Tenants should install only appropriately scaled signs on the buildings. Individual freestanding signs located along the roadway for each tenant are discouraged. Signs and graphics for tenant identification should be compatible in design theme and color, but not necessarily identical. The signs should not compete with one another for attention.

Setback and Building Location

Residential

- Residential structures should abide by the setback provisions of the City Zoning Ordinance. Structures should be sited to create open spaces that promote a "sense of place" or a human scale for the development.
- Residential structures should not front or back directly onto the arterial highways. Where possible, a landscaped buffer adjacent to the right-of-way should be provided before any residential structures are sited. This buffer should be protected from future alteration through use of a protective easement or dedicated to the homeowners association.
- All freestanding signs should be incorporated into the landscape plan for development.
- All lighting used to illuminate signs externally should be positioned at ground level to be hidden yet illuminate the sign adequately and should be designed to avoid any glare onto adjacent properties. All lighting fixtures used to accomplish the external lighting should not overpower the sign. Signs should be externally illuminated as described above and be constructed of wood, fiberglass, or an appropriate long-lasting material.

Non-Residential

- Commercial buildings should be generally oriented toward the front of the lot within a well landscaped green area while locating the parking and loading areas to the rear of the lot.
- Consolidation of buildings within office parks is preferable to the one building one, lot development.
- Buildings should be situated close to the highway just beyond the established buffer setback.
- The length of the wall parallel to the street should be limited along the front to avoid a monotonous expanse of building close to the highway. Buildings should be oriented to the street and designed and scaled to encourage pedestrian movement.
- Large parking areas should be situated behind buildings as described in the section above entitled, Parking Areas.
- Open space areas should be included as part of the development and be strategically located in conjunction with an open space area on adjacent property.
- The buildings and parking areas should be situated on the site to promote pedestrian movement from business to business instead of vehicular movement in the form of moving from one parking space to another to get from one business to another. Walkways should connect buildings and parking areas.

Building Design – Suburban Areas

Understanding the symmetry between a building and its surrounding environment, both natural and built, is critical to achieving a successful design. To achieve high quality a building's architecture and proportional elements of scale, mass and height must be factored in when designing.

Scale

- Scale is vital to achieving compatibility. The ratio of the parts of a structure to the entire structure, the structure's size in relationship to its surroundings, and the structure's size in relationship to an individual are the three most important aspects of scale.
- Buildings should possess details that can be appreciated at a 'human-scale'. Architectural details should be included in the design of buildings that are scaled to the pedestrian (not to passing motorists), that draw the pedestrian's eye, and that create a memory of the building and the place. Amenity features such as public plazas, staggered storefronts, gazebos, fountains, circular passenger drop-off points and distinctive storefront architecture should be included in the design of retail centers. Visual interest should be provided through window and door details, varied rooflines, consistent textures and color, as well as staggered placement of the buildings.

Building Mass

- The mass, or overall size, and height of the structure should be appropriate to the surroundings.

Proportion of Building Components

- Proportion is the relationship of one dimension to another. If proportion is correct, order seems to prevail. Each component of a building should have good proportion (height to width of a door, for example), the relationship of each component to each other (wall to window, for example) should express good proportion, and the ratio of building mass to the spaces around it should possess good proportion.
- The side or rear facade of a building located adjacent to and visible from a roadway should be designed so as to possess as much detail as the primary facade.
- The height, bulk, and architecture of structures should convey a sense of openness, ensuring substantial sunlight access.

Color

- The use of color in building design is a subjective issue. Generally, however, colors should complement the surrounding environment, not serve as the dominant structural feature or intrude upon surrounding uses. Quality architectural design should attract the eye to buildings, not an overstatement of color. Color should be used to accent, not define buildings.

Building Materials

- Materials used on structures should be long-lasting, attractive, and high quality. Building materials should reflect the character of the area associated with it.

RURAL DEVELOPMENT

Rural Development Guidelines - Residential

1. Subdivide residential lots on soils that possess the best drainage and water table characteristics using a reasonable mixture of acceptable rural residential lot sizes provided it is determined by the City that the principal goal of protecting agriculture and conserving our natural resources is not compromised through this subdivision method.
2. Illustrate the ultimate plan of development, as well as anticipated development phases, if any.
3. Maximize the opportunity for agricultural, equestrian, and similar compatible rural activities as part of the residential development. Avoid fragmenting or dividing remaining farmland and open space into small lots.



Typical rural residential

4. Locate protective buffers between proposed residential structures and abutting agricultural operations. These buffers should be at least 50 feet in width. The first 25 feet of such area adjacent to an on-going agricultural operation should be heavily planted with a mixture of grasses and low growing indigenous shrubs; and the second twenty-five feet of such area adjacent to the structure should be planted with a double row of trees with a minimum caliper of one and one half (1 ½) inches and should be centered no more than thirty feet apart. Such trees should be indigenous and consist of a mixture of 25% deciduous and 75% evergreen to screen as necessary or to provide scenic vistas. Seasonal changes and foliage color should be thought of when selecting planting materials.

5. Whenever possible, plan developments to preserve existing trees and other significant natural resources. In those cases where development is proposed within areas of existing tree cover, design the placement of buildings and driveways so as to save and protect as many trees and other significant environmental features as possible.



Horse pasture between road and home

6. Include substantial setbacks, with landscaping, between dwellings and rural arterial roadways as discussed in Section 402 of the City Zoning Ordinance.
7. Provide flag lots, where warranted to advance the purpose of this plan, taking into consideration the size of the lots within the subdivision, existing or future tree cover and other pertinent characteristics relating to the need for rural residential privacy and open space. Design appropriate widths and pavement types for driveways serving flag lots. (e.g. fire truck access).
8. If necessary, provide longer distances for rural cul-de-sac streets than is otherwise permitted throughout the City. Locate roadway drainage ditches a sufficient distance from the edge of pavement to enable emergency vehicles to pass around road obstructions.
9. Minimize all access points along rural arterial roadways, for example, through consolidation of properties.
10. Provide greater streetlight separation distances than is otherwise permitted throughout the City. Focus the light downward, not upward to the sky.
11. Protect land for open space purposes through the use of a variety of legal instruments, such as deed restrictions, appropriate zoning classifications, protective easements or transfer to a stewardship agency (e.g. foundations or conservation groups), or through some other appropriate means.

12. Establish visible landmarks that are incorporated into the design of development entrances that recall the rural heritage of area.
13. Provide trail systems for recreation.

Rural Development Guidelines - Non-Residential

1. Protect rural character and existing scenic views.
2. The identity of Virginia Beach's rural community should take its cue from its rural heritage. The areas known as Creeds and Blackwater have some buildings that encourage a type of design reminiscent to the area.
3. Franchise retail, office parks or shopping centers are not encouraged.
4. Development in rural commercial centers can include locally oriented retail, service, and community uses scaled to be compatible with the character of the rural landscape.



Blackwater Trading Post

5. Non-residential development should be located within the defined Rural Community Areas to encourage interaction of people, not vehicles.
6. Non-residential, locally oriented retail or services are limited in the rural area so as not to require the extension of urban services.
7. Proposals for non-residential development in this area should be designed to complement the surrounding rural character in terms of size, scale, architecture and selection of materials. They should also adhere to sound environmental principles that include energy-efficient design and effective groundwater protection.



Locally oriented retail

PUNGO

Site and Building Development Guidelines

- The scale, proportion, and general character of buildings in all four quadrants around the Pungo intersection should evoke a design vocabulary reminiscent of turn of the century architecture.
- The dominant residential look should complement the Craftsman-style bungalows, using the existing Aladdin Readi-Cut kit homes as an example
- New commercial uses should include bungalow-style architectural elements:
 - Low-pitched, gabled roofs.
 - Wide, overhanging eaves.
 - Exposed rafters under the eaves.
 - Decorative brackets under the gables.
 - Incised porches beneath the main roof.
 - Handcrafted stone or woodwork.
 - Setbacks should be reduced in the village core to allow direct connects between the safe and attractive sidewalks and storefront entrances. Conversely, suburban-style development, including auto-oriented shopping centers and cookie-cutter houses, is not appropriate in the core area of Pungo.
 - To the extent possible, new parking should be oriented behind buildings away from Princess Anne Road or screened if located on the side of buildings.
 - Access points from the roadway should be minimized and, where possible, combined to enhance the historic nature of Pungo.



*Pungo Grill – Aladdin Kit Home
Classic Reuse from House to Restaurant*



Munden's Store - Classic Commercial Style

- o Sidewalks and pathways should provide safe and attractive pedestrian connections within the core and a continuous link one end of the settlement to the other with a minimum of vehicular conflict points.

TRANSITION AREA DESIGN GUIDELINES

The Transition Area (see Section 1.4 of the Comprehensive Plan Policy Document) is meant to serve as a buffer between the City's Suburban and Rural Areas. Accordingly, it should provide an apparent visual shift from suburban development character and form to rural development character and form as one travels from north to south. Therefore, development in the Transition Area should reflect a noticeable transitional pattern with contiguous and unified open space throughout, also in keeping with the accompanying Transition Area Design Guidelines. The Guidelines are adopted by reference as part of the Comprehensive Plan and are available in the online document library at www.vbgov.com/Planning. These guidelines articulate a high quality, 'Rural Transitional' design theme, unique to the Transition Area vision.

SPECIAL PURPOSE GUIDELINES

WORKFORCE HOUSING

The following is a brief summary of development and design provisions relating to workforce housing. For additional information on Workforce Housing see www.vbgov.com/housing.

Workforce Housing Development shall comply with the following Criteria:

- Proposals for Workforce Housing (WFH) Development should comply with the Comprehensive Plan, applicable Design Guidelines, and related ordinances that are applicable thereto.
- Affordable WFH units in a WFH Development shall be mixed with the market-rate units and shall not be clustered together or segregated in any way from the market-rate units.
- If the WFH Development Plan contains a phasing plan, the phasing plan shall provide for the development of affordable housing units concurrently with the market-rate units. No phasing plan shall provide that the affordable housing units built are the last unit(s) in a WFH Development.
- The exterior appearance of the WFH units in a WFH Development shall be similar to the market-rate units by the provision of exterior building materials and finishes substantially the same in type and quality as the market-rate units. The WFH unit exterior shall be substantially indistinguishable from the market-rate units.
- The WFH units shall be comparable in bedroom mix, design, and overall quality of construction to the market rate units in the WFH Development, except that the WFH unit shall not be required to exceed three bedrooms per unit. The square footage and interior features of the WFH units shall not be required to be the same as the market-rate units, so long as they are reasonably similar in size and quality and are consistent with the current building standards for new housing in the City of Virginia Beach.



Example of workforce housing

SHADOWLAWN INFILL DEVELOPMENT

Background

The Shadowlawn neighborhood is a residential enclave located in the southern half of the Resort Area of the city. Residential units consist primarily of single-family dwellings with small clusters of multi-family units.

The neighborhood was platted in the first half of the 20th Century. As a result, the streets and lots are laid out in size and pattern typical of that period. Streets, with right-of-ways of 50 feet, are aligned on a grid pattern. The majority of the lots were established at 30 feet by 100 feet; however, some of the lots adjacent to Lake Rudee were established at 25 feet by 100 feet.

The residential dwellings constructed in the neighborhood vary in style and size and are representative of single-family architecture from throughout the 20th Century. Most of the homes appear to have been constructed during the decades from 1950 to the present, and are Colonial Revival or Ranch in style. The number of stories is one or two, but one-story dwellings seem to predominate. Due to the fact that these styles of homes cannot be constructed on single 30 foot lots, most of them are constructed on a combination of two or more of the 30 foot lots. In most cases, all of the lots in the combined parcel have been built on, but in some cases, one of the 30 foot lots in a combined parcel may not have been built on. As a result, there are several 30 foot or 25 foot lots remaining between constructed homes. Occasionally, two or more unbuilt lots (in the same or separate ownership) may be adjacent to each other, resulting in a potential of 60 or more feet width.

In the last decade, as individuals have sought to reside or own residential property in the neighborhood, homes have been constructed on some of these 'infill' lots, which represent the last residential development opportunities in the neighborhood. In most cases, from a standpoint of land use and aesthetic compatibility with the existing neighborhood, the resulting dwelling units have not been a success.

The reasons that most of these newer dwellings cannot be considered to be a major aesthetic and land use success is:

- a direct result of the narrow lot width that the home is built on,
- the dimensional restrictions placed on new construction by the City's Zoning Ordinance, and
- the style and architectural design characteristics of the adjacent dwellings.

Usually, new construction on the infill lots has resulted in narrow, two-story structures, of almost a townhouse style, located between one-story ranch style structures.

Section 502(e) of the City Zoning Ordinance prohibits a single nonconforming lot from being developed where two or more contiguous lots are being held in common ownership. Such lots must be combined to meet or more closely approximate the frontage and area requirements of the R-5S Residential Single-Family District. Any lot with a width less than 50 feet and an area less than 5000 square feet, where an adjacent property is owned by the same party, can only be approved for development through the subdivision variance process.

Compatibility Guidelines

Utilization of the following design and land use compatibility principles can help to ensure that new dwelling structures constructed on the infill lots in the Shadowlawn neighborhood are integrated into the character of the neighborhood and are less likely to negatively impact adjoining dwellings. Designing a dwelling to satisfy the factors will no doubt be more difficult than utilizing a design that simply fits the site and the accompanying zoning restrictions. The result, however, will be a dwelling that is compatible to the surrounding dwellings, in respect to design and land use, and that will give the impression to those who pass by that it has always been part of Shadowlawn.

Height, Width, and Proportion

- New infill structures should be constructed at a height that is compatible to the adjacent structures. If at all possible, the new dwelling should have the same number of stories as the dwellings on either side or be within 15% of the height of those dwellings. The majority of the dwellings in Shadowlawn are one-story and occasionally, two-story. Introduction of a narrow, two-story structure (which is the case most of the time in Shadowlawn) between two one-story structures creates an incompatibility that can, in effect, act as a detriment to the overall character of the neighborhood.
- Equally important to the height factor for a new infill structure is the width factor. The majority of the remaining infill lots are only 25 to 30 feet in width, with resulting structures of only 20 or less feet in width. Structures on either side of the infill lot were usually constructed on lots of 60 to 90 feet in width, with a resulting dwelling width of 30 to 50 feet. The resulting effect has been that of the insertion of a single townhouse dwelling between two ranch style dwellings. Every attempt should be made to utilize every inch of the available width of an infill lot.
- The relationship of the new structure's width to height establishes its proportion. The proportion of the new structure should be as similar as possible and compatible with the proportion of existing adjacent structures. For example, if in adjacent dwellings, the proportion of the structure is such that for every one foot of height the width is one and one-half feet, the new infill structure should have a proportion as close to that as possible.

Location on Site / Setbacks / Relationship to the Street

- Probably the key factor in ensuring that a new infill structure possesses land use and aesthetic compatibility to the neighborhood is in the relationship of the structure to the street and to the adjacent structures. In order to have that relationship in a manner similar to the adjacent structures, all of the factors discussed in this section must be successfully satisfied. If a good relationship is achieved, two objectives will be met: first, the streetscape (the appearance of all of the buildings, landscaping, and other site improvements on a street seen as a whole) will be maintained, and second, the potential for negative land use impacts to adjacent properties will be reduced.
- The location of the structure on the site should be such that the new dwelling does not disrupt the existing rhythm of building width and spacing and does not have setbacks, which vary significantly from the predominant setbacks in the neighborhood. Accomplishing this on the 25 or 30 foot lots will be difficult, if not impossible. An exact rhythm of width and spacing does not

currently exist in the neighborhood; however, there is a consistent rhythm that a design for an infill lot can strive to reach. To achieve a design that fits the rhythm of the other structures on the street as closely as possible, it will be necessary to utilize the full width of the lot. A minimum lot width of 35 feet with a buildable width of 25 feet should be strived for.

- The front yard setback should meet the requirements of the Zoning Ordinance, while at the same time, be consistent with the front yard setbacks of the adjacent structures. In some cases, it might be necessary to encroach into the required rear yard setback due to the need to have a dwelling that has adequate floor area but still maintains proper height and width proportions.

Materials and Details

- Compatibility cannot be achieved if the building materials used on the facade (outside visible wall) of the structure and the details (windows, doors, decoration) differ substantially from those predominantly found on the other dwellings in the neighborhood. The common facade materials in Shadowlawn are brick and clapboard-style siding (wood and vinyl). New infill structures, therefore, should utilize brick or clapboard-style siding on the exterior facade. Use of materials such as dryvit, stucco, or grooved plywood would reduce the possibility that the new structure would be compatible to the neighborhood.
- Similarly, compatibility can only be achieved if the decorative and functional details of the structure are as similar as possible to the surrounding dwellings. For example, if the surrounding dwellings commonly utilize multi-pane, double-hung windows, of a certain proportion, then the windows to be installed in the new structure should be as similar as possible to them in those respects. Installation of windows with large areas of glass and of irregular shapes probably would not be appropriate.

Parking

- If dealt with successfully, the manner in which the parking is arranged can ensure compatibility of the new dwelling to the surrounding dwellings. The predominant method of parking in the neighborhood is either on the street or on a single-stack driveway. This method of parking arrangement permits the remainder of the front yard area to be left as open space and lawn. New structures should try to achieve the same effect by installing a single-stack driveway and leaving the remaining portion of the front yard as open space or lawn. The paving of the entire front yard area is not desirable, because it will greatly reduce the potential compatibility of the dwelling with the surrounding dwellings. If it is absolutely necessary to utilize the entire front yard area for parking, the surface material should be of a type that permits a lawn groundcover to grow through, such as porous pavers.

HISTORIC PROPERTIES

In 1976, the Secretary of the Interior published standards for the preservation of historic properties listed in or eligible for listing in the National Register of Historic Places. Since their publication, these standards have been adopted by hundreds of preservation commissions nationwide in local design guidelines.

Generally speaking the National Register defines “historic” depend on / uses as their “Criteria for Evaluation”: “the quality of significance and association with American historical events, figures, architecture, archaeology, engineering, and culture that is present in districts, sites, buildings, structure, and objects and possess integrity of location, design, setting, workmanship, materials, feeling, and association.”

The Standards for Rehabilitation

The intent of the Standards is to assist the long-term preservation of a property's significance through the preservation of historic materials and features. The Standards pertain to historic buildings of all materials, construction types, sizes, and occupancy and encompass the exterior and interior of the buildings. They also encompass related landscape features and the building's site and environment, as well as attached, adjacent, or related new construction.

The Standards serve to provide guidance that repairs and alterations not damage or destroy materials, features or finishes that are important in defining the building's historic character. For example, certain treatments--if improperly applied--may cause or accelerate physical deterioration of the historic building. This can include using improper repointing or exterior masonry cleaning techniques, or introducing insulation that damages historic fabric. In almost all of these situations, use of these materials and treatments will result in a project that does not meet the Standards.

The following guidelines are adapted from **The Secretary of the Interior's Standards for Rehabilitation with Guidelines for Rehabilitating Historic Buildings 1990**. GPO stock number: 024-005-01230-3.

- A property shall be used for its historic purpose or be placed in a new use that maximizes the retention of distinctive materials, features, spaces, and spatial relationships. Where a treatment and use have not been identified, a property will be protected and, if necessary, stabilized until additional work may be undertaken.
- The historic character of a property shall be retained and preserved. The replacement of intact or repairable historic materials or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.
- Each property shall be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or architectural elements from other buildings, shall not be undertaken.
- Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.



Frank Lloyd Wright Designed Home

- Distinctive features, finishes, and construction techniques or examples of craftsmanship that characterize a property shall be preserved.
- Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and other visual qualities and, where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.
- Chemical or physical treatments, such as sandblasting, that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the gentlest means possible.
- Significant archeological resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.
- New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.
- New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired
- The landscape surrounding a historic building and contained within an individual parcel of land is considered the building site. The site, including its associated features, contributes to the overall character of the historic property. As a result, the relationship between the buildings and landscape features within the site's boundaries should be considered in the overall planning for rehabilitation project work.

PARKING STRUCTURE STANDARDS

Background

Traditionally, the design of a parking structure takes a secondary position to the development of a larger project or a secondary position to cost considerations. Many times, a parking structure is simply considered to be a building needed to provide temporary storage of vehicles and not as an integral part of the design fabric of Virginia Beach -- or any other city. These guidelines are intended to result in parking structures that integrate into the existing and desired design fabric of the city and in particular, to the existing and desired design fabric of the area in which the structure is located. Hopefully, the final design of the parking structure will be viewed as a long-term, quality amenity to the city and not as a utilitarian 'quick-fix' for a parking problem.



Urban parking structure with retail

Site Design

- Access to parking structures should be designed so as not to obstruct free flow of traffic on adjoining public streets (e.g., right and left turn lanes into the structure). Entrances and exits should be located so that each is separated from the other. Separation of the two reduces the turning movement conflicts which occur as vehicles enter and exit the structure.
- There should be adequate provision for ingress and egress to all parking spaces to ensure ease of mobility, ample maneuvering clearance, and safety of vehicles and pedestrians.
- Access points to the parking structure for pedestrians should be located to avoid pedestrian/vehicle conflicts.
- Loading areas within the structure should be provided for vanpools/carpools which may be picking up or discharging passengers who have vehicles parked in the structure.
- Security features, as described in the security section below, should be incorporated into the site design as appropriate.

Exterior Facade Design

- The exterior facade should maintain a horizontal line throughout. The sloping nature of the interior structure, necessary in the design of parking structures, should not be repeated on the exterior facade.
- The height and mass of the structure should be consistent with the urban design fabric within which the structure is to be located (e.g., a seven-story parking structure should not be situated in an area that consists of primarily two- to three-story structures).

- Facades that face public rights-of-way should incorporate a repeating pattern that includes color change, texture change and material change, each of which should be integral parts of the structure not superficially applied trim, graphics, or paint. In addition, vertical elements should be incorporated into the exterior facade design in order to create a repeating pattern. This can be accomplished through the use of reveals, projecting ribs, or offsets, which should be no less than 12 inches in width. All such elements should repeat at intervals of no more than 30 feet.
- A wall or other screening of sufficient height to screen parked vehicles and which exhibits a visually pleasing character should be provided.
- Elevator and stair shafts should be topped with gabled roofs or other architectural accents.
- In commercial districts with an existing or planned urban design fabric, ground-level retail use is encouraged to enhance the streetscape. Where retail is not practical, other amenities, such as an art wall, are encouraged as means of enhancing the streetscape. The ground-level of the structure should never consist of a featureless length of a wall.
- Pedestrian entrances should be well defined and attractive.
- Exterior building materials for all portions of the building should be high quality, durable, and aesthetically pleasing. Predominant exterior building materials should include any combination of brick, wood, stone, or tinted, textured, concrete masonry units. Bare or painted concrete as the only exterior facade material is strongly discouraged.

Security Features

Proper security is an important aspect of operating a parking structure. A safe, secure environment must be provided for patrons, employees and vehicles. Adequate security measures should be an integral part of the initial design. Secure and lock the parking structure when not in use.

The overall design of the structure should be such that it provides for easy surveillance from the street. The proper placement and design of windows, lighting, and landscaping increases the ability for police and others to observe intruders and maximizes the potential to deter crime.

- **Lighting:** A higher light level improves security and is an important passive technique for preventing crime. Parking structures should be designed to provide high light levels throughout all areas. Lighting should be uniform throughout the structure so that dark hiding places are not created. The recommended light level for a parking structure is a uniformly distributed 10 foot-candles. Light colored ceilings and upper walls are also recommended to increase light. Extra light should be considered in pedestrian areas such as stairs, elevator lobbies, entrances, exits, and ramps. In addition, lighting should be designed so that parkers are not shocked by great contrasts in light levels between the outside and inside of the structure.
- **Elevators:** Elevators should be located along the exterior periphery of the building, preferably on a street side and oriented so that the elevator lobby is visible from the street at each level. The back of the elevator cab and shaft should be made of glass or other similar transparent material that will allow maximum surveillance from the exterior.

- **Stairways:** As with elevators, stairways should be located along the exterior periphery of the building, preferably on a street side and oriented so that the stairway is visible from the street at each level. Glass or a similar transparent material should be used to allow visibility.
- **Access:** Pedestrian access into and out of the building should be channeled through only one or two points to allow surveillance either by a cashier or a remote television camera.
- **Sound Detection Equipment and Cameras:** Both sound detection equipment and cameras can be used to help monitor pedestrian activity, especially in remote sections and at entrances and exits. Television or sound equipment should be installed so that it is tamper-proof.
- **Cash Security:** Use of drop safes and silent alarms in the cashier's booth should be considered.

GOLF COURSE DEVELOPMENT

Location

- Golf courses should be located so as to be easily accessible to the resort areas of the city and activity centers;
- Golf courses should be located on land that consists of medium-textured soils;
- Setbacks of at least 150 feet should be provided between the centerlines of fairways and the course property line. At least 50 feet of this setback should be an existing forested area or planted as a forested buffer. Assistance from the Virginia Department of Forestry is available regarding forested buffers.



Aerial of Virginia Beach National Golf Course

Design

- Where tees and fairways are planned to be separated by landscaped corridors, these design attributes should ultimately convey a strong sense of privacy, peacefulness, natural beauty, and safety. These corridors can also serve as interesting wildlife habitats, thereby making very positive contributions toward protecting the natural environment and helping the marketing potential of the golf course project. In the absence of acceptable natural vegetation in these areas, significant tree stands using native and diverse species with suitable understory landscape material should be planted, where deemed appropriate by the golf course architect or planner, in order to achieve these objectives. Low cost plant material and tree seedlings are available for this and other purposes from the Virginia Department of Forestry. Additional features within these landscaped corridors, such as water traps, creek crossings, and other design attributes are also encouraged as aesthetic complements of the golf course.

- Although public trails are appropriate along the outer periphery of golf courses, there should be no connection between these trails and on-course golf paths; and
- Significant archeological and historic sites located on the site should be identified and impacts to these cultural resources described prior to the submission of preliminary site development plans.

Water Quality / Stormwater Management

- Stormwater and water quality control structures should be used to supplement natural filtering systems such as wetlands and floodplains;
- Wet-ponds and sand-peat filter combinations should be used where conventional infiltration practices are not suitable. A sand-peat filter, a modified version of a wastewater effluent device, may be used in conjunction with a golf course facility. Typically, it consists of an earthen dike with the following layers from bottom to top:
 - 6-inch deep bed of washed bank-run gravel which is fitted with a perforated underdrain pipe;
 - 24-inch layer of fine-medium sand;
 - 4-inch layer of 50/50 peat-sand mixture; and
 - 18-inch layer of peat which is planted in grass.
- The runoff from the sand-peat filter should be released onto natural soils in order to allow recharge into the groundwater system and replenish the base flow of receiving waterways.
- Wet ponds should be designed to serve as a component of the site's irrigation system in order to reduce groundwater withdrawals for course watering;
- Waterways that traverse the proposed site should not be altered or rerouted. All waterway crossings should be kept to a minimum number and designed to minimize impacts on the waterways. Elevated crossings on pilings should be used to minimize impacts on the natural or constructed waterway, drainage way, or wetland.
- The distance between the golf course tees, fairway, and greens and adjacent waterways and tidal or non-tidal wetlands, as defined in the City's Southern Watershed Management and Chesapeake Bay Preservation Area Ordinances (except those established in connection with best management practice facilities or with water landscape features within a golf course which are not connected by surface flow to tidal waters) should be no less than 100 feet from the top of bank, shoreline or edge of such wetlands. Further, buffer areas should either remain in their native vegetative state with trees and shrubs or planted with native material that will enable them to become a forested area in the future. In all cases where new trees are planted, tree survival rates should be taken into account when determining the desired number expected to reach maturity. Sodding these waterway and wetland protection buffer areas does not offer the same level of pollutant removal capabilities as those areas that consist of tree and shrub cover and, therefore, buffer areas should be treated with more than turf alone.



- Facility hazards such as grass bunkers, lakes, and sand traps should be designed as a component of the site's stormwater management system.
- Golf course development plans should include a Best Management Practice facilities maintenance plan. Retention areas should be designed so that maintenance necessitated from siltation deposition is easily achieved. Facility design criteria should include the use of fore bays for sediment control and the establishment of emergent wetlands around the fore bay perimeter.
- Water traps and associated drainage ways should be sized, positioned, and designed to replicate, to the greatest extent possible, storm water effluent characteristics that replicate natural storm flows necessary to protect the normal functioning of receiving hydrologic systems.

Golf Course Natural Resource Protection Plan

In addition to adhering to the General Golf Course Development Guidelines, a Natural Resource Protection Plan should be submitted by applicants who wish to develop such facilities. The following information should be considered when developing the Plan:

- Golf course design should include measures to retain existing woodland cover. The clearing of forested areas should be limited to no more than 25% of the total forest acreage. Reforestation must be implemented to replace any acreage over the 25% limit. Off-site reforestation may be acceptable within other areas of the watershed. An acceptable reforestation plan utilizing, as a minimum, Virginia Department of Forestry guidelines, should be provided prior to or upon submittal of preliminary site plans.
- Rare and endangered species and their natural habitat areas and Natural Heritage Areas, as identified by the U. S. Fish and Wildlife Service and Virginia Department of Conservation and Recreation, should be identified and protective measures described if applicable.
- A water quality monitoring program which includes baseline monitoring of appropriate chemical, physical, and biological parameters, as deemed appropriate upon consultation with the Virginia State Water Control Board, should be established for adjacent surface waters. The baseline monitoring program should include:
 - Monthly water column monitoring for a minimum period of twelve months prior to the commencement of golf course development activities;
 - The monitoring of adjacent surface water columns for a three year period after course development at frequencies determined appropriate upon consultation with the Virginia State Water Control Board;



Signature Golf Course at West Neck

- Storm event monitoring conducted for a three year period after course development at frequencies determined appropriate upon consultation with the Virginia State Water Control Board; and,
 - Biological monitoring of benthic organisms inhabiting adjacent surface waters after course development at frequencies as determined appropriate upon consultation with the Virginia State Water Control Board.
- A groundwater quality and quantity monitoring program should be established in accordance with all criteria required by any groundwater withdrawal permit issued for the site by the Virginia State Water Control Board.
- Irrigation wells should be located or distributed so to avoid adversely affecting groundwater resources and adjacent surface water systems.
- An Environmental Management Plan, including Integrated Pest Management procedures, should be submitted, as a component of the Golf Course Natural Resources Protection Plan, which clearly describes course operations relating to the application of fertilizers, pesticides, and herbicides. A description of the site's storm water management system, designed for control of storm water volumes as well as product residuals associated with grounds management, should be included in the Plan. The Environmental Management Plan should emphasize a site specific and integrated approach to chemical use and pest control. The following guidelines should be considered when developing an environmental management plan:
 - A description of spill prevention control and countermeasure procedures;
 - A description of appropriate handling and mixing procedures;
 - Fertilizer selection based upon low leaching characteristics;
 - Chemical selection for pest control based upon vegetative-cover density and type and the identification of "key Pests" prior to the use of control measures;
 - Coordinated selection of chemicals, dosage, and treatment schedules in order to minimize hazards to non-target organisms and the surrounding ecosystems;
 - Selection and utilization of pest and drought resistant vegetation for maintained course areas such as fairways, tees, and greens;
 - Application of chemicals at times and under weather conditions that are deemed optimal and when the potential for adverse impacts to the surrounding ecosystems is minimized;
 - Introduction and maintenance of natural enemies, and other biological controls, to control "key" pests;
 - Utilization of chemical products only when the course superintendent has established a need to either prevent or control pest problems and when, in his or her professional opinion, there are no biological agents or cultural management practices that can effectively control the problem.

- Areas used to store or dispose of pesticides, fungicides, and herbicides should be designed to contain any possible spills and protect the environment from flooding or accidental leakage to surface waters or to the groundwater system. Site development plans should clearly identify this area;
- Sediment control during construction of golf courses should be implemented in accordance with accepted erosion and sediment control practices including the following techniques:
 - Tees, fairways, and greens should be laid out to minimize the need for widespread disturbance of the land;
 - Clearing and soil exposure should only occur on the portion of the site where construction activity will commence soon. Such activity should be phased in order to enable effective erosion and sediment management of excavated land and be a component of the plan of development;
 - Whenever possible, major excavation should occur during the drier seasons of the year to minimize erosion and sedimentation of waterways; and
- The following techniques should be used, when feasible, to minimize the effect of heat pollution of nearby waterways caused by parking areas and other impervious surfaces. While it is recognized that such areas comprise a proportionally small amount of land in relation to the overall golf course area, these facilities are often located in areas that affect large natural ecosystems. Summertime rainwater runoff can quickly increase the temperature of receiving streams by 15 degrees Fahrenheit and can be damaging to aquatic life in these waterways:
 - Maintain a dense buffer of trees and other shading vegetation along both natural and manmade drainage areas and receiving waterways;
 - Avoid locating wet ponds within waterways that naturally flow intermittently or perennially;
 - Manage groundwater use to sustain acceptable ground water levels. If possible, irrigation wells should be located or distributed so as to avoid depleting groundwater sources, especially those that contribute to surface waterways; and
- Adhere to the provisions of the City's Storm water Management Ordinance, Southern Watersheds Management Ordinance, Chesapeake Bay Preservation Area Ordinance and all other applicable development ordinances. Consider the use of multiple BMP's, both structural and non-structural, in order to reduce the temperature of heated water entering the environment.

DOCUMENTS ADOPTED BY REFERENCE

The following documents and any related amendments to them are hereby adopted by reference as part of this Comprehensive Plan:

1. Virginia Beach Historic Resources Management Plan, 1994
2. Natural Heritage Report, 1994
3. Municipal Center Master Plan, 1997
4. Consolidated Strategy and Plan for Housing and Community Development Programs, 2010
5. Public Facilities: General Aesthetic Guidelines, 2000
6. Shore Drive Corridor Plan, 2000
7. Southern Watershed Area Management Plan, 2001
 - a. Multiple Benefits Conservation Plan
 - b. Strategic Plan for Agriculture in Chesapeake and Virginia Beach
 - c. Southern Watershed Area Rural Area Preservation Plan
 - d. Conservation Plan for the Southern Watershed Area
8. Beach Management Plan, 2002
9. Shore Drive Corridor Design Guidelines, 2002
10. Retail Establishments and Shopping Center Ordinance Guidelines, 2002
11. Mixed Use Development Guidelines, 2004
12. Hampton Roads Joint Land Use Study, 2005
13. Old Beach Design Guidelines, 2005
14. Historic Kempsville Area Master Plan, 2006 (amended 2014)
15. APZ-1 / Clear Zone Master Plan, 2008
16. Virginia Beach Outdoors Plan, 2016
17. Resort Area Strategic Action Plan, 2008 (amended 2020)
18. Burton Station Strategic Growth Area Master Plan, 2009 (amended 2018)
19. Pembroke Strategic Growth Area 4 Implementation Plan, 2009 (amended 2014)
20. Major Street Network Ultimate Rights-of-Way, 2010
21. Newtown Strategic Growth Area Master Plan, 2010
22. Interfacility Traffic Area (ITA) and Vicinity Master Plan, 2011(amended 2017)
23. Bikeways and Trails Plan, 2011 (amended as Active Transportation Plan (ATP), 2021)
24. Rosemont Strategic Growth Area Master Plan, 2011
25. Virginia Aquarium and Owls Creek Area Master Plan, 2011
26. Lynnhaven Strategic Growth Area Master Plan, 2012
27. Oceanfront Resort District Design Guidelines, 2012 (amended 2017)
28. Oceanfront Resort District Form-Based Code, 2012 (amended 2021)
29. Hilltop Strategic Growth Area Master Plan, 2012
30. Centerville Strategic Growth Area Master Plan, 2013
31. Central Business Core District Design Guidelines, 2014 (amended 2016)
32. Urban Forest Management Plan, 2014
33. Transition Area Design Guidelines, 2015
34. Green Sea Blueway and Greenway Management Plan, 2015
35. Seapines Station Voluntary Guidelines, 2017
36. ViBe Creative District Connectivity Plan, 2017
37. Connector Park Design Guidelines, 2017
38. Sea Level Wise Adaptation Strategy, 2020
39. Resort Area Mobility Plan, 2023
40. Flood Resiliency Toolkit, 2023
41. Commercial Area Pattern Book, 2023

These documents are available in the Document Library at www.VBgov.com/planning or by contacting the Virginia Beach Planning Department at 757-385-4621.

TRANSPORTATION

COMPLETE STREETS

The City of Virginia Beach received a grant award during the Fall of 2012 to receive technical assistance from the Smart Growth America organization. A City staff committee met for 18 months to develop the policy as an Administrative Directive.

The purpose of the following Administrative Directive for Complete Streets is to develop streets that balance the needs of all users while implementing the Comprehensive Plan's principles for enhancing Virginia Beach's sense of place and creating a highly connected multi-modal transportation system. Through the implementation of this Complete Streets Administrative Directive, the City of Virginia Beach intends and expects to realize benefits in improved public health; environmental sensitivity; more walkable neighborhoods which can foster interaction; a greater sense of community pride; and an improved quality of life.



Administrative Directive

Title: City of Virginia Beach Complete Streets		Index Number: AD 3.26
Date of Adoption:	Date of Revision:	Page 1 of 3

1.0 Purpose and Need

- A. Complete Streets improve Virginia Beach's transportation system by providing safe, attractive travel for all users, through a prioritized system of connected transportation choices designed in harmony with adjacent land uses.
- B. The purpose of this Administrative Directive is to develop streets that balance the needs of all users while implementing the Comprehensive Plan's principles for enhancing Virginia Beach's sense of place and creating a highly connected multi-modal transportation system. Through the implementation of this Complete Streets Administrative Directive, the City of Virginia Beach intends and expects to realize benefits in improved public health; environmental sensitivity; more walkable neighborhoods which can foster interaction; a greater sense of community pride; and an improved quality of life.
- C. To implement this Vision, the goals of the City of Virginia Beach will be to:
 - 1. Consider all users in all aspects of the project development process for surface transportation projects to the fullest extent practicable.
 - 2. Match and balance roadway functions with user needs, both at the roadway segment level and as part of the larger transportation network.
 - 3. Develop the public rights of way in harmony with the adjacent land uses.
 - 4. Develop an attractive and sustainable transportation system.
 - 5. Promote public health by supporting healthy lifestyle choices and improved air quality.
 - 6. Promote safety and accident reduction.
 - 7. Increase the economic value of business districts and neighborhoods.
 - 8. Strengthen communities by creating a sense of place.

2.0 Administrative Directive

- A. All streets in the City's transportation system will be designed, constructed, operated and maintained to achieve a safe, reliable, convenient, and aesthetically pleasing multi-modal system to the fullest extent possible within the constraints of budgets, acquisition, environmental, and other similar factors.
- B. All users and modes - The needs of current and future users of the City's streets, including but not limited to motorists, pedestrians, bicyclists and transit, will be fully considered, evaluated, balanced and accommodated to the fullest extent practical

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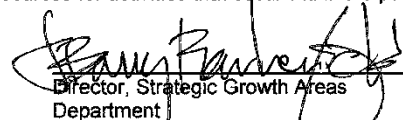
- C. All projects and phases - This policy is intended to cover all streets associated with development and redevelopment in the public domain and areas intended for public use within the City of Virginia Beach. This includes all public street projects such as new road construction, reconstruction, retrofits, upgrades, resurfacing and rehabilitation.
- D. Considerations for Exceptions - There are a number of considerations that may limit the applicability of accommodating all users and modes. These considerations are listed below:
 - 1. There is an absence of current or future need.
 - 2. The costs of accommodations for a particular mode are excessively disproportionate to the need and potential benefit within the project.
 - 3. The purpose and scope of the project does not facilitate provisions of such accommodation.
 - 4. The project involves routine, ordinary maintenance activities designed to keep assets in acceptable condition, such as cleaning, sealing, spot repairs, patching and surface treatments.
 - 5. Natural or cultural resource constraints preclude such accommodations.
 - 6. Conditions or restrictions outside the purview of the City of Virginia Beach prohibit such actions.
 - 7. Certain modes may be prohibited on the facility as per city or state code.
- E. Jurisdiction - Where projects involve other jurisdictions or other transportation agencies, the City will work with those jurisdictions to ensure compliance with this policy to the fullest extent practicable.
- F. Design Standards and Guidelines - Designers may consider flexibility in design to the fullest extent allowed by law and regulation. The following standards and guidelines will be used as applicable:
 - 1. Policy on Geometric Design of Highways and Streets (the "Green Book", AASHTO);
 - 2. Guide for the Planning, Designing and Operating of Pedestrian Facilities (AASHTO);
 - 3. Guide for the Development of Bicycle Facilities (AASHTO);
 - 4. Roadside Design Guide (AASHTO)
 - 5. Manual on Uniform Traffic Control Devices ("MUTCD", FHWA);
 - 6. Public Right-of-Way Accessibility Guidelines (US Access Board)
 - 7. ADA Standards for Accessible Design (US Access Board)
 - 8. Virginia Supplement to the MUTCD (VDOT)
 - 9. Road Design Manual (VDOT)
 - 10. Road & Bridge Standards (VDOT)
 - 11. Structure & Bridge Manual (VDOT)
 - 12. Multimodal System Design Guidelines (VDRPT)
 - 13. Public Works Design Standards Manual
- G. Context Sensitivity - Public rights-of-way and other areas intended for public use shall reflect the context and character of the surrounding built and natural environment, and enhance their appearance. Project design will be context-sensitive, considering adjacent land uses, local needs, standards set forth in the various Comprehensive Plan documents, along with the project's roles for connectivity and continuity within the larger network.

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3.0 Procedure to Accomplish Administrative Directive

- A. As part of its regular meeting, the City's Transportation Committee (reactivated) will facilitate accomplishing the Administrative Directive. The following departments are represented on the City's Transportation Committee:
1. Public Works
 2. Planning
 3. Economic Development
 4. Parks and Recreation
 5. City Manager
 6. Strategic Growth Area
- B. Project review. Each City department involved in the development, review and/or administration of projects applicable to this Directive will consider the Complete Streets process through their normal project review and implementation processes and through coordination with other departments and the general public.
- C. Staff Training. The City will train pertinent City staff on the content of the Complete Streets principles and best practices for implementing the policy.
- D. Collaboration. The City will foster a collaborative atmosphere across departments throughout the planning, design and management phases to promote the most responsible and efficient use of fiscal resources for activities that occur within the public right of way.

Approved as to Content:


 Director, Strategic Growth Areas
 Date: 10.13.14

Approved:


 Director, Department of Public Works
 Date: 10-21-14

Approved:


 Director, Department of Planning
 Date: 10/22/14

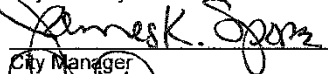
Approved:


 Director, Department of Parks and Recreation
 Date: 10/23/14

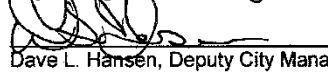
Approved as to Legal Sufficiency:


 City Attorney's Office
 Date: 10/28/14

Approved:


 City Manager
 Date: 11/4/14

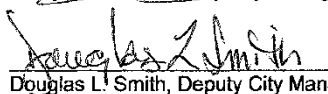
Approved:


 Dave L. Hansen, Deputy City Manager
 Date: 11.4.14

Approved:


 Cindy A. Curtis, Deputy City Manager
 Date: 11/9/14

Approved:


 Douglas L. Smith, Deputy City Manager
 Date: 11/3/14

MAJOR STREET NETWORKS ULTIMATE RIGHTS-OF-WAY TABLE

This table was adopted on May 11, 2010 by City Council as an amendment to the 2009 Comprehensive Plan and includes specific information concerning roadways, including rights-of-way widths, links to corresponding Public Works street cross sections, roadway classifications, and constraint designations. A key agenda for future action listed in the Policy Document of this comprehensive plan is to revise the updated general typical sections and plan views to be consistent with those currently in the Public Works Design Standards. Along with this agenda for future action step, this Major Street Networks Ultimate Rights-of-way table will also be amended as appropriate.

Major Street Network

Ultimate Rights-of-Way

The following Table is intended to provide a tool for long-range planning of the City of Virginia Beach's Major Street Network. The ultimate Rights-of-Way identified in this table have been developed to accommodate the road network needs for the future of the City at its "build-out" stage.

The following information is to be used by City Planning, Development Services, and Public Works Departments when reviewing development proposals for property on or along major road corridors in the City. The road classification, planned lanes, and cross sections are consistent with the official "Public Works Specifications and Standards-Right-of-Way Typical Section Standard Drawings."

It is important to note that these figures are to be used to ensure sufficient Right-of-Way is allowed to accommodate the City's future roadway network. This table, in conjunction with the Typical Sections, gives planners a tool to help plan for the future development. However, road cross sections will be better defined on a project by project basis by the City's Engineer as they are constructed.

Updates to this Table shall be conducted in conjunction with regularly scheduled Master Transportation Plan updates. The Table may also be updated outside of the regularly scheduled Master Transportation Plan updates, following the typical plan amendment process.

This Table shall also be updated if the City Council amends the "Public Works Specifications and Standards-Right-of-Way Typical Section Standard Drawings."

Table 1

**Major Street Network
Ultimate Rights-of-Way**

STREET NAMES & SEGMENT	ROW Adopted April 2010	Planned Maximum Lanes	Classification	Constraint Level	Cross Section
19 ST (Birdneck to Pacific)	70	3	Special Planning Area		N/A
21 ST (Parks to Pacific)	70	4	Special Planning Area		N/A
22 ST (Parks to Pacific)	70	4	Special Planning Area		N/A
ATLANTIC AVE (Shore to Pacific)	100	4	Special Planning Area		N/A
BAKER RD (Newtown to Witchduck)	70	2	Min Coll	Standard	13
BAKER RD (Wesleyan to Newtown)	100	4	Maj Coll	Moderate	11
BAXTER RD (PA to Independence)	110	4	Min Art	Constrained	7
BIRDNECK (Laskin to VBB)	130	6	Mid Arterial	Constrained	7
BIRDNECK (VBB to Gen Booth)	Varies 94-183	6	Mid Arterial	Buildout	N/A
BLACKWATER RD (NC State Line to Ches. City Line)	70	2	Rural		N/A
BOLD RULER DR (Upton to Dam Neck)	70	2	Min Coll	Standard	13
BONNEY RD (Independence to Rosemont)	80	4	Maj Coll	Constrained	12
BONNEY RD (Witchduck to Baxter)	80	4	Maj Coll	Constrained	12
BUCKNER BLVD (Independence to Rosemont)	100	4	Maj Coll	Moderate	11
BUCKNER BLVD (Rosemont to Holland)	80	4	Maj Coll	Constrained	12
CENTERVILLE TPK (Indian River to Kempsville Rd)	150	6	Mid Art	Moderate	5
CENTERVILLE TPK (Kempsville Rd to Ches. City line)	150	6	Mid Art	Moderate	5
CLEVELAND ST (Newtown to Kellam)	80	4	Maj Coll	Constrained	12
COLUMBUS LOOP (Kellam to Constitution)	112	4	Maj Coll	CBD	27
COMMONS LOOP Dam Neck to PA)	110	4	Min Art	Constrained	7
CONSTITUTION DR (Jeanne to VBB)	80	4	Maj Coll	Constrained	12
CONSTITUTION DR (VBB to future overpass)	100	4	Min Art	CBD	26
CORPORATE LANDING BLVD (Gen Booth to Dam Neck)	100	4	Maj Coll	Moderate	11
CULVER LA (Gen Booth to Upton)	100	4	Maj Coll	Moderate	11
DAM NECK RD (aka Elbow) (Ches City line to Salem)	125	4	Min Art	Standard	5
DAM NECK RD (Gen Booth to Naval Facility)	110	4	Min Art	Constrained	7
DAM NECK RD (Holland to Gen Booth)	165	6	Parkway	N/A	9
DAM NECK RD (PA to Holland)	150	6	Mid Art	Moderate	5
DAM NECK RD (Salem to PA)	125	4	Min Art	Moderate	5
DAM NECK STATION (Gen Booth to Dam Neck Rd)	80	4	Maj Coll	Constrained	12
DIAMOND SPRINGS RD (Shore to Northampton)	150	6	Mid Art	Moderate	5
DIAMOND SPRINGS RD (Northampton to Newtown)	150	6	Mid Art	Moderate	5
DORSET RD (VBB to Cleveland)	80	4	Maj Coll	Constrained	12
EDWIN ROAD (Independence to future Overpass)	110	4	Min Art	Constrained	7
ELBOW (Ches City line to Salem) - see Dam Neck (Ches CL to Salem)	125	4	Min Art	Moderate	5
FERREL PKW (Indian Lakes to Salem)	130	6	Mid Art	Constrained	7
FERREL PKW (Indian River to Indian Lakes)	150	6	Mid Art	Moderate	5
FERREL PKW (Salem to PA)	130	6	Mid Art	Constrained	7
FIRST COLONIAL RD (Great Neck to VB Blvd)	150	6	Mid Art	Moderate	5
FIRST COLONIAL RD (VBB to Oceana Blvd)	110	4	Min Art	Constrained	7
GEN BOOTH BLVD (Dam Neck to PA)	150	6	Mid Art	Moderate	5
GEN BOOTH BLVD (Oceana Blvd to Dam Neck Rd)	155	8	Maj Art	Constrained	7
GEN BOOTH BLVD (Rudee Bridge to Oceana Blvd)	165	6	Mid Art	Standard	3
GREAT NECK RD, N (Shore to VBB)	130	6	Mid Art	Constrained	7
GREENWICH RD (Newtown to Witchduck)	80	4	Maj Coll	Constrained	12
HARPERS RD (Oceana Blvd to London Bridge)	100	4	Maj Coll	Moderate	11
HAYGOOD RD (Independence to Newtown)	110	4	Min Coll	Constrained	7
HILLTOP LOOP	80	4	Maj Coll	Constrained	12
HOLLAND RD (Independence to Rosemont)	150	6	Mid Art	Moderate	5
HOLLAND RD (Rosemont to Shipps Corner)	130	6	Mid Art	Constrained	7
HOLLAND RD (Shipps Corner to Dam Neck)	150	6	Mid Art	Moderate	5
HOLLAND RD (Dam Neck to London Bridge EXT North)	110	4	Min Art	Constrained	7
HOLLAND RD (London Bridge EXT North to London Bridge EXT South)	125	4	Min Art	Moderate	5
HOLLAND RD (London Bridge EXT South to Nimmo)	110	4	Min Art	Constrained	7
I-264 (I-64 to Birdneck)	250	8	Interstate		

Table 1
Major Street Network
Ultimate Rights-of-Way

STREET NAMES & SEGMENT	ROW Adopted April 2010	Planned Maximum Lanes	Classification	Constraint Level	Cross Section
I-264 CONSTITUTION Flyover (Independence to Bonney)	150	6	Mid Art	Moderate	5
I-264 GREENWICH FLYOVER (Greenwich to Cleveland)	80	4	Maj Coll	Constrained	12
I-64 (Chesapeake City line to Norfolk City line)	250	8	Interstate		
INDEPENDENCE BLVD (Holland to Salem)	125	4	Min Art	Moderate	5
INDEPENDENCE BLVD (Salem to IR)	110	4	Min Art	Constrained	7
INDEPENDENCE BLVD (Shore to Haygood)	150	6	Mid Art	Moderate	5
INDEPENDENCE BLVD (Haygood to Holland)	155	8	Maj Art	Constrained	7
INDIAN LAKES BLVD (Ferrell to IR)	125	4	Min Art	Moderate	5
INDIAN LAKES BLVD (Providence to Ferrell)	110	4	Min Art	Constrained	7
INDIAN RIVER RD (Ches. City line to I-64)	150	6	Mid Art	Moderate	5
INDIAN RIVER RD (I-64 to Ferrell)	155	8	Maj Art	Constrained	7
INDIAN RIVER RD (Ferrell to Indian Lakes)	80	4	Maj Coll	Constrained	12
INDIAN RIVER RD (Indian Lakes to Independence)	125	4	Min Art	Moderate	5
INDIAN RIVER RD (Independence to canal bridge)	145	4	Min Art	Standard	3
INDIAN RIVER RD (canal bridge to PA)	150	4	TA 4 lane Parkway		35
INDIAN RIVER RD (existing alignment between Elbow and Lynnhaven)	70	2	Rural		N/A
INTERNATIONAL PKW (Lynnhaven to London Bridge)	125	4	Min Art	Buildout	N/A
JEANNE ST (Constitution to Independence)	80	4	Maj Coll	Constrained	12
KELLAM RD (VBB to Columbus Loop)	80	4	Maj Coll	Constrained	12
KEMPSVILLE RD (Ches City line to PA)	150	6	Mid Art	Moderate	5
LASKIN RD (Birdneck to Holly Rd)	150	6	Special Planning Area		N/A
LASKIN RD (Holly to Pacific)	88	4	Special Planning Area		N/A
LASKIN RD (VBB to Linbay)	165	6	Mid Art	Standard	3
LASKIN RD (Linbay to Birdneck)	165	6	Mid Art	Standard	3
LITTLE NECK RD (VBB to Newcastle)	100	4	Min Art	Buildout	N/A
LONDON BRIDGE EXT North (Dam Neck to Holland)	125	4	Min Art	Moderate	5
LONDON BRIDGE EXT South (Holland to PA)	115	4	Maj Coll	Standard	10
LONDON BRIDGE RD (Dam Neck to International)	150	6	Mid Art	Moderate	5
LONDON BRIDGE RD (International to Potters)	130	6	Mid Art	Constrained	7
LONDON BRIDGE RD (Potters to VBB)	130	6	Mid Art	Constrained	7
LONDON BRIDGE RD (Gen Booth to Dam Neck)	110	4	Min Art	Constrained	7
LYNNHAVEN PKW (Ches City line to Indian River)	110	4	Min Art	Constrained	7
LYNNHAVEN PKW (Indian River to Princes Anne)	110	4	Min Art	Constrained	7
LYNNHAVEN PKW (Princess Anne to Rosemont)	130	6	Mid Art	Constrained	7
LYNNHAVEN PKW (Rosemont to Holland)	150	6	Mid Art	Moderate	5
LYNNHAVEN PKW (Holland to Lynnhaven Road)	165	6	Mid Art	Standard	3
LYNNHAVEN PKW (Lynnhaven Road to Potters)	170	8	Maj Art	Moderate	5
LYNNHAVEN PKW (Potters to I-264)	155	8	Maj Art	Constrained	7
LYNNHAVEN PKW (I-264 to VBB)	130	6	Mid Art	Constrained	7
LYNNHAVEN RD S (Little Neck to Lynnhaven Pkw)	115	4	Maj Coll	Standard	10
LYNNHAVEN RD N (VB Blvd to Lynnhaven Parkway)	80	4	Maj Coll	Constrained	12
LYNNHAVEN RD N (Little Neck to VB Blvd)	80	4	Maj Coll	Constrained	12
MILITARY HWY (Ches City line to Norfolk City line)	150	6	Mid Art	Moderate	5
NEWTOWN RD (Diamond Springs to Haygood)	100	4	Maj Coll	Moderate	11
NEWTOWN RD (PA to Diamond Springs)	150	6	Mid Art	Moderate	5
NIMMO PKW (Gen Booth to Sandbridge)	110	4	Parkway	Constrained	3
NIMMO PKW (IR to PA)	150	4	Parkway	Constrained	9
NIMMO PKW (PA to Holland)	230	8	Parkway	Standard	9
NIMMO PKW (Holland to Gen Booth)	165	6	Parkway	Standard	9
NORTH LANDING RD (IR to Ches City line)	70	2	Min Coll	Standard	13
NORTH WITCHDUCK RD (Independence to Pembroke Blvd)	70	2	Min Coll	Standard	13
NORTHAMPTON BLVD (Ches Bay Bridge Tunnel to Diamond Springs)	165	6	Mid Art	Standard	3
NORTHAMPTON BLVD (Diamond Springs to Norfolk City Line)	190	8	Maj Art	Standard	3
OCEANA BLVD First Colonial to Gen Booth)	110	4	Min Art	Constrained	7
OLD DONATION (Great Neck to First Colonial)	115	4	Maj Coll	Standard	10
PACIFIC AVE (Atlantic Ave to Rudee Bridge)	70	4	Special Planning Area		N/A
PEMBROKE BLVD (Independence to Witchduck)	100	4	Min Art	Buildout	N/A
PLEASANT VALLEY RD (Indian Lakes Blvd to Lynnhaven Pkw)	70	2	Min Coll	Standard	13
PLEASURE HOUSE RD (Lookout to Northampton)	80	4	Maj Coll	Constrained	12
PLEASURE HOUSE RD (Northampton to Independence)	80	4	Maj Coll	Constrained	12

Table 1

**Major Street Network
Ultimate Rights-of-Way**

STREET NAMES & SEGMENT	ROW Adopted April 2010	Planned Maximum Lanes	Classification	Constraint Level	Cross Section
PRINCESS ANNE RD (Norfolk City line to Witchduck)	100	4	Min Art	Buildout	N/A
PRINCESS ANNE RD (Witchduck to Ferrell)	120	4	Min Art	Buildout	N/A
PRINCESS ANNE RD (Ferrell to Dam Neck)	150	8	Maj Art	Buildout	N/A
PRINCESS ANNE RD (Dam Neck to Nimmo)	250	8	Parkway	Standard	9
PRINCESS ANNE RD (Nimmo to Gen Booth)	70	2	Min Coll	Standard	13
PRINCESS ANNE RD (Gen Booth to Sandbridge)	135	4	TA 4 lane Parkway	Standard	34
PRINCESS ANNE RD (Sandbridge to IR)	135	4	TA 4 lane Parkway	Standard	34
PRINCESS ANNE RD (IR to NC border)	100	2	Rural	Standard	N/A
PROVIDENCE RD (Ches City line to IR)	110	4	Min Art	Constrained	7
PROVIDENCE RD (IR to Kempsville)	125	4	Min Art	Moderate	5
PROVIDENCE RD (Kempsville to PA)	110	4	Min Art	Constrained	7
PUNGO FERRY RD (PA to Blackwater)	70	4	Rural	Standard	N/A
REPUBLIC RD (First Colonial to Laskin)	80	4	Maj Coll	Constrained	12
ROSEMONT RD (Holland to Dam Neck)	110	4	Min Art	Constrained	7
ROSEMONT RD (VBB to Holland)	165	6	Mid Art	Standard	3
ROUND HILL DR (Lynnhaven to Elbow)	80	4	Maj Coll	Constrained	12
SALEM RD (PA to Lynnhaven)	120	4	Min Art	Buildout	N/A
SALEM RD (Lynnhaven to Elbow aka Dam Neck)	125	4	Min Art	Moderate	5
SALEM RD (Elbow aka Dam Neck to SEPG)	145	4	Min Art	Standard	3
SALEM RD (SEPG to IR)	150	4	TA 4 lane Parkway	Standard	35
SANDBRIDGE RD (New Bridge to Sandpiper)	100	2	Rural		N/A
SANDBRIDGE RD (Upton to New Bridge)	135	4	TA 4 lane Parkway	Standard	34
SEABOARD RD (Nimmo to PA)	66	3	Special	N/A	N/A
SEABOARD RD (PA to PA)	110	2	TA 2 lane Parkway	Seaboard Section	37
SHIPPS CORNER RD (Holland to London Bridge)	80	4	Maj Coll	Constrained	12
SHORE DR (N.Great Neck to Atlantic Ave)	110	4	Min Art	Constrained	7
SHORE DR (Norfolk City line to N.Great Neck)	150	6	Mid Art	Moderate	5
SOUTH PLAZA TR (Holland to VBB)	80	4	Maj Coll	Constrained	12
SOUTH PLAZA TR (PA to Holland)	100	4	Maj Coll	Moderate	11
SOUTHEASTERN PKW	300	8	Highway	SEPG	N/A
UPTON DR (Dam Neck to PA)	100	4	Maj Coll	Moderate	11
VA BEACH BLVD (Pacific to Great Neck)	100	4	SPA/Maj Coll	Moderate	11
VA BEACH BLVD (Great Neck to Newtown)	155	8	Maj Art	Constrained	7
WESLEYAN DR (Northampton to Baker)	125	4	Min Art	Moderate	5
WESLEYAN DR (Baker to Diamond Springs)	110	4	Min Art	Constrained	7
WESLEYAN DR (Diamond Springs to Haygood)	125	4	Min Art	Moderate	5
WEST NECK PKW (Commons Loop to IR)	150	4	TA 4 lane Parkway	Standard	35
WEST NECK RD (North Landing to IR)	115	2	TA 2 lane Parkway	Standard	36
WINDSOR OAKS BLVD (PA to Holland)	80	4	Maj Coll	Constrained	12
WITCHDUCK RD (I-264 to PA)	165	6	Mid Art	Standard	3
WITCHDUCK RD (VBB to I-264)	155	8	Maj Art	Constrained	7
WITCHDUCK RD (Pembroke Blvd to VBB)	110	4	Min Art	Constrained	7
WOLFSNARE RD (Great Neck to First Colonial)	70	2	Min Coll	Standard	13

MASTER TRANSPORTATION PLAN MODELING TECHNICAL MEMORANDUM

This document outlines the tasks associated with assisting the City of Virginia Beach (CVB) in the updating their Master Transportation Plan. An important component of the plan development is the ability to evaluate the transportation options that have been established in previous planning efforts. Past plans did not associate measureable travel model outputs with the highway projects so this effort was to be able to evaluate and identify the potential benefits of each project and attempt to rank them on their performance.

In order to assist with evaluation of those projects a minor update of the TransCad Version of the Hampton Roads Transportation Planning Organizations (HRTPO) travel model to the year 2013 was performed to assist in the evaluation of CVB master plan. This technical memo outlines the updates to the model, the development of a project management system and the coding of the projects, the evaluation and ranking of the projects as well as high level transit analysis for the Virginia Beach region.



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To: Brian Solis, AICP
Transportation and Transit Planning Manager

From: Rhett Fussell, Amar Sarvepalli, Kyle Ward and John Hendrickson
WSP | Parsons Brinckerhoff

Subject: City of Virginia Beach Master Transportation Plan Update

Date: December 2, 2015

Cc: Mark Shea, Phil Pullen, Adam Kirchner

This document outlines the tasks associated with assisting the City of Virginia Beach (CVB) in the updating their Master Transportation Plan. An important component of the plan development is the ability to evaluate the transportation options that have been established in previous planning efforts. Past plans did not associate measureable travel model outputs with the highway projects so this effort was to be able to evaluate and identify the potential benefits of each project and attempt to rank them on their performance.

In order to assist with evaluation of those projects a minor update of the TransCad Version of the Hampton Roads Transportation Planning Organizations (HRTPO) travel model to the year 2013 was performed to assist in the evaluation of CVB master plan. This technical memo outlines the updates to the model, the development of a project management system and the coding of the projects, the evaluation and ranking of the projects as well as high level transit analysis for the Virginia Beach region.

Update Model to 2013 Base Year

The official 2009 HRTPO model was used as the starting point for this task and was updated to a 2013 base year condition. No structural model changes occurred as a part of this update and no re-estimation and calibration was performed. The intent was to validate that the model could estimate general travel patterns in the Virginia Beach portion of the region. Network changes in other portions of the region nor transit routes were not included in this update.

Highway Updates

A detailed review of the highway network was first performed to assure the networks were updated to year 2013 conditions. This was achieved using Google Earth, local knowledge and project completion lists developed by CVB planning staff. Changes made include adding in new facilities, updating attributes for speed and number of lanes and adjustments to the location and connections of centroids in the model. Figure 1 shows the location of the highway network links that were reviewed during this process.

In addition, a review of the count locations determined there needed to be more data in the CVB portion of the model in order to adequately address if the model was performing adequately within CVB for the year 2013 update. Additional count locations were developed from shapefiles found online and coded into the model.

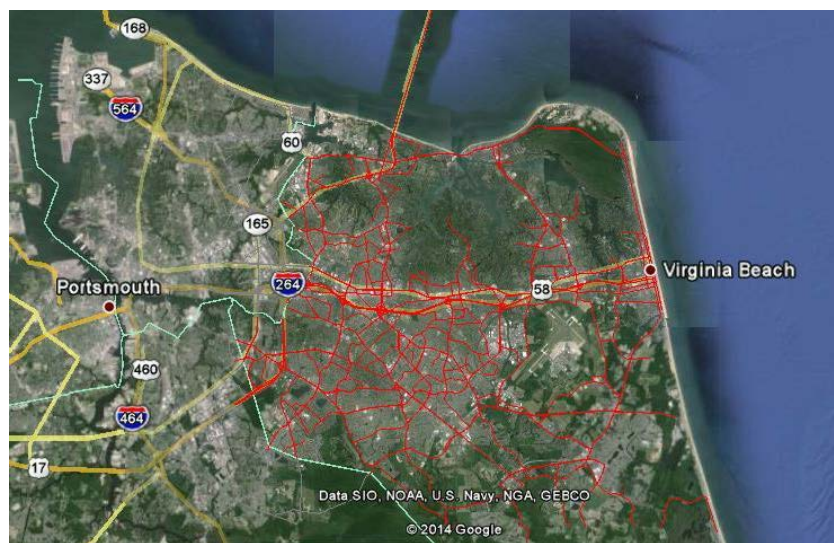


Figure 1: Updated Model Network

Socio-economic Updates

In order to reflect 2013 travel patterns updates to the household and employment information at the TAZ level was necessary. This was accomplished through trend analysis between the 2009 and 2018 data provided from the official model. Additional checks using census and other data sources were performed to assure reasonableness. This included plots of households and employment changes and comparisons of military households and employment in the region.

The official 2040 model datasets were reviewed for reasonableness to assure that strategic growth area data had been properly accounted for in the CVB region. Plots of household and employment changes by

TAZ were given to CVB staff for review and understanding. The official data was deemed acceptable and used in the analysis.

2013 Model Validation Results

The model was run using the updated networks and socio-economic data and the results of the highway assignment were reviewed in detail to determine if the 2013 updated data was able to accurately reflect existing travel patterns. In order to perform the review, automated reports were created in GISDK so that various performance measures were easily output summarizing various calibration statistics for the model.

As a part of the review, visual inspection of key highway locations in the region were performed to ensure the model was understanding travel in important regional locations in the Virginia Beach area. This included reviewing links with zero volumes, assessing the importance of the link, and updating connections where possible to provide better flow on the link. Color plots of volume loadings were also created and reviewed to assure confidence in the results.

In addition to the visual plots, various highway assignment comparisons were used to understand the model performance by facility type, VMT by functional classification, error by facility type and overall R2 for the CVB portion of the 2013 model. Those results are discussed in the remainder of this chapter.

Volume Group and Facility Type Comparisons

High level comparisons of count to model volumes is typical for urban models. The rule of thumb for most any travel model states having +/- 10% deviation is considered acceptable. Table 1 and Table 2 compare the daily count to the daily flow and display the model's ability to understand travel by facility type. Table 1 is the entire HRTPO region while Table 2 is the Virginia Beach region only. For the entire region, the overall the match of volume to count is -6.59% while the VB portion is lower at -3.47%, both of which are within the nationally accepted ranges overall.

The only performance measure not under the acceptable limit is the interstate. This seems to be a result of one major interstate facility in the region not replicating conditions properly.

Facility code	Facility Type	# of Counts	TOT Volume	Count Volume	% Deviation
1	Interstate	58	1,783,106	2,078,000	-14.19
2	Freeway	18	346,594	346,500	0.03
3	Principal Arterial	53	844,741	840,000	0.56
4	Minor Arterial	11	114,207	111,400	2.52
5	Major Collector	89	1,207,760	1,223,450	-1.28
	Total	229	4,296,409	4,599,350	-6.59

Table 1: HRTPO Region-Volume Difference by Facility Type (Counts >= 2500)

Facility code	Facility Type	# of Counts	TOT Volume	Count Volume	% Deviation
1	Interstate	22	533,723	609,000	-12.36
2	Freeway	6	88,598	83,500	6.11
3	Principal Arterial	26	477,702	462,500	3.29
4	Minor Arterial	3	43,491	40,000	8.73
5	Major Collector	63	980,266	1,005,100	-2.47
	Total	120	2,123,782	2,200,100	-3.47

Table 2: Virginia Beach Region-Volume Difference by Facility Type (Counts >= 2500)

As shown in Figure 2, the larger percent difference is found on Interstate 64 and it is affecting the overall suitability of the model. The same set of links is included in the Virginia Beach performance measures summary table which makes the percent deviation for the interstate facility type out of range. It could be that the tolling sensitivity in the model is not properly reflected but this does not invalidate the overall ability of the model to replicated 2013 travel.

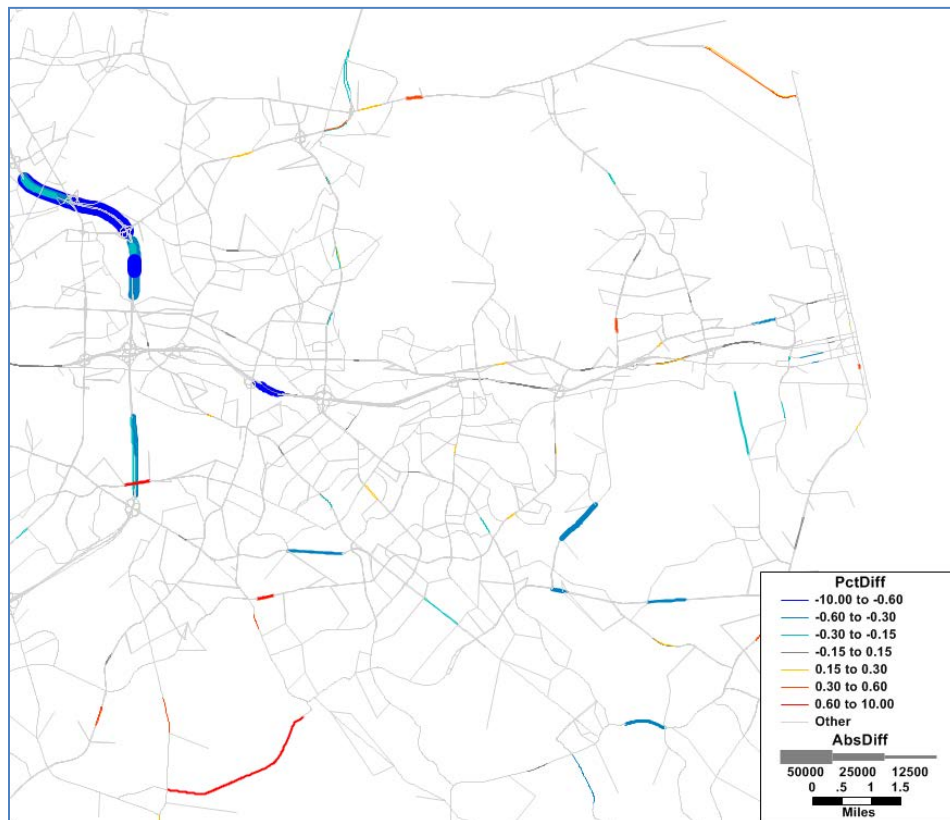


Figure 2: 2013 Percent Difference

In addition to the facility type comparisons, Tables X and X also provide summary results for the model by volume group. These tables exhibit similar patterns of underestimating the higher level facilities. For the

Virginia Beach portion, the absolute numbers are close and assumed reasonable given the limited number of counts for those facilities.

Volume Group	# of Counts	TOT Volume	Count Volume	% Deviation
2500 - 9999	25	122,961	124,950	-1.591763
10000 - 24999	31	345,817	307,000	12.643946
20000 - 39999	92	1,428,169	1,413,000	1.073557
40000 - 59999	41	873,912	909,000	-3.860078
> 60000	49	1,580,235	1,912,000	-17.351731
Total	238	4,351,094	4,665,950	-6.747947

Table 3: HRTPO Region-Volume Difference by Volume Group (Counts >= 2500)

Volume Group	# of Counts	TOT Volume	Count Volume	% Deviation
2500 - 9999	6	30,423	33,400	-8.911971
10000 - 19999	13	159,186	148,500	7.19572
20000 - 39999	63	1,057,131	1,034,500	2.187623
40000 - 59999	22	378,502	415,000	-8.794775
> 60000	20	527,403	612,000	-13.822981
Total	124	2,152,645	2,243,400	-4.04542

Table 4: CVB Region-Volume CVB Region-Volume Difference by Volume Group (Counts >= 2500)

At the link level, several comparisons were made including link assignment summaries by volume group and difference between estimated and observed through the calculation of the percent root mean square error (%RMSE) by facility type and volume group. The %RMSE is a measure of the variance between the observed and modeled volumes (numerator), normalized by the average of the observed data (denominator) and is expressed as a percent. The formula is as follows:

$$\%RMSE = \frac{(\sum_j (Model_j - Count_j)^2 / (Number\ of\ Counts - 1))^{0.5}}{(\sum_j Count_j / Number\ of\ Counts)} * 100$$

Since the differences between estimated and observed are squared before they are averaged, the RMSE gives a relatively high weight to large errors. This means the %RMSE is most useful when large errors are particularly undesirable. Targets for the %RMSE are in the ranges of 30-40%, depending upon the number of low-volume roadway segments included in the count sample. The %RMSE should decrease as volumes increase – thus for facility types with high volumes such as freeways, the %RMSE is expected to be lower (estimated should better match observed) than %RMSE measured on facility types with low volumes such as collectors. The %RMSE by facility type and volume group is summarized in Tables 5 and 6. By facility type, most facilities are within the target range, and the overall %RMSE is around 44%. Consistent with previous tables, there is an issue with the interstate facilities in the overall regional model. However,

when we look at the results for just the Virginia Beach portion of the model in Table 7 and Table 8, it shows that the model is performing exceptionally well.

Facility code	Facility Type	# of Counts	RMSE	% RMSE	Target
1	Interstate	58	16,024	44.73	25%
2	Freeway	18	4,462	23.18	25%
3	Principal Arterial	53	4,218	26.61	50%
4	Minor Arterial	11	2,445	24.14	50%
5	Major Collector	89	4,760	34.63	65%
	Total	229	8,934	44.48	30-40%

Table 5: Percent Root Mean Square Error by Facility Type

Volume Group	# of Counts	RMSE	% RMSE	Target
2500 - 9999	25	2,779	55.59	45%
10000 - 19999	31	4,324	43.66	40%
20000 - 39999	92	4,401	28.65	35%
40000 - 59999	41	5,302	23.92	30%
> 60000	49	17,318	44.38	20%
Total	238	8,793	44.85	30-40%

*all factypes

Table 6: Percent Root Mean Square Error by Volume Group (Entire HRTPO Region)

Facility code	Facility Type	# of Counts	RMSE	% RMSE	% Deviation
1	Interstate	22	8009.84	28.94	25%
2	Freeway	6	3639.81	26.15	25%
3	Principal Arterial	26	3508.31	19.72	50%
4	Minor Arterial	3	1729.58	12.97	50%
5	Major Collector	63	5101.64	31.98	65%
	Total	120	5374.4	29.71	30-40%

Table 7: Percent Root Mean Square Error by Facility Type (CVB Region)

Volume Group	# of Counts	RMSE	% RMSE	Target
2500 - 9999	6	2142.85	38.49	45%
10000 - 19999	13	3454.06	30.24	40%
20000 - 39999	63	4776.58	29.09	35%
40000 - 59999	22	5047.2	26.76	30%
> 60000	20	8370.08	27.35	20%
Total	124	5374.4	29.71	30-40%

Table 8: Percent Root Mean Square Error by Volume Group (CVB Region)

Figure 3 is a plot of the traffic count against the percent deviation of the modeled volume. The maximum desirable deviation curve is also plotted on this figure. This graph is useful in determining which links exceed the maximum desirable deviation so that validation efforts can be focused on these links. The graph shows that more deviation is acceptable for lower volume links, whereas estimates of high volume links should deviate less from the observed flows.

The results show a good fit of the model estimated flows against traffic counts. It is expected that some locations will be above the maximum desirable deviation curve, as it is extremely important not to over calibrate a model just to get all of the link flows to match the traffic counts. One reason is that all traffic counts include some degree of error, but the most important reason is that the model should not be forced to match traffic counts through individual link adjustments as the model must remain sensitive to future changes in travel demand and traffic flow.

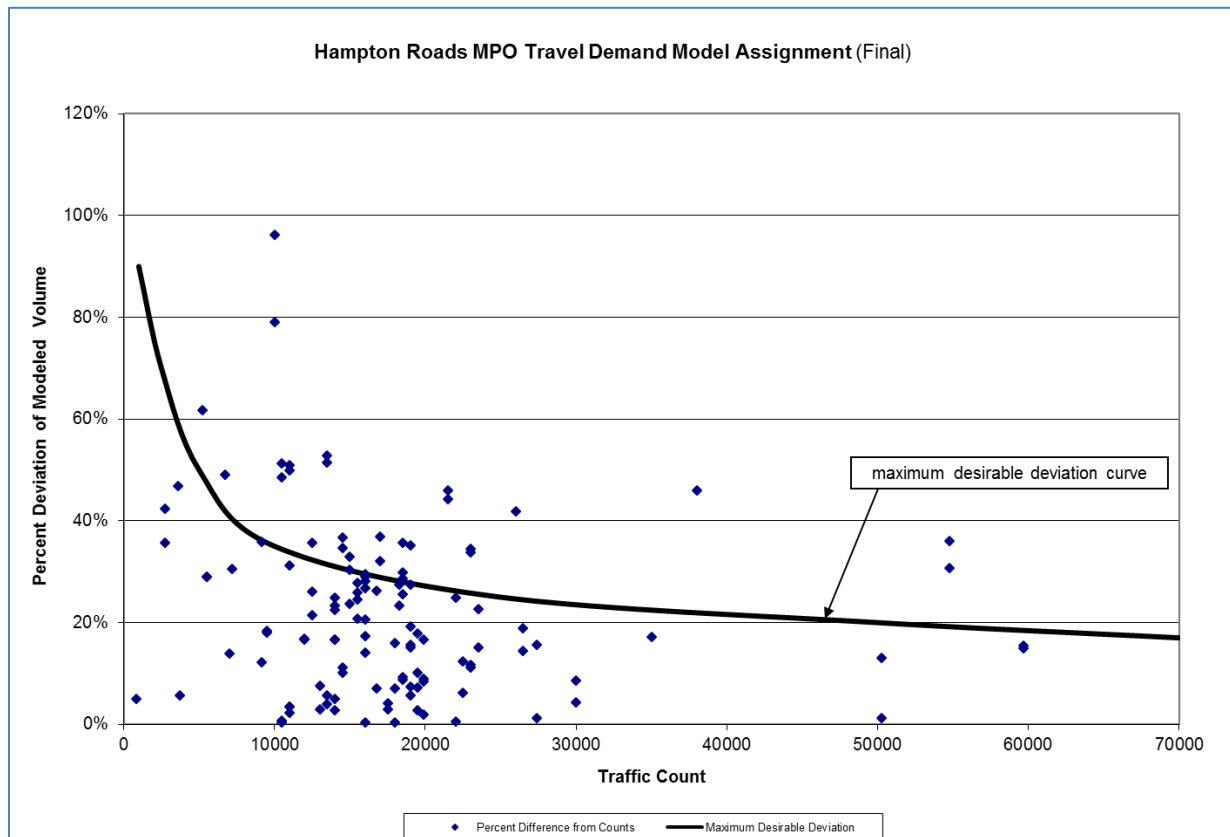


Figure 3: Plot of Traffic Count against the Percent Deviation of Modeled Flow

Given the results reported in the Virginia Beach portion of the region, it was determined that the model is performing well within acceptable standards, indicating that the model is representing base year travel demand properly.

With the overall model validation achieved, the model data could be used for: 1) testing alternative transportation plans; 2) establishing priorities between different transportation investment strategies; 3) analyzing alternative locations for roadway improvements; and 4) forecasting design volumes needed to adequately design and construct new roadway facilities for the Virginia Beach Comprehensive Transportation Master Plan.

Project Management System

In order to facilitate project and alternatives testing, a simple project management system was devised and implemented in two parts. The first was an excel-based project list, which included project attributes such as extent, cost, and final cross section. Appended to this was a small number of binary columns, each defining a scenario. In these columns, a “1” indicated that the project was included, while a “0” meant it was not. To inform the model of which projects to include in a scenario, the excel sheet was filtered, and the list of project IDs to include was stored in a comma-separated file.

	A	B	C	D	E	F
1						
2						
3						
4						
5						
6						
7						
8						
9	ProjID	2020 PID / CIP	Project Name	From	To	Project Type
10	51		I-64	FT EUSTIS BLVD	HUMELSINE PKWY (RTE199) / GROVE	WIDENING
11	52		I-64	I-464	I-264/I-664/BOWERS HILL	WIDENING/BRIDGE REPLACEN
12	53		I-264	I-64 WB	WITCHDUCK RD	WIDENING
13	54		BRIDGE RD	MILLS GODWIN BR	CHESAPEAKE CL	WIDENING
14	55		MILLS GODWIN BR	QUAIL HOLLOW	WATERVIEW RD	WIDENING/BRIDGE REPLACEN
15	56		INDIAN RIVER RD	LYNNHAVEN PKWY	ELBOW RD	WIDENING
16	57	2040-164 / 2-152	ELBOW RD/Dam Neck Rd	INDIAN RIVER RD	Virginia Beach Amphitheater	WIDENING
17	58		DAM NECK RD	HOLLAND RD	DRAKESMILE RD	WIDENING

The second part of the management system was the model infrastructure. First, the master network was modified to two sets of attributes: a base set and a project set. As an example, a link might have one lane per direction in the base set of attributes, but two per direction in the project set. The project set of attributes also includes the project ID that matches up with the comma-separated file. The model script was modified to check the project IDs on the links with the project ID list. If the project ID was included, then the project set of attributes was used. Otherwise, the base attributes were used.

This system is both simple and powerful. It allows the flexibility to code complex projects where a single ID could include freeways, ramps, and centroid connectors.

Project Coding

With the management system in place, projects were then coded into the network. New alignments and the limits for changes in project attributes were provided in a shapefile from the city staff, and were transferred into TransCAD by the consultant. The project management spreadsheet provided the attributes. After multiple iterations of review and comment, 95 projects had been coded into the TransCAD network for analysis.

Project Cost-Benefit Analysis

Projects were analyzed using the Delay-Allocation Method described in Appendix A. While the technical details can be found there, a general overview is provided here. A model scenario was first run with 2040 socio-economic (SE) data, but with no additional projects beyond what was committed to in the State Transportation Improvement Plan (STIP). A second scenario was run with every project in the list included. This second scenario saw a significant reduction in delay, and individual project benefits were measured based on how much of that delay reduction they caused. By comparing those delay reductions to the project cost, a ranking based on cost effectiveness was created.

One important aspect of this analysis was the role of the Southeast Parkway and Greenbelt (SEPG) project, which is almost 20 miles long and over \$2 billion. Due to the size of the project, and the uncertainty surrounding it, projects were analyzed both with and without its inclusion. As expected, project effectiveness scores shifted with the inclusion of such a large project. Performing the analysis twice allowed planners and engineers to be better informed. Projects that did well in either scenario could be emphasized, while a wait-and-see approach could be taken for projects that depended on the SEPG.

Figure 4 below shows the projects' effectiveness scores and total benefits in 2040 assuming the SEPG is constructed. The figure also shows the growth of households and employment between 2013 and 2040.

The lighter colored projects have lower benefits to the region and therefore are less critical to the future transportation system. The thickness of the lines also highlight the level of anticipated benefits of that project to the CVB, with thicker green lines being the better projects.

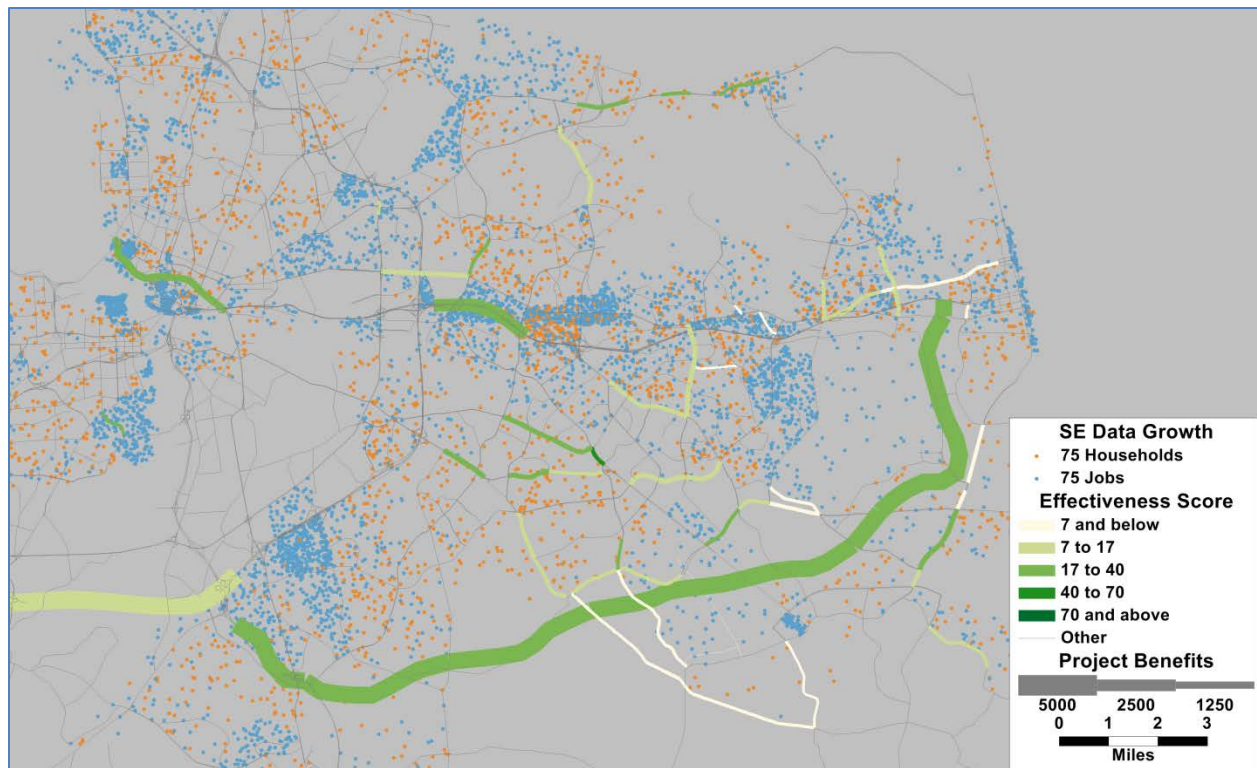


Figure 4: Virginia Beach 2040 Project Effectiveness Scores (with SEPG)

Figure 5 shows the project effectiveness of projects without the SEPG in place. It highlights that some projects have less effect, or are not as necessary, when the parkway is not providing additional access to portions of the region.

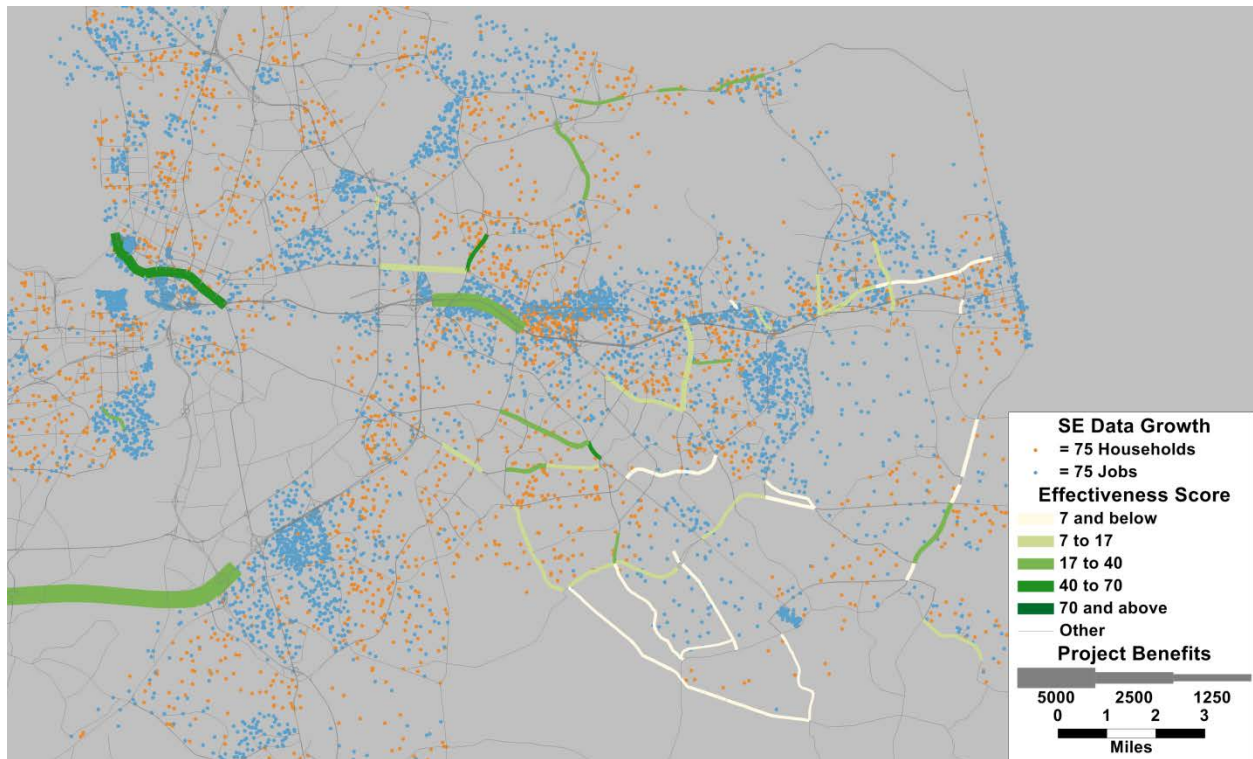


Figure 5: Virginia Beach 2040 Project Effectiveness Scores (without SEPG)

Lane Call Analysis

A second round of analysis was performed to determine if the cross sections of projects were appropriate. This involved preparing congestion maps, which were color-coded based on the ratio of volume to capacity on a link-by-link basis. An example V/C map for the AM period is shown in Figure 6. The width of the link conveys information on the total volume, while the color represents the congestion level.



Figure 6: 2040 AM V/C Map

With maps like this, city planners and engineers could determine where project cross sections should be revised both up or down for the master plan update.

Highway Summary

The ultimate product for the CVB comprehensive transportation plan was a prioritized list of ranked projects based on the use of the travel model it is necessary to recall that:

- Models (using any metric) capture congestion effects
- There are other considerations when prioritizing projects
- The model should be one of a number of tools employed for transportation analysis
- Model results should never be considered the final answer

It is important to keep in mind that the project ranking included in this document is only based on delay benefits. It does not consider other important transportation elements like safety, economic impacts or additional changes in landuse beyond what is in the travel model, which could lead to changes in the prioritization of a project. The final prioritized list is included in Appendix B using the SEPG network.

Transit Analysis Using STOPS

The City of Virginia Beach wanted the ability to look at high level ridership on key light-rail corridors to assist in evaluating the transportation plan. Although the HRTPO model has a transit component, it was clear that additional model re-development and calibration was going to be necessary to use that tool in this evaluation. Given that the goal of the comprehensive plan was to understand the general magnitude

of transit corridor viability, a different analysis was performed using a federally accepted transit analysis tool.

It is important to recognize in the STOPS application for the CVB that the estimates were based on:

1. The 2000 CTPP flow patterns and relationships
2. Estimated station to station travel times not actually calculated based on the track curvature, grades and length of span. More detailed analysis would be needed to properly reflect travel times.
3. The station locations have been approximated to match the South Side Transit System map from 2014.

Changes in any of those components will affect the ridership results reflected in this report.

Simplified Trips-on-Project (STOPS) Model Overview

The Federal Transit Administration (FTA) Simplified Trips-on-Project Software (STOPS) model was used to develop project trip and transit forecasts for the CVB. STOPS is a stand-alone software package that applies a set of travel models to forecast transit person trips, travel patterns, and trips-on-project measure for all travelers and for transit dependents (as required by the FTA), and computes the change in transit ridership between the No-Build and Build scenarios needed for the New Starts evaluation and rating.

STOPS is described by the FTA as a fundamentally conventional “four-step” model set that considers zone-to-zone travel markets stratified by household auto ownership, employs a conventional mode-choice model to predict zone-to-zone transit travel based on zone-to-zone travel characteristics of the transit and roadway networks, and then assigns the trips predicted to use fixed guideways onto the various rail and bus rapid transit facilities (including the proposed project) in the transit network.

STOPS is designed to estimate fixed guideway transit trips on a project using readily available data and procedures that are calibrated to match both local and national experience related to rail and BRT ridership. STOPS is similar, in concept, to traditional trip-based four-step travel forecasting model. This structure is more complex than a simple direct-generation model so that STOPS can discern project ridership in a wide range of situations.

- A fixed guideway starter line
- An extension to an existing fixed guideway line
- A new line added to an existing fixed guideway system
- A gap-filler project in which a new segment connects two previously separated fixed guideway systems

To be able to measure project ridership in all of these situations, STOPS includes the capability to represent the transit system and the project definition so that trips can be identified that benefit from the investment in new fixed guideway services. An overview of STOPS is presented in Figure 8.

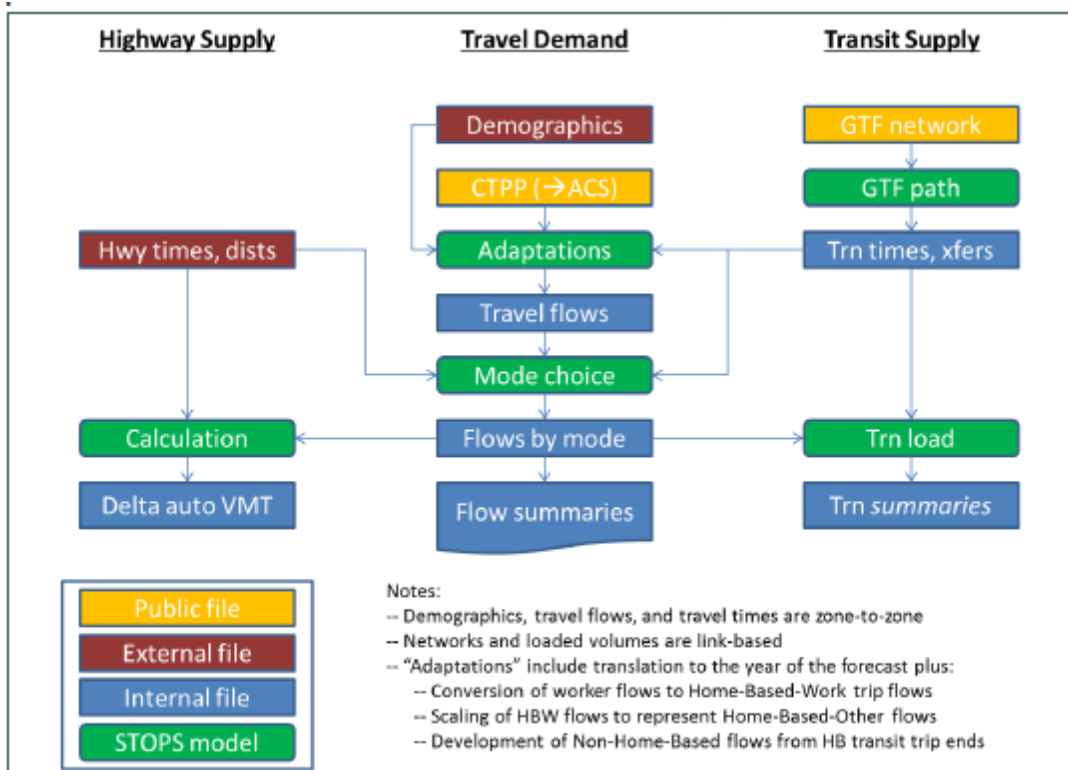


Figure 7: STOPS Application Flow Chart

Similar to nearly all multi-modal travel forecasting models, STOPS has three parallel tracks:

- Highway supply.** The left column in the flow chart represents information about the highway system in the region. STOPS does not directly process information on highway attributes and instead relies on estimates of zone-to-zone highway travel times and distances obtained from the HRTPO regional travel forecasting model. Since MPO models might not still use the same geographic (zone) system used in the CTPP, STOPS includes a procedure to convert MPO geography to CTPP geography.
- Transit supply.** The right column represents information about the transit system. Like traditional models, transit network characteristics are used to build zone-to-zone level of service (skim) matrices and load transit trips to determine ridership by route and station. Unlike traditional forecasting models, STOPS does not use elaborate hand-coded networks. Instead, STOPS takes advantage of a recent advance in on-line schedule data—the General Transit Feed Specification (GTFS). This data format is a commonly-used format for organizing transit data so that on-line mapping programs can help customers find the optimal paths (times, routes, and stop locations) for their trips. STOPS includes a program known as GTFPath that generates the shortest path between every combination of regional origin and destination. This path is used for estimating travel times (as an input to mode choice) and for assigning transit trips (an output of mode choice) to routes and stations.
- Travel Demand.** The central column represents the demand side of STOPS. STOPS uses Year 2000 CTPP JTW data to estimate zone-to-zone demand for travel (i.e., travel flows) as an input to the models that determine the mode of travel. This data is adapted to represent current and future years by using MPO demographic forecasts to account for zone-specific growth in population and

employment. A traditional nested logit mode choice model is used to determine the proportion of trips utilizing transit stratified by access mode and transit sub-mode. Results of mode choice are summarized in a series of district-to-district flow tables.

1. Model Setup and Inputs

Following computer installation of STOPS, the CTPP Journey to Work 2000 trip tables and corresponding zone files were automatically extracted for the Hampton Roads TPO Region. The existing station location file for the fixed-guideway system in the region was also extracted and checked to make sure the existing stations are correctly represented. The STOPS model required three major data inputs prior to initiating a model run, as described below:

- Station locations for existing LRT lines and transit schedules
- Highway skims
- MPO population and household data

Station Locations

The station location file defines fixed-guideway station locations, names, types, and information that relate these stations to the region's automated schedule data. All existing stations, NoBuild and Build stations were coded along with station attribute data. The following are the definitions of the alternatives:

- Existing: 2015 existing transit system(existing LRT line) and 2015 socio-demographic data
- NoBuild (BlueLine): 2015 existing transit system plus three new stations and 2040 socio-demographic data
- Build Alternatives (Orange, Red, Green and Purple Lines): Nobuild transit system plus a range of new stations that represent each alternative with 2040 socio-economic data.

Existing Stations

The existing station locations are coded based on the 2015 General Transit Feed System Data (GTFS) from the Hampton roads transit agency (<http://googletf.gohrt.com>) as shown in Figure 9.



Figure 8: Location of Existing LRT Stations

NoBuild Stations (Blue Line):

Three additional stations that are currently under construction were also coded as shown in Figure 10. Since the exact operational schedules are unknown for these stations, an approximate travel times between the stations based on the distance and travel speeds were computed. Table 9 shows the existing and assumed runtimes between the light rail stations.



Figure 9: Location of NoBuild Stations

Station Group	Distance (Miles)	Travel Time (Minutes)	Type
1-EVMC	0.67	2.00	EXIST
2-NORFOLK CBD	1.29	10.00	EXIST
3-NSUBAL	2.41	7.00	EXIST
4-MILNWT	2.48	5.00	EXIST
5-WITCH	1.78	4.00	NEW
6-KELLAM	0.97	3.00	NEW
7-TOWNCENTER	0.57	2.00	NEW

Table 9: Existing and NoBuild Station Attributes

Build Alternatives (Orange, Red, Green and Purple Lines):

Various extensions were coded as build alternatives extending the NoBuild alternative Blue line to the East as Orange line, towards north as Red line, towards south as Green and southwest as Purple lines as shown in Figure 11.

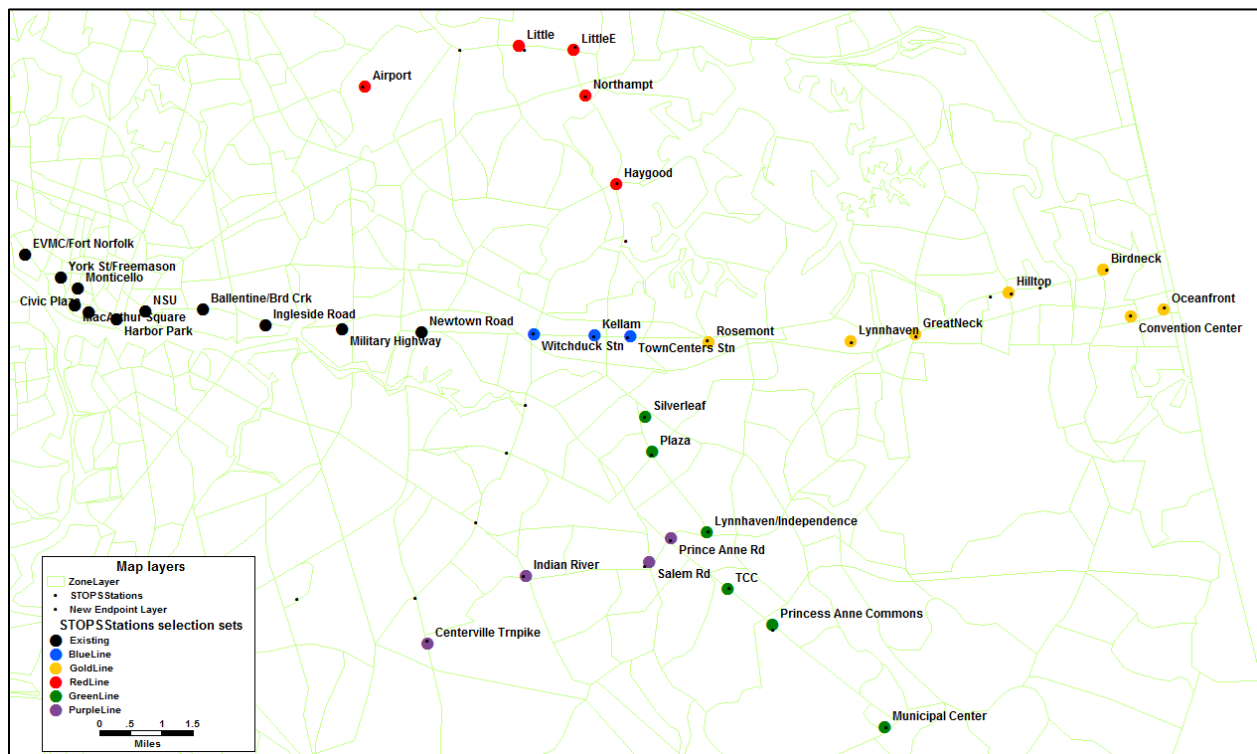


Figure 10: Build Station Locations

Build Alternative Station Attributes

STOPS application uses schedule travel times coded in the GTFS network to model transit system as well as fares and park-n-ride capability. In order to code schedule travel times and properly attribute each of the proposed build stations, the following were assumed:

Transportation / E-26

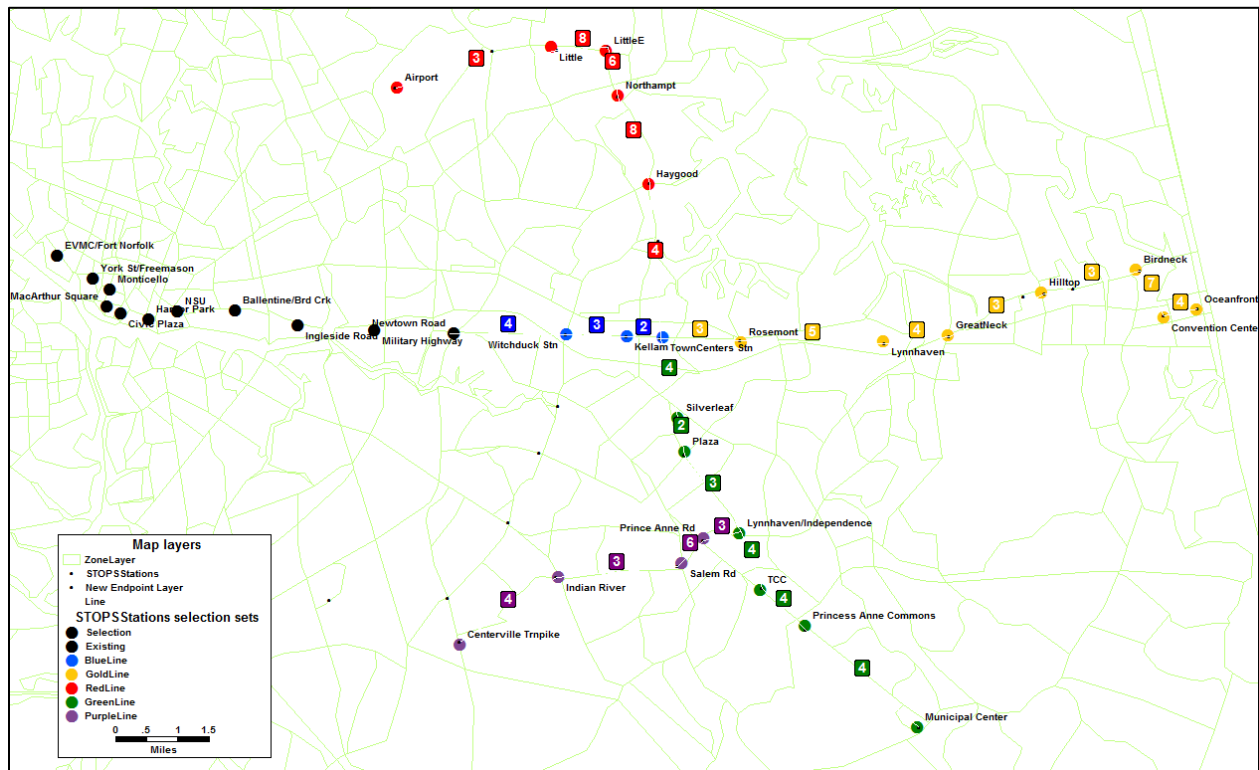


Figure 12: Build Station Runtimes

Table 10 shows the overall line distance, speeds, runtimes and number of stations for the Existing, NoBuild and Build alternatives.

Attributes	Existing	Blue (NoBuild)	Orange (Build)	Red (Build)	Green (Build)	Purple (Build)
Distance (Miles)	6.85	10.17	19.26	20.98	17.85	18.52
Run Time (Minutes)	24.00	33.00	62.00	62.00	54.00	58.00
Speed (MPH)	17.13	18.49	18.64	20.30	19.83	19.16
Num of Stations	11	14	21	19	20	21

Table 10: Attributes of Alternatives

Highway Skims

The regional MPO model was run for 2013 and 2040 to produce highway skims, which consist zone-to-zone travel times and distance. These skim files are used as inputs to STOPS application.

Socio-Demographic Data

Population and employment data at the zonal level from the regional model is extracted for years: 2000, 2015 and 2040. This zonal data is used in STOPS to reflect the future year scenario.

2. Model Calibration

Default STOPS Model Parameters and Input

Figure 13 shows the input of the 2013 regional transit ridership of 53,594 into the STOPS model. Table 11 shows the light rail station boardings for the existing stations as input data for auto calibration of the STOPS model.

Scenario-Specific Model Parameters			
0 car HH, HBO:HBW ratio	=	1.0980 versus base of	1.0980
1 car HH, HBO:HBW ratio	=	0.5350 versus base of	0.5350
2+car HH, HBO:HBW ratio	=	0.5030 versus base of	0.5030
0 car HH, NHB:HBW+HBO ratio	=	0.1990 versus base of	0.1990
1 car HH, NHB:HBW+HBO ratio	=	0.1930 versus base of	0.1930
2+car HH, NHB:HBW+HBO ratio	=	0.2340 versus base of	0.2340
FG Constant Discount		1.0000	
Input regional unlinked transit trips		53594.00	
Input HBW linked transit trips		0.00	

Figure 13: Input Parameters

Station Name	Code	Group	Type	New/Exist	BoardCount
EVMC/Fort Norfolk	EVMC	1-EVMC	1	E	657
York St/Freemason	YORK/FREE	1-EVMC	1	E	172
Monticello	MONTICELL	2-NORFOLK CBD	1	E	608
MacArthur Square	MACARTHUR	2-NORFOLK CBD	1	E	724
Civic Plaza	CIVIC PLZ	2-NORFOLK CBD	1	E	568
Harbor Park	HARB PARK	2-NORFOLK CBD	2	E	275
NSU	NSU	3-NSUBal	3	E	430
Ballentine/Brd Crk	BALLENTIN	3-NSUBal	2	E	395
Ingleside Road	INGLESIDE	3-NSUBal	1	E	91
Military Highway	MILITARY	4-MilNwt	2	E	586
Newtown Road	NEWTOWN	4-MilNwt	2	E	1,094
Total					5,600

Table 11 Current Year Station Boardings

Before and After STOPS Calibration

STOPS model forecasts regional transit ridership and light rail boardings based on the supplied CTPP Journey –to-Work flows, highway skims and transit schedules in GFTS format. However, these are the initial estimates that may or may not match to the observed counts for that year. Thus the model auto-calibrates to match to the regional transit ridership and then applies station level factors to match to the observed station boardings. Table 12 shows the adjustment factor developed for the STOPS model to match observed data. Table 13 shows the station to station flows before applying

the calibration factors. In Table 14 are the adjustment factors developed to match the existing station flows. Table 15 displays the final station to station flows after calibration.

Total Estimated Unlinked Trips Before Adjustment= 52088.78
Total Target Unlinked Trips= 53594.00
Expected adjustment for unlinked trips= 1.0289

Table 12: STOPS Adjustment Parameter Calibration

Origin/Destination	EVMC	NORFOLK CBD	NSUBal	MilNwt	Estimated	Observed
1-EVMC	97	259	88	254	699	829
2-NORFOLK-CBD	259	216	189	427	1091	2175
3-NSUBal	88	189	60	254	592	916
4-MilNwt	254	427	254	305	1241	1680
Estimated Total	699	1091	592	1241	3623	-
Observed Total	829	2175	916	1680	-	5600

Table 13 Estimated Station-to-Station Flows Before Calibration

Origin/Destination	EVMC	NORFOLK CBD	NSUBal	MilNwt
1-EVMC	0.84	1.55	1.13	0.97
2-NORFOLK-CBD	1.55	2.86	2.08	1.78
3-NSUBal	1.13	2.08	1.52	1.3
4-MilNwt	0.97	1.78	1.3	1.11

Table 14 Calibration Factors for Station-to-Station Flows

Origin/Destination	EVMC	NORFOLK CBD	NSUBal	MilNwt	Estimated	Observed
1-EVMC	82	401	100	246	829	829
2-NORFOLK-CBD	401	617	394	762	2175	2175
3-NSUBal	100	394	91	331	916	916
4-MilNwt	246	762	331	340	1680	1680
Estimated Total	829	2175	916	1680	5600	-
Observed Total	829	2175	916	1680	-	5600

Table 15 Estimated Station-to-Station Flows After Calibration

3. Forecasted Ridership

Once calibrated for the 2013 base year the model could be used to forecast the anticipated 2040 ridership for the region. Table 16 shows the regional estimated 2040 transit trips as well as the LRT trips for the various corridors tested. The table also shows the difference in anticipated ridership when compared with the blue line or no-build. As expected the Orange line is the highest ridership of the proposed extensions of the system, while red is the lowest.

Is it important to note that these ridership forecasts do not properly address special markets such as military, colleges and tourists. Given that the region has a high concentration of all of

these markets, additional models would be required to properly estimate that additional ridership on the system. Thus the ridership in Table 16 could increase given those additional markets.

	Existing- 2015	Existing- 2040	Blue (NB)	Orange	Red	Green	Purple
Year	2015	2040	2040	2040	2040	2040	2040
Linked Trips	40,612	47,319	52,245	55,822	54,188	54,752	55,040
Unlinked Trips	56,703	65,903	71,720	77,071	74,704	75,110	75,654
LRT Trips	5,600	7,378	10,931	15,793	13,159	13,835	14,200
Project Trips			2,834	7,936	5,447	5,558	6,303
Difference from 2040 Existing			3,553	8,415	5,781	6,457	6,822
Difference from Blue Line				5,102	2,613	2,724	3,469

Table 16 System wide Transit and Light Rail Ridership

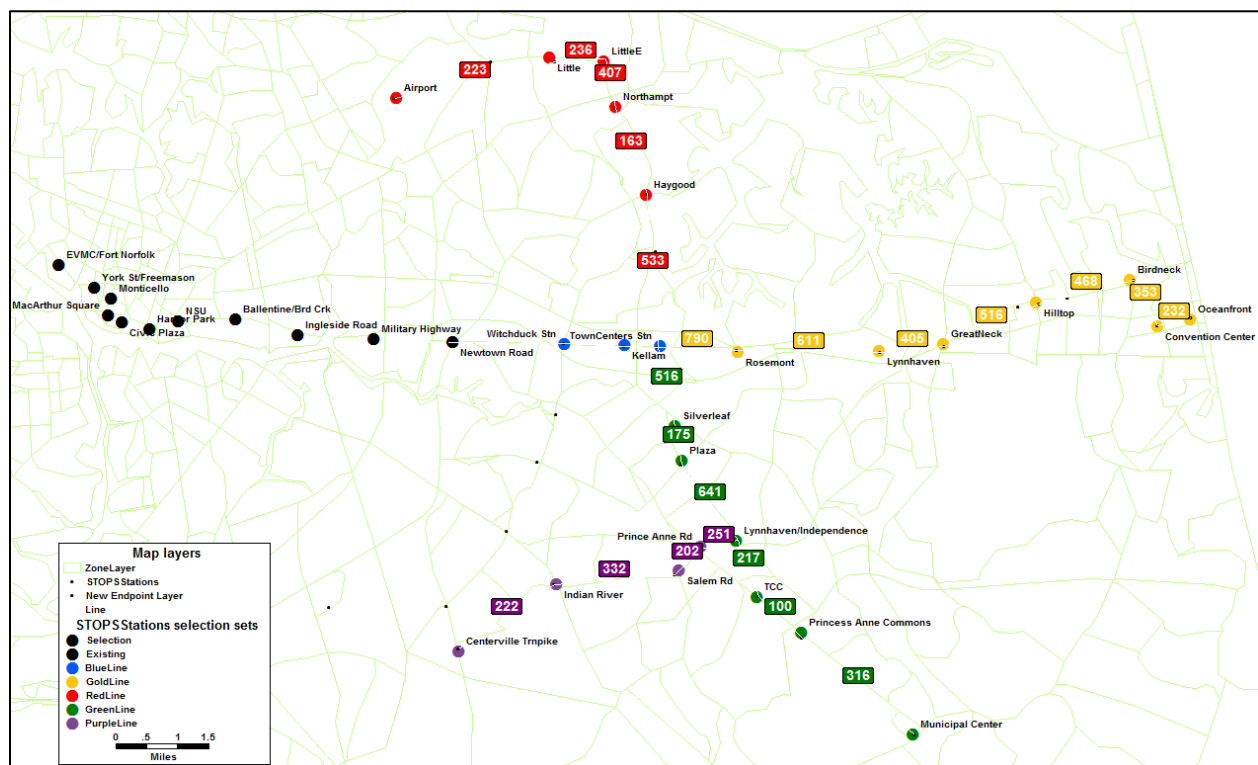


Figure 14 Ridership Estimated Station Level Boarding

Table 17 shows the estimated boardings by station in tabular format and Table 18 shows the actual project trips for each station.

	Existing	NoBuild	Orange	Red	Green	Purple
1-EVMC	829	1,741	1,922	1,934	1,919	2,075
2-NORFOLK-CBD	2,175	3,380	3,809	3,736	3,632	3,697
3-NSUBal	916	2,028	2,121	2,055	1,878	1,959
4-MilNwt	1,680	2,234	2,448	2,113	2,583	2,411
5-Witch		522	560	506	586	791
6-KELLAM		394	587	485	537	502
7-TOWNCE		633	971	1,079	633	668
Total		10,932	12,418	11,908	11,768	12,103

Table 17 Estimated Boardings on the Existing Stations by Build Alternative

	Existing	NoBuild	Orange	Red	Green	Purple
1-EVMC		193	392	403	345	478
2-NORFOLK-CBD		443	955	885	609	807
3-NSUBal		227	339	300	289	280
4-MilNwt		422	755	539	639	682
5-Witch		522	560	506	586	791
6-KELLAM		394	587	485	537	502
7-TOWNCE		633	971	1,079	633	668
Total		2,834	4,559	4,197	3,638	4,208

Table 18 Estimated Project Trips on the Existing Stations by Build Alternative