

CHARLOTTESVILLE STANDARDS & DESIGN MANUAL



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CHAPTER 1

INTRODUCTION

1.1 Intent and Purpose

The City of Charlottesville has evolved since the Standards and Design Manual was last published. The City recognizes that updated guidance is necessary to incorporate recent changes in City Code that promote sustainable growth and overall public health. These design standards are provided to aid practitioners in applying innovative techniques that will result in a compact, urban, walkable, and multimodal environment. The City desires to reduce reliance on the automobile and ensure that the City's public spaces are designed for comfortable and safe use by all.



Figure 1-1: Charlottesville's Downtown Mall (Aaron Webb)

This manual revision consolidates the minimum standards and design criteria into a single user-friendly resource; provides links to supporting codes, references, and design standards; and provides a flexible menu of options that can be used to meet required design criteria. For design guidance on elements not contained in this manual, please refer to applicable state and federal design guidance referenced within each chapter.

This manual applies to all development and redevelopment projects within the City and supports the City's Streets That Work Design Guidelines goals of creating high-quality public spaces and vibrant places of commerce that are safe, accessible, healthy, green, sustainable, connected, and convenient. As the City progresses in its built conditions and learns from experiences resulting from implementation of the design and construction standards herein, future revisions to the City's Standards and Design Manual will be needed. The City intends to perform annual updates to this manual and may make immediate amendments to address issues that should not be delayed for an annual update. Please contact the City of Charlottesville Neighborhood Development

Services at feedbacksadm@charlottesville.org to propose changes for future inclusion in the Standards and Design Manual.

Within this manual, elements of design may be either recommended or mandatory. The word “shall” is used when an element is mandatory and must be incorporated. The words “should” or “may” are used when an element is recommended, but not mandatory.

1.2 Definitions

Agent - the Director of Neighborhood Development Services, or their designee.

Alley - a form of travel way providing access to the rear or side lot line of abutting properties that front along streets. An alley is privately owned and maintained, is intended to be used primarily by the owners and occupants of the abutting properties and persons and vehicles providing services to those properties (including emergency vehicles), and is not intended for through traffic.

Backflow - the flow of water or other liquids, mixtures, or substances into the distributing pipes of a potable supply of water from any source or sources other than its intended source.

Boundary line adjustment - a type of subdivision in which one or more lot lines are relocated or altered so that the land exchanged is added to and becomes part of an existing lot and no additional lot is created.

Bicycle lanes – that portion of a roadway designated by signs and/or pavement markings for the preferential use of bicycles, electric power-assisted bicycles, motorized skateboards or scooters, mopeds, or other approved vehicles per state or local code. Refer to Code of Virginia § 46.2-100 -Definitions.

Block – the distance along a roadway between two intersecting transportation rights-of-way. Refer to the City of Charlottesville Code of Ordinances, Chapter 29 – Subdivision of Land. See § 29-163.-Blocks.

City - the City of Charlottesville.

City Code – the City of Charlottesville Code of Ordinances, as amended.

Commission - the Planning Commission for the City of Charlottesville, created by the City in accordance with Code of Virginia § 15.2-2210 and charged with promoting the orderly development of the City and its environs. The chairperson of the commission or their designee shall have the authority to sign any final plat on behalf of the City.

Common area - an area shown on a plat that is not a platted lot for sale but is either owned or will be owned in common by the lot owners within the subdivision or, if not

owned in common, is available for the common use of the lot owners within the subdivision.

Connection, service line, or service connection - a utility pipeline connecting the property of a single customer to a main or distribution line. Connections can be for a variety of utilities including water, gas, or electricity.

Control point - a known latitude/longitude/elevation (or X/Y/Z) geographic location obtained in the field using either a global positioning system or other location-determining equipment, acquired in a manner that will yield an X, Y, Z position that can be demonstrated to have sub-centimeter accuracy and whose position coordinates are expressed relative to the North American Datum of 1983 (NAD 83).

Cross-connection - any physical connection between a potable water supply and any waste pipe, soil pipe, sewer drain, or any unapproved source or system. Cross-connection includes any potable water supply outlet which is submerged or can be submerged in waste water and any other source of contamination.

Delivery point - synonymous and interchangeable with "meter."

Developer - the person who owns, or who controls, a tract of land developed or to be developed as a unit, which is to be used for any business or industrial purpose or is to contain three or more residential dwelling units. In context, the term shall be construed to include a subdivider.

Development - a tract of land developed or to be developed as a unit under single ownership or unified control which is to be used for any business or industrial purpose or is to contain three or more residential dwelling units. The term "development" shall not be construed to include any property which will be principally devoted to agricultural production.

Drainage control - the removal, collection, or conveyance of stormwater runoff from or on property through structural facilities or other measures including but not limited to ditches, swales, pipes, inlets, ponds, etc.

Drainage district - a drainage project established pursuant to Code of Virginia § 21-292 et seq.

Driveway - a form of private vehicular access from a street or alley to the interior of a lot. Driveway design requirements vary depending on the use and zoning requirements pursuant to City Code § 34-972.

Easement - a right possessed by the owner of one entity to use the land of another for a special purpose not inconsistent with the general property rights of that owner.

Easement, private - a reservation or grant by a property owner to specific individuals or entities for their use of land for a specific purpose or purposes, other than a license revocable by the unilateral act of the grantor.

Effective turning radius – the roadway space available for a vehicle to make a turning movement. The effective turning radius for cars may be higher on many roadways as these roadways have been designed to accommodate larger vehicles that have a larger turning radius.

Fire Apparatus Access Road - a road that provides fire apparatus access from a fire station to a facility, building, or portion thereof. This is a general term inclusive of all other terms such as fire lane, public street, private street, parking lot lane, and access roadway.

Firm service or **FS** - gas which is delivered and sold on a non-interruptible sales service basis under the terms set forth in City Code Sections 31-56 through 31-58.

Frontage - the continuous uninterrupted distance along which a parcel abuts an adjacent street.

Gas Division - the gas division of the City of Charlottesville's Department of Public Works.

Gas Superintendent - the superintendent of the Gas Division.

Health hazard - means any condition, devices, or practices in the water supply system and its operation which create, or in the judgment of the chief or superintendent may create, a danger to the health and well-being of the water consumer.

Illegal and Illicit Discharge - any discharge to the City's municipal separate storm sewer system ("MS4") that is not composed entirely of stormwater, except: (i) discharges pursuant to a VPDES permit; (ii) discharges resulting from firefighting activities; and (iii) any discharges specifically authorized within Article V of Chapter 10 of the City Code.

Improvement - all utilities and facilities required under Chapter 29 of the City Code, including, without limitation: streets, turnarounds, traffic signalization and controls, sanitary sewers, potable water, gas utilities, stormwater management and erosion control facilities, drainage control facilities, curbs and gutters, and sidewalks, regardless of whether such utilities and facilities are publicly or privately owned and/or maintained.

Interruptible sales service or **IS gas** - gas sold on an interruptible basis under the terms set forth in City Code Section 31-60.

Lot - a parcel of land, occupied or intended for occupancy, appearing on an officially approved and recorded subdivision plat and having its principal frontage on a street or one which a subdivider has been contractually obligated to install as a condition of subdivision approval and for which an adequate financial guaranty has been furnished to the City.

Lot, corner - a lot abutting upon two or more street rights-of-way at their intersection.

Lot, depth of - The term "**depth of lot**" - the mean horizontal distance between the front and rear lot line.

Lot, double frontage - a lot having a frontage on two nonintersecting street rights-of-way as distinguished from a corner lot.

Lot, width of. The term "**width of lot**" - the mean horizontal distance between the side lot lines.

Main, main line, or distribution line - a natural gas pipeline serving two or more retail gas customers.

Natural stream - a nontidal waterway that is part of the natural topography, which typically will maintain a continuous, seasonal, or intermittent flow during the year, and which is characterized as being irregular in cross-section with a meandering course. A constructed channel, such as a drainage ditch or swale, is not a natural stream.

Open space - an area containing water or land, or a combination thereof, that is unoccupied by building lots, streets, or other improvements, and which may be vegetated or left in an undisturbed state.

Person - a natural person, corporation, partnership, sole proprietorship, trust, trustee, joint venture, or any other legal entity.

Phased subdivision - a subdivision for which a preliminary plat is approved for the entire property, and for which two or more final plats, individually pertaining to less than the entire property, are submitted sequentially for review and approval.

Plat - the schematic representation of land divided or to be divided.

Plat, final - a plat upon which the plan for a subdivision is presented for approval pursuant to Chapter 29 of the City Code, whether or not preceded by an approved preliminary plat, which is in final form suitable for recording in the land records of the City of Charlottesville, as contemplated by Code of Virginia § 15.2-2254 and the City's subdivision ordinance, and which has been signed by the City's agent.

Plat, preliminary - a plat upon which the plan for a subdivision is presented for preliminary approval pursuant to Chapter 29 of the City Code, and which is not in final form for recording in the City's land records.

Plat reviewers - those individuals designated by the Director of Neighborhood Development Services whose input may, in the opinion of the Director, be of assistance in reviewing a proposed subdivision plat.

Plumbing fixture - installed receptacles, devices, or appliances supplied with water or that receive or discharge liquids or liquid borne wastes.

Plumbing system - the water supply and distribution pipes, plumbing fixtures and traps, soil, waste and vent pipes, building drains and building sewers including their

respective connections, devices and appurtenances within the property lines of the premises, and water-treating or water-using equipment.

Pollution - the presence of any foreign substance (organic, inorganic, radiological, or biological) in the water that tends to degrade its quality so as to constitute a hazard or impair the usefulness of the water.

Property - one or more lots collected together for the purpose of subdividing.

Resubdivision - the division of land by subdivision, where the land being subdivided is the subject of a previously approved and recorded subdivision plat.

Roadway - that portion of a highway improved, designed, or ordinarily used for vehicular travel and that will include any multimodal facilities such as bicycle lanes, separated bicycle lanes, sidewalks.

Separated bike lanes - also known as cycle tracks or protected bike lanes, the exclusive spaces for bicyclists, electric power-assisted bicycles, motorized skateboards or scooters, mopeds, or other approved vehicles per state or local code within a roadway that is physically separated from motor vehicles and pedestrians.

Shared driveway - a private vehicular access to only two lots which have frontage on a street and which are authorized by Chapter 29 of the City Code and by the City's zoning ordinance.

Shared street - a low-speed roadway with a single grade or surface that is shared by people walking, bicycling, or driving. Motor vehicle access should be limited to deliveries, maintenance, or parking.

Sidewalk - a pedestrian way designed to meet City standards.

Staff - employees of the City.

Standards and Design Manual - the City of Charlottesville has created this manual to regulate new street and alley construction, stormwater management, erosion and sediment control, potable water, gas utilities, traffic and transportation, bridges, retaining walls and other related structures, and potable water and sanitary sewer systems and related facilities.

Street, private - any street or other way or means of vehicular access that is not designed, constructed, bonded, or approved to be maintained by the City as part of its urban highway system regardless of ownership. Private streets are prohibited except pursuant to townhouse developments under City Code Section 34-388(b).

Street, public - an area that is encompassed by a right-of-way dedicated to public use for vehicular travel *and* accepted for maintenance by the City as part of the City's public street system. Any requirement of this manual that refers to an existing public street shall mean a public street currently maintained by the City of Charlottesville.

Street right-of-way - the total width of the strip of land dedicated to the City in fee simple for public use or reserved for travel, including without limitation the paved street surface, curbs, drainage improvements and gutters, shoulders, ditches, public sidewalks, bicycle paths, and, where necessary, utilities and associated easements.

Streetscape trees - trees planted adjacent to existing or proposed public streets, as required by City Code Section 34-870.

Subdivide - the process of dividing land to establish a subdivision.

Subdivider - one or more persons who own property to be subdivided, and such person's agent(s) and successor(s) in interest, including, without limitation, the person who develops such property (see also the definition of developer).

Subdivision - (i) the division or consolidation of a parcel or parcels of land into two or more lots or parcels for the purpose of transfer of ownership or building development, including, without limitation, establishment of a condominium regime; and (ii) a boundary line adjustment. The term includes resubdivision and, when appropriate to the context, shall relate to the process of subdividing or to the land subdivided. References to a subdivision in this manual include, in the appropriate context, a proposed subdivision.

Subdivision, major - any subdivision which involves six or more lots, or which involves the creation of new streets and/or extension of public utilities or facilities regardless of the number of lots.

Subdivision, minor - any subdivision involving five or fewer lots, all of which front on an existing dedicated and accepted City street and which does not require the creation of new streets and/or extension of public utilities or facilities.

Technically infeasible - pertaining to Americans with Disabilities Act (ADA) requirements, has little likelihood of being accomplished because existing physical or site constraints prohibit modification or addition of elements or features that are in full and strict compliance with the minimum requirements.

Townhouse - any one of a series of single-family attached dwellings, under single or multiple ownership, separated from one another by continuous vertical walls without openings from basement floor to roof. "Series" refers to a row of three or more townhouse dwellings.

Traffic – The passage of people and motorized and non-motorized vehicles along a transportation route.

Trail – A shared use path or a recreational trail.

Transportation service gas or TS gas - interruptible gas sold to a customer by someone other than the City under the provisions of City Code Section 31-61 and

delivered to the City gate to be transported by the City from that point to the customer's meter.

Water, non-potable - water that is not safe for human consumption or that is of questionable potability.

Water, potable - water free from impurities in amounts sufficient to cause disease or harmful physiological effects. Its bacteriological and chemical quality shall conform to the requirements of the Virginia Waterworks Regulations of the state department of health and the requirements of the City's Department of Public Works.

Water protection ordinance - the provisions set forth within Chapter 10 of the City Code, as amended.

Water system - all structures, appliances, and equipment owned and operated by the City or the Rivanna Water and Sewer Authority and used to collect, store, transport, purify and treat water for drinking or domestic use and the distribution of water to the public.

Zoning ordinance - the provisions set forth within Chapter 34 of the City Code, as amended.

1.3 Abbreviations

AIA	American Institute of Architects
AASHTO	American Association of State Highway and Transportation Officials
AAN	American Association of Nurserymen
ACI	American Concrete Institute
ACSA	Albemarle County Service Authority
ADA	Americans with Disabilities Act
ADT	Average daily traffic
AMR	Automatic Meter Reading
ANSI	American National Standards Institute
AREMA	American Railway Engineering and Maintenance of Way Association
ARV	Air relief valve, Combination Air-Vacuum Relief Valve
ASA	American Standards Association
ASME	American Society of Mechanical Engineers
ASTM	The American Society for Testing Materials
AWG	American Wire Gauge
AWS	American Welding Society
AWWA	American Water Works Association
BMP	Best management practice
BOCA	Building Officials and Code Administrators
CAD	Computer-aided drafting
CI	Cast iron
CMU	Concrete masonry unit

CO	Certificate of Occupancy, cleanout
CRZ	Critical Root Zone
CSI	Construction Specifications Institute
DEQ	Virginia Department of Environmental Quality
DI	Ductile iron
ERT	Electronic radio transmitter
E&S	Erosion and sediment control
F	Fahrenheit
fps	Feet per second
Galv	Galvanized
gpd	Gallons per day
gpm	Gallons per minute
HDPE	High density polyethylene
H:V	Horizontal to vertical
IBC	International Building Code
ID	Inside diameter
IPC	International Plumbing Code
ITE	Institute of Transportation Engineers
ksi	Thousand pounds per square inch
LID	Low-impact development
MH	Manhole
MUTCD	Manual of Uniform Traffic Control Devices
NACTO	National Association of City Transportation Officials
No.	Number
NSF	National Sanitation Foundation
OC	On center
OD	Outside diameter
OSHA	Occupational Safety and Health Administration
pcf	Pounds per cubic foot
PE	Polyethylene
PI	Plasticity index
psi	Pounds per square inch
psig	Pounds per square inch gage
PVC	Polyvinyl chloride
RCP	Reinforced concrete pipe
ROW	Right-of-way
RWSA	Rivanna Water and Sewer Authority
SBL	Separated Bicycle Lane(s)
Spec.	Specifications
SSD	Stopping Sight Distance
Std.	Standard
SDR	Standard dimensional ratio
SWM	Stormwater Management

TIA	Traffic Impact Analysis
Typ	Typical
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VC	Vitrified clay
VESCH	Virginia Erosion and Sediment Control Handbook
VDH	Virginia Department of Health
VDOT	Virginia Department of Transportation
VDPOR	Virginia Department of Professional and Occupational Regulation
VMRC	Virginia Marine Resources Center
VPD	Vehicles per day
VTM	Virginia Test Methods
VUSBC	Virginia Uniform Statewide Building Code
WWR	Welded Wire Reinforcement

1.4 References

[City of Charlottesville Streets That Work Design Guidelines](#)

[City of Charlottesville, Virginia Code of Ordinances](#)

[Code of Virginia](#)

CHAPTER 2

GENERAL SITE PLAN AND PERMITTING REQUIREMENTS

2.1 Intent and Purpose

The City of Charlottesville recognizes the need for a unified site plan approval process to ensure consistency across public and privately developed projects while benefitting the City and developers alike.

Established standards for the investigation, mapping, planning, design, construction, and as-built documentation of sites plan will ensure public safety and quality infrastructure, streamline the approval process, and contribute to the digital documentation of City infrastructure. The purpose and intent of a site plan is to encourage innovative and creative design, to facilitate use of the most advantageous techniques and highest standards in the development of land, and to ensure that land is used in a manner which is efficient, harmonious with neighboring property, and in accordance with the Comprehensive Plan.

See **Site Plan Review Process** for more information.

2.2 Preliminary Site Investigations

Per the City of Charlottesville Code of Ordinances (City Code) §34-802, preliminary site investigations and plans are required for any construction, use, or change in use for any development within the City of Charlottesville. Coordination with the City of Charlottesville early in the design process improves the project's efficiency in design and construction. Private developers must meet all the requirements of the City's development process. These standards should be used by developers during design to assist the Development Review Team's evaluation.

2.2.1 Mapping and Surveys

For all projects occurring within the City of Charlottesville, surveys shall be based on this manual, National Geodetic Vertical Datum (NAVD 88), and State Plane Coordinate System based on North American Datum of 1983 (NAD 83).

All survey documents submitted to the City must be signed and sealed by a Virginia-licensed surveyor and must reference the vertical and horizontal location of the benchmark(s) used in the survey.

Because field conditions can change as a result of both man-made and natural influences, field run surveys are good for a period of five years. After three years, the information in a field run survey should be verified based on visual observation of all areas within the limits of the survey. After five years, a new field run survey must be conducted.

2.2.1.1 Use of GIS-Based Mapping

GIS-based mapping may be used for design projects that do not include any earth disturbances, such as signing and pavement marking projects. Any project involving excavation requires a topographic survey. GIS mapping is available at no cost on the City of Charlottesville's website.

2.2.1.2 Topographic Surveys

Topographic survey standards and practices should follow the latest version of the Virginia Department of Transportation (VDOT) Survey Manual.

At a minimum, every contour line shall be labeled on the 2-foot interval. Larger contour intervals may be permitted for large drainage analysis or for other purposes that intend to analyze off site drainage areas.

2.2.1.3 Utility Surveys

Utility surveys shall follow the American Society of Civil Engineers' (ASCE) Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data.

Subsurface utility engineering investigations shall take place based on the appropriate Quality Level (QL-A through QL-D) for the scope of the project.

2.2.1.4 Right-of-Way and Boundary Surveys

2.1.4.1.1. Contacting property owners

Prior to performing any survey and design work on private property, the engineer/surveyor shall notify the affected landowner of the proposed project. Notification shall be made in the form of a letter to be sent to the property owner seven to ten days before commencing work. Copies of such letter shall be provided to the City along with the initial plan submittal.

2.1.4.1.2. Survey Monuments

Permanent survey monuments shall be placed at all block corners, and at all points of curvature and tangency along any newly platted/created public right-of-way or lots. The location and character of all such monuments shall be clearly designated on the final plat. Such monuments shall be set flush with the surface of the ground or finished grade. Monuments shall be a minimum of 18 inches long rebar with a minimum diameter of 0.5 inches with a plastic cap. The cap shall be provided by the City of Charlottesville Engineering Department. If field conditions do not allow an iron pin to be set, another type of marker may be set with approval by the City Engineer.

The surveyor preparing the final plat shall certify in writing that the survey monuments described above have been accurately placed throughout the subdivision as required before the streets may be accepted for City maintenance or the performance bond or other guaranty released.

Survey monumentation, described above, shall apply to major and minor subdivisions but not boundary line adjustment plats unless that boundary line adjustment affects a monument located along the City right-of-way.

2.1.4.1.3. Control Points

At least two control points, evenly distributed across the property, shall be set. These points shall be accurate to within ± 2 centimeters and shall meet the definition of a control point. Both points shall be benchmarks showing elevation (NAVD 88) and VA State Plane Coordinates (South Zone). These points shall be located in the City right-of-way with a brass disk, provided by the City of Charlottesville's Engineering Department, and secured by concrete. The control points may be set in the top face of curb during sidewalk construction, fastened into existing concrete using a drill and epoxy, or set in a concrete monument meeting VDOT requirements. Control point coordinate and elevation values are to be provided to the City on a copy of the subdivision plat. Coordinate and elevation values are not required to be shown on the final recorded subdivision plat.

The surveyor preparing the final plat shall certify in writing that the control points described above have been accurately placed throughout the subdivision as required before the streets may be accepted for City maintenance or the performance bond or other guaranty released.

Control points described above shall apply to major subdivisions and shall not apply to minor subdivisions or boundary line adjustment plats.

All plats should make clear reference to the type of survey marker for both existing and new monuments.

2.1.4.1.4. Easements

Utility easements shall be required except where utilities are installed within a public right-of-way of the City of Charlottesville or Virginia Department of Transportation. For water and sewer, if the utility is placed within the outer 10 feet of the City’s right-of-way, additional easement width shall be provided to allow 10 feet from the center of the pipeline. Easements shall not be less than 20 feet in width centered on the main. Where minimum easement widths would result in an easement that extends into the public right-of-way, the easement width may be reduced so it does not overlap the right-of-way.

Easements shall be required for all water, sewer lines, and appurtenances except where installed within existing right-of-way. The width of the easement shall be based on the diameter of the line (centered in the easement) and shall be determined using Table 2-1.

Table 2-1

<i>Pipe Diameter</i>	<i>Minimum Easement Width</i>
<i>12" and smaller</i>	20 feet
<i>15" to 18"</i>	30 feet
<i>21" to 42"</i>	40 feet
<i>48" and greater</i>	50 feet

Additionally, if the depth of cover over the utility is greater than 10 feet, then the easement width shall be increased by 2 feet for every additional foot of cover over 10 feet. If the utility is placed within the edge of the right-of-way, then additional easement may be necessary (equal to desired distance from center of pipe as described above).

Combined sewer and water easements shall not be less than 30 feet in width with both mains 10 feet from the edges of the easement. Storm sewer easements shall be a minimum of 20 feet wide, when not able to be placed within the right-of-way (10 feet

from center of pipe). Gas easements shall be a minimum of 20 feet wide. Trail easements shall be a minimum of 20 feet wide for multi-use trails and 10 feet wide for nature trails. The Department of Utilities reserves the right to require additional easement width if construction and maintenance activities require it (i.e. depth of utility).

Easement Plats

Off-site easements shall be recorded and documented (deed book and page number) on the design plans before receiving approval of the plans for construction.

All easements shall have the right of ingress and egress in the recorded deed. The agent also may require that an easement be provided through abutting land under the same ownership as the site. No trees, shrubs, structures, fences, or obstacles that would render the easement inaccessible by equipment shall be placed within an easement. Any person who constructs a structure within a utility easement shall be liable for the cost of removal and any damage to the utilities.

All easements shall be labeled as either “private” or “public”. If a plan or plat fails to distinguish between private or public, then it shall be assumed to be private unless there is further documentation to indicate it is a public easement. If private easements are required to complete the improvements shown on the site plan, then the documentation shall be provided to the City prior to plan approval. Private easements are required to state the entity to which the easement will be dedicated and note that the easement should be recorded prior to approval of the plans. A deed of easement shall be recorded that clearly defines ownership and maintenance requirements by the private entity. Temporary easements can be addressed with a letter signed by the owner of the property impacted. All easements, private or public, shall specify the type of easement (i.e. access, utility, drainage, maintenance, etc.).

2.2.1.5 Historical Survey

The Charlottesville Comprehensive Plan emphasizes Historical Preservation and Urban Design to retain the historic character of Charlottesville through architecture, urban design, and site investigation. Per City Code Section 34-827(d)(1), all projects must identify whether the property is located within a Historic Preservation & Architectural Design Control (ADC) District or Historic Conservation District (CV) or if the property is designated as an Individually-Protected Property (IPP). Sites within an ADC, CV, or IPP must follow the requirements of the district and coordinate with Public Works to ensure the property follows appropriate historic preservation processes. An archeological survey is encouraged for all identified ADC, CV, or IPP properties before any other site

disturbances occur. The City of Charlottesville assists with identifying potential financial resources material to ensure site development adheres to ADC, CV, or IPP standards.

2.2.1.6 Pedestrian, ADA, and Bicycle Surveys

The main goal of the City's Americans with Disabilities Act Transition Plan is to create a connected network of pedestrian facilities that consist of unobstructed sidewalks, curb ramps, accessible signals, and crosswalks. To evaluate the accessibility of the pedestrian network, the City has undertaken an inventory of many sidewalks, curb ramps, and crosswalks to ensure they meet current federal and local guidelines. The City continues to survey and evaluate existing facilities to replace inadequate features or add them where they are missing. To contribute to this inventory, new sidewalk construction and sidewalk alterations must meet federal and local ADA design standards. Following construction, as-built plans verifying ADA compliance must be submitted to the City for integration into the City's pedestrian network inventory. The as-built plans must include a certification statement verifying ADA compliance with a list of facilities constructed, including but not limited to sidewalks, curb ramps, trails, crosswalks, signal equipment, and connections to existing facilities. Following submittal, City staff will review the new pedestrian facilities and verify ADA-compliance before acceptance.

While the City's ADA Transition Plan pertains to all right-of-way under public management, the goal is to ensure that all facilities, both public and privately-owned, are also accessible. The City's pedestrian network is often connected with sidewalks and trails on private property, such as residential developments and commercial centers. As improvements are scheduled for these privately-owned sections of the pedestrian network, additional requirements may be needed and addressed during the preliminary plan review.

The City maintains a GIS inventory of bicycle facilities and tracks usage with counters. Following construction, as-built plans showing bicycle facility type, widths of bicycle lanes, buffers, vertical separators, and the location of new counters must be submitted to the City for integration into the City's bicycle network inventory. Upon receiving as-built plans, City staff will review the new bicycle facilities and verify dimensions before acceptance.

Refer to Chapter 4, Section 4.10 for design guidance.

2.2.2 Geotechnical Investigations

Geotechnical investigations are performed to determine the subterranean aspects of a site including soil composition and groundwater infiltration. Geotechnical investigations

are necessary in determining the site suitability for structures (retaining walls, bridge foundations) and stormwater management facilities. Geotechnical evaluations are encouraged for most projects. Planning for the subsurface exploration program should ensure adequate coverage, location, and depths of borings, and sufficient laboratory tests to produce data required for thorough analyses. The exploration program should result in recommendations for technically sound and cost-effective construction. Where foundations, retaining walls, bridge abutments, and other structural supports are planned, a geotechnical report is required. A copy of the Report of Findings of the Geotechnical Investigation shall be submitted with the structural design calculations. Geotechnical investigations are highly recommended for walls not designed by an engineer to ensure adequate information regarding assumed design criteria utilized in applying manufacturers' or designers' design guides, charts, or graphs.

All field exploration and other project-related activities shall conform to all applicable safety requirements of U. S. Department of Labor, Occupational Safety & Health Administration (OSHA) and Virginia State Occupational Safety and Health (VOSH).

“Miss Utility” shall be notified at least 72 hours in advance of any subsurface exploration. Miss Utility’s marking service includes public utilities. Many utilities (i.e., culverts, wiring, etc.) on publicly owned lands and utilities on private land are considered “private” as they are not owned by designated public utility companies. To protect the private utilities and neighboring landowners, work on such land may require the services of private utility locating companies.

No investigation shall be undertaken on any property that is not within public right-of-way without first notifying the landowner in accordance with §33.1-94 of the Code of Virginia. This restriction includes crossing of property by personnel and equipment to gain access to another property where an investigation will be conducted. Proof of notification shall be provided to the City if requested.

All field exploration activities shall include traffic control for vehicles, bicyclists, and pedestrians per Chapter 3, Section 3.6 of this manual.

Conventional soil borings shall be advanced using hollow-stem augers (ASTM D6151), mud-rotary, or other approved methods. A plug shall be used to prevent cuttings from migrating upward through the hollow-stem auger.

2.2.3 Environmental Surveys

Environmental surveys delineate the limits of certain features such as wetlands, floodplains, Waters of the U.S., or riparian buffers. Disturbance of these areas in

conjunction with development projects requires additional approvals and mitigation as these areas are regulated by state and federal agencies. Identifying these special environmental areas early in the design process is encouraged for proper planning of the site and accounting for efforts related to securing approvals and providing mitigation. Information on the general location of wetlands, floodplains, and other environmental features are available from the City of Charlottesville. Delineation of wetlands, floodplains and Waters of the U.S. must follow U.S. Army Corps of Engineers (USACE) standards and practices.

Environmental features, signed and sealed by a licensed Virginia surveyor, must be shown on submitted site plans.

2.3 General Site Plan Considerations

All plans submitted to the City shall be signed by a professional licensed by the State of Virginia.

All designs and the content within them are the responsibility of the design professional that signs/seals that drawing. All plans submitted to the City for review shall be comprehensive and complete, and the review process shall not be used as a quality control measure. The plan review process is a regulatory requirement to ensure that general conformance with local requirements is followed. The City is not responsible for errors and omissions of the design professional.

The City strongly recommends that designers leave room for construction tolerances by not designing to the maximum or minimum standard. It has been the City's experience that leaving some leeway in the design makes the construction and acceptance process much smoother.

The designer should routinely look beyond the limits of their project and the impacts it may impose on surrounding properties. This includes adjoining private properties, the public right-of-way, utilities, traffic impacts, etc. There may be occasions where additional improvements outside the bounds of the project may be required in order for proper connections to be made or to account for challenges during construction. The designer should think through the construction process as the design evolves to minimize the impacts of construction. In addition, the City's right-of-way shall not be assumed as a permissible staging or laydown area. However, permission for such use may be granted by the City Engineer.

All site plans shall include a Maintenance of Traffic Plan that meets the requirements of Chapter 3, Section 3.6 and that shows that all measures necessary to ensure access for

pedestrians, bicyclists, and persons with disabilities will be maintained throughout the entire construction phase.

All plans submitted to the City shall contain, at a minimum, the information required within this manual. Submittals that do not include the appropriate application, fee, and checklist will not be accepted.

All work proposed within the City's right-of-way or to be accepted by the City shall be warrantied for a period of at least one year from the date of final acceptance and shall be fully covered by a warranty bond.

2.4 Preliminary Site Plan

Applications for preliminary site plan approval shall be submitted to the Department of Public Works. Each application and each re-submittal of an application previously submitted shall be accompanied by the required fee for a site plan, as set forth within the most recent fee schedule adopted by City Council. Contents and requirements for preliminary site plans are stipulated in the City of Charlottesville Code of Ordinances §34-827. Preliminary plan submittal and review will follow the schedule provided in the City Code §34-820.

The site planning agent will circulate the plan for review and comment by the following City officials, employees and departments, together with notice of the date on which the plan has been scheduled for a preliminary site plan conference: the City Engineer, the Traffic Engineer, the Parks and Recreation Department, the Department of Public Works, the Department of Utilities, the Fire Department, the Building Code official, the Zoning Administrator, and other City or state officials, employees, departments, or agencies whose review and comments are deemed necessary by the site planning agent. All resulting requirements and recommendations will be forwarded to the site planning agent by City staff prior to the date required by code.

Per City Code §34-821, a preliminary site plan conference, open to the public, will be scheduled by DPW no sooner than 21 days following the date on which the application for preliminary site plan approval was officially submitted. Upon conclusion of the preliminary site plan conference, the developer will be notified if revisions to the plan are required or recommended. The preliminary site plan conference will be scheduled for a time that maximizes the potential for the public to attend.

2.5 Final Site Plan

Per City Code §34-822, a preliminary site plan is valid for a period of five years once approved, provided the property owner (i) submits a final site plan within one year of such approval and (ii) thereafter diligently pursues approval of the final site plan. Diligent pursuit of approval means that the property owner has incurred extensive obligations or substantial expenses relating to the submitted final site plan or modifications thereto. However, no sooner than three years following such preliminary site plan approval, and upon ninety 90 days' written notice by certified mail to the property owner, the site planning agent may revoke such approval upon a specific finding of fact that the property owner has not diligently pursued approval of the final site plan. Actions and schedules associated with site plan approval are also subject to stipulations provided within the Code of Virginia §15.2-22659.

Contents and requirements for final site plans are stipulated in the City Code §34-822 and §34-828. The site planning agent will thoroughly review a proposed site plan and will make a good faith effort to identify all deficiencies, if any, with the initial submission. In any event, if the site planning agent disapproves a preliminary or final site plan, the agent will set forth in writing the specific reasons therefor. The reasons for disapproval will identify deficiencies in the plan which cause the disapproval, by reference to specific ordinances, laws or regulations, and will generally identify modifications or corrections that will permit approval of the plan.

If the site planning agent disapproves a preliminary or final site plan, such action shall be subject to judicial review as provided within Code of Virginia §15.2-2260. However, if the developer so chooses, they may first appeal a decision of the site planning agent, provided that such appeal is submitted in writing to the site planning agent within 10 days after the date of the site planning agent's disapproval. The Planning Commission may affirm, reverse or modify, in whole or in part, the decision of the site planning agent.

An approved final site plan shall be valid for a period of five years from the date of approval, or for such longer period as the Planning Commission or Director may determine. Duration of site plan validity may be extended per the City Code §34-825.

Any development plan that shows physical improvements on an adjoining parcel of land or within 5 feet of a property boundary must show documentation for a Temporary Construction Easement (TCE). This can be in the form of a letter signed by the adjoining property owner or a platted easement.

See **Site Plan Checklist** for more information.

2.6 Amended Site Plans

Amended site plans shall follow amendment process as stipulated in City Code §34-826. In order to ensure that all plan changes are clearly documented and reviewed, every amended plan that is submitted must clearly reference each item that was changed from the original approval. At a minimum, the cover sheet shall include a list of items that have been amended and each item shown in the plan shall be clouded with the appropriate revision number. In addition, a cover letter shall be provided with the submission that states what each revision is and why that change is proposed.

2.7 Other Permit Requirements

The City of Charlottesville review of plans will require no less than 60 days for the first submittal. Any subsequent review of plans will require no less than 45 days. Applicants are required to submit confirmation on documentation submitted to state agencies within 30 days. Any state agency making such review is required to complete its review within 45 days after receipt of the plan. Upon receipt of approval from a state agency, the site planning agent will act upon the plan within 35 days. If the Planning Commission conducts a public review, it will act on the plan within 45 days after receipt of approval from the state agency. All actions on a plan will be completed by the agent or the commission. Additional plan and permit requirements are subject Code of Virginia §15.2-2258 through §15.2-2266.

Prior to starting any building construction, it must be demonstrated that all fire hydrants are accepted by the City and activated for use.

A floodplain development permit must be acquired from DPW before any disturbance in a 1% annual exceedance probability (AEP) floodplain.

2.8 Innovative Design Proposals

Developers and other applicants may propose specific innovative design features not included in this manual. The City supports exploration of new technologies and approaches to achieving common goals. All innovative design proposals will still require review via the standard City agency review process. Innovative design proposals should be presented to the City as far in advance as possible, and it is highly recommended to meet with City staff prior to submittal to identify any major concerns. Each proposal should be presented to the City in a manner that clearly explains the following:

- What is unique about the proposal

- Why the proposal does not meet the current City standards
- How the objectives of this manual will still be accomplished through the proposed design

The City will review the proposal and may request additional information as needed for staff to fully understand the design approach. Design for roadways and other street treatments not included in this manual will be approved or denied at the discretion of the designated DPW agent.

For projects receiving VDOT funding, a developer proposing any street cross-section that does not meet VDOT minimum criteria for acceptance into the state highway system shall prepare and submit all documentation necessary to support the City's request for VDOT maintenance funding prior to City approval of the final plans. Final City approval of the project will be contingent upon VDOT's approval of maintenance funding. If VDOT denies the City's request for maintenance funding, the City Council may elect to approve the project and provide budget for maintenance by the City Department of Public Works (DPW), or may decline to approve the project.

All proposals shall be consistent with zoning and land use regulations. Innovative design proposals may not propose changes to zoning and land use, and may not be used as a means to request increased density ratios. It should also be noted that the City does not have the authority to approve new stormwater facilities that have not been previously authorized by the Virginia Department of Environmental Quality (DEQ).

2.9 Preconstruction Meeting

The designer is required to schedule a pre-construction meeting prior to any site construction. The preconstruction meeting will be attended by the designer, developer, construction management personnel, and representatives of DPW. Additional City representatives may be required to attend depending on the nature of the project.

2.10 As-built Surveys and As-built Plans

While it is expected that the project will be constructed in accordance with the approved plans, it is understood that unforeseen site conditions often require alterations to the approved plan. Changes that do occur during the construction phase should be brought to the attention of the planner for that project. A developer, builder, owner, or other agent must submit as-built plans to DPW for distribution, review, and approval prior to issuance of a Certificate of Occupancy (CO). Minor alterations to the approved plan may, at the

discretion of City staff, be captured in an as-built plan (as opposed to a site plan amendment for major alterations).

Submission of phased as-built plans as construction progresses is strongly encouraged so that issues can be identified and addressed well in advance of applying for the CO.

As-built plans will be reviewed to ensure that the project was constructed per the approved plans and that all known changes are adequately documented. As-built plans are required for all new construction, excluding new single family residential dwellings that currently adhere to the existing requirements for as-built surveys.

The procedure for as-built surveys and plans is described in sections 2.10.1 and 2.10.2.

2.10.1 As-built Guidelines

The City of Charlottesville has established an “as-built plans” guideline to confirm that the project was built according to the approved plans and that all changes are properly documented. As-built information shall be provided as follows:

- As-built surveys shall be provided for any single family detached residence.
- As-built plans shall be provided to DPW after completion of any multifamily dwelling, subdivision, commercial or industrial development, public roads, public or private utilities, or stormwater management facilities. Municipal agencies are responsible for submitting as-built plans to DPW.
- As-built plans shall be based on a field run survey from a Virginia-licensed surveyor. Information that cannot be easily obtained by a field run survey (such as location or depth of newly constructed waterlines or pressure pipes) should be obtained from the contractor’s marked up record drawings. These record drawings must be furnished to the surveyor prior to the field run survey.
- Plans should be a re-creation of the final site plan (where applicable) and stamped or labeled as “as-built,” and all changes from the approved plans should be marked with revision clouds or drawn in a different color.
- As-built information for bicycle facilities must be provided as separate signing and marking plans in both .pdf and .dwg format.
- As-built plans shall be prepared, signed, and sealed by a Virginia-licensed surveyor or professional engineer.
- As-built plans should be submitted for City review as construction items are in place and complete. As utilities are installed, the utilities may be surveyed and presented to the City for review. Bonding of any construction item that is required to be on the as-built plans will delay the approval of the plans.

- As-built plans shall include all information included in the most recent version of the as-built plan checklist.
- Review of the as-built plans will be inclusive of all building locations, property boundaries, site work, utilities, stormwater management systems, landscaping, trees, and all pertinent information consistent with the approved site plan.
- As-built plans will provide a NAD83 latitude and longitude point in each corner of the plans.
- As-built plans will be submitted in hard copy and digital format, including 2015 AutoCAD (.dwg) format. A waiver for release of electronic data must accompany the CAD submission with spatial reference information in NAD83 Virginia State Plan system.

2.10.2 As-built Procedures

As-built *surveys* pertain to single family residential dwellings. These surveys are required for all new residential construction prior to requesting a final inspection from the zoning and engineering staff. Surveys should be prepared by a licensed surveyor and submitted in .pdf format to the feedbacksurvey@charlottesville.org. The following process should apply to as-built surveys:

- Upon receipt of an as-built survey, all appropriate departments (building, zoning, engineering, and utilities) should inspect the site for compliance with the building permit, City Code, and approved plans.
- Inspections should be completed within two calendar weeks of receipt of the as-built survey.
- Any items identified as deficient should be forwarded to the builder and/or developer within one calendar week of completing the inspection.
- All deficient items shall be addressed prior to issuance of a Certificate of Occupancy.

As-built *plans* pertain to any project that required an approved site plan, road plan, utility plan, E&S/SWM plan, and/or subdivision plan (including any subsequent amendments). As-built plans should be prepared, signed, and sealed by a professional registered in the State of Virginia (engineer, surveyor, architect, or landscape architect). As-built plans shall follow the same process as a site plan with the planner for that project being the lead for distribution of plans, compilation and issuance of comments, and approval. All items that differ between the approved plan and as-built plan should be evaluated for compliance to the requirements of the approved documents and applicable codes. Any

deficiencies shall be resolved prior to issuance of a Certificate of Occupancy (CO) and release of bonds. The as-built plan review process is as follows:

- Upon completion of a project and prior to issuance of a CO, the owner/developer shall submit four copies of an as-built plan to the Department of Public Works and email a .pdf copy of the as-built plan to feedbacksurvey@charlottesville.org.
- Within four weeks, staff will review the as-built plan against the approved site plan and site conditions. This review may occur during an on-site inspection and may require the developer/owner to make modifications to the site or revisions to the as-built plans if there are substantial differences in the field that do not match the approved plans.
- If changes are required for the as-built plan, four additional copies must be provided to replace the previously submitted as-built plan.
- Once City staff is satisfied that the project has been constructed according to the approved plan, electronic copies of the as-built plan should be submitted in .pdf and .dwg format. For .dwg files, they should be saved to operate with the 2015 version of AutoCAD.
- After receipt and acceptance of the as-built plan, a certificate of occupancy permit may be issued and bonds returned.

See **Final As-built Checklist** in Appendix for more information.

2.11 References

[City of Charlottesville Americans With Disabilities Act Transition Plan](#)

[City of Charlottesville Comprehensive Plan](#)

[City of Charlottesville, Virginia Code of Ordinances](#)

[Code of Virginia](#)

[VDOT Survey Manual](#)

2.12 Additional Resources

[VDOT Road Design Manual](#)

CHAPTER 3

TRAFFIC

3.1 Intent and Purpose

The City of Charlottesville recognizes the value of a comprehensive, multimodal approach to traffic regulation in achieving the primary goal set out by the Streets That Work Design Guidelines: to create streets that are safe and comfortable for all users. This chapter provides guidance on implementing design elements such as signs, signals, pavement markings, and roadway geometry to promote safe interactions between all users of public roadways. It also includes proper methodology for multimodal traffic studies to ensure proper multimodal planning and regulation into the future.



Figure 3-1: Bicyclist on Hillsdale Drive in Charlottesville

3.2 Signals and Beacons

The Manual on Uniform Traffic Control Devices (MUTCD) is a document issued by the Federal Highway Administration (FHWA) to specify the standards by which traffic signals and beacons, road surface markings, and signals are designed, installed, and used. This section provides direction for traffic signals, pedestrian hybrid beacons, and flashing beacons. Signals and beacons manage traffic flow for all modes and provide safe opportunities for crossing major streets for pedestrians and bicyclists. Traffic signal design, which includes detection, phasing, timing, and equipment should provide a safe and predictable environment for all users, especially those who are most vulnerable.

3.2.1 Guidance

The decision to install a signal or beacons should be based on an engineering study to determine whether the installation of the traffic control is likely to improve the safety and/or operation of an intersection or crossing. As outlined in Chapter 4C of the MUTCD, an engineering study should include bicycle, pedestrian, and vehicle traffic volumes (existing and future), motor vehicle speeds, nearby facilities and activity centers (especially those that serve young, elderly, and/or persons with disabilities), crash data, and an existing conditions diagram with a topography/grade assessment at a minimum. Additional information may include sight distance, delay study, gap study and queue lengths. AASHTO and NACTO guidance may be helpful in identifying best practice designs that are compliant with the minimum standards of the MUTCD.

3.2.1.1 MUTCD Warrants and Guidelines

MUTCD Chapter 4C includes nine warrants for traffic signals, and Chapter 4F of the MUTCD contains guidance for pedestrian hybrid beacons (PHB) that should be evaluated as a part of an engineering study. There is flexibility in the MUTCD to consider factors beyond traffic volumes, such as crashes and availability of gaps, to justify the installation of a traffic signal or beacon. The proximity to other traffic signals may also be considered in determining whether a signal is an appropriate solution. If the results of a traffic engineering study exceed the reduced threshold criteria in Section 3.3.1.3.2, Mid-Block/Uncontrolled Crosswalks, a PHB shall be considered.

The MUTCD also offers guidance on estimating future demand for intersections and crossings. Section 4C.01 (paragraph 11 and 17) of the MUTCD states that volumes can be estimated where an existing traffic count does not represent future conditions and pedestrians may be discouraged from crossing because there are inadequate gaps in traffic or uncomfortable crossing conditions. Several sources of information can be used to estimate future non-motorized demand. Some examples include multimodal counts at adjacent intersections and nearby walking and bicycling patterns (both may indicate latent crossing demand); and likely generators of walking or bicycling trips such as schools, libraries, community centers, and transit stops. Additionally, in specific cases, the City can establish a “design volume” for a type of crossing (e.g. “X” crossings per hour for a shared use path or bicycle boulevard).

A designer should include a roundabout as an alternate solution to a traffic signal in any engineering study of a crossing. Roundabouts also offer traffic calming benefits as discussed in Section 3.5, Traffic Calming but must be designed to promote pedestrian, cyclist, and bus safety. Refer to the VDOT Road Design Manual, Appendix F and Chapter

4C of the Virginia Supplement to MUTCD for evaluation criteria and design guidance for roundabouts.

3.2.1.2 Enhanced Crossing Treatments

Careful consideration should be given to when a crosswalk is installed and when enhanced crossing treatments are needed. Enhanced crossing treatments shall be strongly considered based on criteria including but not limited to:

- Speed
- Number of lanes
- Pedestrian traffic volume at or above five pedestrians per hour
- Reduced visibility and blind corners
- Safety data/crash history
- Intersection geometry
- Proximity to safe routes to school
- Street type

Enhanced crossing treatments may include but are not limited to:

- Crossing islands
- Curb extensions
- Flashing beacons
- Pedestrian hybrid beacons (PHB)
- Traffic signals

MUTCD warrants and guidelines for traffic signals and PHBs are described previously in Section 3.2.1.1. However, there are no warrants in the MUTCD for flashing beacons. For reference, VDOT's Pedestrian Crossing Accommodations at Unsignalized Locations provides guidance on when to mark crosswalks and other crossing safety treatments, including the flashing beacon, PHB, and traffic signal. At crossings of wider streets with higher speeds (i.e. "Condition D" from Table 2 in VDOT's Pedestrian Crossing Accommodations at Unsignalized Locations), the designer should assess the potential for reducing the speed limit or a road diet to reduce the number of travel lanes so that "Condition C" may be achieved. In addition, detection of pedestrians at enhanced crossings may be wired or wireless. Enhanced crossing treatments with lights or flashing components shall be actuated by the pedestrian or bicyclist.

3.2.2 Design

3.2.2.1 Signal Placement

Signals shall be carefully located close to the curb wherever possible; signals shall also be placed in such a way that avoids obstructing sidewalks, curb ramps and accessible features, sight lines, driveways, building entrances, and other roadside elements. Location of signal faces shall comply with the requirements of Chapter 4D of the Manual of Uniform Traffic Control Devices (MUTCD) and Virginia Supplement to MUTCD.

3.2.2.2 Design Criteria

The design of all traffic signals and beacons shall conform to the requirements of the MUTCD, Virginia Supplement to MUTCD, VDOT Road and Bridge Specifications, VDOT Traffic Engineering Design Manual, AASHTO Guide for the Development of Bicycle Facilities Guidelines, and the Americans with Disabilities Act Standards for Accessible Design.

In the context of this document, the term MUTCD shall refer to the federal MUTCD and the Virginia Supplement to MUTCD.

Design criteria for traffic signalization will be established by the City Traffic Engineer for individual signalized intersections on a case-by-case basis. The City of Charlottesville or VDOT may also have interim approval from the Federal Highway Administration (FHWA) to implement new traffic control devices that are not included in the MUTCD. These approvals are granted on an interim basis provided that the traffic control device has been proven safe and successful. Please refer to the MUTCD List of Approved Requests for Interim Approval to verify the status of requests submitted by City of Charlottesville prior to design.

If neither VDOT nor the City of Charlottesville currently have an FHWA Interim Approval for use of a traffic control device not included in the MUTCD, a formal request for interim approval or experimentation may be submitted to FHWA by the City as requests or needs are identified.

The use of in-pavement warning lights is not supported by VDOT or the City of Charlottesville. In-pavement warning lights are challenging for maintenance and extremely expensive.

3.2.2.3 General

Rather than focusing on reducing delay for motor vehicles, traffic signal design should balance delay for all users with the likelihood and severity of crashes. Pedestrians are vulnerable users who are at a higher risk of injury or death in a crash with a motor vehicle. Most pedestrian and bicycle crashes at signalized intersections occur with a turning motorist; a designer should evaluate potential conflicts between turning motorists and pedestrians and bicyclists. Wherever possible, the cycle length should be reduced to minimize delay for all users. Research shows that as pedestrian delay increases at signalized intersections, they are less likely to comply with the signal, which exposes them to risk. Slower pedestrians and persons with disabilities are expected at all road crossings. To allow sufficient time for crossing, pedestrian phase length should be calculated according to guidance provided in MUTCD 4E.06 Pedestrian Intervals and Signal Phases.

3.2.2.4 Pedestrian Considerations

This section covers signal design considerations for pedestrians. Additional intersection improvements for pedestrians can be found within this chapter under Traffic Calming and Access Management. All pedestrian improvements should comply with Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG), which refers to the MUTCD.

3.2.2.4.1 Leading Pedestrian Intervals

A leading pedestrian interval (LPI) gives pedestrians a 3 to 7 second head start to establish themselves in the intersection before conflicting motorists receive the green indication. LPIs make pedestrians more visible, which reduces conflicts with motor vehicles and improves pedestrian comfort at intersections. LPIs have been shown to increase yielding behavior by drivers and reduce pedestrian-vehicle crashes by 59%. Section 4E.06 of the MUTCD provides guidance on the length of an LPI.

LPIs shall be considered at specific locations that:

- have unique or irregular geometry that compromises the visibility of pedestrians (e.g. larger vehicle turning radii, offset crosswalk, site obstructions);
- have a relatively high volume of pedestrian crossings;
- have a history of crashes between pedestrian and turning vehicles, or observed non-yielding or near-miss incidents;
- are close to a school, park, or other similar public facility; and
- have a relatively high level of vulnerable pedestrians (young, elderly or disabled).

It is recommended that No Turn On Red restrictions are implemented during the LPI at a minimum; implementing them at all times is preferred. Additionally, in locations with a protected left-turn across the crosswalk with an LPI, the left-turn will need to be implemented as a lagging left-turn. Accessible pedestrian signals shall be implemented with all LPIs.

3.2.2.4.2 Exclusive Pedestrian Phases

Exclusive pedestrian phases, also known as pedestrian scrambles or Barnes Dances, occur when all pedestrians may cross when all vehicular traffic is stopped. This treatment has been shown to reduce vehicle-pedestrian crashes; however, this treatment should only be used in unique scenarios. Since exclusive pedestrian phases increase delay for all users, they should only be used in limited cases, including:

- Where pedestrian volumes are high (e.g. over 2,000 pedestrians per hour)
- Where desire lines are equal in all directions
- Where there is restricted sight distance or complex geometry

Exclusive pedestrian phases must be reviewed by the City Traffic Engineer and may be approved on a case-by-case basis. As an alternative, a protected pedestrian phase or an LPI could be provided. In a protected pedestrian phase, vehicles that do not conflict with the pedestrian crossing may be moving at the same time as the pedestrian crossing. Accessible pedestrian signals shall be implemented with all exclusive pedestrian phases.

3.2.2.4.3 Pedestrian Signals

Accessible pedestrian signals and related components shall be placed to facilitate accessible use of sidewalks and curb ramps according to guidance from PROWAG and the MUTCD. Two-section countdown timers shall be provided for all crosswalks with pedestrian signals. This supersedes MUTCD Section 4E.07, which requires countdown timers where the change interval is more than seven seconds.

3.2.2.4.4 Detection and Timing

Refer to Chapter R209 of the PROWAG and Chapter 4E of the MUTCD for guidance on pedestrian signal timing and design of accessible pedestrian signals, pedestrian pushbuttons, and passive detection.

3.2.2.5 Bicycles

This section covers signal design consideration for bicycles. Additional intersection improvements for bicycles can be found in Chapter 4: Transportation, Section 4.9, in

Chapter 9 of the MUTCD, and in the AASHTO Guide for the Development of Bicycle Facilities.

3.2.2.5.1 Traffic Control Options for Bicycles

When bicyclists are operating in the general purpose traffic lanes, they are controlled by a vehicular signal head. In scenarios where a bicyclist is controlled separately from a motor vehicle, the cyclist can be controlled using a pedestrian signal head or a standard traffic signal face designated for bicycle use. Currently, the City of Charlottesville does not have interim approval for the use of bicycle signal faces. See the AASHTO Guide for the Development of Bicycle Facilities for additional details on the benefits and limitations of the options for controlling bicycles.

3.2.2.5.2 Bicycle Phasing

Traffic signal phasing is an essential tool for managing conflicts at intersections. Crashes between bicyclists and turning vehicles represent a significant portion of crashes at signalized intersections. The AASHTO Guide for the Development of Bicycle Facilities includes thresholds for separate phases for bicyclists and examples of phasing scenarios to provide separate phases. No Turn On Red restrictions are recommended during bicycle phases and are required in certain cases adjacent to turn-queue boxes and bike boxes. Refer to FHWA Interim Approvals IA-20 and IA-18, respectively.

3.2.2.5.3 Detection and Timing

Bicyclist operating characteristics (e.g. speed, acceleration, and ability to stop) are different than those of motor vehicles and pedestrians; these unique operating characteristics should be incorporated into traffic signal timing. Additionally, the default assumption is that bicyclist travel is expected throughout the City of Charlottesville. New and modified traffic signals shall include detection for bicycles. The City will determine the feasibility of adding detection facilities to existing traffic signals on a case-by-case basis. Refer to AASHTO Guide for the Development of Bicycle Facilities for guidance on bicycle signal timing and detection design for bicycles.

3.2.2.6 Motor Vehicles

This section covers signal design consideration for motor vehicles. Design criteria for motor vehicles is included in Chapter 4 of the MUTCD and the Virginia Supplement to the MUTCD.

3.2.2.6.1 Emergency Vehicles

Signals shall be upgraded to include pre-emption for emergency vehicles using signal equipment such as Opticom or an approved equal. For further guidance, refer to Chapter 4G of the MUTCD and Section 4D.27 of the Virginia Supplement to the MUTCD

The signal equipment used for emergency vehicle pre-emption is also compatible with transit signal priority (TSP). Therefore, if the City introduces pre-emption for public transit vehicles, replacement of equipment is not necessary.

3.2.2.6.2 Permissive Left-Turn Phase

The flashing yellow arrow is an optional alternative display for the permissive left-turn phase. For further guidance refer to Chapter 4D of the MUTCD.

3.2.3 Submission Requirements

All permanent and temporary traffic signals and beacons shall be shown on the Traffic Signal Plans. An engineering study including signal warrant analysis should be included with Preliminary Traffic Signal Plans. Preliminary Traffic Signal Plans shall include:

- Location of all signal poles
- Location and alignment of all signal heads
- Location of all signal controllers and equipment
- Location of all pedestrian pushbuttons
- Location of power feed(s)
- Crosswalks
- Curb ramps and level landing areas
- Signal warrant analysis

Final design Traffic Signal Plans shall be fully detailed, and shall include all elements of the Preliminary Traffic Signal Plans, including:

- Location and size of all signal conduits
- Location and size of all signal power and communications cabling
- Location of all signal appurtenances
- Signal timing and phasing plans
- Slopes, including longitudinal slopes and cross slopes
- Accessible pedestrian signal components required by PROWAG and MUTCD
- All details necessary to construct the fully functional traffic signal system

Additional specifications for all traffic signal elements not covered in the VDOT Road and Bridge Specifications shall also be submitted with the final design Traffic Signal Plans.

3.3 Pavement Marking and Signing

The MUTCD specifies the shapes, colors, and fonts used in road markings and signs. This section describes the design, installation, and use of these features. AASHTO and NACTO guidance may be helpful in identifying best practice designs that are compliant with the minimum standards of the MUTCD.

3.3.1 Pavement Markings

3.3.1.1 Design Criteria

The design of all pavement markings shall conform to the requirements of the MUTCD, the Virginia Supplement to the MUTCD, and the Virginia Department of Transportation Road and Bridge Specifications. Temporary pavement marking installation for construction zones shall comply with the Virginia Work Area Protection Manual and the VDOT Work Zone Pedestrian and Bicycle Guidance.

The City of Charlottesville or VDOT may also have interim approval from the Federal Highway Administration (FHWA) to implement new pavement markings that are not included in the MUTCD. These approvals are granted on an interim basis provided that the traffic control device has been proven safe and successful. Please refer to the MUTCD List of Approved Requests for Interim Approval to verify the status of requests submitted by City of Charlottesville prior to design.

If neither VDOT nor the City of Charlottesville currently have an FHWA Interim Approval for use of a pavement marking device not included in the MUTCD, a formal request for interim approval or experimentation may be submitted to FHWA by the City as requests or needs are identified.

3.3.1.2 Pavement Marking Applications

Refer to Chapter 12: General Materials and Methods of Construction for a list of allowable pavement marking materials.

3.3.1.2.1 Yellow and White Pavement Markings

When preparing pavement markings, the engineer shall comply with VDOT Road and Bridge Specifications, Section 246 – Pavement Marking. The engineer shall confer with the City Traffic Engineer to determine pavement schedule on the City's pavement index

to determine when the road will be repaved. Based on these factors, pavement markings are applied as follows:

- New construction or existing pavement (life span \geq 5 years): Type B I, Class 1
- Existing pavement (life span $<$ 5 years): Type A
- Temporary pavement markings: Type B, Class IV

3.3.1.2.2 Removal and Replacement

Existing pavement markings shall be removed using a non-destructive eradication method and shall not be painted over.

3.3.1.3 Crosswalks

All crosswalks installed within the City of Charlottesville shall be high-visibility continental-style crosswalks without transverse edge lines, conforming to the requirements of the Virginia Supplement to the MUTCD and PROWAG. Longitudinal crosswalk lines and gaps between longitudinal lines shall comply with the MUTDC. The minimum allowable crosswalk width in the City of Charlottesville is 8 feet. Wider crosswalks should be considered near locations of high pedestrian activity such as schools, business districts, or event venues. Additional guidance for the City of Charlottesville can be found in the Streets That Work Design Guidelines.

Crosswalk pavement markings shall be white and contrast with the pavement surface. In addition, crosswalk markings shall be smooth, stable, and slip-resistant.



Figure 3-2: A high-visibility continental-style crosswalk (Texas Transportation Institute)

3.3.1.3.1 Controlled Crossings

Marked crosswalks shall be installed at each leg of all signal and stop-controlled intersections unless otherwise permitted by the City Traffic Engineer in concurrence with the City Bicycle and Pedestrian Coordinator.

3.3.1.3.2 Mid-Block/Uncontrolled Crosswalks

Where marked crosswalks are greater than 500 feet apart, mid-block or uncontrolled crossings shall be provided. Demand, visibility, speed, and other traffic safety factors that would preclude a crossing shall be reviewed. A traffic engineering study shall be performed to assess the feasibility of a mid-block or uncontrolled crosswalk installation. Refer to VDOT's Pedestrian Crossing Accommodations at Unsignalized Locations Guidance Section 5.3 and associated attachments. If one criterion is not met, the study findings shall be examined using engineering judgement and reduced thresholds including but not limited to:

- The crosswalk would likely see a minimum of five pedestrians/bicyclists per hour.
- Pedestrian and bicycle generators are present within 100 feet of the crossing.
- The crosswalk is expected to be used by a high number of vulnerable pedestrians (pedestrians who are disabled, age 65 and over, or age 15 and under).
- The reduced volume is met for three consecutive hours.
- Engineering judgment determines that sufficient demand and pedestrian desire lines exist to justify both crosswalks.

The distance from the mid-block crosswalk and the nearest marked crosswalk(s) should not be less than the stopping sight distance (SSD) for the roadway. If the SSD requirements cannot be met and the crosswalk cannot be relocated to a place where SSD requirements will be met, warning signs shall be used. (Warning signs may be omitted on downtown urban streets with speed limits of < 35 mph if justified by documented engineering judgment.)

All mid-block marked crosswalks shall be accompanied by advanced signage and pedestrian-scale lighting to improve the visibility of pedestrians.

On uncontrolled multi-lane approaches, advance yield lines and signs should be placed 20 to 50 feet in advance of crosswalks. Parking should be prohibited on the roadway between the yield line and the crosswalk.

3.3.1.3.3 Non-Standard Crosswalk Markings

The use of non-standard crosswalk markings shall be consistent with the character of the neighborhood. All non-standard crosswalk markings must be reviewed by the City Traffic Engineer. Non-standard crosswalk markings proposed in design control districts must also be reviewed by the Board of Architectural Review. All non-standard crosswalk

marking materials must be approved by Director of Public Works prior to implementation. Any approval of non-standard crosswalk markings will be made on a case-by-case basis.

Based on guidance from the FHWA MUTCD Official Ruling 3(09)-24(I) – Application of Colored Pavement, subdued-colored aesthetic treatments are permissible between the legally marked transverse crosswalk lines. The crosswalk treatment shall not include any retroreflective characteristics and shall not diminish the effectiveness of the legally required white transverse pavement markings that make up the crosswalk. Below are permitted non-standard treatments:

- Stamped concrete
- Painted brick lattice patterns
- Paving bricks with pattern skewed to travel direction on top of concrete base

The following non-standard colors for the treatments above are acceptable: red, rust, brown, burgundy, clay, tan, or equivalent earth tones. The pattern and color of all elements of the crosswalk treatment shall be “uniform, consistent, repetitive, and expected so as not to be a source of distraction.” The non-standard treatment on the interior of the white transverse pavement markings shall not be random. In addition, the elements on the interior of the crosswalk shall not contain pictures. No element of the aesthetic interior treatment may implement pictographs, symbols, multiple color arrangements, etc., or otherwise attempt to communicate with any roadway user.

3.3.1.4 Bicycle Facilities

MUTCD Part 9, Traffic Control for Bicycle Facilities, is broken down into four sections:

- 9A, General Requirements for Bicycle Traffic Control Devices
- 9B, Signs for Bicycle Facilities
- 9C, Markings for Bicycle Facilities
- 9D, Traffic Signal Operations for Bicycles

The City of Charlottesville must adhere to the standards in Part 9 of the MUTCD when designing bicycle facilities.

3.3.1.4.1 Shared Lane Markings

Shared lanes may be identified with a shared lane marking (SLM). If used, the SLM symbols should be placed immediately after any intersection and spaced at intervals not greater than 200 feet thereafter; more frequent placement is encouraged. SLM symbols should also be placed immediately after high-volume commercial driveways.

Where used on roadways with restricted on-street parking, the SLM symbol shall be placed with its centerline 4 feet from the curb face. On roadways with on-street parking, SLM symbols shall be placed in the center of the travel lane, but with at least 11 feet between the centerline of the marking and the face of curb or edge of the traveled way where this is no curb.

3.3.1.4.2 On-Road Bike Lanes

As described in the AASHTO Guide for the Development of Bicycle Facilities and Part 9 of the MUTCD, a bike lane should be marked with standard bike lane markings to inform bicyclists and motorists of the restricted nature of the bike lane. Bike lane markings should be placed after each intersection. Additional bike lane markings may be placed at the end of each block, prior to crosswalks, and prior to each driveway crossing where applicable.

Bicycle lanes shall be delineated by a 4-inch-wide solid white painted line parallel to the curb, separating bicyclists from moving traffic. Where parking is allowed, a second 4-inch solid white line shall be installed adjacent to the parked cars, 7-8 feet away from the curb (see 4.3.3.1.2 On-Street Parking). Contra-flow bicycle lanes shall be 5-feet wide minimum and delineated with 4-inch solid double yellow lane line markings that continue through intersections as dashed lines. Design shall follow best practices described in NACTO's Urban Bikeway Design Guide. Contra-flow lanes shall provide signs to alert people walking, biking, and driving to bicycle traffic traveling in the opposing direction. Where parking is provided adjacent to the contra-flow bike lane, the determination of appropriate center line markings should be done in consultation with the City Bicycle and Pedestrian Coordinator and VDOT.

3.3.1.4.3 Separated Bike Lanes

Standard bike lane symbols and arrows may be used in separated bike lanes. Two-way separated bike lanes should have yellow center lines, dashed where passing is permitted and solid where passing is undesirable. Green markings should be reserved for conflict points such as driveways and intersections. It may be desirable to demarcate the edges of vertical curbs with solid white edge lines.

3.3.1.4.4 Shared Use Paths and Recreational Trails

A 4-inch yellow centerline shall be used to separate opposite directions of travel on trails that are 12 feet wide or greater. Centerline striping may be required for paths narrower than 12 feet at the discretion of the recreational trail manager and the City Traffic Engineer. The centerline stripe should be dashed where there is adequate passing sight distance and solid where passing is discouraged, such as blind corners. When pedestrian

volumes are greater than or equal to 500 pedestrians/day in each direction, a 4-inch yellow centerline shall be applied. Edge line striping may be considered in certain instances. If used, edge lines should be 4 inches wide and painted with white paint. Marked crosswalks are required at intersections between shared use paths and roadways.

3.3.1.4.5 Green Pavement Markings

The design of green pavement markings shall conform to the requirements of the MUTCD and Interim Approvals granted by FHWA for Optional Use of Green Colored Pavement Markings for Bike Lanes and Optional Use of an Intersection Bicycle Box. The City has been granted interim approval for both treatments. (See FHWA Interim Approval IA-14 and IA-18 respectively.)

According to the FHWA, research has shown that bicyclists and motorists have a positive impression of the effect of green colored pavement. Green pavement markings can be used as a corridor treatment for up to 50 feet along the stem of a bike lane or separated bike lane prior to a bike box, or as a spot treatment, such as a bike box, conflict area, or intersection crossing marking.

The engineer shall verify the FHWA Interim Approval status of other green pavement markings such as two-stage bicycle turn boxes prior to design.

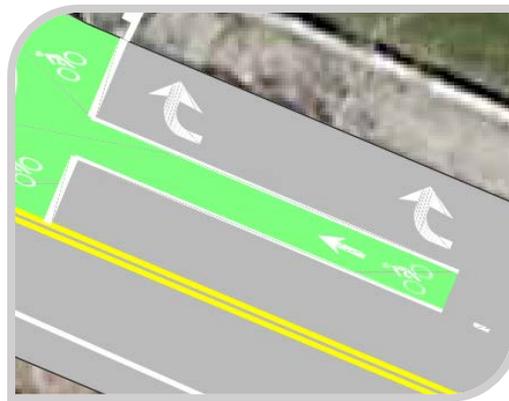


Figure 3-3: A 50-foot green pavement stem (City of Charlottesville)

3.3.1.5 Maintenance of Pavement Markings

See Chapter 13: Maintenance of Existing Infrastructure, for guidance on maintaining pavement markings.

3.3.2 Signs

All signs should be shown on the traffic plan submitted by the applicant. Erection of signs shall be in accordance with the VDOT Road and Bridge Specifications, Division VII. All signs shall comply with the MUTCD and the Virginia supplement to the MUTCD, except where noted below. Signs should be mounted on existing posts where possible based on space and restrictions from the MUTCD. If a new sign post must be installed, it shall be square metal, except where noted below. Generally, on sidewalks with less than 6 feet of clear width, sign posts should be installed at the back of the curb. On wider sidewalks, signs should be installed 12 inches from the face of curb. Transit access, loading zones, and other curbside management concerns may require greater clearance.

3.3.2.1 Regulatory and Warning Signs

Regulatory, warning, and directional signs for motor vehicles, bicycles, and pedestrians shall meet the requirements of the current MUTCD, with the following exceptions:

- W1-6: Arrow shall be 24 inches by 12 inches (24"x12")
- R7-1: No Parking Any Time shall be 12 inches by 18 inches (12"x18")
- R-1-1: Stop Sign shall be 30 inches by 30 inches (30"x30")
- Dead End Streets: Use OM4-3 without wording

3.3.2.2 Custom Signs

Allowable custom signage includes the following types: valet parking, private road, honorary, historic, and electric vehicles (EVs). Wayfinding signs are also types of custom signs and are discussed in Section 3.3.3. Custom signs must be approved and the applicant must receive a waiver before implementation. The applicant shall submit fabrication details and drawings showing the proposed location to the City Traffic Engineer for approval.

A sign displaying the accepted or rejected status of construction is required for all projects pending approval on a public street (see Detail X). The sign shall be visible from the primary construction entrance. The entity posting the sign must obtain a City sign permit prior to installation. A copy of the sign permit must be available on-site at all times.

Sign posts for custom signs shall be consistent with signs in the immediate vicinity. Signs affixed to existing sign posts shall be identified on associated plans and details. Sign posts for historic custom signs shall have tubing with a black powder coat. Refer to Chapter 14 for additional requirements in design control districts.

3.3.2.3 Street Name Signs and Sign Posts

Street name signs shall be large enough to be seen clearly from the roadway. The actual size of the street name sign shall be sufficient to display the street name.

Minimum street name sign dimensions are 9 inches tall with sufficient length to display the street name. Street name sign text shall be white letters 5 inches tall, roman font on a green background. Visibility of the sign and mounting shall meet requirements of the MUTCD. The applicant shall submit drawings showing proposed street name signs with dimensions and street name to the City Traffic Engineer. City Traffic Engineer approval is required prior sign fabrication.

Street name sign posts shall be 1 3/4-inch square, perforated welded steel tubing, 14 gauge, with 7/16 knockouts 1-inch on center, hot dipped galvanized Telespar Quick-Punch or equal. If this sign post material does not match other signs in the area, determine the type allowed for the district or neighborhood.

3.3.2.4 Signs for Bicycle Facilities

Signs for bicycle facilities must adhere to the standards in Part 9 of the MUTCD and the Virginia supplement to the MUTCD.

3.3.2.4.1 Shared Lanes

Signage should be used to increase awareness of bicyclists and therefore promote safety, such as MUTCD sign R4-11 BICYCLISTS MAY USE FULL LANE or the W11-1 and W11-VP2 ON ROAD sign assembly. The use of the W11-1 and W16-1P SHARE THE ROAD sign assembly shall not be used to delineate a shared lane.

3.3.2.4.2 On-Road Bike Lanes

Signs may be used to supplement bike lane lines and markings; however, they are less effective on streets with on-street parking. The standard R3-17 BIKE LANE sign with the R3-17aP AHEAD plaque may be placed in advance of the start of a bike lane. The BIKE LANE sign with the R3-17bP ENDS plaque should be placed a sufficient distance in advance of the merge point to warn motorists and bicyclists that the lane is ending. However, during plan review, the City may request these signs be removed or relocated to reflect extensions of the bicycle network or reduce sign clutter.

For a contra-flow bike lane, signs shall be used to alert people walking, biking, and driving to the presence of bicycle traffic traveling in the opposite direction. Such signs include a modified R9-7 KEEP RIGHT/LEFT sign or a W6-3 TWO WAY sign with the bicycle symbol in the contra-flow direction/location relative to vehicular or pedestrian travel.

3.3.2.4.3 Separated Bike Lanes

Standard bike lane signage is not required to identify separated bike lanes, but the MUTCD R9-7 sign may be considered for locations with sidewalk-level separated bike lanes.

3.3.2.4.4 Shared Use Paths and Recreational Trails

All signs on shared use paths should be retroreflective and conform in color, legend, and shape requirements described in the MUTCD. Roadway users may be warned of a shared use path crossing by using a combined bicycle-pedestrian warning sign (W11-15), or a bicycle warning sign (W11-1). The assembly consists of a W11-15 or a W11-1 accompanied by a W16-7p (down arrow). YIELD and STOP signs are used to assign priority ahead of controlled but unsignalized path-roadway intersections. Refer to MUTCD Chapter 9B for guidance on signs at intersections. Where a high-volume path/trail crosses a low-volume driveway/road, the driveway/road should be yield- or stop-controlled. Multiple closely spaced driveway crossings with STOP signs requiring path/trail users to stop are ineffective; consideration should be given to consolidating crossings and/or reassigning priority to the path/trail.

At locations where the shared use path narrows due to physical constraints, warning signs indicating that the path narrows, such as W5-4a BIKEWAY NARROWS sign should be considered. Custom signs that educate users on proper trail etiquette are also recommended. (See Detail X)

3.3.3 Wayfinding

The goal of wayfinding is to implement a cohesive network of signs directed at different modes of transport, which helps all roadway users find the most efficient or pleasant routes to their destinations while establishing a sense of place.

On-road wayfinding signs shall comply with the MUTCD and the Virginia Supplement to the MUTCD in both design and placement, except where noted below.

3.3.3.1 Community Wayfinding

The MUTCD allows for greater flexibility in design if the signage is deemed “community wayfinding,” as described in MUTCD Section 2D.50. Cultural or historic destinations or routes that promote the overall culture of a city are good candidates for these guidelines. Community wayfinding guidelines recognize a community’s desire for signage that fits within its cultural context, and they provide examples of design adaptations that still maintain clarity and overall uniformity of signage.

The MUTCD’s Community Wayfinding guidance provides more relaxed guidelines than standard MUTCD D-series signs to allow for moderate customization. These guidelines restrict specific colors, fonts, sign sizes, etc. See MUTCD Section 2D.50 for more information.

The City of Charlottesville has implemented community wayfinding throughout the City. The following guidelines should be considered for each of the transportation modes:

3.3.3.2 Vehicle Wayfinding

3.3.3.2.1 Route Design

Vehicle wayfinding should be used to direct users to major traffic corridors and highways. It can also be used to identify parking locations. Routes should be direct but, where possible, should avoid sending through-travelers down streets with heavy pedestrian use.

3.3.3.2.2 Sign Design

Vehicle wayfinding signs shall comply with the MUTCD when placed on public right-of-way or where considered a traffic control device. Vehicle wayfinding signage should be highly standardized to promote clarity for users throughout their trip. This includes specific ranges of colors, font and sign sizes, and sign placement.

Gateway and parking signage shall be considered part of the City’s community wayfinding program. This program allows for greater flexibility from standard MUTCD guide signs in terms of colors, branding, font styles, etc. See MUTCD section 2D.50 for more guidance and Details X-X.



Figure 3-4: A map of Charlottesville's the Downtown Mall (Kai Bates)

3.3.3.3 Bicycle Wayfinding

Bicycle wayfinding should be used to establish and guide users through a network of low-stress streets. In addition to the MUTCD and the Virginia supplement to the MUTCD, the

AASHTO Guide for the Development of Bicycle Facilities provides guidance on the development and implementation of bicycle wayfinding signage.

3.3.3.3.1 Route Design

Route design for bicyclists should prioritize the safety and comfort of the user while balancing directness of the route. Routes should have a uniform, low level of stress whenever possible. Streets with facilities dedicated to biking are preferred, as they can contribute to safety and perceived safety of users. The Charlottesville Bicycle and Pedestrian Master Plan can be consulted in this process, as it identifies routes that fit these lower stress criteria and can contribute to a larger bicycle network.

Bicycle routes should be signed consistently at all decision points and with sufficient frequency between decision points to assure the user they are on the correct route. Route signage at a maximum separation of one-quarter to one-half mile is preferred.

3.3.3.3.2 Sign Design

Signage for bicycles should be designed such that the intended user is clear. Designs should reflect signage already in use in Charlottesville to promote consistency throughout the City. A sign assembly consists of several components: a route designation sign, such as the MUTCD M1-8 sign or a similar custom sign; a directional arrow, in the case of a turn in the route; and destination panels such as the MUTCD D1-1. If desired, these elements can be displayed on a single panel. Sign assemblies shall be installed at least 7 feet above a pedestrian walkway. The top should extend to no more than 10 feet in height to maintain visibility. One assembly should contain no more than three destinations. In the instance that there are additional turns needed to lead a bicyclist to a destination once they have left the main route, D1-1b plaques may be used as a stand-alone assembly.

3.3.3.4 Pedestrian Wayfinding

3.3.3.4.1 Route Design

The Streets That Work Design Guidelines and Charlottesville 2015 Bicycle and Pedestrian Master Plan should be consulted when identifying routes that are pedestrian friendly. Routes should not include areas with insufficient pedestrian infrastructure, such as sidewalk gaps. Routes should prioritize access to economic hubs of the City and public transportation. Pedestrian wayfinding can also be concentrated within one area of high use, such as a downtown.

3.3.3.4.2 Sign Design

Most pedestrian wayfinding is meant to enhance a pedestrian's experience of a culturally significant area and falls under the more flexible MUTCD guidance for community wayfinding. Pedestrian wayfinding should follow these guidelines unless there is a strong case that further variation from the MUTCD would better promote the unique identity of Charlottesville and further improve the experience of users. Pedestrian wayfinding often displays several destinations on one panel, with the design highlighting the City rather than a specific route. In addition to D1-1 destination signs, more striking options such as kiosk signs can contribute to the aesthetics of the streetscape while providing pedestrians with a better understanding of an area's significant destinations.

3.3.3.5 Trail Wayfinding

Trails may be classified as both shared use paths and recreational trails. Trail wayfinding must be designed to meet the needs of both bicycle and pedestrian users. Where trails are adjacent to roadways, standard MUTCD guidelines shall be followed. When a trail is separated from a roadway, more flexible designs are allowable. Adequate frequency of wayfinding is essential on trails to promote safety for users.

Recreational trail wayfinding should follow guidance from the Virginia Department of Conservation Recreation Trail Development and Management Manual. Signage on recreational trails can exhibit a more rustic look and incorporate materials such as wood rather than metal.

As much as possible, trail wayfinding should tie into existing trail signage and infrastructure, as larger networks of trails are much more valuable than isolated sections. Connections to existing trails such as the Rivanna Trail should be highlighted, and signage should reflect the design of these trails.

3.4 Access Management

The location, spacing, and design of intersections, driveways, alleys, and median openings should be designed in a manner that both provides vehicular access to adjacent properties and limits conflicts between other users to provide safe travel along streets.

For any development that will occur immediately adjacent to an intersection or any project that will alter a street within 50 feet of an intersection, that intersection, in its entirety, shall be surveyed and included in the existing conditions for that site plan. This will allow staff to review and assess impacts to the intersection as it relates to road striping, alignment, sidewalks, ramps and landings, crosswalks, etc.

In both residential neighborhoods and along mixed-use corridors, rear-loaded alleys shall be the default means for providing access to properties while reducing the need for driveways along streets. Blocks with multiple driveways can be challenging for pedestrians and bicyclists due to changes in grades and conflicts with turning vehicles. These challenges are more critical for pedestrians with visual impairments, wheelchairs, or strollers. It is up to the developer and design engineer to demonstrate to the City Engineer when an alley is not feasible from a topographical and engineering perspective. For more guidance see Chapter 4: Transportation, Section 4.4, Alleys.

3.4.1 Intersections

The intersection of two or more streets shall be designed in a manner that provides access for pedestrians to cross and that controls the speeds of turning vehicles where pedestrians intersect with active travel lanes.

3.4.1.1 Spacing

Offset intersections should not be proposed. For all streets except the US 250 Bypass and the John Warner Expressway, desirable spacing between intersections or vehicular and other transportation rights-of-way (e.g., shared use, bicycle, or pedestrian rights-of-way) entering a major street is no more than 250 feet. Minimum spacing shall be the greater of the stopping sight distance or the intersection site distance along the through street.

3.4.1.2 Geometry

Intersection design is critical to the safety and functionality of the street system. To create a safe and accessible street system, intersections should be compact and simple right-angles without skews or multiple-legs. Every reasonable effort should be made to design the intersection so there are no more than four legs.

Pedestrian refuges should be strongly considered if the crossing traverses three or more lanes of traffic. Curb extensions are required when parking is provided, and shall provide a minimum 20-foot clearance between the edge of pavement or face of curb of the cross street and the edge of the nearest parking stall. Design shall follow best practices described in NACTO's Urban Street Design Guide. Median islands or sign islands may be permitted if approved by the City Traffic Engineer.

If feasible and practicable, intersections shall be laid out to intersect at right angles; however, intersecting angles between 75 and 90 degrees may be permitted if approved by the City Traffic Engineer. Similarly, channelized right-turn lanes (slip lanes), which are

discouraged but may be necessary in some cases, should have nearly right-angle entry to the cross-street.

For new and reconstructed roads, a landing with a 2% maximum slope should be provided at least 50 feet in each direction from the intersection to ensure ADA-accessible cross slopes are provided at crosswalks. The measurement of 50 feet should start from the edge of pavement of the intersecting road or street, not the center of the intersection. If topographic conditions do not permit a 2% maximum slope, an alternate design shall be coordinated with City staff.

3.4.1.3 Minimum Corner Radii

The AASHTO A Policy on Geometric Design of Highways and Streets (AASHTO Green Book) provides guidance on turn radii at corners for different types of vehicles (large trucks, school buses, etc.). However, designing for the largest vehicle that might use an intersection can encourage drivers to make turns at higher speeds, lengthen crossing distances for pedestrians, and leave less space for sidewalks and other uses. Cross-street lane width, stop line placement, on-street parking, and near-side bus stops should be considered when determining a curb radius.

The minimum corner radius necessary to accommodate the design vehicle should be used for each intersection corner. The minimum corner radius can be as low as 5 feet; however, this will only be applicable where vehicles do not turn adjacent to that corner or where the effective radius is larger. The desirable intersection corner radii for intersecting streets should be 15 feet for Downtown or Neighborhood streets and 20 feet for all other streets, however the effective turning radius should be 28 feet (achievable by mountable truck aprons) to accommodate fire and emergency vehicles. If retrofitting an existing intersection where a 28-foot effective radius cannot be achieved, in no case shall the effective turning radius be less than the existing effective turning radius. Mountable truck aprons are allowed and should be provided in new construction; however, the mountable curb radius should follow these desirable intersection corner radius dimensions. Corner geometry and crosswalk alignment must also be carefully designed to prioritize pedestrian safety. Minimize crossing distances and ensure unobstructed sight lines of sufficient length based on design speed and intersection control. No street furnishings, signs, curb ramps, detectable warning surfaces, or other vertical obstructions shall be located within the effective turning radius of an intersection.

If intercity buses or standard 65-passenger school buses are expected to use the street, they should be used as the design vehicle, and minimum encroachment into the opposing lane of traffic on the receiving street should be permitted. A larger radius or additional

pavement at the intersection may be required on shoulder and ditch sections to avoid shoulder rutting, as determined by the City Traffic Engineer.

For roads with an ADT of greater than 1000 VPD, if buses are not expected to turn at the intersection, the Delivery Truck (SU-30 Single Unit Truck) design vehicle should be used, and minimum encroachment into the opposing lane of traffic on the receiving street should be permitted. A larger design vehicle and/or encroachment into the opposing lane of traffic may be permitted based on adjacent land uses, large vehicle frequency, and approval by the City Traffic Engineer.

All intersections with effective radii of less than 28 feet shall be designed with 7-inch mountable concrete curb in anticipation of vehicular impact.

Table 3-1: Curb Radii

	Mixed Use A	Mixed Use B	Downtown	Industrial	Neighborhood A	Neighborhood B
<i>Desired Curb Radius</i>	15' - 20'	15' - 20'	15'	20'	15'	15'
<i>Effective Curb Radius</i>	28'	28'	28'	28'	28'	28'

3.4.2 Transitions and Turn Lanes

Left or right turn lanes may be provided at intersections when the City determines that turning movements warrant their installation. These facilities shall be designed in accordance with the appropriate provisions of Appendix C of the VDOT Road Design Manual or other traffic analysis tools specifically approved for use by the City Traffic Engineer.

Where roadway through lanes shift laterally, or lane widths change, the length of the transition between these shifts should be calculated using the following formula for design speeds less than 45 mph.

$$L = S^2W / 60$$

L = Length of transition (feet)

S = Design speed (mph)

W = Width of offset (feet)

For roadways with design speeds of 25 mph or less, the City Traffic Engineer may permit transition lengths up to half of those calculated using the formula above.

3.4.3 Designated Truck Routes

Designated Surface Transportation Assistance Act (STAA) Truck Routes shall be designed to accommodate the design vehicles specified by VDOT. Roads within 1 mile of National Network and Virginia Qualifying Highways are permitted for truck use to access terminals and fuel, food, rest, and repairs. Roads within one 1 mile of these roadways that do not accommodate trucks must be coordinated with the City. Coordination between the City and VDOT is required for review and approval of appropriate truck restrictions.

3.4.4 Speed Limits/Design Speeds

Speed limits shall be the maximum speed at which it is lawful to travel. These speeds may be posted using speed limit signs or as established by City or State law. Design speeds shall be no higher than the posted speed limit. Based on lane widths, land use, anticipated street users, or other considerations, the City Traffic Engineer may permit design speeds that are lower than the posted speed limit.

3.4.5 Emergency Access

The width of pavement and mountable areas should be designed to accommodate emergency services by providing at least 20 feet of clear space. Narrow roadway widths and speed tables that apply to local street and alley conditions shall be developed in coordination with the **Fire Code Official**.

Along yield streets, the sidewalk may be used to satisfy the minimum 20-foot clear width with the approval of the **Fire Code Official** and approval of the sidewalk structure by the City Engineer. See Chapter 4, Section 4.5, Yield Streets, for additional design criteria.

Clear space may not be reduced below 20 feet on any road designated as a fire access road. Clear spaces must be configured so that all sides of structures are within a 150-foot hose length of the nearest fire access road/fire lane.

3.5 Traffic Calming

During street layout and design, the issue of traffic calming should be considered to encourage motor vehicles to travel at or below the design speed. Early consideration of traffic calming and design speed can minimize future speeding problems and improve safety and livability for all roadway users. The type of treatments considered or incorporated in the design may depend on the function and traffic volumes of the road.

and the design vehicle. Any traffic calming that changes the physical characteristics of the roadway should be coordinated with the **Fire Code Official**.

3.5.1 Types

Traffic calming features vary in size and complexity and may or may not include physical changes to the roadway. Traffic calming treatments may be implemented as a retrofit installation or as part of new construction projects. Design details and guidance for many types of traffic calming measures may be found in the City of Charlottesville Traffic Calming Handbook and the VDOT Traffic Calming Guide for Neighborhood Streets.

Types of traffic calming may include:

- Bulbouts / curb extensions
- Chicanes
- Chokers
- Diagonal diverters
- Enforcement signs (Additional \$200 Fine, etc.)
- Forced turns
- Gateways
- Medians / refuge islands
- Roundabouts / neighborhood roundabouts / circles
- Speed display signs
- Speed humps / lumps / tables
- Signal timing / green-waves

3.5.2 Appropriate Use

The context for any type of traffic calming feature should be considered with the adjacent land use, design speeds, roadway volumes (ADT), and desired result of implementing the feature. Traffic calming measures should generally be considered when 85th percentile speeds on a street or street segment exceed the design speed, or where slower speeds are desired at conflict points to address pedestrian and/or bicyclist safety issues. If the difference between 85th percentile speeds and 50th percentile speeds exceeds 15 mph, use the USLIMITS2 process developed by FHWA to verify if the 50th percentile speed is appropriate as the basis of a traffic calming treatment selection. In other cases, use the 85th percentile as the basis of treatment selection. Documented cases of excessive speeding that do not meet typical standards—for example, speeding during non-peak hours—may be justification for traffic calming measures. The following table identifies general criteria for when each type of traffic calming may be considered.

Table 3-2: Traffic Calming Treatments

<i>Treatment</i>	<i>Posted Speed</i>	<i>ADT *</i>
<i>Bulbouts / Curb Extensions</i>	N/A	N/A
<i>Chicanes</i>	≤ 30 mph	≤ 6,000
<i>Chokers</i>	≤ 30 mph	≤ 6,000
<i>Closures (Full or Half-Street)</i>	≤ 25 mph	≤ 3,000 **
<i>Diagonal Diverters</i>	≤ 30 mph	≤ 3,000 **
<i>Enforcement Signs (Additional \$200 Fine, etc.)</i>	N/A	N/A
<i>Forced Turns</i>	≤ 30 mph	≤ 3,000 **
<i>Gateways</i>	N/A	N/A
<i>Medians / Refuge Islands</i>	N/A	N/A
<i>Neighborhood Circles</i>	≤ 25 mph	≤ 3,000
<i>Roundabouts</i>	N/A	N/A
<i>Speed Display Signs</i>	N/A	N/A
<i>Speed Humps / Lumps / Tables</i>	≤ 30 mph	≤ 3,000
<i>Signal Timing / Green-waves</i>	N/A	N/A

*Minimum thresholds for traffic calming are typically 800 ADT or 150 vehicles per hour in the peak hour.

**Where traffic diversion will occur (e.g. closures, diagonal diverters, forced turns), traffic analysis for the affected and surrounding streets should be performed to determine the impacts to the network. The ADT may be greater or less than the threshold value indicated.

3.5.3 Design Considerations

Attention to four design areas can help to encourage motorists to travel at the design speed: the width of the roadway surface, the length of tangent sections, the vertical grades, and the adjacent street trees and building façade setbacks relative to the right-of-way.

The width of pavement should be the minimum needed to safely accommodate traffic and emergency services. Where this is not practical, the road width can be restricted at specific points through the use of chokers, medians, or curb extensions. Chokers,

bulbouts, curb extensions, speed bumps, and similar objects should not obstruct or fragment any planned or existing on-street bike lanes.

Tangent lengths of roads should ideally not exceed 500 feet to keep traffic speeds at or below 30 mph. This is not always practical, and as such, traffic calming features such as roundabouts, green-wave signal timing, chokers, raised medians, curb extensions, chicanes, or other geometric changes should be considered on framework streets and local streets.

Steep downgrades tend to increase vehicle speeds and should be avoided. Where horizontal geometry is not practical to maintain slower vehicle speeds, speed humps or other vertical traffic calming features should be considered. Through-truck routes shall be assessed for their appropriateness relative to their compatibility with horizontal and vertical traffic calming treatments and rerouted as necessary.

3.5.4 Fire Code Official Approval

Traffic calming features must be approved by the **Fire Code Official** to ensure that access for emergency services is provided or maintained.

3.6 Maintenance of Traffic

Temporary traffic control plans, in compliance with the MUTCD, VDOT Virginia Work Area Protection Manual (VWAPM), and VDOT Work Zone Pedestrian and Bicycle Guidance, shall be prepared and approved for all projects that include encroachment into motor vehicle, bicycle, and/or pedestrian facilities to ensure that access for all roadway users is provided throughout construction. In the event of temporary lane shifts, maintenance of existing bicycle and pedestrian lanes should take priority over maintaining on-street parking. Temporary access for pedestrians must comply with the Americans with Disabilities Act (ADA).

The actual work areas (zones) should be identified on the plans, and appropriate work site protections must be identified to protect both the public and construction workers. The plans must include notes indicating that all proposed traffic control devices shall meet the crashworthiness requirements of the VWAPM and the MUTCD. Traffic control plans may require more than one phase to construct the improvements. Detours are discouraged and must be approved by the City Traffic Engineer and coordinated with emergency services.

Design projects on all roads shall comply with the VDOT memorandum IIM-LD-241.5 (TED-351.3), Transportation Management Plan Requirements for Work Zone Safety and Mobility.

Any road closures or lane shifts on major roadways that will occur for periods of time that extend into or through the night hours shall require additional signage, lighting, or other components per the above referenced manuals or the direction of the City Traffic Engineer.

3.7 Multimodal Traffic Impact Analysis and Traffic Studies

The City of Charlottesville has the discretion to determine when a traffic impact study is needed. If the proposed site generates 50 total trips or more per hour during the adjacent street peak hour, then a traffic study is required.

This section presents requirements for the submission of Traffic Impact Analysis (TIA) to the staff of the City of Charlottesville's Department of Public Works. Unless otherwise agreed to, in writing by the preparer and City staff, failure to adhere to these requirements shall result in the rejection of the TIA. All deviations from the requirements listed below shall be attached to the TIA, referenced by chapter and section number. This attachment shall bear the signature of the preparer. All documents and deliverables shall be in printed and bound form, and at the option of City staff, provided as electronic files of an agreed upon format, and shall be signed and sealed by a licensed professional engineer.

This analysis will evaluate the peak hours and should also collect daily traffic counts to understand the distribution of traffic over the entire day. It is common for vehicle volumes during the busiest hour of the day to be used to evaluate motor vehicle LOS in traffic impact studies. However, street utilization varies throughout the day so it important the study consider off-peak needs and operations as well when determining the mitigation and recommended improvements for the proposed development.

It is recommended that the Applicant meet with the City Traffic Engineer to determine the scope of the analysis prior to submitting the TIA. VDOT's Pre-Scope of Work Meeting Form should be used to document basic project information and base assumptions prior to the meeting with the City Traffic Engineer.

3.7.1 Traffic Impact Analysis Requirements

3.7.1.1 Introduction and Background Information

The TIA shall include the following description and maps of the study area and project:

Description and map(s) showing the site location, site topography, study area boundaries and intersections, and existing bicycle, pedestrian, transit, and motor vehicle transportation facilities. Unless otherwise agreed upon in writing, transportation facilities external to the development shall be included if the project's generated traffic will constitute at least 15 percent of the facilities' existing traffic volume. This area shall not extend more than 2-4 intersections from the project site.

3.7.1.2 Analysis of Existing Conditions

Analysis of existing conditions shall include:

- Description and map or diagram of existing and proposed land uses/developments of the parcels in the study area in terms of various zoning.
- Description and map or diagram of existing roadways, intersections, and other transportation facilities including road geometrics, lane usage, pedestrian facilities (e.g. sidewalks, curb ramps), bicycle facilities (e.g. bike lanes, shared use paths), traffic control, local public facilities (e.g. schools, churches, parks), and transit routes and stops within the study area.
- Traffic Volumes: Daily and peak hour traffic volumes, including turning movements, pedestrian volumes, and bicycle volumes, shall be collected on all transportation facilities within the study area boundaries. These traffic volumes shall be presented in diagrams and data included in the Appendix.
- Capacity Analysis: Utilizing techniques as described in the most recent version of the Highway Capacity Manual, the relative balance between roadway volumes and capacity shall be assessed. See VDOT Traffic Impact Analysis guidelines for additional guidance on traffic analysis software options. Existing conditions (roadway geometrics and traffic signal control) for all peak hours shall be analyzed. The results shall be displayed in a diagram and tables with levels of service and delay provided for each lane group.
 - a. **Inputs:** All inputs to this traffic analysis software shall reflect observed conditions, including volumes, heavy vehicles, geometrics, and other system parameters. Peak hour factors used in the calculation of design hour volumes shall be calculated from observed volume data. Any assumptions made that deviate from the programmed defaults must be documented and

an explanation provided as to why there was a change (i.e., lane utilization factor).

- b. **Levels of Service (LOS) and Delay:** Based on the results obtained in the analysis, the levels of service and delay for all intersections and intersection movements shall be presented. This should include Bike/Ped LOS and delay. Include a description of typical operating conditions at each level of service. These levels of service shall be presented in diagrams and in tabular form.
- c. **Queuing Analysis:** Based on the most recent version of the Highway Capacity Manual or other acceptable engineering methods, determine the existing queue lengths at the study area intersections and whether sufficient storage exists.
- d. **Volume-to-Capacity:** The volume-to-capacity ratio (v/c) for all signalized intersections and movements shall be presented.

3.7.1.3 Analysis of Future Conditions without Development

An analysis describing projected future conditions assuming the project is not built shall include the following:

- **Analysis Year(s):** The future year(s) for which projections are made will be specified by City staff and will be determined by the timing of the proposed development. In general, the analysis must include the "build out" year, when the development is expected to be completed. It should also include an analysis for each year in which significant phases are to be completed.
- **Future Traffic Volumes:** There shall be a clear indication of the method and assumptions used to forecast future traffic volumes. The method and assumptions used shall be agreed upon by the preparer and City staff. These volumes shall be presented in diagrams.
- **Programmed Improvements:** Description and map or diagram of proposed improvements to roadways, intersections, and other transportation facilities including road geometrics, lane usage, traffic control, and transit routes and stops within the study area. Improvements should be considered in the traffic study if they are included in the region's Long Range Transportation Plan or the relevant Six Year Plan(s).
- **Future Capacity Analysis:** The analysis must determine the ability of the existing roadway system to accommodate future traffic (without site development) for all peak hours based on the Highway Capacity Manual. If roadway improvements or

modifications are committed for implementation, analysis of these conditions may be assumed.

- **Levels of Service, Delay, Queuing Analysis, and Volume-to-Capacity:** Based on the future conditions without development capacity analysis, the levels of service, delay, queues, and v/c shall be presented in diagrams and tabular form.

3.7.1.4 Trip Generation

The multimodal traffic to be generated by the site on both a daily and a peak hour (morning and evening) basis for the adjacent roadway system, plus the peak hour conditions for the site if different from above shall be presented. A table showing the land use amount (square feet, dwelling units, etc.), land use code, the trip rate or trip equation, mode splits, and the number of trips generated for each mode (i.e. auto, pedestrian, bicycle, transit) by the site must be provided. Refer to VDOT Traffic Impact Analysis guidance for recommended approaches to trip generation, including trip reductions for pedestrian accommodations, bicycle accommodations, and transit available near the site. See VDOT's Updated Administrative Guidelines for the Traffic Impact Analysis Regulations. The multimodal trip generation should be reviewed by the City Traffic Engineer prior to capacity analysis for future conditions with development.

3.7.1.5 Traffic Distribution and Assignment

The report must describe the direction of approach and departure for site-generated traffic and show, on diagrams, the traffic assignment to the road network serving the site for the appropriate time periods. The basic methodology and assumptions used must be clearly stated. The directional distribution should be based on anticipated employment, commercial, and residential sites that will serve as the market or "draw" for the proposed development.

3.7.1.6 Analysis of Future Conditions with Development

An analysis describing projected future conditions assuming the project is built shall include the following:

- **Future Traffic Volumes:** Future traffic volumes including both the background traffic and site traffic shall be clearly shown in diagrams for the study area.
- **Future Capacity Analysis:** The analysis must determine the ability of the existing roadway system to accommodate future traffic (with site development) for all peak hours based on the Highway Capacity Manual. If roadway improvements or

modifications are committed for implementation, analysis of these conditions may be assumed.

- **Levels of Service, Delay, Queuing Analysis and Volume-to-Capacity:** Based on the future conditions with development capacity analysis, the levels of service, delay, queues, and v/c shall be presented in diagrams and tabular form.

3.7.1.7 Recommended Improvements

The report must clearly describe and diagram the location, nature, and extent of proposed improvements to ensure safe and efficient access to the site for all modes. Preliminary cost estimates, sources of funding, timing, and assurance of implementation shall be included.

Levels of Service, Delay, Queuing Analysis, and Volume-to-Capacity: Based on the future conditions with development for recommended improvements; capacity analysis, levels of service, delay, queues, and v/c shall be presented in diagrams and tabular form. When evaluating the proposed improvements, motor vehicle delay and queues should be assessed as described in this and previous sections. However, when determining mitigation for motor vehicle traffic, the designer should consider whether potential motor vehicle mitigation would preclude network recommendations or spot improvements recommended in the 2015 Bicycle and Pedestrian Master Plan. Additionally, designers should consider impacts of additional motor vehicle traffic on pedestrian and bicycle safety and comfort. For example, if a development adds a high volume of turning vehicles, the designer should consider mitigation for the increase in vehicle volumes, such as tightening intersection geometry or implementing a protected phase.

3.7.1.8 Conclusions

The last chapter of the report should be a clear, concise description of the study findings. This concluding chapter should serve as an executive summary.

3.8 References

AASHTO A Policy on Geometric Design of Highways and Streets, “The Green Book”

AASHTO Guide for the Development of Bicycle Facilities

[City of Charlottesville Bicycle and Pedestrian Master Plan](#)

[City of Charlottesville Streets That Work Design Guidelines](#)

[City of Charlottesville Traffic Calming Handbook](#)

[Charlottesville/Albemarle MPO Long Range Transportation Plan](#)

[FHWA Interim Approval for Optional Use of Two-Stage Bicycle Turn Boxes \(IA-20\)](#)

[FHWA Interim Approval for Optional Use of an Intersection Bicycle Box \(IA-18\)](#)

Highway Capacity Manual

[Manual on Uniform Traffic Control Devices](#)

[NACTO Urban Bikeway Design Guide](#)

[NACTO Urban Street Design Guide](#)

[US Access Board Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way \(PROWAG\)](#)

[US Department of Justice Americans with Disabilities Act Standards for Accessible Design](#)

[VDOT Administrative Guidelines for the Traffic Impact Analysis Regulations](#)

[VDOT Instructional and Informational Memorandum IIM-LD-241.5 \(TED-351.3\),](#)

[Transportation Management Plan Requirements for Work Zone Safety and Mobility](#)

[VDOT Instructional and Informational Memorandum IIM-LD-384.0 Pedestrian Crossing Accommodations at Unsignalized Locations](#)

[VDOT Road and Bridge Specifications](#)

[VDOT Road Design Manual](#)

[VDOT Six-Year Improvement Plan](#)

[VDOT Traffic Calming Guide for Neighborhood Streets](#)

[VDOT Traffic Engineering Design Manual](#)

[VDOT Virginia Supplement to the Manual on Uniform Traffic Control Devices](#)

[VDOT Virginia Work Area Protection Manual](#)

[VDOT Work Zone Pedestrian and Bicycle Guidance](#)

Virginia Department of Conservation Recreation Trail Development and Management Manual

3.9 Additional Resources

[Virginia Statewide Fire Prevention Code \(SFPC\)](#)

CHAPTER 4

TRANSPORTATION

4.1 Intent and Purpose

The standards and guidelines in this chapter are intended to clearly communicate expectations regarding the design of the City's transportation network. Further, this chapter's purpose is to ensure that transportation design documents balance all modes such that walking, bicycling, transit, and driving are safe, appealing, and convenient ways to travel through Charlottesville.

4.2 General Requirements

Geometric design criteria for all roadways shall be in accordance with the Charlottesville Standards and Design Manual. In addition, the Standards and Design Manual shall not conflict with the Public Rights-of-Way Accessibility Guidelines (PROWAG), the Americans with Disabilities Act Standards for Accessible Design, or the Virginia Statewide Fire Prevention Code (VSFPC). Throughout this manual, coordination with the City's **Fire Code Official** is noted when a specific VSFPC requirement cannot be met.

The following references should be used as guidance:

- Virginia Department of Transportation Road and Bridge Specifications
- Virginia Department of Transportation Road and Bridge Standards
- Virginia Department of Transportation Road Design Manual
- AASHTO Roadside Design Guide
- AASHTO Guide for the Development of Bicycle Facilities
- US Department of Justice Standards for Accessible Design (ADA)
- US Access Board Public Right-of-Way Accessibility Guidelines (PROWAG)
- National Association of City Transportation Officials (NACTO) Urban Street Design Guide

If one of these references differs from the Standards and Design Manual on the same requirement, the Standards and Design Manual shall be used as the prevailing design guidance. AASHTO and NACTO guidance may be helpful in identifying best-practice designs that are compliant with minimum standards of the Manual on Uniform Traffic

Control Devices. AASHTO and NACTO are the preferred source for best practices and should be consulted first.

In the event of conflict among the VDOT Road Design Manual, the Road and Bridge Standards, and/or other references, the City Engineer or Traffic Engineer, guided by the intent and purpose expressed in Chapter 1: Introduction of this manual, will determine the governing provision. When discretionary authority is applied, guidelines that prioritize vulnerable users and urban street forms should take precedence.

For the purposes of this document, “City Engineer or assigned designee” means that employee who oversees engineering for the City of Charlottesville Department of Public Works is the designee assigned by the current City Engineer and is also responsible for the review and approval of street design.

4.3 Streets and Roads

The design of streets and roads in the City is founded on providing for the mobility and safety needs of citizens while establishing an interconnected, multimodal network within different local, state, and private jurisdictions. This section provides clarity on the application and appropriateness of different design standards within this context.

4.3.1 Roadway Classification

Streets in Charlottesville fall within a set of street types that form the framework for appropriate design features based on the context and dimensions of the street. The primary approach to the classification of street types adheres to the guidelines for framework streets established in the City of Charlottesville Streets That Work Design Guidelines and the future land use described in the Charlottesville Comprehensive Plan. The six street types are presented in Table 4-1 below.

Table 4-1: Street Types

	<i>Mixed Use A</i>	<i>Mixed Use B</i>	<i>Downtown</i>	<i>Industrial</i>	<i>Neighborhood A</i>	<i>Neighborhood B</i>
<i>% of Total Miles in City</i>	<3%	8%	2%	<2%	9%	7%
<i>Travel Lanes</i>	4 or more	2	2	2	2	2
<i>Sidewalks</i>	Both sides	Both sides	Both sides	Both sides	One or Both Sides	None or one side

	<i>Mixed Use A</i>	<i>Mixed Use B</i>	<i>Downtown</i>	<i>Industrial</i>	<i>Neighborhood A</i>	<i>Neighborhood B</i>
<i>Dedicated Bicycle Facilities</i>	Yes	Yes	No	No	Yes	No
<i>Land Uses</i>	Commercial, Mixed-use	Mixed-use	Commercial, Mixed-use	Commercial, Industrial	Residential	Residential

Local streets form most of the street network (73%). However, Local streets are not assigned a type due to the variations in context, and thus they are considered non-framework streets.

For street projects requiring review or acceptance by VDOT, the designer should refer to the hierarchy of the urban functional systems listed in the VDOT Road Design Manual, Appendix B, Subdivision Street Design Guide. The urban functional systems consist of principal arterials (for main movement), minor arterials (distributors), collectors, and local roads and streets. This helps to facilitate review and discussion of the City’s street types and similar VDOT functional classifications. A map illustrating the functional classification of the existing roadway network is contained in the Comprehensive Plan and the Streets That Work Design Guidelines. AASHTO’s A Policy on Geometric Design of Highways and Streets (AASHTO Green Book) provides further guidance on the functional classification of roads.

For projects that may not conform to an above listed street type, refer to Chapter 2, Section 2.8, Innovative Design Proposals, for guidance.

4.3.1.1 Non-Public Streets

Any street or other way or means of vehicular access that is not designed, constructed, bonded, or approved to be maintained by the City as part of its urban highway system, regardless of ownership, is considered a non-public street. The City will not assume ownership and maintenance of a private street if the street is not designed and constructed to the standards established in this manual.

Any street that is not constructed per the current requirements at the time of site plan approval will not be accepted into the City’s maintenance system as a public street.

4.3.2 General Design Requirements

The City of Charlottesville intends to encourage new development to provide streets that meet or exceed the minimum standards and design criteria to provide safe and efficient access and mobility for pedestrians, bicyclists, and drivers. This chapter presents

descriptions of the planning and design process for new transportation facilities. It provides guidance and references for the developer to use in preparing designs for new streets and private alleys. Chapter 2: General Site Plan and Permitting Requirements also provides guidance for making the required submittals of roadway plans to the City of Charlottesville for review and approval prior to construction.

4.3.2.1 Geometric Design

Comprehensive street design ensures safe and effective space is available for multimodal travel. Table 4-2 summarizes various street elements to be considered when designing or redesigning Charlottesville streets and correspond to the Streets That Work Design Guidelines.

Table 4-2: Street Elements

	Mixed Use A	Mixed Use B	Down-town	Indus-trial	Neigh-borhood A	Neigh-borhood B	Local	Yield
Design Speed	<30 mph	<30 mph	25 mph	<25 mph	<25 mph	<25 mph	<25 mph	15-20 mph
Sidewalk Width	>7' clear walk zone	>7' clear walk zone	>6' clear walk zone	5' – 6'	7'-8'	7'-8'	5' – 6'	5' - 6' **
Curb Radii	20' – 30'	20' – 30'	15' – 25'	20' – 30'	15' – 25'	15' – 25'	15' – 25'	10' – 15'
Travel Lane Width	10' – 11'	10' – 11'	10' – 11'	11' – 12'	10' – 11'	10' – 11'	10'*	10' – 12'†
Curbside Buffer Zone	3'-6'	3'-6', Loading zones should be considered	3' – 6'	3' – 6'	3' – 6'	3' – 6'	0' – 3'	0' – 3'
On-street Parking	8'	7' – 8'	7' – 8', loading zones	7' – 8'	7' – 8'	7' – 8'	7' – 8'	7' – 8'‡
Diagonal On-street Parking	Back in, 60 degrees, 17' min. stall depth	Back in, 60 degrees, 17' min. stall depth	Back in, 60 degrees, 17' min. stall depth	None	None	None	None	None
Turn Lanes	10'	10'	Major intersections	10' – 11'	None	None	None	None

	<i>Mixed Use A</i>	<i>Mixed Use B</i>	<i>Down-town</i>	<i>Indus-trial</i>	<i>Neigh-borhood A</i>	<i>Neigh-borhood B</i>	<i>Local</i>	<i>Yield</i>
<i>Bicycle Facility</i>	Varies (bike lanes, separated bike lanes, shared use paths)	Varies (bike lanes, separated bike lanes, shared use paths)	Shared lanes	5' bike lanes, 6' climbing lanes	5' bike lanes, 6' climbing lanes, shared lanes	Shared lanes	Shared lanes	Shared Lanes

* Local street lane widths less than 10 feet are subject to review and approval per Section 4.3.2.1.1.

** Smaller sidewalks may be permitted for retrofit conditions in coordination with City staff.

† Travelway with no center line. Curb to curb measurement between 24' and 26'

‡ Checkered parking scheme to allow periodic yield and 20' clear at prescribed intervals.

Dimensions for streets are contingent on the type of street being designed or redesigned. Designing a street with the minimum dimensions for each element compromises both safety and function. When combining multiple elements, minimum dimensions should not be used adjacent to each other.

Additionally, in retrofit situations where limited right-of-way and varying conditions preclude providing all desired street elements, the highest priority street elements are highlighted. The engineer shall consult with City Staff to determine the trade-off that benefits the land use(s) in the area.

The geometric design standards contained in this manual shall be used for Local streets. Processes for applying reduced minimum design criteria on Local streets are described where applicable.

The City Engineer is authorized to consider and render a decision on unresolved issues between the developer and the design engineer that pertain to the interpretation and application of this manual. All appeals shall be made in writing, shall describe the unresolved issue, and shall include copies of all prior relative correspondence.

4.3.2.1.1 Lane Widths

Lane widths are presented in the Streets That Work Design Guidelines and may vary based on Table 4-3.

Table 4-3: Travel Lane Widths

	Mixed Use A	Mixed Use B	Downtown	Industrial	Neighborhood A	Neighborhood B	Yield
Travel Lane Widths*	10'-11'	10'-11'	10'-11'	11'-12'	10'-11'	10'-11'	10'-12'

*11-foot curb lane along transit routes

Proposals for narrower streets must be reviewed by the City as well as Fire and Emergency Services on a case-by-case basis. The standard lane width prescribed by the Virginia Statewide Fire Prevention Code (VSFPC) may be reduced if alternative safeguards will be implemented to assure an equivalent level of protection of life and property from fire and explosion hazards. Requests for modifications shall be submitted to the **Fire Code Official** and must be supported by technical data in accordance with the procedures and standards set forth within Section 106.5 of the VSFPC as amended. The **Fire Code Official** will require, and will consider, statements from City engineers and City planners as to whether the modification will assure the public health, welfare, and safety.

4.3.2.1.2 On-Street Parking

Using the public right-of-way for loading and parking supports a variety of adjacent land uses. Most private vehicles are 6 feet to 6.5 feet wide, and 7-foot parking lanes are allowable on most street types as summarized in Table 4-4 below. On-street parking lanes have a minimum width of 7 feet and a preferred width of 8 feet. An 8-foot parking lane is required when located adjacent to a bicycle lane.

Table 4-4: Parking Lane Widths

	Mixed Use A	Mixed Use B	Downtown	Industrial	Neighborhood A	Neighborhood B
Parking Lane Width	8'	7'-8'	7'-8'	7'-8'	7'-8'	7'-8'
Applicability	Limited or none	Loading zones should be considered	Loading zones should be considered	Limited or none	See note	See note

Note: Only where driveways and off-street parking are not available.

4.3.2.1.3 Grades

The maximum allowed street grade shall be 10 percent.

4.3.2.1.4 Drainage

Adequate street drainage shall be provided in accordance with the VDOT Drainage Manual and Chapter 5 of this manual.

To promote cycling and ease of maintenance, VDOT DI-3 or DI-4 series inlets shall be used. DI-2 series curb inlets are only permitted if approved by the City Engineer. When VDOT DI-2 series curb inlets are permitted, they shall be provided with curb and gutter sections since the cross slope of the grate is designed to function with a gutter pan. For situations in which a VDOT DI-2 is needed where a gutter pan cannot be provided, the grate portion of the inlet shall be precast or modified in the field to match the cross slope of the road. Any modification of a precast DI-2 shall be approved and inspected by a member of the City Engineering inspection staff.

4.3.2.1.5 Alignment

Provision shall be made, when necessary, for the continuation of principal existing or platted streets into adjoining areas.

Local streets shall be laid out to conform as much as possible to the topography to increase connectivity, encourage energy conservation, and permit efficient drainage and utility systems. Refer to Chapter 3, Section 3.5 for traffic calming measures that should be taken to discourage high-speed cut-through traffic.

No more than two streets shall intersect at one point unless specifically approved by the City Engineer or assigned designee. Refer to Chapter 3, Section 3.4.1, Intersections for specific design guidance and orientation to reduce speeding.

4.3.2.1.6 Sight Distance

Stopping sight distance (SSD) shall be based on a height of eye of 3.5 feet and an object height of 2 feet along the center of the travel lane. The grade of the roadway has an effect on the stopping sight distance. The stopping distance is increased on downgrades and decreased on upgrades.

Intersection sight distance should be measured presuming a stop condition of the minor roadway. Sight distance shall be based on a height of eye of 3.5 feet and an object height of 3.5 feet. Dedicated right-of-way may be required to preserve appropriate sight distance at intersections. The City Engineer may consider an easement as an alternative to dedicated right-of-way. The intersection sight distance triangles and roadway grade/sight line profiles shall be noted on plans.

Sight distance triangles are used to determine the visibility of an object approaching along an intersecting roadway. The sight distance triangle is bounded by the point along the major roadway, the object approaching along the intersecting roadway, and the center of the intersecting roadways. The intersection sight distance is measured along the major roadway, based on the major roadway's design or, in the case of existing roadways, the posted speed limit. Sight distance triangles shall be noted on plans.

Sight distance triangles referenced in Chapter 9, Intersections of the AASHTO Green Book shall be used for design of local streets. On roads where VDOT review and approval is required, it is recommended to refer to sight distance triangles in the VDOT Road Design Manual's Appendix B, Subdivision Street Design Guide.

4.3.2.1.7 Vertical and Horizontal Curves

Vertical and horizontal curves will comply with VDOT Road and Bridge Standards (SD-1 to SD-5).

4.3.2.1.8 Vertical Clearance

At no point shall vertical clearance over a street be less than 14 feet, nor shall it impede vehicular and pedestrian access. Planned resurfacing of any road shall consider opportunities to provide additional clearance. The vertical clearances for proposed bridges shall comply with the requirements of Part II, Chapter 6 of the VDOT Manual of the Structure and Bridge Division. For more guidance see Chapter 8: Bridges, Retaining Walls, and Other Related Structures.

4.3.2.1.9 Widths

The minimum acceptable widths of right-of-way, paved surface, and adjacent elements for newly constructed streets of various categories are presented in the City of Charlottesville Streets That Work Design Guidelines.

Generally, right-of-way widths should be consistent throughout the corridor where possible. Public infrastructure should be placed to minimize the need for maintenance easements.

4.3.2.1.10 Cul-de-sacs and Turnarounds

To afford the greatest flexibility in design, various types of turnaround designs may be used on streets.

Any street that exceeds 150 feet in length from the point of intersection to the end of the pavement shall include a cul-de-sac or other approved turnaround. Additional right-of-

way shall be provided as required by the turnaround design to continue the right-of-way limits around the perimeter of the turnaround. A 10-foot clear zone shall be provided beyond the edge of pavement. The clear zone shall not include vertical elements, such as fences or walls, that may impede emergency apparatus.

On low-volume streets with fewer than 25 dwellings and 1/4 mile in length, a radius of 30 feet shall be used.

Provide signs and reflective markers complying with MUTCD for streets that terminate in dead ends or cul-de-sacs. Provide guardrails where hazards exist adjacent to dead ends or cul-de-sacs.

Circular Type Turnarounds

For circular turnarounds, a well-defined identifiable street segment, equal to the normal lot width along the intersected street that serves the cul-de-sac or 50 feet, whichever is greater, shall extend from the intersected street to the turning area. A minimum radius of 40 feet, measured to the edge of pavement or face of curb, shall be used. On low-volume streets with fewer than 25 dwellings and less than 0.25 miles in length, a radius of 30 feet shall be used.

Cul-de-sacs with Unpaved Centers (Islands)

When a circular turnaround is proposed with an unpaved area in the center, the roadway around the center should be considered a one-way street and designed according to Table 3 in Appendix X. Pavement widths may be increased by the City Engineer to accommodate turning radii of single unit truck design vehicle. Cul-de-sacs with curb and gutter should have a mountable curb along the circumference of the island.

The unpaved area shall have a minimum radius of 30 feet, as shown in Detail XX. Any non-travel areas included within turnarounds should be included in the dedicated right-of-way of the facility.

If the center radius is greater than 120 feet, the street will be considered a loop street and should be designed in accordance with tables in Appendix X.

Sidewalk and curb built to City standards shall be installed around the open circumference of the cul-de-sac. No cul-de-sac street shall exceed 700 feet in length, excluding the turnaround.

Alternative Turnarounds (for Residential Streets Only)

“T and Branch” type turnarounds may be considered for short streets less than 0.25 miles in length. Examples are shown in Detail XX. Other proposals must be judged on their

merits by the City Engineer and the City **Fire Code Official**. However, when proposed, the ability of single unit truck design vehicles to reverse direction on these alternative types of turnarounds without leaving the pavement area should be proven.

Temporary turnarounds and stub streets

A turnaround should be provided for any temporary stub street longer than 150 feet from the point of intersection to the end of pavement. Any portion of the turnaround outside the dedicated right-of-way for the temporary stub street must be placed in an easement, which can be vacated at the time that street is extended to its final condition.

Stub streets terminate temporarily and take on the characteristics of a dead-end street. Stub streets may be part of various developments but are included with the intention that the street will continue in the future. Stub streets shall be provided with a turnaround area having a radius no less than 45 feet or a “T” style turnaround approved by the City **Fire Code Official**. All permanent streets that exceed 150 feet shall have a permanent turnaround fully located within the public right-of-way.

4.3.2.1.11 Clear Zones

The right-of-way along new public streets and highways maintained by the City must remain clear of all obstacles that are not designed to break away under impact. For the purposes of this section, breakaway structures are defined as a single, 4-inch by 4-inch square, 4-inch diameter wooden post, or a standard strength metal pipe post no greater than a two 2-inch diameter.

When curbing is used, the clear zone is measured from the face of the curb, except where a bike lane or parking lane exists between the curb and the traveled way. In such a case, clear zone may be measured from the edge of the traveled way. For shoulder and ditch sections, the clear zone is measured from the edge of pavement.

For roadways with curb, a clear roadway is still the goal. However, many compromises are likely to be necessary in urban or restricted environments. A minimum lateral offset of 1.5 feet shall be provided beyond the face of curb, with 3 feet minimum at intersections and driveway openings (10–15 feet recommended). Refer to the VDOT Road Design Manual Appendix A, Section A-2 Clear Zone / Lateral Offset Guidelines for more clear zone requirements.

Approved mailboxes and newspaper boxes may be placed on the City’s right-of-way. Placement should not interfere with safety, maintenance, or use of the roadway or sidewalk. Support structures for multiple mailboxes shall be designed and constructed in accordance with VDOT’s Road and Bridge Standard RFD-1. However, lightweight

newspaper boxes may be mounted on the side of the support structure. Breakaway structures noted above will be acceptable as a mailbox post.

Traffic volume, operational or design speed of the street, and the typical cross-section of the street determines the required clear zone. The geometric design Tables 1, 2, 3 and 4 in VDOT's Road Design Manual, Appendix B provide suggested clear zone requirements for subdivision streets. Any structures or landscaping, including trees, fences, stone or brick mailbox posts, and columns or walls that do not meet breakaway requirements may not be located within the clear zone and will require review by City Engineer to be placed on the right-of-way.

4.3.2.2 Names

Where a street is planned as a continuation of an existing street, such street will bear the same name.

New street names shall be sufficiently different from existing street names in the City of Charlottesville or Albemarle County to avoid confusion. Street names are required prior to final approval of any plat or site plan. Road A, B, C, etc. should only be used during the design phase. Once a street name is approved and platted, it cannot be changed until the project is completed.

The developer shall furnish and install one street name sign per street at new intersections. Street name signs shall meet the requirements in this manual.

4.3.2.3 Typical Sections

Roadway sections vary on the street type and land use setting. Retrofit and unconstrained cross-sections are available in Section 3.3 of the Streets That Work Design Guidelines to reflect available right-of-way and recommended street elements.

4.3.2.4 Pavement Sections

Geotechnical investigation requirements and recommendations are described in Chapter 2: General Site Plan and Permitting Requirements. The engineer shall design pavement sections to a California Bearing Ratio (CBR) value of 5.0 or higher. Pavement sections shall be inspected by the City at the appropriate time defined in Chapter 12: Maintenance and Methods of Construction.

The minimum pavement section for any City street shall be 6 inches of stone base (21A), 2.5 inches of base mix (BM-25.0A), and 1.5 inches of surface mix (SM-9.5A). Anticipated traffic or soil conditions may warrant a thicker pavement section as determined by VDOT pavement design criteria.

When designing subdivisions with new streets, the designer shall consider the impact of construction traffic and the associated heavy equipment during the interim stages of road construction. If the road is intended to be paved and used by construction traffic as the subdivision is built out, then a thicker stone section or base layer shall be incorporated into the design. In cases where the road construction is anticipated to take longer than 12 months prior to application of the surface mix, an intermediate course (IM-19.0A) with a minimum thickness of 2 inches shall be incorporated into the design until the surface layer is applied prior to street acceptance. If the design of a road does not accurately anticipate the duration of road construction, an intermediate course will be required by the City after 12 months. This intermediate course will then be milled and replaced with a surface mix prior to street acceptance.

When any construction project results in pavement cuts that lower the Pavement Condition Index (PCI) to a value of 68 or below, standard pavement patching will not be acceptable and the road (or portion of) must receive a 2-inch mill and pave to maintain a PCI of 69 or above. The limits of the mill and pave shall extend from the edge of pavement to the centerline of the road, or for the full width, whichever is minimally required by the City Engineer to maintain a PCI of 69.

4.3.3 Driveways

4.3.3.1 Residential Entrances

Residential driveways with curb and pedestrian facilities along the roadway shall be constructed using a standard entrance (See Detail RE-1 and RE-2, Appendix X) to provide continuous and level pedestrian access and encourage entering and exiting vehicles to yield to pedestrians.

With the approval of the City Engineer, residential driveways without curb and pedestrian facilities along the roadway (mountable Std. CG-3) shall tie into the existing street in accordance with Detail X.

4.3.3.2 Commercial Entrances

Unless signalized, commercial driveways with pedestrian facilities along the roadway shall be constructed using a standard entrance (Std. CG-9 or CG-11) to provide continuous and level pedestrian access and encourage entering and exiting vehicles to yield to pedestrians. Design of uncurbed roadways without sidewalks pedestrians is depicted in Detail X.

4.3.3.2.1 Angle

If feasible and practicable, commercial entrances shall be laid out to intersect at right angles; however, intersecting angles between 75 and 90 degrees may be permitted if approved by the City Engineer.

4.3.3.2.2 Spacing

The number of driveways accessing a property should also be limited to one unless approved by the City Engineer. The spacing of driveways should be such that driveways are not immediately adjacent to one another or that they are consolidated where possible. Offset driveway intersections should not be provided. The minimum spacing between commercial driveways on the same side or opposing sides of the street should be no less than 100 feet.

4.3.3.3 Entrance Profile/Grade

In the interest of assuring adequate and convenient access to and from public roads, the difference in grade between the slope of the roadway and the slope of the driveway should not exceed 10%. Proposed driveway locations and grades shall be shown for every driveway shown on a site or subdivision plan.

Any grade change that results in a crest condition shall not exceed 10%. Any grade change that results in a sag condition shall not exceed 9%. Grade changes may exceed these limits if a vertical curve is provided and it can be demonstrated that passenger cars will not drag or scrape.

Entrance grades shall be no greater than an 8% grade difference with the landing area. If the existing grades do not allow for this, a driveway tie-in shall extend at 8% up to 75 feet behind the edge of roadway pavement to the existing grade.

4.3.3.4 Private Entrances

See VDOT Road Design Manual Appendix B, Subdivision Street Design Guide “Private Entrances.”

4.3.3.5 Driveway Materials

To eliminate tracking of gravel and sediment into the public ROW, across sidewalks, or into the City’s storm drain system, driveways must be constructed from a non-erodible surface.

Non-erodible surfaces include but are not limited to asphalt, concrete, pavers, or other surfaces approved by the City Engineer. Gravel is considered to be an erodible surface.

The non-erodible requirement applies for a distance of at least 20 feet from the point where a driveway connects to the City's improved ROW (usually the back of sidewalk or edge of pavement). Beyond 20 feet, a driveway may transition to a compacted stone such as 21A, pea gravel, or tar and chip, but in no case shall any part of a driveway be composed of highly erodible material such as bare earth or compacted soils. In cases where the driveway slopes away from the public ROW, the non-erodible requirement shall only be required for a distance of 10 feet.

4.3.4 Minimum Street Improvements Required

Pavement markings shall be replaced any time the pavement is disturbed for utility cuts and patching. The disturbance of pavement also requires full milling and overlay of any temporary patching. When one third of the pavement in a block is disturbed, the entire block shall be resurfaced with milling and overlay. Refer to Chapter 12: General Materials and Methods of Construction for further guidance.

4.4 Alleys

Alleys are an integral part of the street network. They provide access to the rear or side lot line of abutting properties that front along streets, thereby keeping the pedestrian and bicycle zone of the public street clear of vehicular conflict points and changes in grade.

Alleys shall be provided in the rear of all business and industrial district lots. Alleys are strongly encouraged for all subdivided lots regardless of use. No dead-end alleys shall be permitted. Where an alley serves as the principal means of access for emergency or service vehicles, the alley shall be no less than 20 feet in width. The City Engineer and City **Fire Code Official** may waive this requirement if, in their opinion, other provisions will satisfactorily meet the access needs of the subdivision. Alleys shall be paved. Sidewalks intersecting alleys shall be ADA-compliant, although detectable warnings surfaces are not required.

Alleys are to be constructed of asphalt, concrete, pavers, or other hard surfaces. Alternative materials may be considered with the approval of the City Engineer. As alleys are privately held, long-term maintenance of the alley should be considered during the design process and approved by the Department of Public Works.

4.5 Yield Streets

Two-way yield streets may be proposed in residential environments where designs expect and encourage drivers to travel at lower speeds, typically with less than 1,500 ADT.

Yield streets are to have curb-to-curb widths of 24-26 feet and intermittent parking on both sides. They encourage a yield condition via a single two-way travel lane without a centerline. Periodic relief from parking on both sides of the street is required to allow two vehicles to pass. Yield streets should use a design speed of 15-20 miles per hour and a single unit truck as a design vehicle. Yield streets should not be proposed along school bus routes or designated fire access roads/lanes.

Yield street design must be approved by City Traffic Engineer and City **Fire Code Official** as part of the site plan review process.

Yield streets shall meet current ADA design standards. At intersections, detectable warning surfaces are required to alert pedestrians of potential vehicular context.

4.6 Lanes

Lanes require an innovative design proposal (see Chapter 2, Section 2.8) and may be proposed in residential environments where drivers are expected and encouraged through design to travel at lower speeds, typically with less than 400 ADT.

Lanes are to have curb-to-curb widths of 16-18 feet and parking on one side. They encourage a yield condition via a single two-way travel lane without centerline. Periodic relief from parking on both sides of the street is required to allow two vehicles to pass. Lanes should use a design speed of 15-20 miles per hour and a single unit truck as a design vehicle. Lanes should not be proposed along school bus routes or designated fire access roads/lanes.

Approval of the lane design and design vehicle must be obtained from the City Traffic Engineer and City **Fire Code Official**.

Lanes shall meet current ADA design standards. At intersections, detectable warning surfaces are required to alert pedestrians of potential vehicular context.

4.7 Shared Streets

Shared streets require an innovative design proposal (see Chapter 2, Section 2.8). Shared streets work best where there are nearly equal volumes of pedestrians, bicyclists, and motorists. Street furniture, including bollards, benches, planters, and bicycle parking, can help define a shared space, subtly delineating the traveled way from the pedestrian-only space. Shared streets can be considered in residential, commercial, or mixed-use contexts where constrained settings deter thru-traffic, minimizing motor vehicles traffic volumes. Motor vehicle use of the shared street should be limited to residents of the street, deliveries, maintenance, or emergency access.

Shared streets are to be as narrow as practical, but no more than 25 feet in width without sidewalks, bounded by adjacent buildings or landscaping. Shared streets will use a design speed of 10 miles per hour and a single unit truck as a design vehicle.

Approval of the shared street design and design vehicle must be obtained from the City Traffic Engineer and City **Fire Code Official**.

Shared streets may use a variety of materials and surface textures to equalize speeds between all travel modes and alert motorists to a change in operating procedure.

Shared streets shall meet current ADA design standards. At intersections, detectable warning surfaces are required to alert pedestrians of potential vehicular presence.

As shared streets do not utilize curbs, alternate drainage and stormwater management practices must be considered with curbless design. Valley gutters may be used to channelize flow.

4.8 Streetscapes

As stated in the Streets That Work Design Guidelines, the citizens of Charlottesville and the owners, employees and patrons of its businesses are the end users of the streets. Streetscape elements help create a consistent and inviting setting. Elements such as benches, tables, chairs, refuse receptacles, plantings and bicycle parking create a space where visitors and potential customers can congregate. Pavers and pedestrian level streetlighting also adds to the ambience of the streetscape. To ensure a uniform street setting, the City of Charlottesville has identified select streetscape materials to be used.

4.8.1 Alternative Materials

The City of Charlottesville maintains all materials within the public ROW and must approve alternative materials to be placed within the public ROW. For street furnishings within a design control district, refer to Chapter 14: Design Control Districts. Unless Streetscapes fall within a design control district, streetscapes shall use the following approved elements (subject to review by the Board of Architectural Review):

Table 4-5: Approved Streetscape Elements

Element	Type	Size	Material	Mounting	Note
<i>Bench</i>	Backless Bench	18”H x 18”W x 67”L	JarraH Hardwood – No finish, Powdercoated metal Colors: mercury, ocean, flambé	Surface mount	
<i>Bench</i>	Backed and	21”H x 23”W, 6’ or	JarraH Hardwood – No finish, Powdercoated metal Colors: mercury, ocean, flambé	Surface mount	Customized finish allowed

Element	Type	Size	Material	Mounting	Note
	Backless Bench	10' lengths			
<i>Bench</i>	Backed Chair	21"H x 23"W, 24" length	JarraH Hardwood – No finish, Powdercoated metal – stormcloud	Surface mount	Customized finished allowed
<i>Bench</i>	Sitting Rail	18"H x 7"W x 45"L	JarraH Hardwood – No finish, Powdercoated metal – mercury, ocean, flambé, stormcloud	Surface mount	
<i>Bench</i>	Leaning Rail	30"X x 6"W x 45"L	JarraH Hardwood – No finish, Powdercoated metal Colors: mercury, ocean, flambé, stormcloud	Surface mount	
<i>Bench</i>	Stone Bench	20"H x 40" W x 158"L	Reinforced concrete	Freestanding	Custom made to order
<i>Bicycle Parking</i>	Bike Rack	36"H x 24"W	Powdercoated metal Colors: black	Surface mount	U-Shaped with flat top
<i>Litter Receptacle</i>	Trash Receptacle	43"X, 36 or 45 gallon	Powdercoated metal Colors: Slate	Surface mount	
<i>Table/Chair</i>	Parc Center Table and Chairs	24" Round Table	Powdercoated metal Colors: mercury, ocean, flambé,	Freestanding	
<i>Table/Chair</i>	Standing Rail	42"H x 12"W	Powdercoated metal	Surface mount	
<i>Tree Grate</i>	Tree Grate	4' x 8'	Cast Ductile Iron – No finish Colors: Natural Patina with age	Embedded frame	
<i>Tree Grate</i>	Paver Tree Grate	4' x 4'	Cast Ductile Iron – No finish Colors: Natural Patina with age	Embedded Frame	
<i>Tree Grate</i>	Tree Grate	4' x 8'	Plastic Colors: Black	Embedded frame	
<i>Tree Grate</i>	Paver Tree Grate	4' x 4'	Plastic Colors: Black	Embedded Frame	
<i>Planter</i>	Cast Stone Planter	45-87 cubic feet	Reinforced cast stone Colors: Calgary, Beige	Freestanding	

4.8.2 Placement

Streetscape features shall be installed per the manufacturer’s installation instructions. Streetscape elements shall not obstruct pedestrian travel-ways, hinder street level or car doors from opening.

4.8.3 Maintenance

Streetscape elements will need to undergo routine maintenance. Maintenance guidance on specific non-standard elements shall be included on the plans.

4.9 Bicycle Facilities

The City of Charlottesville recognizes a variety of different types of bicycle facilities. Design standards for the various facility types are described throughout this section. The facility types are:

- Shared lanes
- On-road bike lanes
- Separated bike lanes
- Shared use paths and recreational trails
- Bicycle parking

While this manual provides the framework needed to design the above bicycle facilities, City staff may prefer to go beyond these standards in the development of bicycle infrastructure. Additional design resources listed in Section 4.13 are available to address more complex design situations such as protected intersection treatments.

4.9.1 General Design Requirements

The City of Charlottesville has adopted two important documents that provide the framework for implementing bicycle facilities, the 2016 Streets That Work Design Guidelines and the 2015 Bicycle and Pedestrian Master Plan. The Streets That Work Design Guidelines provide guidance for street design to ensure that Charlottesville's streets meet the needs of all users, including bicyclists. The bicycle facility recommendations are consistent with the 2015 Bicycle and Pedestrian Master Plan, which focus on developing a low-stress network of connected bicycle facilities that provides access to popular destinations throughout the City. These two documents should be reviewed by designers to ensure that any proposed bicycle facility is consistent with the goals and objectives of the two plans, whether on public or private roadways.

4.9.1.1 Geometric Design

The American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities (AASHTO Guide) is a document that contains geometric design standards for bicycle facilities. The AASHTO Guide is recognized as the source for best practices in bicycle facilities design. The AASHTO

Guide provides information on how to accommodate bicycle travel and operations in most riding environments. It presents sound guidelines that result in facilities that meet the needs of bicyclists. (Note: The 2012 edition of the AASHTO Guide does not contain guidance on the design of Separated Bike Lanes. The upcoming revised edition will have detailed geometric design standards for Separated Bike Lanes. Until the new edition is published, designers should refer to FHWA Separated Bike Lane Planning and Design Guide and the Massachusetts Department of Transportation's Separated Bike Lane Planning & Design Guide.)

4.9.2 Shared Lanes

Shared lanes are typically at locations where the available roadway space (pavement) is not sufficient to accommodate a space that is exclusively for bicycle travel. While bicycles are generally allowed on all roadways (except where specifically prohibited), the competing uses for roadway pavement (motor traffic lanes, parking, bicycle facilities) sometimes necessitates that bicyclists and motorists share the same travel lanes. Shared lanes can exist on any street type, including Local streets, Neighborhood streets, and Downtown and Mixed Use streets. On Mixed Use and Downtown streets, shared bicycle lanes generally are short segments that fill a gap between higher level bicycle facilities, such as traditional bike lanes, separated bike lanes, or shared use paths.

Typically, roads that carry low volumes of motor vehicle traffic operating at low speeds are suitable as shared lanes in their present condition without additional markings or signage.

4.9.2.1 Geometric Design

Shared lanes shall be a minimum width of 10 feet and a maximum width of 15 feet. In instances where the lane width is 14 feet or greater, motor vehicles can comfortably pass a bicyclist without encroaching into the adjacent lane. At these locations, bicyclists and motorists may share the same travel lane without any special marking or signage. Shared lanes may be implemented on yield streets.

4.9.3 Bicycle Boulevards

At times, it may be advantageous to direct bicyclists to a specific low-volume street that is designed to prioritize bicycling. These streets, known as bicycle boulevards, attract bicyclists of all ages and abilities who are not comfortable traveling on roadways with higher traffic volumes, even when bike lanes are provided. Bicycle boulevards use traffic calming elements, such as speed humps, traffic circles, curb extensions, and chicanes,

as well as pavement marking and signage, to provide a low-stress riding experience. (See Chapter 3: Traffic for guidance on traffic calming techniques.) These traffic calming elements are intended to reduce traffic volumes and speeds. A low-speed differential between motor vehicle traffic and bicycle traffic enhances the comfort and safety of people riding bicycles and reduces crash severity should a collision occur. Bicycle boulevards should be limited to roadways that have less than 2500 motor vehicles a day and where the average motor vehicle operating speed is 25 mph or less.

4.9.3.1 Geometric Design

Similar to shared lanes, bicycle boulevards shall be a minimum width of 10 feet and a maximum width of 15 feet. Bicycle boulevards may be implemented on yield streets.

4.9.4 On-Road Bike Lanes

On one-way streets, bicycle lanes may be positioned on the left side of the street to improve visibility. In some one-way street locations, the bicycle movement can be against the direction of motor vehicle traffic in a contra-flow bicycle lane. Bicycle lanes are typically installed on streets with higher traffic volumes and speeds such as Mixed Use, Downtown, and Neighborhood streets. Where on-street parking is allowed, traditional bicycle lanes are placed between the parked cars and moving traffic. However, there is evidence that placing the bike lane between the curb and the parked cars is safer. Bicycle lanes encourage bicyclists to ride on the roadway, where they are most likely to be seen by motorists and where they are not as likely to interfere with pedestrians.

Buffered bike lanes are on-road bike lanes with additional space between the bicycle travel lane and the adjacent motor vehicle travel lane. This additional space is delineated with pavement marking. Buffered bike lanes provide additional space for bicyclists to pass and to ride outside the door zone. When extra space is available, the buffer makes the bike lane appear safer for bicyclists by increasing the distance with motorized vehicle traffic. If a physical barrier is placed in the buffer area, a separated bike lane is created (see Section 4.9.5).

Contra-flow bike lanes allow bicyclists to ride in the opposite direction of motor vehicle traffic on one-way streets. Contra-flow bike lanes convert one-way streets to two-way streets for bicycle travel. Contra-flow lanes are separated from the motor traffic moving in the opposite direction with yellow center lane striping. If additional roadway width is available, a physical barrier or on-street parking can be installed to create a separated bike lane. Contra-flow lanes reduce dangerous wrong-way riding and sidewalk riding while providing better access for bicyclists traveling in both directions.

4.9.4.1 Geometric Design

Traditional bicycle lanes vary between 5 feet wide (minimum) and 7 feet wide (preferred) when adjacent to parked vehicles or on higher speed roadways. When a bike lane is adjacent to the curb with a gutter section, the width varies between 4 feet (minimum) and 6 feet (preferred), measured from the flange joint. In instances where the curb is integral with the adjacent roadway, the bike lanes vary between 5 feet wide (minimum) and 7 feet wide (preferred), measured from the curb face. A buffered bike lane shall have the same width as a traditional bike lane, with two 4-inch-wide solid white lines, a minimum of 18 inches apart, between the bike lane and the motor vehicle travel lane. If the buffer is 3 feet wide or greater, interior diagonal hatching is required. Contra-flow bicycle lanes shall be a minimum of 5 feet wide, delineated with a 4-inch wide solid double yellow line.

4.9.5 Separated Bike Lanes

Separated bike lanes (SBL) are also known as cycle tracks and protected bike lanes. SBLs are safer than non-separated bike lanes, as they maintain separation between motor vehicles and bicyclists. SBLs also appeal to bicyclists who are uneasy traveling in a standard 5-foot wide bike lane, and thus encourage more bicycle trips by more users while promoting a healthier community. SBLs are therefore preferred where space allows their implementation.

When planning for a SBL, several factors must be considered. In addition to the type of separation and the elevation of the riding surface, one-way or two-way operation must be determined. The amount of available width will help determine the configuration of the separated bike lane. Pavement marking, signs, drainage, landscaping, and lighting are all elements that must be considered. Intersection treatment of separated bike lanes must also be carefully evaluated.

4.9.5.1 Geometric Design

The cross-section of a separated bike lane is composed of three zones: the bike lane, the street buffer, and the sidewalk buffer. Separated bike lanes can operate as one-way or two-way facilities. One-way facilities have been shown to be safer and have fewer design constraints. One-way separated bike lanes range in width from 5 feet from the face of curb in streets with a low volume of bicyclists (less than 150 bicyclists in the peak hour), to 10 feet wide from the face of curb where over 750 bicyclists are present in the peak hour. At least 6.5 feet of width is recommended to enable passing movements. Two-way separated bike lanes range in width from 8 feet where less than 150 bicyclists are present in the peak hour, to 14-feet where over 400 bicyclists are present in the peak hour. At

least 10 feet of width is recommended to enable passing movements. The physical separation from moving motor traffic can comprise parked cars, raised curbs, medians, bollards, landscaping, or planters. The type of separation depends on the amount of available space and whether on-street parking will remain. Street buffer zones shall be a maximum of 6 feet wide and a minimum 2 feet wide. The elevation of a separated bike lane can be at the roadway level, the sidewalk level, or at an intermediate elevation. The selected bike lane elevation will depend on several factors, usually based on physical constraints and feasibility.

4.9.6 Shared Use Paths and Recreational Trails

Shared use paths are bikeways that are physically separated from motor vehicular traffic by an open space or barrier. Shared use paths can be within the street right-of-way, where they are known as side paths, or along a separate alignment within an independent right-of-way. The users of shared use paths include pedestrians alongside many forms of non-motorized and electrically-assisted modes, such as bicycles, scooters, skates, and skateboards. The users are of all ages and abilities, and the pedestrians include people walking, people running, people using wheelchairs, people with baby strollers, and people walking dogs. Shared use paths are typically two-way facilities. Shared use paths should not be used to replace on-road bicycle facilities, but rather to supplement a network of on-road bike lanes, shared roadways, and bicycle boulevards. While it is generally preferable to select shared use path alignments in independent rights-of-way, there are situations where the existing street right-of-way provides the only available corridor.

Side paths are a specific type of shared use path that runs parallel to the adjacent roadway; however, they do not function the same as sidewalks. Sidewalks are designed for the exclusive use by pedestrians, while side paths are designed for bicycle traffic. There are many issues that must be considered when planning a side path. Most noteworthy are the conflicts that occur at intersections and driveways. Motorists may not notice bicyclists when turning into or out of driveways that cross a side path. Bicyclists crossing driveways and intersections at high speeds may increase the likelihood of crashes. Motorists do not expect bicyclists in what is normally a sidewalk area. Other issues related to side paths include the proximity to fixed objects, such as utility poles, trash cans, or mailboxes in the street right-of-way. Side paths are best located where roadway and driveway crossings are few or consolidated.

Side paths should be located as far as practical from the edge of the roadway, with a minimum of a 5 feet buffer from the curb. If this separation cannot be attained, a physical barrier or railing should be provided between the path and the roadway. While side paths

have several operational concerns, they may be necessary at locations where a higher order bicycle facility cannot be provided. For example, side paths may be desirable adjacent to a high-volume/high-speed roadway where bicyclists would otherwise be discouraged from riding. A side path can be used for short distances to provide continuity between other bicycle facilities.

Shared use paths within an independent right-of-way, such as an abandoned railroad corridor or a utility corridor, are also known as recreational trails. The design criteria for recreational trails in an urban setting must consider children as a frequent user. It is generally assumed that the speed of youth bicyclists is lower than adult bicyclists, therefore engineering judgement should be exercised when selecting design criteria for new trails.

Refer to the AASHTO Guide for the Development of Bicycle Facilities for further design considerations concerning side paths and recreational trails.

4.9.6.1 Geometric Design

Shared use paths shall have a preferred width of 12 feet and a minimum width of 10 feet. A formal design exception must be sought for reduced widths of no less than 8 feet where space is restricted by existing conditions.

A 2-foot clear zone shall be provided on both sides of the SUP. A desirable clearance between lateral obstructions such as trees, tree grates, poles, wall, fences, etc. is 3 feet from the edge of trail.

The grade of a shared use path should be less than 5 percent unless the adjacent roadway exceeds 5 percent or physical constraints prevent compliance with the 5 percent maximum grade. The grade of a side path can exceed 5 percent, but it must be less than or equal to the roadway grade. If the physical environment forces excessive grades, additional width of 4 to 6 feet should be considered to permit slower bicyclists to dismount and walk uphill, and to provide maneuvering space for fast downhill bicyclists. Other ways to mitigate excessive grades are to provide switchbacks to traverse the grade or provide resting intervals with flat grades to permit users to stop periodically. In cases where a shared use path is in an independent right-of-way not adjacent to a roadway, longitudinal grade is permitted up to 5 percent.

The horizontal alignment of shared use paths is based on design speed and lean angle. The minimum radius of a horizontal curve is calculated using formulas based on various design speeds and a desirable lean angle. The cross slope of a shared use path should

not exceed 2 percent, with 1 percent cross slopes being recommended to better accommodate people with disabilities.

The minimum vertical clearance above a trail is 8 feet, however 10 feet is required where maintenance or emergency vehicles may be present.

4.9.6.2 Acceptable Materials

Shared use paths should be paved with either asphalt or Portland cement. Both materials provide good quality, all-weather pavement structures. Unpaved surfaces such as crushed stone, stabilized earth, and limestone screenings are not appropriate in urban settings. In addition to greater long-term maintenance needs, these materials require bicyclists and other wheeled users to use greater effort to travel. Refer to Chapter 12: General Materials and Methods of Construction for further information on materials.

4.9.7 Bicycle Parking

Providing bicycle parking facilities are an essential element in a multimodal transportation system. Bicycle parking should be provided at all public facilities and should be incorporated into roadway and streetscape projects. Bicycle parking should be conveniently placed in a location that is highly visible and as close to the building entrance as practical. Bicycle racks should be:

- easily accessible;
- visible to passers-by;
- away from pedestrian traffic; and
- away from doors, bus stops, and loading zones.

Bicycle parking can be divided into two categories:

1. Short-term parking where convenience and ease of use is most important
2. Long-term parking where secure and sheltered parking is most important

Short-term parking is designed to meet the needs of people visiting businesses and institutions for durations of, typically, up to two hours. Short-term users may be infrequent visitors to a location, so the parking installation needs to be readily visible and self-explanatory. Short-term bicycle parking facilities are typically inverted U racks, or post and ring racks. The facilities should be constructed out of strong metal tubing and securely anchored to the ground. The racks should support the bicycle at two points above its center of gravity; accommodate u-shaped bike locks; be placed a minimum of 3 feet, 3 inches apart so that they do not interfere with each other; not have sharp edges; and not require the user to lift the bicycle off the ground.

Short-term bicycle parking shall be located within the streetscape so that a parked bicycle does not encroach upon adjacent buildings, parked vehicles, or other obstacles. A minimum horizontal clear space of 2 feet shall be provided at each end of the bicycle parking locations.

Bike corrals provide bicycle parking in the roadway in place of a motor vehicle parking space. A bike corral can generally fit 8 to 12 bicycles in a space that holds one car. Bike corrals work best where sidewalks are too narrow to accommodate bike racks and in areas where there is high demand for bicycle parking.

Long-term parking is designed to meet the needs of employees, residents, public transit users, and others with similar needs who generally place high value on security and weather protection. These users typically park either at home or at a routine destination such as a workplace. They often leave their bicycles unmonitored for a period of several hours or longer, so they value bicycle parking that affords parking without unreasonable concern for loss or damage.

4.9.7.1 Bicycle Parking Specifications

All bicycle parking should be coordinated with the City of Charlottesville's most recent Bicycle and Pedestrian Master Plan. Detailed specifications for bicycle parking are provided by the City of Charlottesville Code §. 34-882. - Bicycle parking requirements for WME and WMW zoning districts. Non-conventional racks such as sculptures will be approved on a case-by-case basis. They are required to meet City specifications for durability and safety, be anchored to the ground, and comply with PROWAG and all City codes and ordinances.

4.10 Curbs and Sidewalks

Curbs and sidewalks are required on both sides of new streets. Sidewalks should generally conform to the vertical alignment of the adjacent roadway.

All developments shall provide new sidewalks along any perimeter that is adjacent to an accepted public ROW. Any development that proposes perpendicular or angled parking within 2 feet of any sidewalk or pedestrian way should incorporate wheel stops or other measures to prevent cars from blocking the pedestrian path.

In cases where a development will occur adjacent to a sidewalk that does not meet current standard, that sidewalk shall be upgraded to meet current design standards for the entire length of the boundary adjacent to the sidewalk.

Where sidewalks cannot be fully located inside the ROW, the applicant should first consider dedication of ROW. Pedestrian and public access easements are strongly discouraged for maintenance and liability reasons.

In cases where sidewalk is not required for development projects, concrete curb shall still be provided. Similarly, if development is to occur adjacent to curbing that does not meet current standards, that curbing shall be upgraded to meet current design standards for the entire length of the boundary adjacent to the curb.

4.10.1 Curb Ramps

All streets that incorporate routes for pedestrian use shall include curb ramps at intersections, without regard to the curb design used. Upgrades to curb ramps are required at any leg of an intersection where a ramp is not ADA-compliant. Curb ramps should be constructed in accordance with Standard CG-12. See Appendix X, CG-12 Detectable Warning Surface. Further guidance on the design of curb ramps may found in VDOT Instructional and Informational Memorandum IIM-LD-55, Guidelines for the Placement of Curb Ramps for Pedestrian Access Routes.

4.10.2 Accessible Routes

The City of Charlottesville strives to create a fully accessible pedestrian system where all sidewalks and crosswalks within the public ROW are MUTCD and ADA-compliant. When sidewalks are altered, the federal design standards shall be followed for reconstruction. If full ADA compliance is found to be technically infeasible (see Chapter 1, Section 1.2, Definitions), the facility must come as close to being ADA-compliant as possible.

Accessible routes are ADA-compliant pedestrian pathways. All public and private sidewalk and pedestrian networks within the City of Charlottesville are considered accessible routes and must be ADA-compliant. While new construction can more immediately be ADA-compliant, older facilities should be scheduled to meet ADA-compliance as prescribed in the City of Charlottesville ADA Transition Plan.

ADA-compliant accessible routes will follow the most direct pedestrian route with all new construction. The accessible route may be difficult to maintain along the most direct pedestrian route in existing conditions due to a variety of factors including steep terrain, buildings, and other vertical encroachments. Where the accessible route deviates from the logical pedestrian route in existing conditions, the accessible route will be signed and marked to provide guidance. Refer to Chapter 3: Traffic for additional guidance on signs and wayfinding.

4.10.3 Minimum Requirements

Sidewalks shall be a minimum of 5 feet in width with a preferred width of 6 feet exclusive of curbing and constructed to City standards. Along Mixed Use (A and B) streets, sidewalks shall be a minimum width of 7 feet. For retrofit conditions, narrower sidewalks meeting accessibility standards may be permitted and shall be coordinated with the City Engineer.

Sidewalks shall be provided on both sides of every new street (unless the City Engineer waives sidewalk on one side) designated as:

- Mixed Use (A and B)
- Downtown
- Industrial
- Neighborhood A

Streets designated as Neighborhood B shall have a sidewalk on one side of the street. In all instances, the dedicated right-of-way shall be sufficient to permit installation of sidewalk on both sides of the street.

Sidewalks shall be designed in accordance with:

- this manual;
- PROWAG requirements;
- the VDOT Instructional and Informational Memorandum IIM-LD-55, Guidelines for the Placement of Curb Ramps for Pedestrian Access Routes; and
- the AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities.

Additionally, sidewalks along ditch section streets shall be constructed in accordance with VDOT's Road and Bridge Specifications for asphalt concrete sidewalk or hydraulic cement concrete sidewalk, on a compacted subgrade.

Sidewalks constructed along a shoulder and ditch section shall be placed behind the ditch in a manner that will be compatible with the roadway if the roadway is converted to a curb and gutter section. (Note: Construction of sidewalk within the shoulder area is not permitted.) See the "Detail Back of Curbs" in the VDOT Road Design Manual Appendix B, Subdivision Street Design Guide, "Curb and Gutter Design" section for proper integration of curb and sidewalk.

Concrete curbing or combination curb and gutter, of City standard design shall be installed at the limits of the paved surface on both sides of new streets. Curb or combination curb and gutter may still be required for drainage. Curb design and

installation shall be in accordance with the VDOT Road Design Manual Appendix B, Subdivision Street Design Guide. Allowable curb types include 6-inch standard curb and *exclude* 4-inch rolltop curb. See the VDOT Road Design Manual Appendix B, Subdivision Street Design Guide section “Curb and Gutter Designs” for appropriate application of each curb type. Within the section “Curb and Gutter Designs,” see detail “Curb and Gutter Details” for acceptable curb design.

4.10.4 Sidewalks at Driveway Entrances

Where sidewalks and driveways intersect, changes in running grades and cross slopes may present challenges with meeting federally mandated ADA requirements. The 2% cross slope of the sidewalk shall be maintained even where an intersecting driveway’s running slope is greater than 2%.

Detectable warning surfaces shall not be implemented where sidewalks intersect residential driveways and alleys. Raised sidewalks may be used to prompt the pedestrian and driver to proceed with caution and to be aware of one another.

Detectable warning surfaces are required where sidewalks intersect driveways to commercial parking lots and structures where vehicles access is greater than 500 vehicles per day. Detectable warning surfaces are required where sidewalks intersect emergency access driveways, including at fire stations and police stations.

4.10.5 Acceptable Materials

Sidewalks may be constructed with a variety of materials, including concrete or solid unit pavers. Sidewalks constructed of concrete shall not be less than 4 inches thick, except when used at an intersection with an effective radius of less than 28 feet, in which case the thickness shall be 7 inches.

While decorative surfaces provide a pleasing aesthetic to historical or culturally significant sites, cobblestones and many other similar tiling methods for a pedestrian route are quite often not designed properly to provide an accessible route. The stones or tiles may, over a period, become uneven and become a significant challenge to a wheelchair or a cane user. Interlocking pavers may serve the same aesthetic and environmental purpose as the cobblestone, and if designed properly, can provide a smooth surface that is ADA-accessible. A concrete base is recommended to prevent uneven settling of surfaces.

Curb may be constructed of standard concrete or granite if a more decorative roadway is desirable. For method of installing of granite curb, see Detail X within this manual.

New concrete curb shall not be constructed with metal edging, as it can cause damage to vehicle tires.

Special materials used in sidewalks and curbs may require additional maintenance. See Chapter 13: Maintenance of Existing Infrastructure for more information.

4.10.6 Installing Around Trees

When trees are to be planted between the curb and the sidewalk, the sidewalk shall be no less than 4 feet, and preferably 6 feet, behind the back of curb. Where this is not possible, tree grates should be considered. Trees are to be planted so that the center of the tree trunk is not less than 3 feet behind the curb as shown in Detail X. Species of acceptable trees vary with available right-of-way widths. Please refer to the Master Tree List in the City of Charlottesville's Tree Packet, available in the Department of Public Works office and on the DPS website. Refer to the City of Charlottesville Urban Forest Management Plan for further City goals and requirements related to trees.

4.10.7 Reinforcement at Intersections

Curbs at intersections shall meet standards described in the Minimum Requirements section above. Curbs should be installed in accordance with Section 200 of the VDOT Road and Bridge Standards. Where curb and gutter are used for drainage, curb installation shall be in accordance with the VDOT Road and Bridge Standards. Curb types that can be used at intersections include granite and concrete standard 6-inch curb.

4.11 Special Design Considerations

Street and roadway design standards need to consider access for all travel mode users, especially those with disabilities. As such, the following design considerations are to be followed to ensure access for all.

Regardless of the type or location, the design of accessible features shall include a detailed grading plan with spot grades showing how the accessibility requirements are being met. In many instances, this may require a larger scale inset window for the area being designed.

4.11.1 Shared Use Paths and Recreational Trails

Ramps and detectable warning surfaces must encompass the entire width of the shared use path or trail. Trails to be used for transportation purposes, or constructed using

federal or State funding, must comply with ADA requirements. The City will evaluate recreational trails on a case-by-case basis.

4.11.2 Stairway Bicycle Access

Stairways in the public right-of-way shall be designed to accommodate bicycles with the addition of a runnel. A runnel is a grooved channel that allows a dismounted bicyclist to walk the bicycle up or down the stairs. Runnels shall be designed and constructed so that stairway railings do not prevent the effective operation of the runnel as intended, and to assure ease of operation for the bicyclist using the stairway and runnel.

4.11.3 Accessible Parking

Accessible parking will be available to ensure those with mobility challenges may have easy access. Accessible parking will be reserved along public roadways where paid parking is required. Accessible parking will be required for all commercial and multi-family residential parking lots and structures.

The accessible parking space will be 8 feet in width and a minimum of 18 feet in length. One of every six accessible parking spaces must be an accessible van space. Accessible van spaces will be 11 feet wide and a minimum of 18 feet in length. The accessible van space may be 8 feet wide if adjacent to an access aisle that is also 8 feet wide. An accessible landing area immediately adjacent to the parking space will be required. The landing area will be a minimum of 6 feet in width and a minimum of 18 feet in length. The landing area will have gore striping and associated signing to indicate that parking is restricted in the landing area. Accessible parking will be connected to all accessible facilities by an accessible route.

4.11.4 Emergency Services

Roadway access for emergency services vehicles is needed for public safety. All roads in Charlottesville are considered to be Fire Apparatus Access Roads and shall meet the requirements in Appendix D of the Virginia Statewide Fire Prevention Code (VSFPC).

4.11.4.1 Design Requirements

Fire lanes will be marked with signs 12 inches wide by 18 inches high with red letters on a white reflective background. Signs will be posted on one or both sides of the fire apparatus road as needed.

Roadway surfaces of fire access roads will be constructed of asphalt, concrete, or other approved driving surface capable of supporting the imposed load of a fire apparatus weighing 85,000 pounds.

Where a fire hydrant is located on a fire access lane, a minimum clearance of 15 feet is required on each side of the hydrant with a minimum of 20 feet roadway width.

Buildings or portions of buildings or facilities exceeding 30 feet in height above the lowest level of fire department vehicle access shall be provided with approved fire apparatus access roads capable of accommodating fire department aerial apparatus. Overhead utility and power lines shall not be located within the aerial fire apparatus access roadway.

4.11.4.2 Gates and Gate Access

Gates shall be a minimum width of 15 feet and must be accessible by one person through slide or swing mechanism. Gates will remain unlocked unless capable of being opened by means of forcible entry tools. Electric gates shall be equipped so that fire department personnel may open gate in emergency.

4.11.5 Encroachments

Encroachments in the City's ROW are prohibited unless approved and accepted by City Council. All encroachments in the City's ROW that are approved by City Council require a maintenance agreement.

Encroachments that are not permitted in the ROW include but are not limited to:

- Tie-backs for foundation systems, retaining walls, or other subsurface elements
- Building features such as awnings, decks, or window or façade treatments
- Site improvements such as ramps, stairs, railings, patios, and retaining walls
- Private utilities, etc.

Encroachments that are permitted in the ROW without special approval are as follows:

- At-grade connections to adjacent properties such as walkways and driveways
- Utility connections such as water or gas services, sanitary laterals, or storm drain connections
- Communication lines that connect to a main line of a private utility provider that has a current franchise agreement with the City

4.11.6 Public Transit and School Busses

The Charlottesville Area Transit (CAT) and other services provide bus service to the greater Charlottesville area. All transit vehicles are ADA-compliant and mobility device accessible. As such, all transit stops must also be ADA-compliant and be designed and constructed so as not to impede access for passengers. Individual bus stops should be designed to accommodate transit vehicles that are approximately 40 feet in length, 11 feet in height, and 8.5 feet in width, and that have a wheelbase of approximately 34 feet.

Where the proposed subdivision or site development fronts on an arterial or collector street which has bus routes, the City Traffic Engineer may require that adequate land be dedicated to permit installation of a turnout lane or bus stop and a bench or shelter.

4.11.6.1 Provisions for Bus Stops

Public transit amenities, stop placement, lighting, alignment, and space requirements should be planned and designed with safe pedestrian access in mind. Developers should coordinate with the City Engineer and the Transit Director as much as possible. Transit stops are to be located at the far side of an intersection. Unless approved by the Transit Director, no bus stop will be located mid-block or on the near side of an intersection. For high-density residential buildings (those expected to have 50 or more bus passengers per day), bus stop shelters shall be required. Bus stops will be indicated with a sign 12 inches in width and 18 inches in height with the lowest point of the sign 7 feet above the ground surface.

A **high-volume transit stop** serves more than three buses per hour during peak travel hours.

At bus stops where passenger volume is expected to be higher, additional amenities should be provided, including shelters and pedestrian level lighting.

Ninety-six inches of perpendicular clear space should be available from the curb or roadway to allow passengers access to the bus stop. This area must be clear of signs, bus shelters, and other encumbrances.

Where bus stops are located adjacent to a bike lane, the curbside bicycle lane must terminate 50 feet prior to the bus stop. Dashed white pavement markings shall continue through the bus stop location to indicate the location of the bike lane but allow buses to stop immediately adjacent to the curb. Refer to NACTO Transit Street Design Guide's Far-Side Pull-Out with Bike Lane.

FAR-SIDE PULL-OUT WITH BIKE LANE



Figure 4-1: This far-side pull-out uses dashed white pavement markings to indicate the location of the bike lane. (NACTO Transit Street Design Guide)

Where a bus stop is located adjacent to a separated or protected bike lane, a landing area 8 feet wide and 5 feet long must be installed so that passengers may have direct access to the bus alighting area. For high-volume or high-speed roads, bus pullouts and warning signage shall be required.

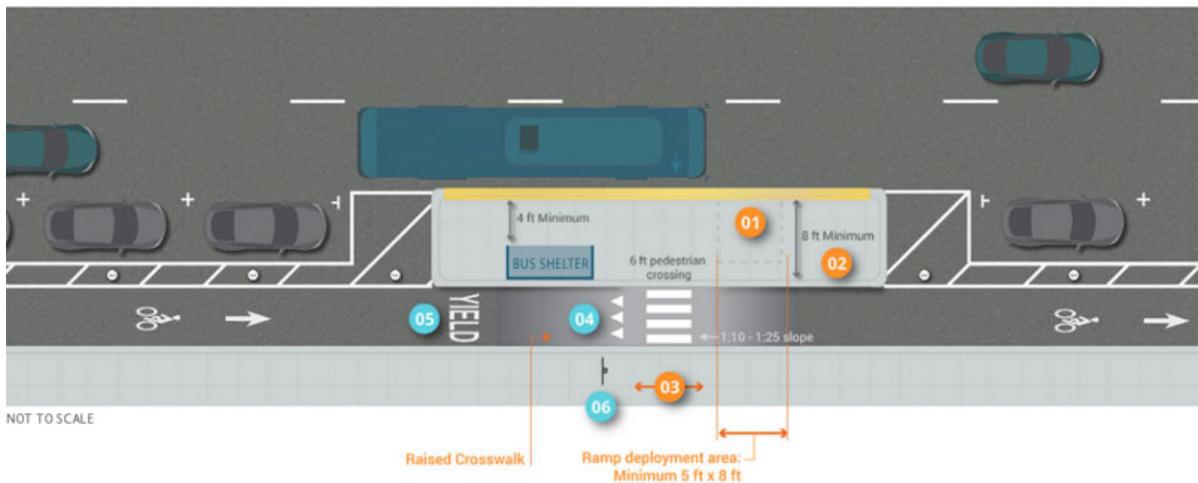


Figure 4-2: Per the FHWA's Separated Bike Lane Planning and Design Guide, landing areas are needed where bus stops are located adjacent to separated bike lanes. (FHWA)

4.11.6.2 Provisions for Bus Vehicles

Roadway design should consider necessary accommodation for public transit vehicles, including CAT buses and school buses.

4.12 References

AASHTO A Policy on Geometric Design of Highways and Streets, “The Green Book”

AASHTO Guide for the Development of Bicycle Facilities

AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities

[City of Charlottesville Americans With Disabilities Act Transition Plan](#)

[City of Charlottesville Bicycle and Pedestrian Master Plan](#)

[City of Charlottesville Comprehensive Plan](#)

[City of Charlottesville Streets That Work Design Guidelines](#)

[City of Charlottesville Tree Packet](#)

[City of Charlottesville Urban Forest Management Plan](#)

[FHWA Separated Bike Lane Planning and Design Guide](#)

[Massachusetts Department of Transportation’s Separated Bike Lane Planning & Design Guide](#)

[Manual on Uniform Traffic Control Devices](#)

[NACTO Urban Bikeway Design Guide](#)

[NACTO Urban Street Design Guide](#)

[US Access Board Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way \(PROWAG\)](#)

[US Department of Justice Americans with Disabilities Act Standards for Accessible Design](#)

[VDOT Drainage Manual](#)

[VDOT Functional Classification Comprehensive Guide](#)

[VDOT Instructional and Informational Memorandum IIM-LD-55, Guidelines for the Placement of Curb Ramps for Pedestrian Access Routes](#)

[VDOT Manual of the Structure and Bridge Division](#)

[VDOT Road Design Manual](#)

[VDOT Road and Bridge Standards](#)

[VDOT Virginia Supplement to the Manual on Uniform Traffic Control Devices](#)

[Virginia Statewide Fire Prevention Code \(SFPC\)](#)

4.13 Additional Resources

[Association of Pedestrian and Bicycle Professionals Essentials of Bike Parking](#)

[City of Charlottesville Area Transit Title VI Plan](#)

CHAPTER 5

STORMWATER MANAGEMENT

5.1 Intent and Purpose

Chapter 10 of the City Code establishes a locally administered Virginia Stormwater Management Program that integrates stormwater management requirements with the City's erosion and sediment control program, the City's MS4 permit, and stream buffers. The City Code also outlines specific land disturbance thresholds and permit requirements that are more stringent than current Virginia Department of Environmental Quality (DEQ) regulations.

This chapter provides guidance on the application of City Code and state design criteria (DEQ, VDOT) for stormwater and drainage systems, discusses allowable facility types and materials, and defines the minimum requirements for stormwater and drainage plan submissions at each stage of the City's Site Plan Permit process.

See City Code Chapter 10 for additional information on land disturbing activity definitions and exemptions.



Figure 5-1: McIntire Park bioretention area (City of Charlottesville)

5.2 General Plan and Calculation Requirements

No application for land development, land use conversion, or land disturbance can be approved, and no permits issued, without all elements required for a Land Disturbance Permit including a Stormwater Pollution Prevention Plan (SWPPP), as more fully described in the City Code Chapter 10 and the VA DEQ Stormwater Management Handbook (including the 2013 Draft SWMH and 2013 Draft Specifications, or most

current edition). These elements generally include a permit application, erosion and sediment control plan, stormwater management plan, stormwater maintenance agreement, performance bond, fees, SWPPP (if land disturbance is one acre or more, or required by the City), and executed development agreements.

5.2.1 Preliminary Requirements

The applicant is encouraged to submit a preliminary plan to the Department of Public Works for the proposed design of the stormwater management plan. Applicants are encouraged to consult with the City prior to submittal to discuss the conceptual stormwater management design and to determine whether they are subject to additional stormwater design requirements. The submittal for the preliminary plan review shall document adequate planning for management of stormwater runoff from new development and/or redevelopment and shall include the following in either plan and/or report format. (See Appendix XX for the Preliminary Plan and Calculation Requirements Checklist.)

1. Existing and proposed site maps indicating:
 - a. Project limits and property lines
 - b. Perennial and intermittent streams
 - c. Critical slopes
 - d. Boundaries of 100-year floodplain and floodway (where applicable)
 - e. Dam inundation zone and mapping, where applicable
 - f. Stream buffers (Rivanna River, Meadow Creek and Moores Creek only)
 - g. Boundaries of existing predominant vegetation and limits of proposed clearing
 - h. Boundaries for protection areas such as wetlands, lakes, ponds, stream buffers
 - i. Existing and proposed pavements and buildings
 - j. Existing and preliminary proposed stormwater conveyance channels, culverts, ditches behind culverts, and storm drains, or modifications to existing structures
 - k. Stormwater drainage divides and flow paths
 - l. Preliminary location, size, access, and limits of disturbance of proposed structural stormwater management practices.
2. Mapping of predominant soils from USDA soil surveys

3. Hydrologic and hydraulic analysis:
 - a. Runoff rates, volumes, time of concentrations, and velocities for the existing (pre-construction) conditions, showing methodologies used and supporting calculations
 - b. Runoff rates, volumes, time of concentrations, and velocities for the proposed (post-construction) conditions, showing methodologies used and supporting calculations
 - c. Preliminary analysis of downstream impacts/effects of the project, where necessary. Note the change in drainage patterns and verify downstream channel is adequate.
 - d. Preliminary selection and rationale for structural stormwater management practices
 - e. Preliminary sizing calculations for structural stormwater management practices including contributing drainage area, surface area, and storage. Detailed calculations and routings are not required provided the analysis demonstrates sound engineering judgement and a feasible stormwater approach.
4. Sufficient engineering analysis to show that the proposed stormwater management measures can control runoff from the site in compliance with Chapter 10 Section 10-54 of the City Code and the requirements of this design manual.
5. Preliminary Erosion & Sediment Control Plan (Phase I only – initial controls)
6. A map (or maps) indicating the proposed land use with tabulation of the percentage of surface area to be adapted to various uses; drainage patterns; and a written description of the site plan and justification of proposed changes in natural conditions.
7. A written summary or graphic inventory of the natural resources at the site and surrounding area as it exists prior to the commencement of the project and a description of the watershed and its relation to the project site. This description should include a discussion of soil conditions, forest cover, topography, wetlands, and other native vegetative areas on the site. Attention should be paid to environmentally sensitive features, including but not limited to steep slopes, highly erodible soils, existing wetlands, stream buffers, and floodplains that provide opportunities or constraints for development.

5.2.2 Final Requirements

The final stormwater management plan submittal, as part of the development plan, shall include all information listed in Section 10-53 of the City Code and as shown in the Final Plan Requirement checklist in Appendix XX, including:

1. Existing and proposed site maps (Scale 1 inch = 50 feet or larger, 2-inch topographic contours), indicating:
 - a. Project limits and property lines, owner and tax map parcel numbers of all properties under development and adjoining properties
 - b. Perennial and intermittent streams
 - c. Critical slopes
 - d. Boundaries of the 100-year floodplain and floodway (where applicable)
 - e. Dam inundation zone and mapping, where applicable
 - f. Boundaries of existing predominant vegetation and limits of proposed clearing
 - g. Boundaries for protection areas such as wetlands, lakes, ponds, and stream buffers
 - h. Existing and proposed pavements and buildings
 - i. Existing and proposed utilities and their easements
 - j. Existing and preliminary proposed stormwater conveyance channels, ditches, culverts, and storm drains, or modifications to existing structures
 - k. Stormwater drainage divides and flow paths, including the 1% Annual Exceedance Probability (AEP) overland flow path(s)
 - l. Location, size, and access of proposed structural stormwater management practices
 - m. Tabulation of elevation/storage volume for all stormwater management facilities that provide storage (maximum 2-foot elevation intervals)
2. Mapping of predominant soils from USDA soil surveys at same scale as site plan, indicating:
 - a. Property lines
 - b. Perennial and intermittent streams
 - c. Existing and proposed pavements and buildings
 - d. Existing and proposed stormwater conveyance channels, culverts, and storm drains, or modifications to existing structures, and stormwater management facilities
 - e. Stormwater drainage divides and flow paths

- f. Soil names and boundaries
 - g. Hydrologic soil group (HSG) classifications
 - h. Location of slopes 2:1 (H:V) or greater, or highly erodible soils
 - i. Soil boring locations, boring logs, and geotechnical reports, if required
3. Hydrologic and Hydraulic Analysis and Water Quantity Control:
- a. Narrative outlining assumptions and methodologies used in calculations
 - b. Design storm frequency, duration, and intensity
 - c. Time of concentration and flow paths
 - d. Peak runoff rates, volumes, and velocities for each watershed drainage area under the existing (pre-construction) conditions, showing methodologies used and supporting calculations
 - e. Peak runoff rates, volumes, and velocities for each watershed drainage area under the proposed (post-construction) conditions, showing methodologies used and supporting calculations
 - f. Verification of downstream adequate channel; compliance with the energy balance satisfies the downstream adequate channel requirement
 - g. Sizing calculations for structural stormwater management practices including the contributing drainage area, surface area, storage and outlet configuration, etc.
 - h. Analysis of potential downstream impacts/effects of project, where necessary to include 1% AEP overland relief
4. Stormwater conveyance (culverts, channels, inlets, drains) design details and calculations
- a. Hydraulic calculations showing each structure is adequately sized
 - b. Plan view, existing and proposed structural locations, elevations, and direction of flow
 - c. Profile drawings of channels, pipes, and culverts showing size, type, class, length, slope, hydraulic gradeline, and all utility crossings
 - d. Calculations and typical cross-sections for open channels and storm drain outfalls showing bottom width, height, water level for the design storms, freeboard, side slopes and type of stabilization used, such as Class I rip-rap
 - e. Storm drain conduits designed with minimum capacity and minimum and maximum velocity requirements per the current VDOT Drainage Manual
 - f. Inlet and outlet pipe invert elevations at all structures
 - g. Existing and proposed grades for all channels

- h. Water surface elevations, velocities and discharge for the design storm
 - i. Design storm and 1% AEP check stormwater surface elevations at culvert entrances and outfalls
 - j. Outfall protection details
 - k. Grading at outflows, inlets and headwalls
 - l. 10% AEP hydraulic grade line calculations, including the HGL analysis of the downstream segment of any existing pipe system that a proposed development is tying into.
 - m. VDOT Drainage Manual storm drain design criteria regarding AEP storm analysis where the vertical alignment of the roadway creates a sag condition in a depressed roadway section or a roadway section utilizing concrete barriers applied, as necessary. Structures located in a sag condition of a City street shall show the 1% AEP HGL to confirm surcharge will not create a safety hazard.
5. Stormwater Best Management Practice (BMP) Design Details and Calculations
- a. Hydrologic and hydraulic calculations showing each structure to be adequately sized
 - b. BMP drainage area map that corresponds with the grading plan to support the design calculations.
 - c. Stage-discharge or outlet rating curves and inflow/outflow hydrographs for storage facilities
 - d. Water quality calculations showing pre-development conditions, and removal rate using latest DEQ Runoff Reduction Method spreadsheets
 - e. Plan view, existing and proposed structural elevations
 - f. Design water surface elevations and depth, and discharge flow, volume and velocity
 - g. Delineation of 100%, 50%, 10%, and 1% AEP water surface elevations in quantity and quality stormwater facilities
 - h. Detailed and site-specific cross-sections of SWM facilities showing pertinent elevations, horizontal and vertical dimensions, under drains, spillways, etc.
 - i. Cross-section through dam showing existing and proposed grades, dam side slopes and top width, top of dam crest elevation, emergency spillway crest, inlet, outlet and level control, and inverts of orifices and weirs
 - j. Principal and emergency spillway design, profile, and outlet details
 - k. Riser structure detail, materials, orifice dimensions, anti-vortex device, structural details, maintenance access, and trash rack if needed

- l. Outfall protection details showing rip-rap size, thickness, bottom width, side slope and filter cloth, with keyed depth
 - m. Flow paths in extended detention basins and stormwater wetlands to avoid short circuiting
 - n. For manufactured treatment devices, a letter from the manufacturer must be provided which states that the system was designed in accordance with the manufacturer's requirements.
 - o. SWM facility maintenance access shall be shown with a minimum width of 10 feet and a maximum slope of 20%. If access to a SWM facility needs to exceed 20%, there must be adequate area at the bottom of the slope to perform maintenance needs, considering necessary equipment and staging.
 - p. Dam breach analysis, where necessary as required by the Virginia Administrative Code §4VAC50-20: Virginia Dam Safety Regulations
6. Final landscaping plan showing any re-vegetation or buffers used as a stormwater management practice
 7. Project construction sequence narrative
 8. For plans with SWM facilities, a BMP summary table documenting the following:
 - a. New or re-development
 - b. Land disturbance area
 - c. Total drainage area to BMP
 - d. Impervious drainage area to BMP
 - e. Pervious drainage area to BMP
 - f. Required phosphorus removal rate
 - g. Provided phosphorus removal rate
 - h. Provided nitrogen removal rate (for reporting purposes only)
 - i. Hydrologic Unit Code
 - j. Name of Impaired surface water facility discharges to
 - k. Name of VA SWM Handbook BMP
 - l. Maintenance activities and frequency of inspections
 - m. Latitude/longitude coordinates of the BMP facility
 - n. Latitude/longitude coordinates of any outfalls daylighting to an open channel
 9. List of BMP-specific construction inspection requirements and stages where City-designated inspectors shall be notified. See Section 5.6 for these requirements.

10. Operation and maintenance description for any proposed stormwater management facility (or manual if a manufactured treatment device)
11. Stormwater maintenance agreement to be executed. SWM maintenance agreement must be inclusive of drainage conveyance.
12. Evidence of acquisition of all applicable local, state, and federal permits
13. Locations of the following specific items required by the Construction General Permit (CGP). See Appendix XX for details:
 - a. Concrete washouts on E&S plans
 - b. Fuel storage on E&S plans
 - c. Rain gauges
 - d. Wash rack
 - e. Paint and masonry washouts
 - f. Construction waste storage
 - g. Sanitary facilities, i.e. port-a-jons.
14. Submittal of stormwater calculations: Calculations shall be submitted to the City supporting the stormwater management and storm drainage design. Calculations shall be bound together in a booklet or stapled together with sections tabbed and pages numbered, and in the following general format:
 - a. Cover Sheet – The cover sheet shall contain the project name, property tax parcel(s) number(s), applicant’s name, design professional’s name, calculations date, and the seal and signature of the design professional.
 - b. Table of Contents – A table of contents shall be provided to assist the reviewer in locating information in the calculations. All pages must be sequentially numbered.
 - c. Introduction – A general description of the project providing information to assist the reviewer in understanding the nature and scope of the project and of the storm drainage and stormwater management facilities that are proposed.
 - d. Criteria and Methodology – A listing of the basic design criteria and of the methodologies that the calculations will follow to demonstrate that the basic design criteria are met.
 - e. References – A listing of references that are used in the calculations.
 - f. Assumptions – A listing of all assumptions used in the calculations and justification of the assumptions.
 - g. Analysis – The body of the calculations shall be clearly labeled as to which stormwater management facility or storm drainage system the calculations

pertain. The calculations shall be step-by-step to ensure that a reviewer that is not familiar with the project can follow the progression of the calculations. All calculation parameters must be fully supported and documented and must include the design storm frequency, intensity and duration, times of concentration, soil curve numbers or runoff coefficients; calculations identifying total runoff volumes for each watershed area, infiltration rates (where applicable), culvert, storm drain, and open channel capacities, flow velocities, data on the increase in rate and volume of runoff for the specified design storms, pre- and post-development phosphorous loadings, downstream channel analysis, and all other calculations needed to support the proposed design.

- h. Summary and Conclusions – A summary of the results, preferably in tabular or chart form, for each storm drain system and stormwater management facility to indicate that the land disturbing project meets the requirements of the design manual with conclusions.
- i. Appendices and Attachments – Any supporting information such as drainage area maps, soils maps, USGS quadrangle maps, design nomographs, and computer printout.

5.3 Water Quantity Control

5.3.1 Minimum Requirements

Water quantity control shall be developed to the stormwater regulations in accordance with City Code Chapter 10. For sites required to incorporate any stormwater management facilities, the designer is encouraged to first analyze the use of water quality BMPs to include Green Stormwater Infrastructure (GSI) to achieve the water quantity control to the maximum extent practicable. To that end, perform the following:

- Provide pre-development condition of parcel area's peak runoff flow rate for the 100%, 50%, and 10% annual exceedance probability (AEP), 24-hour design storms. (Include off-site area if ROW is being affected as part of the project.) Show time of concentration flow types (sheet flow—100 feet maximum distance, shallow concentrated flow and channel flow) for the pre-development conditions of the parcel area.
- Provide the post-development peak runoff flow rate for the parcel area (exact area as pre-development analysis) for the prescribed design storms. Assume a time of concentration of 5 minutes and that no analysis is needed; otherwise, provide the time concentration calculations for the parcel area, to the detention

structure for example. Satisfactory compliance with the energy balance and pre-development design storm flow rates will meet the flow-rate requirement.

- Provide the analysis for the watershed to the point of analysis if off-site stormwater passes through the parcel area. Use the results of this analysis to design the control structures, outlet protection, sediment basin, etc. for the appropriate overflow/bypass peak flow rates. Include the 1% AEP, 24-hour design storm in the analysis to show the manner that this stormwater will be conveyed safely through the site.

5.3.1.1 Flood Protection Compliance

Applicants must demonstrate flood protection compliance to the limits of analysis outlined in the Part IIB stormwater regulations, or current requirements. For existing downstream man-made stormwater conveyance systems, containment of the hydraulic grade line (HGL) from the post-development 10% AEP 24-hour storm event within the pipe and junction system analyzed shall be considered sufficient demonstration of confinement of the peak flow within the system.

5.3.1.2 Design and Check Storm Frequencies

The most current NOAA Atlas 14 Point Precipitation Frequency Estimate data for rational method and US Soil Conservation Service (SCS) method 24-hour rainfall depths and rainfall distribution curve types shall be utilized for peak discharge calculations.

A 1% AEP storm event shall be utilized as a check storm for all proposed stormwater facilities. An emergency overflow spillway shall be provided in all instances where the primary spillway cannot adequately contain the 1% AEP check storm within the stormwater facility with sufficient freeboard.

5.3.1.3 Drainage Conveyance Systems

Current VDOT Drainage Manual requirements for capacity and minimum/maximum velocity and erosion protection shall be applied to all open channel, storm drain, and culvert conveyance systems. This includes but is not limited to design criteria regarding AEP storm analysis where the vertical alignment of the roadway creates a sag condition in a depressed roadway section or a roadway section utilizing concrete barriers.

HGL calculations for storm drains shall start at 0.8 times the diameter of the downstream pipe unless tailwater conditions are known.

Stormwater drainage piping in City right-of-way shall typically be perpendicular or parallel to the roadway in plan view. Crossings with other utilities shall be perpendicular where possible. Orientation and structure requirements to satisfy this requirement will be at the City's discretion.

All new storm drain pipes within the right-of-way or in connection with the construction of streets and sidewalks shall be constructed of reinforced concrete pipe (RCP), minimum class III. Any change in pipe material due to connections with existing or off-site pipes shall occur only at junctions with booted connectors. See Table 13-1 in Chapter 13: Maintenance of Existing Infrastructure for guidance on upgrading existing piping.

The minimum pipe diameter for storm drain and roadway culverts is 15 inches. The minimum pipe diameter for driveway entrance culverts is 12 inches.

Larger storm drain pipes will not be allowed to tie into existing smaller diameter pipes.

Comply with the following minimum clearances from utilities:

- 5 inches minimum horizontal separation is required from edge to edge of storm pipes from all other utilities.
- 18 inches minimum vertical separation is required for all storm pipes from sanitary sewer.
- 12 inches minimum vertical separation is required between all storm pipes, waterlines, and gas lines.
- 12 inches minimum vertical separation is required between storm pipes and duct banks or other dry utilities.

Inlets should be placed at the end of every new subdivision street and commercial entrance that connects to an existing street to prevent the unnecessary flow of water into the intersection or onto city streets. Roadway spread shall be analyzed in these areas to verify adequacy.

Roof drains from residential dwellings shall be placed in a manner that will not have a negative impact on adjacent properties. All roof drains shall daylight a minimum of 10 feet from an adjoining property line. Where roof drains cannot be daylighted a minimum of 10 feet from an adjoining property line, the roof drain shall tie directly into a stormwater system to convey the water to an appropriate location. Roof drains that daylight through a sidewalk shall incorporate a traffic-rated trench drain with a solid, removable, non-slip cover that is large enough to receive a minimum 4-inch pipe. Roof drains cannot be directed to send concentrated water over a sidewalk. All private storm drains from roof or foundation drains are required to be Schedule 40 PVC pipe at the right-of way line.

Existing structures that are altered in any way shall be reviewed during design and replaced as necessary.

All drainage systems that convey private water shall be located on private property. The only private drainage systems permitted in the ROW are those that connect roof or foundation drains to the public system.

When any storm pipe is taken out of service, it should be removed in its entirety. Abandoning storm pipe will only be permitted in circumstances where removal will create a significant challenge, such as where there is excessive depth or the potential for conflict with other utilities. Abandoned pipes must be approved and coordinated with the City’s Utility Engineer so that they can be mapped in the City’s GIS system. Flowable fill is required for all abandoned storm pipes. Generally, all storm pipes 4 inches or less in depth shall be removed, not abandoned.

Geotextile fabric for drainage systems including pavement subgrades and riprap shall conform to the requirements of the most current version of the VDOT Road and Bridge Specifications. Geotextile fabric for stormwater management facilities shall conform to the requirements of the most current version of the Virginia Stormwater BMP Clearinghouse Standards and Specifications.

5.3.2 Methodology

The most current VDOT Drainage Manual methodology for drainage calculations is required for all roadway systems. Stormdrain capacity must be analyzed to a minimum of one structure downstream of the project outfall point.

When the Rational or Modified Rational Method is calculated, the following coefficients should be used:

Table 5-1: Recommended Rational Coefficient of Runoff Values for Various Selected Land Uses

Description of Area	Runoff Coefficients
<i>Business: Industrial and Commercial</i>	0.80-0.90
<i>Apartments and Townhomes</i>	0.65-0.75
<i>Schools</i>	0.50-0.60
<i>Residential: - lots 10,000 sq. ft.</i>	0.40-0.50
<i>- lots 12,000 sq. ft.</i>	0.40-0.45

Description of Area	Runoff Coefficients
- lots 17,000 sq. ft.	0.35-0.45
- lots 1/2 acre or more	0.30-0.40
Parks, Cemeteries and Unimproved Areas	0.20-0.35
Paved and Roof Areas	0.90
Lawns	0.30-0.35
Forest	0.20-0.30
Steep Grass (2:1)*	0.40-0.70
Shoulder and Ditch Areas*	0.35-0.50
Open Water	0.90
Reforested Areas	0.25-0.35
Permeable Pavement Blocks	$(I-1.0)/I$ I = peak design rainfall intensity (in./hr.)

* Lower runoff coefficients should be used for permanent or established conditions. Higher runoff coefficients should be used to design roadside ditch linings. The design should consider the ditch lining as not yet established.

For site development projects requiring stormwater facilities, the SCS method shall be utilized for analysis and design of the facilities and any connected downstream conveyance systems that convey runoff from the facility to the limits of analysis. The rational method may be used for all other systems if the drainage area is generally uniform and less than 200 acres in size.

When determining time of concentration in existing conditions, all surface conditions selected (Manning's N values) should be based on the assumption that all pervious areas are in good hydrologic condition, regardless of actual field conditions. The Tc path should typically be selected to represent the most hydraulically distant point within the watershed. This means the path that takes the longest time to reach the outfall and not simply the longest measurable path. In proposed conditions, the Tc path should be the most hydraulically distant point, with the exception that sheet flow shall not be maximized for time, based on; length, roughness, land cover, or slope, unless that

drainage condition is actually overwhelmingly representative of the initial flow regimes generated within the developed site. Only after special consideration should Tc paths start in the 'sheet flow' regime if there is any upstream contributing drainage area, whether offsite or not. If velocities are used for any flow type segment, they shall not be arbitrarily selected but based on reasonable assumptions and a preliminary hydraulic analysis of the proposed flows in the proposed system, generated by the design storm in question. All Tc path determinations should conform to the methodologies found within the Virginia Stormwater Management Handbook Volume II Section 4-4.3.3. Any water quantity or quality facilities located in the floodplain must demonstrate that all components of the facility will be above the 1% AEP water surface elevation, including the outfall.

Underground detention systems should provide full access for closed-circuit television (CCTV) inspection. Each chamber susceptible to inflow of stormwater shall have an individual access port so that the remote-control CCTV equipment does not have to navigate any turns or corners. Isolation rows and observation ports are required for any chamber that does not have direct access for CCTV inspection.

5.4 Water Quality Control

5.4.1 Minimum Requirements

Water quality control shall be developed to the stormwater regulations in accordance with City Code Chapter 10. Unless otherwise noted, the latest Virginia Stormwater BMP Clearinghouse Standards and Specifications and DEQ Stormwater Management Handbook, including versions in draft format, shall be applied to all projects.

5.4.2 Methodology

For City-administered projects, providing stormwater quality treatment on site shall be a priority. If it is determined that on-site stormwater quality treatment is not feasible or economical, then off-site treatment in the form of new or retrofit facilities may be considered provided that the treatment is within the same eight-digit hydrologic unit code as the project site and approval by the City is obtained. The City allows nutrient credits for stormwater quality as an approved BMP to be used as a "last resort" option for public projects. Private site development projects may utilize nutrient credit purchasing for water quality credits in accordance with current VA DEQ policy, although it is strongly encouraged, and preferred, to utilize on-site systems that offer a true value to the local environment. Local nutrient banks should be considered first.

Any water quality facilities located in the floodplain must demonstrate that all components of the facility will be above the 1% AEP water surface elevation, including the outfall.

It is preferred that water quality facilities capture and treat water from the portions of the site that are likely to contain the most pollutants. For example, parking and drive isles will generate more pollutants than a rooftop will. These areas should be the focus of stormwater quality when the entire site does not need to be treated.

5.5 Best Management Practices and Green Stormwater Infrastructure

5.5.1 Minimum Requirements

Stormwater Best Management Practices (BMP) are on-site control and treatment techniques to reduce stormwater runoff volume and improve water quality. Green Stormwater Infrastructure (GSI) includes specific types of BMPs that use land conservation, plants, soils, and infiltration areas that provide both visual and functional enhancement to the site or streetscape. GSI gives the designer flexibility to fit BMPs within the site design, in small areas, and around potential conflicts. These areas can include roadside elements such as medians, curbside buffer zones, and clear walk zones, and traffic calming elements such as curb extensions and chicanes. GSI can be used to meet the site stormwater requirements and provide additional ecological and social benefits for wildlife habitat, air quality, temperature moderation, human health and safety, and enhanced livability.

The City recognizes that the stormwater industry is evolving at a rapid rate and that modern technologies that provide both quality and quantity benefits are frequently arriving on the market. The City routinely explores innovative ways to address stormwater concerns and encourages others to do the same. However, stormwater facilities that are required to meet state-mandated requirements must adhere to the state's requirements at a minimum. The City also encourages the retrofit of existing facilities to meet stormwater goals where feasible. Many facilities that exist today are dated and do not necessarily meet the objectives of today's regulations. These facilities should be analyzed carefully to maintain the controls that are in place, and designers should seek opportunities to improve upon existing conditions to provide additional benefit.

When evaluating BMP facilities for private development projects, the City strongly encourages adherence to the preferences listed below. With the exception of affordable

housing projects where funding sources have been committed and approved by the City for long term maintenance of stormwater BMPs, private development projects shall not utilize public right-of-way areas for stormwater BMPs. BMPs associated with private development projects shall be developed in accordance with City Code.

When evaluating BMP facilities that will be ultimately maintained by the City, including those within public street right-of-way, consideration shall be given to the following City preferences on BMP selection, which prioritize smaller practices, utilizing existing space, and improving the site landscape:

Green Stormwater Infrastructure

Preferred:

- Bioretention
- Open landscape areas, stormwater tree planters, and stormwater curb extensions with plantings, mulch layer, and filter media bed, with or without underdrain.
 - a. If underdrains are proposed, the minimum spacing is 10 feet.
 - b. If underdrains are proposed, the maximum stone depth permitted to be used in the quality calculations is 18 inches. More can be used for water quantity purposes, but only 18 inches can be counted towards the quality analysis.
- Infiltration Practices
 - a. Use surface or underground storage for runoff to allow water to infiltrate into soil, usually covered with stone or grass.
 - b. Underdrain requirements for stormwater tree planters shown above shall apply.
- Sheetflow to a Vegetated Filter Strip or Conserved Open Space
 - a. Project site landscape and natural areas are used to receive sheet flow runoff.
 - b. Land conversion: paved and impervious areas are removed and changed to vegetated areas or other pervious surface to allow water infiltration.
- Soil Compost Amendments
 - a. Existing landscape soil areas are enhanced with tilling and addition of enriched materials, i.e. compost, etc.
- Grassed Channels and Dry Swales

- a. Linear conveyance grass channels are used to filter and infiltrate water.
- b. Underdrain requirements for stormwater tree planters shown above shall apply.

Less Preferred:

- Permeable interlocking concrete pavers
 - a. Paved surfaces that allow water to filter through voids
 - b. Underdrain requirements for stormwater tree planters shown above shall apply.
 - c. A maximum 8% longitudinal slope shall be applied to the system unless otherwise approved. Subgrade slopes greater than 3% should include check dams or baffles.
 - d. Shall be kept out of City right-of-way

Do Not Use: Porous asphalt or pervious concrete

Standard BMPs

- Constructed wetlands, wet ponds, and extended detention ponds
 - a. Larger basin BMPs can be used when other upland runoff reduction and treatment techniques have been exhausted.
- DEQ-approved proprietary BMPs/manufactured treatment devices
 - a. May be considered when no other BMPs are an option and device is only option to meet site stormwater requirements.

See Appendix XX for BMP details.

5.5.2 Post-Construction Requirements

An as-built drawing shall be provided for permanent stormwater management facilities and shall be signed and sealed by a professional registered in the Commonwealth of Virginia.

For manufactured treatment devices, a letter from the manufacturer must be provided stating that it was installed correctly.

A BMP post construction certification is required in accordance with City Code Section 10-57. The certification form prepared by the City must be used.

A BMP summary table shall be required on all plans with SWM facilities as described in the Final Requirements checklist in Appendix XX.

5.6 Maintainability and Maintenance Access Responsibilities

5.6.1 Stormwater Management Facilities

See Section 10-56 of the City Code for requirements on long-term maintenance of permanent stormwater facilities.

There shall be detailed and specific maintenance requirements for each stormwater management facility in the plans. These maintenance requirements should follow the specifications of the Virginia BMP Clearinghouse. Maintenance requirements for manufactured treatment facilities should be per the manufacturers recommendations and outlined in the plans. Maintenance requirements should have general timeframes as to inspections and actual maintenance.

The City's stormwater management/BMP facilities maintenance agreement is available on the City's engineering website

Construction inspection requirements: Inspection requirements shall be provided for various types of stormwater facilities, as shown below. For more information, see Chapter 12: General Materials and Methods of Construction and Chapter 13: Maintenance of Existing Infrastructure. Failure to coordinate with the City on the inspections will result in delay of bond return and issuance of a Certificate of Occupancy.

- *Bioretention Inspection Requirements* - Bioretention facilities must be inspected at the following points:
 - a. When the facility is excavated and graded, prior to installation of stone layer, underdrains, geotextile, or filter media
 - b. When stone sump layer and underdrain are placed, prior to the pea gravel layer
 - c. Placement of filter media and material verification
 - d. Installation of plants and mulch
 - e. Setting of overflow invert
 - f. Connection of the underdrain to the storm system
 - g. Final completion
- *Infiltration Practices Inspection Requirements* - Infiltration Practices must be inspected at the following points:

- a. When the facility is excavated and graded, prior to installation of any sand layer, stone layer, underdrains, or storage chamber
 - b. When sand layer is placed
 - c. When stone sump and underdrain are placed, prior to any storage chamber placement
 - d. Prior to surface layer placement of soil, sod, geotextile, or other specified material
 - e. Setting of overflow invert
 - f. Connection of the underdrain to the storm system
 - g. Final completion
- *Grassed Channel and Dry Swale Inspection Requirements* - Grass channels and dry swales must be inspected at the following points:
 - a. When the facility is excavated and graded, prior to installation of stone layer, underdrains, geotextile, or engineered soil mix
 - b. When stone sump layer and underdrain are placed, prior to the pea gravel layer
 - c. Placement of filter media and material verification and prior to connection of the underdrain to the storm system
 - d. Final completion
- *Permeable Interlocking Concrete Pavers Inspection Requirements* - Pavers must be inspected at the following points:
 - a. When the facility is excavated and graded, prior to installation of stone layer, geotextiles, or underdrains
 - b. When stone sump layer and underdrain are placed, prior to placing stone above underdrain
 - c. Before placement of surface pavement material
 - d. Connection of the underdrain to the storm system
 - e. Final completion and verification of pavement permeability
- *Underground Detention Inspection Requirements* – Underground detention facilities must be inspected at the following stages:
 - a. When the facility is excavated; prior to installation of stone layer, underdrains, or fill
 - b. Just before setting detention outlet system
 - c. Following setting of outlet system prior to backfill begins

- d. Prior to filling over the top of the outlet system (so City may verify minimum cover requirements)
- e. Final completion
- *Constructed Wetlands Inspection Requirements* – Constructed wetland facilities must be inspected at the following points:
 - a. When the facility is excavated, prior to installation of any liners, geotextile, or stone layers or detention outlet system
 - b. Just before setting detention outlet system
 - c. Following setting of outlet system prior to backfill begins
 - d. Prior to filling over the top of the outletsystem (so City may verify minimum cover requirements)
 - e. Prior to planting plugs, shrubs, trees, etc.
 - f. Final completion
- *Extended Detention Ponds Inspection Requirements* – Extended detention facilities must be inspected at the following points:
 - a. When the facility is excavated, prior to installation of any liners, geotextile, or stone layers or detention outlet system
 - b. Just before setting detention outlet system
 - c. Following setting of outlet system prior to backfill begins
 - d. Prior to filling over the top of the outletsystem (so City may verify minimum cover requirements)
 - e. Final completion

5.6.2 Conveyance Systems

All stormwater conveyance systems that are to be publicly owned and/or maintained shall be located in the City right-of-way or in a drainage easement that is dedicated to the public.

All stormwater conveyance systems that are to be privately owned and/or maintained shall be placed in a private drainage easement dedicated to the property owner or HOA.

Both public and private stormwater conveyance systems include but are not limited to structures, pipes, ditches, swales, and channels. Roof drains and/or drainage conveyance systems which convey runoff from a single property shall not be contained within an easement.

5.7 Stream Buffers

The following documents provide guidance for work within designated stream buffers:

- The City ordinance (Chapter 10 Article IV) defines general stream buffer establishment requirements, authorized development within buffers, and basic mitigation plan requirements;
- The City Stream Buffer Mitigation Manual provides detailed information on the City's stream buffer mitigation plan process, mitigation options, and preferences (i.e. BMPs, setbacks, preserve or provide compensatory plantings, etc.) for different development projects (site plans, individual lots, SWM facilities, trails); and
- The VA DCR Riparian Buffer Modification and Mitigation Guidance Manual provides vegetation and planting types and planting rate guidance for buffers and should be referenced when developing a compensatory mitigation planting plan. This manual also provides guidance (i.e. slopes, location, and widths) on designing trails within stream buffer areas.

For more information, see Chapter 7: Environment and Sustainability.

5.8 Exemptions

See Section 10-51 of the City code for a list of activities exempt from land disturbing permit requirements.

See Virginia DEQ Guidance Memo No. 15-2003 for guidance on stormwater management implementation on linear utility projects.

5.9 References

[City of Charlottesville Stream Buffer Mitigation Manual](#)

[City of Charlottesville, Virginia Code of Ordinances](#)

[NOAA Atlas 14 Point Precipitation Frequency Estimates](#)

[VDOT Drainage Manual](#)

[VDOT Road and Bridge Specifications](#)

[Virginia Administrative Code](#)

[Virginia Department of Conservation and Recreation Riparian Buffer Modification and Mitigation Guidance Manual](#)

[Virginia Department of Environmental Quality Stormwater Management Handbook](#)

[Virginia Stormwater BMP Clearinghouse Standards and Specifications](#)

5.10 Additional Resources

[City of Charlottesville Water Resources Protection Program](#)

[City of Charlottesville Best Management Practices for Tree Preservation, Transplanting, Removal and Replacement](#)

CHAPTER 6

EROSION AND SEDIMENT CONTROL

6.1 Intent and Purpose

Chapter 10 of the City Code establishes requirements for the control of soil erosion, sediment deposition, and nonagricultural runoff, and establishes procedures by which these requirements will be administered and enforced. All regulated land disturbing activities must comply with the minimum standards specified in Virginia Erosion and Sediment Control Law and Regulations, 9 VAC 25-840 inclusive.

The City Code also outlines specific land disturbance thresholds and permit requirements which may be more stringent than current Virginia Department of Environmental Quality (DEQ) regulations. This chapter provides guidance on the application of City Code and state design criteria for erosion and sediment control, discusses allowable erosion and sediment control measures, and defines the minimum requirements for phased erosion and sediment control plan submissions at each stage of the City Site Plan Permit process.

See City Code Chapter 10 Article II for additional information on land-disturbing activity definitions and exemptions.

6.2 Plans

The applicant shall submit an erosion control plan to the Department of Public Works for the proposed design in accordance with City Code. See Appendix XX for the Erosion and Sediment Control Plan Requirements Checklist. The erosion control plans shall be developed in accordance with all VA DEQ requirements and shall include:

- VA Erosion and Sediment Control Handbook details for each proposed erosion and sediment control measure.
- Additional notes on erosion control plans:
 - a. All erosion and sediment control practices shall be in accordance with the current City of Charlottesville Erosion and Sediment Control Ordinance, the current edition of the Virginia Erosion and Sediment Control Handbook, and Virginia Erosion and Sediment Control Regulations. The

permittee or their agent and/or contractor shall secure a copy of each publication and thoroughly familiarize themselves with all applicable practices contained therein which may be pertinent to this project.

- b. The purpose of such practices, including but not limited to those shown on these plan sheets, shall be to preclude all waterborne or airborne sediments resulting from construction activities from entering onto adjacent properties or into state waters. All sediments must be confined to the project site at the location(s) shown on the plans. Protection of existing natural vegetation from needless disturbance is essential. All construction personnel shall be cautioned to avoid damage to existing trees and vegetation during construction activities.
- The following shall be included in the narrative to address erosion control practices:
 - a. Construction entrance (CE) shall be installed prior to the initiation of overall site clearing and grubbing operations.
 - b. Sediment basins and traps, perimeter dikes, sediment barriers, and other measures intended to trap sediment shall be constructed as a first step in any land-disturbing activity and shall be made functional before upslope land disturbance takes place. The basin(s) are to be kept clear of debris and sediments shall be cleaned out periodically during and after construction activities. Care shall be taken not to pump sediment out when dewatering temporary sediment traps, basins, trenches, or other low-lying areas. All pumping shall be routed through an approved dewatering device prior to discharging.
 - c. All temporary or permanent erosion and sediment control practices necessary for retaining sediments on the construction site shall be installed and tree protection fencing shall be erected at the locations as specified on the approved plans prior to any land clearing, grubbing, grading, or earth moving activities.
 - d. Clearing and grubbing debris shall be properly disposed of.
 - e. The installation and maintenance of erosion control and drainage facilities shall take precedence over all other construction activities. Site drainage facilities shall be scheduled to be completed within 30 days following completion of the rough grading operations at any point on the project.
 - f. Outfall ditches shall be constructed and stabilized prior to the initiation of any utility construction or building construction activity. Outlet Protection

- (OP) shall also be installed where called for immediately after construction of the outfall ditch(es).
- g. All temporary or permanent earthen structures such as slopes, dams, stormwater conveyance channels (SCC), and diversion dikes shall be stabilized (seeded) immediately after their construction. Stone outlet(s) shall be provided where shown on the plans.
 - h. Topsoil stockpiles shall be placed in the location(s) shown on these plans. Silt fence or straw bale barriers shall be erected at the toe of the stockpile(s). Silt fence or straw bale barriers shall be maintained throughout the duration of the project. Stockpiles shall be seeded and stabilized with a firm stand of grass.
 - i. Construction road stabilization (CRS) shall be applied to access roads, subdivision roads, parking areas, and/or other vehicle transportation routes immediately after grading.
 - j. All areas designated for underground utilities shall be stabilized as soon as practical but not exceeding 14 days following their installation and backfilling. Trench length to be opened at any one time is not to exceed 500 feet. Excavated material shall be placed on the uphill side of trenches. Effluent from dewatering operations shall be filtered or passed through approved sediment trapping device, or both, and discharged in a manner that does not adversely affect flowing streams or off-site property.
 - k. Sediment traps and basins should have a cleanout stake installed. All cleanout material should be placed in an upland area and stabilized.
 - l. Permanent or temporary soil stabilization shall be applied to denuded areas within seven days after final grade is reached on any portion of the site. Temporary soil stabilization shall be applied to denuded areas that may not be a final grade but will remain dormant (undisturbed) for longer than 14 days. Permanent stabilization shall be applied to areas that are to be left dormant for more than one year. Temporary vegetative cover may be eliminated in favor of the permanent vegetative cover if site conditions permit and the owner and/or engineer so directs. Permanent vegetation shall not be considered established until a ground cover is uniform, mature enough to survive, and able to inhibit erosion. Permanent vegetative cover (stabilization) shall consist of topsoiling, liming, fertilizing, seeding, and mulching to assure a firm stand of grass. When sod is used as permanent stabilization, it shall be installed perpendicular to the slope and

- perpendicular to any water flow. Sod requires staples on slopes 3:1 or steeper.
- m. Additional E&S measures or modification of existing E&S measures shall be installed as required by the City's E&S Inspector if at any time it is found that the plan-approved measures are inadequate or there is a potential for sediment deposition in state waters or beyond the limits of construction.
 - n. Maintenance of all erosion and sediment control practices shall be scheduled on a weekly basis and after each runoff producing rainfall event per the VA E&SC Handbook. Any sediment that has been transported beyond the project limits shall be removed. Maintenance and replacement of E&S measures are included with any scope of work associated with an E&S plan and shall be included when bidding or pricing a job.
 - o. Sediment traps, basins, and other temporary erosion control measures are to be removed only when stabilization has been established. Trapped sediment and the disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation. All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization or after the temporary measures are no longer needed, unless otherwise directed by the City.
 - p. All applicable federal, state, and local regulations pertaining to this project shall be met.
 - q. The permittee shall be held responsible for the actions and performance of any other parties performing work on this project.

6.3 Sequencing and Phasing

Erosion control plans shall be developed to a sufficient level of phasing to account for all construction sequencing that would otherwise be unprotected when applying a typical two-phased erosion control plan (i.e. Phase 1 initial clearing erosion control / Phase 2 substantially complete erosion control). Additional phases and/or sub-phases specific to a construction element or sequence shall be required as part of the erosion control plans as necessary so that sufficient erosion control measures are provided to all site areas throughout construction.

The designer should use good engineering judgment in determining how many E&S phases to include in a development plan and is strongly encouraged to discuss the construction process with a licensed contractor who is intimately familiar with actual

construction practices. If determined necessary, the designer shall provide additional E&S phases as requested by the reviewing engineer. As a rule of thumb, small pad sites will seldom require more than two phases, and on occasion may only require one phase if there is minimal land disturbance and little grade change across the site. As the area of land disturbance increases, there is often a need for additional and more detailed E&S plans.

Other issues to consider in setting up a phasing plan for E&S are existing and proposed site features; grade change across the site; presence or creation of steep slopes; existence of environmentally sensitive areas such as streams or wetlands; surrounding uses; ingress/egress; depth of excavations; the need to provide routine dewatering; intensity of the development as it relates to relocation or abandoning E&S measures as the site is built out; etc.

Plans shall include a written description of the anticipated sequence of construction that matches the phasing plans. The sequence shall be detailed and specific to the project and shall consider each major milestone of the development such as clearing, grading, utilities, retaining walls, roads, buildout, etc.

The City strongly recommends a sequence that limits the amount of denuded area open at a given point. Mass grading is discouraged.

6.4 Erosion and Sediment Control Measures

All erosion control measures shall be designed and installed per the VA E&S Handbook and the Charlottesville Best Management Practices for Tree Preservation, with the following requirements:

- Limits of Disturbance (LOD) must be shown and labeled with the area to be disturbed. The LOD shall consider all area required to perform the work, including but not limited to staging and laydown areas, stockpiles, grade tie-ins, ingress/egress, utilities, etc. The LOD for utility trenches should take into account the size of the utility, depth/width of the trench, and the location of equipment and placement of excavated materials. Generally, the LOD should be located a minimum of 5 feet outside of any proposed improvements.
- Chain link safety fence shall be required for all construction areas as deemed necessary by the City.
- Chain link safety fence shall be required around all sediment traps and basins except at access points and emergency spillways, etc.

- Chain link tree protection shall be required for all areas to receive tree protection as deemed necessary by the City.
- When approved for use by the City, super silt fence shall be installed in accordance with the specifications for silt fence with wire support as outlined in the VA ESC Handbook, except that standard chain link fence (2-inch mesh) shall be substituted for the wire support. Note that the VA ESC Handbook requires stronger filter fabric be used with super silt fence than standard silt fence.
- The City prefers biodegradable materials be used for E&S measures provided that the materials meet the minimum performance requirements outlined in the VA ESC Handbook. Socks/Gutter Buddies must not have manufactured material like Styrofoam or tire pieces, it must be natural fiber or mulch.
- Underground BMP systems shall not be utilized for sediment control unless the design demonstrates full compliance with the VA E&SC Handbook for sediment traps and sediment basins, including wet and dry storage and proper drawdown times.
- Inlet bags may be used per manufacturer recommendations.
- The rational method or the SCS TR-55 method may be utilized for determining peak discharges for sediment basin sizing criteria.
- A concrete washout must be shown on all phases of the E&S plan where concrete work is anticipated.
- Fuel storage location must be shown on the E&S plan, or it should be noted that a mobile fueling system will be used.
- A cleanout stake should be included for sediment traps and basins.
- Plans shall show the drainage divides with the areas to each E&S measure labeled.
- Dewatering plans shall be part of all E&S plans, regardless of the size of the project. The dewatering plan will be appropriate for the operations expected. For example, if occasional dewatering of a utility trench is likely, then an appropriate sized silt sack/pump should be used. Operations that will require more frequent dewatering will require a more intensive dewatering plan to provide the appropriate level of sediment filtration.
- The limits of tree protection should be 1.5 feet for every inch of the Diameter at Breast Height (DBH).
- Stand-alone utility projects shall provide the following:
 - a. Inlet protection on all storm drain inlets immediately downstream of any utility project.

- b. Excavated trench materials shall be hauled off site and not stored in the public ROW.
- c. To minimize denuded areas in the public ROW, utility cuts shall not exceed 500 feet of continuous length prior to asphalt patching. This distance may be extended in special circumstances to accommodate testing requirements of water lines.
- d. Materials storage (stockpiles) in the public ROW shall be kept to a minimum and protected with covering and/or surrounded with a filtering device to prevent conveyance of sediment down the street.

6.5 References

[City of Charlottesville Best Management Practices for Tree Preservation, Transplanting, Removal and Replacement](#)

[City of Charlottesville, Virginia Code of Ordinances](#), Sections 10-22 through 10-43, Erosion and Sediment Control Ordinance

[Virginia Erosion and Sediment Control Handbook](#)

[Virginia Erosion and Sediment Control Law and Regulations](#)

CHAPTER 7

ENVIRONMENTAL SUSTAINABILITY

7.1 Intent and Purpose

The City's 2025 Vision Statement to be A Green City is as follows:

Citizens live in a community with a vibrant urban forest, tree lined streets, and lush green neighborhoods. We have an extensive natural trail system, along with healthy rivers and streams. We have clean air and water, we emphasize recycling and reuse, and we minimize stormwater runoff. Our homes and buildings are sustainably designed and energy efficient.

This sustainability-based vision means working together within the Charlottesville community to create an attractive, clean area in which to live, work, and visit and to protect the natural resources upon which all life is dependent. Examples include using energy and water more efficiently, managing waste through recycling and composting, producing less waste, and reducing pollution.



Figure 7-1: Charlottesville's Green City logo (City of Charlottesville)

As part of the recently adopted Strategic Plan, Charlottesville has set the goal of being “A Beautiful and Sustainable Natural and Built Environment” with an objective to “Be responsible stewards of natural resources.” The City defines sustainability as “a process or a state that can be maintained at a certain level indefinitely; meeting the needs of the present without compromising the ability of future generations to meet their own needs.” Establishing sustainable design objectives encourages future development to preserve

or restore the natural environment and maintain the City for future generations. As Charlottesville is an urban area, urban ecology (interaction between constructed and natural systems), health and safety, quality of life, waste management, resource efficiency, optimization, and environmental impacts are all important. The City is increasingly recognizing the impact that design and operations have on the City's climate in terms of both emissions and resiliency.

By implementing sustainable practices in buildings and operations as well as in the public right-of-way, the City can conserve energy, improve air and water quality, and protect our waters, making our community more beautiful and livable. As presented in the Envision™ Version 2.0 – A Rating System for Sustainable Infrastructure, sustainability must be considered across all phases of a project: planning and design, construction, operations and maintenance, and decommissioning and deconstruction. Additionally, and importantly, sustainability encompasses a broad range of social, environmental, and economic criteria. As presented by the Sustainable Sites Initiative™ (owned by the Green Business Certification, Inc), “What is built on the land profoundly impacts ecological systems as well as the health, safety, and welfare of our communities.”

7.2 Sustainable Buildings and Energy

High-performing green buildings increase the efficient use of energy, water, and materials while reducing building impacts on human health and the environment. Renewable energy systems also can reduce operating costs and greenhouse gas emissions. The City encourages sustainable building practices and has completed several municipal projects to demonstrate this commitment.

7.2.1 Water Conservation

Water is an essential component of life itself, and developers should look to maximize water conservation and efficiency within projects. Sound water conservation practices can both ensure that water remains available and keep project costs down, especially in times of drought. Efficient water use should be considered both inside buildings and outside for landscaping and street trees.

Consider implementing the following water conservation practices:

- Incorporate EPA WaterSense labeled fixtures, including irrigation controllers and indoor fixtures, (certified to use 20% or less water than standard models) when appropriate.
- Install Water Wise landscapes with drought-tolerant plants that require little to no irrigation.

- Incorporate rainwater harvesting and alternative water sources to reduce dependence on potable water consumption.
- Remove or phase out single-pass/once-through cooling systems and installation of air-cooled equipment or closed-loop recirculation systems.

Refer to Chapter 5: Stormwater Management for guidance pertaining to green stormwater infrastructure that also accomplishes water conservation goals and to Chapter 10: Trees and Landscape for guidelines pertaining to water conservation measures and landscaping.

7.2.2 Energy Optimization

According to the Environmental Protection Agency, buildings account for 36% of overall annual energy consumption in the United States and 65% of the overall electricity use. Buildings also account for 30% of the total carbon dioxide (CO₂, which is the primary greenhouse gas associated with atmospheric warming), 49% of the sulfur dioxide, and 25% of the nitrogen oxides emitted in the U.S. (Source: EPA) Differing from the national greenhouse gas profile, buildings account for 60% of total emissions in the City of Charlottesville. (Source: City of Charlottesville 2016 Greenhouse Gas Inventory)

Developers should aim to optimize their projects' energy performance. The adopted Virginia Uniform Statewide Building Code has included amendments to the model International Building Code that reduce building energy performance, thereby leaving a range of options for energy optimization.

Per the National Institute of Building Sciences Whole Building Design Guide, the following comprehensive, integrated approach should be applied during a building's design and development as well as during the reuse, renovation, or repair of existing buildings:

- Reduce heating, cooling, and lighting demand through passive strategies such as climate-responsive design, daylighting, and conservation practices.
- Specify efficient HVAC and lighting systems that consider part-load conditions and utility interface requirements.
- Employ renewable energy sources such as solar heating for hot water, photovoltaics, geothermal space heating, and groundwater cooling, sized for the reduced building loads.
- Optimize building performance by employing energy modeling programs during design.
- Optimize system control strategies by using occupancy sensors, CO₂ sensors, and other air quality alarms during operation.

- Monitor project performance through a policy of commissioning, metering, annual reporting, and periodic re-commissioning.
- Consider retro-commissioning of buildings which were never originally commissioned.
- Integrate water saving technologies to reduce the energy burden of providing potable water.

An effective online tool that building owners and operators can use to measure and track energy and water consumption, as well as greenhouse gas emissions, is EPA ENERGY STAR Program's Portfolio Manager <https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager>. This tool can be used to benchmark the performance of one building or a whole portfolio of buildings, all in a secure online environment. Benchmarking data allows developers, contractors, and designers to establish baselines and track improvements.

7.2.3 Clean Energy, Renewable Energy

There is great potential for solar power generation in Charlottesville. There are local programs and incentives to help make installing solar power more cost-effective, and solar energy systems are allowed as by-right accessory uses in all zoning districts; the Zoning Ordinance clarifies allowable locations and heights. During new construction and roof replacement projects, developers and property owners can facilitate and support solar generation by either including solar in the initial project or by making the building “solar-ready,” and including the electrical components necessary to accommodate adding a solar installation at a later date.

Other clean energy technologies and strategies, such as geothermal, combined heat and power, and microgrids are also encouraged.

7.2.4 Lighting

Street and pedestrian lighting is a unique piece of infrastructure that has experienced significant advancements in technology that support sustainability goals. Specific guidelines are provided in Chapter 11: Lighting.

7.3 Natural Resources

Stewardship of natural resources in an urban environment can lead to clean air and water, diverse forests and plant communities, healthy habitats, resiliency, and access to outdoor recreation and natural beauty, and can assist with management of the city's historic

landscape. These are just a few of the benefits often referred to as ecosystem services: direct and indirect benefit to humans produced by processes that involve the interactions of living elements (such as vegetation) and non-living elements (such as water and air).

Charlottesville has a maturing Green Infrastructure (GI) Program that is based on strategically integrating nature into the urban environment to enhance environmental values and create a more healthful city. The City recognizes that weaving natural processes into the built environment provides the benefits of stormwater management, flood mitigation, air quality management, habitat, and improved aesthetics, just to name a few.

There are several natural site features that are desirable to retain, protect, or enhance. These include healthy soils and vegetation, vegetated stream buffers (required on three City waterways per City Code Chapter 10, Article 4 but strongly encouraged on all waterways), steep slopes, mature trees, and water resources.

Preservation of prime habitat, wetlands and surface waters, and floodplain functions are effective strategies that contribute to ecosystem health.

7.3.1 Water Resources

Maintaining clean water for the community is a basic goal of Charlottesville's A Green City vision. Charlottesville is located in the Rivanna River Watershed, which flows into the James River and then into the Chesapeake Bay.

7.3.1.1 Regulatory Compliance

Effective strategies to achieve clean water include stormwater management as well as water resources protection and improvements (e.g., stream restoration, stream daylighting, removal of stream obstructions, etc.). Many regulatory compliance programs exist to support clean water goals. Chapter 5: Stormwater Management and Chapter 6: Erosion and Sediment Control provide details pertaining to regulatory requirements that cover the following:

- erosion and sediment control (E&S), relevant for land disturbing activities greater than or equal to 6,000 square feet;
- Stormwater Construction General Permit, including Stormwater Pollution Prevention Plans (SWPPPs);
- in addition, City Code Chapter 10, Article V addresses the prohibition of illicit discharges to the stormwater system.

7.3.1.2 Stream Buffers and Offsets

All development shall adhere to the stream buffer requirements outlined in Chapter 10 of the City Code and the City's Stream Buffer Mitigation Manual, included as an appendix to this manual.

In addition to the stream buffer requirements, all development and man-made improvements shall maintain a minimum 15-foot offset to any stream or waterway as identified by the City's critical slopes ordinance. This offset is measured from the top of bank. It is permissible that utilities and trails may be located closer than 15 feet to a stream or waterway as necessary to cross or navigate a constrained area.

7.3.1.3 Daylighting Streams

Daylighting streams helps create green spaces and regulate temperatures; benefitting pedestrians and cyclists. Charlottesville has at least 2.5 miles of buried streams, and every opportunity should be taken to bring these to the surface. A thorough hydrologic and hydraulic evaluation is required to determine feasibility of daylighting. (See Section 5.2.1.)

7.3.1.4 Green Stormwater Infrastructure

Green stormwater infrastructure utilizes plants, trees, and other measures to mimic natural processes that control and treat stormwater before it enters surface waters. It includes practices such as vegetated roofs, bioretention, tree planting and stormwater tree planters, permeable pavement, and rainwater harvesting. These practices intercept, evaporate, transpire, filter, infiltrate, capture, and reuse stormwater. Designers shall refer to the Virginia Department of Environmental Quality (DEQ) Stormwater Design Specification No. 9, Appendix 9-A Urban Bioretention for appropriate stormwater planters. The designer shall verify that selected stormwater planters comply with the City's Approved Plant Species List in Chapter 10, Section 10.2.1.5.

7.3.1.5 Pollution Prevention

Other effective strategies include removing trash, minimizing the use of pesticides and fertilizers, and preventing surface and groundwater contamination. In addition to the required erosion and sediment control measures (see Chapter 6), designers should incorporate language into project plans and specifications requiring contractors to implement good housekeeping and other best practices including but not limited to:

- appropriate management and disposal of on-site waste;
- xeriscaping to reduce water use;

- including educational plates/signage on storm drain inlets;
- providing designated areas for on-site fueling and hazardous materials storage which include measures to prevent unintentional releases and keep them from entering the surrounding environs;
- installing plantings at appropriate times of year to minimize the need for pesticide and fertilizer application and watering.

7.3.2 Urban Forestry

One of the critical components of green infrastructure is the urban forest system. Trees in and near the right-of-way can contribute to the overall function of that system. Trees are known to provide numerous benefits including opportunities for recreation, habitat and food source, shading and buffering, improved air and water quality, protection of biodiversity, erosion protection and stormwater runoff reduction, urban heat island reduction, and climate change mitigation.

A recent analysis of existing trees and possible planting opportunities (Charlottesville Green Infrastructure GreenPrint 1.0) should be referenced as part of development activities. Charlottesville's Tree Packet contains suggestions for the types and species of trees that the City of Charlottesville endorses as well as a listing of trees not recommended for planting in the city.

7.3.3 Biodiversity

A robust urban ecosystem relies on the existence of natural species and natural habitat. Invasive plant and animal species can impact the success of natural species and habitats, and proactive management to control invasive species is important. Management includes taking care not to introduce invasive species and removing invasive species to prevent their spread. Information about invasive species is maintained by the Virginia Cooperative Extension Service.

7.4 Sustainable “Getting Around”

Less than 1 percent of the land area of the U.S. is covered by roads, according to the Federal Highway Administration, (<https://www.artba.org/about/faq/>) however the transportation sector accounted for the largest portion (29%) of total U.S. greenhouse gas emissions in 2017. (<https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions>). Multimodal streets, also known as Complete Streets, address the mobility needs of all users regardless of race, income, age, or ability. (<http://old.smartgrowthamerica.org/documents/cs/factsheets/cs-equity.pdf>)

The City of Charlottesville encourages sustainable options for getting around town, including public transit, bike and pedestrian infrastructure, ride sharing, and alternative fuel locations. The City recognizes the value of better connecting people to services, employment, and recreation. The LEED for Neighborhood Development rating system promotes good connections for pedestrians, cyclists, and vehicles—both within a neighborhood and to surrounding areas—as essential elements of a sustainable neighborhood. This means frequent street connections and pathways to surrounding areas, a high degree of internal connectivity, and few barriers to adjacent areas and uses. Street connectivity is an important cross-cutting strategy for neighborhood sustainability since it also improves access to parks, schools, transit, businesses, jobs, and services.

Chapter 4: Transportation presents relevant guidelines that support the environmental sustainability objectives of connectivity and multimodal transportation.

7.4.1 Electric Vehicle Charging

Increased mass market adoption of electric vehicles (EV) is expected to continue rising and will be supported for travel within Virginia through investments from the Commonwealth in electric vehicle charging infrastructure. Developers are encouraged to coordinate with the City to ensure that electric vehicle charging stations are located throughout Charlottesville and integrated into public parking and housing developments. Installing electric wiring and running conduit during a building's construction phase – thereby making it “EV ready” – can significantly lower the cost to install electric vehicle charging equipment at a later date. Guidelines for the installation of electric vehicle supply equipment and recommendations for charging station layouts continue to be developed. Many resources related to alternative fuel transportation can be found via the Virginia Clean Cities website, <http://vacleancities.org/>. The U.S. Department of Energy has funded the development of best practice guides and recommended codes for electric vehicle supply equipment that developers and property managers can use for reference, such as <https://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/EV-Ready-Codes-for-the-Built-Environment.pdf>.

7.5 Sustainable Material and Waste Management

The most effective way to reduce waste is not to create it in the first place. The City promotes reducing, reusing, and recycling/composting items to save natural resources, reduce costs, and protect the environment.

7.5.1 Reusable, Renewable, and Recycled Materials

Designers and contractors shall prioritize the reuse of existing building and construction materials. Reusing materials diverts waste from disposal, may provide cost benefits to the project, and may contribute to the historic preservation of Charlottesville.

For new materials, the use of recycled or locally/regionally sourced materials is encouraged whenever possible. Asphalt, concrete, and aggregate can often be acquired locally and can be broken up and recycled. Choosing rapidly renewable materials or certified wood may also be appropriate measures for specific projects. Materials are considered rapidly renewable if derived from plants harvested within a 10-year cycle or shorter.

Where possible, use low-maintenance materials.

7.5.2 Life Cycle Cost Consideration

Resource choice is vital to sustainable design and construction. The process of extracting, processing, and transporting new materials can be extensive, and the disposal of replaced materials means added waste in landfills.

7.5.3 Waste Diversion

Waste diversion minimizes the quantity of waste generated and maximizes opportunities for recycling or reuse. Effective approaches require planning, including the determination of potential waste streams, separation of materials, and identification of available facilities to take materials to. Contractors can also divert waste, redirecting the material from landfills back into the manufacturing process or to alternative projects.

Property owners, developers, and designers need to provide adequate space for the on-site collection of up to three waste streams (trash, recycling, compost) in separate containers as well as sufficient space for temporary placement of containers for curbside pickup (if relevant) that does not impede bicycle/pedestrian access or ADA accessibility.

7.6 Third Party Certifications

Projects are encouraged to pursue third party certifications. The following are some relevant programs to consider:

- LEED (<https://new.usgbc.org/leed>)
- SITES (<http://www.sustainablesites.org/certification-guide>)
- Envision (<https://sustainableinfrastructure.org/envision/>)
- Greenroads (<https://www.greenroads.org/publications>)

- ParkSmart (<https://parksmart.gbci.org/certification>)
- EarthCraft (<https://earthcraft.org/>)
- EPA ENERGY STAR (<https://www.energystar.gov/>)
- EPA WaterSense (<https://www.epa.gov/watersense>)

7.7 Innovation and Pilot Projects

The City encourages innovation and technological advancements that promote sustainability. The City is willing to consider pilot projects if the developer meets with and receives City approval and commits to maintaining the project as long as it is considered a pilot. There also may be opportunities where the City's partnership in innovative and pilot projects may be mutually beneficial and helpful in offsetting the cost of the pilot. These opportunities should be discussed in detail with a clear outline of responsibilities and expectations.

7.8 References

[City of Charlottesville A Green City](#)

[City of Charlottesville Best Management Practices for Tree Preservation, Transplanting, Removal and Replacement](#)

[City of Charlottesville Green Infrastructure GreenPrint 1.0](#)

[City of Charlottesville Strategic Plan](#)

[City of Charlottesville Stream Buffer Mitigation Manual](#)

[National Institute of Building Sciences Whole Building Design Guide](#)

[Virginia Clean Cities Program](#)

[Virginia Cooperative Extension Service Invasive Species Program](#)

[Virginia Department of Environmental Quality \(DEQ\) Stormwater Design Specification](#)

7.9 Additional Resources

[High Performance Infrastructure Guidelines: Best Practices for the Public Right-of-Way](#)

CHAPTER 8

BRIDGES, RETAINING WALLS, AND OTHER RELATED STRUCTURES

8.1 Intent and Purpose

This chapter provides guidance on the application of VDOT design criteria for structures, discusses allowable structure types and materials, and defines the minimum requirements for structural plan and calculation/report submissions. The City of Charlottesville encourages the planning and design of structures to incorporate treatments that provide an aesthetically pleasing appearance that complements the setting of the structure.

8.2 Design Codes

The design and construction of structures shall be in accordance with these criteria and the current edition of the codes, manuals, and specifications listed below. These are to be used in accordance with the project-specific requirements that are dictated by the type of structure specified. Unless otherwise noted, the most recent version and the most stringent criteria, code, manual or specification shall govern.

- American Association of State Highway and Transportation Officials (AASHTO), AASHTO LRFD Bridge Design Specifications, including all interim revisions and VDOT modifications.
- VDOT Manual of the Structure and Bridge Division
- VDOT Instructional and Informational Memorandum (I&IM), all divisions
- VDOT Road and Bridge Standards, Volume I and II
- VDOT Road and Bridge Specifications
- National Fire Protection Association (NFPA) 502: Standard for Road Tunnel, Bridges, and Other Limited Access Highways
- AASHTO LRFD Bridge Construction Specifications
- AASHTO LRFD Guide Specifications for Design of Pedestrian Bridges

- Precast/Prestressed Concrete Institute (PCI), PCI Design Handbook – Precast and Prestressed Concrete
- Virginia Work Area Protection Manual
- Virginia Uniform Statewide Building Code (VUSBC)
- American Railway Engineering and Maintenance-of-way Association (AREMA) Manual for Railway Engineering
- VDOT Road Design Manual
- AASHTO Guide Specifications for Structural Design of Sound Barriers
- AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals
- Virginia Statewide Fire Prevention Code

8.3 Bridges

Bridge properties and detailing shall be in accordance with VDOT Manual of the Structure and Bridge Division. Vehicle load limits shall be posted at both entrances to bridges when required by the fire code official.

8.3.1 Vehicular Bridges

A bridge is defined as follows:

A structure, including supports, erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway or other travelway of more than 20 feet between under copings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.

In general, where pedestrian and bicycle facilities exist or are planned in proximity to a vehicular bridge, those facilities shall be carried across the bridge or on an adjacent pedestrian bridge. This applies to facilities that are part of the roadway, as well as off-road trail connections that may be nearby. Refer to the City of Charlottesville Bicycle and Pedestrian Master Plan for locations of planned pedestrian and bicycle facilities.

8.3.1.1 Structural Design

Bridges shall be designed in accordance with the AASHTO LRFD Bridge Design Specifications and the VDOT Manual of the Structure and Bridge Division.

8.3.1.2 Materials

Material specifications shall be in accordance with VDOT Road and Bridge Specifications.

8.3.1.3 Loading

Bridge and culvert loading shall be designed in accordance with AASHTO LRFD Bridge Design Specifications and VDOT modifications.

Bridges carrying railway traffic shall be designed in accordance with the American Railway Engineering and Maintenance-of-way Association (AREMA) and other applicable design guidelines as provided in contract documents.

For dead loads of materials not included in the codes, the best available technical information shall be used and its source or reference provided in calculations.

8.3.1.4 Width and Clearance

Horizontal widths and vertical clearances for bridges shall comply with Part II, Chapter 6 of the VDOT Manual of the Structure and Bridge Division. For proposed bridges, the City requires that bridges be designed to meet all of VDOT's "desired" or "preferred" minimum dimensions unless otherwise authorized by the City.

8.3.1.5 Railings and Barriers

Railings and barriers on bridges shall be designed in accordance with Part II Chapter 25 and Chapter 6 of the VDOT Manual of the Structure and Bridge Division. Vehicular bridges that also have a pedestrian or bicycle facility shall have screening or fencing only where required by the jurisdiction owning the roadway or railway below. Screening shall be as transparent as possible.

8.3.1.6 Aesthetics

Aesthetic treatment of any part of a proposed structure shall be approved by the City and shall be reasonably consistent with the surrounding environment. The preferred aesthetic pattern shall be discussed with the City during design.

8.3.1.7 Geotechnical Requirements

Geotechnical investigations for bridges and culverts shall be completed in accordance with Chapter 3 of the VDOT Manual of Instructions for the Materials Division. Prior to the 60% plan submittal (50% submittal for culverts), a Geotechnical Engineering Report detailing at a minimum site description, test locations and procedures, soil properties, and foundation recommendations shall be submitted to the City for approval.

Boring locations shall be included in the earliest available plan submittal. Boring logs shall be included, at a minimum, in the 100% plan submittal.

Foundation design calculations performed by the geotechnical engineer shall be submitted either as part of the Geotechnical Engineering Report or with the structural calculations at 100% plan submittal.

8.3.1.8 Drainage Requirements

Drainage design for both bridges and culverts shall follow the VDOT Drainage Manual for peak discharge, scour requirements, and the bridge opening or size of culvert. Refer to the Chapter 34 of the City Code for flood plain impacts and analysis.

8.3.2 Bicycle/Pedestrian and Trail Bridges

Bridges or tunnels should be provided where necessary to allow continuous pedestrian and bicycle access and to avoid unnecessarily long bypass routes. Bridges are typically preferred because they provide better visibility, allow a more comfortable user experience, and have fewer security concerns. In addition, natural and man-made features such as water bodies, major roadways, and railroads often present barriers to pedestrian and bicycle travel.

The placement of bridge facilities includes but is not limited to planned shared use path and trail bridges identified in the City of Charlottesville Bicycle and Pedestrian Master Plan.

8.3.2.1 Structural Design

Bridges designed for pedestrian and bicycle use shall be designed in accordance with the AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges and the VDOT Manual of the Structure and Bridge Division. Where emergency or maintenance vehicle access is necessary, the structure shall be designed to meet these vehicular loading requirements.

8.3.2.2 Pedestrian Width and Clearance

Horizontal widths and vertical clearances for independent pedestrian and bicycle bridges shall comply with Part II, Chapter 6.04 of the VDOT Manual of the Structure and Bridge Division. For proposed bridges, the City requires that bridges be designed to meet all of VDOT's "desired" or "preferred" minimum dimensions unless narrowing the facility is necessary to reduce or avoid adverse environmental impacts. Requests to narrow

pedestrian and bicycle bridges to limit right-of-way impacts or project costs will be considered on a case-by-case basis.

Where emergency or maintenance vehicle access is required, increased horizontal and vertical clearance may be necessary. Where pedestrian bridges are designed to be ADA-compliant, bridges may be no less than 48 inches wide, with 60-inch by 60-inch passing space every 200 feet.

8.3.2.3 Railings

Per Part II, Chapter 6.04 of the VDOT Manual of the Structure and Bridge Division, pedestrian and bicycle railings and handrails are required along pedestrian and bicycle bridges and approaches. Where emergency or maintenance vehicle access is required, crash-tested vehicular barriers may also be necessary.

Railings should be accompanied by fencing/screening only where required by the jurisdiction owning the roadway or railway below. Screening shall be as transparent as possible.

Where pedestrian bridges are designed to be ADA-compliant, handrails must comply with ADA standards.

8.3.2.4 Bridge Type

Overall, materials of construction and aesthetics of pedestrian and bicycle bridges should be sensitive to the surrounding context, using materials and colors that complement or blend with adjacent architecture, historic setting, streetscape features, and/or natural environs. Bridge designers should also consider the bridge's anticipated life span, long-term maintenance needs, and associated costs. The City desires to minimize life cycle costs and maintenance requirements while providing structures that are convenient, comfortable, and aesthetically pleasing.

8.3.3 Process

8.3.3.1 Submittals

Unless coordinated differently in the project-specific contract, bridge plans shall be submitted for review at approximately 30%, 60%, 90%, and 100% completion in accordance with the VDOT LAP Manual. Culverts shall be submitted for review at approximately 50%, 90%, and 100% completion.

Structural calculations that provide comprehensive design shall be submitted for inclusion in structure records at the 100% plan submission. Calculations and quality control/assurance are the responsibility of the Engineer or Record.

Pedestrian and bicycle bridges that do not span over a roadway or a railroad and do not require state or federal permits or funding may be submitted for review only at 30% and 100% completion if agreed to by the City. Any bicycle/pedestrian or trail bridge design funded by the City, whether prefabricated or not, must follow the guidelines in Section 8.3.2.

Upon acceptance of both 100% plans and calculations, plans shall be signed and sealed and submitted for advertisement.

8.3.3.2 Variances

A request for variance to any criteria listed herein shall be submitted in writing to the City for review and approval. The request shall include all pertinent information as to why the criteria cannot be met and supporting justification for the requested deviation. Justifications may include effects on safety, maintenance, and constructability.

8.3.3.3 Notification of Changes

The designer or contractor shall notify the City and obtain approval for any changes in structure design, specifications, manufacturer (in the case of a pre-engineered product), location, or changes in site conditions that alter the design values or assumptions prior to construction. Submittals shall include supplemental detailed information, revised plans, and/or computations for review and approval.

8.4 Retaining Walls

All freestanding walls and walls extending from a building foundation wall that are 4 feet or greater in height, regardless of whether they are attached or a continuous extension of a building foundation, shall be submitted to the City for review. This requirement includes engineered walls, pre-engineered manufactured wall systems, VDOT standard gravity retaining walls (RW-2 & RW-3), and mechanically reinforced earth systems.

All retaining walls greater than 4 feet in height shall be engineered, designed, certified, and sealed by a professional engineer licensed in the Commonwealth of Virginia. The design for both public and private retaining walls shall be in accordance with either the AASHTO LRFD Bridge Design Specifications or the International Building Code. For the purpose of this section, the height shall be defined as the vertical dimension from the base of the toe/footing of the wall to the top of the wall.

The designer may utilize a “pre-engineered” wall system such as Modular Block, Segmental Walls, or MSE walls for walls less than 4 feet in height provided that the wall is constructed in accordance with the manufacturer’s design guides. When standard or pre-engineered walls are used, appropriate documentation indicating that the wall design meets the VDOT standards or the manufacturer’s design constraints shall be submitted with the plans.

8.4.1 Materials

Material specifications shall be in accordance with VDOT Road and Bridge Specifications.

8.4.2 Loading

Retaining walls supporting roadways or within the clear zone of a road shall be designed to AASHTO standards with adequate geotechnical data obtained as discussed in Section 8.3.1.7, Geotechnical Requirements.

For dead loads of materials not included in the codes, the best available technical information shall be used and its source or reference provided in calculations.

8.4.3 Aesthetics

It is the City’s intent that all walls proposed for construction within the City of Charlottesville shall include aesthetic treatments and finishes that are compatible with the surrounding environment. If a concrete wall is utilized, the finished, exposed surfaces shall be constructed utilizing a form liner system as a minimum.

Form liner finish shall replicate brick, stone veneer, or random board finish, and the concrete shall be tinted or painted as required to provide a finished surface in keeping with the pattern of the finished face. Alternatively, a brick, ashlar stone, or field stone finish may be used. See Detail XX for suggested wall finishes. Modular or segmental wall systems shall utilize finished faces of an appropriate finish, preferably a split face block, and color to complement the adjacent environment. The exposed face of all walls shall be battered a minimum of .25 inches per foot of height toward the retained soil mass. The City shall review and approve the proposed wall finish prior to the construction of any retaining wall.

8.4.4 Drainage Requirements

All retaining walls shall be designed with foundation drains, weep holes, or other means of releasing hydrostatic pressure.

8.4.5 Geotechnical Requirements

Geotechnical investigations for retaining walls shall be completed in accordance with Chapter 3 of the VDOT Manual of Instructions for the Materials Division. Prior to the 50% submittal, a Geotechnical Engineering Report detailing, at a minimum, site description, test locations and procedures, soil properties, and foundation recommendations shall be submitted to the City for approval.

Boring locations shall be included in the earliest available plan submittal. Boring logs shall be included, at a minimum, in the 100% plan submittal.

Foundation design calculations performed by the geotechnical engineer shall be submitted either as part of the Geotechnical Engineering Report or with the structural calculations at 100% plan submittal.

8.4.6 Plan Requirements

All walls—regardless of whether they are engineered—will be detailed on the plans. At a minimum, the plans shall include the following information:

8.4.6.1 Notes and Specifications

At a minimum, structural notes and specifications shall describe the following:

- Soil bearing capacity, as indicated in the geotechnical report or the assumed value if a geotechnical report was not required. If the assumed bearing capacity exceeds the minimum value listed in the applicable code, the notes shall indicate the basis for this assumption as well as the necessary testing required to prove that the assumption is met in construction.
- Soil properties used in design, including but not limited to: unit weight, friction angle, cohesion, and equivalent density of the retained soil mass. The source for each of these items shall be cited.
- Wall materials and their design strengths.

8.4.6.2 Typical Sections

Typical sections shall show and label the items described below:

- Maximum slope and dimensions of backfill
- Assumed loading/surcharge on the retained soil mass
- Provisions for backfill and wall/foundation drainage
- Size and location of keys or dowels, if required to resist sliding

- Location of horizontal construction joints and keys
- Method of attachment for wall facing, if provided (i.e. block ledge, masonry anchors, etc.)
- Guardrail/parapet where adjacent vehicular traffic is expected in accordance with VDOT Road Design Manual clear zones and AASHTO crash ratings, as applicable
- Handrails where adjacent pedestrian use is expected, in accordance with the requirements of the Virginia Uniform Statewide Building Code or AASHTO
- Profile to show utility crossings, measures required to protect and/or maintain utilities, or special features as necessary

8.4.6.3 Plans and Profile

The following plan and profile information shall be shown:

- A plan view of the entire wall, providing all necessary information (offsets, tie-ins, curve/turn data, etc.) to establish vertical and horizontal control for construction of the wall
- A profile view of the wall, providing all information necessary (top of wall elevations, footing elevations, vertical offsets, etc.) to establish vertical control for construction of the wall
- Location of expansion and construction joints
- Details of wall finish

8.4.7 Process

8.4.7.1 Submittals

Unless coordinated differently in the project-specific contract, retaining walls shall be submitted for review at approximately 50%, 90%, and 100% completion.

Structural calculations that provide comprehensive design shall be submitted for inclusion in structure records at the 100% plan submission. Calculations and quality control/assurance are the responsibility of the Engineer of Record.

Upon acceptance of both 100% plans and calculations, plans shall be signed and sealed and submitted for advertisement.

8.4.7.2 Notification of Changes

The designer or contractor shall notify the City and obtain approval for any changes in structure design, specifications, manufacturer (in the case of a pre-engineered wall

product), location, or changes in site conditions that alter the design values or assumptions prior to construction. Submittals shall include supplemental detailed information, revised plans, and/or computations for review and approval.

8.5 Box Culverts for Pedestrian and Bicycle Use

Where barriers to pedestrian and bicycle travel cannot be traversed by bridges, it may be possible to provide a box culvert tunnel undercrossing to serve the same purpose.

Enclosed tunnels often make pedestrians feel uncomfortable and can result in both perceived and real risks to personal safety. It may therefore be appropriate to implement safety measures such as installing lighting or call boxes periodically along the length of the culvert.

Refer to the City of Charlottesville Bicycle and Pedestrian Master Plan for locations of planned pedestrian and bicycle tunnels.

8.5.1 Width and Clearance

Horizontal widths and vertical clearances for pedestrian and bicycle tunnels shall meet the same basic width and clearance requirements as pedestrian and bicycle facilities on bridges, as outlined in Part II, Chapter 6.04 of the VDOT Manual of the Structure and Bridge Division. For proposed tunnels, the City requires that tunnels be designed to meet all of VDOT's "desired" or "preferred" minimum dimensions, unless narrowing the facility is necessary to reduce or avoid adverse environmental impacts. Requests to narrow pedestrian and bicycle facilities to limit right-of-way impacts or project costs will be considered on a case-by-case basis.

Proposed tunnels should be designed to be as short as possible, utilizing wingwalls or retaining walls to limit length.

For retrofit projects, where pedestrian and bicycle facilities are being added to existing box culverts, it is first necessary to inspect the existing tunnel to ensure it is structurally sound before converting it to pedestrian use. It may not be possible to meet minimum horizontal and vertical clearance requirements within the physical constraints presented by the existing box culvert. In addition, pedestrian and bicycle facilities may be within the floodplain or below the high-water elevation. In these cases, designers may consider several options, including the following:

- Providing enhanced signage to warn users of constrained conditions
- Providing a high-water warning system
- Providing a high-water detour route

- Widening the existing box culvert
- Widening entrances to the box culvert
- Adding wingwalls or retaining walls to shorten box culvert length

8.5.2 Drainage

Tunnels and underpasses often exhibit drainage issues, particularly if the tunnel is frequently inundated during storm events. Designers should incorporate measures to facilitate proper drainage, which may include:

- Elevating the tunnel floor (subject to vertical clearance requirements and hydraulic analysis)
- Providing scuppers or drainage channels
- Providing a pumping system

8.5.3 Lighting

Proper lighting should be installed to allow users to see the paved surface in front of them, see other users around them, and gauge other users' relative speed and direction of travel. Designers should consider both the illumination levels inside the tunnel and the effects of lighting as users transition to and from exterior lighting at the tunnel entrance and exit. Tunnel lighting shall be designed in accordance with American National Standards Institute/Illumination Engineering Society (ANSI/IES) RP-22, Standard Practice for Tunnel Lighting. Other measures that can be used to enhance tunnel lighting include:

- Painting the tunnel interior with a light-color paint to aid visibility
- Providing striping in tunnels designed for two-way traffic
- Providing supplemental up lighting or side lighting
- Providing skylights or other openings in the top of the tunnel
- Adding murals to tunnel walls to provide a sense of progression

8.6 References

AASHTO LRFD Bridge Construction Specifications

AASHTO LRFD Bridge Design Specifications, including all interim revisions

AASHTO LRFD Guide Specifications for Design of Pedestrian Bridges

AASHTO Guide Specifications for Structural Design of Sound Barriers

AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering

ANSI/IES RP-22 Standard Practice for Tunnel Lighting

[National Fire Protection Association \(NFPA\) 502: Standard for Road Tunnel, Bridges, and Other Limited Access Highways](#)

Precast/Prestressed Concrete Institute (PCI), PCI Design Handbook – Precast and Prestressed Concrete

[VDOT Manual of the Structure and Bridge Division](#)

[VDOT Modifications to the AASHTO LRFD Bridge Design Specifications](#)

[VDOT Instructional and Informational Memorandum \(I&IM\), all divisions](#)

[VDOT Road and Bridge Standards](#)

[VDOT Road and Bridge Specifications](#)

[VDOT Road Design Manual](#)

[VDOT Virginia Work Area Protection Manual](#)

[Virginia Statewide Fire Prevention Code \(SFPC\)](#)

[Virginia Uniform Statewide Building Code \(VUSBC\)](#)

CHAPTER 9

UTILITIES

9.1 Intent and Purpose

Chapter 31 of the City Code establishes minimum requirements, criteria, practices, and procedural guidelines for the planning, design, construction, and approval of public utility infrastructure, including potable water, sanitary sewer, storm sewer, and gas. This chapter provides guidance on the application of federal, state, and local (City Code) standards relative to utility provider design criteria, discusses allowable materials, and defines the minimum requirements for utility plan submissions at each stage of the City's Site Plan Permit process. When standards are in conflict, the more stringent requirements shall apply. All water, sanitary sewer, and gas shall be provided by the City when the property requiring the design is located within City limits.

This chapter also includes guidance on addressing private utilities proposed in public right-of-way and public easements.



Figure 9-1: Typical utility installation

9.2 Water

The design of all potable water systems shall conform to the Virginia Department of Health Waterworks Regulations and to the requirements of other state and federal agencies having jurisdiction. The design of all potable water systems shall be performed under the direction of a registered professional engineer with a current registration in the

Commonwealth of Virginia in accordance with Title 54.1, Chapter 3 of the Code of Virginia, as amended. Where applicable and in accordance with the Virginia Department of Professional and Occupational Regulation (DPOR), design may be performed under the direction of a certified land surveyor in accordance with Section 54.1-408 of the Code of Virginia.

9.2.1 Preliminary Design Requirements

A preliminary engineering report for all new water systems shall be submitted to and approved by the City prior to submittal and approval of drawings and specifications. In addition, a capacity study may also be required, as indicated below:

1. **Preliminary Engineering Report.** The Preliminary Engineering Report (PER) shall include a preliminary system design report and an overall system layout plan. The system layout plan shall delineate service area boundaries and clearly define the areas pertinent to interim and ultimate development of the service area. The report shall demonstrate that the water lines are designed to serve the entire subdivision or development. Where phased development is contemplated, the extent of each phase shall be clearly delineated. For water system projects that only consist of new water service laterals below 10,000 gallons per day, this report shall not be required.
2. **Capacity Study.** A capacity study for water lines will be required for developments exceeding 40,000 gallons per day average flow based on Virginia Department of Health Waterworks Regulations. A water model shall be required to justify the water system design, unless this requirement is waived by the Department of Utilities.

Requirements for PER and/or Capacity Study

1. **Design capacity.** The water distribution system and any extensions thereof shall have adequate capacity to supply the peak hour demands of all customers while maintaining a pressure of not less than 30 psi at all points of delivery. In addition, the system shall be capable of delivering maximum hour customer demand plus fire flow as indicated in Table 9-1 and Table 9-2 and as determined by the City's **Fire Code Official** while maintaining a residual pressure of not less than 20 psi at each service connection.
2. **Customer demands.** The following criteria will be used in estimating customer water demands for hydraulic design computations:
 - a. Residential demand (single-family homes, townhouses, apartments).
 - b. Maximum hour demand: 2 gpm per connection.

- c. Peak hour demand: 3 gpm per connection.
- d. Where the number of residential units is less than 1,000, the greater of the following equation or 2 gpm (for max hour demand, use 3 gpm for peak hour demand) per connection shall be used to estimate maximum hour demand:

$$Q = 11.4 * N^{0.544}$$

where Q = total demand (gpm)

N = total number of residential units

Commercial, industrial, and institutional water demand.

- e. Maximum hour demand: Use Table 9-1 and Table 9-2 for estimation of water demand. Maximum hour demand shall be at least 300% of average hour demand computed from average daily flows. Note: In cases where VUSBC (Virginia Uniform Statewide Building Code) requirements are more stringent, the VUSBC requirements govern.
 - f. Peak hour demand: Calculate peak hour demand by applying a 1.5 factor to maximum hour demand.
 - g. Industrial flows shall be estimated from flow records or from similar large water users.
 - h. Maximum hour demand and peak hour demand per connection shall not be less than 2 gpm and 3 gpm, respectively.
 - i. Applicable design flows shall be selected and confirmed through the Department of Utilities.
3. **Extensions.** When water distribution system extensions are to be made, the designer shall first determine the quantity of water required and then obtain from the City the hydraulic gradient for the point of connection to the City's system while providing said demands. Distribution piping design will be based upon providing capacities and service pressures in accordance with these standards from the supply design gradient furnished by the Department of Utilities.
4. **Hydraulic Coefficients.** Hydraulic design of distribution piping will be based on pipe carrying capacities consistent with head losses determined using a Hazen-Williams Coefficient (for pipe roughness) of C=120, unless other values are required by the Department of Utilities.

9.2.2 Final Design Requirements

Once the preliminary design requirements have been achieved, the final design requirements for all new water systems shall be followed in preparing construction

drawings for approval by the City. The below criteria shall apply:

1. **Design and Capacity Criteria.** The design shall be in accordance with the requirements of the studies required in the preliminary design requirements. The fixture count method per American Water Works Association (AWWA) Manual M22: Sizing Water Service Lines and Meters shall be used to determine maximum flow and for water service line and meter sizing purposes.
2. **Distribution system layout criteria.** The following criteria shall apply to the design of new water systems:
 - a. Location. All water lines shall be located in legally established road rights-of-way or permanent easements, either existing or as proposed by the designer.
 - b. Alignment. Generally, waterlines will be allowed under the pavement 5 feet from the outside edge of the pavement or from the face of curb on undivided highways.
 - c. Structures. Water lines shall be located a minimum of 10 feet horizontally from any part of a building, structure, or its foundation.
 - d. Looping. Secondary loops and cross mains with diameters of less than 12 feet shall be spaced not more than 1,000 feet apart with no dead-end length exceeding 500 feet for any 8-inch main.
 - e. Dead-ends. Dead ends in the water system should be minimized by looping of all mains. Where dead-end lines occur, they shall be provided with a fire hydrant, flushing hydrant, or blow-off for flushing purposes. No flushing device shall be directly connected to any sewer. However, where dead-end lines are unavoidable, they shall be designed subject to the approval of the Department of Utilities.
3. **Pipe size.** In general, minimum pipe sizes shall be determined based on the preliminary engineering requirements for design capacity to achieve required flows and pressures. Additional criteria for pipe size determination are listed below:
 - a. Minimum Size. The minimum size pipe for water distribution systems shall be 6 inches in diameter for residential areas, and 8 inches in diameter for commercial and industrial areas. Any departure in minimum sizing shall be justified by hydraulic analysis and future water use. Water mains not sized for fire flows shall not be connected to fire hydrants.
4. **Velocity.** In general, maximum velocity within water lines at peak demand shall not exceed 5.0 feet per second. Minimum velocity at peak demand shall be at least 2.5 feet per second.

5. **Distribution System Components.** The following items are required for proper water system design:
- a. Depth of cover. Water pipe shall be laid with a minimum cover of 3.5 feet measured from established finished grade to the top of the pipe. Maximum depth of cover shall be 5 feet where it is beneficial in avoiding high points, thereby eliminating the need for air relief valves. Depth of cover in excess of 5 feet shall only be considered on a case-by-case basis.
 - b. Valves. Gate valves shall be installed at the intersections of all water lines. Generally, three valves will be used at crosses and two valves at tees. A valve shall also be installed every 1000 feet on distribution mains. Additional valves may be required at the discretion of the City.
 - c. Fire hydrants. Fire hydrants shall be located on the distribution system as follows:
 - i. In residential areas (one- or two-family), fire hydrants shall be located so that there will be at least one hydrant within 300 feet of any building (based on ultimate development). Hydrants along streets or roads on which residences front shall be spaced not more than 500 feet apart.
 - ii. In commercial, industrial, apartment, and townhouse areas, fire hydrants shall be located as required to meet the fire protection standards of the American Insurance Association. In no case shall more than 300 feet of fire hose be required to reach any point at the base of any exterior building wall from the nearest fire hydrant or from each of the hydrants required to supply the required fire flow.
 - iii. No more than one fire hydrant shall be located on any 6-inch dead-end main, and no fire hydrant shall be located not more than 300 feet from a looped main.
 - iv. Fire hydrants located near intersections shall be located 3 to 6 feet from curb radius to avoid potential vehicle conflicts. See appropriate detail for more specifics.
 - v. Fire hydrants shall be located directly behind sidewalks and be placed where practical to meet ADA requirements.
 - vi. Any deviation from the above requirements shall be approved by the City **Fire Code Official**.
6. **Bends.** The use of bends shall be minimized where possible by the use of pipe-joint deflections. However, the pipe shall not be deflected more than 50 percent of the manufacturers recommend maximum.

7. **Restraints.** Provide thrust restraint at all fire hydrants, tees, bends, valves, and other fittings and as required in design details. Proper restraint shall be accomplished by use of restrained joint pipe or mechanical joint pipe with approved retainer glands and shall be shown on plans. Concrete thrust blocks are not required, but may be used when connecting to existing water mains or where using restrained fittings is not possible.
8. **Blow-Offs.** All mains, branches, and dead-ends shall be equipped with blow-offs and/or hydrants of adequate size and number to develop a velocity in the main of at least 2.5 feet per second. Blow-offs will be required at low points of lines 8 inches and larger.
9. **Air Release Valves.** Where high points cannot be avoided by deepening the water main, automatic combination air-vacuum release valves shall be installed at high points of water mains 10 inches and larger. Automatic air release valves shall be installed in all other main sizes 8 inches and less.
10. **Pressure Reducing Valves.** When the maximum static pressure in the system exceeds 80 psi, businesses and residences shall be equipped with a pressure-reducing valve. The valve should be located on the customer side of the water meter and shall be installed and maintained by the customer.
11. **Separation of Water and Sanitary Sewer.** The following guidelines shall apply for separation between water and sanitary sewer mains:
 - a. Water mains (including all appurtenances) and sanitary sewers shall be separated horizontally by a minimum of 10 feet (edge to edge).
 - b. If local conditions preclude a horizontal separation of 10 feet, the installation will be permitted provided the water main is in a separate trench and at such elevation that bottom of the water main is at least 18 inches above the top of the sewer.
 - c. Where neither of these requirements can be obtained, the sewer shall be constructed of AWWA-specified water pipe and pressure tested in place without leakage prior to backfilling. Sewer manholes shall be of watertight construction and tested in place. This will require VDH approval.
 - d. Provide a minimum vertical separation of 18 inches between the water pipe and sewer (measured edge to edge) when a potable water main must cross over a sewer line.
 - e. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA-specified water pipe and pressure tested in place without leakage prior to backfilling.

- f. Sewers passing over water mains shall be constructed of AWWA-specified water pipe. Minimum vertical separation of potable water line and sewer shall be 18 inches. In addition, center one full-length section of pipe so that the sewer joints will be equidistant from the water main joints. Provide adequate structural support for the sewer so as to maintain line and grade.
- 12. Separation of Water Mains and Other Utilities.** The following guidelines shall apply for separation between water and utility lines:
- a. Water lines (and appurtenances) shall have a minimum parallel separation of 5 feet from gas lines and all other utilities. If not practical, provide the maximum separation possible with approval of Department of Utilities.
 - b. At all crossings, provide a minimum vertical separation of 12 inches between potable water lines and gas mains or "wire-type" utilities.
- 13. Surface water crossings.** Water lines intended to cross streams, rivers, or other surface waters should be discussed with the Department of Utilities, VDH, and the Virginia Marine Resources Commission (VMRC) before final plans are prepared. Only under extraordinary conditions will the City approve above-ground crossings.
- a. The water line is to be installed a minimum of 3 feet under the stream or river bed and be of special construction having flexible watertight joints.
 - b. With approval by the Department of Utilities, Horizontal Directional Drilling (HDD) may be considered for water main installation due to permitting requirements. In using HDD, the minimum depth below the bottom of the water feature shall be 6 feet.
 - c. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repairs; the valves shall be easily accessible and not subject to flooding.
- 14. Roadway Crossings.** All roadway crossings are subject to the approval and requirements of the governing authority having jurisdiction. Where approved, roadway crossings are to be by "open cut." Encasement in a steel casing pipe shall be done only at the direction of the governing authority.
- a. Where crossings are required to be tunneled, bored, or jacked, said crossings are to be in accordance with the requirements of the City design details.
 - b. Valves shall be provided at both ends of the crossing so that the pipe section can be isolated for testing or repairs. Valves are to be located a minimum of 40 feet from the ends of the crossing, easily accessible, and

not subject to flooding. No service connections shall be located between valves unless approved otherwise by the Department of Utilities.

15. **Railroad Crossings.** Railroad crossings are subject to the approval and requirements of the operating railway company. Crossings are to be by tunneling, boring, or jacking, and are to comply with the requirements of the railway and appropriate Detail Drawing. Valves shall be provided at both ends of the crossing so that the pipe section can be isolated for testing or repairs.
16. **Water Service Laterals.** Service laterals shall be sized for maximum anticipated peak flow demand for the building being serviced in accordance with the requirements of the Virginia Uniform Statewide Building Code.
 - a. Service lateral shall not be less than 3/4-inch diameter.
 - b. Maximum allowable velocity for water service line is 8 feet per second.
 - c. All service laterals are to be installed with 36 inches minimum cover on the City side of the meter. Minimum cover may be reduced to 24 inches with written permission from the Department of Utilities.
 - d. The service lateral shall run perpendicular to the main straight to the meter box or vault. The meter shall be located on the property that it is intended to service.
 - e. Where a service lateral must cross a sanitary sewer, the bottom of the service lateral shall be at least 12 inches above the top of the sewer (for a distance of 10 feet on both sides of crossing point).
 - f. Meter boxes or vaults are to be located a minimum of 12 inches and a maximum of 36 inches directly behind the curb where possible or as directed by the Public Utilities Engineer. Where no curb exists, meter boxes and vaults shall be installed in readily accessible locations beyond the limits of the street surfacing and driveways.
 - g. Water laterals may not connect to fire lines or hydrant lines. Each water lateral must have its own connection to a public main line with a corporation stop or valve located adjacent to the main line.
17. **Water Meters.** All water meters shall be sized for peak hourly maximum flow rate in accordance with AWWA M22 method and VUSBC. In cases where VUSBC requirements are more stringent, VUSBC governs.
 - a. For all proposed meters, the designer shall provide estimated domestic water demand calculations based on fixture counts or other means acceptable to the Department of Utilities.

18. Backflow Preventers. Backflow preventers shall be provided for all commercial and industrial facilities connected to the public water system in accordance with the Virginia Uniform Statewide Building Code.

19. Design Flow. Table 9-1 and Table 9-2 are based on state standards and shall be current version.

Table 9-1: Average Flow Quantities

<i>Land Use</i>	<i>Land Use Type</i>	<i>Gallons/Day/Acre</i>	<i>Equivalent Persons/Acre</i>
<i>Residential</i>	Low (R-25, R-40)	500	5
	Medium (R-9, R-12, R-15)	1000	10
	High (RTH, RMF)	2500	25
	Other (Agriculture/Undeveloped Land)	1000	10
<i>Commercial</i>	Retail	2000	20
	Office	1500	15
<i>Industrial</i>	Light (M-1)	2000	20
	Medium (M-2, M-3), Heavy	3500	35

Note: R-9, R-12, R-15, R-25, R-40, RTH, RMF, M-1, M-2 and M-3 are defined in Building Officials and Code Administrators (BOCA) National Building Code, latest edition.

Table 9-2: Average Facility Flow Rates

<i>Discharge Facility</i>	<i>Design Units</i>	<i>Flow (gpd)</i>
<i>Single family units (includes townhouses, individual house trailers, etc.)</i>	3.5 people/dwelling	400
<i>Apartments and condominiums</i>	4 people/3-bedroom apt.	400
	3 people/2-bedroom apt.	300
	2 people/1-bedroom apt.	200
<i>Schools with showers and cafeteria</i>	Per person – elementary	16
	Per person – high school	25
<i>Motels and hotels at 65 gals./person (rooms only)</i>	Per room	130
<i>Trailer courts at 4 persons/trailer</i>	Per trailer	400
<i>Restaurants</i>	Per seat	50
<i>Service stations</i>	Per vehicle services	10
<i>Factories</i>	Per person per 8 hr. shift	25
<i>Shopping centers</i>	Per 1000 sq. ft.	250
<i>Hospitals</i>	Per bed	300
<i>Nursing homes</i>	Per bed	200
<i>Homes for the aged</i>	Per bed	100
<i>Doctor’s office in medical center</i>	Per 1000 sq. ft.	500
<i>Laundromats, 9 to 12 machines</i>	Per machine	500
<i>Theaters (auditorium type)</i>	Per seat	5
<i>Bowling alleys</i>	Per lane	75
<i>Office buildings</i>	Per 1000 sq. ft. of ultimate floor space	200

Note: Other classifications may be found in the BOCA National Plumbing Code, latest edition; the Virginia Department of Health Waterworks Regulations, latest edition, and the Virginia Department of Environmental Quality Sewage Collection and Treatment Regulations (SCAT Regs), latest edition.

9.2.3 Materials

This section provides the general requirements for water system materials. For more specific information, see Sections 15062 and 15100 of the Construction Specifications.

- **Water Main.** All pipe for water main construction shall be cement-lined ductile iron pressure pipe of the push-on joint, mechanical joint, restrained joint variety, conforming to ANSI 21-51 (AWWA C151, latest revision). Thickness class shall be a minimum Class 52 for all pipe diameters.
- **Fittings.** All fittings for ductile iron pipe shall be mechanical joint ductile iron in accordance with AWWA Specifications C111, latest revision, with a minimum pressure rating of 250 psi.
- **Service Laterals.** Service laterals 2 inches and less shall be soft copper tubing, Type K, conforming to ASTM B88 and ANSI/AWWA C800. Service lines 4 inches and larger shall be ductile iron pipe. Three-inch service line is not allowed without written approval of the Department of Utilities.
- **Fire Hydrants.** Fire hydrants shall be designed for 150 psi service and for installation in a trench that will provide a minimum of 3.5 feet of cover. Hydrants shall be of the safety flange, breakaway top type, meeting requirements of AWWA C502. Hydrants shall have a barrel diameter no smaller than 6 inches and a hydrant valve opening diameter no smaller than 5.25 inches, and shall be equipped with two 2.5-inch hose nozzles and one 4.5-inch pumper connection. Threads on the 4.5-inch pumper connection and the operating nut shall be National Standard threads. Threads on the hose connections shall be “Charlottesville Thread”—3 and 21/64-inch female, 3 and 9/32-inch male, 8 threads per inch (gauge 8-322). Hydrants shall be Mueller Super Centurion Model A-243, or Kennedy K-81D Guardian. The hydrant valve opening shall be obstructed only by the valve rod. Each hydrant shall be able to deliver a minimum of 600 gallons per minute through its two 2.5-inch hose nozzles when opened together with a loss of not more than 2 psi in the hydrant.
- **Valves and Appurtenances.** All valves and appurtenances shall be of the size shown on the drawings, and as far as possible all items of the same type shall be from one manufacturer. In addition, the following shall apply:
 - All valves and appurtenances shall have the name of the manufacturer, flow directional arrows, and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.
 - All valves shall open left (counterclockwise).

- Extension stems for valves shall be made from Type 304 stainless steel. Stem guides shall be provided as necessary to support extension stems.
- Interior coatings are to be NSF 61-approved for potable water use.

9.3 Sanitary Sewer

The design of all sanitary sewer systems shall conform to the Virginia Department of Environmental Quality (VDEQ) Sewage Collection and Treatment (SCAT) Regulations and to the requirements of other state and federal agencies having jurisdiction.

The design of all sanitary sewer systems shall be performed under the direction of a registered professional engineer with a current registration in the Commonwealth of Virginia in accordance with Title 54.1, Chapter 3 of the Code of Virginia, as amended. Where applicable and in accordance with the Virginia Department of Professional and Occupational Regulation, design may be performed under the direction of a certified land surveyor in accordance with Section 54.1-408 of the Code of Virginia.

9.3.1 Preliminary Requirements

A preliminary engineering report for all new sanitary sewer systems shall be submitted to and approved by the City prior to submittal and approval of drawings and specifications. In addition, a capacity study may also be required, as indicated below:

1. **Preliminary Engineering Report.** The Preliminary Engineering Report (PER) shall include a preliminary system design report and an overall system layout plan. The system layout plan shall delineate service area boundaries and clearly define the areas pertinent to interim and ultimate development of the service area. The report shall demonstrate that the sewer system is designed to serve the entire subdivision or development. Where phased development is contemplated, the extent of each phase shall be clearly delineated. For sanitary sewer system projects that only consist of sewer laterals below 10,000 gallons per day, this report shall not be required.
2. **Capacity Study.** A capacity study that includes an estimate of flow based on the criteria shown in Table 9-1 and Table 9-2. A minimum peaking factor of 4.0 (peak flow/average flow) shall be used for lateral and submain sewers and a minimum peaking factor of 2.5 shall be used for mains and trunk sewers. Additional provisions for excessive inflow and infiltration shall be provided by the City in consultation with the designer. The estimated design flow shall be based on the current Charlottesville Comprehensive Plan's land use plan for ultimate build-out

of the sewer basin that the property is part of. Developments generating an average daily flow of more than 40,000 gallons per day shall also require an evaluation of the impacts to the downstream sewer collection system. The designer shall:

- a. Provide sewage quantity estimates from the development .
- b. Provide capacity of receiving line at tie-in point and downstream at any critical points (as determined in consultation with the Department of Utilities) to where the line connects with a trunk line.
- c. Provide a plan indicating the sanitary sewershed that the proposed development will impact. Label manholes with the city manhole ID numbers. Indicate manhole top elevations, invert elevations, slope of line, and diameter of pipes. Include this information in a table as well.
- d. Provide a table indicating the proposed additional load on the sewage collection system, the current capacity of the downstream lines, and a determination of whether there is available capacity to accommodate the proposed additional flow.
- e. Note: Evaluation of capacity of the existing system shall include flow monitoring at a minimum of one location and may include additional locations as determined by the Department of Utilities after consultation with the designer. Flow monitoring device(s) shall be in place so as to obtain 30 days of flow data (during which a minimum of one rain event in excess of 2 inches must occur, or monitoring is to be extended for a longer period). The City requires analysis to a point where the sanitary sewer becomes a trunk line (i.e., where it has a continuous 12-inch diameter or greater).

3. Preliminary System Design.

- a. New sewer system capacity shall be designed on the basis of an average daily per capita flow of sewage of not less than that set forth in Table 9-1. These figures are assumed to include infiltration but do not address inflow from surface water.
- b. An analysis shall be prepared that tabulates the number of people being served or proposed to be served. The tabulation shall be by incremental areas for evaluation purposes.
- c. Average and maximum flows shall be developed for areas and sub-areas and tabulated in the report as deemed necessary or appropriate.

- d. The design documentation shall address total current and projected future flows and system capacities of existing and proposed utilities and shall provide the proposed line sizes.
- e. Facility sizing shall be based on ultimate development (complete build-out of the area) and shall present all information necessary for a sound evaluation of the factors used in development of the report.
- f. The system layout plan shall delineate service area boundaries and clearly define the areas pertinent to interim and ultimate development of the service area. The system layout plan shall show:
 - i. Present and future development, proposed interim and future utilities, and existing utilities that will be affected by or have an effect on the proposed utilities.
 - ii. Existing and proposed ground elevations at contour intervals not exceeding 5 feet unless otherwise approved by the City.
 - iii. Proposed utilities necessary to serve adjacent properties and associated easements shall be shown.

9.3.2 Final Design Requirements – Sanitary Sewer

Once the preliminary design requirements have been achieved, the final design requirements for all new sanitary sewer systems shall be followed in preparing construction drawings for approval by the City. The below criteria shall apply:

1. **Pipe Size.** Gravity sewers shall be sized to serve the estimated ultimate tributary population and maximum anticipated flows for commercial, industrial, and institutional users consistent with the 50-year growth and land use projections for the City of Charlottesville. Hydraulic computations and other design data should clearly establish the capacity of proposed sewers.
 - a. Sewer size shall not be less than 8 inches in diameter.
 - b. The size of pipes shall be the same or continually increasing in direction of flow with addition of tributary areas, no exceptions.
2. **Sewer Grades.** The following table represents the minimum slopes to be provided for gravity sewers; however, slopes greater than those listed are desirable:

Table 9-3: Minimum Sewer Slope

Sewer Size	Minimum Slope (feet/100 feet)	Maximum Allowable Capacity (mgd)
	Non-settled Sewage	N=0.013
8"	0.50	0.54
10"	0.28	0.75
12"	0.22	1.07
14"	0.17	1.45
15"	0.15	1.6
16"	0.14	1.8
18"	0.12	2.4
21"	0.10	3.1
24"	0.08	4.2
27"	0.067	5.2
30"	0.058	6.3

3. Pipe slopes shall not be arbitrarily decreased to take advantage of larger diameter pipes.
 - a. Sewers shall be installed with uniform slope between manholes.
 - b. Sewers constructed on 20 percent slope or greater shall be anchored securely with concrete anchors or equal. Minimum anchorage is as follows:
 - i. Slopes 20% to 35%: Not over 36 feet center-to-center.
 - ii. Slopes 35% to 50%: Not over 24 feet center-to-center.
 - iii. Slopes over 50%: Not over 16 feet center-to-center.
4. **Velocity.** All sewer lines shall be designed for a minimum mean velocity of 2.0 fps when flowing full and a maximum velocity of 15 fps. Computations for velocity of flows shall be based upon the Manning formula for velocity of flow in pipes flowing full (using n=0.014).

- a. Suitable provisions shall be provided to break steep slopes to limit the velocities in the connecting sewer pipes between manholes. Where velocities greater than 15 feet per second are unavoidable, special provisions shall be made to protect against internal erosion. The pipe shall conform to applicable American Standard Test Method (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), or other appropriate standards or specifications, which provide protection against internal erosion of pipe material.
5. **Sewer System Layout Criteria.** The following criteria shall apply to the design of new water systems:
- a. **Location.** All sewer lines shall be located in legally established road rights-of-way or permanent easements, either existing or as proposed by the designer.
 - b. **Alignment.** Sanitary sewers shall be designed to be as close to the center of the roadway as possible or in the centerline of easements, except when this location has been previously used by another utility. Exception to this specified location will be allowed only when it can be established that it is not practical to adhere to the standard location.
 - c. **Depth.** Sewers shall be installed to provide 3 feet of cover (minimum) in non-traffic areas and 6 feet of minimum cover in roadways and parking lots. In the special case of less than minimal cover, ductile iron pipe of adequate thickness shall be provided.
 - d. **Access.** Full access to sewers will be required following installation. This includes properly graded easements, gates in fences, culverts, trees over ditches, etc.
 - e. **Separation from Structures.** Where sewer depth is 10 feet or less, sewer lines and manholes shall be located a minimum of 10 feet horizontally from any part of a building, structure, or its foundation. Where the depth of sewer is greater than 10 feet, the sewer lines and manholes shall be located a minimum of 15 feet from any part of a building, structure, or its foundation.
 - f. **Straight Sewers.** All sewers shall be installed with a straight alignment between manholes. No curved sewers are allowed.
 - g. **Size and Material.** Sewer size and pipe material shall remain constant between manholes.
 - h. **Angles.** Sewers should intersect in manholes at deflection angles no less than 90 degrees.

- i. **Depth and Pipe Type.** Only ductile iron or SDR-26 PVC will be considered acceptable material for sewers. Sewers having more than 15' of cover shall be ductile iron.
 - j. **Separation from Wells.** No sewer line shall pass within 50 feet of a drinking water supply well, unless special construction and pipe materials are used to obtain adequate protection. The local or State Department of Health will need to approve protection method.
 - k. **Sewer Service Certification.** The design engineer shall prove to the Department of Utilities that all existing and proposed sites that are within the property boundary and are upgradient will be served by gravity with sewer service connections installed at a slope of 1/4 inch per 1 foot (2%).
6. **Manholes.** Manholes shall be installed at the end of each line, at all grade, size, or alignment changes, and at all sewer line intersections. The following requirements shall apply:
- a. When manholes are located in areas accessible to vehicular traffic, they shall be spaced at distances no greater than 400 feet. When located in inaccessible areas, spacing of manholes on sewer lines shall not exceed 300 feet.
 - b. Sewer lines shall be protected from a 100-year flood by either raising manhole tops one (1) foot above base flood elevation of 100-year flood plain or by the use of watertight frames and covers. Where watertight frames and covers are used, unventilated length of sewer shall not exceed 1,000 feet. In addition, watertight frames and covers shall be used whenever manhole tops may be flooded.
 - c. Manhole top elevations shall be a minimum of 24" above grade in un-landscaped areas. In all other areas, the manhole top shall be flush with the surrounding grade.
 - d. Manholes shall be constructed of pre-cast concrete sections sized in accordance with Table 9-4, unless flow angles dictate a larger size.

Table 9-4: Minimum Manhole Sizes

<i>Nominal Pipe Size (inches)</i>	<i>Manhole Minimum Inside Diameter (feet)</i>
8" – 15"	48"
16" – 27"	60"
30" – 45"	72"
48" or larger	84"

- e. The use of drop manholes shall be avoided if possible. Where the use of a drop manhole is necessary the following requirements shall apply.
 - i. A drop pipe should be provided for an upstream sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Internal pipe drops shall only be used at existing manholes and only with the approval of the City. Where approved, the number of internal pipe drops at a manhole shall be limited to one.
 - ii. Sewer lines entering a manhole less than twenty-four (24) inches above the manhole invert shall not enter the manhole greater than twelve (12) inches above the manhole invert and shall be incorporated into a smooth transition by filleting the invert.
- f. Miscellaneous head losses at manholes shall be computed in accordance with the equations shown in the Appendices. Junctions of more than 2 pipes will require special consideration.

Table 9-5: Minimum Drop through Manholes

<i>Nominal Pipe Size (inches)</i>	<i>Minimum Drop Through Manhole (feet)</i>
≤ 16"	0.2
≥ 16"	0.1

7. Pump Stations and Force Mains. The Department of Utilities does not allow pump stations and force mains. All sanitary sewer design shall be by gravity. Where gravity sewer is not possible, as demonstrated to the Department of Utilities, small privately maintained and operated pump stations and force mains may be considered.

8. **Separation of Sanitary Sewer and Potable Water Mains.** The following guidelines shall apply for separation between water and sanitary sewer mains:
- a. Sewers shall be laid at least ten (10) feet horizontally from a water main (measured edge-to-edge).
 - b. When the minimum 10-foot separation between manholes and water lines cannot be attained, manholes must be both of watertight construction and tested in place.
 - c. When local conditions prohibit horizontal separation, the sewer may be laid closer provided that the water main is in a separate trench or an undisturbed earth shelf located on one side of the sewer and the bottom of the water main is at least 18 inches above the top of the sewer.
 - d. Where this vertical separation cannot be obtained, the sewer shall be constructed of water pipe material in accordance with AWWA specifications and pressure tested in place without leakage prior to backfilling. The hydrostatic test shall be conducted in accordance with the most recent edition of the AWWA standard (ANSI/AWWA C600-82) for the pipe material with the minimum test pressure of 30 psi. Sewer manholes shall be of watertight construction.
 - e. Provide a minimum vertical separation of 18 inches between the bottom of the water main and the top of the sewer (measured edge to edge) when the sewer passes under the water line.
 - f. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA specified water pipe and pressure tested in place without leakage prior to backfilling in accordance with Virginia SCAT regulations.
 - g. Sewers passing over potable water lines shall be constructed of AWWA specified water pipe and pressure tested in place without leakage prior to backfilling in accordance with State SCAT regulations. Minimum vertical separation of potable water line and sewer shall be 18 inches.
 - h. Sewers passing over water mains shall be constructed of AWWA specified water pipe. Minimum vertical separation of water line and sewer shall be 18 inches. In addition, center 1 full-length section of pipe so that the sewer joints will be equidistant from the water main joints. Provide adequate structural support for the sewer so as to maintain line and grade.
 - i. All sewer service lines shall be laid a minimum of five (5) feet from any water line.

9. **Separation of Sanitary Sewer and other Utilities.** The following guidelines shall apply for separation between sanitary sewers and other utility lines.
- a. A minimum horizontal separation of five (5) feet shall be maintained between parallel sewers and gas lines. Should this horizontal separation not be obtainable, this may be reduced to three (3) feet with approval of the Department of Utilities.
 - b. A minimum horizontal separation of five (5) feet shall be maintained between parallel sanitary and storm sewers lines. Should this horizontal separation not be obtainable, this may be reduced with approval of the Department of Utilities.
 - c. Sanitary sewers crossing under storm sewers shall maintain a minimum separation of 12 inches. Where this separation is not possible, the sanitary sewer shall be constructed of AWWA specified ductile iron pipe. Concrete supports may be required for the storm sewer.
10. **Surface water crossings.** Sewer lines intended to cross streams, rivers, or other surface waters, should be discussed with the Department of Utilities before final plans are prepared. Only under extraordinary conditions will above ground crossings be approved.
- a. The tops of all sewers entering or crossing streams shall be at a sufficient depth below the natural bottom of the streambed to protect the sewer line. In general, two (2)-foot minimum of suitable cover shall be provided. All proposed sewer stream crossings shall be ductile iron pipe (P401 lined) encased in concrete. Stream crossings should also take future streambed improvements into consideration.
 - b. Sewers shall remain fully operational during the 25-year flood. Sewers and their appurtenances located along streams shall be protected against the normal range of high and low water conditions, including the 100-year flood.
 - c. Sewers entering or crossing streams shall be constructed of watertight pipe. Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternative exists. Such sewers on piers shall be constructed of ductile iron pipe and in accordance with the requirements for sewers entering or crossing under streams. Consideration shall be given to using long-span ductile iron pipe or steel.
11. **Roadway crossings.** All roadway crossings are subject to the approval and requirements of the governing authority having jurisdiction. Where approved,

roadway crossings are to be by “open cut.” Encasement in a steel casing pipe shall be done only at the direction of the governing authority. Where encasement is required, it shall be in compliance with the requirements of the governing authority and appropriate Detail Drawing.

- a. Where crossings are required to be tunneled, bored, or jacked, said crossings are to be in compliance with the requirements of the governing authority and appropriate Detail Drawing.
- b. Manholes shall be provided at both ends of the crossing when casing is required to be installed. Manholes shall be located a maximum of 60 feet from the end of the casing and shall be easily accessible and not subject to flooding.

12. Railroad crossings. Railroad crossings are subject to the approval and requirements of the operational railway company. Crossings are to be by tunneling, boring, or jacking, and are to comply with the requirements of the railway and appropriate Detail Drawing.

- a. Manholes shall be provided at both ends of the crossing a maximum of 60 feet from the end of the casing. Manholes shall be easily accessible and not subject to flooding.

13. Monitoring Manholes. A monitoring manhole may be required on all new construction or renovations or modifications to existing facilities, where the discharge originating in the new, renovated, or modified facility is, or will have the potential to be, non-domestic in nature. All wastewater from the facility shall flow through the monitoring manhole.

- a. These facilities include but are not limited to industrial facilities, food preparation establishments, grocery stores, bakeries, automobile service stations, gasoline stations, hospitals, animal hospitals, cleaners, machine shops, photographic finishers, printing shops, laboratories, funeral homes, etc.
- b. For multi-use buildings such as shopping centers, the sewer should be an adequate distance from the building to allow installation of a monitoring manhole and grease trap on each sewer lateral when the tenant spaces are upgraded.
- c. A sewer lateral is required for each individually metered facility. This section provides the general requirements for sanitary sewer system materials. For more specific information, see Sections 15250 through 15270 of Appendix XX: Construction Specifications.

- **Sewer Mains.** All gravity sewer shall be PVC or ductile iron pipe. PVC gravity sewer pipe and fittings shall be manufactured of compounds conforming to ASTM D1784-81, current revision. Pipe and fittings shall meet and/or exceed all of the requirements of ASTM Specification D3034-89 PSM SDR 26 (cell class 12454-B), or current revision, for heavy wall PVC. All ductile iron pipe shall be of the push-on joint or mechanical joint or restrained joint variety, conforming to ANSI 21-51 (AWWA C151, latest revision). Thickness class shall be a minimum Class 52 for all pipe diameters. All ductile iron piping (DIP) and fittings shall have a shop-applied Protecto 401 interior lining.
- **Manholes.** Unless otherwise approved, precast manhole components shall consist of reinforced concrete pipe sections especially designed for manhole construction and manufactured in accordance with ASTM C478, except as modified herein. Joints between manhole components shall be the tongue and groove type, employing a single, continuous rubber O-ring gasket, and shall conform to AWWA C302. All precast manhole components shall be of approved design and of sufficient strength to withstand the loads imposed upon them. They shall be designed for a minimum earth cover loading of 130 pounds per cubic foot, an H-20 wheel loading, and an allowance of 30 percent in roadways and 15 percent in rights-of-way for impact. Manhole bases shall have two cages of reinforcing steel in their walls, each of the area equal to that required in the riser sections. Wall thickness shall not be less than 5 inches. Base thickness shall not be less than 6 inches. See specific manhole details for more information.

9.4 Storm Sewer

Refer to Chapter 5: Stormwater Management for design requirements for storm sewer systems. This section will address the allowable materials for storm drain sewer infrastructure to be placed in public right-of-way or public easements (note: all storm sewer shall be placed in public right-of-way unless public easements are the only option).

9.4.1 Materials

This section provides the general requirements for storm sewer system materials. For more specific information, see VDOT Road and Bridge Standards and Detail XX through Detail XX.

- **Storm Sewer Pipe.** All storm sewer pipe shall be reinforced concrete pipe, appropriate class based on depth of cover and highway loading. No alternate storm pipe materials, such as high-density polyethylene (HDPE), will be allowed.
- **Storm Structures.** All storm sewer manholes, drop inlets, and other junction structures shall be precast concrete and constructed in accordance with the current version of the VDOT Road and Bridge Standards and Details. Where City details show an alternate structure, those shall supercede VDOT Road and Bridge Standards and Details.

9.5 Gas

The design of all gas distribution systems shall be performed in accordance with the requirements of the current edition of the City of Charlottesville Gas Distribution System Standard Specifications and Details included in Appendix XX and Appendix XX, and the National Fuel Gas Code (PHMSA 49CFR 192).

9.5.1 Preliminary Design Requirements

For developments requiring City of Charlottesville gas service, the Department of Utilities should be contacted to schedule a Preliminary Engineering Conference (PEC). In order to schedule the meeting, the designer should provide an overall project layout showing locations of other utilities (water, sewer, electric) and also general desired customer usage/consumption for gas utility. After the PEC, the Department of Utilities will provide additional design criteria and assist accordingly.

9.5.2 Final Design Requirements

The gas distribution system currently maintained by the Department of Utilities provides natural gas to customers located in the City of Charlottesville and selected areas within Albemarle County. Gas main extensions or enlargements required to meet a specific demand or to extend the service area will be handled in accordance with the City's Gas Main Extension Policy, included in Appendix XX. The below criteria shall apply:

1. **General.** Design of a gas piping system will be performed by the Department of Utilities and consists of three basic steps: (1) select a pipe with the correct pressure capability; (2) choose a pipe size adequate for the required flow; and (3) evaluate the pipe's ability to function when properly installed. The following guidelines are typical considerations when designing a pipe system:
 - a. Evaluate the system's flow requirements to determine the pipe size.

- b. Determine pipe wall thickness to meet the project's pressure requirements.
- c. Verify the pipe's ability to function under planned installation conditions. Examples include burial calculations, thermal effects, etc.
- d. Adjust the pipe wall thickness as required for external loads. All piping to be used for new or replacement gas lines shall be either steel or polyethylene.
- e. Steel pipe shall be used for all gas lines operating at pressures above 100 psi.
- f. Review the final pipe size and wall thickness to meet flow, pressure, and external load requirements when the system is installed and operated as designed.
- g. This work will be completed by the Department of Utilities with information provided by the developer/design engineer. Demand and pressure shall be included in the final site plan submission.

2. Distribution System Layout Criteria. The following criteria shall apply to the design of new gas systems:

- a. Location. All gas lines shall be located in legally established road rights-of-way or legally established permanent easements for such purpose, either existing or as proposed by the designer.
- b. Alignment. The alignment for gas mains shall be on the opposite side of the water main, where possible, except when this location has been previously used by any other utility. Exception to this specified location will be allowed only when it can be established that it is not practical to adhere to the standard location. Minimum horizontal separation of 5 feet between the gas main and other utilities should be maintained where practicable.
- c. Minimum cover. Minimum depth of cover for gas mains in roadways shall be 36 to 42 inches, measured from established finish grade to the top of pipe. Where heavy off-road truck or locomotive traffic exists, minimum cover shall be 42 inches. All service lines shall have a minimum cover of 24 inches if exposed to vehicular traffic or 12 inches where no overland traffic exists.
- d. Structures. Gas mains shall be located a minimum of 10 feet horizontally from any part of a building, structure, or its foundation.
- e. Trees. Gas mains shall be located a minimum of 10 feet from any existing or proposed trees.

- f. **Meter Protection.** Meter protection will be shown on the plans and installed by the developer at the developer's expense. The meter protection shall meet City specifications.
3. **Design flow.** The following criteria shall apply:
- a. **Mains or Extensions.** The design flow for new mains or main extensions to service proposed developments, commercial facilities, industrial complexes, or other large users is to be based on the maximum estimated gas demand provided by the customer or customer's authorized representative requesting said main or main extension plus any additional flow as determined by the Department of Utilities for servicing the area traversed by the new main or main extension.
 - b. **Services.** The design flow for services is to be based on the maximum estimated gas demand provided by the customer or customer's representative or builder. Said demand is to be based on actual appliance requirements. In the event actual appliance requirements are not known or available, the maximum demand can be estimated from tables provided as part of the National Fuel Gas Code or related handbooks.
4. **Stream Crossings**
- a. In general, gas mains crossing streams shall be installed by open cutting. As an alternate method, horizontal directional drilling with HDPE pipe may be considered, but will require approval by the Department of Utilities.
 - b. Pipeline shall pass under the streambed with 48 inches minimum separation from bottom of streambed to top of pipe.
 - c. The designer is reminded that specific requirements by the US Army Corps of Engineers, VDEQ, VMRC, and/or the Department of Utilities may apply to any stream crossing.
5. **Roadway Crossings and within Roadway Rights-of-Way.** Pipeline installation within roadway rights-of-way shall be with approval of the authority having jurisdiction. The method of installation selected should be the least disruptive to traffic. Encasement in a steel casing pipe shall be done only at the direction of the Department of Utilities. Where encasement is required, casing pipe shall be sealed at each end with the requirements at vents to be determined by the Department of Utilities.
- a. Where crossings are required to be bored or jacked, said crossings are to be in compliance with the requirements of the appropriate details.
 - b. Depth of cover shall be as required by the authority having jurisdiction, or 36 inches minimum.

- 6. Railroad Crossings and Within Railroad Rights-of-Way.** Pipeline installation within railroad rights-of-way are subject to the approval and requirements of the operating railway company. Crossings are to be by boring or jacking and are to comply with the requirements of the pertinent details. All crossings shall be encased in steel pipe (P401 coated steel) with sealed ends and vents.
- a. Selection of carrier pipe material shall be as required by the railway.
 - b. Depth of cover shall be as required by the railroad, or a minimum of 5 feet.
- 7. Distribution Line Valves.** The following requirements shall apply:
- a. Valves should be located at intersections of gas mains as determined by the Department of Utilities.
 - b. Each high-pressure distribution system must have additional valves spaced so as to reduce the time needed to shut down a section of main in an emergency. Valve spacing shall be determined with due consideration to operating pressure, the size of the mains, and the local physical conditions.
 - c. Each regulator station controlling the flow or pressure of gas in a distribution system must have a valve installed on the inlet piping at a distance from the regulator station sufficient to permit the operation of the valve during an emergency that might preclude access to the station.
 - d. Each valve on a main installed for operating or emergency purposes must comply with the following: The valve must be placed in a readily accessible location so as to facilitate its operation in an emergency, and the operating stem or mechanism must be readily accessible
- 8. Meter Selection.** Displacement type meters (diaphragm) will be installed for all customers unless otherwise approved by the Department of Utilities. All sizing and selection criteria are included in the separate Gas Design Manual.

9.6 Private Utilities (Phone, Cable, Fiber, and Electric)

All private utility owners who wish to locate utilities inside City right-of-way shall obtain a franchise agreement that has been reviewed and approved by the City Attorney's Office and accepted by City Council.

All private underground utility projects shall include installation of up to three spare 4-inch conduits dedicated to the City for future fiber optic routing. The number of spare conduits required will be at the discretion of the City Utilities Engineer.

9.6.1 Overhead

Overhead utilities to be installed on an existing utility pole shall be coordinated with the owner of that utility pole. Where a new pole is required to be set inside City right-of-way, a plan view of that location showing right-of-way limits, existing utilities, and existing surface infrastructure shall be submitted to the City for review and approval. Additional information may be required for review.

All overhead utilities shall maintain clearances over City right-of-way as outlined in the VDOT Road and Bridge Standards for the type of road it crosses and shall be at least 16.5 feet above any vehicular travel lane.

9.6.2 Underground

General Requirements

- Underground utilities shall be placed outside City right-of-way when possible.
- All proposed underground utilities to be located inside City right-of-way shall be submitted to the City for review and approval.
- When designing or planning for underground utilities in City right-of-way, the following considerations are required:
 - a. Coordination shall occur among the various utility providers, and utilities should be placed in a single trench.
 - b. Duct banks shall be as narrow as physically possible to preserve the City's limited right-of-way.
 - c. How service connections are to be made.
 - d. The minimum cover over any underground utility is 24 inches. For electric power utilities, a minimum of 36 inches is required.
 - e. When any electrical power line is to be placed underground within City right-of-way, it shall be encased in concrete with a minimum cover of 36 inches.

Utilities within Right-of-Way

When location of the utilities outside of the pavement area is not practical and is approved by the City, such installations:

- Are acceptable within the parking area and the shoulders along the street.
- May be acceptable beneath the travel lanes of the street when provisions are made to ensure adequate inspection and compaction tests and when longitudinal installations and manholes are placed out of the wheel path.

The City avoids the open-cutting of hard-surfaced roads whenever possible, except in extenuating circumstances. Therefore, all underground utilities within the right-of-way, as determined necessary by good engineering practice to serve the complete development of adjacent properties, shall be installed during the street's initial construction and prior to the application of its final pavement surface course. This shall include extensions of all necessary cross-street connections or service lines to an appropriate location beyond the pavement and preferably the right-of-way line.

In the event it is necessary to open the street pavement to work on utilities after the surface has been placed, additional compaction tests and paving as necessary to restore the integrity and appearance of the roadway may be required at the discretion of the City Engineer.

Coordinate the design for new construction with affected utility companies in early stages of the design. Every effort should be made to avoid relocating the existing utilities unless it is deemed necessary. The cost for relocating the existing utilities will be borne by the affected utility companies.

9.6.3 Access Covers

- All manhole lids, utility access covers, and range box access covers must be depressed no more than .5 inches below the adjacent finished street surface. If located in concrete, all access covers must be set flush with surrounding concrete.
- Manholes or valves must not be constructed in the wheel path of a travel lane or at any location within a bike lane.

9.6.4 Trees and Large Shrubs Near Utilities

- Utility access must not be built in a tree box, regardless of whether there is an existing tree.
- Trees must be installed along all rights-of-way regardless of location of overhead or underground utilities.
- Utility work to be performed within the critical root zone of a street tree must be coordinated with the City of Charlottesville Urban Forestry. The critical root zone is measured as 1.5 feet away in radial distance from the tree trunk for every inch in stem diameter at breast height (4.5 feet above grade). Work within this zone should be performed so as to minimize damage to the tree and the root zone and may require measures such as root pruning or tunneling to protect the tree and root zone during utility installation.

9.6.5 Conduits and Sleeves

- To minimize future repairs and street cuts, all utilities must be installed in non-corrosive conduits or sleeves equivalent to Schedule 40 PVC meeting the requirements of the utility companies, or other conduits and sleeves encased in concrete, slurry, or flow-fill material on all public streets.

9.6.6 Location Criteria

- **General**

Utilities must be installed outside the curbs and gutters. They must be separated at least 2 feet from existing buried utilities. When less than 2 feet of clear space is available, the matter must be conferred with the affected utility for concurrence.
- **Power and Street Lighting**

Generally, power and street lighting lines should be located on one side of the street, either in the ROW or in an adjacent easement.
- **Electric Utility Vaults**

Access vaults for electrical power and similar equipment should not be located in public space unless locating them on private space is impossible. If they are located in public space, they must be located in the pedestrian clear zone and be covered with a solid lid made of sidewalk paving materials.
- **Other Utilities**

Cable TV and telephone lines generally serve properties from the back. Utility companies must coordinate the locations of their installations in the right-of-way or easements with the City and other utility companies.
- **Traffic Signals and Signs**
 - a. **Location.** Poles, signs and any other above-ground streetscape (except regulatory signs) should be located within 5 feet of the right-of-way line or 10 feet from the travel lane (flow line), whichever is more restrictive.
 - b. **Clearance.** Light poles must be placed no closer to the roadway than 2 feet behind a vertical curb line and no closer than 2 feet to any sidewalk.
 - c. **Breakaway Poles.** The City may require breakaway poles on public rights-of-way where the speed limit is 40 mph or higher.
 - d. **Other Requirements.** All signs and poles must meet the requirements of Chapter 4: Transportation of this manual.

9.6.7 Utility Attachments on Bridges

General

The following guidance on utility installations on bridges should be followed:

- In most cases, attachment of utilities to highway structures, such as bridges, is a practical arrangement considered to be in the public interest. However, every effort should be made when attaching utility lines to a highway structure so that they do not affect structural integrity, safe operation of traffic, efficiency of maintenance, or appearance.
- Since highway structure designs and site conditions vary, the adoption of a standard method to accommodate utility facilities is not feasible; however, the method employed should conform to logical engineering practices for preserving the highway, its safe operation, and its maintenance and appearance. Generally, acceptable utility installations are those that occupy a position beneath the bridge floor, between the outer girders, on beams or within a cell, and at an elevation above low superstructure steel or masonry.
- The controls for providing encasement, allied mechanical protection, and shut-off valves to pipeline crossings of highways, and for restricting varied use, must be followed for pipeline attachments to bridge structures, except that sleeves are required only through the abutment backwalls. Where a pipeline attachment to a bridge is encased, the casing should be effectively opened or vented at each end to prevent possible buildup of pressure and to detect leakage of gases or fluid.
- Since an encasement is not normally provided for a pipeline attachment to a bridge, additional protective measures must be taken. Such measures must employ a higher factor of safety in the design, construction, and testing of the pipeline than would normally be required for cased construction.
- Communication and electric power line attachments must be suitably insulated, grounded, and carried in protective conduit or pipe from the point of exit from the ground to re-entry. The cable must be carried to a manhole located beyond the backwall of the structure. Carrier pipe and casing pipe should be suitably insulated from electric power line attachments.
- Guy wires supporting any utility may never be allowed to attach to a bridge structure.

9.7 Plan Requirements

Plan requirements to meet the intent of the design standards manual for all utility improvements are provided below:

1. **Drawing organization.** Drawings shall consist of the following types of sheets arranged in the order listed:
 - a. Cover sheet.
 - b. Index sheet (if necessary).
 - c. Plan and profile sheets.
 - d. Standard sheets and special details.
 - e. Erosion and sediment control details.
2. **Sheet format.** Drawings shall be prepared in accordance with the following guidelines:
 - a. All construction drawings shall be on sheets 24 inches by 36 inches.
 - b. The cover sheet shall contain the City's name and project description, a vicinity map drawn on a scale of 1 inch = 2000 feet, an index to the plan sheets, and a seal of the design engineer or person responsible for the design (i.e. consistent with DPOR regulations).
 - c. A plan index map shall be prepared for all pipeline projects. The index map shall be to a scale of not less than 1 inch = 600 feet, and shall show all proposed utilities with tie-ins to existing utilities.
 - d. Plan sheets, as well as plan and profile sheets, shall show horizontal, vertical, and topographical data.
 - e. All plans shall bear a suitable title showing the City's name and project title. The plans shall also show the scale in feet, the North arrow, the date, and the name of licensed professional responsible for preparation of the plans.
3. **Drafting conventions.** The below conventions shall be followed:
 - a. Industry standard symbols should be used for drawings where applicable.
 - b. When standard symbols are not used, a symbol key shall be included in the drawing set. Existing facilities shall be differentiated from new facilities.
 - c. Text, dimensions, and notes: Lettering shall be consistent and clear, with a minimum height of 0.125 inches (.125 inch). The larger size lettering type shall have proportionately wider line widths. When drawings are prepared using computer-aided drafting (CAD), the minimum text height shall be 0.10 inches.

4. **Drawing standards.** All plans shall comply with the format and quality control requirements of the City. Plans that do not meet these criteria will not be acceptable for review. The following standards shall apply:
 - a. Plans submitted for review shall be direct blue line or black line prints.
 - b. Drawings shall be clear and legible. Text shall be readable when drawings are reduced to half size.
 - c. The contrast of the printed material shall be high, with blank areas being as white as possible, and all information being as dark as practicable, while remaining clear and distinct.
 - d. Shading, such as on plan views for paving, shall not be used on the drawings where it will hide any information when the drawing is photocopied or scanned. For areas that need to be identified or highlighted, stippling or cross-hatching may be used, provided no other information is hidden.
5. **Additional information.**
 - a. Horizontal scale in plan and profile sheets shall be no smaller than 1 inch = 50 feet in bar scale format.
 - b. Vertical profile scale shall be no smaller than 1 inch = 10 feet.
 - c. A bar scale shall be included on each sheet.
 - d. All known existing structures and utilities, both above and below ground, which might interfere with the proposed construction, particularly water mains, sewer mains, gas mains, storm drains, utility service lines, etc., shall be shown in plan and profile. Approximate locations shall be noted as such.
 - e. Benchmarks shall be set no more than 500 feet apart along the lines of construction but outside the limits of construction. Datum for elevations shown shall be North American Vertical Datum 1988 (NAVD88).
 - f. Drawings shall show existing and off-site easements required and identify deed book and page number.
 - g. Drawings shall show all property lines bordering the proposed work area.
 - h. Property owners and tax map parcels shall be identified.
 - i. Drawings shall include notes indicating that use of steel plates for utility trenching is prohibited from November through March, unless otherwise approved by the Director of Public Works.
 - j. Project specifications shall be in the Construction Specifications Institute (CSI) 16-Division format. Specification sections contained herein shall be incorporated into the project specifications.

- k. All sub-surface investigations, including test bores, reports, etc., used in the design shall be incorporated into the project specifications.
- l. As-built drawings shall be prepared and delivered to the City of Charlottesville by the designer, based on information provided by the Contractor.

9.8 References

AWWA Manual M22: Sizing Water Service Lines and Meters

BOCA National Building Code

BOCA National Plumbing Code

[City of Charlottesville Comprehensive Plan](#)

[City of Charlottesville Main Gas Line Extensions](#)

[City of Charlottesville, Virginia Code of Ordinances](#), Chapter 31: Utilities

[Code of Virginia](#)

[Natural Fuel Gas Code](#)

[VDOT Road and Bridge Standards](#)

[Virginia Department of Health Waterworks Regulations](#)

[Virginia DEQ Sewage Collection and Treatment Regulations](#)

[Virginia Uniform Statewide Building Code \(VUSBC\)](#)

CHAPTER 10

TREES AND LANDSCAPE

10.1 Intent and Purpose

Landscaping is a key element of the public realm that enhances the character of a city's neighborhoods and provides attractive, comfortable, and accessible public spaces that foster social interaction and encourage economic vitality. The City of Charlottesville recognizes that landscape elements are essential to creating the high-quality public spaces and healthy, green, and the sustainable environment envisioned as a part of the guiding principles of the City's Streets That Work Design Guidelines. This chapter provides minimum standards and design criteria for the selection, design, and installation of plantings in the public right-of-way.

10.2 Landscape in the Right-of-Way

Landscape within the public ROW includes all streetscape plant material including trees, shrubs, understory plantings, and stormwater plantings. Plantings selected should be able to tolerate the site context, including existing soils, sun exposure, climate, pollution, road salt, minimal water and low levels of maintenance. All proposed landscaping within the ROW must be reviewed by the Landscape Manager, Traffic/Engineering Department, and the City Urban Forester to ensure the landscape proposed will thrive and that safety and regulatory standards will be met.

Designers are encouraged to explore opportunities to treat stormwater runoff within the public right-of-way as outlined in Chapter 2 of the Streets That Work Design Guidelines. Refer to Chapter 5: Stormwater Management for requirements for implementing green stormwater infrastructure in the public right-of-way.

10.2.1 Street Trees

Designs shall provide a continuous row of trees along a street while respecting clearances and adjacent uses. Trees should be planted at regular spacing in straight rows to create a continuous street edge. Spacing should be adjusted as needed to maintain clearances and to:

- frame, define, and accentuate spaces;
- emphasize views and focal points;

- create a ceiling and sense of enclosure;
- provide needed shade and filtered light;
- reinforce the rhythm of a street wall;
- add texture, delight, and human scale; and
- create edge friction and a visual cue for a driver's speed.

Tree selection must address the ability of the tree to mature in each microclimate, as well as its ability to meet design objectives. Scale and form are key design considerations. Other considerations for selecting the right tree include sight line requirements; the tree's tolerance to drought, insects, and inundation; the tree's resistance to vehicular emissions and salt; the tree's ability to remediate pollutants, and the amount of maintenance the tree will require. From an aesthetic perspective, spring flowers, fall color, the quality of light and shade, and the abundance of fruit, nuts, and leaf litter should also be considered.

Trees provide many ecological benefits and help to define street corridors. Urban environments, however, are a very challenging setting for urban street trees. As a result, streetscape plantings and tree species must be thoughtfully selected, located, and provided with supportive growing conditions to achieve their intended objectives and enable them to succeed. Choosing a tree that is appropriate to the habitat can help minimize conflicts with adjacent infrastructure. Some important considerations are:

- **Tree size:** Large canopy trees must be 2 to 2.5 inches in caliper at time of planting installation.
- **Branching height:** Large and medium canopy trees must have a clear trunk that is free of branches at least 7 feet above the sidewalk to maintain clear sightlines.
- Small and medium trees are preferred where overhead power lines will not allow a large street tree to reach maturity without considerable pruning.
- Select tree species that consider existing conditions including above- and below-grade obstructions (utilities, overhead wires).
- Shallow rooted species should be considered near sewer or drain pipes.
- Trees with deeper roots and small trunk flares should be used adjacent to pavements.

Providing sufficient rooting space is a challenge, however this does not limit plantings to smaller trees; even small trees will suffer in a limited rooting environment. The size of a selected tree should be proportional to the volume of soil and the size of the open area around the tree. Street trees should be planted to flourish and survive without roots rising to the surface and deforming sidewalks.

Design for street trees should be appropriate for the specific street and existing site conditions. All street tree species must be selected from the Master Tree List in Charlottesville's Tree Packet and placed in appropriate locations in the ROW.

Species diversity is important to the long-term health of the community forest. Continuous rows of the same tree species can be susceptible to diseases and pests and should be limited in use. Facilitate species diversity by selecting two or more tree species to plant along a street while coordinating at the neighborhood and city scale.

Spacing Recommendations

Recommended tree spacing is shown below. Adjust spacing as needed to maintain minimum clearances from utilities, street lights, and other streetscape elements; and maintain proper sight lines at intersections and driveways. (Refer to City Tree List for definition of tree size classification.)

Small trees:

- 15-20 feet minimum on center
- Trees that have a maximum height of 25 feet and can be used in restricted areas where overhead clearance is a factor (e.g., under power lines)

Medium trees:

- 25-30 feet on center

Canopy trees:

- 30-40 feet on center
- Trees that have a minimum height of 30 feet and provide a significant "canopy" over the street and adjacent properties

Minimum Street Tree Clearances

- Street lights: Maintain 10 feet minimum between street lights and tree trunks.
- Stop signs or other traffic control: Place trees 30 feet minimum from corner.
- Driveways: Place trees 10 feet minimum from driveways.
- Fire Hydrants: Place trees 10 feet minimum from fire hydrants.
- Bus stops: Place trees 10 feet minimum from bus stops.
- Underground utilities: Place trees minimum 10 feet from underground utilities (5 feet minimum if approved by the Utilities Engineer).
- Check standard lines of sight based on street classification.

10.2.1.1 Soil Volume and Soil Health

Providing sufficient soil volume for healthy tree root development in a dense, urban environment can be costly but is worthwhile given the unique benefits that trees provide. A tree’s ability to grow is directly related to the volume of soil available—if adequate soil is not provided, a tree will not achieve its projected height. Also, tree roots do not survive well in highly compacted soil because it lacks the void spaces needed for air and water to circulate. Roots in compacted soil will migrate toward the surface for air and water, causing sidewalks to crack and heave.

The following chart shows the minimum soil volume necessary for tree rooting:

Table 10-1: Minimum Soil Volume Requirements

Tree Size	Mature Height of Tree	Planter Width	Open Soil Area	Minimum Soil Volume
<i>Small Tree</i>	10-30 feet	4 feet	4 feet x 6 feet	250 cubic feet
<i>Medium Tree</i>	30-50 feet	4 feet (6 feet preferred)	4 feet x 8 feet	400 cubic feet
<i>Large Tree</i>	40+ feet	4 feet (6 feet preferred)	4 feet x 10 feet	400 cubic feet (1000 cubic feet preferred)

Note: Where trees are planted in a continuous planter of three or more trees, with shared soil volume, the overall soil volume can be reduced up to 25%.

Soil volumes shall be calculated based on the length and width of the planting area multiplied by a depth of 3 feet.

Soil Health

The provisions of this section are intended to enhance soil water storage, improve conditions for plant growth, and reduce water runoff. Soil must have good structure: it should be unscreened and loosely compacted with 12- to 16-inch lifts, and each layer should be lightly tamped after installation. Planting area soil is not to exceed 80% Proctor density. Soil pH is not to exceed 7.0, and soil should have an organic matter range from 3%-5%.

See Section 10.2.2.1 for bioretention soil mix and filter media requirements.

10.2.1.1.1 Contiguous Soil Volumes

Trees should be planted in locations that provide the best conditions for growth within a given design framework. This can mean clustering trees in open planting areas on wide sidewalks or in plazas. Large, contiguous planting areas should be employed where available, or when feasible, as they provide for larger soil volume and enable large canopy

trees to reach maturity. Street tree plantings should strive for continuity along a street while respecting adjacent uses. Trees should not be planted in loading zones or within 10 feet of bus stop landing pads. Tree limbs should be pruned to maintain sight lines and maximize visibility of the street wall.

The intent of the 400 cubic feet of soil volume in Table 10-1 is to allow larger roots to grow within the Critical Root Zone (CRZ) and prevent sidewalk heaving, which can come as a result of spreading root growth.

The last decade has brought several innovations in engineered planting soils and sidewalk designs to support root growth. Below are several strategies that are intended to increase soil volume while maintaining accessible sidewalks:

- Open tree trenches
- Covered tree trenches
- Tree pits
- Raised tree beds
- Engineered structural soils



Figure 10-1: Open tree trench (New York City Department of Environmental Protection)



Figure 20-2: Covered tree trench (Janis – Iron Age Designs)



Figure 30-3: Tree pit (NACTO Urban Street Stormwater Guide)



Figure 40-4: Raised tree bed in Lincoln, NE's P Street District (Hanyou23, licensed under CC BY 4.0)

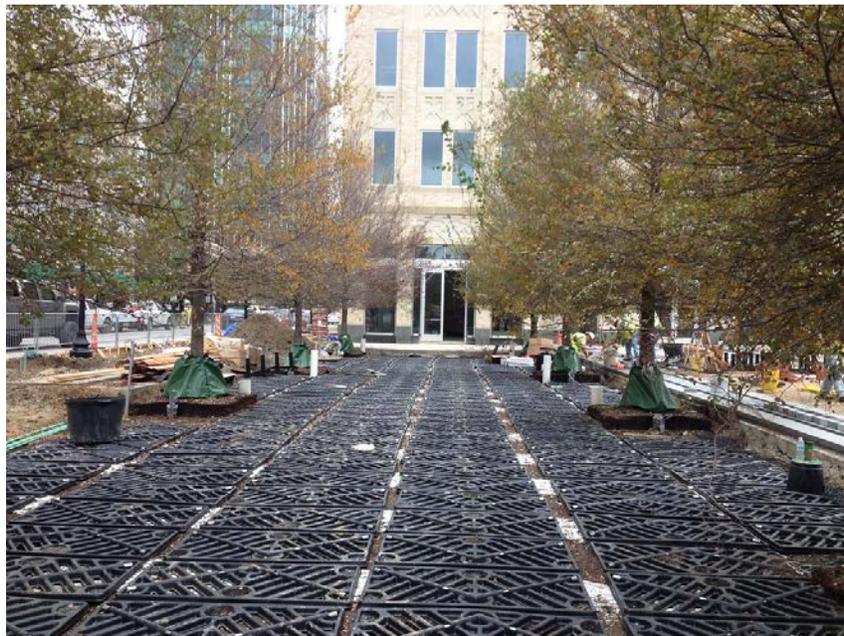


Figure 50-5: Structural soils and modular soil cell system (DeepRoot Green Infrastructure, LLC)

10.2.1.1.2 Modular Soil Cell Systems / Proprietary Technologies

Soil compaction is one of the major limiters of tree growth. The City of Charlottesville allows load-bearing module technologies to maintain required soil volumes where pervious areas are limited and to meet the minimum soil volumes in constrained spaces. Load-bearing module technologies also qualify as BMPs under the Virginia Stormwater

Best Management Practice Clearinghouse. These modular systems can help meet City's obligation, under the Chesapeake Bay Preservation Act, to reduce the discharge of harmful chemicals known as Total Maximum Daily Loads (TMDLs) that are carried by street-borne stormwater runoff into the watershed.

Too often, trees are planted in cramped planting pits and poor subsoil. This results in stunted growth and roots colonizing space immediately underneath the paved surface, which results in pavement damage. Load-bearing soil cells create structurally adequate soil systems that are conducive to root growth but that do not compromise or damage the structural integrity of paved surfaces. Many of these proprietary technologies are designed for accommodating maximum soil volume while also being utility-friendly and providing desired strength characteristics.

Soil cell systems are modular suspended pavement systems that use soil volume to support tree growth and provide powerful on-site stormwater management through absorption, evapotranspiration, and interception. Rather than take a "one size fits all" approach, modular soil cells give the individual tree as much growing advantage as possible. The soil contained within the modular cells serves two important functions: growing larger and healthier trees and treating stormwater on site. Larger trees intercept and evapotranspire significantly more rain than small trees. As the tree roots grow and then decay, they leave open channels in the soil that restore and/or enhance porosity and infiltration rates. Ultimately, trees and vegetation are critical to many water quality benefits, including removal or sequestration of dissolved nutrients, hydrocarbons, and total suspended solids.

10.2.1.2 Shrubs and Groundcovers

Landscape plantings typically consist of turf grass located in the planting zone and are maintained by the adjacent property owner. Plantings may include other species when planted and maintained by adjacent property owners, residents, or businesses. Landscape plantings are appropriate on all streets, including those with high pedestrian traffic associated with mixed-use and high-density residential areas. Along those corridors, every effort should be made to unclutter the limited space within the right-of-way (for example, undergrounding utilities, thereby removing utility poles and relocating transformers) as the corridor redevelops or is slated for streetscape improvements. Streetscape plantings may include plantings that are selected, planted, and maintained by the Parks Department to create a unique aesthetic character for that street.

The primary concerns regarding understory plantings are pedestrian access, security, visibility, and ongoing cost and ease of maintenance. Consequently, streetscape plantings shall conform to zoning requirements, including the following:

- Within 30 feet of intersections and corners, plants must not exceed 12 inches.
- Plants beyond 30 feet of intersections and corners must not exceed a height of 36 inches.
- Plantings shall be maintained in such a way that there is no overhang or encroachment onto the sidewalk, curb, or street area.
- When placed adjacent to on-street parking, plants should be located away from the “door zone” of parked cars, typically 2 feet from the curb.
- Plantings should be salt- and drought-tolerant.
- Plantings should be selected and planted as to not interfere with street tree health.

10.2.1.3 Tree Protection

Trees shall be retained and protected from incidental impacts, injury, and damage brought on by permitted or unpermitted construction or use of space in the right-of-way. Landscaping plans shall include tree protection measures in accordance with Charlottesville Best Management Practices for Tree Preservation, Transplanting, Removal, and Replacement, Chapter 3.

10.2.1.4 Tree Grates

In limited locations, such as bus zones and heavily traveled sidewalks where sidewalk width limits pedestrian movement at peak times, it may be necessary or desired to install tree grates to provide an adequate walking surface or design treatment.

Maintenance of grates in high pedestrian traffic areas should include the periodic resizing of grates to accommodate tree growth. Tree grate expansion involving cutting or welding shall be performed at a distance from the tree to prevent damage to the trunk.

Tree grates must meet the following requirements:

- Tree grates must be ADA-compliant, with less than .5 inches between rings to provide a safer walking surface and to prevent material from being trapped or falling into the basin; heelproof grates are required.
- Tree grates must be expandable to accommodate tree growth.

- Tree grates should be two-piece ductile iron or plastic grates (plastic grates are acceptable if deemed appropriate for design control districts by the City's Board of Architectural Review (BAR)).
- Minimum size of tree grate: 4-foot square or 5-foot diameter (6-foot square is recommended).

10.2.1.5 Approved Plant Species List

Refer to the Master Tree List in Charlottesville's Tree Packet for approved street trees; this list is updated periodically. Overused species with Limited Use designation can be included at a rate of 10% of the total proposed tree list.

The invasive species that must be removed and avoided in all landscape plantings are those identified by the Virginia Department of Conservation and Recreation with low, medium, and high invasiveness rankings on the Virginia Invasive Plant Species List. More information can be found at <https://www.dcr.virginia.gov/natural-heritage/document/nh-invasive-plant-list-2014.pdf>.

Examples of common invasive species from the Virginia Invasive Plant List include:

<u>Scientific Name</u>	<u>Common Name</u>
Ailanthus latissimi	Tree-of-Heaven
Ampelopsis brevipedunculata	Porcelainberry
Albizia julibrissin	Mimosa
Alliaria petiolata	Garlic Mustard
Celastrus orbiculatus	Bittersweet
Elaeagnus umbellata	Autumn Olive
Euonymus alatus	Winged Euonymus
Hedera helix	English Ivy
Lonicera sp.	Asian Honeysuckles
Ligustrum japonicum	Chinese Privet
Paulownia tomentosa	Princesstree
Phyllostachys sp.	Bamboo

Polygonum cuspidatum	Japaneses Knotweed
Pueraria montana	Kudzu
Pyrus calleryana	Callery Pear
Rosa multiflora	Multiflora Rose
Securigera varia	Crown vetch
Ulmus pumila	Siberian elm
Vinca major and V. minor	Periwinkles
Wisteria floribunda	Japanese Wisteria

10.2.2 Bioretention Planting

Charlottesville’s streets and sidewalks are one of the city’s most valuable resources, and they offer tremendous opportunities to improve stormwater management. New green strategies for managing runoff along streets and sidewalks can reduce flooding, increase groundwater recharge, and reduce pollution to rivers and streams.

The Stormwater Elements section in Chapter 4 of the Streets That Work Design Guidelines describes the many environmental and aesthetic benefits of stormwater elements. Two examples of green stormwater infrastructure are stormwater planters and linear bioretention. Other strategies to be considered include bioretention curb extensions, grass channels, drop inlet tree boxes, and structural tree trenches.

- **Stormwater planters** are designed to capture and absorb runoff from surrounding impervious areas, including rooftops, sidewalks, plazas, parking lots, and streets. They consist of structural walls and curbs which form the planter, underdrains, and overflow drains connected to the storm drain system, a high draining soil mix above a gravel layer, and mulch and plants.
- **Linear bioretention** functions similarly to stormwater planters by receiving and filtering stormwater. Linear bioretention facilities are built into the existing subgrade and may appear more like conventional landscaped areas when compared to stormwater planters. Linear bioretention facilities require more space given their larger size (relative to typical stormwater planters) and are more likely to be constrained by existing below-ground utilities. Benefits include the potential to treat slightly larger drainage areas and the ability to support more plantings.

Groundcover and shrub plant palette in bioretention areas shall be limited to 3-5 species for reduced maintenance needs.

10.2.2.1 Bioretention Planting Soils

Soil mix or filter media shall meet the requirements and specifications set by the Virginia Department of the Environment.

General Filter Media Composition

The recommended bioretention soil mixture is generally classified as a loamy sand on the USDA Texture Triangle, with the following composition:

- 85% to 88% sand
- 8% to 12% soil fines
- 3% to 5% organic matter

Filter Media for Tree Planting Areas

A more organic filter media is recommended within the planting holes for trees, with the following composition:

- 50% sand
- 30% topsoil
- 20% acceptable leaf compost

Depth

The standard minimum filter bed depth ranges from 24 to 36 inches (uncompacted) for Level 1 and Level 2 designs, respectively (18 to 24 inches for rain gardens or micro-bioretention). If trees are included in the bioretention planting plan, tree planting holes in the filter bed must be at least 4 feet deep to provide enough soil volume for the root structure of mature trees.

Mulch

A 2- to 3-inch layer of mulch on the surface of the filter bed enhances plant survival, suppresses weed growth, and pre-treats runoff before it reaches the filter media. Shredded, aged hardwood bark mulch makes a very good surface cover, as it retains a significant amount of nitrogen and typically will not float away.

10.3 Curb Side Buffer

In Chapter 4 of Streets that Work Design Guidelines, the curbside buffer zone describes additional information on street trees, soil volume minimums, stormwater elements, and lighting.

The curbside buffer zone is comprised of two parts:

The **Greenscape/Furnishing Zone** (if used: 4 inches for small, medium, and large trees; 6 inches is preferred for medium and large trees. Smaller widths can be achieved if soil volume minimums are met) may include street trees or other plantings, street lights, signage, hydrants, benches, bicycle racks, public art, trash bins, parking meters, transit stops, green stormwater infrastructure, traffic signal poles, and utilities. Where street trees are provided, minimum soil volumes must be met, and the minimum width should be 4 inches for a small, medium, or large tree as defined in Master Tree List in Charlottesville’s Tree Packet.

Placement of objects in the greenscape/furnishing zone should consider factors such as sight lines, potential damage from vehicles on the street, and access to parked cars. Elements such as furniture, plantings, and seating may not protrude into the clear walk zone. Ideally, planted elements should be designed to make use of stormwater runoff from the sidewalk and/or the street and to be resistant to damage from snow storage.

The **Step Zone** (if used: 18 inches min, 2-foot preferred, 5-foot max) is the area between the edge of the street and the front edge of the greenscape/furnishing zone. Beyond providing a small area for people stepping out of cars or dismounting bicycles, this area may be used for snow storage to keep both the roadway and the clear walk zone accessible. Since this zone is designed to be walked on, it should be constructed with a hard surface. The widths of the clear walk zone and curbside buffer zone for each street type are summarized in Table 10-2.

Table 10-2: Sidewalk Zone Widths

	<i>Mixed Use A</i>	<i>Mixed Use B</i>	<i>Downtown</i>	<i>Industrial</i>	<i>Neighborhood A</i>	<i>Neighborhood B</i>
<i>Clear Walk Zone</i>	>7'	>7'	>6'	5'-6'	5'-6'	5'-6'
<i>Curbside Buffer Zone</i>	3'-8'	3'-6'	3'-8'	4'-6'	0'-5'	0'-5'

The clear walk zone is the area of the sidewalk space that is specifically allocated for pedestrian travel. This space is the highest priority area in the sidewalk design. This zone must allow for unobstructed pedestrian movement regardless of ability, be free of any

physical barriers, and be well-lit and clear in all weather conditions. The surface material should be durable and slip-resistant, with minimal gaps.

10.4 References

[City of Charlottesville Best Management Practices for Tree Preservation, Transplanting, Removal and Replacement](#)

[City of Charlottesville Streets That Work Design Guidelines](#)

[City of Charlottesville Tree Packet](#)

[Virginia Stormwater BMP Clearinghouse Standards and Specifications](#)

CHAPTER 11

LIGHTING

11.1 Intent and Purpose

Lighting is a key element of the public realm that enhances the character of a city's neighborhoods and provides attractive, comfortable, safe, and accessible public spaces that foster social interaction and encourage economic vitality. The City of Charlottesville recognizes that lighting is essential to creating the high-quality public spaces and the healthy, green, and sustainable environment envisioned as a part of the guiding principles of the City's Streets That Work Design Guidelines. This chapter provides minimum standards and design criteria for the selection, design, and installation of lighting in the public right-of-way.

11.2 Lighting

Outdoor lighting is a key organizing element that defines the nighttime visual environment in urban settings. Quality lighting helps create a positive urban character and supports nighttime activities. The quality of visual information outdoor lighting provides is critical for both traffic safety and pedestrian safety and security.

Outdoor lighting should complement the existing context and should be consistent with the surrounding aesthetic and lighting levels. It should also aid in achieving the City's sustainability goals by complying with the City Code's Outdoor Lighting Ordinance and energy efficiency objectives.

All outdoor lighting in the City of Charlottesville is subject to the requirements of the City's Outdoor Lighting Ordinance, which is outlined in Section 34-1000 through Section 34-1005 of the City Code. The Outdoor Lighting Ordinance generally regulates luminaire assemblies that emit 3,000 or more lumens and that are in or adjacent to low-density residential uses. It also regulates other high-intensity luminaire assemblies which may emit fewer than 3,000 lumens. For the purposes of this manual, the lamps listed in Table 11-1 are deemed to emit 3,000 lumens or more.

Table 11-1: Lamps Emitting 3,000 or More Lumens

<i>Lamp Type</i>	<i>Wattage</i>
<i>Incandescent</i>	160 W or more
<i>Quartz Halogen (Halogen)</i>	160 W or more
<i>Fluorescent (FL)</i>	35 W or more
<i>Mercury Vapor (MV)</i>	75 W or more
<i>Metal Halide (MH)</i>	40 W or more
<i>High Pressure Sodium (HPS)</i>	45 W or more
<i>Low Pressure Sodium (LPS)</i>	25 W or more
<i>Light Emitting Diode (LED)</i>	25 W or more*

* LED technology and energy efficiency continue to rapidly change. When proposing LED luminaires, designers should check whether the selected fixture type meets the 3,000-lumen threshold, regardless of wattage.

11.3 Design Criteria

The design of all electrical and lighting systems shall be in conformance with the Charlottesville Municipal Code, NFPA 70: National Electrical Code, the National Electrical Safety Code, the Virginia Uniform Statewide Building Code, and applicable standards of the Illuminating Engineering Society of North America. New or relocated street lighting shall be designed using the most recent edition of the recommended illumination and electrical systems guidelines. Existing street light systems may be required to meet the design criteria to maintain reliability and maintenance standards.

Charlottesville’s roads are assigned to one of several possible functional classifications within a hierarchy according to the character of motor vehicle service each roadway provides. The Streets That Work Design Guidelines sorts the streets even further into types: framework streets and local streets. There are two types of streetlighting design used within the City of Charlottesville:

- Continuous lighting: required for all framework streets
- Safety lighting: required for local streets

Continuous lighting is streetlighting that provides specific average maintained light levels and uniformity ratios between adjacent poles in accordance with the Streets That Work

street type and level of pedestrian use. Continuous lighting shall be provided in both high and medium pedestrian conflict areas, including areas where significant numbers of pedestrians are expected to be on sidewalks or crossing the streets during darkness. High pedestrian areas include the Mixed Use and Downtown types, which feature retail areas, theaters, and other major pedestrian generators. Medium pedestrian conflict areas include elements such as libraries, apartments, neighborhood shopping, parks, and schools.

Safety lighting does not provide specific maintained light averages and uniformity ratios between adjacent poles; it is designed to provide enough light on the street to enhance the safety of street users while avoiding over-lighting the area. All residential streets shall be designed based on the safety lighting design parameters.

Safety lighting shall be installed at all crosswalks and at intersections with other residential streets to provide adequate lighting within the conflict area of the two streets.

A minimal number of mid-block streetlights shall be installed to achieve the desired safety lighting, with pole spacing of approximately 250 feet. Lights should be located on or near a property line and not in front of windows when possible.

11.3.1 Illuminance and Luminance

Illuminance is defined as the amount of light generated by the luminaire lighting a surface, and luminance is the amount of light being reflected by the surface being illuminated. Both are important in the design of outdoor lighting systems, and some measures of both illuminance and luminance are used to calibrate outdoor lighting designs. The specific characteristics of each measure are discussed below.

In general, lighting systems should be designed to utilize the shortest poles, lowest wattage luminaires, and maximum spacing possible for achieving the target luminance values.

The City has defined the following design criteria for lighting on the public right-of-way:

Table 11-2: Street Lighting Criteria

<i>Street Type</i>	<i>Horizontal Average Illuminance (fc)</i>	<i>Uniformity of Illuminance (avg/min)¹</i>	<i>Veiling Luminance</i>
Downtown	1.1	4.0	0.4:1
Industrial	1.1	4.0	0.4:1

Street Type	Horizontal Average Illuminance (fc)	Uniformity of Illuminance (avg/min) ¹	Veiling Luminance
Mixed Use A	.8	4.0	0.4:1
Mixed Use B	.8	4.0	0.4:1

Source: Virginia Department of Transportation (VDOT) [Traffic Engineering Design Manual](#), [Virginia Lighting Law](#), and IESNA's report IES-RP-8, Roadway Lighting.

Table 11-3: Pedestrian Lighting Illuminance Criteria

Street Type	Horizontal Average Illuminance (fc)	Uniformity of Illuminance (avg/min) ¹	Vertical Minimum (fc)
Downtown	1.5	4.0	0.5
Industrial	1.0	4.0	0.5
Mixed Use A	1.0	4.0	0.5
Mixed Use B	1.0	4.0	0.5
Neighborhood A	0.4	6.0	0.1
Neighborhood B	0.4	6.0	0.1

Source: Virginia Department of Transportation (VDOT) [Traffic Engineering Design Manual](#), [Virginia Lighting Law](#), IESNA's report IES-RP-8, Roadway Lighting, and the City of Charlottesville's 2015 [Pedestrian Lighting Study](#).

Table 11-4: Recommended Backlight, Uplight, and Glare (BUG) Ratings for All Luminaires

Street Type	Backlight Rating	Uplight Rating	Glare Rating
Downtown	B3	U0	G1
Industrial	B3	U0	G1
Mixed Use A	B2	U0	G0
Mixed Use B	B2	U0	G0
Neighborhood A	B0	U0	G0

Street Type	Backlight Rating	Uplight Rating	Glare Rating
<i>Neighborhood B</i>	B0	U0	G0

Source: Joint International Dark Sky Association – Illuminating Engineering Society [Model Lighting Ordinance](#), June 15, 2011

11.3.2 Light Distribution and Uniformity

In general, luminaires and luminaire optics should be selected to efficiently direct light to the desired area of the roadway and/or sidewalk. Light fixtures should enable a variety of light distributions to adapt to different street and sidewalk configurations while maintaining the same fixture appearance. Typically, street lighting and lighting for trails on independent alignments should be directed toward the pavement by using luminaires with a Type III (directional) distribution pattern. A Type V (symmetrical) distribution pattern is allowed for street-side pedestrian and trail lighting so that luminaires can cast light on both sidewalks/trails and roadway pavements. See Figure 11-1 and Figure 11-2 for typical lighting distribution criteria for City standard luminaires.

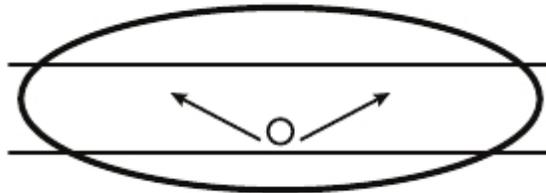


Figure 11-1: Type III lighting distribution (Illuminating Engineering Society of North America report IES-RP-8, Roadway Lighting)

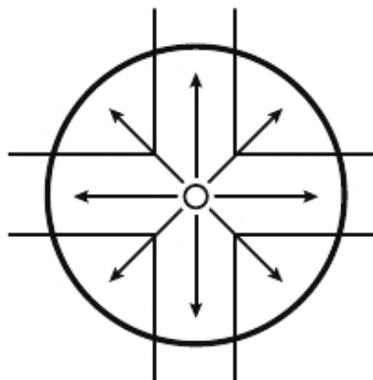


Figure 11-2: Type V lighting distribution (Illuminating Engineering Society of North America report IES-RP-8, Roadway Lighting)

Uniformity of light is also desirable in a lighting scheme. Non-uniform lighting often results in dark areas between luminaires and can also result in temporary blindness when travelling from well-lit areas into darker areas. The measure of lighting uniformity is calculated as the ratio of average illuminance to minimum illuminance within a selected area. The City has established target values for uniformity ratio, as shown in Table 11-2 and Table 11-3, based on IES-RP-8. Uniformity ratio is a function of luminaire optics and pole height/spacing. To achieve target uniformity ratios, it is often necessary to increase overall light levels beyond the recommended horizontal averages. Lighting designers should work with City staff to determine the best approach for a given site.

11.3.3 Backlight, Uplight, and Glare

Backlight, uplight, and glare are light distribution characteristics of luminaires that are managed by shielding and optics within each luminaire. The City's Outdoor Lighting Ordinance requires that all proposed luminaire assemblies be full-cutoff fixtures to reduce backlight, uplight, and glare; however, this rating system does not apply to light emitting diode (LED) luminaires. Where LED fixtures are proposed, the Illuminating Engineering Society of North America's (IESNA) IESNA TM-15-07 Luminaire Classification System for Outdoor Lighting should be applied. This system defines the distribution of the light from a luminaire within three primary solid angles, including backlight (B), uplight (U), and glare (G). This system is also commonly known as the BUG rating system.

Backlight is the portion of the light which falls opposite the direction of the luminaire's focus (often called spillover or light trespass), and enters an area where it is not wanted, such as street light entering a residential property.

As noted in the City's Lighting Ordinance, spillover light may not exceed 0.5 foot-candles (fc) onto public roads or adjoining low-density residential uses, as measured horizontally and vertically at the property line, right-of-way line, or edge of easement, whichever is closest to the light source.

Uplight is the portion of the light that occurs above the horizontal plane, which can result in sky glow. Sky glow is a consequence of two components of lighting: light directed to the sky from fixtures and light reflected off the ground.

Glare is dependent on the viewer's position relative to the luminaire and can cause temporary visual disability or visual discomfort as the viewer passes through the luminaire's area of impact, which is typically from 75 to 90 degrees from nadir for drivers and 0 to 75 degrees for pedestrians. Veiling luminance is a measure of disability glare based on a person's position relative to the luminaire and the angle at which the light is viewed. Limiting veiling luminance is particularly important for roadways due to the speeds

at which vehicles travel. Even on a low-speed roadway (25 to 30 miles per hour), a vehicle can travel 40 to 50 feet during a one-second visual lapse.

While glare is generally not desirable, in the case of pedestrian lighting, some glare is often unavoidable. A certain amount of vertical illuminance is necessary for facial identification; however, this is often difficult to achieve using luminaires that minimize uplight, particularly if mounting heights are also minimized.

Backlight, uplight, and glare should be mitigated by selecting luminaires certified the manufacturer as dark skies-compliant that direct the light downward and away from residential properties. In the case of industrial or sports field lighting, extra care should be taken to ensure lighting is shielded and directed away from residential uses, even when not directly adjacent.

11.3.4 Color Temperature

Newer LED luminaires can often be equipped with LED panels that provide illuminance in a variety of color temperatures, generally measured in kelvins (K). Outdoor lighting proposed within the City of Charlottesville should be within the range of 3,000K to 4,000K; however other color temperature values will be considered on a case-by-case basis.

11.3.5 Energy Efficiency and Sustainability

The City of Charlottesville seeks to enhance sustainability, in part by reducing its energy consumption, increasing the lifespan of its infrastructure, and reducing maintenance costs. Implementation of LED lighting presents an opportunity to achieve all of these goals. Where possible, designers should also consider further energy-saving measures such as dimmable, timed, or motion sensor lighting.

11.4 Street Lighting

Street lighting includes roadway and pedestrian lighting in the public right-of-way. Lighting should be designed not only for vehicular and bicycle traffic on roadways, but also for pedestrians on sidewalks and pedestrian paths. Street lighting is intended to create nighttime environment in which people can see comfortably and can quickly and accurately identify objects on traveled roadways. Appropriate street lighting facilitates the safe movement of traffic and provides a sense of safety and security for pedestrians. However, when used effectively, lighting can do even more. Good streetscape lighting lends character to a street, and by highlighting salient features, provides a sense of place and civic pride.

Charlottesville’s historic neighborhoods and local landmarks make the city unique. The preservation of the historic attributes of these areas is an important goal of the City, and lighting hardware is a significant element in achieving these goals. Pole heights, lamp wattage, and shielding methods should be based on the surrounding context and characteristics of a street. This includes roadway width, sidewalk width, adjacent building height, and building setback.

The City’s street lighting requirements can be broadly classified into three groups: downtown, historic, and residential neighborhood. Streetlight hardware on historic streets need to preserve the street’s traditional appearance. Downtown and residential streets do not have this requirement; however, standards are used to promote an appearance of uniformity and consistency. The street typology in the Streets That Work Design Guidelines identifies Mixed Use A and Mixed Use B street types as playing a significant role in carrying multimodal travelers in and out of Charlottesville’s downtown, and the hardware and pole heights used on them should have a uniform character. Industrial streets and major arterials are wider, have higher volumes of vehicular traffic, and less pedestrian traffic; these streets can be lit with typical cobra-head street lighting.

To promote consistency within the public right-of-way, all street, pedestrian, trail, and parking lot lighting systems to be maintained by the City are recommended to use the equipment shown in Table 11-5. Lighting to be maintained by Dominion Energy should meet the requirements for General Street and Intersection Lighting.

Table 11-5: Standard Equipment for Lighting in Public Rights-of-Way

	<i>Pedestrian Scale Lighting</i>					<i>Street Lighting</i>
	<i>Downtown Mall – Adjacent Intersections</i>	<i>Downtown Mall – Perimeter Streets</i>	<i>Downtown Mall - Intersections</i>	<i>Residential Areas, Trails</i>	<i>Trails</i>	<i>General Street and Intersection</i>
<i>Luminaire*</i>	Us Architectural Lighting “Galaxy 300”	Environmental Lighting for Architecture “Bowery”	Cooper-Invue “ICM”	Environmental Lighting for Architecture “Mediterranean”	Cooper “Aspen” bollard	General Electric “Evolve” scalable cobrahead
<i>Lamp</i>	100 W metal halide, horizontally mounted	100 W metal halide, horizontally mounted	137 W LED, horizontally mounted	85 W LED, horizontally mounted	20 W LED	54 W, 106 W, or 244 W LED, horizontally mounted
<i>Optics</i>	Full cut-off, Dark Skies compliant	Full cut-off, Dark Skies compliant	Full cut-off, Dark Skies compliant	Full cut-off	N/A	Full cut-off, Dark Skies compliant
<i>Lens</i>	Flat glass	Frosted glass	Flat glass	Frosted glass	UV stabilized clear acrylic	Flat glass
<i>Distribution</i>	Type III	Type III	Type III	Type V	Type V	Type III

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	<i>Pedestrian Scale Lighting</i>					<i>Street Lighting</i>
	<i>Downtown Mall – Adjacent Intersections</i>	<i>Downtown Mall – Perimeter Streets</i>	<i>Downtown Mall - Intersections</i>	<i>Residential Areas, Trails</i>	<i>Trails</i>	<i>General Street and Intersection</i>
<i>Lamp Holder</i>	Medium base porcelain	Medium or mogul base porcelain	N/A	N/A	N/A	N/A
<i>Ballast/ Driver</i>	H.P.F./C.W.A. autotransformer, 30° Celsius starting temperature (multi-tap voltage)	H.P.F./C.W.A. autotransformer, 30° Celsius starting temperature (multi-tap voltage)	LED Driver - Universal voltage (120-277V/50-60Hz), >0.9 power factor, <20% harmonic distortion, ambient temperature range of +40°C (104°F) to -30°C (-22°F).	LED Driver - Universal voltage (120-277V/50-60Hz), >0.9 power factor, <20% harmonic distortion, ambient temperature range of +40°C (104°F) to -30°C (-22°F).	LED Driver - Universal voltage (120-277V/50-60Hz), >0.9 power factor, <20% harmonic distortion, ambient temperature range of +40°C (104°F) to -30°C (-22°F).	LED Driver - Universal voltage (120-277V/50-60Hz), >0.9 power factor, <20% harmonic distortion, ambient temperature range of +40°C (104°F) to -30°C (-22°F).
<i>Arm</i>	Durable, corrosion resistant cast aluminum construction	N/A	Custom, durable, corrosion resistant, cast aluminum construction	N/A	N/A	Durable, corrosion resistant cast aluminum construction
<i>Shaft*</i>	Fabricated from steel coil stock (11 gage). Shaft has 5.5" butt, tapering to 4" top. Minimum yield strength 55,000 psi. Shaft includes a handhole furnished with cover. Shaft shall sustain a minimum of 90 mph wind gust.	Decorative aluminum alloy, 4" diameter, plain. Shaft includes a handhole furnished with cover. Shaft shall sustain a minimum of 90 mph wind gust.	Fabricated from steel coil stock (11 gage). Shaft has 5.5" butt, tapering to 4" top. Minimum yield strength 55,000 psi. Shaft includes a handhole furnished with cover. Shaft shall sustain a minimum of 90 mph wind gust.	Decorative aluminum alloy, 4" diameter, fluted. Environmental Lighting for Architecture "P3066." Shaft includes a handhole furnished with cover. Shaft shall sustain a minimum of 90 mph wind gust.	Decorative aluminum alloy, Shaft includes a handhole furnished with cover. Shaft shall sustain a minimum of 90 mph wind gust.	Fabricated from steel coil stock (11 gage). Shaft has 5.5" butt, tapering to 4" top. Minimum yield strength 55,000 psi. Shaft includes a handhole furnished with cover. Shaft shall sustain a minimum of 90 mph wind gust.
<i>Mounting Height</i>	11' – 9"	14'	17' – 5"	12'	30"	30'
<i>Shaft Base Plate</i>	**	**	**	**	**	**
<i>Base Cover</i>	***	***	***	***	***	***
<i>Anchorage</i>	****	****	****	****	Fully-galvanized three anchor bolt assembly as provided by manufacturer.	****

	Pedestrian Scale Lighting					Street Lighting
	Downtown Mall – Adjacent Intersections	Downtown Mall – Perimeter Streets	Downtown Mall - Intersections	Residential Areas, Trails	Trails	General Street and Intersection
					Each bolt supplied with two nuts and two washers	
Finish	*****	*****	*****	*****	*****	*****

* or approved equal

** from structural quality hot rolled steel, base telescopes and is circumferentially welded to shaft

***two pieces, heavy wall construction, entirely conceals anchor base

****four 1" x 36" fully galvanized anchor bolts. Each bolt supplied with two nuts and two washers

*****polyester powder coat (black or dark green)

In some cases, it may be necessary to deviate from specified wattages or pole heights to achieve required illuminance and uniformity values. The City will consider proposed deviations on a case-by-case basis.

The primary factors of lighting system depreciation are lamp lumen depreciation (LLD) and luminaire dirt depreciation (LDD). A typical range for LLD is from 0.9 to 0.78, and a range for LDD is 0.95 to 0.78. The product of these two factors is referenced as the maintenance factor. Lumen depreciation is the process in which the total output of lumens a fixture produces decreases during its lifetime. The rate at which a fixture’s lumens depreciate mainly depends on the type of lighting technology used and the total hours used. Florescent and LED lamps are typically the lowest to depreciate its lumen output.

Lighting designs shall plan for lumen depreciation and other light loss factors for proper luminance throughout the lighting fixture’s lifetime. Designers should exercise caution in applying the maintenance factor described above to avoid over-lighting to offset this calculation. Over-lighting typically results in higher capital and maintenance costs and unnecessary energy consumption due to the use of extra fixtures.

To offset these issues, designers should specify light fixtures that offer "constant lumen output." These fixtures are optimal for ensuring lumen output levels are consistent throughout the fixture’s life. This is done by increasing the output of the driver as lumen depreciation begins. While issues such as dirt accumulation will still need to be addressed, this provides a less maintenance-intensive way to deal with the issue of lumen depreciation.

11.4.1 Location and Spacing

Where sidewalks are directly adjacent to the curb, street light poles should be located on the sidewalk close to the curb and should not encroach on the sidewalk's clear walk zone. Where the street includes a greenscape/furnishing zone, street light poles should be positioned either along the curb side edge or at the center of the greenscape/furnishing zone. Lateral offsets to street light poles shall comply with clear zone/lateral offset guidelines established in Appendix A of the VDOT Road Design Manual. Lateral position of streetlight poles should be consistent within each neighborhood and along each street.

Typically, pedestrian light poles align with the street light poles. However, where sidewalks are very wide, pedestrian light poles may be farther from the curb than the street light poles to light the primary walkway.

Light poles should be carefully coordinated with other streetscape elements. In areas of new construction, light poles and equipment should be placed in the desired locations at the back of curb or within the greenscape/furnishing strip. Proposed utilities should also be coordinated to avoid conflicts.

Street trees should be carefully selected and coordinated with light pole locations to ensure that tree canopies, once mature, will not block illumination, and that they will not overshadow photo sensors or solar panels for solar lighting. When determining tree species, anticipated height and diameter of the tree canopy should be considered relative to lighting fixture height and spacing based on light level and uniformity requirements. Appropriate distance between the tree and light fixture depends upon the species of tree and type of light fixture.

In the case of lighting retrofit projects on existing streets, light pole locations should be carefully selected to minimize conflicts with existing utilities and tree canopy. If blocking the light output of the fixture cannot be avoided due to existing locations of the light fixture and trees, consider adding additional light fixtures to mitigate the shadows from the tree canopy.

The rhythm of the light poles should be consistent in each neighborhood and along each street. On wide streets, light fixtures should be located on both sides of the street and can be staggered or placed directly opposite one another depending upon light level and uniformity considerations. Light poles should have a consistent spacing with regard to trees and other street poles. When selecting pole locations for residential or mixed-use areas, designers should select pole locations that fall between buildings to minimize negative impacts to residential properties from stray light and glare.

11.4.2 Intersections and Mid-Block Crossings

Intersections and mid-block crossings pose the highest potential for conflicts for both vehicles and pedestrians. Therefore, the light levels should be higher for intersections and crosswalks than other areas of the street. The illuminance method, rather than the luminance method, is the recommended design for intersection lighting. All signalized intersections must be illuminated by either 12-foot City pedestrian light poles with 85W LED or 20-foot DVP light pole and 106W LED cobra head luminaires. The selection of the proper light pole and fixture is based upon the City standard lighting criteria shown on Table 11-2, Table 11-3, and Table 11-4; and level of pedestrian activity. Lighting should be installed on traffic signal poles wherever possible.

Crosswalks require special consideration because the placement of luminaires can have a significant impact on the visibility of pedestrians and cyclists in the crosswalk. Intersection lighting should be located to front-light crosswalks, with the light source situated between the crosswalk and the motor vehicle, in the direction of motor vehicle travel (see Figure 11-3). For wider intersections, it may be necessary to place light poles on all four corners of each intersection to achieve required illuminance levels (see Figure 11-4).



Figure 11-3: Example of crosswalk front-lighting

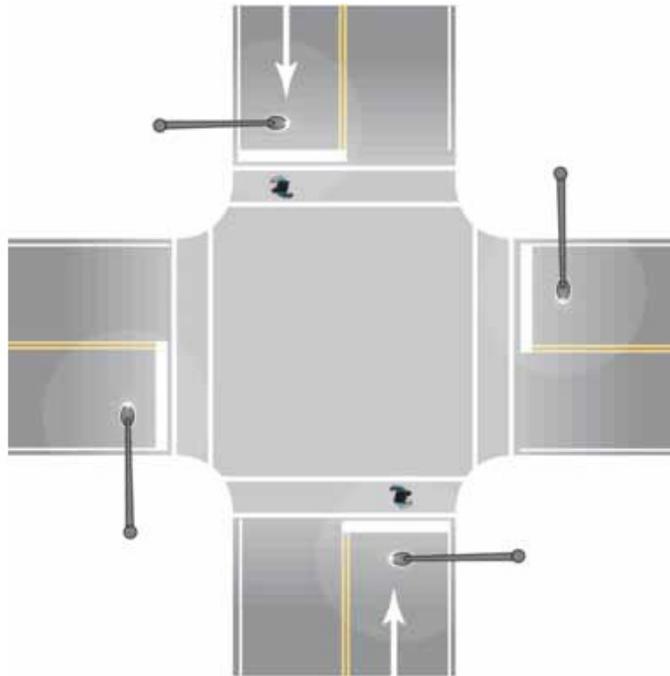


Figure 11-4: Proper placement of intersection lighting with four lights (FHWA, Informational Report on Lighting Design for Midblock Crosswalks)

Where only two light poles are required to achieve required illuminance levels in an intersection, primary light pole placement should generally prioritize the street that has higher potential for pedestrian/vehicle interaction. Streetlights shall also be installed on the secondary legs of the intersection, a minimum of 50 feet back from the curb line of the primary street.

Mid-block crosswalks must have a minimum of two luminaires, one placed in advance of each end of the crosswalk in the direction of vehicular travel. (see Figure 11-5).

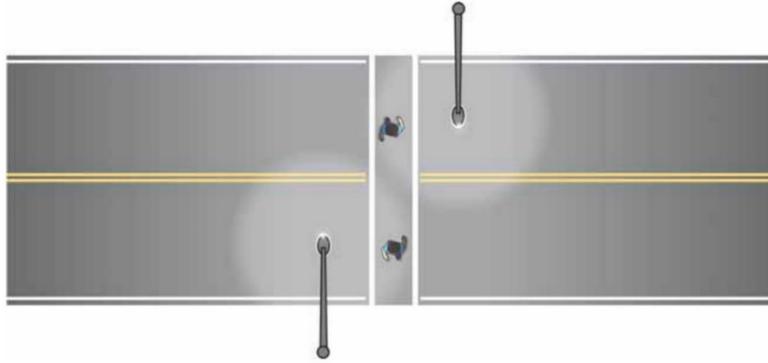


Figure 11-5: Proper placement of mid-block crosswalk lighting with two lights (FHWA, Informational Report on Lighting Design for Midblock Crosswalks)

11.4.3 Pedestrian Areas

Pedestrian lights are lights in the right-of-way that primarily function to illuminate pedestrian areas such as sidewalks. Pedestrian lights are pole-mounted lighting fixtures less than 16 feet tall that are part of a secondary lighting system used to supplement street lighting levels. In general, providing sidewalk lighting allows pedestrians to detect obstacles, stay visually oriented, and recognize faces from a distance of 13 feet, a minimum distance that brings comfort with regard to normal social contact.

Pedestrian lighting should be provided on corridors with high pedestrian volumes, in residential areas, or where a special design treatment is desired to supplement roadway lighting. Pedestrian lighting should be consistent throughout a block. Spacing of light poles must be determined based on an illumination study and should be designed to maximize uniformity of illuminance and minimize “dark spots.”

Pedestrian lighting should be prioritized in the following locations:

- Streets with high pedestrian volumes
- Key civic, downtown, and commercial streets
- Streets with concerns about pedestrian safety and security, such as at freeway underpasses
- Residential streets
- Small streets such as alleys and pedestrian pathways

11.4.4 Trails

Installing lighting along a trail or pathway is an effective way to enable safe nighttime use. Trail lighting that is well-placed, properly installed, and frequently maintained can improve visibility, increase overall trail access and convenience, and give trail users a sense of security while passing through at night.

In contrast to highway lighting, trail lighting should be done on a small scale and only where necessary. In some locations, low-level bollards cast just enough light. To preserve dark skies and wildlife, lenses should be flat, shedding light only on the path below. Round lenses, comparatively, shine light in all directions. Fixtures should be selected to reduce loss of light and glare.

Lighting fixtures should be shorter and closer together than streetlamps; they must be of an appropriate scale for the trail's users while still providing an appropriate amount of horizontal and vertical clearance. Trail lighting fixtures should typically be placed 50 to 100 feet apart depending on tree placement and the curve of the path.

Lights on a trail could, at a minimum, be installed at the following locations according to AASHTO lighting guidelines:

- tunnels
- overpasses
- trailheads
- bridge entrances and exits
- public gathering places
- streets
- crosswalks
- where the path crosses another path or sidewalk
- on signage

11.4.5 Mall Lighting Standards

Quality of lighting is essential to the success of public spaces, especially at locations with an active and vibrant nightlife like the Main Street Pedestrian Mall. The original plan for the Main Street Pedestrian Mall prioritized a lit central spine with pedestrian-scale lighting and ambient lighting from the adjacent buildings. Now that the large shade trees have matured and block some of the direct light and the lighting fixtures have aged, the dramatic lighting environment has lost its strength and is fairly dim. The architectural elements, large trees, dining areas, and central spine shall be carefully lit to further highlight their uniqueness as part of the Main Street Pedestrian Mall environment.

The Main Street Pedestrian Mall lighting fixtures and poles shall match the originals in design, color, finish, and spacing. Spacing for pedestrian mall street fixtures shall range from 50 feet to 60 feet on center. The fixture at the end of each block face and the fixture closest to the center point of the block face shall include a mall pedestrian fixture. Civic anchors and dining areas will be punctuated by catenary lighting, creating a unique and festive environment that will set these areas apart from the rest of the Mall.

11.5 Electrical Requirements

11.5.1 Wired Installations

Wired lighting is the most expensive to install and the most difficult to repair, but with good design and quality components, it can be the easiest to operate and maintain. In general, all wiring for outdoor illumination should be underground, regardless of whether the project is new construction or a retrofit. The exceptions are where street lights are mounted to existing utility or traffic signal poles with overhead wiring. All underground wiring shall be in conduits. When minimal surface disturbance is required or when lane closures are otherwise infeasible, directional boring shall be used where necessary to prevent damage to street trees.

All new lighting should utilize transformer base poles with in-line fuses. Where lighting is installed on existing utility or signal poles, a pull box should be provided near the base of the pole. The City prefers that individual lights be equipped with photocells; however, it may be preferable to install a single photocell at the controller location when heavy tree cover or other site constraints render individual photocells impractical.

Electrical design for wired street lighting systems shall comply with Chapter 2 of the VDOT Traffic Engineering Design Manual.

11.5.2 Solar Stand-Alone Units

Solar lights power themselves and are the most environmentally conscious option. There are no interconnecting wires with solar lighting, which means repairs are contained to a single fixture at a time. However, solar-powered lights are not recommended in places with significant tree canopy or in areas where natural light is limited. In addition, solar panels for individual lights can be large, and they are typically not aesthetically pleasing. Solar lighting should be avoided in historic areas and along gateway corridors unless solar panels can be located at a centralized location.

Despite these limitations, solar stand-alone lights may be advantageous along trails and in remote locations where electric power is unavailable.

11.5.3 Battery Powered Units for Trail Lighting

Battery powered lighting may only be used with approval of the City of Charlottesville Department of Parks and Recreation. Battery powered lights are the least costly to install and repair, but they are very difficult to maintain. Depending on the brightness of the lighting, batteries may need frequent replacement. Dead batteries that go unnoticed present a danger to trail users, forcing them to face a completely dark section of trail.

Lights of this kind are usually only practical on trails with high traffic, where notice of a dead battery is likely to be reported before an emergency.

11.6 Plan and Calculation Requirements

The following elements related to outdoor lighting systems must be provided to the City for review and approval as part of the site plan approval process:

11.6.1 Illumination Study

Provide an illumination study based on proposed luminaires and pole heights. The illumination study should be completed using AGI 32 or similar software and should include the following elements:

- Plan view drawing showing location, type, and mounting height for all proposed luminaires
- Grid of illumination values, space at not more than 5 feet apart for roadways and sidewalks, and not more than 10 feet apart for parking areas and site lighting
- Graphical display of photometric files used or proposed lighting (obtain .ies files for City standard lighting from the City, and obtain non-standard .ies files from the lighting manufacturer.)
- Calculated values for horizontal average illuminance, uniformity, veiling luminance, and vertical minimum illuminance as applicable, calculated separately for roadways, intersections, pedestrian ways, and site/parking lot lighting areas
- Boundaries of calculation zones

Illumination studies for street lighting must also include an analysis of existing and proposed background lighting that may have an impact on the roadway. Information on existing background lighting shall be obtained via a lighting survey, which may be a combination of modeled existing luminaires (if specifications are known) and illumination values measured with a light meter. Illumination studies for street lighting must also consider street trees and vegetation at full growth.

11.6.2 Preliminary Lighting Plans

Provide plan view drawings for lighting systems which include:

- Location, fixture and pole type, and mounting height for all proposed luminaires, including station and offset or dimensions sufficient for locating each light pole
- Location, fixture and pole type, and mounting height for all existing luminaires, to remain and to be removed
- Locations of existing and proposed trees and landscaping

- Location of existing and proposed underground and overhead utilities
- City and VDOT standard details applicable to proposed lighting
- Details and manufacturer specifications for proposed non-standard lighting

11.6.3 Final Lighting Plans

Provide plan view drawings for lighting systems that include all elements of the preliminary lighting plans, plus the following:

- Location, type, and size of all conduits, cables, hand boxes, control cabinets, power feeds, and lighting system appurtenances, including station and offset or dimensions sufficient for locating each item
- VDOT or manufacturer standard details for electrical components of the lighting system, as applicable

11.6.4 Lighting Calculations

As early as possible during the design process, provide a draft electrical load letter for review by the City. Upon completion of electrical system design, provide voltage drop calculations complying with Chapter 2 of the VDOT Traffic Engineering Design Manual.

11.7 References

AASHTO Roadway Lighting Design Guide

[City of Charlottesville, Virginia Code of Ordinances](#), Section 34-1000 through Section 34-1005: Outdoor Lighting Ordinance

[City of Charlottesville Pedestrian Lighting Study](#)

[Code of Virginia](#)

[FHWA Publication No. FHWA-HRT-08-053, Informational Report on Lighting Design for Midblock Crosswalks](#)

IESNA TM-15-07 Luminaire Classification System for Outdoor Lighting

IESNA IES-RP-8, Roadway Lighting

Institute of Electrical and Electronics Engineers, National Electrical Safety Code

[Joint International Dark Sky Association – Illuminating Engineering Society Model Lighting Ordinance](#)

National Fire Protection Association, NFPA 70: National Electrical Code

[VDOT Road Design Manual](#)

[VDOT Traffic Engineering Design Manual](#)

[Virginia Uniform Statewide Building Code \(VUSBC\)](#)

CHAPTER 12

GENERAL MATERIALS AND METHODS OF CONSTRUCTION

12.1 Intent and Purpose

The City of Charlottesville recognizes that a consistent application of materials and methods of construction is essential to creating the high-quality public spaces envisioned as a part of the City's Streets That Work Design Guideline's guiding principles. This chapter provides guidance on allowable materials within the Downtown Mall, historic districts, and other areas of the City. It also describes inspection and testing requirements and discusses the recommended approach to design tolerances for typical elements of construction.

12.2 Inspection and Testing

Project designers shall ensure that appropriate inspection and testing requirements are described in project design plans and specifications. See Appendix X, Detail X for required inspection and testing notes.

12.3 Materials

Materials and methods of construction of all improvements required in subdivisions, site development, redevelopment, public and private streets, utilities, and any improvements within the public right-of-way shall be in accordance with standards and specifications prescribed by this manual. If no City of Charlottesville standard exists, then the current edition of the VDOT Road and Bridge Specifications shall be used. Other materials may be approved by the City Engineer on a case-by-case basis. Any request for alternate materials must be accompanied by material specifications and details demonstrating where/how the material is to be used.

12.4 Soils

The soil materials shown in Table 12-1 shall be used for all soil fill within the public right-of-way.

Table 12-1: Allowable Soil Materials

Designation	Allowable Uses	Notes
COMMON FILL	General grading, roadway construction.	1. Suitable native or borrow embankment material conforming to VDOT specifications, free of deleterious material and rocks larger than 2 inches.
SELECT FILL	Utility backfill and other areas where higher strength material is required	1. Same as Common Fill, except free from all rock and with plasticity index <20.
SAND	Mix ingredient for concrete and grout	1. Fine aggregate material conforming to VDOT specifications, Section 202, Grade A.
IMPERVIOUS FILL	Dams or bulkheads along utility installations	1. Unsuitable for placement under asphalt and concrete pavements, including sidewalks, driveways, and shared use paths.
BIORETENTION SOIL	Bioretention basins and infiltration best management practices (BMPs) for stormwater management	1. Loamy sand material conforming to the Virginia Department of Environmental Quality Design Specification No. 9, Bioretention.
TOPSOIL	Areas where vegetation is to be established	1. Soil material conforming to VDOT specifications, Section 244.02.

12.4.1 Inspection and Testing Requirements

The construction contractor shall perform a visual inspection of all soil materials delivered to the project site and ensure soil materials are free of deleterious material and rocks as noted above.

The construction contractor shall obtain samples and furnish soil tests as required by the VDOT Road and Bridge Specifications. Proposed soil materials shall be approved by the City Engineer prior to placement. Refer to VDOT Road and Bridge Specifications, Section 106 – Control of Materials and Section 200 - General.

The City Inspector shall be present for all third party tests and shall check material delivery tickets. Additional City inspections are required during subgrade preparation. All delivery tickets and test results shall be submitted to the City Engineer for review.

For materials obtained from sources preapproved by VDOT, the contractor may submit material certifications for approval by the City Engineer in lieu of testing. The contractor shall comply with the sampling and testing requirements shown in Table 12-2 for in-place density testing and for all materials obtained from sources not preapproved by VDOT.

Table 12-2: Sampling and Testing Requirements for Soil Materials

TEST DESCRIPTION	SAMPLING/TESTING FREQUENCY
<i>GRADATION</i>	Three samples, taken from the center of the roadway and four feet in from each edge of the roadway, prior to compaction.
<i>ATTERBERG LIMITS</i>	Three samples, taken from the center of the roadway and four feet in from each edge of the roadway, prior to compaction.
<i>CALIFORNIA BEARING RATIO (CBR)</i>	One test per project.
<i>IN-PLACE DENSITY</i>	One test per every 500-foot length of fill for each compacted lift within the top 5 feet of fill.

12.4.2 Grading and Slopes

All final slopes within the right-of-way shall be a maximum of 3:1 to promote ease of maintenance.

12.4.3 Bridging of Excavation and Trenches

Whenever trenches and excavations will be bridged to permit an unobstructed flow of traffic, trench walls and adjacent soils must be sufficiently stable before using steel plates.

Bridging must be secured and displacement shall be prevented by using adjustable cleats, angles, bolts, or other devices that restrain movement due to traffic.

The trench must be adequately shored to support the bridging and traffic.

Excavations are to be backfilled with select fill and compacted to 95% in maximum 1-foot lifts.

Crush and run stone is to be placed in the excavation a minimum of 8 inches, and a temporary asphalt patch is to be placed before any use by vehicular traffic.

Steel plates used for bridging must extend at least 1 foot beyond the edges of the trench. Temporary paving materials, such as “premix,” will be used to feather the edges of the plate to minimize wheel impact damage.

12.5 Aggregates

The aggregate materials shown in Table 12-3 shall be used for all work within the public right-of-way.

Table 12-3: Allowable Aggregate Materials

Designation	Allowable Uses	Notes
RIPRAP	Slope stabilization, embankment protection, channel lining, erosion and sediment control	1. Conforming to VDOT specifications, Section 414.
COARSE AGGREGATE	Mix ingredient for asphalt and concrete, stone base for drainage structures, backfill for manhole abandonment	1. Conforming to VDOT specifications, Section 203, Grade B or better.
CRUSHER RUN AGGREGATE	Erosion and sediment control surfacing of staging areas	1. Conforming to VDOT specifications, Section 205, for No. 25.
FINE AGGREGATE	Mix ingredient for concrete	1. Conforming to VDOT specifications, Section 202, Grade A.
VDOT NO. 21A - MODIFIED	Trench backfill, pavement subbase, select backfill around structures	1. Conforming to VDOT specifications, Section 208 VDOT No. 21A Coarse Aggregate
VDOT NO. 8 COARSE AGGREGATE	Permeable paver installations	1. Conforming to VDOT specifications, Section 203, Grade B or better.
VDOT NO. 9 COARSE AGGREGATE	Permeable paver installations	1. Conforming to VDOT specifications, Section 203, Grade B or better.
VDOT NO. 10 STONE DUST	Surfacing for recreational trails	1. Conforming to VDOT specifications, Section 203, Grade B or better.
MULCH	Surfacing for recreational trails, landscaping, stormwater management facilities	1. Refer to Appendix ??, specification Section ??? Mulch.

12.5.1 Inspection and Testing Requirements

The construction contractor shall perform a visual inspection of all aggregate materials delivered to the project site and ensure that aggregate materials are free of deleterious material and are consistent in general appearance with required gradation.

The construction contractor shall obtain samples and furnish aggregate tests as required by VDOT Specification Section 200.04. Proposed aggregate materials shall be approved by the City Engineer prior to placement. Refer to VDOT Road and Bridge Specifications, Section 200 – General.

The City Inspector shall be present for all third party tests and shall check material delivery tickets. Additional City inspections are required prior to placement of stone base for pavements and structures. All delivery tickets and test results shall be submitted to the City Engineer for review.

12.6 Concrete

This section applies to incidental and structural concrete applications only. See Section 12.8, Concrete Pavement for requirements for concrete pavements.

12.6.1 Incidental vs. Structural

Incidental concrete work includes construction of concrete sidewalks, curb ramps, drainage structures, curbs and gutters, ditches or flumes, bridge drainage aprons and chutes, median barriers, and islands. Incidental concrete elements that are subject to vehicular loadings shall be thickened, reinforced, or otherwise designed to handle the proposed loads.

Structural concrete work includes construction of buildings, bridges, retaining walls, culverts, inlets, catch basins, manholes, end walls, and other concrete elements subject to significant loading and subject to building code requirements.

12.6.2 Vehicular Loading

Incidental concrete elements that are subject to vehicular loadings shall be thickened, reinforced, or otherwise designed to handle the proposed loads.

12.6.3 Mix Requirements

The concrete mixes shown in Table 12-4 shall be used for all incidental and structural concrete work within the public right-of-way.

Table 12-4: Allowable Concrete Mixes

MIX DESIGNATION	MINIMUM 28-DAY COMPRESSIVE STRENGTH	ALLOWABLE USES	NOTES
VDOT CLASS A3	3,000 psi	Utility thrust blocking, encasement	1. Buried applications only.
VDOT CLASS A4, INTEGRALLY COLORED	4,000 psi	Concrete work for right-of-way elements (curbs, gutters, sidewalks, driveways, slabs for high-volume transit stops as defined in 4.11.6.1 as serves more than three buses per hour during peak travel hours, etc.) and Incidental and structural concrete work other than right-of-way elements	1. Use Rockwood Pigments/Davis Colors #5084, Omaha Tan. Integrally Colored Concrete. 2. Use of fly ash in this mix is not allowed. 3. All aggregates used on a project must be from a single source and shall be consistent in color.

MIX DESIGNATION	MINIMUM 28-DAY COMPRESSIVE STRENGTH	ALLOWABLE USES	NOTES
VDOT CLASS A5, INTEGRALLY COLORED	5,000 psi	Curb and sidewalks subjected to frequent vehicular impacts	<ol style="list-style-type: none"> 1. Use Rockwood Pigments/Davis Colors #5084, Omaha Tan Integrally Colored Concrete. 2. Use of fly ash in this mix is not allowed. 3. All aggregates used on a project must be from a single source and shall be consistent in color.
VDOT FLOWABLE FILL	30 psi	Fill material for abandoned pipelines, backfill material	<ol style="list-style-type: none"> 1. Use as directed by the City Engineer. 2. Coordinate with the City Engineer to determine whether a different compressive strength is necessary.

Proposed mix designs shall be approved by the City Engineer prior to concrete placement. Refer to Appendix X, Specification Section X Integrally Colored Concrete, and VDOT Road and Bridge Specifications, Section 217 – Hydraulic Cement Concrete for mix design specifications.

12.6.4 Inspection and Testing Requirements

The construction contractor shall procure the services of a VDOT Certified Concrete Field Technician for the duration of concrete placement. The field technician shall be responsible for performing and documenting all concrete inspection and testing as outlined in Chapter IV of the VDOT Manual of Instructions for the Materials Division, with testing frequency as shown in Tables IV-1 and IV-2. Strength tests shall be performed at 7 and 28 days of curing.

The City Inspector shall be present for all third party tests and shall check concrete delivery tickets. All delivery tickets and test results shall be submitted to the City Engineer for review. Additional City inspections are required during subgrade preparation; prior to placement of stone base, concrete forms, and reinforcing steel; and prior to pouring concrete.

The batching, mixing, transporting, placing, and curing of concrete is also subject to the inspection by the City Engineer at any time. The City Engineer may have cores taken from any questionable area in the concrete work for independent determination of concrete quality. The results of tests on such cores shall be the basis for acceptance or rejection of the concrete work. The contractor shall cooperate in obtaining cores by allowing free access to the work and permitting the use of incidental equipment as may be required. The contractor shall also repair all core holes. Cores for testing shall not be

taken until concrete has aged a minimum of 56 days. The work of cutting and testing the cores will be at the expense of the City.

When the tests on specimens of concrete fall below the specified strength, the City Engineer will permit check tests for strength to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39 at the contractor's expense. In the case of cores not indicating adequate strength, the City Engineer, in addition to other recourses, may require, at the contractor's expense, the replacement of those portions of the concrete work that fail to develop the required strength.

12.6.5 Final Finish

Final finish of concrete surfaces within roadways shall adhere to the most recent edition of the VDOT Road and Bridge Specifications.

Final finish of incidental concrete such as stairs, sidewalks, curbs, ramps, etc. shall be broom-finished. Broom finish shall result in a consistent and visually appealing surface acceptable to the City Engineer. Grooves created by the broom shall be a minimum of 1/16 inches in depth but not exceed 1/8 inches to maintain a slip-resistant surface.

12.6.6 Curing

Only clear curing compounds are permitted.

12.7 Asphalt Pavement

12.7.1 Mix Requirements

The asphalt mixes shown in Table 12-5 shall be used for all asphalt work within the public right-of-way and for City-owned and maintained facilities such as multi-use trails.

Table 12-5: Allowable Asphalt Mixes

MIX DESIGNATION	ALLOWABLE USES	NOTES
VDOT SM-9.5A SURFACE MIX	Roadway and commercial driveway surface/wearing course, wedge and leveling course, residential driveways, asphalt sidewalks, and shared use paths.	1. Reclaimed asphalt pavement and reclaimed asphalt shingle materials are allowed in conformance with VDOT specifications.
VDOT IM-19.0 INTERMEDIATE MIX	Low speed roads, long-term temporary repairs	1. Reclaimed asphalt pavement and reclaimed asphalt shingle materials are allowed in conformance with VDOT specifications.
VDOT BM-25.0 BASE MIX	Roadway and commercial driveway base course	1. Reclaimed asphalt pavement and reclaimed asphalt shingle materials

are allowed in conformance with VDOT specifications.

Proposed mix designs shall be approved by the City Engineer prior to asphalt placement. Refer to VDOT Road and Bridge Specifications, Section 211 – Asphalt Concrete for mix design specifications.

Asphalt pavements shall be constructed in accordance with VDOT Road and Bridge Specifications, Section 315 – Asphalt Concrete Placement.

12.7.2 Inspection and Testing Requirements

The construction contractor shall procure the services of a VDOT Certified Level II Asphalt Field Technician for the duration of asphalt placement. The field technician shall be responsible for performing and documenting all asphalt inspection and testing as outlined in Chapter 5 of the VDOT Manual of Instructions for the Materials Division.

The City Inspector shall be present for all third party tests and shall check asphalt delivery tickets. All delivery tickets and test results shall be submitted to the City Engineer for review. Additional City inspections are required during subgrade preparation and prior to placing stone base, base course, and each subsequent lift of asphalt.

12.8 Concrete Pavement

12.8.1 Mix Requirements

The concrete mixes shown in Table 12-6 shall be used for all concrete pavements within the public right-of-way.

Table 12-6: Allowable Concrete Mixes

MIX DESIGNATION	MINIMUM 28-DAY COMPRESSIVE STRENGTH	ALLOWABLE USES	NOTES
<i>VDOT CLASS A4, INTEGRALLY COLORED</i>	4,000 psi	Roadway pavements	<ol style="list-style-type: none"> 1. Use Rockwood Pigments/Davis Colors #5084, Omaha Tan. Integrally Colored Concrete. 2. Use of fly ash in this mix is not allowed. 3. All aggregates used on a project must be from a single source, and shall be consistent in color.
<i>VDOT CLASS A5, INTEGRALLY COLORED</i>	5,000 psi	Concrete slabs for high-volume transit stops as defined in 4.11.6.1, serves more than 3 buses per hour	<ol style="list-style-type: none"> 1. Consult with the City Engineer to determine whether Class A5 concrete is required. 2. Use Rockwood Pigments/Davis Colors #5084, Omaha Tan. Integrally Colored Concrete. 3. Use of fly ash in this mix is not allowed.

during peak
travel hours

4. All aggregates used on a project must be from a single source, and shall be consistent in color.

Proposed mix designs shall be approved by the City Engineer prior to concrete placement. Refer to Appendix X, Specification Section X Integrally Colored Concrete, and VDOT Road and Bridge Specifications, Section 217 – Hydraulic Cement Concrete for mix design specifications.

See Chapter 13: Maintenance of Existing Infrastructure for method of repairing concrete pavements.

12.8.2 Concrete Crosswalks

Use of integrally colored stamped concrete crosswalks is encouraged. Stamped concrete colors and patterns will be considered on a case-by-case basis but must comply with the requirements of the Manual on Uniform Traffic Control Devices, the US Access Board's Public Right-of-way Accessibility Guidelines, and City of Charlottesville Historic District Regulations. White, retroreflective pavement marking lines are required in addition to any stamped concrete colors and patterns. Refer to Chapter 3: Traffic for more information on crosswalks.

Concrete crosswalks shall comply with Detail X.

12.8.3 Inspection and Testing Requirements

The construction contractor shall procure the services of a VDOT Certified Concrete Field Technician for the duration of concrete placement. The field technician shall be responsible for performing and documenting all concrete inspection and testing as outlined in Chapter IV of the VDOT Manual of Instructions for the Materials Division, with testing frequency as shown in Tables IV-3. Strength tests shall be performed at 7 and 28 days of curing.

The City Inspector shall be present for all third party tests and shall check concrete delivery tickets. All delivery tickets and test results shall be submitted to the City for review. Additional City inspections are required during subgrade preparation and prior to placing stone base, steel reinforcing, and pouring concrete pavement slab.

The batching, mixing, transporting, placing, and curing of concrete is also subject to inspection by the City Engineer at any time. The City Engineer may have cores taken from any questionable area in the concrete work for independent determination of concrete quality. The results of tests on such cores shall be the basis for acceptance or rejection of the concrete work. The contractor shall cooperate in obtaining cores by

allowing free access to the work and permitting the use of incidental equipment as may be required. The contractor shall also repair all core holes. Cores for testing shall not be taken until concrete has aged a minimum of 56 days. The work of cutting and testing the cores will be at the expense of the City.

When the tests on specimens of concrete fall below the specified strength, the City Engineer will permit check tests for strength to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39 at the Contractor's expense. In the case of cores not indicating adequate strength, the City Engineer, in addition to other recourses, may require, at the Contractor's expense, the replacement of those portions of the concrete work that fail to develop the required strength.

12.8.4 Final Finish

Final finish of concrete pavements shall adhere to the most recent edition of the VDOT Road and Bridge Specifications.

12.8.5 Curing

Only clear curing compounds are permitted.

12.9 Composite Pavement

12.9.1 Material Requirements

Composite pavements exist in some areas of the City. This section is limited to repair of existing composite pavements for installation of utilities or other small-scale activities. Installation of new composite pavement where composite pavement does not currently exist should be avoided.

Composite pavement shall be replaced in kind. Concrete and asphalt thickness shall match existing. Reinforcing bar size, type, and spacing shall match existing. Concrete mix design shall be VDOT Class A4 or A5, and asphalt mix design shall be VDOT SM-9.5A Surface Mix as described above.

See Chapter 13: Maintenance of Existing Infrastructure for method of repairing concrete and asphalt pavements.

12.9.2 Inspection Requirements

Inspection and testing for composite pavements shall be the same as those for concrete and asphalt pavements, as described in Sections 12.3.4.2 and 12.3.5.3, respectively.

12.10 Steel Reinforcement

12.10.1 Material Requirements

All steel reinforcement used to provide additional flexural strength or control cracking in concrete materials shall comply with VDOT Road and Bridge Specifications, Section 223 – Steel Reinforcement. Reinforcing steel used in structural applications shall be epoxy-coated, meeting the requirements of Section 406 of the VDOT Road and Bridge Specifications. Handling and storage of epoxy-coated reinforcing steel shall be in accordance with Section 406.03 – Procedures.

12.10.2 Inspection Requirements

The construction contractor shall inspect reinforcing bars to ensure they are clean and free of dirt, grease, or other deleterious materials. Coatings shall be free of damage or shall be repaired in compliance with VDOT specifications prior to use.

12.11 Granite Curbing

12.11.1 Material Requirements

Granite curbing exists in some areas of the City. Consult with City staff to determine whether existing granite curbing should be replaced in kind or replaced with concrete. Requests to install new granite curbing will be considered on a case-by-case basis. All new curbstones shall be first-quality granite; hard and durable; of a uniformly light color from a single deposit or quarry; free from seams, cracks, or other imperfections; and have a smooth splitting character. New curbstones shall also be clean and show no evidence of any iron rust or iron particles.

Straight granite curbstone shall have a nominal width of 6 inches, and the front surface shall be between 12 inches and 14 inches in height. Straight curbing may be of random lengths, but no piece shall be less than 3 feet in length.

Unless otherwise shown in the contract documents, or directed by the City Engineer, the front face shall have a batter of 1 inch in 12 inches.

Circular curb up to and including 100-foot radius shall have the same cross-section dimensions as straight curb and shall be cut exactly true to the radius ordered. Circular curb with a 3-, 6-, or 15- foot radius shall have an arc length of 4.71 feet. All others shall have an arc length of 5.25 feet. Circular curb greater than 100 feet through 200 feet radius shall consist of straight sections not exceeding 5 feet in length with ends cut to form radial joints.

Granite curbing shall be set in a dry concrete setting bed, as shown in Detail X.

12.12 Yellow and White Pavement Markings

12.12.1 Material Requirements

Permanent yellow and white pavement markings shall be Type B, Class I non-skid retroreflective thermoplastic, complying with VDOT Road and Bridge Specifications, Section 246 – Pavement Marking. However, if the lifespan of the pavement is to be 3 years or less before replacement, then permanent yellow and white pavement markings shall be Type A fast-drying, water-based, non-lead, acrylic resin paint. Contrast tape a minimum of 1.5 inches wide shall be provided along both edges of yellow or white markings applied on concrete, or other light-colored surfaces. Temporary yellow and white pavement markings shall be Type B, Class IV plastic-backed preformed tape.

12.13 Green Pavement Markings

12.13.1 Material Requirements

Green pavement markings for bicycle facilities shall be Ennis-Flint CycleGrip™ MMAX or approved equal and shall be applied in strict adherence to manufacturer recommendations.

12.14 Pavers within Sidewalks and Roadways

12.14.1 Material Requirements

All pavers installed in the public right-of-way shall be pressed concrete. Paver sidewalks shall be supported by a minimum of 4 inches of concrete reinforced with welded wire fabric. Support systems for pavers exposed to vehicular traffic shall be designed based on geotechnical engineering recommendations, but in no case shall be underlain by less than 6 inches of reinforced concrete and 6 inches of coarse aggregate base. Pavers shall be set in an asphalt setting bed with tight joints (without sand fill), or joints shall be filled with polymeric sand installed in strict adherence to manufacturer recommendations.

12.15 Detectable Warning Surfaces

12.15.1 Material Requirements

Detectable warning surfaces shall be a single panel, a minimum of 0.4 inches thick, “safety yellow” in color, and set flush with the surrounding concrete. The panel shall be

anchored per manufacturer recommendations at all four corners, and at intervals no greater than 12 inches on center throughout the panel. Detectable warning surfaces shall extend the entire width of the curb ramp.

In design control districts, the City will give consideration to alternative colors (which must still provide the required level of contrast) and alternative materials such as concrete pavers or metal studs on a case-by-case basis.

Approved alternate detectable warning surfaces materials and installation shall comply with VDOT Road and Bridge Specifications, Section 504 – Sidewalks, Steps, and Handrails. Detectable warning surfaces should be installed with gaps between truncated domes aligned perpendicular to the grade break between the ramp run and the street so that persons using wheelchairs can “track” between the domes. Where detectable warning surfaces are provided on a surface with a slope that is less than 5 percent, dome orientation is less critical. Avoid locating detectable warning surfaces along a curve or on a diagonal to the path of travel.

12.16 Porous Materials for Stormwater Management

12.16.1 Material Requirements

Permeable pavements and permeable concrete may not be used in the public right-of-way. All porous materials within the public right-of-way shall be porous grid pavers which allow openings in the paver grid to be filled with granular materials designed to filter stormwater. The pavers themselves may not be permeable.

Soil and granular materials placed below porous pavers shall be selected and thickness determined based on the design criteria provided in Chapter 5: Stormwater Management.

12.17 Methods

All materials described in this chapter shall be installed in accordance with VDOT Road and Bridge Specifications.

12.18 Design and Construction Tolerances

Typical methods of construction and equipment used for field measurement often introduce a degree of error into the constructed facility. Therefore, it is advisable to design for less than allowable maximum or greater than allowable minimum requirements to accommodate potential error introduced in the construction process.

This section establishes target design values for key construction elements within the public right-of-way and aims to ensure that constructed facilities are compliant with applicable regulations and guidelines.

12.19 ADA Accessibility

This introduction of error is especially critical in the construction of ADA-accessible facilities where slopes are measured over very short distances and a small change in elevation at a single point can result in a curb ramp or other facility that is not ADA-compliant. Table 12-7 provides a summary of minimum and maximum allowable slopes and lists target values that should be used when designing and constructing facilities that must be ADA-compliant.

Table 12-7: Target Design Values for ADA-Compliant Facilities

DESCRIPTION	APPLICATION	REQUIREMENT	DESIGN TARGET VALUE	CONSTRUCTION TOLERANCE
MAXIMUM CROSS SLOPE	Roadways, accessible landings, sidewalks, transit boarding areas, pedestrian street crossings	2.00%	1.50%	+/- 0.2% of value shown on plans, must be less than or equal to 2.00%
MAXIMUM RUNNING SLOPE	Sidewalks, trails and shared use paths, pedestrian street crossings	5.00% or match slope of adjacent roadway	4.50% or match slope of adjacent roadway	+/- 0.2% of value shown on plans, must be less than or equal to 5.00%
MAXIMUM RAMP RUNNING SLOPE	Curb ramps, sidewalks, trails, and shared use paths on independent alignment*	8.30%	7.50%	+/- 0.2% of value shown on plans, must be less than or equal to 8.30%
MINIMUM RAMP RUNNING SLOPE	Curb ramps	5.00%	5.0%	+/- 0.2% of value shown on plans, must be less than or equal to 5.00%
MAXIMUM SLOPE OF FLARED SIDES	Perpendicular curb ramps	10.00%	9.00%	+/- 0.2% of value shown on plans, must be less than or equal to 10.00%
MAXIMUM HEIGHT OF SURFACE DISCONTINUITIES	Sidewalks, trails and shared use paths, pedestrian street crossings	0.50 Inches	0.25 inches	+/- 0.1 inches of value shown on plans, must be less than or equal to 0.5 inches
MAXIMUM HEIGHT OF ACCESSIBLE PEDESTRIAN SIGNAL PUSH BUTTONS	Signalized intersections	42 inches above landing grade	42 inches above landing grade	+/- 0.25 inches

DESCRIPTION	APPLICATION	REQUIREMENT	DESIGN TARGET VALUE	CONSTRUCTION TOLERANCE
MAXIMUM REACH DISTANCE FOR ACCESSIBLE PEDESTRIAN SIGNAL PUSH BUTTONS	Signalized intersections	10 inches maximum from landing for parallel approach, 0 inches from landing for forward approach	8 inches from landing for parallel approach, 0 inches from landing for forward approach	+/- 0.25 inches of value shown on plans
MINIMUM CLEAR WIDTH OF SIDEWALK PEDESTRIAN ZONE	Sidewalks	60 inches (can be reduced to 48 inches at driveways and alleyways)	72 inches	+/- 0.5 inches of width shown on plans
MINIMUM LANDING DIMENSIONS AT CURB RAMPS	Pedestrian crossings	60 inches x 60 inches	60 inches x 60 inches	+1 inch/ -0 inches
DIMENSIONS OF DETECTABLE WARNING SURFACES	Pedestrian crossings for sidewalks and shared use paths	Width of ramp x 24 inches	Width of ramp x 24 inches	+/- 0.1 inches of width shown on plans

* Landings must be provided every 30 feet where running slope exceeds 5%

Slope requirements shown in Table 12-7 are based on the United States Access Board's Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way.

12.20 Roadways and Paved Areas

In general, longitudinal grades of roadways should be as flat as possible while still promoting positive drainage. Table 12-8 provides a summary of minimum and maximum allowable slopes and lists target values that should be used when designing roadways and paved or concrete surfaces.

Table 12-8: Target Design Values for Roadways and Paved Areas

DESCRIPTION	APPLICATION	REQUIREMENT	DESIGN TARGET VALUE	CONSTRUCTION TOLERANCE
MAXIMUM RUNNING SLOPE	Roadways and paved areas*	10.00%	9.50%	+/- 0.2% of value shown on plans, must be less than or equal to 10.00%
MAXIMUM CROSS SLOPE	Roadways and paved areas *	2.00%	1.50%	+/- 0.2% of value shown on plans, must be less than or equal to 2.00%
MINIMUM CROSS SLOPE	Roadways and paved areas *	0.50%	0.70%	+/- 0.1% of value shown on plans, must be greater than or equal to 0.50%
MINIMUM SLOPE	Paved and concrete surfaces	0.50% (except vertical curves)	1.00%	+/- 0.1% of value shown on plans, must be greater than or equal to 0.50%

* ADA-compliant curb ramp and street crossing design shall dictate road grades in intersections.

12.21 Pipe Slopes

Gravity piping should generally be designed to achieve minimum scour velocities, but in constrained conditions it is often necessary to construct gravity piping at less than the desirable slopes. Where gravity piping is installed with minimal slope, pipe size should be adjusted to increase flow velocity.

12.21.1 Sanitary

Table 12-9 provides a summary of minimum and maximum allowable slopes and lists target values that should be used when designing gravity sanitary sewers.

Table 12-9: Target Design Values for Roadways and Paved Areas

DESCRIPTION	APPLICATION	REQUIREMENT	DESIGN TARGET VALUE	CONSTRUCTION TOLERANCE
MAXIMUM LONGITUDINAL SLOPE	Sanitary Sewers	10.00%	9.50%	+/- 0.25% of value shown on plans, must be less than or equal to 10.00%
MINIMUM LONGITUDINAL SLOPE	Sanitary Sewers	0.50%*	1.00%	+/- 0.1% of value shown on plans, must be greater than or equal to 0.50%
MINIMUM SCOUR VELOCITY	Sanitary Sewers	2.0 feet per second	2.5 feet per second	+/- 0.25 feet per second, must be greater than or equal to 2.0 feet per second

DESCRIPTION	APPLICATION	REQUIREMENT	DESIGN TARGET VALUE	CONSTRUCTION TOLERANCE
MAXIMUM FLOW VELOCITY	Sanitary Sewers	6.0 feet per second	5.5 feet per second	+/- 0.25 feet per second, must be less than or equal to 6.0 feet per second

* Minimum allowable pipe slope should be calculated based on pipe size and flow conditions to produce the minimum scour velocity. 0.50% is intended to be an absolute minimum for constructability and should not be interpreted as allowable regardless of flow velocity.

12.21.2 Storm Drains

Table 12-10 provides a summary of minimum and maximum allowable slopes and lists target values that should be used when designing gravity storm drains.

Table 12-10: Target Design Values for Roadways and Paved Areas

DESCRIPTION	APPLICATION	REQUIREMENT	DESIGN TARGET VALUE	CONSTRUCTION TOLERANCE
MAXIMUM LONGITUDINAL SLOPE	Storm Drains	16.00%	15.00%	+/- 0.50% of value shown on plans, must be less than or equal to 16.00% *
MINIMUM LONGITUDINAL SLOPE	Storm Drains	0.50%**	1.00%	+/- 0.1% of value shown on plans, must be greater than or equal to 0.50%
MINIMUM SCOUR VELOCITY***	Storm Drains	3.0 feet per second	3.2 feet per second	+/- 0.25 feet per second, must be greater than or equal to 3.0 feet per second

* If slope over 16% is unavoidable due to site constraints, concrete anchor blocks are required.

** Minimum allowable pipe slope should be calculated based on pipe size and flow conditions to produce the minimum scour velocity. 0.50% is intended to be an absolute minimum for constructability and should not be interpreted as allowable regardless of flow velocity.

*** Improved lining in downstream receiving channel may be necessary where flow velocity exceeds 2.5 feet per second

12.22 References

[Americans with Disabilities Act \(ADA\) Accessibility Guidelines \(ADAAG\)](#)

[City of Charlottesville, Virginia Code of Ordinances](#), Section 34-335 through Section 34-339: Historic District Regulations

[VDOT Road and Bridge Specifications](#)

[VDOT Manual of Instructions for the Materials Division](#)

[Manual on Uniform Traffic Control Devices](#)

[US Access Board Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way \(PROWAG\)](#)

CHAPTER 13

MAINTENANCE OF EXISTING INFRASTRUCTURE

13.1 Intent and Purpose

The City of Charlottesville strives to provide high-quality public spaces that are safe, accessible, healthy, green, sustainable, connected, and convenient. Maintenance of existing infrastructure is a key element of achieving that goal. This chapter provides guidance on the requirements for and design of repairs to existing City infrastructure and design considerations to promote ease of maintenance.

13.2 Roads

The City maintains all streets, sidewalks, and paved trails within the City limits, with the following exceptions:

- Private streets that, by virtue of their designation as private, design, or approval status, have not been accepted into the City's urban street system
- Alleys not formally dedicated for public use or accepted into the City's urban highway system
- VDOT-maintained roads

When designing for work which extends into the street right-of-way, the design of pavement and concrete repairs for existing streets and sidewalks must conform to the standards outlined in the following sections.

The design of repairs for VDOT-maintained roads must comply with the VDOT Road and Bridge Standards and Road and Bridge Specifications.

13.3 Pavement Repair, Restoration, and Resurfacing

Pavement repairs shall be performed using materials specified in Chapter 12: Materials and Methods of Construction and details provided in Appendix X.

Any pavement patching that occurs within the limits of a marked and dedicated bike lane shall be repaired such that longitudinal joints will be located at the edge of the bike lane.

13.3.1 Asphalt Pavement Repair/Restoration

Asphalt pavement repairs for utility trenches, curb installation, or other design elements that require removal of large areas of existing pavement shall comply with Detail X.

Asphalt pavement repairs for borings, vacuum test pits, and other small punched or drilled penetrations shall comply with Detail X.

Pavement markings shall be restored in compliance with Section 13.6.1.

13.3.2 Concrete Pavement Repair/Restoration

Concrete pavement repairs for utility trenches, curb installation, or other design elements that require removal of large areas of existing concrete must be designed to maintain the structural integrity of the concrete. Utility or other cuts in concrete pavement shall be made parallel and perpendicular to concrete joints. Diagonal or circular cuts will not be allowed. Where a cut falls within 2 feet of an existing joint, the cut shall be made at the joint. If a cut removes an existing isolation or expansion joint (or a portion thereof), the joint should be reconstructed at the same location as a part of the repair.

For concrete pavements less than 7 inches thick, sawcut the full pavement depth along the edges of concrete to be removed, and then sawcut to approximately 1/3 of the pavement depth along a “buffer” boundary 4 to 6 inches away from the full-depth cut. Chip away the remaining concrete thickness so that it tapers inward toward the bottom of the slab. Clean, protect, and incorporate any existing reinforcing or dowel bars into the patched section.

For concrete pavement greater than 7 inches thick, the buffer is not required. Sawcut full pavement depth and provide longitudinal load transfer dowels between existing and new sections of pavement. Perform all trench compaction prior to installing dowels.

For narrow trenches, or other areas where standard compaction equipment cannot be used, trenches shall be backfilled with flowable fill.

Concrete pavement repairs shall comply with Details X and X.

Borings, vacuum test pits, and other punched or drilled penetrations less than 4 inches in diameter may be repaired with asphalt. Repairs shall comply with Detail X.

13.4 Sidewalk Repair, Restoration, and Replacement

Where existing sidewalks must be removed to facilitate construction of proposed improvements, sawcut the existing sidewalk at the nearest joints and entirely replace the affected sidewalk panel(s). Repairs shall comply with Detail X.

Where the root systems of existing trees encroach on sidewalk areas, it may be necessary to relocate the sidewalk; perform excavation with air spades; or prune, shave, or bridge over roots. Where encroachment of tree roots is possible, provide welded wire fabric reinforcement, consider additional stone or other materials between the roots and the bottom of the concrete to reduce moisture, and provide a root barrier at the back of curb and along the edges of planting beds. Refer to Chapter 10: Trees and Landscape and the City of Charlottesville's Best Management Practices for Tree Preservation, Transplanting, Removal and Replacement for additional information on protecting existing trees. Sidewalk repairs near existing trees shall comply with Details X through X.

Where new paver sidewalks are proposed, designers should ensure appropriate subgrade conditions to minimize settlement and paver displacement, tree root intrusion, and other damage to paved surfaces. Measures to be considered include:

- Concrete paver base with adequate provisions for drainage
- Tight joint spacing with asphalt or sand setting bed
- Use of longer-life pressed concrete pavers in lieu of brick

13.5 Misc. Concrete Repair, Restoration, and Replacement

Miscellaneous concrete repairs generally consist of repair or replacement of deteriorated concrete in curb and gutter, sidewalks, medians, barriers, minor structures, and other concrete construction in the public right-of-way. Cracking and deterioration in pavements and larger structures such as retaining walls shall be repaired based on evaluation by a licensed structural engineer.

Cracks smaller than 1/32 inch may be repaired using epoxy injection or gravity fill polymer sealing methods in strict conformance with manufacturer recommendations. Where cracks are larger than 1/32 inch, or where deterioration covers more than one half of the surface area or extends through one half of the depth of the existing

concrete, sawcut the existing concrete at the nearest joints and entirely replace the affected panels.

13.6 Pavement Markings and Signage

13.6.1 Pavement Markings

Construction projects often include utility work and other activities that impact portions of the roadway pavement. Project design plans should include provisions for in-kind restoration of existing pavement markings in areas where they have been removed. Unless pavement is being replaced or overlaid, existing pavement markings must be removed using pressurized water or other non-destructive methods.

If more than one third of the markings on any given block are disturbed, including bicycle lane markings, the entire block of roadway surface shall be milled and overlaid, and pavement markings replaced throughout. The City requires thermoplastic for permanent pavement markings. Either thermoplastic or standard traffic paint with glass beads may be used for temporary markings.

When entire blocks of pavement markings are to be replaced, designers should carefully document the location of existing pavement markings, and consult with the City Traffic Engineer to determine whether there is a need to implement safety enhancements within the affected area. For longer corridors, designers should also consult the City's Bicycle and Pedestrian Master Plan to determine whether the project presents an opportunity to implement on-road bike facilities. Coordinate with the Department of Public Works staff for a determination.

13.6.2 Signage

If a project proposes to remove existing signs from sidewalks or paved areas, signposts and foundations should be removed to a point 6 inches below the existing surface. Openings in asphalt shall be patched in-kind and finished flush with the surrounding grade. For sign removals in concrete, sawcut at nearest joints, remove sign, concrete panel, and anchors; and replace entire concrete panel. Repairs shall comply with Detail ??.??.

Signs in grassed areas should be fully removed; this includes their concrete foundations. Holes should be backfilled with compacted soil to a point 6 inches below existing grade, topsoil should be added to bring backfill even with surrounding grade, and permanent seed and mulch should be applied. Repairs shall comply with Detail ??.??.

Where existing signs are to remain or be reset, design plans should specify replacement of sign panels or poles that have been damaged, and replacement of sign panels that have faded legends or compromised retro reflectivity. All new sign panels shall include a sticker on the back of the panel showing the date the sign panel was replaced.

13.7 Storm Infrastructure

The City's Department of Utilities and Department of Parks and Recreation maintain all storm drainage and stormwater management (SWM) facilities in the public right-of-way. In addition, the City may also be called upon to maintain SWM facilities on private property if landowners fail to comply with required maintenance agreements. As such, drainage and SWM facilities should be carefully designed and located to provide sufficient maintenance access based on the types of vehicles and equipment needed to service the facility.

Installation of drainage and SWM in roadway medians should be avoided, but may be allowable if one lane of traffic can be maintained in each direction during maintenance or if median is wide enough for a maintenance vehicle to pull fully out of the roadway onto the median. The median must be of sufficient width to provide adequate space to perform the necessary maintenance activities. Where maintenance vehicles are expected to drive or park on natural surfaces, provide mountable curbing, reinforced turf, or other measures designed to prevent damage to maintenance vehicles and natural surfaces.

13.8 Structure Repair, Restoration, Replacement, and Upgrading

Many of the existing drainage structures within the City are more than 50 years old and are often constructed of brick and mortar instead of modern concrete. When a project proposes to tie into or modify the existing storm drainage system, designers must investigate the condition of the receiving structure and ensure it can withstand the construction of proposed modifications and addition of post-development flows. Table 13-1 provides guidelines on structure condition and the type of repair that should be implemented. Recommended repairs shall comply with the National Association of Sewer Service Companies (NASSCO) Manhole Assessment and Certifying Program. The proposed method and details of repair must be shown on the design plans.

Table 13-1: Structure Repair Recommendations

Structure Type	Condition	Required Minimum Repairs
Brick	Mortar loss <5%, brick in good condition, no displacement	Apply new mortar to deteriorated joints
Brick	Mortar loss 6% - 25%, brick in good condition, minimal brick displacement	Line Structure (Detail ??.??)
Brick	Mortar loss > 25%, moderate deterioration of brick, more than 10% of bricks displaced	Replace Structure (Detail ??.??)
Brick	Structure .10 feet deep, deterioration of access ladder wall embedment	Replace Structure (Detail ??.??)
Concrete	Cracking of structure top, damage due to vehicular loading	Replace structure top, replace grate with bike-safe version (Details ??.?? and ??.??)
Concrete	Hairline cracking in individual structure segments	Repair cracks per VDOT specifications
Concrete	Structural cracking in individual structure segments	Reset existing structure, replace cracked segments (Detail ??.??)
Concrete	Structural cracking in multiple structure segments	Reset existing structure, replace cracked segments (Detail ??.??)
All	Clogging, accumulated debris	Request cleanout by Department of Public Utilities

For new installations, the following measures should be considered to minimize future maintenance costs and ensure structures are accessible and maintainable:

- Locating manhole covers outside the wheel path of vehicles, especially bicycles, when they fall within paved areas
- Using curb inlets along roadways whenever possible, and minimize use of inlet grates adjacent to vehicular travelways
- Locating structures in protected areas such as parking lanes, at inside corners of curb extensions, etc.

13.9 Pipe Replacement and Lining

Similar to drainage structures, much of the City’s storm drain piping is not constructed of modern materials. In 2012, approximately 24% of the existing drainage piping was either corrugated metal pipe (CMP) or terra cotta/vitrified clay pipe (TCP/VCP) in various states of deterioration.

When a project proposes to tie into or modify the existing storm drainage system, designers must investigate the condition of the downstream piping and ensure it can withstand the addition of post-development flows. Table 13-2 provides guidelines on pipe condition and the type of repair that should be implemented. The proposed method and details of repair must be shown on the design plans.

Table 13-2: Storm Drain Pipe Repair Recommendations

<i>Pipe Type</i>	<i>Condition</i>	<i>Required Minimum Repairs</i>
<i>CMP</i>	Significant corrosion, no loss of cross sectional area	Line pipe with cured in place pipe (CIPP) liner (Detail X)
<i>CMP</i>	Significant corrosion, <25% loss of cross sectional area at any point along pipe	Replace collapsing section(s) of pipe, line pipe with cured in place pipe (CIPP) liner (Detail X)
<i>CMP</i>	Significant corrosion, >25% loss of cross sectional area at any point along pipe	Replace pipe
<i>Terra Cotta/Vitrified Clay</i>	All	Replace with concrete pipe
<i>Concrete</i>	Joint separation	Re-lay pipe
<i>Concrete</i>	Hairline cracking	Repair cracks per VDOT specifications
<i>Concrete</i>	Structural cracking	Replace affected sections of pipe
<i>All</i>	Clogging, accumulated debris	Request cleanout by Department of Utilities

To minimize future maintenance costs, Locate storm drain piping along edges of roadways rather than under pavements. See Chapter 9 of this manual for additional information on required pipe materials.

13.10 Utilities

The City’s Department of Utilities maintains water, sewer, and gas infrastructure within the City limits.

13.11 Water

The City’s water system generally comprises cast iron pipe, galvanized steel pipe, and ductile iron pipe. The City has an ongoing initiative to replace galvanized steel piping with ductile iron and galvanized steel service connections with copper.

For projects that tie into or modify the existing water system, designers must investigate the condition of existing piping immediately adjacent to the project site, and ensure it has adequate capacity to serve the proposed development. All galvanized steel water piping within the project limits should be replaced with ductile iron, and the following measures should be considered to minimize future maintenance:

- Looping water lines to address pressure, flow, and stagnancy issues
- Ensuring all water lines have adequate cover to prevent freezing and defend against water main breaks
- Ensuring fire hydrants and fire department connections are in readily accessible locations

13.12 Sewer

Gravity sanitary sewers are very similar to storm drains, and much like the existing storm drain system, much of the City's sanitary sewer system is not constructed of modern materials. A large percentage of the existing sewer piping is either vitrified clay (VCP) or terra cotta pipe (TCP) in various states of deterioration.

Given these similarities, the recommendations for gravity sanitary sewers are the same as the recommendations for storm drains, above.

13.13 Gas

Charlottesville Gas, a gas utility owned and operated by the City of Charlottesville, maintains all-natural gas infrastructure within the City limits.

For projects that tie into or modify the existing natural gas system, designers must coordinate with Charlottesville Gas to design and install gas service for proposed development sites and ensure the system has adequate capacity to serve the proposed development. The following measures should be considered to minimize future maintenance:

- Ensuring gas valves, meters, and other equipment are in readily-accessible areas
- Ensuring all gas lines have adequate cover to meet utility company requirements
- Ensuring adequate clearance around gas meters and equipment

13.14 Lighting

Recent developments in lighting technology such as light emitting diode (LED) luminaires have provided significant benefits such as reduced energy consumption, increased system life, and better control of light trespass and glare. The City of

Charlottesville desires to capitalize on these new technologies to increase environmental, physical, and financial sustainability of the City's lighting systems.

City lighting systems fall into two categories:

- Standard cobrahead style lighting owned, operated, and maintained by Dominion Energy
- Custom street, pedestrian, and trail lighting systems powered by Dominion Energy and maintained by the City's Department of Public Works (Trail lighting systems are maintained by the City's Parks and Recreation Department.)

Whenever allowable, designers should incorporate LED lighting technology. Consider the following additional measures to reduce cost, energy usage, light trespass, and glare:

- Timer-controlled or dimmable lighting in non-essential areas
- Timer-controlled sports field lighting
- Providing a single photocell at the control panel rather than on individual luminaires
- Providing centralized solar panel locations for solar installations rather than solar panels on each pole

See Chapter 11 of this manual for additional information on design of lighting systems in the public right-of-way.

13.15 Trails and Related Facilities

When designing trails and related facilities, designers should pay particular attention to potential maintenance needs. Trails often traverse undeveloped areas and are constructed within sensitive environmental zones. Sensitive environmental features may be damaged by heavy maintenance equipment, and trail components that require frequent maintenance may be difficult to access. Consider the following measures to promote ease of maintenance for trails in remote locations:

- Ensuring trail features which require frequent maintenance such as lighting, extensive landscaping, hardscaping, waysides, and SWM facilities are located near convenient access points from City streets
- Providing maintenance roads, reinforced turf, or other measures designed to enhance access to remote areas
- Using stand-alone solar or battery powered installations for trail lighting, restroom kiosks, etc.

13.16 Vegetation

The Department of Parks and Recreation is responsible for planting, maintenance, and removal of trees and other vegetation on more than 250 City acres, including public properties such as parks, schools, and street rights-of-way, and at public buildings. Many of these public planting areas require regular maintenance and careful attention.

Designers developing streetscapes and other public planting areas should consider the following measures to minimize maintenance needs:

- Utilizing drought-tolerant native vegetation that does not require irrigation
- Providing designs which include adequate soil volumes to allow street trees to thrive
- Minimizing planting in difficult-to-access areas such as under power lines, in roadway medians, and on remote sites
- Avoiding overly complex landscape installations
- Including measures in the design plans which require the installation contractor to establish vegetation and ensure it is thriving, rather than just performing a full replacement at the end of the warranty period
- Avoiding selecting invasive species; refer to Virginia Invasive Plant Species List.
- Selecting plant species that require little or no fertilizer
- Selecting plant species that do not require pesticide for successful growth and establishment

13.17 References

[City of Charlottesville Best Management Practices for Tree Preservation, Transplanting, Removal and Replacement](#)

[City of Charlottesville Bicycle and Pedestrian Master Plan](#)

[VDOT Road and Bridge Specifications](#)

[VDOT Road and Bridge Standards](#)

CHAPTER 14

DESIGN CONTROL DISTRICTS

14.1 Intent and Purpose

The City of Charlottesville has established three types of design control designations, with the intent to promote the preservation of structures and areas with special historic, cultural, architectural, and archeological significance and encourage the construction of new structures and sites that are complementary:

- Historical Preservation and Architectural Design Control Districts and Individually Protected Properties (ADC and IPP)
- Historic Conservation Districts (HC)
- Entrance Corridor Districts (EC)

The City both respects the past and values present creativity. This relationship of new to old should be complementary and add to the architectural vitality of the City. Within each type of design control district, the goal is that new structures, additions, and related elements will be in harmony with the scale and character of the existing buildings, sites, and landscapes.

The following is for general guidance only. Please refer to the listed regulations and guidelines for specific information.

14.2 Historical Preservation and Architectural Design Control Districts and Individually Protected Properties

Purpose: The intent of ADC districts and IPPs is to promote the identification, preservation, and enhancement of buildings, structures, landscapes, settings, neighborhoods, places, and features with special historical, cultural, and architectural significance.

Designated ADC Districts and IPPs:

- Downtown (District A)
- North Downtown (District B)
- Ridge Street (District C)

- West Main Street (District D)
- Wertland Street (District E)
- The Corner (District F)
- Oakhurst-Guildersleeve Neighborhood (District G)
- Rugby Road/University Circle/Venable Neighborhood (District H)
- There are approximately 75 Individually Protected Properties. See Section 34-273 of the city code for complete list.

City Code: Section 34-271 to Section 34-291

Design Guidelines: Architectural Design Control Districts Design Guidelines

Application Form: Board of Architectural Review Certificate of Appropriateness (COA)

Fees: (See application form)

Submittal Deadlines: Three weeks prior to next monthly Board of Architectural review (BAR) meeting; typically on the third Tuesday of each month.

General Review Standards:

- Whether the form, height, scale, mass, and placement of the proposed construction are visually and architecturally compatible with the site and the applicable conservation district
- The harmony of the proposed changes in terms of overall proportion and the size and placement of entrances and windows
- The impact of the proposed change on the essential architectural form and integrity of the existing building
- The effect, with respect to architectural considerations, of the proposed change on the architectural design control district neighborhood
- Any applicable provisions of the City's architectural design control district design guidelines

Actions that require a COA: With some exceptions, no contributing structure shall be moved, removed, encapsulated, or demolished (in whole or in part) unless and until approval of the COA. Additionally, a contributing structure and protected property shall not fall into a state of disrepair.

Pre-application meeting: Required

Review Process:

- **BAR Review:** Following a presentation by the applicant, the BAR reviews and discusses each request. The BAR may vote to approve or deny a COA, request

additional information, or, if warranted, allow an applicant to defer the decision until later date. BAR proceedings are public, with comments from the community allowed on each proposal.

- **Administrative Approval:** Department of Public Works staff may administratively approve certain requests, with examples including maintenance repairs; replacement windows to match existing; repainting of exterior; replacing a roof in kind; etc.

Period of validity for a COA: A COA is valid for 18 months from the date of approval.

Appeal of BAR decision: An applicant may appeal a BAR decision to City Council (within ten days from the date of decision). An applicant may appeal a City Council decision to the Charlottesville Circuit Court Council (within 30 days from the date of decision).

14.3 Historic Conservation Districts (HC)

Purpose: The intent of HC districts—by design, less stringent than ADCs and IPPs—is to identify and conserve buildings, structures, and areas with special historical, cultural, architectural, and archaeological significance.

Designated Districts:

- Martha Jefferson Neighborhood
- Rugby Road Neighborhood
- Woolen Mills Village

City Code: Section 34-335 to Section 34-349

Design Guidelines: Historic Conservation District Design Guidelines

Application Form: Board of Architectural Review Certificate of Appropriateness (COA)

Fees: (See application form)

Submittal Deadlines: Three weeks prior to next monthly Board of Architectural review (BAR) meeting; typically on the third Tuesday of each month.

General Review Standards:

- Compatibility of the form, height, scale, mass, and placement of the construction with the conservation district
- The harmony of the proposed changes in terms of overall proportion and the size and placement of entrances and windows
- The impact of the proposed change on the essential architectural form and integrity of the existing building

- The effect, with respect to architectural considerations, of the proposed change on the conservation district neighborhood
- Any applicable provisions of the City's conservation district design guidelines

Actions that require a COA: All new buildings or structures that require a building permit, with some exceptions; fencing and walls, with some exceptions; additions that are generally visible from the street; additions that exceed 50% of the existing floor space; additions that exceed the height of the existing structure; some building demolition.

Pre-application meeting: Not required

Review Process:

- **BAR Review:** Following a presentation by the applicant, the BAR reviews and discusses each request. It may vote to approve or deny a COA, request additional information, or, if warranted, allow an applicant to defer the decision until a later date. BAR proceedings are public, with comments from the community allowed on each proposal.
- **Administrative Approval:** Department of Public Works staff may administratively approve certain requests, with examples including fencing and minor additions.

Period of validity for a COA: A COA is valid for 18 months from the date of approval.

Appeal of BAR decision: An applicant may appeal a BAR decision to City Council (within ten days from the date of decision). An applicant may appeal a City Council decision to the Charlottesville Circuit Court Council (within 30 days from the date of decision).

A Note on Historic Designation: In the City of Charlottesville, there are numerous properties, sites, structures, and districts listed on the Virginia Landmarks Register and the National Register of Historic Places. However, these designations do not, in and of themselves, result in any additional regulations by the city, the state, or the federal government. The state and federal designations provide some protection from the impacts of actions approved and/or funded by state and/or federal agencies, and there are tax incentives available for preservation and rehabilitation. However, **only those properties, structures, and sites designated by the City** are subject to the City's ADC and HC regulations. State and/or federal designation does not automatically result in local designation. Correspondingly, there are numerous locally designated properties, sites, structures, and districts that do not have state and/or national designation; local designation does not automatically result in state and/or federal recognition.

14.4 Entrance Corridor Districts (EC)

Purpose: The intent of EC districts is to stabilize and improve property values; to protect and enhance the city's attractiveness to tourists and other visitors; to sustain and enhance the economic benefits of tourism in the city; and to support and stimulate development complementary to the prominence afforded properties and districts having historic, architectural, or cultural significance.

Designated Corridors:

- Route 29 North from the corporate limits to Ivy Road
- Hydraulic Road from the corporate limits to the 250 Bypass
- Barracks Road from the corporate limits to Meadowbrook Road
- Ivy Road from the corporate limits to Emmet Street
- Fontaine Avenue/Jefferson Park Avenue from the corporate limits to Emmet Street
- Fifth Street SW from the corporate limits to the beginning of the Ridge Street Design Control District
- Avon Street from the corporate limits to the CSX railroad tracks
- Monticello Avenue/Route 20 from the corporate limits to Avon Street
- Long Street from the corporate limits to St. Clair Avenue
- East High Street/9th Street from Long Street to East Market Street
- Preston Avenue from McIntire Road to Rosser Avenue
- McIntire Road, from Preston Avenue to Route 250

City Code: Section 34-306 to Section 34-314

Design Guidelines: Charlottesville Entrance Corridor Design Guidelines

Application Form: Entrance Corridor Review Application Certificate of Appropriateness (COA)

Fees: (See application form)

Submittal Deadlines: Three weeks prior to next monthly Planning Commission meeting; typically on the second Tuesday of each month. (For EC applications, the Commission serves as the Entrance Corridor Review Board or ERB.)

General Review Standards:

- Overall architectural design, form, and style of the subject building or structure, including but not limited to the height, mass and scale
- Exterior architectural details and features of the subject building or structure
- Texture, materials, and color of proposed materials

- Design and arrangement of buildings and structures on the subject site
- The extent to which the features and characteristics described above are architecturally compatible (or incompatible) with other buildings and structures within the EC
- Provisions of the Entrance Corridor Design Guidelines

Actions that require a COA: All new construction that requires a building permit; additions that exceed 25% of the existing floor area; signs; installation or replacement of roofing, windows, doors, and siding. No COA is required for single- and two-family dwellings.

Review Process:

- ERB Review: Following a presentation by the applicant, the ERB reviews and discusses each request. They may vote to approve or deny a COA, request additional information, or, if warranted, allow an applicant to defer the decision until a later date. ERB proceedings are public, with comments from the community allowed on each proposal.
- Administrative Approval: Department of Public Works staff may administratively approve certain requests, with examples including alterations or materials that are not substantial changes to the originally approved design.

Period of validity for a COA: A COA is valid for 18 months from the date of approval.

Appeal of BAR decision: An applicant may appeal an ERB decision to City Council (within ten days from the date of decision).

Staff Contact: Jeff Werner, AICP
Historic Preservation and Design Planner
Phone: 434.970.3130
Email: wernerjb@charlottesville.org

City's Historic Preservation and Design Review webpage:

<http://www.charlottesville.org/departments-and-services/departments-h-z/neighborhood-development-services/historic-preservation-and-design-review>

14.5 BAR and ERB reviews: Work Within City Right-of-Way or On City Property

When work occurs within City right-of-way in any of the three design control districts, it is encouraged to adhere to the appropriate guidelines for that particular district. Consult with Department of Public Works staff prior to design work on any project that will affect the ROW within one of these districts.

Improvements in the right-of-way should strive to meet the context and architectural elements of the design district while maintaining a lasting function that can be maintained within current ROW operational limits. When special features are proposed within the public ROW of a design control district, they should only be considered upon a thorough analysis of the long-term maintenance impacts and any additional requirements to maintain them.

For example, in historic districts there may be stone and/or masonry walls that contribute to the district's historic character. If repair or replacement is necessary, the preference is to match the existing walls. Other examples can be found in the respective guidelines for historic districts and entrance corridors, which are located on the City's website.

Also reference the details in the Appendix, which provide direction for items such as granite curb, construction barriers, meter vaults, etc.

14.6 References

[City of Charlottesville, Virginia Code of Ordinances](#), Section 34-335 through Section 34-339: Historic District Regulations

[National Register of Historic Places](#)

[Virginia Landmarks Register](#)

14.7 Additional Resources

[City of Charlottesville Comprehensive Plan](#)

[City of Charlottesville Urban Design and Historic Preservation Vision, Goals and Narrative](#)

[Virginia Department of Historic Resources](#)

