



FINAL REPORT

New River Valley Metropolitan Planning Organization

Bus Stop Safety and Accessibility Study for the Town of Blacksburg



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Executive Summary

Purpose

The *New River Valley Metropolitan Planning Organization Bus Stop Safety and Accessibility Study* developed a data-driven prioritization tool to guide the efficient allocation of resources to bus stop improvements in the Town of Blacksburg. These improvements are intended to improve safety around and access to bus stops within the Town of Blacksburg to encourage the use of transit for bus riders who walk, bike, or have mobility impairments.

Process

The study involved periodic work sessions with a Technical Committee that was composed of representatives from Blacksburg Transit, the Town of Blacksburg Planning and Building Department, the New River Valley Metropolitan Planning Organization, and the New River Valley Regional Commission. The project team developed several prioritization criteria that were used to evaluate and rank the 65 bus stops identified by the Technical Committee and stakeholders as needing improvement. Discussions with stakeholder yielded information from a local perspective about transit needs.

- *The Bus Stop Safety and Accessibility Study created a prioritization tool and developed recommendations for the twenty highest-ranked bus stops. The study also offers recommended improvements for strategic bus stop corridors and the Blacksburg Transit system as a whole.*
- *Key themes for bus stop recommendations include:*
 - *Enhancement of sidewalk connectivity and accessibility,*
 - *Installation of accessible concrete landing pads, and*
 - *Clear and consistent delineation of bus stops, which may include standardized signage, curb markings, and pavement markings.*
- *The prioritization tool is intended to be updated in the future to guide the New River Valley MPO and Blacksburg Transit in continuing to identify bus stops where safety and accessibility should be improved.*

Coordination with the Town of Blacksburg Corridor Committee and a review of existing plans and policies provided additional input to the prioritization process. The project team also conducted a field review to inventory existing amenities and to guide the development of the study's recommendations.

Outcome

The prioritization tool is intended to be updated for use in future studies. For the near term, the project team developed detailed recommendations for ten “high priority” bus stops as identified by the prioritization tool. The study also includes preliminary recommendations for the next ten bus stops, classified as “medium priority” bus stops. The detailed recommendations for the high priority stops included, descriptions of needs and improvements, cost estimates, and concept imagery. The study also includes recommendations for key corridors and the Blacksburg Transit system as a whole.

Recommendations were developed for four key corridors: Tall Oaks Drive, Giles Road, Roanoke Street, and Progress Street. Notable corridor-based recommendations include stop consolidation along Roanoke Street and the completion of sidewalk connectivity along Tall Oaks Drive and Progress Street. Additional street lighting and roadway striping were also recommended to improve safety along Giles Road.

The study’s system-wide recommendations include a range of improvements spanning infrastructure and maintenance to safety and policy. These recommendations are intended to improve the accessibility and safety of all Blacksburg Transit bus stops. The installation of concrete landing pads and adequate lighting were recommended to enhance the comfort and perception of safety for riders waiting at the bus stops. The objective of increasing the number of riders walking or cycling to and from the stops served as the basis for many of the system-wide recommendations.

Suggested next steps for Blacksburg Transit include the pursuit of funding from a variety of sources to enhance the high and medium priority bus stops. The prioritization tool should be updated on a regular basis with the most up-to-date data to guide Blacksburg Transit in identifying the most pressing needs in improving safety and accessibility at bus stops in Blacksburg.

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Introduction

Blacksburg Transit provides public transportation services to the Town of Blacksburg, the Town of Christiansburg, and Montgomery County as a department of the Town of Blacksburg, Virginia. Anchored by Virginia Tech, public transportation services and demand of such services have significantly grown over the past 30 years. As the transit system grows, safe and convenient access to bus services will continue to be one of Blacksburg Transit's major goals. Blacksburg Transit's mission statement is:

Blacksburg Transit provides safe, courteous, reliable, accessible, and affordable public transportation to the citizens of the Town of Blacksburg, Virginia Tech, Town of Christiansburg, and partnering communities within the New River Valley.

Purpose of the Study

The tangible elements of bus service, such as bus stops and their amenities, play a critical role in encouraging full use of a transit system. Furthermore, transit generally is just one portion of the average person's trip-chain—most transit riders access transit service via other modes of transportation such as driving, walking, or cycling.

The *New River Valley Metropolitan Planning Organization Bus Stop Safety and Accessibility Study* prioritizes bus stops within the Town of Blacksburg and offers bus stop, corridor, and system-level recommendations to improve safety and accessibility, especially for people who bike, walk, or are mobility-impaired. This study developed a prioritization tool that established a priority list of bus stops based on existing data. This tool can be carried forward by Blacksburg Transit staff and adapted to respond to changes in data availability and transit service delivery. The study's Action Plan includes a broad set of recommendations to improve access to and operation of Blacksburg Transit routes. The Action Plan is organized around four categories of recommendations:

- High Priority Bus Stops—Detailed project sheets for 10 stops
- Medium Priority Bus Stops—Primary issues and preliminary recommendations for 10 stops
- Corridor-based—Coordinated improvements that address multiple stops
- System-wide—Broader recommendations related to infrastructure, safety, maintenance, and policy

The study begins with background information about multimodal access to transit, explains the purpose and requirements of the Americans with Disabilities Act, and briefly describes other plans, policies, and documents that have guided this study's development. The following two sections describe Blacksburg Transit's existing service, bus stops, and ridership, and how cyclists and pedestrians currently reach the bus stops. The stakeholder outreach conducted as part of this study fed directly into the bus stop prioritization process and informed a detailed assessment of the high priority bus stops. Following the Action Plan, the study concludes with a discussion of potential funding sources and next steps for Blacksburg Transit regarding improving safety and accessibility at their bus stops.

Background

Multimodal Access to Transit

Transit riders typically begin their trips by walking, cycling, or driving to the transit stop, highlighting the need for municipalities to provide for all users of the transportation system. Transit-dependent riders (i.e. people who have no option other than transit to reach school, work, or other critical destinations) are particularly impacted by connectivity between modes, the quality of transit stops and services, and the quality of bike infrastructure and sidewalks. Enhancing connectivity for riders traveling to and departing from Blacksburg Transit's bus stops; improving safety for riders waiting at the bus stops; and ensuring that riders of all levels of mobility can reach the bus stops are the goals of the *Bus Stop Safety and Accessibility Study*.

Americans with Disabilities Act

An important component of providing multimodal access to transit is accommodating mobility-impaired riders. The Americans with Disabilities Act (ADA) includes Standards for Accessible Design, issued by the Department of Justice (DOJ) and the United States Department of Transportation (USDOT) in 1990 and revised in 2010. These standards apply to facilities used by state and local governments to provide designated public transportation services, including bus stops. The standards specify the minimum clear lengths of boarding areas, maximum steepness of slopes perpendicular to the roadway, and the minimum clear floor space underneath bus shelters.

One feature required by the American with Disabilities Act are detectable warning surfaces on sidewalk ramps. Detectable warnings are built in or applied to walking surfaces or other elements to warn visually-impaired people of hazards on a circulation path. They consist of a surface of truncated domes and are required by USDOT on curb ramps at public transportation facilities. The addition of ADA-compliant curb ramps at Blacksburg bus stops would further Blacksburg Transit's goal of providing safe and accessible public transportation.

Plan & Policy Review

The *Bus Stop Safety and Accessibility Study* builds upon previously published plans and policies at the local, regional, and national level. Documents related to or developed as a result of recent efforts to improve cycling, walking, and riding transit, as well as their findings and recommendations, are summarized in the table below. The development of the *Bus Stop Safety and Accessibility Study's* bus stop, corridor-based, and system-wide recommendations, detailed in later sections, considered the findings and recommendations from the documents included below.

Document Title	Date	Description	Findings/Recommendations
Local			
Blacksburg Transit Comprehensive Operational Analysis	May 2006	The Comprehensive Operational Analysis evaluates Blacksburg Transit's service, establishes service standards, and offers recommendations to improve service operations.	<ul style="list-style-type: none"> • Service areas are defined by quarter-mile buffers around bus stops. • Blacksburg Transit formally designates bus stop locations to provide a safe environment for passenger boarding and alighting. All bus stops should include route and schedule information, and as a general rule, bus stops should be no closer than every 0.2 miles. • Bus stops with 50 or more average daily boardings warrant a bus shelter, while those with between 25 and 50 average daily boardings warrant a bench.
Blacksburg Transit 2011-2017 Transit Development Plan	June 2011	This document details the objectives of Blacksburg Transit and recommends strategies to accomplish those objectives. The plan includes a system evaluation, a transit service and facility needs assessment, an operations plan, a capital improvement program, a financial plan, and strategies to monitor and evaluate the plan.	<ul style="list-style-type: none"> • The TDP proposes a Bus Stop Improvement Program, which would update Blacksburg Transit's 250 bus stops to a new bus stop design, replace existing shelters and benches, and establish ridership standards for warranting electronic signage, shelters, benches, and other amenities. • Blacksburg Transit anticipates using approximately \$300,000 of projected funding for bus stop shelters and amenities from 2012 to 2017.
Blacksburg 2046 Comprehensive Plan - Transportation	December 2012	Virginia localities are required to develop comprehensive plans every five years. The Town of Blacksburg's Comprehensive Plan guides decision-making regarding land use and transportation. Specifically, the comprehensive plan's transportation chapter aims to guide the Town in providing an interconnected, multimodal transportation system that is safe and efficient, serves a diverse population, and supports land use.	<ul style="list-style-type: none"> • Blacksburg Transit desires to increase the number of stops with amenities at major transfer locations on-campus, large trip generators, and stops with high average daily boardings to provide overall safety and comfort for its riders. • Relevant recommendations include ensuring the sidewalk system is ADA accessible, increasing the number of covered bus shelters and covered bike parking at transit stops, and ensuring that transit service and access between transit stops and the development are provided.

Document Title	Date	Description	Findings/Recommendations
Virginia Tech Alternative Transportation Commuter Survey Results	May 2014	This summary provides the results of more than 1,200 surveys that collected information about travel distance, mode access, mode use, typical time and day of travel, and destinations.	<ul style="list-style-type: none"> • 36% of respondents use Blacksburg Transit to get to campus, 13% bike, and 38% walk. • 70% of respondents commute using Blacksburg Transit.
Virginia Tech Campus Traffic Survey	April 2014	This summary provides the results of a web-based survey sent to 7,000 randomly selected Virginia Tech faculty, staff, and students. A total of 1,182 completed surveys were received.	<ul style="list-style-type: none"> • 64% of students, 10% of staff, and 13% of faculty reported that they ride Blacksburg Transit during the typical week • Time, parking, weather, and traffic were the most significant factors that positively influenced Blacksburg Transit riders. • The top three suggested improvements for local bus service were: Better capacity at peak times, expanded/more efficient routes, and web/phone apps for real-time information.
Blacksburg Transit Route Analysis: Survey Results	September 2014	This summary provides the results of a survey developed during Blacksburg Transit's recent Route Analysis.	<ul style="list-style-type: none"> • When asked to select all the travel modes used to access Blacksburg Transit bus stops, nearly 98% of survey respondents reported that they walk while 8% bike to reach the bus stops. • One out of ten survey respondents cited the lack of sidewalks around bus stops as a reason for not riding the bus.
Town of Blacksburg Code of Ordinances	April 2015	The Town's Code of Ordinances has several provisions for sidewalks, bike facilities, and transit stops. Sections 5 and 12 are particularly relevant.	<ul style="list-style-type: none"> • Section 5-321 – All proposed collector and arterial streets within a subdivision shall be constructed with bicycle lanes. • Section 5-401 – Sidewalks at least 5' wide must be constructed on at least one side of the street in all subdivisions. • Section 5-403 – The Planning Commission shall consider the location of transit stops when considering waiving the requirements of section 5-401. • Section 5-500 – Multi-use trails are required for proposed subdivisions to provide safe and convenient access to schools, parks, and the bikeway/greenway system and between adjacent subdivisions. • 5-503 – Multi-use trails must be at least 10' feet, and handicap ramps must be provided where multi-use trails meet curbs. • Section 12-410 – Only buses are permitted to stop, stand, or park at bus stops.

Document Title	Date	Description	Findings/Recommendations
Blacksburg Bicycle Master Plan – Draft Pending Adoption	TBD 2015	The purpose of the master plan is to serve as a guiding document for the development of an integrated network of bicycle facilities and supporting programs, linking neighborhoods and activity centers throughout the Town.	<ul style="list-style-type: none"> Bicyclists face many barriers to mobility, including high-crash areas, intersection crossings, mid-block crossings, driveway connections, poor lighting, lack of bike facilities and connectivity, poor surface conditions, faded or non-compliant marking, and on-street parking among several others. The master plan recommends improvements to educational programming for all road users as well as bicycle facility improvements. The master plan recommends that bicycle parking should be provided at all Blacksburg Transit bus stops.
Regional			
Pedestrian to Transit Accessibility Prioritization	May 2010	Prince George’s County desired to identify gaps in its bus stop network and prioritize bus stop locations for access and safety improvements. The report includes several regional and national examples of bus stop prioritization.	<ul style="list-style-type: none"> Scoring was based four categories: safety, usage, accessibility, and land use. Short-term improvements were identified for bus stops in proximity to a prior pedestrian-vehicle crash. Medium-term improvements were identified for bus stops with accessibility issues. Long-term improvements were identified for bus stops that don’t require immediate attention.
VTrans2040 – Applying the Accessibility Measures to a Statewide Dataset	January 2013	Virginia’s long-range multimodal transportation plan, VTrans2040, is currently under development. Phase 2 of the plan, the Multimodal Transportation Plan, is targeted to be completed in the first quarter of 2016. An associated technical memorandum entitled “Applying the Accessibility Measures to a Statewide Dataset” was produced in January 2013. This memo describes the development of measures of accessibility.	<ul style="list-style-type: none"> Pedestrian accessibility was based on the number of intersections per square mile. Bicycle accessibility was based on the number of centerline miles of comfortable bikeable roads, quality of the bicycle network, and bike network directness index. Given the lack of available statewide data for transit stops and routes, transit accessibility was measured by the hours of transit service in each activity center defined by the study.
Roanoke Valley-Alleghany Regional Commission Bus Stop Accessibility Study	September 2013	This bus stop accessibility study identifies improvements at specific high activity bus stops and provides guidance for bus stop improvements throughout the regional transit system.	<ul style="list-style-type: none"> The study recommends providing a wheelchair-accessible landing pad at each bus stop and using the space between the sidewalk and the curb to accomplish adequate landing pads. Parking should be restricted during transit service hours next to bus stops to enable the bus to pull-up to the curb and safely allow passengers to board from and alight onto the sidewalk. Bus stop improvements should be included in all infrastructure projects in which a bus stop is located within the project limits.

Document Title	Date	Description	Findings/Recommendations
Division of Rail and Public Transportation Multimodal System Design Guidelines	October 2013	VDOT's Division of Rail and Public Transportation developed design guidelines for multimodal systems in Virginia. The intent of the document is to establish a basic framework for multimodal planning.	<ul style="list-style-type: none"> • Separate curb ramps are preferred for each corner at a crossing and should align directly with the crosswalks. • The best location for bus stops near intersections is on the far end of the intersection to minimize conflicts with turning vehicles.
New River Valley MPO Bicycle and Pedestrian Master Plan	June 2014	The Bicycle and Pedestrian Master Plan is a long-range multimodal transportation strategy for the New River Valley MPO region. It establishes multimodal systems plans for the towns of Blacksburg, Christiansburg, and Radford.	<ul style="list-style-type: none"> • One of the plan's objectives is to ensure connections and reliability between various transportation modes throughout the NRV MPO region. • The plan identifies several multimodal districts based on existing and future population and employment growth projections.
National			
A Profile of Public Transportation Passenger Demographics and Travel Characteristics Reported in On-Board Surveys	May 2007	This document summarizes the results from 150 on-board vehicle passenger surveys conducted by public transportation agencies from 2000 to 2005.	<ul style="list-style-type: none"> • Less than one-half of public transportation riders have a vehicle available to them. • The primary mode used to access and egress transit vehicles is walking. • Approximately 60% of survey respondents reported work as their primary trip purpose when taking transit. Almost 11% reported traveling to school as their primary trip purpose.
Active Transportation – Making the Link From Transportation to Physical Activity and Obesity	Summer 2009	This research brief, developed by Active Living Research, draws conclusions about the impact of walking, bicycling, and public transit infrastructure and programs on health.	<ul style="list-style-type: none"> • Three out of ten people who use transit were more physically active because they walk to and from public transit stops. • High traffic volumes at high speeds is a strong deterrent to walking and cycling. Traffic calming measures might include speed bumps, visibility aids, lane reductions, sidewalk extensions, and on-street parking.
National Physical Activity Plan	May 2010	The National Physical Activity Plan recommends policies, programs, and initiatives intended to increase the physical activity of all Americans.	<ul style="list-style-type: none"> • The plan recommends the creation of standards and identification of best practices to adopt initiatives like Safe Routes to School, Bike-to-Work Day, and other active transportation programs. • One major strategy of the plan is to increase connectivity and accessibility to community destinations to increase active transportation. Improving access to public transportation is one the tactics of this strategy.

Document Title	Date	Description	Findings/Recommendations
Bicycling Access and Egress to Transit: Informing the Possibilities	April 2011	This study assists transit agencies in integrating bicycling and transit and evaluates four integration strategies.	<ul style="list-style-type: none"> Enhancing bike parking at transit stops offers more advantages than increasing transit vehicle bike carrying capacities. City bus service is characterized by small catchment areas, a low return on investment, bike racks instead of bike lockers, and the likelihood of cycling transit users to substitute the transit trip with cycling or walking. Based on the study, cyclists prefer to take their bike with them during the transit trip instead of storing the bike at the stop location.
Low-Stress Bicycling and Network Connectivity	May 2012	Four levels of traffic stress were proposed to classify roadway segments as a part of this study. Low-stress connectivity assumes that cyclists can reach their destinations without having to exceed their tolerance for traffic stress.	<ul style="list-style-type: none"> Connectivity at an acceptable level of stress and without undue detours is the critical measure of service for a community's bicycle network. Separated bikeways are characterized by low levels of traffic stress between intersections. Bike lanes range in levels of traffic stress, varying based on facility width, motor vehicle speeds, high traffic volumes, adjacent parking, and intersection operations.
FHWA Course on Bicycle and Pedestrian Transportation – Bicycle and Pedestrian Connections to Transit	February 2013	Lesson 9 of FHWA's Course on Bicycle and Pedestrian Transportation covers cyclist and pedestrian access to transit in the United States.	<ul style="list-style-type: none"> Multi-use trails, bike lanes, wide shoulders, and sidewalks improve connectivity and access to transit stops from neighborhoods and commercial districts. Improving bike access to transit services increases the distance cyclists can travel, can increase overall ridership, and can enlarge a transit system's catchment area.
Exploring Synergy in Bicycle and Transit Use: Empirical Evidence at Two Scales	November 2013	This study performs two analyses. First, the study investigates how bicycle commuting changed in urban areas from 2000 to 2010. Second, the study uses statistical modeling on a household travel survey to estimate how transit use affected the odds of cycling in households, individuals and trips.	<ul style="list-style-type: none"> From 2000 to 2010, the number of commuters cycling to work in urbanized areas increased by more than 50% while the share of transit commuters increased. Household survey data showed that people who cycled were more likely to use transit, supporting a complementary relationship between cycling and transit use.

Document Title	Date	Description	Findings/Recommendations
First Mile, Last Mile: How Federal Transit funds can improve access to transit for people who walk and bike (Advocacy Advance, 2014)	August 2014	This study conducted by Advocacy Advance takes a closer look at how biking and walking can be integrated with transit as well as how federal transit funds can support these multimodal programs to increase overall accessibility for alternative transportation modes.	<ul style="list-style-type: none"> • Some Federal Transit Administration (FTA) programs can fund bicycling- and walking-related programs: <ul style="list-style-type: none"> ○ Metropolitan & Statewide and Nonmetropolitan Transportation Planning (5303, 5304, 5305) ○ Urbanized Area (5307) ○ New Starts (5309) ○ Enhanced Mobility of Seniors and Individuals with Disabilities (5310) ○ Rural Area (5311) ○ Bus and Bus Facilities (5339) ○ TOD Planning Pilot (20005b) • In 2011, the FTA issued its final policy statement on the catchment area of bicycle and pedestrian improvements: “all pedestrian improvements located within one-half mile and all bicycle improvements located within three miles of a public transportation stop or station shall have a de facto physical and functional relationship to public transportation.”
Assessment of Bicycle Service Areas around Transit Stations	2015	This study assessed how far cyclists are willing to catch a ride on a bus or train to travel the rest of their trip in three large U.S. metropolitan areas: Los Angeles, Atlanta, and Twin Cities.	<ul style="list-style-type: none"> • Travel mode and availability of train service influenced bicycle access distance. • Node degree was found to be associated with longer bicycle access distances, indicating that cyclists traveled longer distance to better connected transit service. • Higher street intersection density decreased bicycle access distances while higher percentages of dead ends increased bicycle access distance.
Evaluating Active Transport Benefits and Costs	February 2015	The Victoria Transport Policy Institute developed a report to assess the benefits and costs of walking and cycling.	<ul style="list-style-type: none"> • Pedestrian improvements can reduce the travel delay that vehicular traffic imposes on pedestrians. • The benefit of pedestrian and bicycle facility improvements is impacted by their integration in a community’s overall alternative mode network.
Transit Use, Physical Activity, and Body Mass Index Changes: Objective Measures Associated with Complete Street Light-Rail Construction	May 2015	This study evaluated the physical activity and weight impacts of a complete street intervention extending a light-rail line in Salt Lake City, Utah.	<ul style="list-style-type: none"> • Round trips on transit typically include four walking trips or bike rides to and from the transit stop, making transit use a form of active transportation.
Health and climate change: policy responses to protect public health	June 2015	The efforts of the 2015 Lancet Commission on Health and Climate Change are summarized in this report.	<ul style="list-style-type: none"> • The report recommends that cities support and promote healthy lifestyles. This would include the improving the ease and convenience of low-cost active transportation.

Transit Service

Blacksburg Transit began operations in 1983 and marked total ridership in its first year at 690,000 boardings. In 2014, Blacksburg had 3,653,744 unlinked passenger trips, an increase of 4.4% from 2013.

Service/Routes

Blacksburg Transit operates the following services:

- CRC/Hospital: Provides service from the Drillfield to the Corporate Research Center (CRC)
- Harding Avenue: Connects with the Hethwood route after certain times; Provides service along Roanoke Street and Harding Avenue to campus
- Hethwood: Connects with the Harding Ave route; Provides service from the Hethwood residential area to campus
- Hokie Express: Provides service from Oak Lane to the Drillfield
- Main Street: Provides service along Main Street (from Whipple Drive to Fairfax Road) to campus
- Patrick Henry: Provides service from Giles Road, Seneca Circle, Patrick Henry Drive, and Progress Street to campus
- Toms Creek: Provides service along Toms Creek and University City Boulevard to campus
- Progress Street: Provides service along Progress Street, Patrick Henry Drive, and Toms Creek to campus
- Two Town Trolley: Connects Blacksburg and Christiansburg; Provides service from campus through the downtown area in Blacksburg to the hospital, New River Valley Mall, and Walmart
- University City Boulevard: Provides service along University City Boulevard, Patrick Henry, and Progress Street to campus.
- University Mall: Provides service from campus to the Math Emporium at University City Mall
- Warm Hearth Service: Provides reserved service for Warm Hearth Village on select days of the week

The map on the next page is Blacksburg Transit's route map. Route-specific maps are available via Blacksburg Transit's website: <http://www.blacksburg.gov/index.aspx?page=885>.

Bus Stops

Blacksburg Transit maintains and serves approximately 189 bus stops in the Town of Blacksburg. Standard bus shelters exist at nearly 18% of the bus stops, while some subdivisions have constructed unofficial bus shelters at several stops. In general, Blacksburg Transit's bus stops are "mirrored" to facilitate the operation of bus routes that have outbound and inbound directions.

Ridership

In 2014, Blacksburg Transit had more than 3.6 million unlinked passenger trips. Average daily boardings and alightings by bus stop in 2014 indicate several corridors have high transit ridership. These corridors (30 boardings per day on average) include University City Boulevard / Patrick Henry Drive, Tall Oaks Drive, and Progress Street. High ridership on these corridors most likely is due to the density of off-campus student housing in these areas. Ridership is also very high at bus stops located on Virginia Tech's campus.

Figure 1. Blacksburg Transit Bus Routes

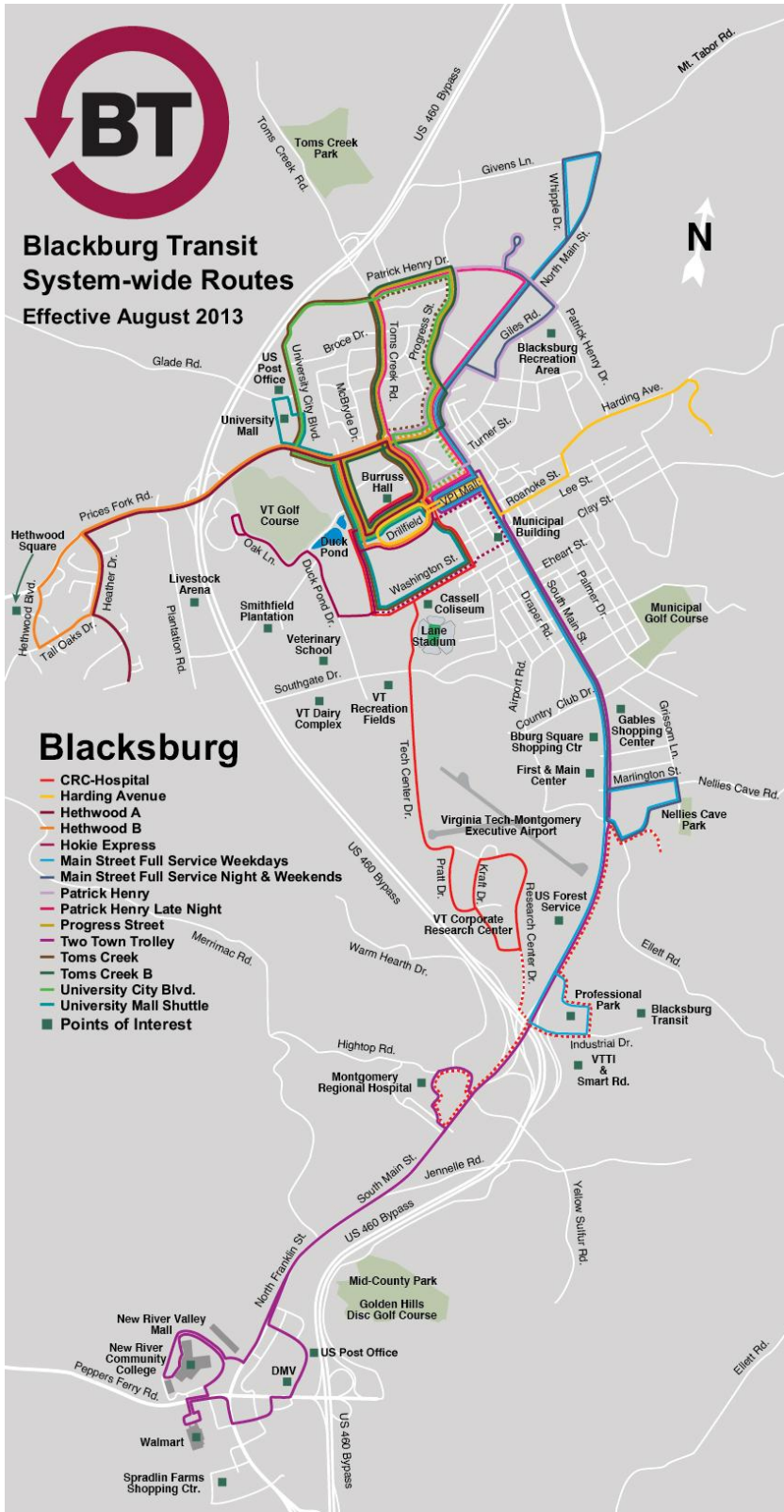
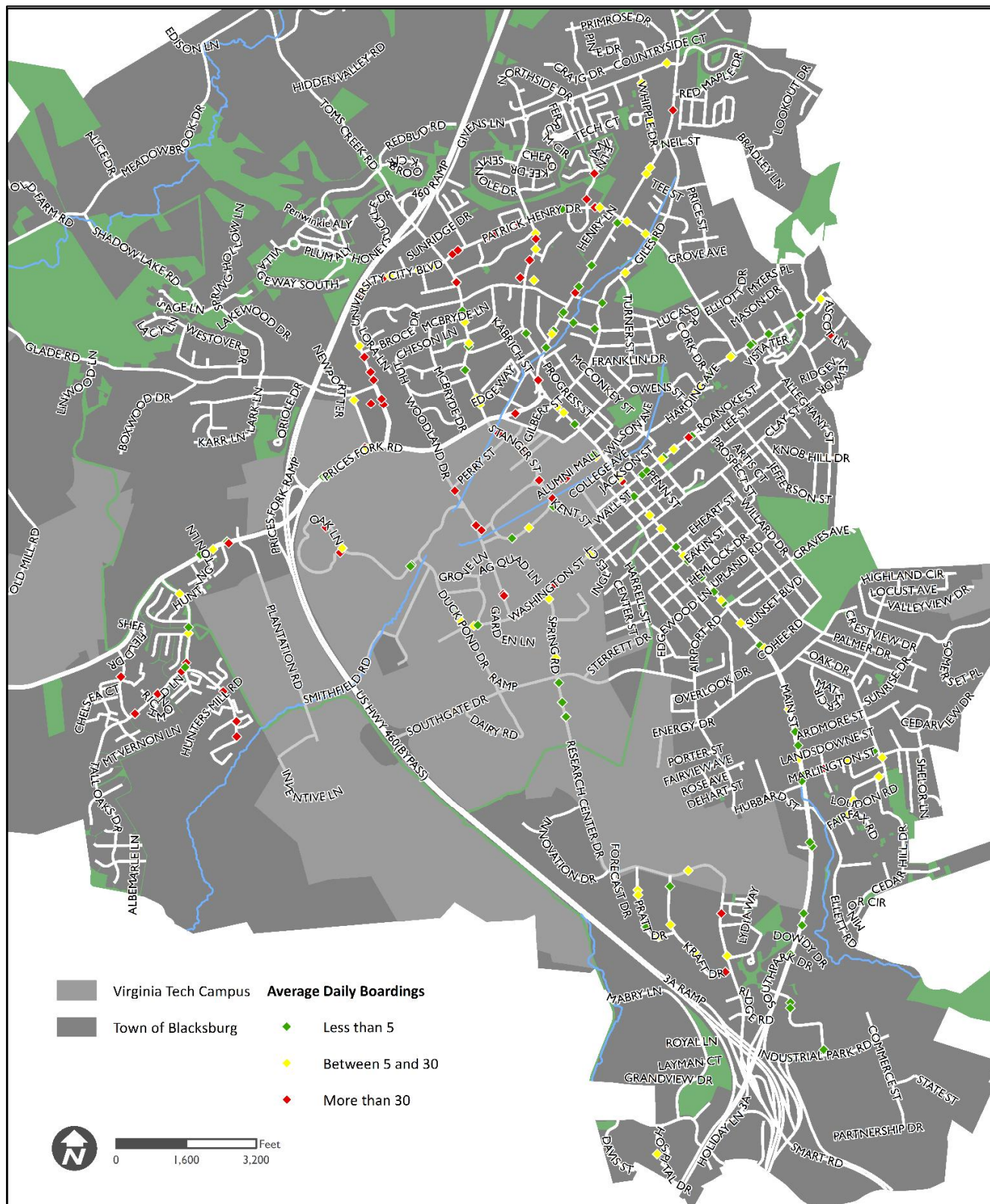


Figure 2. Average Daily Bus Stop Boardings



Multimodal Mobility

Corridor Committee

The Blacksburg Town Council established the Greenway/Bikeway/Sidewalk/Corridor Committee (i.e. the Corridor Committee) to promote the maintenance, use, and expansion of the Town's cycling and walking infrastructure. The Corridor Committee is consulted regarding any recommendations to improve the existing bike facilities and sidewalk systems in Blacksburg, and they regularly facilitate coordination between Town facilities and neighborhood facilities. The project team engaged the Corridor Committee as stakeholders to provide input into the development of the *Bus Stop Safety and Accessibility Study*.

Walking

Approximately 128 miles of sidewalk exist within the Town of Blacksburg and on Virginia Tech's campus. Several major roadways in Blacksburg have sidewalks on both sides. However, numerous roadways only have sidewalks on one side (e.g. Giles Road, Roanoke Street, Glade Road, and University City Boulevard). Additionally, several roads are missing sidewalk connections, resulting in many sidewalk gaps. While the Town's Code of Ordinances only requires sidewalk on one side for new development, many older neighborhoods have no sidewalks at all. Neighborhoods with sidewalks only on one side and neighborhoods with no sidewalks at all should consider sidewalk on both sides of the roadways to encourage walking and improve pedestrian connectivity.

The Corridor Committee most recently updated their process to prioritize sidewalk recommendations across the Town of Blacksburg in spring of 2015. The process identified several high priority sidewalk projects, though these projects did not align with any of the high priority bus stops detailed in a later section.

The sidewalks in Blacksburg, based on the data derived from the New River Valley MPO Bicycle and Pedestrian Master Plan, is shown in Figure 3.

Cycling

Along designated routes as defined by the draft 2015 Blacksburg Bicycle Master Plan, the Town of Blacksburg has approximately 2 miles of standard bike lanes, 11 miles of sub-standard bike lanes (less than 5 feet in width) and 17 miles of multi-use paths. The sub-standard bike lanes include those striped to include two feet of pavement and the gutter pan. Multi-use paths in the Town of Blacksburg include sidepaths (generally located adjacent to roadways) and greenways (generally located in creek easements and dedicated open space).

From March 23 to April 3, 2015, Blacksburg Transit pilot-tested a bike and wheelchair count process where bus operators would call the office every time riders with bikes or wheelchairs boarded or alighted a Blacksburg Transit bus. Over the 2 weeks, bus operators reported more than 100 riders boarding and alighting with bicycles and 7 riders boarding and alighting with wheelchairs. Maps showing bike and wheelchair boardings and alightings by bus stop are provided in the Appendix.

The bike lanes and multi-use paths in Blacksburg, based on the data derived from the New River Valley MPO Bicycle and Pedestrian Master Plan, are shown in Figure 4.

Figure 3. Existing Sidewalks from New River Valley MPO Bicycle and Pedestrian Master Plan

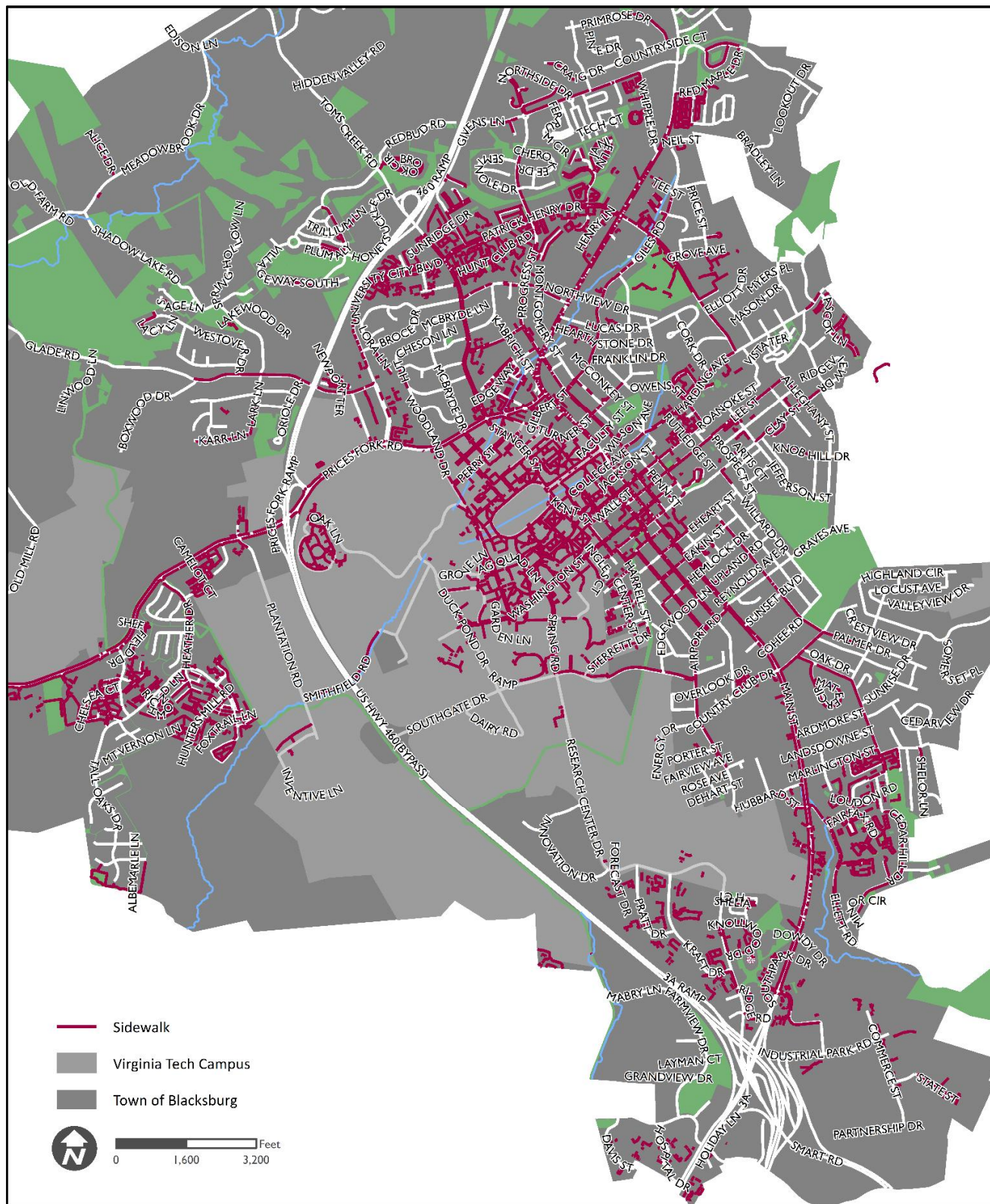
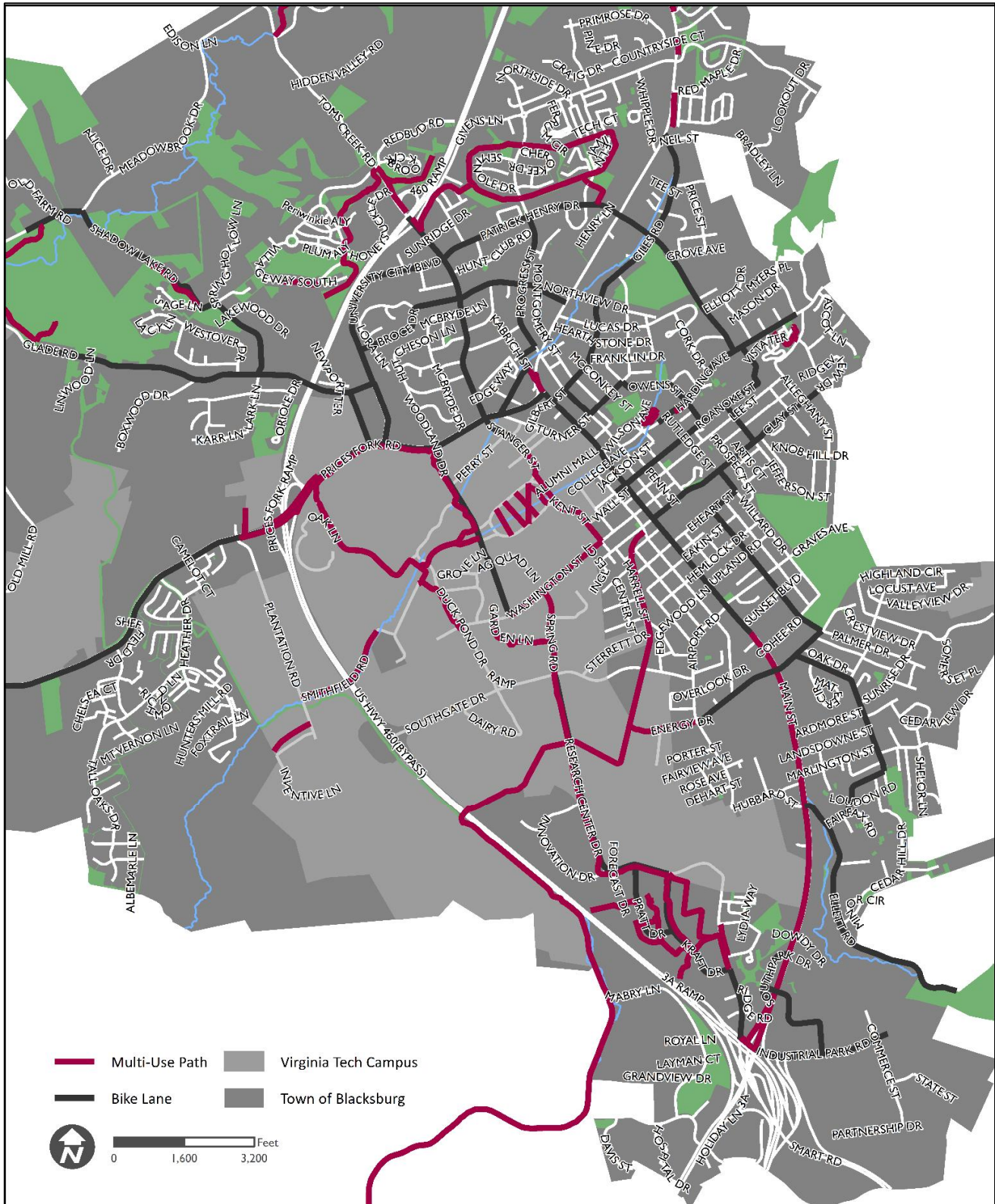


Figure 4. Existing Bicycle Facilities from New River Valley MPO Bicycle and Pedestrian Master Plan



Stakeholder Outreach

The successful development of the *Bus Stop Safety and Accessibility Study* was due in part to the establishment of transparency, clear communication, and various ways for stakeholders to provide input. The project team engaged with stakeholders through a technical committee, stakeholder interviews, and stakeholder work sessions. The feedback obtained from these efforts was incorporated into the bus stop prioritization process detailed in a later section.

Technical Committee

A technical committee was established to guide the direction of the study. Specifically, the committee was consulted during the creation of the bus stop prioritization tool and reviewed project deliverables prior to the public. The Technical Committee typically coordinated on a bi-weekly basis and consisted of representatives from Blacksburg Transit, the Town of Blacksburg Planning and Building Department, the New River Valley Metropolitan Planning Organization, the New River Valley Regional Commission, and the project team. The Technical Committee convened for in-person meetings on January 18, April 28, and July 14.

Stakeholder Interviews

The project team engaged several stakeholders to better understand the local context and obtain input into the prioritization process. In addition to the members of the Technical Committee, stakeholders included the following:

- Blacksburg Transit managers
- Parks & Recreation Department
- Public Works Department
- Virginia Tech
- Blacksburg Transit operators
- New River Valley Apartment Council
- Corridor Committee
- Town Manager

Work Sessions

To supplement the stakeholder interviews, the project team facilitated three series of work sessions at the Blacksburg Transit office to obtain feedback from Blacksburg Transit managers, bus operators, and other stakeholders. The first work session series (February 18 and 19, 2015) provided stakeholders the opportunity to weigh-in on the prioritization criteria and suggest bus stops to be included in the prioritization process. The second work session (April 28, 2015) allowed stakeholders to review a draft of the priority bus stop list and suggest preliminary recommendations. Finally, during the last series of work sessions (July 14, 2015), stakeholders reviewed the study's findings and recommendations, and they offered suggestions for changes in the final report.

Bus Stop Prioritization

The prioritization tool developed as part of this study provides a way for Blacksburg Transit to make data-driven decisions about the expenditure of resources for bus stop improvements.

Prioritization Criteria

The criteria by which bus stops are prioritized went through several iterations. Blacksburg Transit originally presented seven criteria for prioritization to the project team. Based on the Plan & Policy Review, best practices, and available data, the project team revised and supplemented the criteria to present to stakeholders through a prioritization worksheet exercise. The prioritization worksheet exercise asked participants to rank and weight each criterion based on level of importance. The project team collected nearly 100 completed worksheets. How heavily each criterion is weighted in the final prioritization tool is based on the results synthesized from the worksheets. The prioritization worksheet is shown on the following page.

Technical Committee Review

Following the prioritization worksheet exercise, the project team presented revised prioritization criteria to the Technical Committee. The committee suggested removing and adding criteria, changing criteria weighting, and revising criteria names for clarity. Two notable changes resulting from the Technical Committee's review was the removal of the Dependent Population Presence criterion and the addition of the Stop Safety criterion. These changes were suggested based on limitations of the data sources.


- In the early stages of the study, the project team collected and analyzed demographic data obtained from the 2013 American Community Survey 5-Year Estimates. Populations likely to be dependent on transit include Youth (between 5 and 19 years old); Elderly (65 years old or older); Low-Income; Zero Car Households; and Disabled. The American Community Survey collects this information at the Census Tract level, which did not provide the necessary level of detail to be of value in the bus stop prioritization process. Maps presenting each of the transit-dependent populations in Blacksburg are provided in the Appendix.
- The Safety prioritization criterion shown in the prioritization worksheet is based solely on reported crash history and does not take into account the perceived safety at bus stops from the perspective of riders. To capture the influence of perceived safety, the Safety criterion was renamed to Reported Crashes, and a new criterion named Stop Safety was added to the list of priority criteria. Stop Safety considers the presence of street lighting, shelter lighting, and a waiting area. Waiting areas include concrete pads, sidewalks, and multi-use paths.

One prioritization criterion that was considered but not included in the final prioritization was stop waiting time (i.e. dwell time or service frequency). Dwell time is a function of service frequency. Without any advance information, the average length of time riders will wait at a stop before a bus arrives is half the service frequency of the route serving the stop. Blacksburg Transit provides real-time information on their buses and stop arrival times via their web application BT4U¹, potentially reducing the amount of time riders might spend waiting at a stop. The Technical Committee discussed the validity of including dwell time as a priority criterion but ultimately decided against it due to the lack of available data.

The four major iterations of the prioritization criteria are shown on page 18.

¹ <http://www.blacksburg.gov/Index.aspx?page=1427>

Figure 5. Prioritization Worksheet



Bus Stop Safety and Accessibility Study

Prioritization Exercise

Kimley-Horn is conducting a study to identify bicycle and pedestrian needs near BT bus stops within the Town of Blacksburg. Please help us rank and weight the categories we'll use to prioritize the bus stops.

- Pick the top 5 categories that are most important to you.
- Assign points to your top 5 categories based on what you think is most important. The points should total 100.

		Rank	Points	
Transit Use	Boarding and alightings, particularly bicycles and wheelchairs	[]	[]	What is your role in the community? (Check all that apply) <ul style="list-style-type: none"> <input type="radio"/> Frequent Rider <input type="radio"/> Town Resident <input type="radio"/> Town Staff (Planning) <input type="radio"/> Town Staff (Engineering) <input type="radio"/> Town Staff (Other) <input type="radio"/> Elected Official <input type="radio"/> Operator (Fixed Route) <input type="radio"/> Operator (Paratransit) <input type="radio"/> Corridor Committee <input type="radio"/> Other <hr/>
Service Hours	Early morning and late evening service	[]	[]	
Bus Stop Distance	Distance to the next closest bus stop	[]	[]	
Bus Stop Amenities	Benches, shelters, bicycle parking, and lighting	[]	[]	
Connectivity	Service for multiple bus routes	[]	[]	
Accessibility	Nearby sidewalks, crosswalks, bike facilities, multi-use paths, etc.	[]	[]	
Safety	Crash history, particularly those involving bicyclists or pedestrians	[]	[]	
ADA Compliance	Barriers such as lack of curb ramps and steep slopes	[]	[]	
Cost & Constructability	Construction constraints (e.g. slopes, right-of-way, utilities, cost, etc.)	[]	[]	
Community Support	Locations where the community has requested improvement	[]	[]	
Land Use / Design	Local context and mix of residential and commercial land uses	[]	[]	
Other	Please describe.	[]	[]	
		Total	100	Contact Information (Optional) Name: _____ Email: _____

Please use this space or the back of this sheet to provide additional comments.

Study of BT bus stops within the Town of Blacksburg limits, funded by the New River Valley Metropolitan Planning Organization and conducted by Kimley-Horn, a multidisciplinary planning and engineering firm.

Criteria	Blacksburg Transit	Prioritization Worksheet	Presented to Technical Committee	Final Prioritization
Ridership (Transit Use)	✓	✓	✓	✓
Stop Wait Time	✓			
Stop Amenities (Bus Stop Amenities)	✓	✓	✓	✓
Cycling & Walking Infrastructure (Accessibility)	✓	✓	✓	✓
Sidewalk Curb Cuts (ADA Compliance)	✓	✓	✓	✓
Reported Crashes (Safety)	✓	✓	✓	✓
Stakeholder Feedback (Community Support)	✓	✓	✓	✓
Service Hours		✓	✓	✓
Stop Interval (Bus Stop Distance)		✓	✓	✓
Connectivity		✓	✓	
Construction Constraints (Cost & Constructability)		✓	✓	✓
Land Use / Design		✓	✓	
Multimodal Activity (High Activity Location)			✓	✓
Visibility Obstruction (Landscaping / Visibility)			✓	✓
Dependent Population Presence			✓	
Stop Safety				✓

Ultimately, the project team in coordination with the Technical Committee agreed on the twelve prioritization criteria shown below. Each criterion was weighted based on stakeholder feedback from the worksheet exercise and input from the Technical Committee.

Criteria	Weight	Description
Cycling & Walking Infrastructure	13.6 %	Presence of sidewalks, crosswalks, pedestrian signals, bike lanes, and multi-use paths; data obtained from the NRVMPPO Bicycle and Pedestrian Master Plan and verified during field review
Stop Safety	13.4%	Presence of street lighting, shelter lighting, and waiting areas; data provided by Blacksburg Transit and verified during field review
Stop Amenities	12.0%	Presence of amenities including shelters, shelter lighting, benches, trash cans, recycling cans, schedule information, bus pull-offs, street lighting, and waiting areas; data provided by Blacksburg Transit and verified during field review
Ridership	11.5%	Average daily boardings based on data collected in April and September 2014, provided by Blacksburg Transit
Service Hours	11.5%	Maximum daily duration of service, provided by Blacksburg Transit
Visibility Obstruction	9.0%	On-street parking, landscaping, and structures that restrict visibility from the bus stop based on field review
Sidewalk Curb Cuts	8.6%	Presence of curb cuts providing access to the bus stop and curb cut features including detectable warning surfaces, clearance areas, and gradual slopes; data provided by Blacksburg Transit and verified during field review
Stakeholder Feedback	5.4%	Frequency of mention among stakeholders and Technical Committee
Stop Interval	5.3%	Distance to the next closest upstream or downstream bus stop, measured based on GIS data provided by the Town of Blacksburg
Construction Constraints	4.8%	Steep slopes, utilities, and structures based on field review
Reported Crashes	3.4%	Number of reported crashes with more weight given to crashes involving bicyclists or pedestrians, provided by the Town of Blacksburg Police Department
Multimodal Activity	1.5%	Location relative to primary walkshed, secondary walkshed, or primary bikeshed of multimodal centers defined by the NRVMPPO Bicycle and Pedestrian Master Plan

Priority Bus Stop List

During the stakeholder interviews, stakeholder work sessions, and the prioritization worksheet exercise, the project team identified 61 bus stops to run through the prioritization process. Following the Technical Committee's review of the list of bus stops and in response to the request of Blacksburg Transit, the project team modified the bus stop list yielding a total of 65 bus stops to be prioritized.

Each bus stop was assigned scores for each of the twelve prioritization criteria to yield a prioritized list. A full list of the prioritized bus stops is included in the Appendix.

Recommendations Development

The project team developed recommendations for each of the high and medium priority bus stops based on coordination with the Technical Committee, stakeholder input, field review, and the Plan & Policy Review. Improvements at each bus stop address concerns voiced by stakeholders and issues identified via field review. Consideration was given to ridership, existing safety and accessibility issues, and bike and wheelchair boarding and alighting data collected by Blacksburg Transit in the spring of 2015. The recommendations are described in detail in the *Bus Stop Safety and Accessibility Study's* Action Plan.

Field Review

On Tuesday, June 9, 2015, the project team and representatives from Blacksburg Transit conducted a field review of the top 20 bus stops based on the results of the prioritization at the time. The field review consisted of photographing and verifying the presence and condition of sidewalks and curb cuts, bike facilities, and stop amenities. In addition to verifying the data Blacksburg Transit provided to the project team, the field review informed the development of specific recommendations for stop improvements and their feasibility and value. The discussion of recommendations included the consideration of transit from a regional perspective and local development that will impact transit operations. The information gained during the field review informed final updates to the prioritization tool.



Stop #1210 – Tall Oaks Drive at Foxridge Lane
(Northbound)

Action Plan

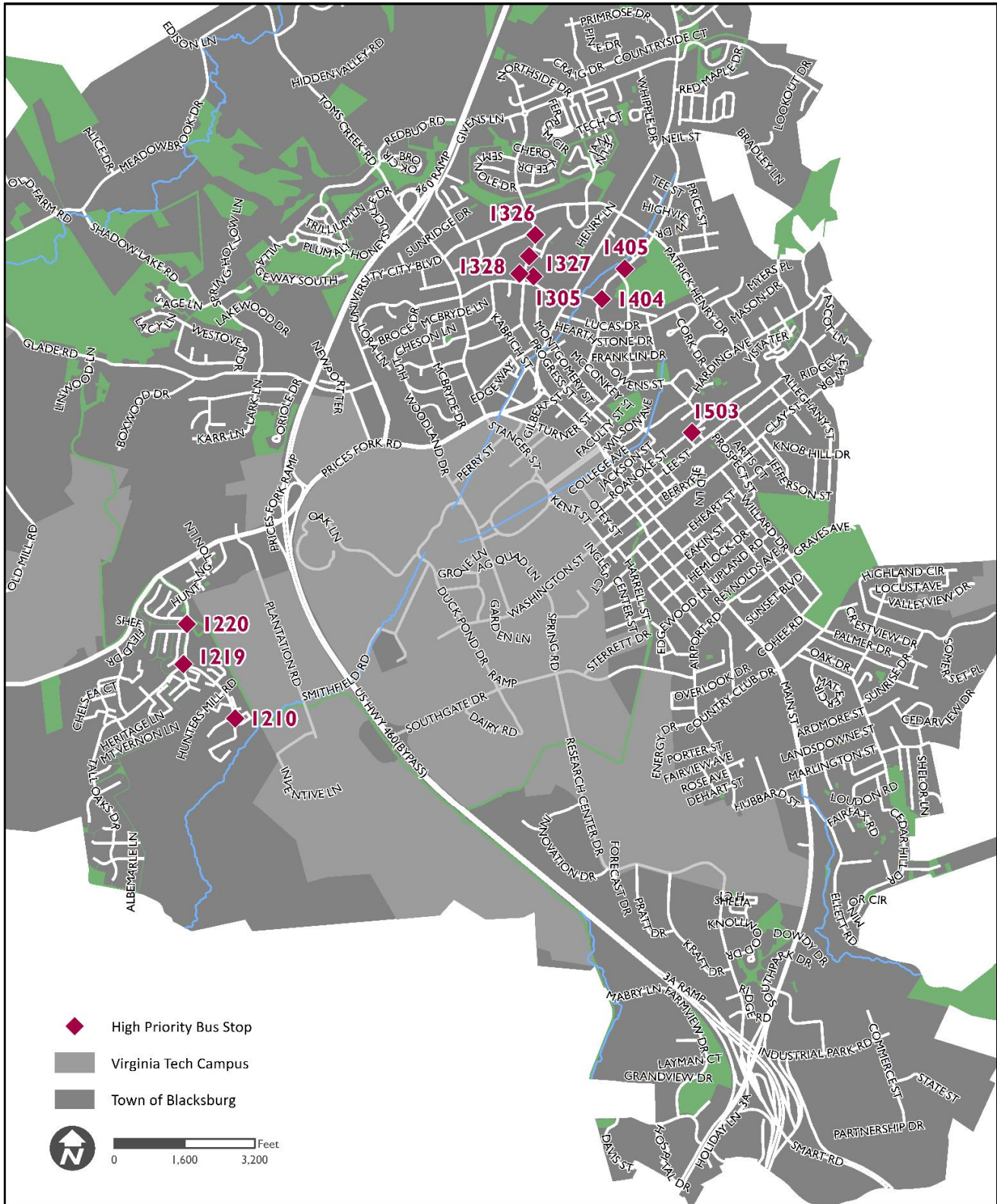
The *Bus Stop Safety and Accessibility Study's* Action Plan includes recommendations for the high priority and medium priority bus stops as identified by the prioritization process. Project sheets detailing each of the high priority bus stops and their recommended improvements are included in the following section. Following the project sheets are a matrix displaying the recommended improvements for the medium priority bus stops and a discussion regarding corridor-based and system-wide recommendations.

High Priority Bus Stop Recommendations

The top ten bus stops identified through the prioritization process were categorized as “high priority.” The project team collaborated with the Technical Committee and conducted a field review to develop a detailed inventory of these ten stops, ultimately resulting in project sheets that highlight key characteristics about each stop and list recommended improvements and their associated planning-level cost estimates. The high priority bus stops are displayed in the table below (in numerical order by stop ID) and shown in the map on the following page.

Stop ID	Stop Name	Route	Total Cost Estimate of Improvements
1210	Tall Oaks Drive at Foxridge Lane (Northbound)	Hethwood	\$ 5,000
1219	Heather Drive at Tall Oaks Drive (Southbound)	Hethwood A, Hethwood B	\$ 23,000
1220	Heather Drive at Plymouth Street (Southbound)	Hethwood A	\$ 13,200
1305	Progress Street at Broce Drive (Northbound)	Progress Street	\$ 19,800
1326	Progress Street at Hunt Club Road (Southbound)	University City Boulevard	\$ 17,200
1327	Progress Street at University Terrace (Southbound)	University City Boulevard	\$ 11,200
1328	Progress Street at Broce Drive (Southbound)	University City Boulevard	\$ 32,400
1404	Giles Road at Northview Drive (Northbound)	Main Street, Patrick Henry	\$ 6,600
1405	Giles Road at Heights Lane (Northbound)	Main Street, Patrick Henry	\$ 4,700
1503	Roanoke Street at Woolwine Street (Eastbound)	Harding Avenue	\$ 4,500

Figure 6. High Priority Bus Stops



Project Sheet Example

An example project sheet is shown below with callout text describing each of the project sheet elements. The project sheets for the high priority locations follow in numerical order by bus stop ID.

#1220 Heather Drive at Plymouth Street - Southbound

PURPOSE AND NEED STATEMENT

Bus stop #1220 is located on the opposite side of the Hethwood neighborhood's duck pond, next to the west entrance of the multi-use path tunnel under Heather Drive. The existing railing along the top of the tunnel entrance does not adequately protect pedestrians from the steep slope. Recommendations at this bus stop are intended to improve safety.



Existing

Concept

Route	Hethwood A
Loadings	1 rider per day
Alightings	13 riders per day

SITE PHOTO



Existing

Facilities

Sidewalk ●	Street Lighting ●
Curb Cut ●	Concrete Landing Pad ●
Crosswalk ○	Bench ○
Multi-Use Path ●	Shelter ○

● Existing
 ● Needs Improvement
 ● Recommended

RECOMMENDATIONS

Recommendations with Cost Estimates	
Move bus stop sign post closer to sidewalk	n/a
Extend railing from multi-use path tunnel	\$ 1,400
Install street lighting	\$ 3,800
Pave over grass verge	\$ 800
Improve curb cuts	\$ 7,200

VICINITY MAP

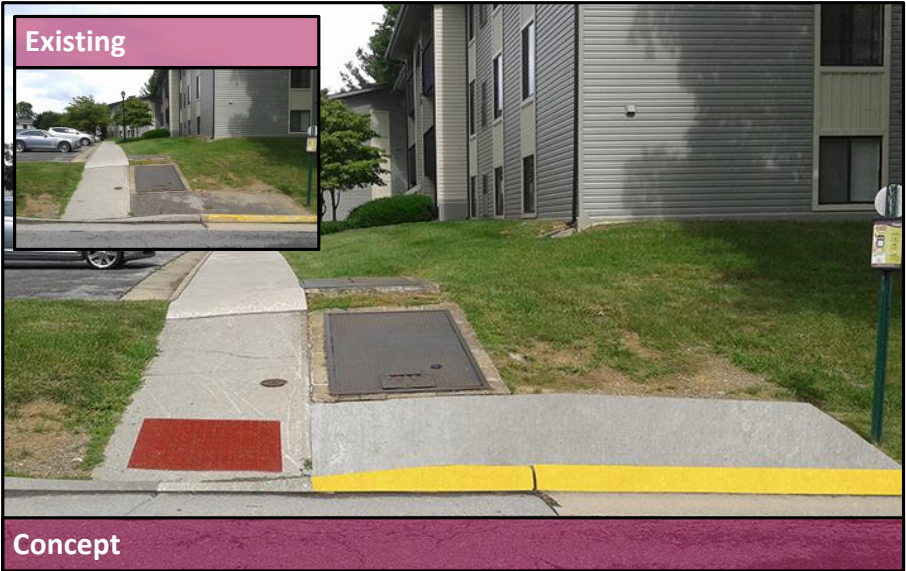


#1210 Tall Oaks Drive at Foxridge Lane - Northbound

July 2015

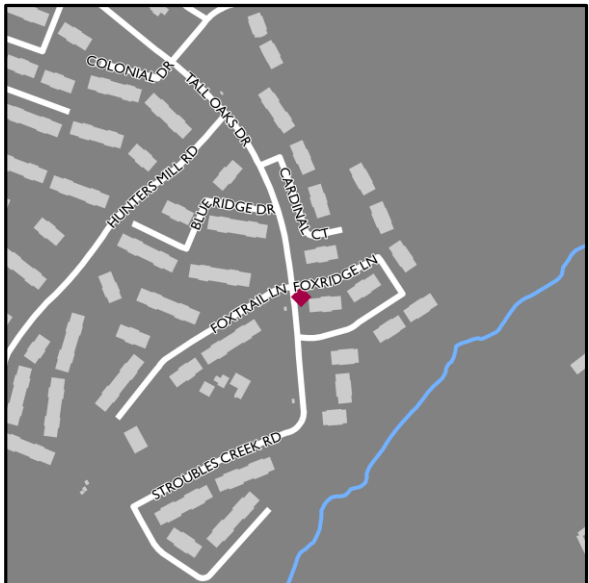
Route	Hethwood
Boardings	128 riders per day
Alightings	4 riders per day

Bus stop #1210 is located within the Hethwood apartment complex on Tall Oaks Road. The existing landing pad and sidewalk leading to the landing pad are very steep, and no curb cut exists at the street. Recommendations at this bus stop are intended to improve accessibility and provide a more comfortable waiting area.



Facilities	
Sidewalk <input type="radio"/>	Street Lighting <input type="radio"/>
Curb Cut <input type="radio"/>	Concrete Landing Pad <input type="radio"/>
Crosswalk <input type="radio"/>	Bench <input type="radio"/>
Multi-Use Path <input type="radio"/>	Shelter <input type="radio"/>
<input checked="" type="radio"/> Existing <input type="radio"/> Needs Improvement <input type="radio"/> Recommended	

Recommendations with Cost Estimates		
Fix sign post	\$	200
Install BT4U signs on both sides of sign post	\$	200
Standardize sign height	n/a	
Repaint curb	\$	100
Improve curb cut	\$	1,800
Level landing pad	\$	2,700
Total	\$	5,000



#1219 Heather Drive at Tall Oaks Drive - Southbound

July 2015

Route	Hethwood A and B
Boardings	3 riders per day
Alightings	230 riders per day

Bus stop #1219 is located in the northwest quadrant of the intersection of Tall Oaks Road and Heather Drive. The existing crosswalk is located in advance of the stop bar. Recommendations at this bus stop are intended to improve safety for riders crossing Tall Oak Road or Heather Drive.



Concept



Existing

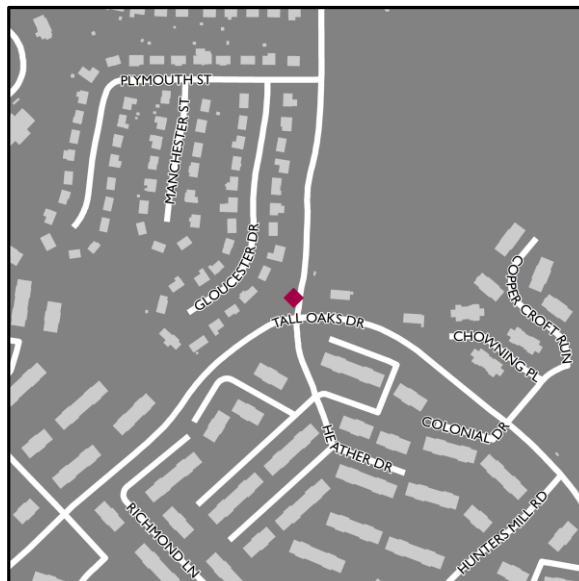
Facilities

Sidewalk	●	Street Lighting	●
Curb Cut	●	Concrete Landing Pad	●
Crosswalk	●	Bench	○
Multi-Use Path	●	Shelter	○

● Existing ● Needs Improvement ● Recommended

Recommendations with Cost Estimates

Install curb cut at crosswalk	\$	1,800
Repaint crosswalk	\$	7,500
Extend sidewalk south along Heather Drive	\$	2,300
Install crosswalk at Heather Drive and Tall Oaks Drive on west side	\$	7,500
Install accompanying curb cuts	\$	3,600
Consider potential on-property lighting	n/a	
Install in-street pedestrian crossing sign	\$	300
Total	\$	23,000



#1220 Heather Drive at Plymouth Street - Southbound

July 2015

Route	Hethwood A
Boardings	1 rider per day
Alightings	13 riders per day

Bus stop #1220 is located on the opposite side of the Hethwood neighborhood's duck pond, next to the west entrance of the multi-use path tunnel under Heather Drive. The existing railing along the top of the tunnel entrance does not adequately protect pedestrians from the steep slope. Recommendations at this bus stop are intended to improve safety.



Concept



Existing

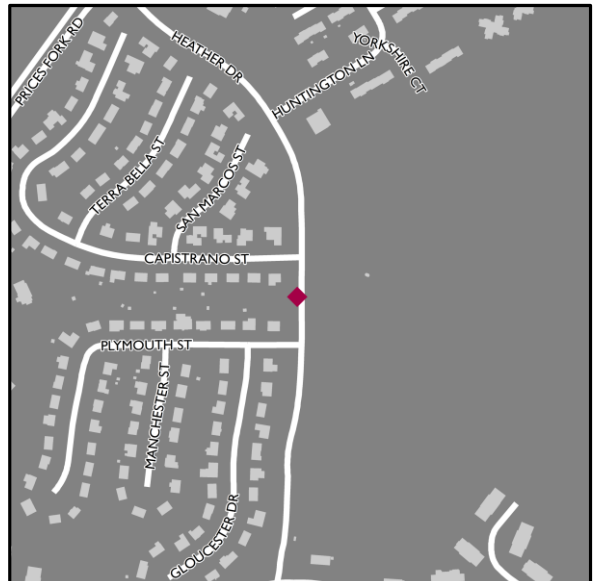
Facilities

Sidewalk		Street Lighting	
Curb Cut		Concrete Landing Pad	
Crosswalk		Bench	
Multi-Use Path		Shelter	

Existing
 Needs Improvement
 Recommended

Recommendations with Cost Estimates

Move bus stop sign post closer to sidewalk	n/a
Extend railing from multi-use path tunnel	\$ 1,400
Install street lighting	\$ 3,800
Pave over grass verge	\$ 800
Improve curb cuts	\$ 7,200
Total	\$ 13,200



#1305 Progress Street at Broce Drive - Northbound

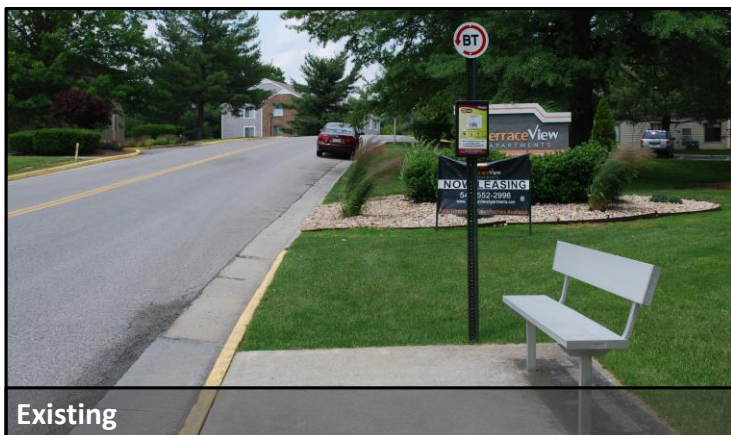
July 2015

Route	Progress Street
Boardings	11 riders per day
Alightings	110 riders per day

Bus stop #1305 is located on Progress Street opposite bus stop #1328, just north of Broce Drive. A dirt path is visible between the bus stop and the adjacent driveway, indicating riders walk through the grass to access the bus stop. Cyclists occasionally board and alight at this stop. Recommendations are this stop are intended to improve pedestrian and cyclist connectivity.



Concept



Existing

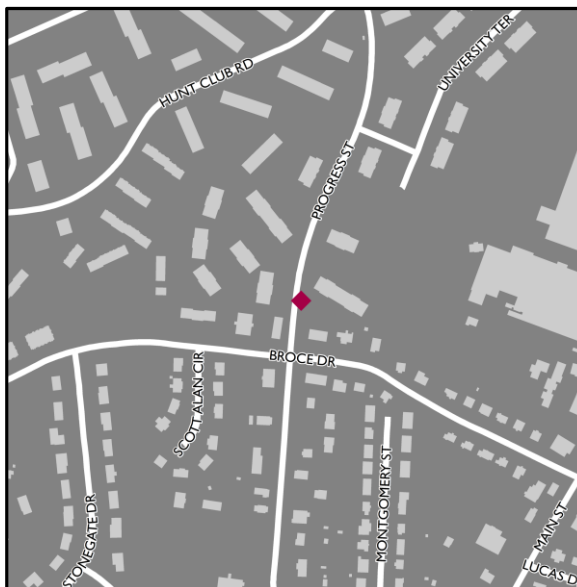
Facilities

Sidewalk	<input checked="" type="radio"/>	Street Lighting	<input type="radio"/>
Curb Cut	<input type="radio"/>	Concrete Landing Pad	<input checked="" type="radio"/>
Crosswalk	<input checked="" type="radio"/>	Bench	<input checked="" type="radio"/>
Multi-Use Path	<input type="radio"/>	Shelter	<input type="radio"/>

Existing
 Needs Improvement
 Recommended

Recommendations with Cost Estimates

Install bike rack	\$	600
Install sidewalk south along Progress Street to Broce Drive	\$	6,300
Install accompanying curb cuts at residential driveway	\$	3,600
Install crosswalk at Progress Street and Broce Drive on north side	\$	7,500
Install accompany curb cut in northeast quadrant	\$	1,800
Total	\$	19,800



#1326 Progress Street at Hunt Club Road - Southbound

July 2015

Route	University City Blvd
Boardings	315 riders per day
Alightings	28 riders per day

Bus stop #1326 is located on the west side of Progress Street just south of Hunt Club Road. The stop includes an unofficial shelter and is bounded by sidewalks. However, a sidewalk gap approximately 110' long exists to the south of the stop. Recommendations at this bus stop are intended to improve visibility and pedestrian connectivity.



Concept



Existing

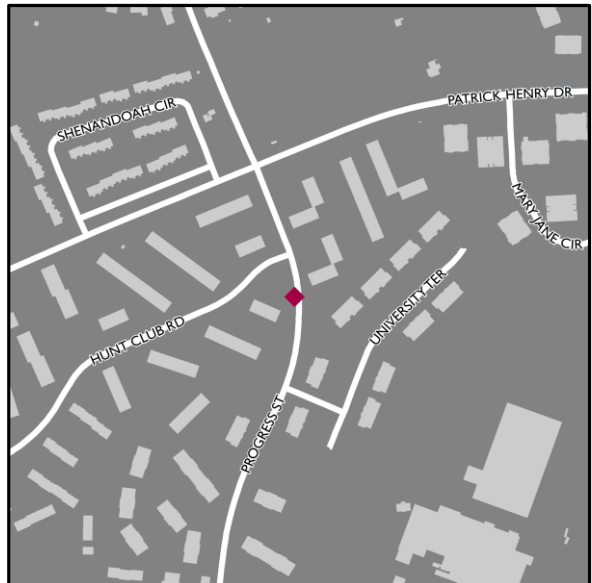
Facilities

Sidewalk	<input checked="" type="radio"/>	Street Lighting	<input type="radio"/>
Curb Cut	<input checked="" type="radio"/>	Concrete Landing Pad	<input type="radio"/>
Crosswalk	<input type="radio"/>	Bench	<input checked="" type="radio"/>
Multi-Use Path	<input type="radio"/>	Shelter	<input checked="" type="radio"/>

Existing
 Needs Improvement
 Recommended

Recommendations with Cost Estimates

Replace shelter	\$	11,300
Extend sidewalk south along Progress St	\$	5,400
Replace missing detectible warning surface at curb cut on southwest corner of Progress Street and Hunt Club Road	\$	500
Total	\$	17,200

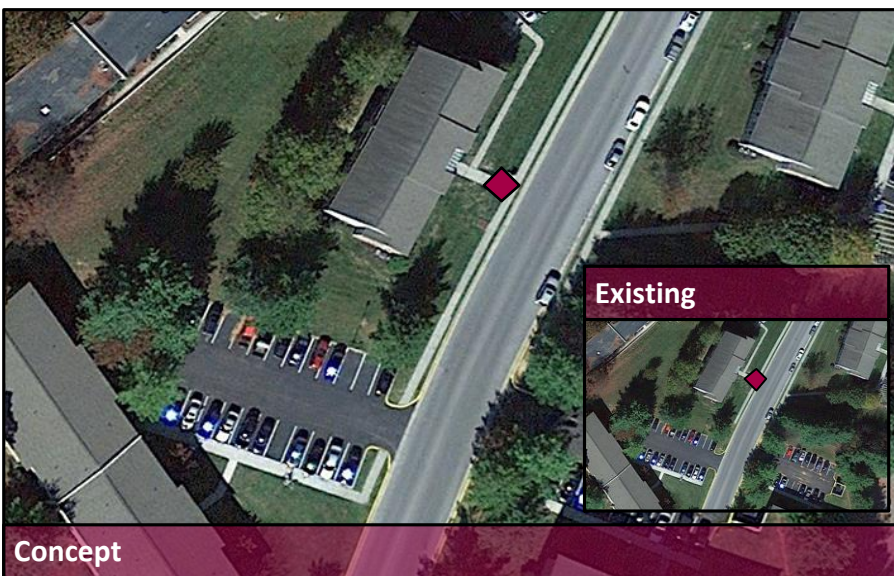


#1327 Progress Street at University Terrace - Southbound

July 2015

Route	University City Blvd
Boardings	81 riders per day
Alightings	7 riders per day

Bus stop #1327 is located at 1215 Progress Street. At the stop is a mailbox and newspaper box. There are missing sidewalk connections to the south on both sides of Progress Street. Recommendations at this bus stop are intended to improve pedestrian connectivity and to provide a more comfortable waiting area.



Concept



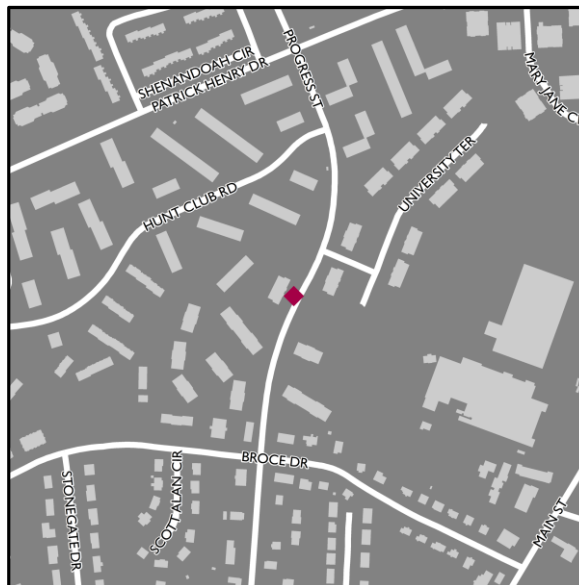
Existing

Facilities

Sidewalk	●	Street Lighting	●
Curb Cut	●	Concrete Landing Pad	●
Crosswalk	○	Bench	○
Multi-Use Path	○	Shelter	○
● Existing		● Needs Improvement	
		● Recommended	

Recommendations with Cost Estimates

Extend sidewalk south along Progress Street	\$	3,200
Install accompanying curb cuts at apartment parking lot driveway	\$	3,600
Extend sidewalk south along Progress Street on east side	\$	1,800
Install accompanying curb cut	\$	1,800
Pave over grass verge	\$	800
Coordinate on-property lighting with property owner	n/a	
Total	\$	11,200



#1328 Progress Street at Broce Drive - Southbound

July 2015

Route	University City Blvd
Boardings	99 riders per day
Alightings	7 riders per day

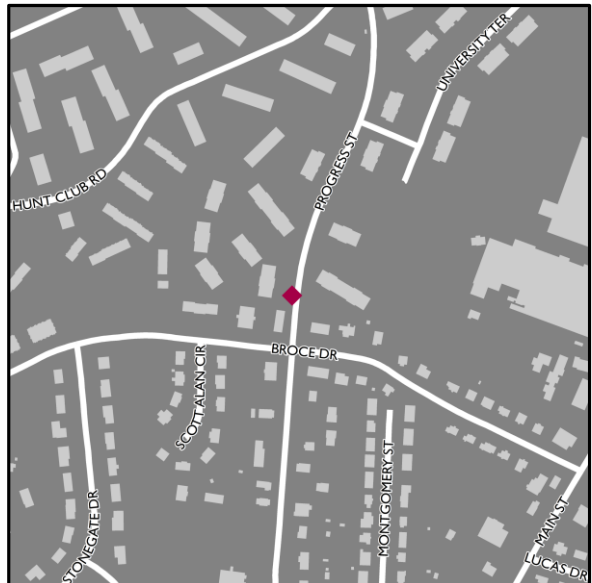
Bus stop #1328 is located opposite bus stop #1305 on Progress Street, north of Broce Drive. The bus stop is characterized by a concrete pad and bench. Collegiate Times has placed a newspaper box against the bus stop sign post. Sidewalk gaps exist to the north and south of the bus stop. Recommendations at this bus stop are intended to improve pedestrian connectivity and provide a more comfortable waiting area.



Existing

Facilities			
Sidewalk	●	Street Lighting	○
Curb Cut	○	Concrete Landing Pad	●
Crosswalk	●	Bench	●
Multi-Use Path	○	Shelter	●
● Existing ● Needs Improvement ● Recommended			

Recommendations with Cost Estimates		
Extend sidewalk south along Progress Street (no grass verge)	\$	6,800
Extend sidewalk north to existing apartment sidewalk	\$	5,000
Expand concrete pad	\$	1,800
Remove bus stop sign post	n/a	
Install shelter with solar lighting	\$	11,300
Install crosswalk at Progress Street and Broce Drive on west side	\$	7,500
Total	\$	32,400



#1404 Giles Road at Northview Drive - Northbound

July 2015

Route	Main St, Patrick Henry
Boardings	2 riders per day
Alightings	11 riders per day

Bus stop #1404 is located at the intersection of Giles Road and Northview Drive. There is no waiting area at the bus stop. Recommendations at this stop are intended to provide a more comfortable waiting area.



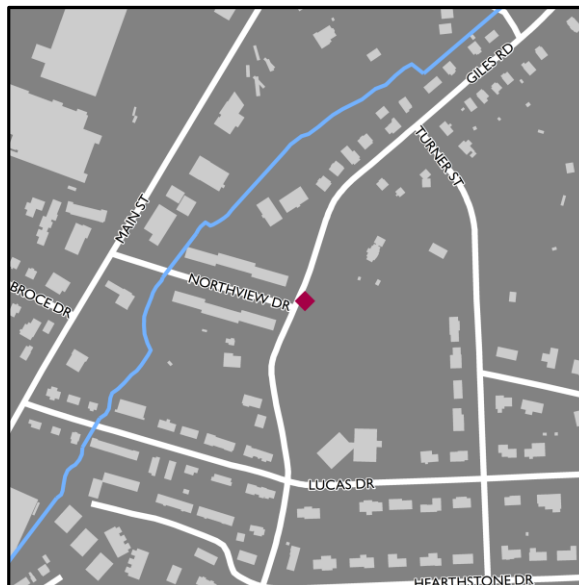
Facilities

Sidewalk	<input type="radio"/>	Street Lighting	<input type="radio"/>
Curb Cut	<input type="radio"/>	Concrete Landing Pad	<input type="radio"/>
Crosswalk	<input type="radio"/>	Bench	<input type="radio"/>
Multi-Use Path	<input type="radio"/>	Shelter	<input type="radio"/>

Existing
 Needs Improvement
 Recommended

Recommendations with Cost Estimates

Install landing pad	\$	3,000
Improve curb cuts on Northview Drive	\$	3,600
Total	\$	6,600



#1405 Giles Road at Heights Lane - Northbound

July 2015

Route	Main St, Patrick Henry
Boardings	5 riders per day
Alightings	7 riders per day

Bus stop #1405 is located on Giles Road north of Turner Street. While there is existing sidewalk on the opposite side of the street, no sidewalk or concrete pad is present at the bus stop. Recommendations at this bus stop are intended to increase visibility and provide a more comfortable waiting area.



Facilities

Sidewalk	<input type="radio"/>	Street Lighting	<input checked="" type="radio"/>
Curb Cut	<input type="radio"/>	Concrete Landing Pad	<input checked="" type="radio"/>
Crosswalk	<input type="radio"/>	Bench	<input type="radio"/>
Multi-Use Path	<input type="radio"/>	Shelter	<input type="radio"/>

Existing
 Needs Improvement
 Recommended

Recommendations with Cost Estimates		
Install street lighting	\$	1,500
Install landing pad	\$	3,000
Install BT4U sign	\$	200
Total	\$	4,700



#1503 Roanoke Street at Woolwine Street - Eastbound

July 2015

Route	Harding Avenue
Boardings	5 riders per day
Alightings	24 riders per day

Bus stop #1503 is located at the end of a residential driveway on Roanoke Street between Rutledge Street and Woolwine Street. There is no sidewalk on the east side of Roanoke Street, and a retaining wall abuts the curb to the north of the driveway. These suggested changes are intended to improve visibility and provide a more comfortable waiting area. See Corridor-Based Recommendations (p. 36) for a discussion of stop consolidation along Roanoke Street.



Facilities			
Sidewalk	<input type="radio"/>	Street Lighting	<input type="radio"/>
Curb Cut	<input type="radio"/>	Concrete Landing Pad	<input checked="" type="radio"/>
Crosswalk	<input type="radio"/>	Bench	<input type="radio"/>
Multi-Use Path	<input type="radio"/>	Shelter	<input type="radio"/>
<input checked="" type="radio"/> Existing <input type="radio"/> Needs Improvement <input checked="" type="radio"/> Recommended			

Recommendations with Cost Estimates		
Repave end of driveway	\$	1,500
Install concrete landing pad	\$	3,000
Trim vegetation	n/a	
Total	\$	4,500



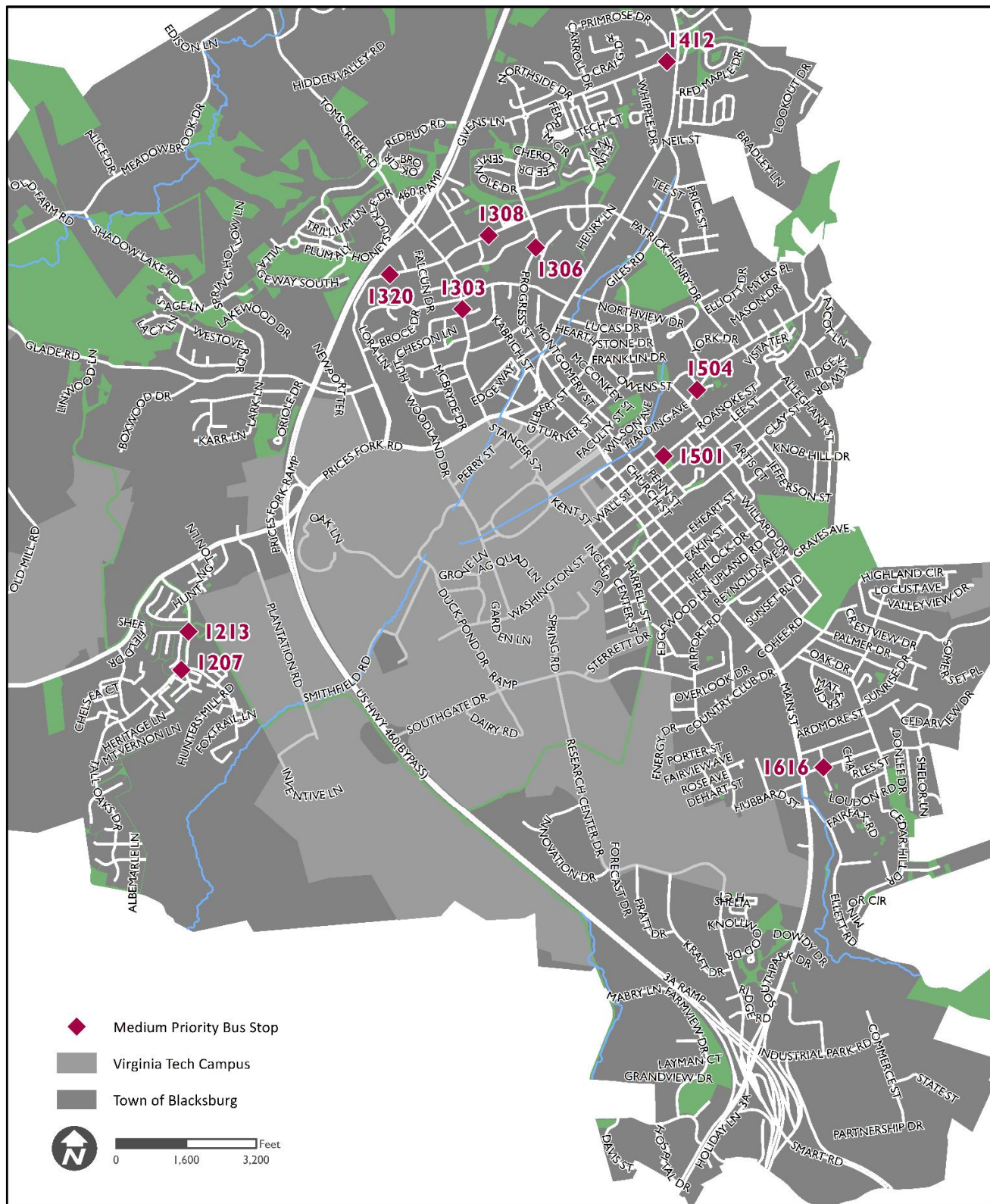
Medium Priority Bus Stop Recommendations

In the prioritization process, bus stops ranked 11 to 20 were categorized as medium priority. The project team conducted a preliminary analysis to identify issues and possible improvements at these stops, though further study is required to complete a detailed evaluation.

Stop ID	Stop Name	Primary Issue	Preliminary Recommendations
1207	Tall Oaks Drive at Heather Drive (Eastbound)	Accessibility	<ul style="list-style-type: none"> • Install curb cuts • Install crosswalk
1213	Heather Drive at Plymouth Street (Northbound)	Accessibility	<ul style="list-style-type: none"> • Paint bus lane markings • Replace bike route sign • Reconstruct curb cuts where multi-use path meets the roadway • Install bench or shelter • Pave over grass verge
1303	Toms Creek Road at McBryde Drive (Northbound)	Safety	<ul style="list-style-type: none"> • Improve curb cuts • Consider street lighting
1306	Progress Street at University Terrace (Northbound)	Accessibility	<ul style="list-style-type: none"> • Restrict on-street parking • Improve sidewalk connections
1308	The Village on Patrick Henry Drive (Westbound)	Stop Amenities	<ul style="list-style-type: none"> • Install shelter • Install bike rack
1320	Shawnee on University City (Eastbound)	Accessibility	<ul style="list-style-type: none"> • Install curb cuts • Repave sidewalks
1412	Givens Lane at Main Street (Westbound)	Accessibility	<ul style="list-style-type: none"> • Install sidewalk • Install curb cuts • Move bus stop downstream (to the west) • Install landing pad • Consider crosswalks on Main Street²
1501	Roanoke Street at Wharton Street (Eastbound)	Accessibility	<ul style="list-style-type: none"> • Trim vegetation • Paint curb yellow • Replace sign post • Consider stop consolidation
1505	Harding Avenue at Cork Drive (Eastbound)	Stop Amenities	<ul style="list-style-type: none"> • Install landing pad • Trim vegetation • Evaluate for bike racks
1616	Marlington Street at Grayland Street (Westbound)	Stop Amenities	<ul style="list-style-type: none"> • Reorient signs to face east Marlington Street • Consider painting waiting area, based on Blacksburg Transit standards • Install curb • Consider moving bus stop upstream

² A pedestrian was struck and killed by a motorist while crossing Main Street near Givens Lane On November 20, 2014.

Figure 7. Medium Priority Bus Stops



Corridor-Based Recommendations

Corridor improvements, in addition to benefitting individual bus stops, can provide connectivity and enhance multimodal mobility along the corridor. The majority of the high priority bus stops are located along one of the following four corridors: Tall Oaks Drive, Giles Road, Roanoke Street, and Progress Street. Based on stakeholder feedback and the review of relevant plan and policy documents, the project team developed recommendations to improve these corridors.

Tall Oaks Drive

The Tall Oaks Drive corridor, spanning from Heather Drive to Stroubles Creek Road, would benefit from the addition of sidewalks and multi-use paths to improve pedestrian connectivity. There are existing sidewalks along the north side to the west of Hunters Mill Road and along the west side south of Foxridge Lane. On-street parking along Tall Oaks Drive, while permitted, is underutilized. The width of the roadway encourages higher vehicular speeds and subjects pedestrians crossing the street to longer exposure times than necessary. Installing pavement markings to delineate the center line and edge of travelway could help mitigate these effects. This striping would provide de facto bike lanes and an area for pedestrians to walk if no sidewalks exist. The addition of lighting in the shelters along Tall Oaks Drive is also advised. High priority bus stop #1210 is located in this corridor.

Giles Road

Spanning from Lucas Drive to Patrick Henry Drive, the Giles Road corridor is served by the Main Street and Patrick Henry transit routes in the northbound direction. High priority bus stops #1404 and #1405 are located on Giles Road at Northview Drive and Turner Street, respectively. Both stops are located on the east side of the street to serve the northbound bus routes, though sidewalks exist only on the west side. Street lighting and lane striping would enhance the safety and comfort of riders as they access the bus stops. Parking restrictions are recommended to provide bus drivers with more reliable access to the stops.

Roanoke Street

The Roanoke Street corridor extends for 0.3 miles from Church Street to Woolwine Street. Roanoke Street has sidewalks on its north side east of Penn Street. Sidewalks are located on both sides of Roanoke Street between Church Street and Penn Street. Several challenges exist for pedestrians walking along or riders waiting at bus stops on the south side including the lack of sidewalks, retaining walls, residential fencing, and vegetation. Along the corridor are four closely-spaced pairs of mirrored stops serving the Harding Avenue route. The table to the right presents 2014 average ridership numbers for the bus stops in both the eastbound and westbound directions. Based on the ridership data, the most heavily utilized bus stops are on the western end of the corridor. Bus stops #1501, #1502, and #1503 are all located adjacent to residential driveways. Bus stop #1502 has the most open area for riders waiting for the bus. Bus stop #1503 was identified as a high priority for improvement in this study, and should be considered for relocation away from the large existing retaining wall. Stop

Stop ID	Average Daily Boardings	Average Daily Alightings
Eastbound		
1500	0.31	0.39
1501	0.59	3.76
1502	5.08	13.19
1503	4.73	23.51
Westbound		
1518	52.64	1.15
1519	27.80	0.39
1520	5.76	0.15
1521	2.15	0.95

consolidation along Roanoke Street would improve motor vehicle traffic and transit operations along the corridor, in addition to reducing the potential conflict between motorists and riders crossing the street to board

or after alighting a bus. The removal of stop #1501 and its mirror stop, #1520, is therefore recommended for consideration.

Progress Street

Traffic calming and new sidewalk connections are recommended along Progress Street between Broce Drive and Patrick Henry Drive to reduce vehicular speeds, enhance walkability, and improve safety for riders accessing bus stops. Progress Street has a posted speed limit of 25 miles per hour. Recommended traffic calming measures include landscaping, travel lane narrowing via pavement striping, and bus stops delineated with pavement markings. Disconnected sidewalk segments and missing sidewalk connections make the six bus stops difficult to access, especially for mobility-impaired transit riders. Three of the bus stops – #1305, #1307, and #1328 – have concrete landing pads but are not connected by sidewalks. Completing the sidewalk network should be a priority for improving the Progress Street corridor between Broce Drive and Patrick Henry Drive. The high priority bus stops in the Progress Street corridor include #1305, #1326, #1327, and #1328.

System-Wide Recommendations

While corridor-based improvements have a broader reach than those at a single bus stop, it is also necessary to assess recommendations for the entire Blacksburg Transit network. Over the course of this study's development, the project team recognized a variety of themes regarding the needs of the Blacksburg Transit system, ranging from infrastructure enhancements to policy changes. Stakeholder engagement, field review, coordination with the Technical Committee, and the Plan & Policy Review provided a foundation for the development of these system-based recommendations.

Infrastructure

Several infrastructure improvements are recommended across the Blacksburg Transit system for the enhancement of safety and accessibility at its bus stops.

- Pave over grass verges to create concrete landing pads at stops located along sidewalks. Grass verges make it increasingly difficult for mobility-impaired riders to board and alight buses.
- In coordination with the Corridor Committee, identify gaps in the sidewalk and multi-use path network and prioritize construction needs to enhance connectivity and improve accessibility to the bus stops, thereby encouraging greater use of transit.
- Install curb cuts that adhere to ADA compliance standards. Detectable warning surfaces and adequate dimensions, orientations, and slopes of concrete sidewalks and landing pads will increase accessibility, especially for mobility-impaired transit riders.
- Standardize bus stop signs. Each Blacksburg Transit bus stop sign post contains the standard BT circular sign and the rectangular BT4U sign that provides riders with detailed route and stop information. Blacksburg Transit is currently seeking to standardize the heights of these two signs throughout its transit system. The top of the circular sign should reach 72" above ground to be visible to the driver, while the top of the BT4U sign should reach 48" to be accessible to mobility-impaired riders.



Stop #1220 – Heather Drive at Plymouth Street (Southbound)

- Ensure bus stop sign posts are placed at an offset from the road to prevent bus mirrors from colliding with the signs. For example, the sign post at stop #1220 should be moved to be located closer to the multi-use path than the curb.
- Identify a selection of bus stops for installation of bike racks. Blacksburg Transit should select bus stops based on counts of cyclists boarding and alighting the buses. The draft 2015 Blacksburg Bicycle Master Plan recommends that bike parking should be made available at all Blacksburg Transit bus stops.
- Consider the installation of new roofs or windows at non-Blacksburg Transit bus stop shelters. Some sub-standard shelters obstruct bus operators' view of passengers waiting inside the shelter, like stop #1326 pictured to the right. Blacksburg Transit should consider partnering with the neighborhood developments to modify the shelters to increase visibility.
- Evaluate collector roads for potential striping. Marking the centerline and the edge of travelway on collector roads like Tall Oaks Drive and Giles Road could improve safety for pedestrians and cyclists who travel along the shoulder of the road to access bus stops.



Stop #1326 – Progress Street at Hunt Club Road (Southbound)

Safety

Blacksburg Transit prioritizes the safety of its riders. Strategic infrastructure improvements and community outreach efforts would aid Blacksburg Transit in enhancing safety across the transit network.

- Clearly mark mid-block crossings. The installation of ADA-compliant concrete medians with pedestrian refuges should be considered on sufficiently wide streets with high traffic volumes. Actuated signals for pedestrians should be considered where warranted by high traffic volumes.
- Install lighting for bus stops not currently illuminated by existing lighting. Where adequate lighting currently is not provided, Blacksburg Transit should coordinate with the Town of Blacksburg or property owners to install lighting. Lighting should be installed in shelters where other lighting is insufficient.
- Champion community outreach programs to educate riders and drivers about bus safety. Blacksburg Transit should prioritize the dissemination of educational information in regards to utilizing the transit network at night. Warnings should also be communicated to local drivers not to pass buses that are stopped to load or unload passengers. Safety information about biking and walking could also comprise a multimodal safety education program.
- Consider the use of green-painted bike lanes to increase motorists' awareness of the bike lane and cyclists. Transit riders may access bus stops by bike, so the facilitation of safe travel for cyclists along Blacksburg Transit bus stop corridors would promote transit use. A candidate bike lane for green paint may be the southbound bike lane on Toms Creek Road approaching Prices Fork Road, since the bike lane is located between two general purpose lanes.

Maintenance

Blacksburg bus stops inevitably suffer the effects of harsh weather, erosion, and wear from motor vehicles including transit buses. Vigilant maintenance of the stops therefore is necessary to preserve the Town's existing infrastructure and improve the safety and appearance of its roadways.

- Regularly sweep the asphalt debris that accumulates in the gutters adjacent to bus stops. This debris can increase the risk of riders slipping and falling as they board or alight from the buses. Regular clean-up of this debris would create a safer zone for riders.
- Monitor pavement quality and repave when quality reaches an unacceptable level. The repetitive weighting of buses at bus stops leads to visible rutting and cracking of the pavement.
- Repaint the curbs at bus stops yellow. At many stops the yellow curb paint marking the bus stop area has eroded. Curbs should be repainted regularly to discourage parking in the bus loading area and to increase the visibility of the bus stops.



Stop #1219 – Heather Drive at Tall Oaks Drive (Southbound)

Policy

Blacksburg Transit is in the process of implementing standard policies throughout the transit network to facilitate smooth and efficient transit operations. Several policies apply to the entire Blacksburg Transit system and are based on stakeholder feedback, input from the technical committee, and observations made in the field.

- Develop a policy to regulate non-Blacksburg Transit objects at bus stops (e.g. newspaper boxes). The policy will need to address a variety of bus stop configurations and conditions, such as the presence of a shelter or the location of the stop along residential property.
- Continue to collect data aiding in the identification of locations for enhanced accessibility. Where possible, designs should go beyond ADA compliance standards to make riders as comfortable and safe as possible given available resources and site constraints.
- Review existing shelter and bench thresholds. Currently, Blacksburg Transit policy warrants the installation of a bench if there are at least 25 daily boardings at a stop and a shelter if there are 50 or more daily boardings. Blacksburg Transit should meet with stakeholders to review the current thresholds and decide whether or not they are still appropriate. Ridership thresholds could also be established for other bus stop amenities, such as trash cans and recycling cans.
- Recommendations at bus stops should be responsive to ridership, though a distinction should be made between boardings and alightings. Where boardings are high, rider amenities at the waiting area should be prioritized. Shelters, benches, and BT4U sign visibility are top priorities. In contrast, at bus stops where alightings are high, safe crossings for pedestrians and sidewalk connectivity take greater precedence.
- Continue to utilize data-driven prioritization and improvement decisions to guide the systematic improvement of bus stops, beginning with the most urgent needs. Blacksburg Transit should continue to collect data on a regular basis, building on the effort initiated in 2009 to create an inventory database of Blacksburg Transit's bus stops. The bus stop inventory should include existing bike and wheelchair boardings and alightings similar to those collected in March and April 2015 by Blacksburg Transit. A

team at Virginia Tech is currently collecting bicycle and pedestrian counts at approximately 100 locations in the Town of Blacksburg with the intent of building a model to develop average annual daily bicycle and pedestrian traffic volumes for the entire Town. Updates to the prioritization tool should incorporate the data from the bicycle and pedestrian model.

Funding Sources

The ultimate outcome of the *Bus Stop Safety and Accessibility Study* is to move its recommended improvements to planning, design, and construction. To this end, Blacksburg Transit must identify funding sources and establish a timeline for implementation. Funding for bus stop improvements, pedestrian facilities, and bikeways range from local partnerships to federal grants. Existing and potential funding sources are described in detail below.

Federal/State

Transportation Alternatives Program

The Transportation Alternatives Program (TAP) was authorized through the United States' current surface transportation program, Moving Ahead for Progress in the 21st Century (MAP-21). TAP funding is apportioned to state departments of transportation with 50 percent suballocated based on population while the remaining 50 percent is eligible for use anywhere within the state. Funding through TAP may be used for the construction, planning, and design of on-road and off-road trail facilities and infrastructure-related projects and systems that will provide safe routes for non-drivers. The program also can fund projects and activities previously eligible for funding through the Recreational Trails Program and the Safe Routes to School Program.

FTA Urbanized Area Formula Grants (Section 5307)

The Urbanized Area Formula Grants program provides funds to transit agencies for transit capital projects that include improving bicycle routes to transit, bike racks, and bus shelters. MAP-21 dictates that at least 1 percent of allocated Section 5307 funds must be used for Associated Transit Improvements, which include bus shelters, pedestrian facilities, and enhanced access for mobility-impaired transit riders.

Local

Infrastructure Improvement Projects

Infrastructure improvement projects for roadways on which bus stops are located offer opportunities to incorporate improvements for transit use, cycling, and walking. The Town of Blacksburg has initiated the construction of the University City Boulevard project that will reconstruct the roadway, sidewalk, curb and gutter.

Capital Improvement Program

The Town of Blacksburg's adopted FY2015-FY2019 Capital Improvement Program (CIP) includes annual funding for the following projects:

- Streetlight Installation – \$5,000
- Curb, Gutter, and Sidewalk In-Fill Construction Projects – \$15,000
- Sidewalk Trip Hazard Removal – \$12,500
- Curb, Gutter, and Sidewalk Replacement – \$31,000

Also included in the CIP is the Blacksburg Shelter, Amenities, Bike Rack Replacement and Expansion Program that matches federal grant funding with a 10% state share from the Division of Rail and Public Transportation and a 10% local share from the Town of Blacksburg and Virginia Tech. Annual totals range from \$31,000 to \$35,000 over the life of the CIP.

Development Review Process

The Retreat, a large apartment complex to be located on the north side of Prices Fork Road near Huntington lane and Brightwood Manor Drive, has been coordinating with Blacksburg Transit to provide peak hour on-site transit service. Future improvements should be addressed through the development review process where possible.

Proffers

In Virginia, developers can voluntarily proffer fees with localities during a rezoning approval process to fund improvements related to the proposed development. For example, Blacksburg Estates has proffered \$10,000 for Blacksburg Transit to identify a location for and install a bus stop. The developers of Smith's Landing and Maple Ridge paid for the installation of shelters at the bus stops serving those neighborhoods.

Public-Private Partnerships

Many of Blacksburg Transit's bus stops are located near or on private property. Blacksburg Transit can establish partnerships with property owners to implement improvements that would both benefit the property owner and improve safety and accessibility at the bus stop. Additional information may be found in the Blacksburg Transit Route Analysis Partnership Plan dated September 2014. The document includes several examples of partnership models, including university-supported systems.

Next Steps

The *Bus Stop Safety and Accessibility Study* has initiated a data-driven evaluation process for Blacksburg Transit bus stops to be used beyond this study. By identifying high priority bus stops and providing recommendations for them, this study has set the stage for Blacksburg Transit to systematically implement recommendations that improve specific bus stops, key corridors, and the system as a whole.

Updated Prioritization

The prioritization tool has been designed to be updated with new data in the future to aid in the identification of the next series of priority bus stops. Blacksburg Transit has the opportunity to continue to collect prioritization input data regularly from its operators and stakeholders. The project team recommends an update of the prioritization tool at least every five years to continue identifying the greatest needs at its bus stops.



Future Studies

The prioritization tool developed for this study has been tailored to the specific geography of the Town of Blacksburg and the priorities of Blacksburg Transit. However, similar tools could be created through future studies to serve neighboring communities and the Virginia Tech campus.

Other topics recommended for future study include:

- Assessment of proposed locations for new Blacksburg Transit bus stops
 - Blacksburg Transit Office
 - Jefferson Street and Clay Street
 - Givens Lane and Carroll Drive (Blacksburg Estates)
- Evaluation of the Blacksburg Transit network for potential bus stop consolidation and service re-routing
- Investigation of the feasibility of the recommendations provided in this report, based on Town regulations and potential right-of-way issues
- Development of a Bus Stop Design Standards and Improvement Program

Prioritization Matrix

Tables presenting the results of the prioritization process for each of the 65 bus stops are shown in the following pages of this Appendix.

Bus Stop		Priority Tier	Prioritization Criteria					Visibility Obstruction
ID	Location		Cycling & Walking Infrastructure	Stop Safety	Stop Amenities	Ridership	Service Hours	
			13.6%	13.4%	12.0%	11.5%	11.5%	9.0%
1328	Progress/Broce Sbnd	High	High	High	Medium	High	High	High
1210	Tall Oaks/Foxridge Nbnd	High	High	High	High	High	Medium	Medium
1327	Progress/University Terrace Sbnd	High	Medium	High	High	High	High	Low
1326	Progress/Hunt Club Sbnd	High	Medium	High	Low	High	High	High
1305	Progress/Broce Nbnd	High	High	High	Medium	Medium	Medium	Low
1503	Roanoke/Woolwine Ebnd	High	High	High	High	Low	Medium	Medium
1404	Giles/Northview Nbnd	High	High	High	High	Low	Low	Low
1220	Heather/Plymouth Sbnd	High	Medium	High	High	Low	Medium	High
1219	Heather/Tall Oaks Sbnd	High	Low	High	High	Low	Medium	Medium
1405	Giles/Heights Nbnd	High	High	High	High	Low	Low	Low
1213	Heather/Plymouth Nbnd	Medium	Medium	High	High	Medium	Medium	Low
1505	Harding/Cork Ebnd	Medium	Medium	High	High	Low	Medium	Medium
1501	Roanoke/Wharton Ebnd	Medium	High	Medium	Medium	Low	Medium	Medium
1616	Marlington/Grayland Wbnd	Medium	High	Medium	Medium	High	Low	Low
1308	The Village on Patrick Henry Wbnd	Medium	Low	High	Medium	High	Medium	Low
1207	Tall Oaks/Heather Ebnd	Medium	High	Low	Low	High	Medium	Low
1320	Shawnee on University City Ebnd	Medium	Low	Medium	Medium	Medium	High	Medium
1303	Toms Creek/McBryde Nbnd	Medium	Low	High	High	Low	Medium	High
1306	Progress/University Terrace Nbnd	Medium	Medium	High	High	Medium	Medium	Low
1412	Givens/Main Wbnd	Medium	Low	High	High	Medium	Low	Low
1203	Prices Fork/Huntington Wbnd	Low	Low	High	High	Low	Medium	Low
1310	University City/Toms Creek Wbnd	Low	Low	High	Low	High	Medium	Low

Bus Stop		Prioritization Criteria						
ID	Location	Sidewalk Curb Cuts	Stakeholder Feedback	Stop Interval	Construction Constraints	Reported Crashes	Multimodal Activity	Weighted Average
		8.6%	5.4%	5.3%	4.8%	3.4%	1.5%	
1328	Progress/Broce Sbnd	High	Medium	Low	Medium	High	High	2.67
1210	Tall Oaks/Foxridge Nbnd	Medium	High	Low	Medium	Low	Low	2.46
1327	Progress/University Terrace Sbnd	High	Medium	Low	Medium	Low	High	2.41
1326	Progress/Hunt Club Sbnd	Medium	Medium	Medium	High	Medium	High	2.40
1305	Progress/Broce Nbnd	High	Low	High	High	High	High	2.36
1503	Roanoke/Woolwine Ebnd	High	Medium	Low	Low	Medium	High	2.28
1404	Giles/Northview Nbnd	High	High	High	Medium	Low	High	2.24
1220	Heather/Plymouth Sbnd	Medium	Low	High	Medium	Medium	Medium	2.23
1219	Heather/Tall Oaks Sbnd	High	Medium	High	High	Medium	Medium	2.19
1405	Giles/Heights Nbnd	High	High	High	Low	Low	Medium	2.18
1213	Heather/Plymouth Nbnd	Medium	Low	Medium	High	Medium	Medium	2.16
1505	Harding/Cork Ebnd	High	Low	Low	Medium	Medium	Medium	2.12
1501	Roanoke/Wharton Ebnd	High	High	Low	Low	Medium	High	2.08
1616	Marlington/Grayland Wbnd	High	Medium	Low	Medium	Low	High	2.06
1308	The Village on Patrick Henry Wbnd	Medium	Low	High	High	Low	High	2.05
1207	Tall Oaks/Heather Ebnd	High	Medium	High	Medium	Medium	Medium	2.05
1320	Shawnee on University City Ebnd	High	Medium	Medium	Medium	Low	High	2.05
1303	Toms Creek/McBryde Nbnd	Medium	Low	Medium	Low	High	High	2.04
1306	Progress/University Terrace Nbnd	Medium	Low	Low	Medium	Low	High	2.04
1412	Givens/Main Wbnd	High	Medium	High	Medium	Low	High	2.03
1203	Prices Fork/Huntington Wbnd	High	Medium	Medium	Medium	Medium	High	2.01
1310	University City/Toms Creek Wbnd	Medium	Medium	Medium	High	High	High	2.00

Bus Stop		Priority Tier	Prioritization Criteria					Visibility Obstruction
ID	Location		Cycling & Walking Infrastructure	Stop Safety	Stop Amenities	Ridership	Service Hours	
			13.6%	13.4%	12.0%	11.5%	11.5%	9.0%
1502	Roanoke/Rutledge Ebnd	Low	High	Medium	Medium	Low	Medium	Medium
1206	Tall Oaks/Foxhunt Ebnd	Low	High	Low	Low	High	Medium	Low
1636	Industrial Park/Transportation Res Ebnd	Low	Medium	High	High	Low	Low	Low
1520	Roanoke/Wharton Wbnd	Low	Medium	Medium	Medium	Low	Medium	Medium
1414	Pheasant Run	Low	Low	Medium	Low	High	High	Low
1317	University City/Glade Nbnd	Low	Medium	Medium	Medium	Medium	High	Low
1518	Roanoke/Woolwine Wbnd	Low	Medium	Medium	Medium	Medium	Medium	Medium
1205	Tall Oaks/Hethwood Ebnd	Low	High	Medium	Low	Medium	Medium	Low
1314	University City/Glade Sbnd	Low	Medium	Medium	Low	High	Medium	Low
1421	Main/Kabrich Sbnd	Low	Medium	Medium	Medium	Medium	Low	Low
1333	Toms Creek/Winston Sbnd	Low	Low	Medium	Medium	Medium	Medium	Low
1214	Heather/Huntington Nbnd	Low	Medium	Medium	Medium	Medium	Medium	Low
1307	Progress/Patrick Henry Nbnd	Low	Medium	Medium	Low	Medium	Medium	Low
1200	Prices Fork/Old Glade Wbnd	Low	Low	Medium	Medium	Medium	Medium	Low
1500	Roanoke/Church Ebnd	Low	Medium	Medium	Medium	Low	Medium	Medium
1519	Roanoke/Rutledge Wbnd	Low	Medium	Medium	Medium	Medium	Medium	Medium
1311	Shawnee on University City Wbnd	Low	Low	Medium	Medium	High	Medium	Low
1215	Prices Fork/Huntington Ebnd	Low	Low	Medium	Medium	Medium	Medium	Medium
1209	Stroubles Crt	Low	Medium	Medium	Low	Medium	Medium	High
1202	Prices Fork/Plantation Wbnd	Low	Medium	Medium	Medium	Low	Medium	Low
1640	Main/S Hill Nbnd	Low	Medium	Medium	Medium	Low	Low	Low
1511	Ascot/Hampton	Low	Medium	Low	Low	High	Medium	Low

Bus Stop		Prioritization Criteria						
ID	Location	Sidewalk Curb Cuts	Stakeholder Feedback	Stop Interval	Construction Constraints	Reported Crashes	Multimodal Activity	Weighted Average
		8.6%	5.4%	5.3%	4.8%	3.4%	1.5%	
1502	Roanoke/Rutledge Ebnd	High	Medium	Low	Low	Low	High	1.99
1206	Tall Oaks/Foxhunt Ebnd	High	Low	Medium	Medium	Medium	Medium	1.94
1636	Industrial Park/Transportation Res Ebnd	High	Low	High	Low	Low	Medium	1.94
1520	Roanoke/Wharton Wbnd	High	Medium	Low	Medium	Medium	High	1.93
1414	Pheasant Run	High	Low	Medium	High	Low	Medium	1.93
1317	University City/Glade Nbnd	Low	Medium	Medium	Medium	Low	High	1.92
1518	Roanoke/Woolwine Wbnd	Medium	Medium	Low	Low	Medium	High	1.91
1205	Tall Oaks/Hethwood Ebnd	High	Low	Medium	Medium	Low	Low	1.91
1314	University City/Glade Sbnd	Medium	Low	Medium	Medium	High	High	1.90
1421	Main/Kabrich Sbnd	Medium	Medium	High	Medium	High	High	1.90
1333	Toms Creek/Winston Sbnd	Medium	High	High	Medium	Medium	High	1.90
1214	Heather/Huntington Nbnd	Medium	Low	High	Medium	Medium	Low	1.89
1307	Progress/Patrick Henry Nbnd	High	Medium	Low	High	Medium	High	1.89
1200	Prices Fork/Old Glade Wbnd	Medium	High	High	Low	High	High	1.88
1500	Roanoke/Church Ebnd	Medium	Low	Medium	Medium	High	High	1.88
1519	Roanoke/Rutledge Wbnd	Medium	Medium	Low	Low	Low	High	1.88
1311	Shawnee on University City Wbnd	Medium	Medium	High	Low	Low	High	1.88
1215	Prices Fork/Huntington Ebnd	Medium	Medium	Low	High	Medium	High	1.87
1209	Stroubles Crt	Medium	Low	Low	High	Low	Low	1.86
1202	Prices Fork/Plantation Wbnd	Medium	Medium	Medium	High	Medium	High	1.86
1640	Main/S Hill Nbnd	High	Low	High	High	High	Medium	1.85
1511	Ascot/Hampton	High	Low	High	Medium	Low	Medium	1.82

Bus Stop		Priority Tier	Prioritization Criteria					
ID	Location		Cycling & Walking Infrastructure	Stop Safety	Stop Amenities	Ridership	Service Hours	Visibility Obstruction
			13.6%	13.4%	12.0%	11.5%	11.5%	9.0%
1204	Hethwood Square on Hethwood	Low	Low	Medium	Low	High	Medium	Low
1318	University City/Broce Nwnd	Low	Low	Medium	Medium	Low	High	Low
1302	Toms Creek/Watson Nwnd	Low	Low	High	High	Low	Medium	Low
1309	Patrick Henry/Toms Creek Wwnd	Low	Low	Medium	Low	High	Medium	Low
1622	Main/Sunset Nwnd	Low	Medium	Medium	Medium	Medium	Low	Low
1323	Patrick Henry/Toms Creek Ewnd	Low	Low	Medium	Low	High	High	Low
1600	Main/Roanoke Swnd	Low	Low	High	Medium	Medium	Low	Low
1211	Tall Oaks/Copper Croft Nwnd	Low	Medium	Low	Low	High	Medium	Low
1212	Heather/Tall Oaks Nwnd	Low	Low	Medium	Low	High	Medium	Low
1617	Marlington/Main Wwnd	Low	Low	High	High	Low	Low	Low
1610	Fairfax/New Kent Ewnd	Low	Medium	High	Low	Low	Low	Medium
1408	Patrick Henry/Main Wwnd	Low	Low	Medium	Medium	Medium	Low	Low
1208	Tall Oaks/Foxtrail Swnd	Low	Medium	Low	Low	High	Medium	Low
1608	Main/Landsdowne Swnd	Low	Low	Medium	Medium	Low	Low	Low
1336	University Mall Main Entrance	Low	Low	Medium	Low	High	Medium	Low
1324	The Village on Patrick Henry Ewnd	Low	Low	Medium	Low	High	High	Low
1322	University City/Toms Creek Ewnd	Low	Low	High	Low	Low	High	Low
1430	Patrick Henry/Seneca Wwnd	Low	Low	Medium	Medium	High	Low	Low
1406	Giles/Patrick Henry Nwnd	Low	Low	Medium	Low	Low	Low	Low
1620	Blacksburg Square	Low	Low	Low	Low	Medium	Low	Low
1607	Gables Shopping Center	Low	Low	Low	Low	Medium	Low	Low

Bus Stop		Priority Tier	Prioritization Criteria					
ID	Location	Sidewalk Curb Cuts	Stakeholder Feedback	Stop Interval	Construction Constraints	Reported Crashes	Multimodal Activity	Weighted Average
		8.6%	5.4%	5.3%	4.8%	3.4%	1.5%	
1204	Hethwood Square on Hethwood	Medium	Low	High	High	Medium	Medium	1.82
1318	University City/Broce Nbnd	Medium	High	Medium	Low	High	Medium	1.81
1302	Toms Creek/Watson Nbnd	Low	Low	Medium	High	Low	High	1.80
1309	Patrick Henry/Toms Creek Wbnd	Medium	Low	Medium	High	High	Medium	1.80
1622	Main/Sunset Nbnd	High	Low	Medium	Low	Medium	High	1.79
1323	Patrick Henry/Toms Creek Ebnd	Low	Low	Medium	Medium	High	Medium	1.78
1600	Main/Roanoke Sbnd	Low	Low	High	Medium	High	High	1.76
1211	Tall Oaks/Copper Croft Nbnd	Low	Medium	High	High	Low	Low	1.74
1212	Heather/Tall Oaks Nbnd	Low	Medium	Medium	High	Medium	Medium	1.73
1617	Marlington/Main Wbnd	Low	High	Low	Low	High	High	1.71
1610	Fairfax/New Kent Ebnd	Low	High	Low	High	Low	Medium	1.71
1408	Patrick Henry/Main Wbnd	Medium	Medium	Medium	Medium	High	High	1.71
1208	Tall Oaks/Foxtrail Sbnd	High	Low	Low	Medium	Low	Low	1.70
1608	Main/Landsdowne Sbnd	High	High	Medium	Medium	Medium	High	1.70
1336	University Mall Main Entrance	Medium	Low	Low	High	Low	High	1.69
1324	The Village on Patrick Henry Ebnd	Low	Low	Medium	Low	Low	High	1.68
1322	University City/Toms Creek Ebnd	Low	Low	Low	High	Low	High	1.62
1430	Patrick Henry/Seneca Wbnd	Low	Medium	Low	Low	High	Medium	1.62
1406	Giles/Patrick Henry Nbnd	High	Medium	Low	Medium	High	High	1.51
1620	Blacksburg Square	High	Low	Medium	High	Medium	High	1.50
1607	Gables Shopping Center	Medium	Low	High	High	Medium	High	1.47

Local Context

Demographics

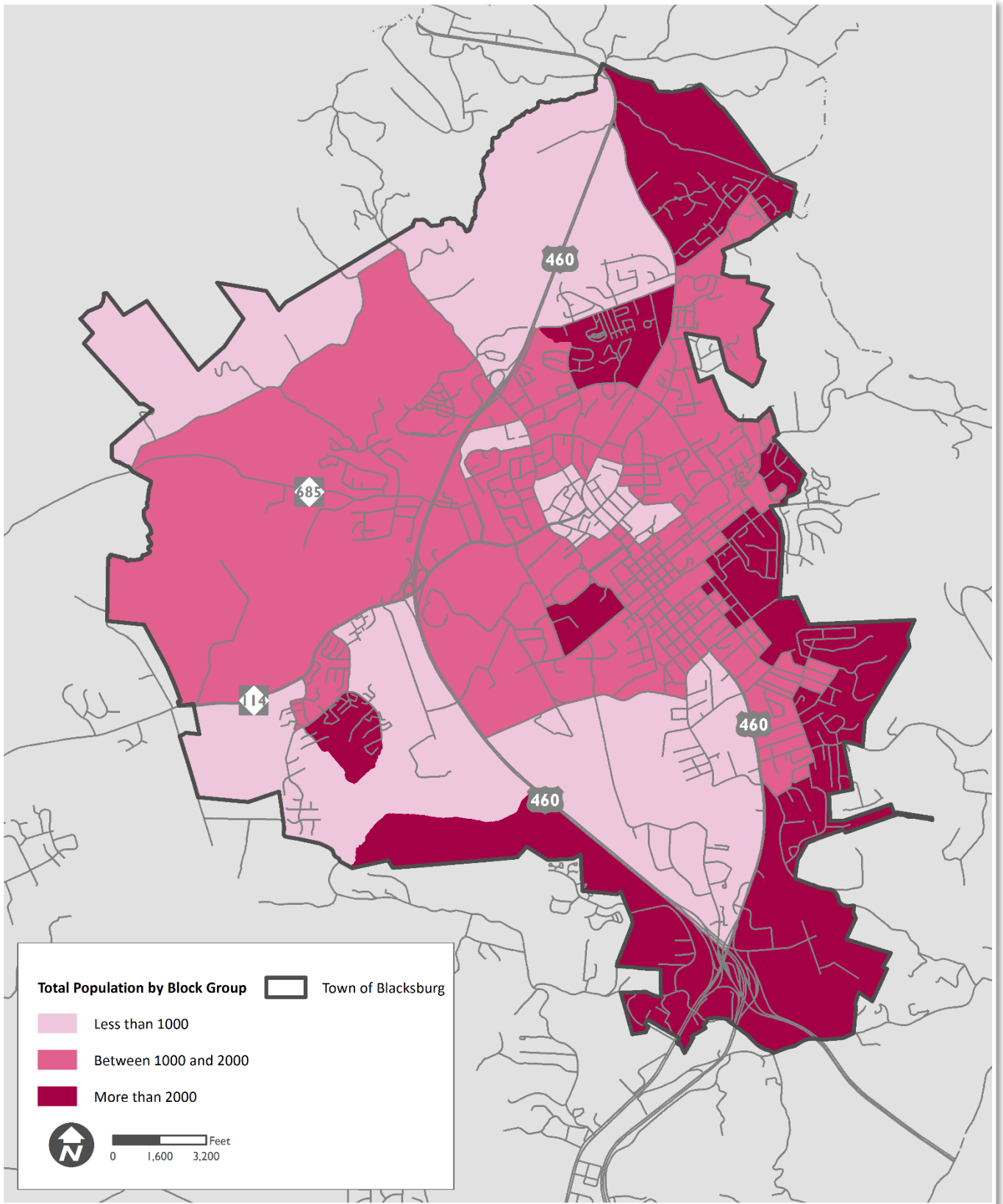
Population

According to the 2013 American Community Survey (ACS) 5-year estimates, the population within Blacksburg 2013 grew just over 10% from 39,573 to 43,609 (estimated from January 1, 2009 to December 31, 2013). The average population density in Blacksburg is 2,193 persons per square-mile. Blacksburg is approximately ten times denser than the Commonwealth of Virginia. Blacksburg is most densely populated just north of Virginia Tech's campus.

The map on the following page shows the population of the Town of Blacksburg by block group.

Virginia Polytechnic Institute and State University (Virginia Tech)

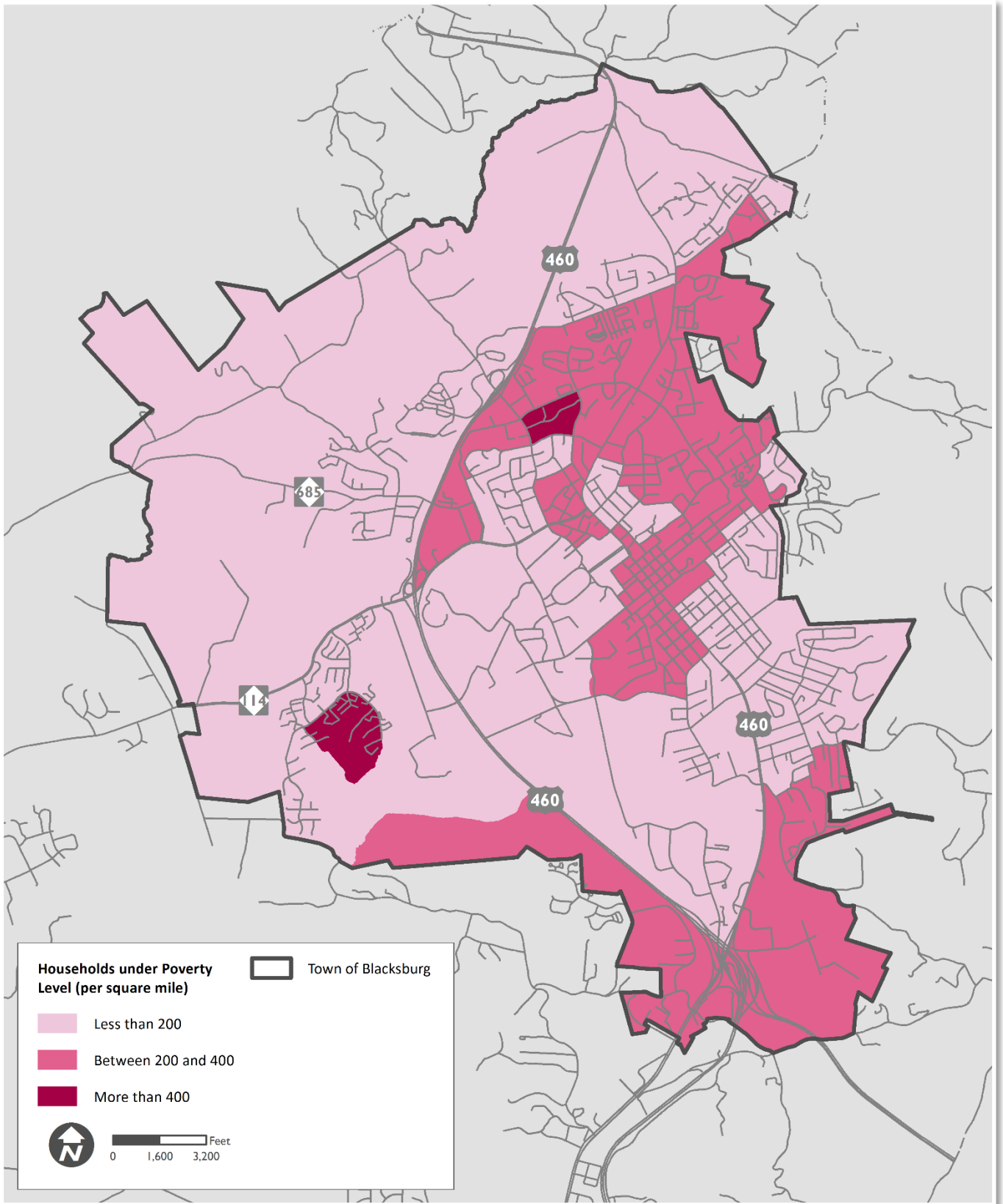
In terms of on-campus enrollment (2014-2015), Virginia Tech has approximately 30,000 students, 24,000 of which are enrolled in undergraduate programs. Off-campus enrollment for the 2014-2015 school year is about 2,000 students, with over 96% enrolled in graduate programs. It is estimated that only about a fourth of the student body stays in Blacksburg during the summer months.



Poverty Status

The national poverty threshold for a family of four in 2012 was an annual income of \$23,492. For the population whom poverty status was determined through 2013 ACS block group level estimates, Blacksburg included 33.4% more than the statewide average of 11.3% of persons living below the poverty level. According to 2013 ACS 5-year estimates, the Town's population has a median income of \$30,982, a number that is less than half of the median household income of the Commonwealth of Virginia as a whole (\$63,907).

It is likely, however, that the poverty status is skewed due to the high concentration of college students in the Town of Blacksburg. The map on the following page shows the poverty levels of the Town of Blacksburg by block group.

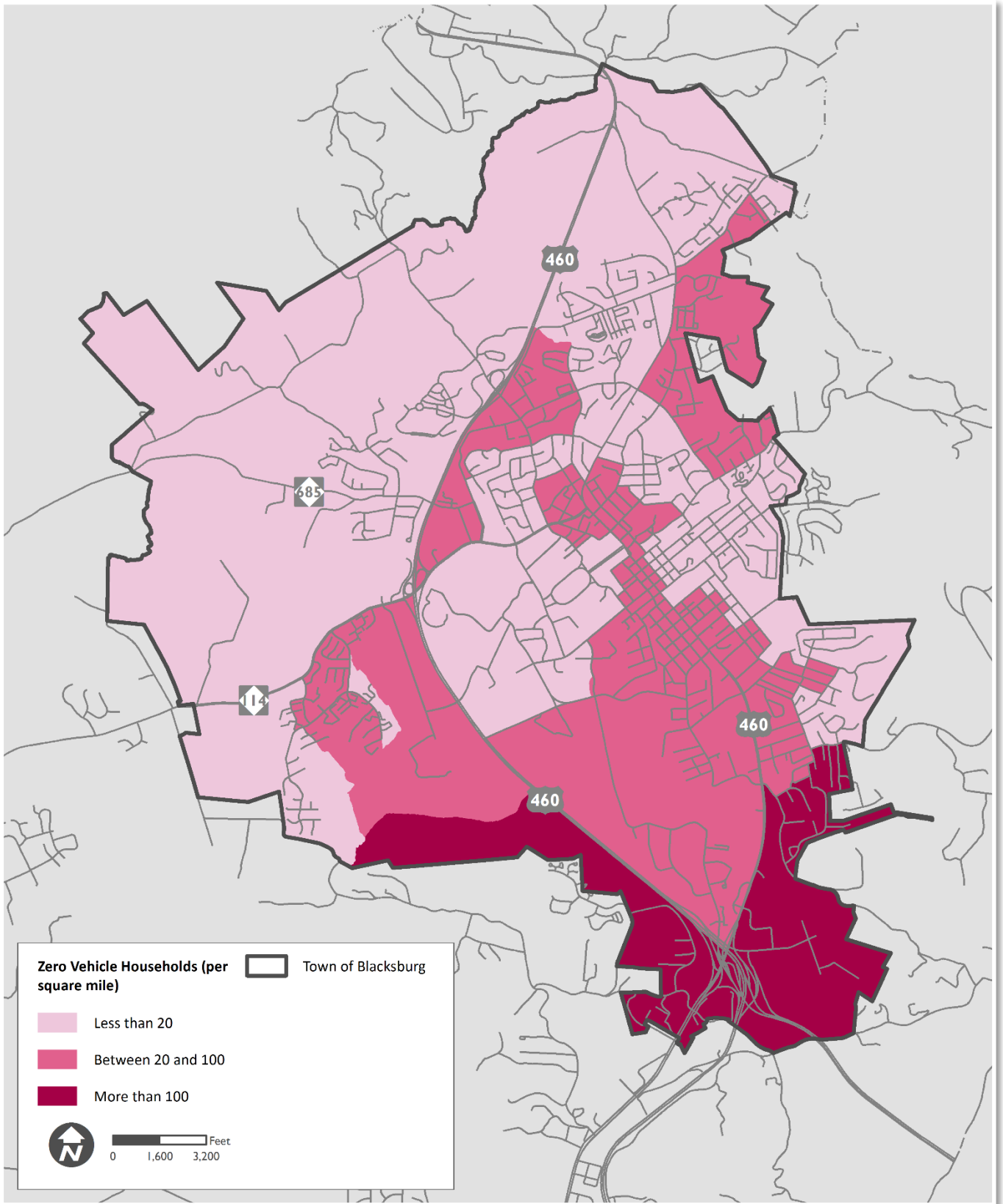


Zero-Vehicle Households

According to the 2013 ACS, 1,160 of the 13,408 households in Blacksburg do not have access to a vehicle. This accounts for approximately 8.65% of the total number of households in the study area, a slightly higher percentage than the countywide percentage (5.65%). Zero-vehicle households are largely concentrated in three clusters of residential development in the study area:

- Residential apartment and single-family area along Prices Fork Road and Hethwood Boulevard. The area is also anchored by Food Lion and is directly west of Virginia Tech's campus.
- Residential area east Main Street (US 460 Business) from Ardmore Street to Fairfax Road.
- Pockets of apartments and single-family development (mostly off-campus housing options for students) east of US 460 and along the US 460 Business corridor bordered to the south by Southgate Drive and anchored by Toms Creek Road. (Terrace View, The Village, Pheasant Run Apartments, etc.)

The map on the following page shows the concentrations of zero-vehicle households in the Town of Blacksburg.



Land Use

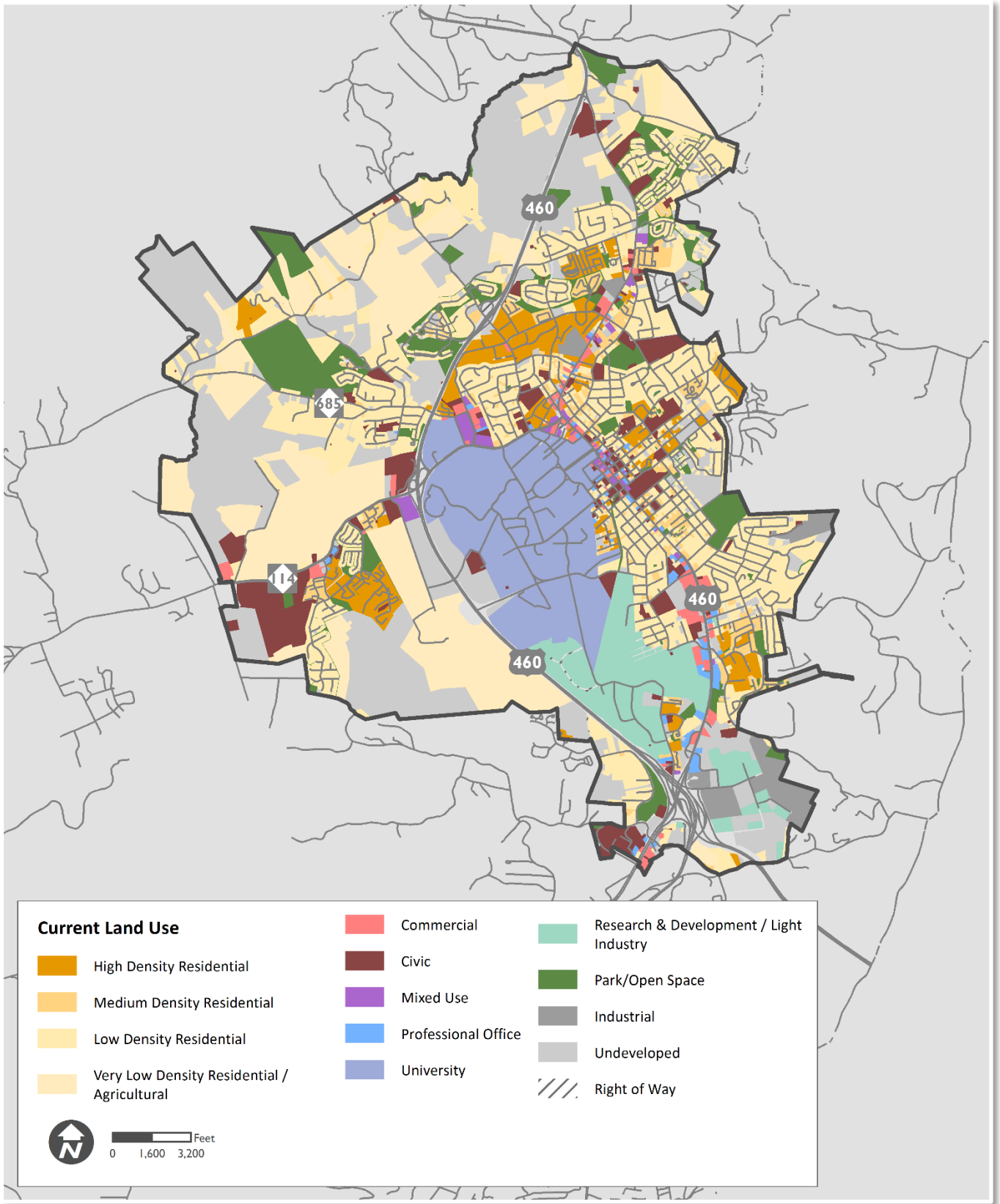
Existing Land Use

Existing land use for Blacksburg was inventoried using data provided by the Town of Blacksburg. Blacksburg’s existing land use is detailed in the following graphic and table.

The predominant land use in the study area, encompassing nearly 4.21 square-miles (23.3% of total land area), is classified as Low Density Residential. Low Density Residential land uses are found interspersed throughout the study area. The largest concentration is located east of Main Street. The next largest land use is coded as undeveloped land, at 4.14 square-miles (23.0%). Larger undeveloped parcels in the study area are located west of US 460, and Virginia Tech contributes to the third largest land use classified as University. Virginia Tech covers 1.73 square-miles and accounts for 9.6% of Blacksburg’s land area.

Land Use Type (Existing)	Area (Square Miles)	Percentage of Total
High Density Residential	0.85	4.7%
Medium Density Residential	0.53	2.9%
Low Density Residential	4.2	23.3%
Very Low Density Residential/Agricultural	2.78	15.4%
Commercial	0.23	1.3%
Civic	0.96	5.3%
Mixed Use	0.11	0.6%
Professional office	0.12	0.7%
University	1.73	9.6%
Research & Development/Light Industrial	1.11	6.2%
Park Land/Open Space	1.19	6.6%
Undeveloped	4.14	23.0%
Right of Way	0.05	0.3%

The map on the following page illustrates current land usage in the Town of Blacksburg.

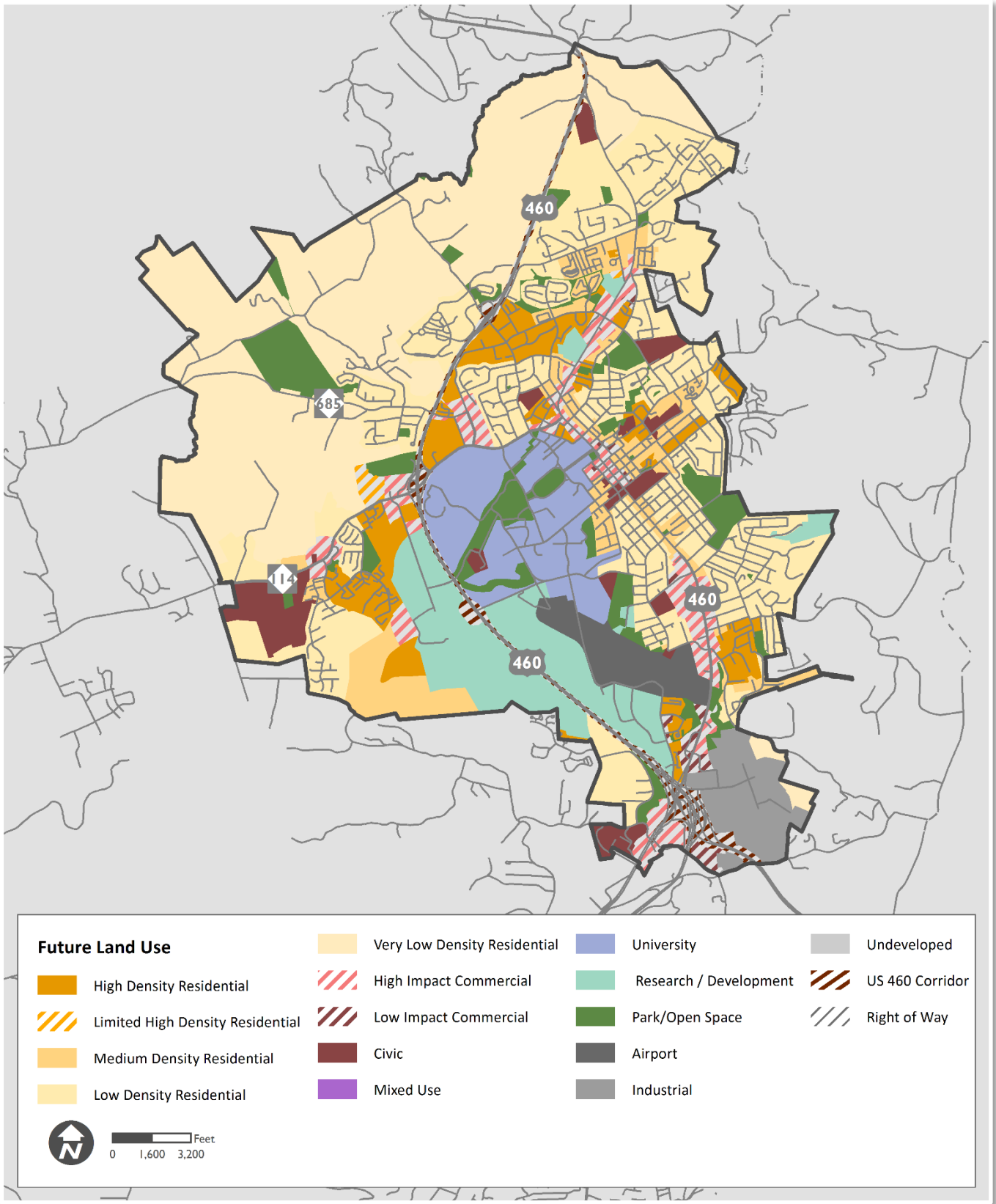


Future Land Use

Blacksburg’s future land use map was last updated in 2012. Similar to existing land use in Blacksburg, the predominant land use is Low Density Residential and Very Low Density Residential, encompassing just over 50% of total available land. The next dominant land use is planned to be Research and Development followed closely by Park Land/Open Space/Resource Protection, University, and High and Medium Density Residential (each about 6% of Blacksburg’s land area).

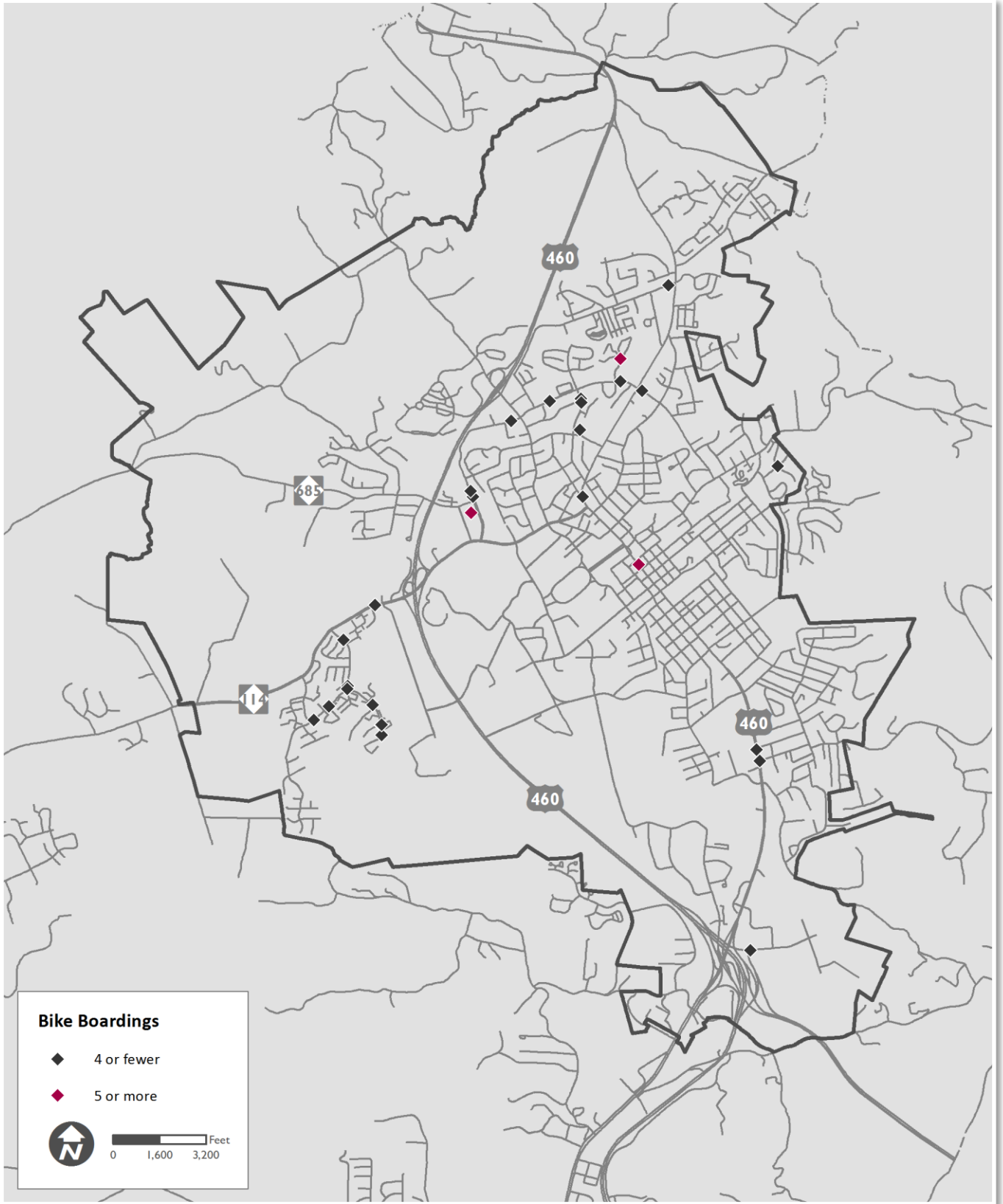
Land Use Type (Future)	Area (Square Miles)	Percentage of Total
High Density Residential	1.18	6.0%
Limited High Density Residential	0.06	0.3%
Medium Density Residential	1.19	6.0%
Low Density Residential	4.86	24.7%
Very Low Density Residential	5.3	26.9%
High Impact Commercial	0.85	4.3%
Low Impact Commercial	0.14	0.7%
Civic	0.61	3.1%
University	1.21	6.1%
Research/Development	1.5	7.6%
Park Land/Open Space/Resource Protection	1.26	6.4%
Airport	0.45	2.3%
Industrial	0.55	2.8%
US 460 Corridor	0.54	2.7%

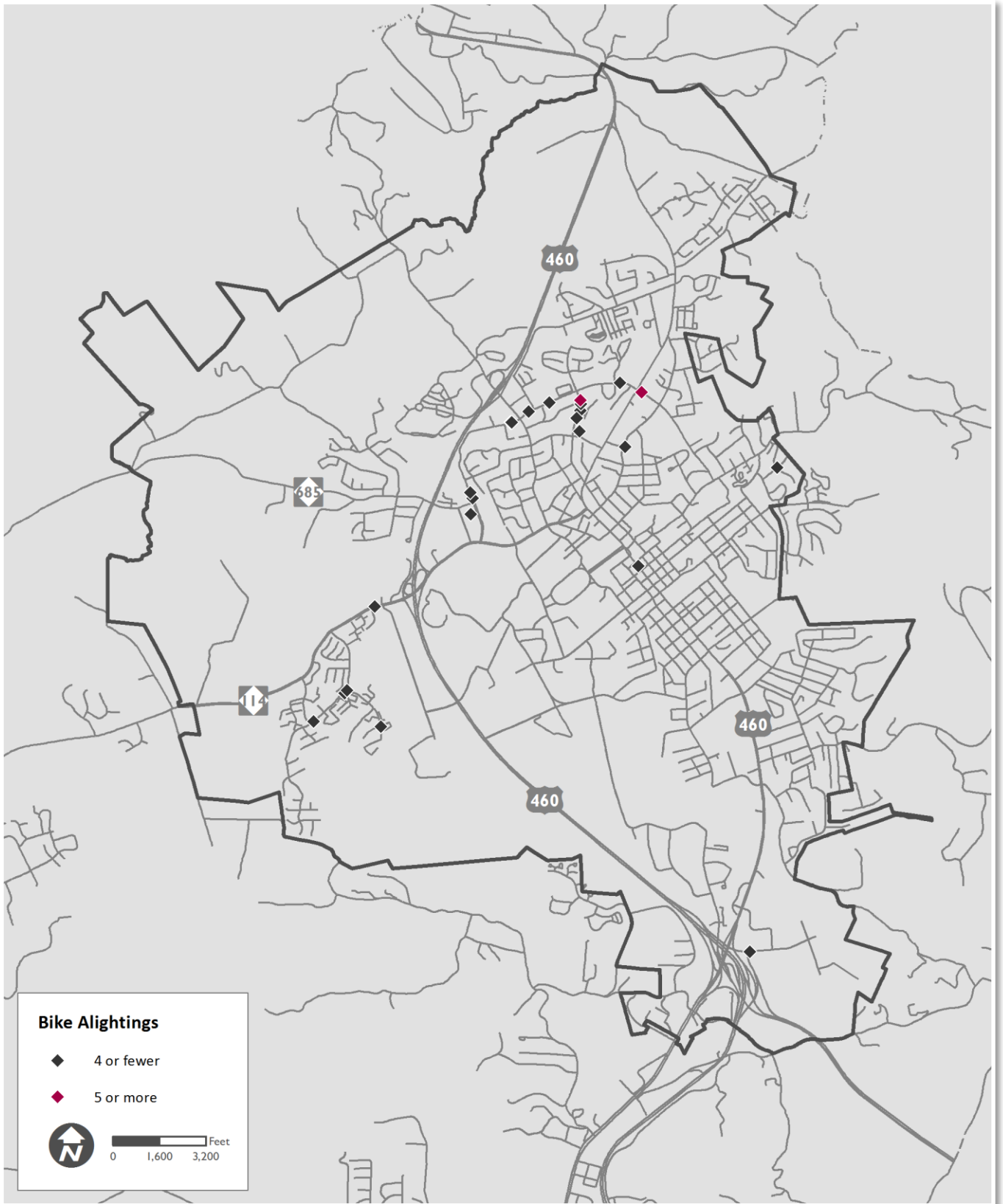
The map on the following page illustrates future land usage in the Town of Blacksburg.

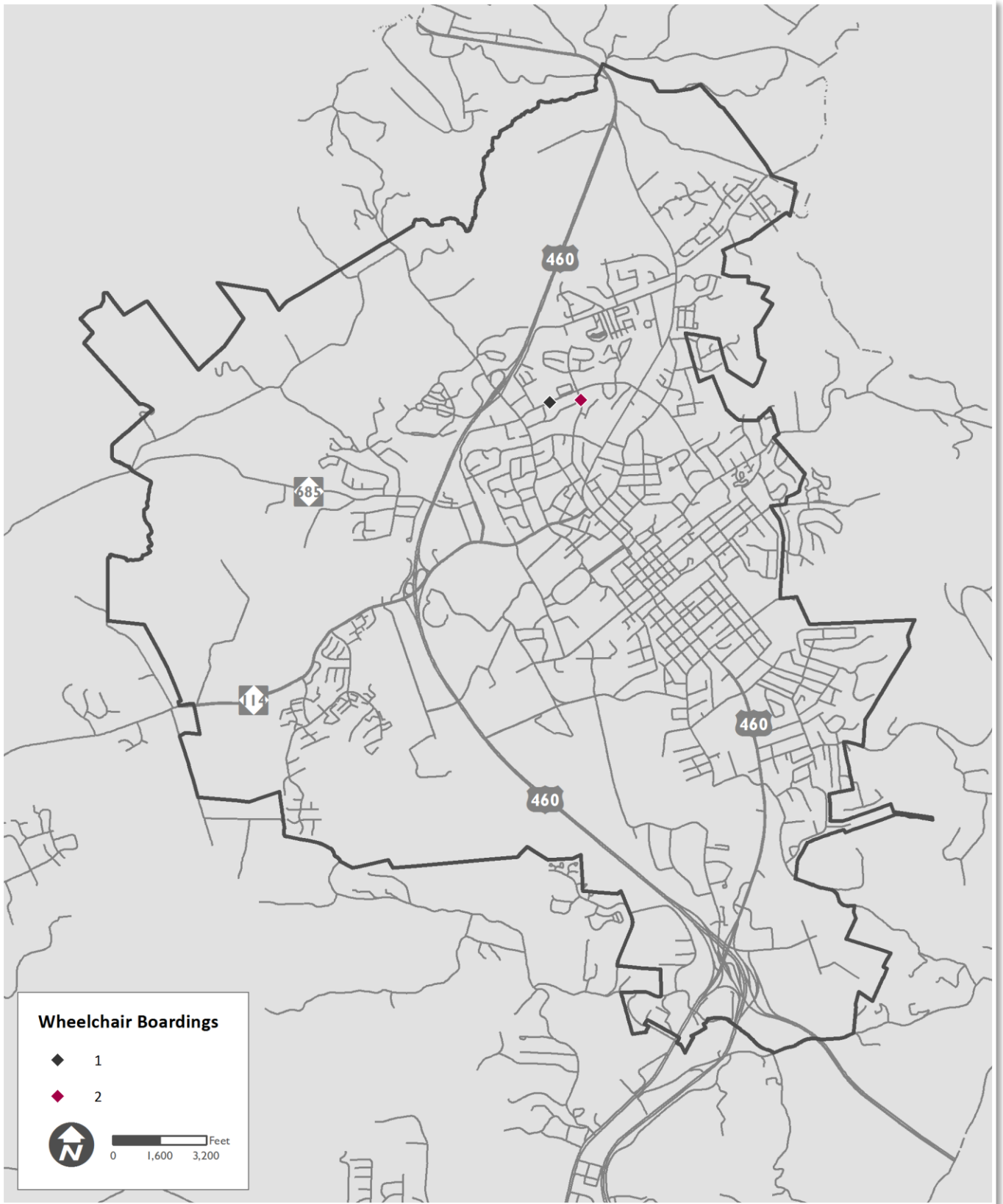


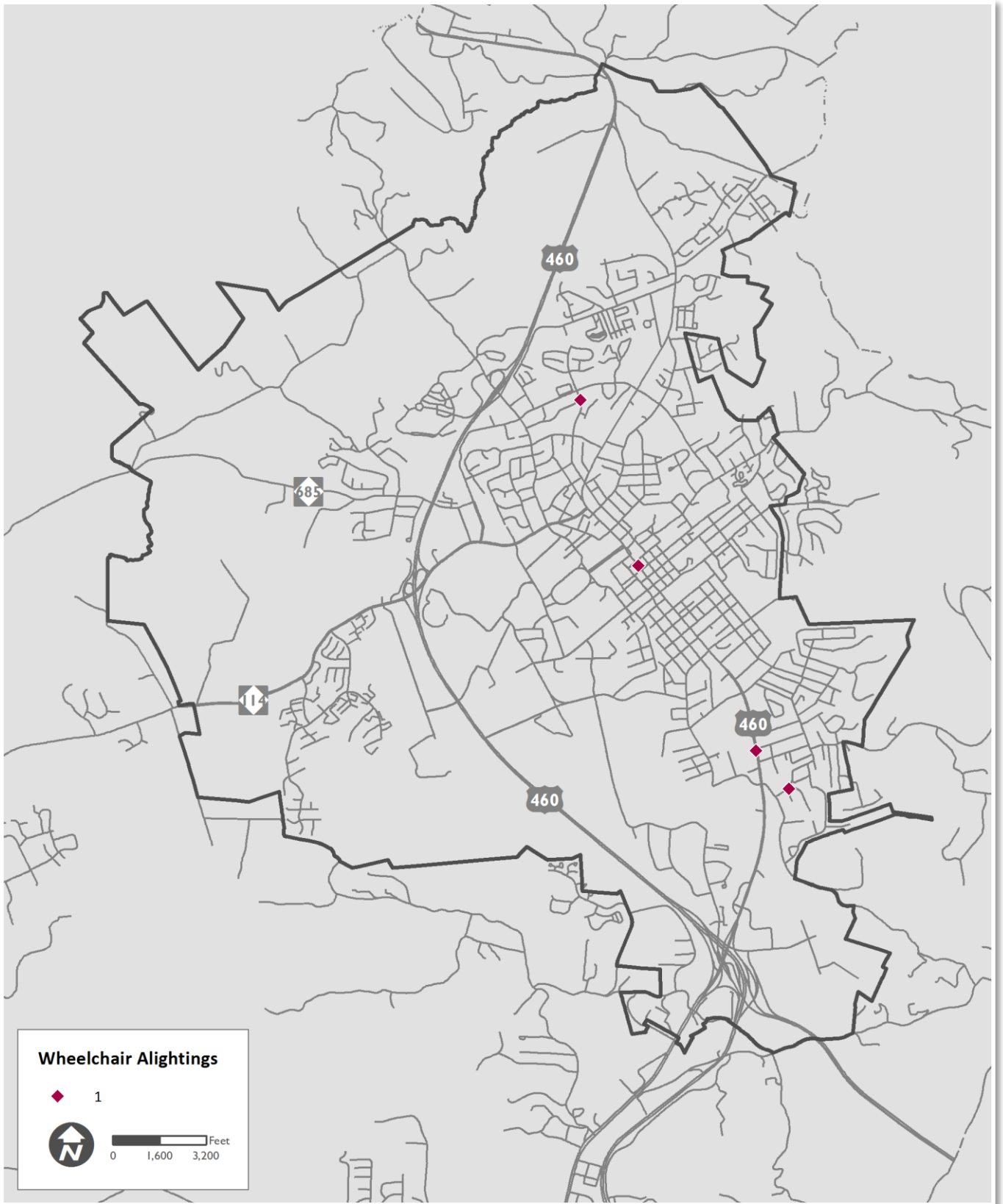
Bicycle and Wheelchair Boardings and Alightings – Spring 2015

Maps presenting the data for bicycle and wheelchair boardings and alightings from the spring of 2015 are shown in the following pages of this Appendix.









Prioritization Tool User Guidance

The prioritization tool developed as part of the *New River Valley MPO Bus Stop Safety and Accessibility Study* is intended to guide improvements beyond the high priority bus stops in the future as more up-to-date data is made available or prioritization parameters change. This document provides detailed guidance to users in updating and modifying the prioritization tool.

Prioritization Spreadsheet Contents

The following sections are organized by the tabs currently available in the prioritization tool.

Priority Stops

The **Priority Stops** tab presents the bus stops that were identified for prioritization and the respective scores for each of the prioritization criteria. The 65 bus stops currently listed in this tab include all bus stops in the Town of Blacksburg that were mentioned by the Technical Committee and stakeholders. The rows can be copied and pasted to accommodate additional bus stops.

Column A displays the bus stop identification numbers and references column A in the **Raw** tab.

The cells in columns B to P are formula-based and will update based on user input in column A and in the spreadsheet's remaining tabs.

- Column B references the bus stop names in column B in the **Inventory** tab
- Column C show the relative priority of the bus stops in the priority bus stop list. The top ten bus stops, ranked by the weighted averages in column P, are labeled “High Priority” and are shown in orange. The next ten bus stops, ranked 11th to 20th, are labeled “Medium Priority” and are shown in yellow. All remaining bus stops are shown in green and are labeled “Low Priority.”
- Columns D to O show the priority scores for each bus stop by prioritization criterion. The raw data for this scoring is shown in the **Raw** tab, and the scores are assigned based on the scoring thresholds in the **Scores** tab. The scores range from “Low” to “Medium” to “High” and are symbolized using a blue color gradient.
 - Row 3 shows the criteria weights based on feedback from the Technical Committee and stakeholders. These values were manually inputted and can change to reflect evolving priorities in future iterations of the prioritization tool.
- Column P presents the weighted average scores for each bus stop, based on a quantification of the qualitative scores for the purposes of ranking. “Low,” “Medium,” and “High” scores are assigned values of 1, 2, and 3 respectively, and the averages are weighted by the criteria weights in Row 3.

Rows 76-78 count the number of bus stops scoring “Low,” “Medium,” and “High” by prioritization criterion. The purpose of these counts is to aid the user in ensuring there is a relatively balanced distribution of scores.

Criteria

The **Criteria** tab includes each priority criterion's weight, scoring thresholds, and definitions. Columns A and B link to the **Priority Stops** tab. Columns C to E can be manually modified by the user based on the **Scores** tab. Column F can be manually modified based on the **Raw** tab. The intent of this tab is to provide a snapshot of how the bus stops are scored. The tab summarizes the information in the **Scores** and **Raw** tabs.

Scores

The **Scores** tab includes the scoring thresholds for each prioritization criterion.

Columns C, D, E, G, I, and N, which represent the Cycling & Walking Infrastructure, Stop Safety, Stop Amenities, Service Hours, Sidewalk Curb Cuts, and Multimodal Activity prioritization criteria respectively, include manual inputs of integers for the scoring thresholds. Because these prioritization criteria are based on the presence of features at the bus stops or service hours, the thresholds are integers instead of percentiles.

Columns F, K, and M, which represent the scoring thresholds for the Ridership, Stop Interval, and Reported Crashes prioritization criteria respectively, reference the **Raw** tab and show the 33rd, 66th, and 100th percentiles.

Columns H, J, and L, which represent the Visibility Obstruction, Stakeholder Feedback, and Construction Constraints prioritization criteria respectively, are based on scoring thresholds of 1, 2, and 3. The scoring for these prioritization criteria are subjective and wholly based on user input in the **Visibility Obstruction**, **Stakeholder Feedback**, and **Construction Constraints** tabs.

Row 2 indicates the relationship of the quantitative scoring thresholds to the qualitative scores of “Low,” “Medium,” and “High.” A direct relationship implies that as the quantitative values increase, the priority scores also increase. An inverse relationship implies that as the quantitative values increase, the priority scores decrease. The values in this row are used to assign scores appropriately on the **Priority Stops** tab.

Raw

The **Raw** tab includes all of the quantitative measures for each of the prioritization criteria by bus stop. This tab is intended to house the master list of bus stops for prioritization. Any bus stops that the user would like to add to the prioritization tool should first be included in the list of bus stops in this tab.

- Column A includes bus stop IDs manually inputted by the user.
- Column B references the bus stop names in column B of the **Inventory** tab.
- Column C references the **Inventory** tab, counting and summing for sidewalks, crosswalks, pedestrian signals, bike lanes, and multi-use paths.
- Column D references the **Inventory** tab, counting and summing for street lighting, shelter lighting, and waiting areas.
- Column E references the **Inventory** tab, counting and summing for shelters, shelter lighting, benches, trash cans, recycling cans, schedule information, bus pull-offs, street lighting, and waiting areas.
- Column F references the **Ridership** tab, presenting the average daily boardings from counts conducted in the spring and fall of 2014.
- Column G includes manual user inputs, based on the information in the **Service Hours** tab which was originally derived from the **Inventory** tab.
- Column H references the **Visibility Obstruction** tab directly.
- Column I references the **Inventory** tab, counting and summing for curb cuts and ADA compliance.
- Column J references the **Stakeholder Feedback** tab directly.
- Column K includes distances to the next closest bus stop manually inputted by the user. The distances were measured to the nearest bus stop along the same route using ArcMap.
- Column L references the **Construction Constraints** tab directly.
- Column M references the **Reported Crashes** tab, counting and summing the number of crashes occurring within 250’ of the bus stop. Crashes involving cyclists or pedestrians are weighted ten times as much as crashes involving only motor vehicles.
- Column N references the **Multimodal Activity** tab directly.

Rows 74-80 count the number of bus stops with scores from 0 to 6 for the Cycling & Walking Infrastructure, Stop Safety, Stop Amenities, Visibility Obstruction, Sidewalk Curb Cuts, Stakeholder Feedback, Construction Constraints, and Multimodal Activity prioritization criteria. The purpose of these counts is to aid the user in ensuring there is a relatively balanced distribution of scores.

Reference Tabs

The **Inventory** tab includes data taken directly from Blacksburg Transit's Access database of bus stops. Updates were made to several values during the development of the prioritization tool, based on input from the Technical Committee and field verification. The updated cells are highlighted in red. These changes should also be applied to the Access database file.

The **Ridership** tab includes ridership data collected by Blacksburg Transit in April and September of 2014. The boardings and alightings represent averages across the data collection period.

The **Service Hours** tab includes the daily hours of service by route. This information was used to manually populate Column F in the **Raw** tab and develop the scoring thresholds in the **Scores** tab.

The **Visibility Obstruction** tab includes general descriptions of visibility around each bus stop, and general assignments of scores based on those descriptions. A score of 1 indicates there are no visibility obstructions. A score of 2 indicates that there may be visibility obstructions. A score of 3 indicates there are visibility obstructions.

The **Stakeholder Feedback** tab includes scores indicating how frequently each bus stop was mentioned during the study's stakeholder engagement efforts. Every subsequent iteration of the prioritization tool should include an update to this tab.

The **Construction Constraints** tab includes general descriptions of construction constraints around each bus stop, and general assignments of scores based on those descriptions. A score of 1 indicates there are construction constraints. A score of 2 indicates that there may be construction constraints. A score of 3 indicates there are no construction constraints.

The **Crash (All)** and **Crash (BikePed)** tabs include outputs from ArcGIS based on a proximity analysis of bus stops and crashes occurring within 250'. Column B in each tab indicates how many crashes have occurred within 250' of each bus stop from 2012 to 2014 based on data provided by the Town of Blacksburg Police Department.

The **Multimodal Activity** tab includes outputs from ArcGIS based on an overlap analysis of bus stops and multimodal center travelsheds from the NRVMPPO Bicycle and Pedestrian Master Plan. The travelsheds include the primary walkshed, secondary walkshed, and primary walkshed of the multimodal centers. Column H indicates the number of travelsheds in which each bus stop is located.

Adding Bus Stops

The process by which the user should take to add bus stops within the prioritization tool should generally follow the steps below:

1. Input new bus stop identification number in column A of the **Raw** tab.
2. Copy and paste formulas from row with existing cell data into new row.
 - a. The raw scores for the Cycling & Walking Infrastructure, Stop Safety, Stop Amenities, Ridership, Sidewalk Curb Cuts, Reported Crashes, and Multimodal Activity criteria will automatically update based on the data in the **Inventory**, **Reported Crashes**, and **Multimodal Activity** tabs.
3. Reference the **Service Hours** tab to manually populate column G.
4. Add the new bus stop to the **Visibility Obstruction**, **Stakeholder Feedback**, and **Construction Constraints** tabs.
5. Measure the distance from the newly added bus stop to the next closest bus stop along the same route and input the value into column K.
6. Add the new bus stop to the list by modifying the reference formula in column A in a new row.