CITY OF BOULDER
City Council AGENDA ITEM

MEETING DATE: December 1, 2022

AGENDA TITLE: Second reading and consideration of a motion to adopt Ordinance 8561, updating transportation design standards by amending the City of Boulder Design and Construction Standards (D.C.S.), originally adopted pursuant to Ordinance 5986; and setting forth related details. Consideration of this ordinance is Transportation Standards Update (Phase 2) of the Design and Construction Standards.

AND

Second reading and consideration of a motion to adopt Ordinance 8560, updating Section 6-6-6, "Protection of Trees and Plants," B.R.C. 1981 and Section 9-9-7, "Sight Triangles," B.R.C. 1981;and setting forth related details.

PRESENTER(S):

Nuria Rivera-Vandermyde, City Manager
Chris Meschuk, Deputy City Manager
Brad Mueller, Director of Planning and Development Services
Natalie Stiffler, Interim Director of Transportation and Mobility
Edward Stafford, Senior Manager – Planning and Development Services
Gerrit Slatter, Principal Transportation Projects Engineer – Transportation and Mobility
Scott Schlecht, Transportation Maintenance Manager – Transportation and Mobility

EXECUTIVE SUMMARY:

The Transportation Standard Phase 2 update of the Design and Construction Standards (DCS) has been focused on Street Geometric Design Standards, Streetscape and Landscaping Design and Maintenance Standards and also updates portions of the Sight Triangle section of the Boulder Revised Code 9-9-7 (BRC) and to BRC 6-6 Protection of Trees and Plants related to street trees.

The purpose of the Phase 2 update project is to align these sections with recently adopted policy and technical documents (e.g., Transportation Master Plan, Low-Stress Walk and Bike Network Plan, and internal Transportation Landscapes Plan) and to ensure that industry best practices are being followed.

The DCS is used to help guide public infrastructure built by both private development and city funded capital infrastructure and maintenance projects.

Phase 2 of this project was initiated in June 2021, with an initial round of community engagement in Fall 2021 that has continued through Summer 2022. Staff have considered the feedback provided and integrated additional changes that reflect this input which is now included in this final document of recommended changes.

STAFF RECOMMENDATION

Staff recommends City Council adoption of the updates to the Design and Construction Standards, BRC 9-7-7 Sight Triangles and Boulder Revised Code 6-6-6 Protection of Trees and Plants.

Suggested Motion Language:

Motion to adopt Ordinance 8561, updating transportation design standards by amending the City of Boulder Design and Construction Standards (D.C.S.), originally adopted pursuant to Ordinance 5986; and setting forth related details. Consideration of this ordinance is Transportation Standards Update (Phase 2) of the Design and Construction Standards.

AND

Motion to adopt Ordinance 8560, updating Section 6-6-6, "Protection of Trees and Plants," B.R.C. 1981 and Section 9-9-7, "Sight Triangles," B.R.C. 1981; and setting forth related details.

BACKGROUND:

The current DCS was adopted in 1998 and had major updates to various sections in 2000 and again in 2020. The DCS exists to prescribe minimum standards to be used in the design and construction of infrastructure located in public right-of-way/easements of the city of Boulder, as well as private transportation improvements that connect to or impact public infrastructure. Additional standards, especially related to street cross sections, are also included in area plans (such as the North Boulder Subcommunity Plan and the Transit Village Area Plan). The DCS is enacted through the BRC, and changes are adopted by City Council with recommendations from appropriate boards, such as WRAB, TAB and Planning Board.

A number of DCS transportation standards have been previously identified for potential update, which has been based in part upon community feedback received over the years. Additionally, the Transportation Master Plan Update in September 2019, the Low-Stress Walk and Bike Network Plan in 2019 and completion of the Transportation Landscapes Plan in 2020, along with other transportation staff work, has highlighted need for additional items to be updated in the DCS and BRC. The proposed changes in Phase 2 are intended to update relevant standards to current best practices and provide consistency between adopted master plans and the standards of the DCS.

Additional updates to other sections, including transportation sections of the DCS, are anticipated in future years.

The goals of the Phase 2 update are:

- **Overall**: Modernize the requirements to which facilities are designed and constructed so private and public projects are consistent in application. This aligns with the departments' Operational Excellence guidepost and being more efficient and effective in the delivery of our desired results.
- **Street geometric design**: Decrease the potential for and/or severity of conflicts between all users (motorists, bicyclists and pedestrians) by modifying conflict points, reducing the speed of vehicles at conflict points such as driveways and intersections, and increase visibility between modes.
- **Streetscape, landscaping, and irrigation**: Support landscapes that are fiscally maintainable within city resources and in line with the environmental sustainability goals highlighted in the Urban Forestry Strategic Plan and the Transportation Landscape Maintenance Plan.
- **Sight triangle section in the Boulder Revised Code**: further embrace Boulder's multimodal system by adding standards related to private land that relate to multi-use paths, increase visibility between modes at intersections and recognize the built environment's impact to sight distance through the placement of buildings.

COMMUNITY ENGAGEMENT:

Community engagement has included targeted outreach to groups that regularly use the DCS and/or that have expressed an interest in the update (e.g., the development and engineering community, Community Cycles Advocacy Committee (CCAC) and TAB), as well as informing and consulting with the community at large. An online BeHeard Boulder questionnaire was shared via partners like the Boulder Chamber of Commerce and on the City's social media. The team presented to CCAC and to the Center for People with Disabilities and held three separate virtual office hours. Highlights of the recommendations, a summary of community engagement, and working drafts of Chapters 2, 3, and 10 have been provided on the project website. The key areas of input received through the community engagement process include the following areas:

- Narrower lane widths to slow vehicle traffic (this is included in the update)
- Minimizing the number of left turn lanes to minimize crossing distances (this is included in the update)
- Support for additional raised crossing details (this is included in the update)
- Support for minimizing corner radii as a method to reduce turning vehicle speeds, as well as a desire to accommodate larger vehicles, such as transit (this is included in the update)
- Reminder to build facilities that we can maintain (this is indirectly included in the update with revisions to landscape standards that will allow the city to better maintain installed landscape areas)
- Concern about excessive signage and markings (this may be addressed in a future update)
- Concern about pedestrians and people with disabilities being able to safely and easily navigate traffic circles (this may be addressed in a future update)

The Transportation Advisory Board held a public hearing regarding this project on September 12, 2022 and unanimously recommended approval of the DCS and BRC updates. Overall, TAB was appreciative of the changes made since the 60% version and expressed support for future updates on additional transportation standards including sidewalks.

The Planning Board held a public hearing regarding this project on October 11, 2022 and unanimously recommended approved of the DCS and BRC updates and also recommended additional modifications to BRC 6-6-1 Legislative Intent for Chapter 6 Protection of Trees and Plants to support the health and expansion of Boulder's Urban Forest canopy. Staff has proposed this addition as a part of the ordinance for this item.

PROJECT SCOPE:

The scope of the Phase 2 recommendations is focused on street geometric design and streetscape design and standards, as detailed below.

Street Geometric Design – (See Exhibit A to Proposed Ordinance 8561)
The intent of the Street Geometric Design (Section 2.07) revisions is to make changes to the standards of radius of intersections, curb returns, horizontal curves, lane widths, design speed and turning radii for improved bicyclist and pedestrian safety. The Street Geometric Design section is applicable to city-funded capital projects such as the North Broadway Reconstruction project currently under construction and the 30th Street Separated Bike Lanes project which is currently being designed. It is also used on private development projects when a developer is responsible for implementing infrastructure in the public right-of-way. An example of this type of project is the Junction Place roadway between Pearl Parkway and Prairie.

Within **Section 2.07 STREET GEOMETRIC DESIGN**, the following subsections and tables/figures were updated:

Section 2.07 STREET GEOMETRIC DESIGN	
Topics: (A) Minimum Requirements (B) Right-of-Way **(C) Lane Width—UPDATED** **(D) Horizontal Alignment—UPDATED** (E) Vertical Alignment **(F) Sight Distance—UPDATED** (G) Medians (H) Vertical Clearance of Structures	Tables: **Table 2-5: Minimum Street Lane Widths—UPDATED** Table 2-6: Minimum Horizontal Street Curve Specifications **Table 2-6a: Separated Bike Lane Minimum Horizontal Curve Specifications—NEW** Table 2-7: Minimum Street Spacing **Table 2-8: Minimum Intersection Radii** **Table 2-8a: Relationship between Effective and Actual Radius for the Default Design Vehicle (SU-30)—NEW** Table 2-9: Maximum Street Grades Table 2-10: Vertical Curve Design Control **Table 2-11: Separated Bike Lane Intersection Sight Distance** Table 2-12: Median Width Design Standards

	Figures: **Figure 1. Actual and Effective Radius at a Conventional Intersection Corner—NEW** **Figure 2. Actual and Effective Radius at a Conventional Intersection Corner with a Curb Extension—NEW** **Figure 3. Example of a Mountable Truck Apron at an Intersection Corner—NEW**

Highlights of the specific changes include:

Vehicle Lane Widths	Update lane widths table with new, narrower preferred widths for vehicle lanes to align with current best practice for constructing streets that serve people walking and bicycling. **Anticipated benefit**: Narrower vehicle lane widths typically yield slower vehicle speeds.
Bicycle Lane Widths	Add lane widths for all expected types of bike lanes including conventional, buffered, separated, and parking-protected. **Anticipated benefit**: Providing standard widths for bicycle lanes will lead to more consistent projects that prioritize bicyclist safety and comfort.
Separated Bike Lanes	Provide additional technical information about operating speed of bicyclists and the effect on design features. **Anticipated benefit**: Providing more nuanced information about separated bike lane design will lead to more consistent design of separated bike lanes that are comfortable for bicyclists of all ages and abilities.
Road Width Tapers (Bike Lanes)	Add information about bike lane tapers in addition to existing motor vehicle lane tapers. **Anticipated benefit**: Eliminating bike lane designs with abrupt tapers (changes in direction) that can cause rider discomfort
Left-Turn Lanes	Clarify goal to use a single left-turn lane first, then dual left turns if necessary. Added statement that double and triple left-turn lanes are only allowed with Director approval. **Anticipated benefit**: Reducing the number of left-turn lanes at intersections shortens crossing distances for pedestrians and bicyclists.

While the focus of the updates within Chapter 2 is Street Geometric Design (Section 2.07), for consistency and completeness, other related and incidental updates are also being proposed. For example, the project team wanted to ensure that the new bike lane widths in Table 2-5 and other related details are now also reflected in Section 2.11 – Bicycle Facilities and Multi-Use Path Design. In addition, as new drawings were developed to address other design features (such as traffic circles and

raised pedestrian crossings), staff put the additional related text in a new section (Section 2.14 – Traffic Calming).

Highlights of the specific changes within **Section 2.11** include:

Separated Bike Lanes at Driveways	Add new figures **Figure 4 - Typical Layout for One-way Street Level Separated Bike Lanes at Driveways—NEW** **Figure 5 - Typical Layout for Sidewalk Level One-way Separated Bike Lanes at Driveways—NEW** **Anticipated benefit**: Separated bike lanes typically cross driveways and alleys. Standardizing this element of design can improve visibility of bicyclists and improve yielding compliance.
Separated Bike Lanes at Intersections	Add new figures **Figure 6 - Typical Layout of Street Level Separated Bike Lanes at Intersection in Retrofit Conditions—NEW** **Figure 7 - Typical Layout of Street Level Separated Bike Lanes at Intersections in New or Retrofiited Condition—NEW** **Figure 8 - Typical Layout of One-way Separated Bike Lane and Right Turn Lane—NEW** **Figure 9 - Typical Layout of One-way Separated Bike Lane and Right Turn Lane—NEW** **Anticipated benefit**: The most complex aspect of separated bike lanes is at intersections. Providing examples of how to maintain safety and good sightlines through the intersection will lead to consistent design of future projects.

Highlights of the new **Section 2.14** include:

Neighborhood Traffic Circles	Add new figure **Figure 10 – Typical Layout and Standard Dimensions of Neighborhood Traffic Circle—NEW** **Anticipated benefit**: Neighborhood traffic circles are a great traffic calming technique for local streets. Standardizing their design with typical dimensions will help provide consistent design of future projects.
Raised Crossings	Add new figures **Figure 11 - Typical Layout of Raised Crossing at Mid-Block Location—NEW** **Figure 12 - Typical Layout of Raised Crossing at Intersection Leg Location - NEW**

	Figure 11 - Typical Layout of Raised Crossing at Channelized Right Turn Location —NEW **Anticipated benefit**: Standardizing raised crossing design will help provide consistent traffic calming and yielding compliance benefits.

Streetscape Design and Standards Chapters

The intent of the update to the Streetscape Design and Standards chapters is to consider changes to tree buffer and irrigation standards, Additionally, these modifications update recommended plantings to reflect the Green Infrastructure a Plan for Transportation Landscapes and other Parks and Recreation and P&DS work efforts. The Streetscape Design and Standards chapters are used for both city capital project and private development public transportation infrastructure projects where there are landscape implementation elements. For example, the Diagonal Reconstruction project constructed in 2016 used Chapter 3 of the DCS as a standard.

Within **Chapter 3** and **Chapter 10**, the following sections and tables/figures were updated (*see Exhibit A to Proposed Ordinance 8561*):

Chapter 3 STREETSCAPE DESIGN AND TREE LOCATIONS	
Topics: **3.01 General—UPDATED** **3.02 Landscaping Plan—UPDATED** **3.03 Street Trees and Plants—UPDATED** **3.04 Tree Removal and Relocation—UPDATED** **3.05 Tree Protection for Construction Sites—UPDATED** **3.06 General Landscaping and Maintenance Requirements—UPDATED**	Tables: **Table 3-1: Approved Street Tree List for Non-paved Medians and Landscape Planting Strips—REMOVED** **Table 3-2: Limitations on Individual Tree Species—UPDATED** **Table 3-3: Tree Grates and Planting Pits Standards—UPDATED** **Table 3-4: Approved Street Tree List for Paved Areas Using Tree Grates and Planting Pits—REMOVED** **Table 3-5: Approved Median Shrub List—REMOVED** **Table 3-6: Tree Characteristics—REMOVED**
Chapter 10 STREETSCAPE & LANDSCAPE STANDARDS—RENAMED	
Topics: **10.1 General—UPDATED** **10.2 Site Preparation—UPDATED** **10.3 Planting—UPDATED** **10.4 Seeding/Sodding—UPDATED** **10.5 Permanent Underground Irrigation System—RENAMED AND UPDATED**	Tables: Table 10-1: Topsoil Mechanical Analysis **Table 10-2: Minimum Root Ball Sizes—UPDATED** **Table 10-3: Wildflowers—REMOVED** **Table 10-4: Grasses—REMOVED** Table 10-5: Soil Amendment Mix Mechanical Analysis

Technical Drawings (Chapter 11) (see Exhibit B to Proposed Ordinance 8561)
Chapter 11 contains technical drawings related to the above sections. The following new drawings were added:

- Related to Section 2.07:
    - 2.07.L Bike Ramp and Pre-Cast Curb Buffer
    - 2.07.M Curb Extension Detail
    - 2.07.N Curb Extension Cross Sections
    - 2.07.O Floating Bus Stop Detail
    - 2.07.P Floating Bus Stop Cross Sections

The following existing drawings were updated:

- Related to Section 2.07:
    - 2.02.D Multi-Use Path Section Detail
    - 2.03 Crosspan and Radii Curb Return Accesses
    - 2.42.A Median Paved Curb Skirt
    - 2.42.C Median Separated Bike Lane
    - 2.51 Bicycle Path Cross-Section
    - 2.61.A Non-Residential Street Cross-Section Examples
    - 2.61.B Non-Residential Street Cross-Section Examples
- Related to Chapter 3:
    - 3.01 Streetscape Tree Spacing and Location Drawing
    - 3.03 Tree Grate for Sidewalk Planting Drawing

Boulder Revised Code 9-9-7 Sight Triangles (see Attachment A)
The intent of the update to the Boulder Revised Code (BRC) is to consider changes to sightlines for improved safety for all travel modes. The specific section to be revised is 9-9-7.

Highlights of the **BRC 9-9-7 Sight Triangles** updates include:

15'x15' Sight Triangle	Update the location of where the sides of the sight triangle are measured when the public street has a sidewalk in the existing figure. Currently the sight triangle is measured along the right-of-way line of the public street and either the right-of-way line of the public alley or the edge of the private driveway and whose third side is a line connecting the two sides. **Anticipated benefit**: This change will provide staff with physical features to measure the sides of the sight triangle when responding to sight triangle complaints.
Multi-use path intersecting either an Alley or Driveway	Add a new figure with a 15' x 96' sight triangle. The sides of the new multi-use path sight triangle would be 15' x 96' with the third side of the sight triangle being the line that connects the two sides. **Anticipated benefit**: The 15' x 15' sight triangle is currently used where a multi-use path (path) intersects with either a driveway or alley. The new sight triangle increases the sight triangle area between the path and either a driveway or alley.

Boulder Revised Code 6-6 Protection of Trees and Plants (see Attachment A)

The intent of the update to this section of the BRC is to clarify the protection of trees and plants on any city property or right-of-way to include prohibitions on damage to such material and provide a financial remedy for any damaged tree(s) or plant(s).

ATTACHMENTS

Attachment A - Proposed Ordinance 8560
Attachment B - Proposed Ordinance 8561
Exhibit A to Proposed Ordinance 8561 - Markup of Chapter 2 DCS Amendments
Exhibit A to Proposed Ordinance 8561 - Markup of Chapter 3 DCS Amendments
Exhibit A to Proposed Ordinance 8561 - Markup of Chapter 10 DCS Amendments
Exhibit A to Proposed Ordinance 8561 - Glossary
Exhibit B to Proposed Ordinance 8561 - Chapter 11 Drawing Revisions and Additions

ORDINANCE 8560

AN ORDINANCE AMENDING TITLE 6, "HEALTH, SAFETY, AND SANITATION," B.R.C. 1981, AND TITLE 9, "LAND USE CODE," B.R.C 1981, TO CLARIFY THE REQUIREMENTS FOR SIGHT TRIANGLES AND TREE PROTECTION IN CONJUNCTION WITH THE DESIGN AND CONSTRUCTION STANDARDS TRANSPORTATION STANDARDS UPDATE (PHASE 2); AND SETTING FORTH RELATED DETAILS.

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF BOULDER, COLORADO:

Section 1. Section 6-6-1, "Legislative Intent," B.R.C. 1981, is amended to read as follows:

6-6-1. Legislative Intent.

(a) The purpose of this chapter is to protect the public health, safety, and welfare by prescribing requirements for the protection of trees and plants within the city, including, without limitation, trees, shrubs, lawns, and all other landscaping.

(b) The city council finds that all trees, plants, and other landscaping located, standing or growing within or upon city property, including, without limitation, any city-owned or controlled street, alley, rights of way, or other public place or city or mountain park, recreation area or open space, belong to the city and are a community asset comprising a part of the public infrastructure.

(c) The city council finds that the protection, expansion, and maintenance of the urban forest is important to support community resilience. Preservation of trees is necessary for the continuity of the environmental, economic, social and human health services provided by the urban tree canopy. Continued maintenance ensures the health and value of individual trees and maximizes the services provided by this resource.

(d~~e~~) The city council finds that the requirements of this chapter are necessary to ensure the continued protection, maintenance, replacement, and management of city-owned trees, plants, and other landscaping.

Section 2. Section 6-6-4, "Planting in Public Areas," B.R.C. 1981, is amended to read as

follows:

6-6-4. Planting in Public Areas.

(a) No person shall plant in or remove from any city property any plant or tree without first obtaining written permission from the city manager to do so.

(b) No person shall plant in or remove from any public right of way or public easement any plant or tree without complying with the requirements set forth in Chapter 8-5, "Work in the Public Right of Way and Public Easements," B.R.C. 1981.

(c) The planting, maintaining, relocating, or removing of any tree or plant located within any public right of way or public easement shall conform with the standards in the City of Boulder Design and Construction Standards.

(d) A property owner may plant trees along the streets of the city, fronting on such person's property, if the person plants the trees of the species, in the places, and in the manner set forth in the City of Boulder Design and Construction Standards or as designated by the city manager, between the gutter line and the property line. Planting trees within the tree lawn of a city street within city right-of-way requires written permission from the city manager as described in 6-6-4 (a) above.

Section 3. Section 6-6-6, "Protection of Trees and Plants," B.R.C. 1981, is amended to read as follows:

6-6-6. Protection of Trees and Plants.

(a) No person shall, remove, damage, or destroy any tree or plant growing within or upon any city-owned, city controlled property, or within or upon any public right of way without first having obtained written permission from the city manager or a permit pursuant to Chapter 8-5, "Work in the Public Right of Way and Public Easements," B.R.C. 1981. ~~No person shall remove, damage, or destroy any tree or plant growing within or upon any city owned or controlled property, except for public rights of way, without first having obtained written permission from the city manager.~~

~~(b) No person shall remove, damage, or destroy any tree or plant growing within or upon any public right of way without first having obtained a permit pursuant to Chapter 8-5, "Work in the Public Right of Way and Public Easements," B.R.C. 1981.~~

(~~e~~b) No person shall attach to or install on any tree or plant growing within or upon any ~~C~~city-owned or controlled property, including public rights-of-way, without first having obtained approval from the city manager, any metal material, sign, cable, wire, nail, swing or other material foreign to the natural structure of the tree, except materials used for standard tree care or maintenance, such as bracing and cabling, installed by tree professionals.

(~~d~~c) No person shall attach any electric insulator or any device for holding electric wires to any tree or plant growing or planted upon any city property. No person owning any wire charged with electricity running through public property shall fail to fasten such wire securely to a post or other structure so that it will not contact any plant. If the city manager determines it is necessary to prune or cut down any plant growing on city property in the City across which electric wires run, no person owning such wires shall fail to remove any such wire or to discontinue electric service within twenty-four hours after being notified by the manager of the scheduled pruning or cutting of the trees.

(~~e~~d) No person owning or operating a gas pipe or main within a radius of forty feet of any tree or plant shall fail to repair the same immediately if a leak occurs and stop such leak in order to protect the plant and the public health, safety and welfare.

(~~f~~e) No person shall perform any work or construction within or upon any City-owned property, public right of way or public easement without providing tree protection in conformance with the City of Boulder Design and Construction Standards.

(~~g~~f) No person shall engage in the business of cutting, pruning, removing or applying pesticides to any trees on public or private property within the City for commercial gain or profit without first obtaining from the city manager a license under this chapter.

Section 4. Section 6-6-7, "Mitigation of Trees or Plants Removed or Destroyed," B.R.C. 1981, is amended to read as follows:

6-6-7. Mitigation of Trees or Plants Removed or Destroyed.

No person shall remove, damage or destroy any tree or plant in the public right-of-way without first having a plan approved by the city manager for the mitigation of the loss of such tree or plant. The person who removed, damaged or destroyed tree or plant shall ~~be replaced~~ mitigate in an amount equivalent to the value, as determined by the city manager, of the tree, shrub or plant that existed prior to loss, by:

(a) Planting or transplanting an approved tree or plant of a species approved by the city ~~forester~~ manager that is the same ~~species and~~ size as previously existed in a location approved by the city manager; or

(b) Planting one or more approved trees or plants where the combined value equals or exceeds that which previously existed in terms of species, condition and size, in a location approved by the city manager; or

(c) Reimbursement ~~of~~ to the ~~C~~city for the value of the tree or plant removed or destroyed, subject to a determination by the city manager that the trees or plants lost could not be adequately replaced at or near the location where the loss occurred.

(d) All tree plantings required for the mitigation of a tree removed or destroyed from the public right of way shall be completed under the supervision of a certified arborist ~~that has~~ with a valid contractor license pursuant to chapter 4-28, "Tree Contractor License," B.R.C. 1981.

Section 5. Section 9-9-7, "Sight Triangles," B.R.C. 1981, is amended to read as follows:

9-9-7. Sight Triangles.

(a) Sight Triangle Required: Where a driveway intersects a public right-of-way or where property abuts the intersection of two public rights of way, the owner or occupant of the driveway or property shall provide unobstructed sight distance as described in subsections (c) through (e) of this section ~~shall be provided at all times~~ within the sight triangle area on the property adjacent to the intersection in order to ensure that safe and adequate sight distance is provided for the public use of the right-of-way.

(b) Obstruction Prohibited: No person shall place or maintain any structures, fences, landscaping, or any other objects within any sight triangle area described in subsections (c) through (e) of this section that obstructs or obscures sight distance visibility through such structures, fencing, landscaping, or other objects by more than twenty-five percent of the total view in the vertical plane above the sight triangle area between a height of thirty inches and ninety-six inches above the roadway surface, except for the following:

(1) Landscaping, structures, or fences that protrude no more than thirty inches above the adjacent roadway surface may be permitted within the sight triangle area.

(2) Trees may be planted and maintained within the sight triangle area if all branches are trimmed to maintain a clear vision for a vertical height of ninety-six inches above the roadway surface and the location of the trees planted, based on the tree species expected mature height and size, does not obstruct sight visibility by more than twenty-five percent of the sight triangle area.

(c) Sight Triangle Area: For purposes of this section, the sight triangle area for a driveway intersecting with the public right-of-way is:

(1) Driveways intersecting with a public street without a public sidewalk: The area formed at a corner intersection of public right-of-way and a driveway, whose two sides are fifteen feet, measured along the right-of-way line of the street and the edge of the driveway, and whose third side is a line connecting the two sides (see Figure 9-7 of this section).

(2) Driveways intersecting with a public street with a public sidewalk: The area formed at a corner intersection of a public sidewalk and a driveway, whose two sides are fifteen feet, measured along the edge of the public sidewalk and the edge of the driveway, and whose third side is a line connecting the two sides (see Figure 9-7a of this section).

(3) Driveways intersecting with a public street with a public multi-use path: The area formed at a corner intersection of a public multi-use path and a driveway, whose sides are measured ninety-six feet along the edge of the multi-use path and fifteen feet measured along the edge of the driveway, and whose third side is a line connecting the two sides (see Figure 9-7b of this section).

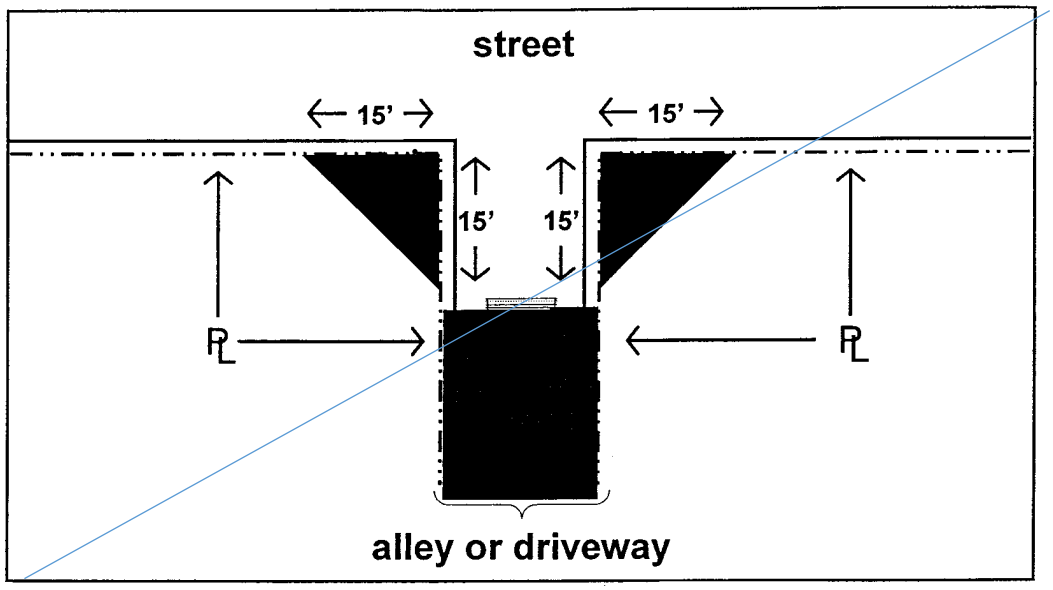
(d) Sight Triangle Area: For purposes of this section, the sight triangle area for an alley intersecting with the public right-of-way is:

(1) Alleys intersecting with a public street without a public sidewalk: The area formed at a corner intersection of an alley public right-of-way and a street right-of-way whose two sides are fifteen feet, measured along the right-of-way line of the alley and the right-of-way line of the street, and whose third side is a line connecting the two sides (see Figure 9-7 of this section); or

(2) Alleys intersecting with a public street with a public sidewalk: The area formed at a corner intersection of an alley and the public sidewalk, whose two sides are fifteen feet, measured along the edge of the alley and the edge of the public sidewalk, and whose third side is a line connecting the two sides (see Figure 9-7a of this section).

(3) Alleys intersecting with a public street with a public multi-use path: The area formed at a corner intersection of an alley and public multi-use path, whose sides are measured fifteen feet along the edge of the alley and ninety-six feet measured along the edge of the multi-use path, and whose third side is a line connecting the two sides (see Figure 9-7b of this section).

~~(2) Alleys: The area formed at a corner intersection of an alley public right-of-way and a street right-of-way whose two sides are fifteen feet, measured along the right-of-way line of the alley and the right-of-way line of the street, and whose third side is a line connecting the two sides (see Figure 9-7 of this section); or~~



~~**Figure 9-7: Sight Triangle Area at the Intersection of a Driveway or Alley and a Street (without a sidewalk or multi-use path)**~~

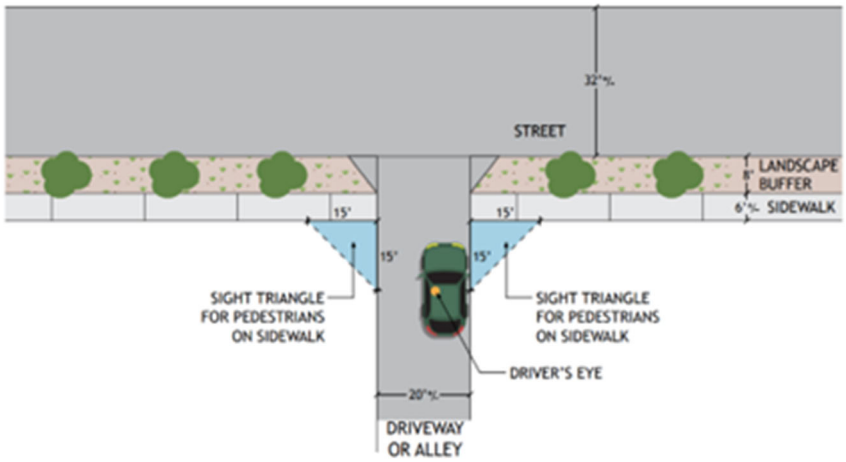


Figure 9-7a: Sight Triangle Area at the intersection of a Driveway or Alley and a Street with a sidewalk.

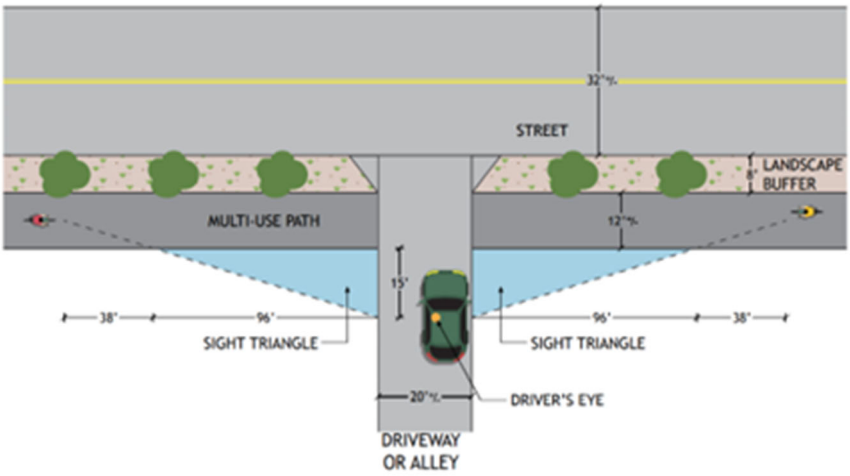
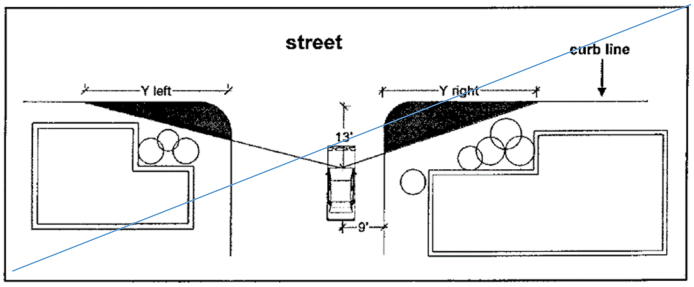


Figure 9-7b: Sight Triangle Area at the intersection of a Driveway or Alley and a Street with a multi-use path

(~~3~~e) Streets: The area formed at a corner intersection of two public rights-of-way lines defined by a width of dimension X and a length of dimension Y as shown in Table 9-9 and Figure 9-8 of this section. The Y dimension will vary depending on the speed limit and configuration of the intersecting street~~,~~ and is outlined in the table below. The X distance shall be thirteen feet measured perpendicular from the curb line of the intersecting street. This triangular area is significant for the determination of sight distance requirements for right angle intersections only.



~~**Figure 9-8: Sight Triangle at Intersection of Streets**~~

The shaded area is required to be kept free of all structures, fences, landscaping and other materials. The size of the sight triangle is based on the size of the road and speed limit, as shown in the table below.

TABLE 9-9: SIGHT TRIANGLE REQUIREMENTS

Lane Usage	Additional Facilities	Speed Limit	Y Distance (Left)	Y Distance (Right)

2 lanes	None	25 mph	155 feet	105 feet
		30/35 mph	210 feet	145 feet
	Bike lane or on-street parking	25 mph	110 feet	85 feet
		30/35 mph	150 feet	115 feet
	Bike lane and on-street parking	25 mph	90 feet	75 feet
		30/35 mph	125 feet	100 feet
3 or 4 lanes	None	25 mph	155 feet	80 feet
		30/35 mph	210 feet	110 feet
		40/45 mph	265 feet	135 feet
	Bike lane or on-street parking	25 mph	110 feet	65 feet
		30/35 mph	150 feet	90 feet
		40/45 mph	195 feet	115 feet
	Bike lane and on-street parking	25 mph	90 feet	60 feet
		30/35 mph	125 feet	80 feet
		40/45 mph	160 feet	100 feet
5 or more lanes	None	25 mph	155 feet	60 feet
		30/35 mph	210 feet	85 feet
		40/45 mph	265 feet	110 feet
	Bike lane or on-street parking	25 mph	110 feet	55 feet
		30/35 mph	150 feet	75 feet
		40/45 mph	195 feet	95 feet
	Bike lane and on-street parking	25 mph	90 feet	50 feet
		30/35 mph	125 feet	65 feet
		40/45 mph	160 feet	85 feet

(~~d~~f) Modifications: The requirements of this section may be modified by the city manager, pursuant to Section 9-2-2, "Administrative Review Procedures," B.R.C. 1981, if accepted engineering practice would indicate that a modified visibility distance, either greater or lesser, would be acceptable or necessary for the safety of pedestrians, motorists, and bicyclists.

(~~e~~g) Violations: No person shall violate or fail to prevent or remedy any violation of the provisions of this section on such property. When a violation of this section is observed, the city manager will provide a written notice to correct the condition to the property owner or occupant, whichever is applicable. Personal service of such notice or mailing such notice to the last known address of the owner of the premises by certified mail shall be deemed sufficient service. Any such notice shall describe the violation, describe the corrective measures necessary, and set forth a time limit for compliance, dependent upon the hazard created, which time limit shall not be less than seven days from the service of the notice.

(~~f~~h) Failure to Comply: In the event that there is failure to comply with the notice when the time limit prescribed therein has expired, the city manager may trim or cause to be trimmed, or otherwise remove the obstruction described in the notice. Such action shall not preclude any prosecution for violation of the terms of this section. The costs of such action shall be paid by the property owner, and, if not paid, may be certified by the city manager to the county treasurer for collection as taxes.

(~~g~~i) Public Nuisance: Notwithstanding any other provision in this section, any landscaping, structure, fence or other obstruction which the city manager deems as an immediate and serious danger to the public, is hereby declared a public nuisance and the property owner or occupant shall be trim~~med~~ or remove~~d~~ within twenty-four hours after notification by the city manager. If the property owner or occupant fails to do so, the city manager may trim or remove the nuisance. The costs of such action shall be paid by the property owner, and, if not paid, may be certified by the city manager to the county treasurer for collection as taxes

Section 6. This ordinance is necessary to protect the public health, safety, and welfare of the residents of the city and covers matters of local concern.

Section 7. The city council deems it appropriate that this ordinance be published by title only and orders that copies of this ordinance be made available in the office of the city clerk for public inspection and acquisition.

INTRODUCED, READ ON FIRST READING, AND ORDERED PUBLISHED BY TITLE ONLY this 17th day of November 2022.

_____
Aaron Brockett,
Mayor

Attest:

_____
Elesha Johnson,
City Clerk

READ ON SECOND READING, PASSED AND ADOPTED this 1st day of December 2022.

_____
Aaron Brockett,
Mayor

Attest:

_____
Elesha Johnson,
City Clerk

ORDINANCE 8561

AN ORDINANCE UPDATING TRANSPORTATION DESIGN STANDARDS BY AMENDING THE CITY OF BOULDER DESIGN AND CONSTRUCTION STANDARDS (D.C.S.), ORIGINALLY ADOPTED PURSUANT TO ORDINANCE 5986, AND SETTING FORTH RELATED DETAILS.

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF BOULDER, COLORADO:

Section 1. The city council herby repeals and re-enacts the following chapters of the *City of Boulder Design and Construction Standards,* originally adopted pursuant to Ordinance 5986 (and amended by Ordinance 7088, 7400, 7688, 8006, 8324, and 8370), to read as shown in **Exhibit A** attached to and hereby incorporated into this ordinance:

- Chapter 2, Transportation Design;
- Chapter 3, Streetscape Design and Tree Protection;
- Chapter 10, Streetscape and Landscape Standards; and
- Glossary.

Section 2. Chapter 11 of the *City of Boulder Design and Construction Standards* is further amended by the addition of technical drawings, as shown in **Exhibit B** attached hereto and incorporated into this ordinance.

Section 3. This ordinance is prospective in nature and shall apply to all technical document review and permit applications submitted to the city on or after the effective date of this ordinance. Technical document review applications are administrative in nature and the application date shall be the date that the fee required by Section 4-20-43, "Development Application Fees," B.R.C. 1981, has been paid. Complete site review and form-based code review applications that have been submitted to the city prior to the effective date of this

ordinance will be permitted to continue through the process under the standards in effect at the time such application is made. Such applicants shall be required to pursue such approvals and meet all requirements and deadlines set by the city manager and the Boulder Revised Code. Technical document review applications and permits applied for prior to the effective date of this ordinance may proceed under the standards in effect at the time of application. The city council intends that any project approved under the standards of the *City of Boulder Design and Construction Standards* effective prior to the effective date of this ordinance be built and otherwise constructed and maintained in accordance with those standards.

Section 4. The city council orders and directs the city manager to make any additional citation, reference, and formatting changes to the *City of Boulder Design and Construction Standards* not included in this ordinance that are necessary to properly implement these amendments to the *City of Boulder Design and Construction Standards*.

Section 5. This ordinance is necessary to protect the public health, safety, and welfare of the residents of the city and covers matters of local concern.

Section 6. The city council deems it appropriate that this ordinance be published by title only and orders that copies of this ordinance be made available in the office of the city clerk for public inspection and acquisition.

INTRODUCED, READ ON FIRST READING, AND ORDERED PUBLISHED BY TITLE ONLY this 17th day of November 2022.

_____
Aaron Brockett,
Mayor

Attest:

_____
Elesha Johnson,
City Clerk

READ ON SECOND READING, AMENDED, AND ADOPTED this 1st day of December 2022.

_____
Aaron Brockett,
Mayor

Attest:

_____
Elesha Johnson,
City Clerk

CITY OF BOULDER

DESIGN AND CONSTRUCTION STANDARDS

CHAPTER 2

TRANSPORTATION DESIGN

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

Number **Page**

2.01 General

(A) Intent

The Transportation Design Standards are intended to provide for an integrated transportation system for all transportation modes, including pedestrian, bicycle, transit, and motor vehicle.

(B) Transportation Master Plan

All improvements proposed to the city's transportation system shall conform with the goals~~,~~ and policies~~, and standards adopted~~ in the Transportation Master Plan (TMP).

(C) Reference Standards

Where not specified in these Standards or the B.R.C. 1981, to protect the public health, safety, and welfare, the Director of Public Works will specify the standards to be applied to the design and construction of transportation improvements and may refer to one or more of the references listed in the References Section of these Standards.

(D) Functional Street Classification

Public streets shall be designed and improved to conform to the applicable functional street classification as defined on the "Street Function Class and Proposed Street Facilities" map of the TMP.

2.02 Traffic Study

(A) Traffic Assessment

The Director will require an applicant to submit a Traffic Assessment in order to adequately assess the impacts of any development proposal on the existing and planned transportation system. The Assessment shall include a peak hour trip generation study projection (Refer to 2.03(J)) and may require additional information as determined by the Director.

(B) Traffic Study Requirements

For any development proposal where trip generation from the development during the peak hour of the adjacent street is expected to exceed 100 vehicles for nonresidential applications, or 20 vehicles for residential applications the Director will require an applicant to submit a Traffic Study to evaluate the traffic impacts of the development proposal. The Traffic Study may include the information required in Subsections (A) through (K), of Section 2.03, "Traffic Study Format," of these Standards at the discretion of the Director.

(C) Responsibilities for Traffic Studies

An applicant for construction approval shall be responsible for assessing all traffic impacts associated with a proposed development, with the c~~C~~ity serving in a review and approval capacity.

(D) Preparation

A Traffic Study shall be prepared by an Engineer with adequate experience and expertise in transportation engineering. The Engineer shall be identified in the Traffic Study.

(E) Coordination with City

Transportation consultants and Engineers preparing Traffic Studies shall discuss proposed development projects with the Director prior to initiating the study. Issues to be discussed include, without limitation, the TMP, definition of the study area, relevant subarea, area, and subcommunity plans, methods for projecting build-out volumes, background traffic conditions, trip generation, directional distribution of traffic, and trip assignment. These aspects of the Traffic Study shall be approved by the Director prior to study preparation.

(F) Submittal

A Traffic Study shall be prepared in conformance with, and including, the information required in Section 2.03, "Traffic Study Format," of these Standards.

2.03 Traffic Study Format

(A) Study Requirements

The information provided in the Traffic Study shall include the following sections as outlined below. The study shall be typed and bound, and clearly identify the data and information in the appropriate sections. In addition, the study shall contain a table of contents, lists of figures, and tables, and shall identify any map pockets and included drawings.

(B) Introduction

The Traffic Study shall provide an introduction with an overview and discussion of the project or development proposal.

(C) Site Location and Zoning

Include a vicinity map detailing the property location, a conceptual site plan reflecting the boundaries of the project or development, and information detailing the designated zoning district, general terrain and physical features of the site and the surrounding area.

(D) Study Area Boundaries

Include the Study Area Boundaries as determined based on discussions with the Director and include all roadways and transportation routes providing access to the site and the surrounding transportation system.

(E) Existing Area Street System Description

Describe and include roadway orientations, functional classifications and geometries, intersection geometries, and traffic controls, including without limitation signage and striping, speed limits, parking restrictions, sight distance, transit routes, the presence of bicycle and pedestrian facilities,

and any other related traffic operations information and improvements approved or planned by government agencies. For identified improvements scheduled by government agencies, include the nature of the improvements, extent, implementation schedule, and the agency or funding source responsible.

(F) Existing and Projected Roadway and Intersection Traffic Volumes

Include diagrams that map existing traffic volumes, and each variation of projected traffic volumes, for all roadways and intersections within the study area. Also provide diagrams that map the intersection and roadway geometries and traffic control within the study area.

(G) Existing and Proposed Site Uses

Include an identification of the existing land use and proposed land use or the highest potential land use based on zoning and maximum trip generation where a specific use has not been determined. If rezoning is proposed, the study shall provide a comparison between the highest trip generation uses for the existing zoning and the highest trip generation uses for the proposed zoning.

(H) Existing and Proposed Land Uses in Vicinity of the Site

Document any vacant land or potential redevelopment that may result in a change in traffic volume conditions within the study area during each time period studied. Perform and provide trip generation on these parcels and include the trips generated from these parcels in the trip volume diagrams and level of service analyses for each appropriate time period studied.

(I) Transportation Demand Management Strategies

Include an outline of transportation demand management strategies to mitigate traffic impacts created by proposed development and implementable measures for promoting alternate modes of travel, including but not limited to the following:

(1) **Site Design:** Incorporate design features that facilitate walking, biking, and use of transit services to access a proposed development, including features such as transit shelters and benches, site amenities, site design layouts, orientations and connections to increase convenience for alternate modes and reduce multiple trips to and from the site, and direct connections to existing offsite pedestrian, bicycle, and transit systems.

(2) **Programs and Education:** Incorporate alternate modes programs, such as providing transit passes to employees and residents, van pooling to the site by a major employer, ride-sharing, parking pricing, and planned delivery services, and educational measures such, as promoting telecommuting, distributing transit schedules and trails maps, signing alternate travel routes, and providing an onsite transportation coordinator or plan to educate and assist residents, employees, and customers in using alternate modes.

(J) Trip Generation

Traffic estimates for the proposed project and potential developed or redeveloped properties in the study area shall be obtained by performing trip generation using the procedures outlined in the most current edition of the *Trip Generation Manual* of the Institute of Transportation Engineers

(ITE). If adequate *Trip Generation Manual* data is not available for a specific land use, the procedures used to estimate trip generation data shall be approved by the Director. Include the following specific trip generation information:

(1) **Summary Table:** List each land use that requires trip generation analysis, including the project plus developed or redeveloped land uses within the study area. For each trip generation summary include land use type, amount, intensity, average trip generation rates for total daily traffic and peak hour traffic (a.m., noon and/or p.m. peak hour traffic generation may be required), and the resultant total trips generated for each time period and each land use.

(2) **Calculations:** Calculation of projected trip generation for any land use, used to determine study area impacts, shall be based on the following:

(a) Trip generation formulas (or rates, if formulas are not available) published in the most recent version of the *Trip Generation Manual*. Trip generation reports from other industry publications may be considered but are subject to the approval of the Director.

(b) A local trip generation study, following procedures outlined in the most recent version of the *Trip Generation Manual*, if no published rates are available and similar land uses can be studied.

(c) Additional data or studies from other similar jurisdictions. Trip generation obtained in this fashion is subject to the review and approval of the Director.

(3) **Trip Generation Reductions:** Credit for any trip reductions is subject to review and approval in advance by the Director. Anticipated trip reduction assumptions should be discussed and approved by the Director prior to the preparation of the Traffic Study. Trip reductions typically fall into one of two categories: those that reassign some portion of the trip generation from the surrounding roadway network (passerby and diverted trip reductions), and those that remove trips generated from the land use trip generation (internal and modal split reductions).

(a) Use of passerby and diverted trip reductions may be evaluated and considered in reducing the additional estimated total trip generation of a new land use. However, passerby and diverted trip reduction factors are not to be applied directly to reduce trip generation and turning movement volumes at driveways serving the studied land use. These factors are subject to the approval of the Director.

(b) Internal trip reductions and modal split assumptions may reduce the total trip generation of a land use. These factors considered in the Traffic Study shall supply analytical support and detailed documentation to demonstrate how the estimates were derived and incorporated and are subject to the approval of the Director.

(K) Trip Distribution/Assignment and Modal Split

Trip distribution/assignment of any generated traffic estimates shall be clearly summarized and illustrated for each access route entering and exiting the generating land use, using the study area transportation system as a basis. Include the following specific trip distribution/assignment information:

(1) **Trip Distribution:** The trip distribution for each site shall be identified and illustrated with a graphical figure detailing the percentages making each movement, at each intersection in the study area. The trip distribution shall be logically based upon factors such as the site's location within the c~~C~~ity's existing traffic volume data in the study area, market analyses, applied census data, and/or professional engineering judgment. Trip distribution assumptions are subject to the approval of the Director.

(2) **Trip Assignment:** Trip assignment shall be done by applying the trip generation totals for each time period studied, to the trip distribution percentages developed. The trip assignment shall develop anticipated traffic volumes for each of the movements identified by the trip distribution and each of the time periods identified in the analyses. The resulting traffic volumes shall be illustrated with graphical figures detailing the anticipated volumes making each movement, at each intersection in the study area, during each time period studied.

(L) Existing and Projected Traffic Volumes

(1) **Traffic Volume Scenarios:** Five traffic volume scenarios and three separate times of the day may be required to be included in a Traffic Study analysis. The applicant shall meet with the Director to determine the scenarios and time periods to be studied, prior to the development of the Traffic Study. The number of scenarios and time periods to be studied are subject to the approval of the Director. The potential scenarios and time periods include the following:

(a) Scenario 1 - Existing Conditions: An analysis of existing traffic conditions will be required in the Traffic Study. Existing Conditions analysis should attempt to model traffic conditions at the time the Traffic Study is being prepared. Traffic counts that are older than the year the study is being prepared shall be factored up or adjusted to existing year volumes.

(b) Scenario 2 - Anticipated Project Completion Year Without Project Volumes: Include an analysis of the anticipated traffic conditions during the year the project is intended to be finished and traffic is generated. The analysis shall anticipate the increase in background traffic volumes and the generation of other related projects that are not present in the existing condition, but would likely be completed and generating trips in this time period. The trip generation for the proposed project shall not be included in this scenario. If the project is intended to be completed the same year that the Traffic Study is being prepared, then this scenario is the same as Scenario 1 - Existing Conditions.

(c) Scenario 3 - Anticipated Project Completion Year With Project Volumes: This scenario is the same as Scenario 2, except that the project volumes are assigned

to the roadway network and included in the analyses.

(d) Scenario 4 Future Buildout Conditions Without Project Volumes: An analysis of the anticipated traffic conditions during buildout, using the projected buildout year defined in the c~~C~~ity's TMP. The analysis shall anticipate the increase in background traffic volumes and the generation of other related projects that are not present in the existing condition, but would likely be completed and generating trips in this time period. The trip generation for the proposed project should not be included in this scenario.

(e) Scenario 5 Future Buildout Conditions With Project Volumes: This scenario is the same as Scenario 4, except that the project volumes are assigned to the roadway network and included in the analyses.

(2) **Traffic Volume Projections:** The traffic volume projections shall identify existing and projected daily traffic counts and peak hour turning movement counts for each access point, intersection and street identified in the Traffic Study area for each of the aforementioned scenarios required in the study.

(3) **Time Periods:** Each scenario may be required to look at three different time periods (the a.m., noon and p.m. peak hour conditions). The Director will determine which time periods and scenarios are required for each Traffic Study depending upon the project's size, location, types of land uses and other pertinent factors.

(4) **Raw Traffic Count Data:** Include all raw traffic-count data for average daily and peak hour conditions and traffic analysis worksheets in the appendices of the Traffic Study for reference. Computer techniques and associated printouts may be used for this part of the report.

NOTE: All total daily traffic counts must be actual machine counts, not based on factored peak hour sampling. Latest available machine counts from the c~~C~~ity, and other agencies, may be acceptable if not more than 2 years older than the year the Traffic Study is being prepared. Data older than the year the Traffic Study is being prepared shall be factored up to current year numbers, using growth rates approved by the Director.

(M) Transportation Service Standards

Include a discussion and analysis assessing the impacts of the project or development proposal on the existing and planned transportation system in the study area with respect to the following traffic impact and mitigation objectives:

(1) **Transportation Master Plan Objectives:** TMP service standards' objectives include the following:

(a) No long-term growth in auto traffic over current levels described as a 0 percent increase in vehicle miles traveled.

(b) Reduction in single occupant vehicle travel to 25 percent of total trips.

(c) Continuous reduction in mobile source emission of air pollutants, and no more than 20 percent of roadways congested at LOS F.

(2) **Level of Service Design Guide:** LOS standards objectives include:

(a) Minimum LOS D design guide for peak hour conditions for all movements. Project impacts that maintain LOS D or better for all intersections and street segments may not be required to provide LOS-related traffic mitigation improvements.

(b) LOS E and lower peak hour conditions require the implementation of one or more transportation management strategies consistent with the goals and objectives of the TMP. A transportation management strategy plan required to address and mitigate these conditions may include travel demand management, land use intensity reduction, site design, layout and access modifications, parking reduction measures, or transportation infrastructure improvements.

(N) Level of Service Analysis

(1) The Traffic Study shall provide LOS analyses for all study area intersections (signalized and unsignalized) and mid-block roadway segments using methodologies outlined in the current *Highway Capacity Manual*. The analyses should be performed for Scenarios 1 through 5, described in Section 2.0 3(L), "Existing and Projected Traffic Volumes," and for each time period (a.m., noon and/or p.m. peaks) that is required in the Traffic Study, unless otherwise required by the Director.

(2) Level of service analyses shall consider the appropriate infrastructure, lane usage, traffic control and any other pertinent factors for each scenario to be studied. Intersections with planned improvements, discussed in c~~C~~ity planning documents, may have those improvements shown in the level of service analyses.

(3) Signalized intersection level of service analyses shall use the existing timing and phasing of the intersections for all scenarios. If the analyses are to deviate from existing timings or phasing, then a detailed signal progression analyses for the affected corridor shall also be provided.

(4) The results of the level of service analyses for each scenario and each time period shall be summarized into one or more tables that illustrate the differences in level of service for each scenario. At a minimum, these tables shall list the level of service results for each intersection to include the level of service for each approach and the total intersection level of service, as well as the appropriate delay values for each approach and the total intersection. These tables shall highlight any locations where the addition of project traffic has caused any approach of any intersection to fall below the LOS D standard for the c~~C~~ity.

(O) Traffic Counts and Analyses Worksheets

Provide capacity analysis calculations based on the planning or operational analysis techniques

contained in the current *Highway Capacity Manual* or subsequent highway capacity techniques established by the Federal Highway Administration, including the following:

(1) **Raw Traffic Count Data:** Include all raw traffic count data for average daily, hourly Average daily trip (ADT), and peak hour conditions and traffic analysis worksheets in the appendices of the Traffic Study for reference. Computer techniques and associated printouts may be used for this part of the report.

(2) **Level of Service Analyses:** Include all level of service analyses performed for intersections and roadway links. If signal timing or phasing changes are proposed for traffic mitigation and the signal is currently part of a coordinated system, a progression analysis will be required to ensure that adequate progression is maintained or provided. All progress analysis and assumptions to be used shall be reviewed and approved by the Director.

(P) Traffic Control and Signals

The Traffic Study shall discuss and analyze any traffic control measures that may be necessary to serve a proposed project or development. Any traffic control measures are to be evaluated based on the requirements established in the *Manual on Uniform Traffic Control Devices* (MUTCD) and by the c~~C~~ity, and will be applied as necessary to ensure safe and efficient operation of the c~~C~~ity's transportation system. The analysis shall demonstrate the need for traffic control measures considering the objectives and policies of the TMP and alternative site designs in order to minimize or mitigate traffic impacts from the proposed project or development. The following traffic control measures are to be addressed:

(1) **Regulatory Signage, Markings and Islands:** These traffic control measures shall be applied as necessary in conformance with the MUTCD and c~~C~~ity standards and policies.

(2) **Traffic Signals:** The installation of new traffic signals is not encouraged by the c~~C~~ity and all possible alternatives to signalization shall be evaluated before the installation of a new traffic signal will be considered. The need for new traffic signals will be based on warrants contained in the MUTCD and on c~~C~~ity policies. In determining the location of a new signal, safety and community traffic circulation and progression will be the primary considerations. If a traffic signal is suggested as part of a mitigation package, and the intersection lies within a series of coordinated traffic signals, then a progression analysis may be required to ensure that adequate progression may still be provided. Generally, a spacing of one-half mile between all signalized intersections is to be maintained, to achieve optimum capacity and signal progression. Pedestrian and bicycle movements shall be considered in all cases and adequate pedestrian clearance is to be provided in the signalization design.

(3) **Intersection and Access Locations:** To provide flexibility and safety for the existing roadway system and to ensure optimum two-way signal progression, an approved traffic engineering analysis shall be made to properly locate all proposed intersections that may require signalization, and any accesses to the proposed development.

(Q) Traffic Crashes

The Traffic Study may need to include crash analyses at one or more locations in the study area. The Director shall specify whether such crash analyses are needed for each Traffic Study. Where required, estimates of increased or decreased crash potential shall be evaluated for the proposed project or development and appropriate safety related mitigation measures are to be included. Traffic crash data is available through the Sate Streets Report and from the City of Boulder's Police Department or from the Director.

(R) Noise Attenuation

If residential development is planned adjacent to a roadway designated collector or greater, the c~~C~~ity may require noise attenuation measures. A discussion and analysis of noise attenuation measured using the methods in the *Fundamentals and Abatement of Highway Traffic Noise Textbook* is to be included in all traffic studies for residential developments adjacent to roadways designated collector or greater.

(S) Recommendations

(1) The Traffic Study shall include a section in the report that provides any recommendations of the Engineer. These recommendations shall include the Engineer's recommended location, nature and extent of proposed transportation improvements associated with the project or development to ensure safe and efficient roadway operations and capacity, and compatibility with the c~~C~~ity's transportation system and the goals of the TMP.

(2) These recommendations are to be supported with appropriate documentation and discussion of the technical analyses, assumptions and evaluations used to make the determinations and findings applied in the Traffic Study. In the event that any Traffic Study analyses or recommendations indicate unsatisfactory levels of service on any study area roadways, a further description of proposed improvements or mitigation measures to remedy deficiencies shall be included.

(3) These proposed improvements or mitigation measures may include projects by the c~~C~~ity or ~~T~~the Colorado Department of Transportation for which funds have been appropriated and obligated. These proposals may also include improvements to be funded and constructed by the applicant as part of project or development construction. Assumptions regarding future roads, widths and lane usages in any analyses are subject to the approval of the Director.

(4) In general, the recommendation section shall include:

(a) Proposed and Recommended Improvements: Provide a detailed description and sketch of all proposed and recommended improvements. Include basic design details showing the length, width and other pertinent geometric features of any proposed improvements. Discuss and ~~abalyze~~analyze whether speed ~~chage~~change lanes are necessary to serve a project of development adjacent to a collector or arterial street. Discuss whether these improvements are necessary because of development traffic or whether they would be necessary due to background traffic. Specify the approximate timing necessary for each

improvement.

(b) Level of Service Analysis at Critical Points: Provide another iteration of the LOS analyses that demonstrate the anticipated results of making recommended improvements, such as movement LOS, operational and safety conditions, and conformance with the cCity's transportation system goals and TMP. In association with LOS analyses for recommended improvements, include a comparison of these results with the background LOS analyses without the proposed project or development. Where appropriate, this step is to be provided for both near term (year of project completion) and buildout scenarios.

(T) Conclusion

Include a conclusion in the report that provides a clear and concise description of the study findings and recommendations and serves as an executive summary.

(U) Revisions to Traffic Study

(1) Following cCity review, the Director may require revisions to a Traffic Study based on the following considerations:

(a) Completeness of the study,

(b) Thoroughness of the level of service and impact analyses and evaluations,

(c) Compatibility of the study with the proposed access design, project or development plan and local transportation system,

(d) Compliance with local and state regulations and design standards, and

(e) An analysis of study deficiencies, errors, or conflicts.

(2) Revisions may also be required as a result of public process with surrounding neighborhoods and land uses or review by City Council or the Planning Board. Additional details requiring Traffic Study revisions may include, but are not limited to, the following:

(a) An enlarged study area,.

(b) Alternative trip generation scenarios,.

(c) Additional level of service analyses, and.

(d) Site planning and design issues.

2.04 Site Access

(A) Access Requirements

All accesses and curb cuts shall be designed and constructed in compliance with these Standards and the requirements set forth in Section 9-9-5, "Site Access Control," B.R.C. 1981.

(B) Access Permit Required

All accesses and curb cuts proposed and constructed on c~~C~~ity streets and alleys require a permit, as set forth in Section 9-9-5, "Site Access Control," B.R.C. 1981.

(C) Location of Access

(1) **Spacing:** Table 21, "Access Spacing Requirements," shows the required spacing of access points and curb cuts. Minimum spacing from corners shall be measured from point of intersection of the street flowlines. Minimum spacing between accesses shall be measured at the property line.

Table 2-1: Access Spacing Requirements

Minimum Spacing (measured from edge of access)	Single Family Residential	Other Residential	Commercial	Industrial
Local Streets				
- from property line	7.5'	10'	10'	10'
- from corner	20'	50'	50'	50'
- between accesses	15'	20'	20'	20'
Collector Streets	Permitted only when no other access is available.			
- from property line		10'	10'	10'
- from corner		50'	50'	50'
- between accesses		20'	20'	20'
Arterial Streets	Permitted only when no other access is available.			
- from property line		75'	75'	75'
- from corner		150'	150'	150'
- between accesses		250'	250'	250'

(2) **Alignment:** Accesses shall intersect c~~C~~ity streets at a 90-degree angle. Accesses to properties on opposite sides of a collector or arterial, where turning movements are not controlled by a center median or access island, shall either be aligned, or offset by at least 150 feet on collectors, or at least 300 feet on arterials. Greater offsets may be required if left-turn storage lanes are required.

(3) **Relocation of Existing Access Points and Curb Cuts:** Relocation, alteration, or reconstruction of any existing access points and curb cuts shall meet the requirements of these Standards.

(D) Sight Distance

All access points and curb cuts shall provide adequate sight distance as set forth under Section

9-9-7, "Sight Triangles," B.R.C. 1981.

(E) Restriction of Turning Movements

Along streets designated arterial or greater, or where necessary for the safe and efficient movement of traffic, the cCity will require access points and curb cuts to provide for only limited turning movements, as follows:

(1) **Access With Barrier Island - Left-Turn Restrictions ("**Pork Chop**"):** Where restricted turning movements are required by the cCity, and where the abutting street does not have a median, a barrier island will be required:.

(a) Islands shall have a minimum area of 150 square feet, be bounded by vertical curb, and have an appropriate concrete center surface treatment, approved by the Director.

(b) Barrier island lanes shall be at least 12 feet wide, have a radius of at least 20 feet, and be designed to accommodate the largest vehicle using the access on a daily basis. The island shall provide congruent curb ramps or cut through for sidewalks. The pedestrian crossing over the barrier island shall be raised. The dimensions of a raised crossing shall be designed considering standards for accessible design and site conditions, including topography, stormwater flow, and location of utilities. The minimum width of the island along the abutting roadway frontage shall be 30 feet for right-in, right-out only islands, and 15 feet for islands allowing right-in, right-out and left-turning movements.

(2) **Access With Median Divider Barriers – Left-Turn Restrictions:** Median barriers may be permitted where a median design can improve traffic circulation and safety, or overall site access. Where permitted, medians shall be at least 4 feet wide, and shall extend at least 25 feet beyond the right-of-way.

(F) Traffic Control

All accesses shall be designed and constructed with appropriate traffic control and signage conforming to the MUTCD, B.R.C. 1981, and these Standards.

(G) One-Way Access Lanes

One-way access lanes may be permitted where restricted access is limited to one turning movement, or where the one-way access improves traffic circulation and safety. One-way access lanes shall be at least 12 feet wide, have at least radius of 20 feet, and be designed to accommodate the largest vehicle using the access on a daily basis.

(H) Speed Change Lanes

Speed change lanes shall be required on Colorado state highways as designated in the Colorado State Highway Access Code in accordance with the standards of Section 4.8 of the Colorado State Highway Access Code. For all collectors or arterials that are not Colorado state highways, the Traffic Study shall make recommendations on the need for speed change lanes, based on the criteria contained in the Colorado State Highway Access Code. When required by the Director

based on the criteria in the Colorado State Highway Access Code, design of speed change lanes shall conform with Subsection 2.07(D), "Horizontal Alignment," of these Standards.

(I) Access and Curb Cut Type

(1) **Driveway Ramp and Curb Cut:** All new accesses and curb cuts shall be designed as driveway ramps and curb cuts, using the standard ramp driveway details provided in Chapter 11, except as allowed in Subsection (2), along streets where no curb and gutter exists, or for single family lots where roll-over curbs have been provided.

(2) **Radii Curb Returns:** Radii curb return accesses may be required or permitted by the Director under the following conditions:

(a) The access is located along an arterial or collector.

(b) Access volumes indicate a need for a radii curb return where the ADT exceeds 500 or where speed change lanes would be required.

(c) The access is designed to restrict turning movements, requiring the installation of an access island or center median.

(d) The roadway has no curb and gutter.

(e) The access serves an industrial property, or provides for commercial deliveries, where large truck movements are required.

(f) The Director determines that a radii access is necessary to ensure adequate traffic safety and operation.

(g) The access is for a new public street

Table 2-2: Access Design Specifications

	Single Family Residential	Other Residential	Commercial	Industrial
Width (in feet)				
- Minimum	10	10	15	20
- Maximum	20	35	35	35
- One-Way Lane	N/A	12-18	12-20	14-24
Radii (in feet)				
- Minimum	N/A	15	15	20
- Maximum	N/A	30	30	40
Access Grades				
Initial Grade (to a point 10 ft beyond ROW)				
- Minimum	(+) 3%	(+) 1%	(+) 1%	(+) 1%
- Maximum	(+) 8%	(+) 6%	(+) 6%	(+) 6%
Final Grade (G2)				
- Minimum	(+/-) 3%	(+/-) 1%	(+/-) 1%	(+/-) 1%
- Maximum	(+/-) 14%	(+/-) 8%	(+/-) 8%	(+/-) 8%
Max Grade Break	(+/-) 10%	(+/-) 6%	(+/-) 6%	(+/-) 6%

(J) Access and Curb Cut Width

Access and curb cut widths shall be consistent with Table 2-2, "Access Design Specifications," of

these Standards. Access design for Colorado state highways shall conform to the Colorado State Highway Access Code. All other access widths shall be determined using turning templates, as designated by the Director, for a 10 MPH design speed for the largest vehicle expected to use the access on a daily or routine basis. The width of each access shall be the minimum width that is necessary to serve the property and use. No more than 50 percent of the street frontage shall be occupied by the access driveway, except for access to a cul-de-sac or flag lot. All access widths are measured from edge of pavement to edge of pavement (or curb to curb) at the throat of the driveway (or edge of the right-of-way~~), and~~) and are not inclusive of drive cut transitions or curb return radii.

(K) Access and Curb Cut Radii

Access and curb cut radii shall meet the specifications shown in Table 2-2, "Access Design Specifications," of these Standards. All radii are measured from the flowline (front face of the curb) or from the edge of the pavement where no flowline exists.

(L) Access and Curb Cut Grades

Access and curb cut grades shall be consistent with Table 2-2. The initial grade (G1) shall be a positive grade, beginning at the back of the sidewalk, the back of the driveway ramp or pan section, or the edge of the pavement (where no curb and gutter exists), and shall continue at least 10 feet beyond the right-of-way. The final grade (G2) may be positive or negative, depending on the access conditions. The maximum grade break (or change in slope) shall apply at all grade changes. Additional grade changes may occur at intervals of at least 20 feet.

(M) Driveways

(1) **Vehicle Storage:** Adequate driveway storage capacity for both inbound and outbound vehicles to facilitate safe, unobstructed, and efficient traffic circulation and movements from the adjacent roadway and within the development shall be provided, except for single-family or duplex residential driveways on local streets. Adequate driveway length will be subject to approval by the Director and shall extend at least 24 feet beyond the right-of-way before accessing the first off-street parking space or parking lot aisle.

(2) **Internal Circulation:** Developments requiring off-street parking facilities shall provide onsite vehicular circulation allowing access to all portions of the site without using the adjacent street system unless a joint access or parking easement with one or more of the adjacent property owners has been dedicated.

(3) **Backing Into the Right-of-Way Prohibited:** Driveways shall be designed to contain all vehicle backing movements onsite, except for single family or duplex residential uses on local streets.

(4) **Minimum Back-Up Distance for Detached Single-Family Residential Driveways Accessing Public Alleys:** Driveways shall provide for a minimum distance of 24-feet from the rear of the parking stall or face of garage to the far edge of the adjacent alley right-of-way or turn around area as required by Chapter 9-9-6, "Parking Standards," B.R.C. 1981.

(5) **Shared Driveways (Detached Single-Family Residential Only):** Shared driveways to access detached single-family residential lots may be permitted pursuant to an approved site review or subdivision as set forth in Chapter 9-9-14, "Site Review," B.R.C. 1981 or Chapter 9-12, "Subdivision," B.R.C. 1981, if they meet the following criteria:

(a) A common parking court is provided at a ratio of 0.5 additional spaces per unit if less than two onsite parking spaces, meeting c~~C~~ity requirements, are provided on each single-family lot served by the shared driveway.

(b) The shared driveway is no more than 100 feet long, except in districts zoned RL-1 (Residential-Low 1), RE (Residential-Estate), and RR1 (Residential-Rural 1) and RR 2 (Residential-Rural 2), where the shared driveway may extend up to 300 feet long if each lot accessing the shared driveway exceeds 10,000 square feet.

(c) The number of units served shall be no more than three lots or houses that have less than 30 feet of usable frontage on the accessing street.

(d) Adequate turnaround for vehicles is provided either on an individual lot or lots.

(e) The driveway is properly engineered and constructed to mitigate any adverse drainage conditions and is appropriately surfaced for the type of development, usage, and zoning district.

(f) The driveway is at least 12 feet wide.

(g) For units not fronting on the accessing street, addressing shall be located near the entrance to the shared driveway insuring visibility of the numbering from the street.

(h) A public access easement, a minimum fifteen feet in width, for the benefit and use of all properties and property owners accessing the shared driveway has been dedicated and recorded to ensure legal access rights in perpetuity for each property served.

(i) Driveway spacing conforms with the requirements in Table 21, "Access Spacing Requirements," of these Standards.

2.05 Right-of-Way Requirements

Dedication or reservation of public right-of-way required as part of any project or development proposal shall comply with the requirements set forth in Section 9-9-8, "Reservations, Dedication, and Improvement of Rights-of-Way," B.R.C. 1981.

2.06 Base Street and Alley Standards

(A) Base Street Standard

Except for residential streets approved pursuant to Chapter 9-12, "Subdivision," B.R.C. 1981, and Section 2.09, "Residential Streets," all new streets shall provide at a minimum the base street standard components listed in Table 2-3, "Base Street Standard Components."

(B) Base Alley Standard

Except for residential streets approved pursuant to Chapter 9-12, "Subdivision," B.R.C. 1981, and Section 2.09, "Residential Streets," all new alleys shall provide at a minimum the base alley standard components listed in Table 2-4, "Base Alley Standard Components."

Table 2-3: Base Street Standard Components

Street Component	Base Standard
Right-of-Way	60' Minimum Width
Paved Street Section	36' Minimum Width, Curb Face to Curb Face
Travel Lanes	Two Travel Lanes, Two-Way Traffic
Curb and Gutter	Required Both Sides
Parking	Parking Allowed Both Sides
Sidewalks	6' Preferred Width (5' Minimum), Detached, Required Both Sides
Streetscape Planting Strips*	8' Width Required Both Sides

*NOTE: In commercial streetside retail zones where 12foot wide attached sidewalks may be provided, streetscape planting strips may be created using street trees in planting pits with tree grates (15-foot width between back of curb and back of walk).

Table 2-4: Base Alley Standard Components

Alley Component	Base Standard
Right-of-Way	20' Minimum Width
Paved Street Section	18' Minimum Width, Pavement Edge to Pavement Edge
Travel Lanes	Two-Way Traffic Allowed
Parking	Parking on Alley Not Permitted

2.07 Street Geometric Design

(A) Minimum Requirements

Except for State Highways and the geometric design variations allowed for residential streets approved pursuant to Chapter 9-12, "Subdivision," B.R.C. 1981, and Section 2.09, "Residential Streets," all city streets shall be designed in conformance with this section. The design standards outlined in this section are minimum design standards, and all street design shall meet or exceed these standards. On streets designated collector or arterial in the TMP, the Director may specify standards to be applied to street design that may exceed the minimum standards in this section based on functional need to ensure safe and efficient operation of the street.

(B) Right-of-Way

The right-of-way width required for new streets shall comply with the requirements of Section 9-9-8, "Reservations, Dedication, and Improvement of Rights-of-Way," B.R.C. 1981, and shall include without limitation the following elements:

(1) The paved roadway section including without limitation travel lanes, turning and speed change lanes, transit lanes, bicycle lanes, and parking lanes;

(2) Curbs and gutters or drainage swales;

(3) Roadside and median landscaping areas;

(4) Sidewalks and multi-use paths; and

(5) Any necessary utility corridors.

(C) Lane Width

Street lanes shall meet the ~~minimum~~ width specifications shown in Table 2-5, "~~Minimum and~~ ~~1~~Preferred Street Lane Widths," of these Standards.

Table 2-5: Preferred Street Lane Widths

Design Criteria		Street Characteristics		
		With Parking Lane	No Parking Lane	With Fixed-Route Bus Transit Service and No Parking Lane
		Preferred	Preferred	Preferred
General Purpose Travel Lanes*		10'	10'	1~~2~~1' (Outside lane)
Auxiliary Lanes*		10'	9'	10'
Conventional Bike Lanes		7'	6.5'	7'
Contra-Flow Bike Lanes (On One-Way Streets)		7'	6.5'	N/A
Buffered Bike Lanes	Bike Lane	7'	6.5'	6'
	Buffer	3'	3'	2'
Separated Bike Lanes	Bike Lane	7' (for parking protected bike lanes, a painted 3' buffer is between curbside of parking lane and bike lane)	7'	7'
	Buffer	3~~'~~' (with vertical element)	3~~'~~' (with vertical element)	3~~'~~' (with vertical element)

Two-Way Separated Bike Lanes	**Bike Lane**	12’ Two-way bike lane (for parking protected bike lanes, a painted 3’ buffer is between curbside of parking lane and bike lane)	12’ Two-way bike lane (buffer is between curbside of parking lane and bike lane)	N/A
	Buffer	3’’ (with vertical element)	3’’ (with vertical element)	N/A
Parking Lanes		8’ (measured from curb face, including gutter pan)	N/A	8’ (measured from curb face, including gutter pan)

*NOTES: Travel, auxiliary lane and bike lane dimensions do not include gutter pan width. Auxiliary lanes include, without limitation, turning and speed change lanes.

~~Table 2-5: Minimum~~ and Preferred ~~Street~~ Lane Widths

~~Design Criteria~~	~~Travel Lanes *~~	~~Auxiliary Lanes*~~	~~Conventional Bike Lanes~~~~On Street Bike Lanes~~	~~Buffered Bike Lanes~~	~~Separated Bike Lanes~~		~~Parking Lanes~~
~~Parking Lane With~~ ~~Parking~~ ~~Lane~~	~~10’’~~	~~9’’~~	~~6’’~~	~~2’’ buffer plus, 3’ preferred, plus 5’ bike lane, 6’ preferred~~ ~~5’’ bike lane~~	~~3’’ horizontal vertical buffer (min. and pref,) between curbside of parking lane and bike lane, plus 6.5’’ bike lane, (7’ preferred)buffer 3’’ vertical buffer3’’ vertical buffer plus 5’’ bike lane, buffer is between curbside of parking lane and bike lane~~	~~horizontal (min. and pref,) between curbside of parking lane and bike lane, plus~~	~~?’’ minimum, 8’ preferred. M(measured from curb face (inclusive of gutter pan)~~ ~~face)~~
~~Without No Parking Lane~~ ~~Parking~~	~~10’’~~	~~9’’~~	~~6.5’’ (Mmeasured from curb face (inclusive of gutter pan)6.5’’ (measured from curb~~	~~2’’ buffer plus, 3’ preferred~~ ~~6.5’’ bike~~	~~3’’ vertical horizontal buffer (min. and pref,)., Vertical barrier type and dimension may vary, ,~~ ~~plus 6.5’’ bike~~	~~horizontal (min. and pref,). Vertical barrier type and dimension may vary, plus min. and pref.). M (inclusive of gutter pan)~~	

~~Lane~~			~~face~~	~~lane~~ ~~Measured from curb face (inclusive of gutter pan) (measured from curb face)~~	~~lane, 7' preferred. Measured from curb face (inclusive of gutter pan)(measured from curb face)~~		

~~*NOTES: Travel and auxiliary lane dimensions do not include gutter pan width. Auxiliary lanes include, without limitation, turning and speed change lanes.~~

(D) Horizontal Alignment

(1) **Conformance to Street Plan:** Horizontal alignment shall conform to the pattern of streets in the Boulder Valley Comprehensive Plan, TMP, and adopted right-of-way plans and shall provide continuous alignment with existing, planned, or platted streets with which they will connect.

(2) **Extension to Property Line:** All streets shall be extended to the property lines across the property to be developed, unless the street to be constructed has been approved by the c~~C~~ity as a cul-de-sac or other no-outlet street.

(3) **Minimum Horizontal Curve:** Street curvatures shall meet the minimum specifications shown in Table 2-6, "Minimum Horizontal Street Curve Specifications," of these Standards.

Table 2-6: Minimum Horizontal Street Curve Specifications

Design Criteria	Local Street	Collector Street	Arterial Street
Minimum Design Speed	20 mph	35 mph	40 mph
Minimum Centerline Radius	100 feet	300 feet	500 feet
Minimum Reverse Curve Tangent	50 feet	100 feet	200 feet
Minimum Intersection Approach Tangent	100 feet	200 feet	300 feet

Table 2-6a: Separated Bike Lane Minimum Horizontal Curve Specifications

Design Criteria	Flat, level terrain	Congested, urban area	Intersection approach
Minimum Design Speed	15 mph	12 mph	8 mph
Minimum Centerline Radius*	42 feet	27 feet	12 feet

*Radius assumes a 20-deg lean angle of the bicyclist.

(4) **Design Horizontal Curve:** The design horizontal street curvature shall meet or exceed

the minimum horizontal curvature and be calculated using the following equation:

$$R = V^2 / 15 * (e-f)$$

Where: E = rate of superelevation per foot
F = side friction factor

V = vehicle speed in MPH
R = radius of curve in feet

Side Friction Factors	
Design Speed (mph)	Side Friction Factor (f)
20	0.26
25	0.23
30	0.22
35	0.20
40	0.18
45	0.16

(5) Intersections and Street Spacing

(a) **Angles:** All streets shall intersect at right angles (90°).

(b) **Minimum Street Spacing:** Spacing between streets, as measured from centerline to centerline, shall equal or exceed the minimum distances shown in Table 2-7, "Minimum Street Spacing," of these Standards.

Table 2-7: Minimum Street Spacing

Street Type	Minimum Street Spacing
Local	150 feet
Collector	300 feet
Arterial	500 feet

(c) **Street Spacing for Signalized Intersections:** Signalized intersections, where feasible, shall be spaced at ~~no more than~~ half-mile intervals. Closer signal spacing may be~~is generally desired and may be~~ approved by the Director based on context-sensitive design. ~~The development~~Signalized intersections shall comply with the ~~Transportation Master Plan~~TMP and Low-Stress Walk and Bike Network Plan ~~shouldshall be consulted when consideringdesigning placement of signalized intersections~~ to ensure signalized intersections along arterial and collector streets provide controlled crossing ~~opportunities~~ where existing and proposed walking and bicycling network streets cross those arterial and collector streets.~~.~~

(d) **Receiving Width:** The minimum receiving width is 20 feet. This may include both an opposing and receiving vehicle through lane and a paved shoulder and/or bicycle lane.

(e~~d~~) **Corner Radii:** The smallest feasible actual curb radii shall be selected for corner designs. Corner design shall account for the effective turning radius, the

actual curve of a turning vehicle. This shall include the additional turning area provided by on-street parking, bicycle lanes, medians, and other roadway features. Figure 2-1 and Figure 2-2 demonstrate the relationship between the effective radius and actual curb radius. Table 2-8 shall be used to determine actual versus effective turning radii for SU-30 design vehicles.

The effective radius shall be analyzed for the design vehicle; the default design vehicle is the SU-30 for all intersections. The Director may require a different design vehicle based on functional need to ensure safe and efficient operation of the street (for example, a bus or transit route, or a semi-tractor and trailer on streets with industrial land-uses).

The Director may require a larger effective curb radii to provide no encroachments at locations served by transit and where the transit agency operators have policies that prohibit drivers from encroaching into adjacent lanes. The Director may require a mountable truck apron for locations where large trucks turn infrequently, but there is limited space for encroachment. The truck apron design shall provide a smaller effective radius for the design vehicle and a larger effective radius to accommodate larger vehicle turn movements. Figure 2-3 is an example of a truck apron.

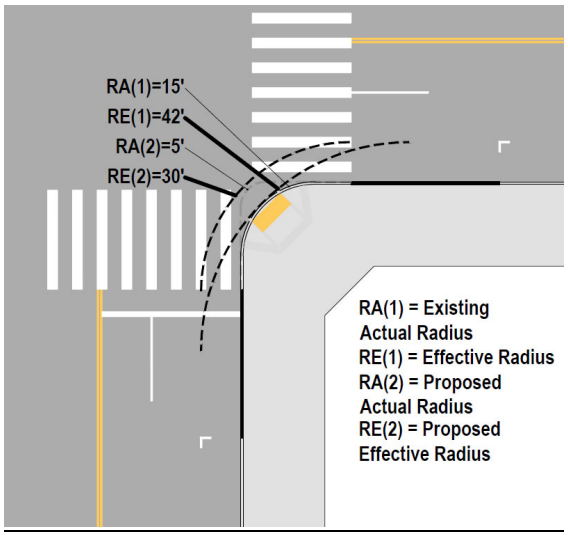


Figure 2-1. Actual and Effective Radius At A Conventional Intersection Corner

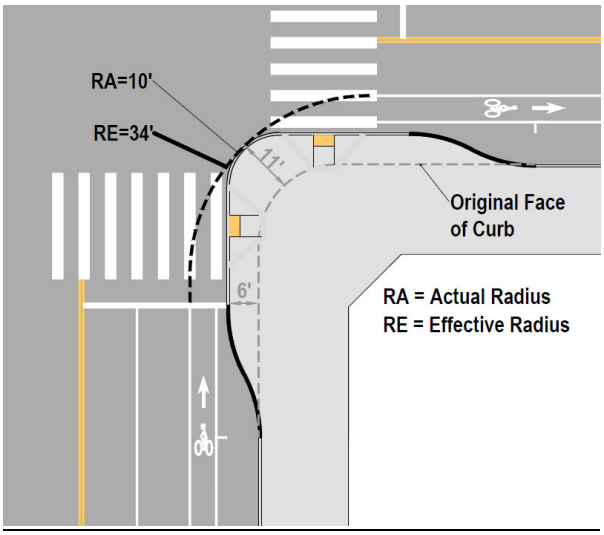


Figure 2-2. Actual and Effective Radius At An Intersection Corner With A Curb Extension

~~Table 2-8: Minimum Intersection Radii~~

~~Street Type~~	~~Minimum Flowline Radius~~	~~Minimum Property Radius~~
~~Local~~	~~25 feet~~	~~15 feet~~
~~Collector~~	~~30 feet~~	~~15 feet~~
~~Arterial~~	~~30 feet~~	~~10 feet~~

Table 2-8: Relationship between Effective and Actual Radius for the Default Design Vehicle (SU-30)

			Street B			
		Parking	No	No	Yes	Yes
		Bike Lane	No	Yes	No	Yes
Street A	Parking	Bike Lane				
	No	No	RA = 30’ (RE = 30’)	RA = 25’ (RE = 30’)	RA = 25’ (RE = 30’)	RA < 10’ (RE = 30’)
	No	Yes	RA = 25’ (RE = 30’)	RA = 15’ (RE = 30’)	RA < 10’ (RE = 30’)	RA < 5’ (RE = 30’)
	Yes	No	RA = 25’ (RE = 30’)	RA < 10’ (RE = 30’)	RA < 5’ (RE = 30’)	RA < 5’’ (RE = 35’)

	Yes	Yes	RA < 10' (RE = 30')	RA < 5' (RE = 30')	RA < 5' (RE = 35')	RA < 5' (RE = 45')

**When the difference between the effective and actual corner radii becomes larger, or when the effective radius cannot be reduced to what is necessary for the control vehicle, the director may require a curb extension.*

(f) **Allowable turning encroachments for curb radii design**: The following shall be used to reduce effective and actual curb radii. The SU-30 design vehicle turns may encroach into other lanes as follows:

i. For turns onto local streets from arterial, collector, or local streets~~)~~, the design vehicle is allowed to utilize the entire width of the departing and receiving lanes, including oncoming travel lanes, to negotiate the turn.

ii. At intersections where the minor leg is stop controlled and the major leg is uncontrolled, turns are allowed to use the entire width of both the minor leg departing or minor leg receiving lanes, including oncoming travel lanes, to negotiate the turn.

iii. At signalized intersections that have a "No Right on Red" restriction, turning vehicles are allowed to utilize multiple lanes on the receiving street to complete their turn.

(g) **Additional Corner Radii Design Considerations:** The following turning scenarios shall be used to reduce the effective and actual curb radii:

i. Emergency vehicles are allowed to utilize the entire street pavement width for departing and or receiving lanes to negotiate turns, including all adjacent and oncoming travel lanes.

ii. WB-40 and larger design vehicles are allowed to utilize adjacent lanes on the departing and receiving streets at all intersections; large trucks may use the entire street pavement width on local streets.

Figure 2-3. Example of A Mountable Truck Apron At An Intersection

(6) **Road Width Transition Tapers:** Where two street sections or different widths are to be connected, a transition taper is required between the outside traveled edge of the two sections. The length of the transition taper shall be calculated using the following equation:

L = WS

Where: S = Speed in MPH
L = Length in feet
W = Width of offset in feet

This transition is not to be used in the design of left turn storage lanes or speed change lanes.

Design of tapers for on-street bike lanes ~~should~~shall use a minimum length as calculated using the formula below:

$$L = \frac{WS^2}{60}$$

Where: L = Longitudinal lane shift (ft), minimum 20 ft

W = Lateral width of offset (ft)

S = Target bicyclists operating speed (mph)

If the bikeway is delineated by paint-only~~,~~ and ~~if~~ the off-tracking of a bicycle pulling a trailer would not put the trailer into a motor vehicle lane, a maximum taper ratio of 2:1 (longitudinal:lateral) may be ~~considered~~approved ~~-~~required by the Director.

(7) **Left Turn Lanes**

(a) **Storage Length:** Left turn lane storage length for unsignalized intersections shall be determined based on traffic volumes using the Leisch nomographs provided in the ITE "Guidelines for Major Urban Street Design." ~~The left turn lane storage length shall not be less than 50 feet.~~ The left turn storage length for an unsignalized intersection shall not be less than 25 feet. Unsignalized intersections shall only use single lane turn lanes.

For signalized intersections, ~~L~~left turn lane storage length ~~for signalized intersections is~~shall be determined utilizing the Highway Capacity Manual. ~~-~~The minimum left turn lane storage length is 80 feet. Single lane left turn storage shall be maximized to~~single left turn lanes to the maximum~~ the extent feasible and ~~should~~shall be exhausted before ~~including~~consideration of dual turn lanes. If storage length requirements cannot be met in a single lane the Director may, after considering the impacts to the pedestrian and bicycle crossing distance~~,~~ and expected left turn queuing impacts to safety and intersection operations, approve a dual or triple left turn lane configuration. In a location ~~W~~where dual left turn lanes are approved ~~are provi,ded,~~ the lane storage length shall be based on at least 60 percent of the single lane storage length. ~~. The left turn lane storage length of any single or dual left turn lanes shall not be less than 80 feet. Double or Ttdrivriple left turn lanes are only allowed with Director approval.~~

(b) **Lane Change Taper:** Left turn lane change tapers shall be calculated using the equation for bay tapers in Subsection (8).

(8) **Speed Change Lanes:** Speed change lanes required for transitional access to turning lanes shall be designed according to the design standards provided in the ITE "Guidelines for Major Urban Street Design," as follows:

(a) **Bay Tapers:** Bay tapers are required for the lane transition from the travel lane into a turn lane. The bay taper length shall be calculated using the following equation:

$$\mathbf{L = WS / 3}$$

Where: S = Speed in MPH
L = Length in feet
W = Width of offset in feet

(b) **Approach Tapers:** Approach tapers are required to transition the position of travel lanes to accommodate turn lanes. The approach taper length shall be calculated using the following equation:

$$\mathbf{L = WS^2 / 60}$$

Where: S = Speed in MPH
L = Length in feet
W = Width of offset in feet

(9) **Cul-de-sacs:** Where allowed, cul-de-sacs shall have a minimum pavement diameter of 90 feet, curb face to curb face, and a minimum right-of-way diameter of 115 feet, except for residential streets approved pursuant to Chapter 9-12, "Subdivision," B.R.C. 1981, and Section 2.09, "Residential Streets." Cul-de-sacs are prohibited on arterial and collector streets, and are strongly discouraged on local and residential streets. The Director may permit cul-de-sacs where there is no other possible street or driveway access to a property from a public right-of-way, or if a cul-de-sac would avoid direct property access to a collector or arterial.

(E) Vertical Alignment

(1) **Minimum Street Grade:** All street grades shall equal or exceed the minimum street grade of 0.5 percent.

(2) **Maximum Street Grade:** Street grades shall not exceed the maximum street grades shown in Table 2-9, "Maximum Street Grades," of these Standards.

Table 2-9: Maximum Street Grades

Street Type	Maximum Street Grade
Local	8%
Collector	6%
Arterial	5%
Intersection Approach (Minimum 50')	4%
Signalized Intersection Approach (Min. 50')	2%

(3) **Design Controls for Vertical Curves:** Design control for sag and crest vertical curves~~,~~ (based on a design speed of 30 mph) shall meet the specifications shown in Table 2-10, "Vertical Curve Design Control," of these Standards. For design speeds in excess of 30 mph, design control shall be in accordance with the current edition of "A Policy on Geometric Design of Highways and Streets,"~~,~~ prepared by the American Association of State Highway and Transportation Officials.

Table 2-10: Vertical Curve Design Control

Algebraic Difference in Grades	Sag Curve Minimum Vertical Curve Length	Crest Curve Minimum Vertical Curve Length
0.5 - 1.0 %	50 feet	100 feet
1.0 - 3.0 %	100 feet	100 feet
3.0 - 5.0 %	200 feet	150 feet
5.0 - 7.0 %	300 feet	200 feet
7.0 - 8.0 %	300 feet	300 feet
Min. Vert. Sight Distance	N/A	250 feet

(4) **Vertical Sight Distance:** Vertical curve sight distance shall equal or exceed 250 feet. Greater vertical sight distance may be required by the Director to ensure safe travel and street crossings for all transportation modes.

(F) Sight Distance

All streets and alleys shall provide adequate sight distance as set forth under Section 9-9-7, "Sight Triangles," B.R.C. 1981.

(1) **Design Sight Distance for Separated Bike Lanes:** Departure sight triangles shall be used to provide adequate sight distance for a stopped driver on a minor roadway to depart from the intersection.

(a) **Parking Restrictions**: Separated bike lanes and access driveways shall be designed so that parking is prohibited within 20 feet of a driveway in locations where a parking lane is designated between bike lane motor vehicle lane.

(b) **Two Stage Crossing**: Where side streets intersect the separated bike lane, intersections shall be designed as two-stage crossings for motor vehicles.

(c) **Departure Sight Triangle:** Use the following equation to compute the departure sight triangle between a passenger vehicle and user of the bike lane.

$$ISD_{bike} = 1.47\, V_{bike}\, t_g$$

Where:

ISD_{bike}	=	intersection sight distance (length of the leg of sight triangle along the bikeway) (ft)
V_{bike}	=	design speed of bikeway (mph)
t_g	=	time gap for passenger vehicle to cross bikeway (s), use 5.5 seconds

Table 26a, "Separated Bike Lane Minimum Horizontal Curve Specifications," shall be used to establish the V_{bike} value.

AASHTO *Green Book* Case B sight distance shall be used to calculate the departure sight triangle between the motorist and the intersecting motorist travel lanes.

(G) Medians

Raised medians are required on new arterial streets. Raised medians, where feasible, shall extend past the pedestrian crosswalk to allow for a pedestrian refuge zone.

(1) **Median Widths:** Medians shall be at least 4 feet wide, curb face to curb face. If left turn lanes are installed in the median, the median width adjacent to the left turn storage lanes shall be 4 feet and the median width at the start of the left turn lane bay taper shall be at least 14 feet wide, curb face to curb face. Median design widths shall conform to Table 2-11, "Median Width Design Standards," of these Standards.

Table 2-11: Median Width Design Standards

Function	Minimum Width	Recommended Width
Separation of Opposing Traffic	4 feet*	10 feet*
Pedestrian Refuge or Traffic Control Device Location	6 feet*	14 feet
Medians Separating Left Turn Lanes	14 feet	20 feet

* NOTE: Cannot accommodate left-turn lanes

(2) **Landscaping in Medians:** Landscaping in medians shall comply with the requirements of Chapter 3, "Streetscaping," of these Standards.

(H) Vertical Clearance of Structures

At least 17.5 feet of vertical clearance shall be provided for all overhead structures. Vertical clearance is measured from the crown of the street to the lowest portion of the structure on all streets and alleys.

2.08 Sidewalks

(A) Required

Sidewalks are required on both sides of all new streets, except for residential streets that were approved without required sidewalks pursuant to Chapter 9-12, "Subdivision," B.R.C. 1981, and Section 2.09, "Residential Streets."

(B) Conformance with the Transportation Master Plan

Off-street sidewalks may be required as part of any project or development proposal in conformance with the TMP.

(C) Compliance with Americans with Disabilities Act (ADA)

All public sidewalks shall comply with the requirements of the ADA's "Standards for Accessible Design," which includes without limitation sidewalk widths, grades, locations, markings, surface treatments, and access ramps.

(D) Minimum Widths

Sidewalk widths shall conform to the dimensions shown in Table 2-12, "Minimum Sidewalk Widths," of these Standards.

Table 2-12: Minimum Sidewalk Widths

Minimum Sidewalk Width			
	Adjacent Land Use		
Street Type	Commercial/Retail	Commercial/Industrial	Residential
Local	12	5	4

Collector	12	5	5
Arterial	12	8	8

Note: All off-street multi-use/bike paths designated in the Transportation Master Plan shall be 12 feet wide.

(E) Vertical Grades

The vertical grade of a sidewalk shall not exceed 8.33 percent, a ratio of 12 feet horizontal to 1 foot vertical (12:1).

At sidewalk locations adjacent to transit stops or transfer points, the Director may require wider sidewalk sections to provide for adequate passenger storage areas.

(F) Vertical Clearance

A minimum ~~8 foot~~8-foot vertical clearance shall be provided between all sidewalk and multi-use path surfaces and any overhead encroachments.

2.09 Residential Streets

(A) Purpose

(1) The residential street standards were developed to allow a variety of choices in the creation of new transportation corridors within the urban environment under conditions that will not compromise the safety and function of the city street system. Traditionally streets have provided the following:

(a) Corridors for pedestrian, bicycle, transit, and motor vehicle movement;

(b) Parking for vehicles;

(c) Fire, police, and emergency access;

(d) Locations for public utilities networks including water supply, sewage, electricity, telecommunications and gas services, and refuge disposal; and

(e) Postal and other delivery services.

(2) These ~~s~~Standards recognize that streets, if appropriately designed, may provide additional community amenities including landscape buffers, attractive public gathering spaces, opportunities for neighborhood interaction, public art, view corridors, and potential avenues for new technologies.

(B) Scope

(1) Location of Streets

(a) These standards are intended to be used for new streets in undeveloped areas of the city.

(b) Where infill development in the existing developed portions of the city requires the creation of new streets, these alternative standards may be used if the Director finds, after completing the review process described in Section (C) below, that the new streets will not impair the functions of the surrounding transportation system nor negatively impact the character of the surrounding existing development.

(c) Further, the Director may determine that these standards are appropriate for redesigning and reconfiguring existing streets. Because the public cost of retrofitting, reconfiguring, or redesigning existing streets is often expensive, decisions about reconstruction of individual streets in accordance with these standards shall be made pursuant to the city's Capital Improvements Program process.

(2) **Methods of Review**

(a) Permitted: The following street types may be developed without review:

(i) Residential collector street
(ii) Residential street
(iii) Residential alley

(b) By Director Review: Residential streets listed in paragraph (B)(2)(a) and the street types listed below may be developed upon approval by the Director under the criteria outlined in Section (C) below.

(i) Rural residential street
(ii) Access street
(iii) Access lane

(c) By Site Review: Those underlined criteria and specifications in the following residential street standards may be appropriate for modification under certain limited circumstances. Developments requesting such modifications shall meet all of the requirements of Section 9-2-14, "Site Review," B.R.C. 1981, in addition to the criteria outlined in Subsection (C), "Director Review," below.

(3) **Cumulative Standards:** These street standards are intended to be used in combination with Section 2.07, "Street Geometric Design," of these Standards. Where the standards in this section are silent, the criteria or specifications contained in Section 2.07 shall control.

(C) Director Review

(1) **Application:** As part of a subdivision application, the applicant for residential street construction approval shall include plans that depict the building envelopes of all proposed structures, and the location of proposed trees, street furniture, fire hydrants, meter pits, utility cabinets, or pedestrians in the right-of-way.

(2) **Criteria:** The Director will consider the following factors in determining whether an alternative street design is appropriate in a particular location:

(a) Urban Design: The street should contribute to the creation of an attractive community and to a clearly defined sense of place. Streets shall be designed with due attention to building spacing and setbacks, green spaces, attractive materials, plantings, and landscaping. Pavement and right-of-way widths that are less than the Residential Street standard should provide a benefit to the community that includes improved safety, improved site design, the creation of street canopies through landscaping, and secondary lot access through the use of alleys. Rural Residential streets shall be consistent with the existing character of the area, or with an approved subcommunity or area plan.

(b) Street Function: The street should be designed according to its function. This may require a diversity of street types, each serving a role in a hierarchical system. The street pattern and any reduced pavement or right-of-way widths should provide acceptable levels of accessibility, safety and convenience for all street users, including emergency service providers. The pattern shall discourage residential streets from operating as pass through traffic routes for externally generated traffic, while minimizing the length of time local drivers need to spend in a low-speed environment.

(c) Connectivity: The neighborhood street pattern should be simple, and logical, with the following characteristics:

(i) "No outlet" streets will be highly discouraged and allowed only when street connectivity is unachievable:
(ii) The street pattern provides for safe and convenient movements for pedestrians, bicycles, and motor vehicles, including transit.

(d) Design Speed: The design of the streets will control vehicular speeds under normal driving conditions to that specified in the residential street standards, while maintaining reasonable access for emergency vehicles.

(e) Minimize Maintenance Costs: The street will not create additional city obligations for maintenance and repair that exceed a standard street section.

(f) Adequate Parking: The site design provides for adequate on-street and off-street parking to serve the area.

(g) Infill Streets: In the case of infill development, the residential street design will not impair the functioning of, and will have a compatible transition to, the surrounding street system and will not negatively impact the character of the surrounding existing development. No additional density may result from approval of the reduced rights-of-way provided for in the case of Access Streets, Access Lanes, or Residential Alleys.

(D) Residential Street Sections

Five residential street sections and a residential alley may be applied to the design of residential neighborhoods as part of subdivisions approved pursuant to Chapter 9-12, "Subdivision," B.R.C. 1981. Residential streets shall be designed in compliance with the standards outlined in Table 2-13, "Residential Street Design Standards," "Technical Drawings 2.63 - 2.68," Chapter 11, of these Standards, and the requirements of this Section.

(1) **Residential Collector Street:** The residential collector street collects and distributes neighborhood traffic from residential streets to community collector and arterial transportation systems and provides access to individual properties. The residential collector street is designed for residential streets where anticipated traffic volumes range from 1,000 to 2,500 vehicle trips per day. In addition to the requirements outlined in Table 213, "Residential Street Design Standards," and "Technical Drawing 2.63," Chapter 11, the residential collector street shall be designed to meet the following minimum standards:

(a) Parking: On-street parking is allowed on both sides.

(b) Bicycle Facilities: Additional street and right-of-way width shall be provided where on-street bicycle lanes are required by a cCity-adopted subcommunity or area plan, the TMP, or the BVCP.

(c) Provision of Alleys: Where alleys are provided or required to be provided under a City-adopted subcommunity or area plan, onsite parking spaces shall be accessed from the alley and not the street.

(d) Emergency Response: Residential collectors exceeding 500 feet in length from any intersection shall provide a secondary emergency access at 500-foot intervals.

~~(1)~~(2) **Residential Street:** The residential street is designed to provide access to individual properties as well as access to the higher classification street network. The residential street provides for neighborhood circulation and may carry neighborhood traffic and through movements. The residential street shall be designed to meet the minimum standards shown in Table 2-13, "Residential Street Design Standards," and "Technical Drawing 2.64," Chapter 11, of these Standards.

Table 2-13: Residential Street Design Standards

Design Standards	Residential Collector	Residential Street	Rural-Type Residential Street	Access Street	Access Lane	Residential Alley
Design Speed	25 mph	25 mph	20 mph	15 mph	10 mph	10 mph
Design Traffic Volumes (Vehicle Trips Per Day)	1,000 -2,500	500 - 1,000	500 - 1,000	400	250	N/A
Minimum Right-of-Way	60'	60'	60'	40'	30'	16'
Minimum Pavement Section	32'	30'	22' plus 2' gravel shoulders	26'	20'	12'
Sidewalk	5'	4'	4' where required	4'	N/A	N/A
Streetscape Planting Strip	8'	8'	N/A	N/A	N/A	N/A
Minimum Centerline Radius	300'	150'	150'	100'	100'	100'
Minimum Curb Radius	20'	20'	20'	10'	10'	10'
Maximum Length Between Connecting Streets	500'	500'	500'	350'	350'	N/A
Maximum Street Length - No Outlet	500'	500'	500'	150'	150'	500'
Maximum Street Length - Loop or Circle Street	500'	500'	500'	500'	500'	500'
Minimum Turn-Around Area	35' Radius	35' Radius	30' Radius or "Y" or "T" Turn	30' Radius or "Y" or "T" Turn	25' Radius or "Y" or "T" Turn	25' Radius or "Y" or "T" Turn
Emergency Response Set Up Area Intervals	N/A	N/A	N/A	150'	150'	N/A
Sidewalk Placement	Detached Required	Detached Required	Adjacent to Property Line Where Required	Attached	N/A	N/A
Curb and Gutter	Required	Required	N/A	Required	N/A	N/A
On-Street Parking	Allowed	Allowed	Allowed	Allowed	Allowed	Not Allowed
Minimum Lot Frontages	N/A	N/A	60' no alley 40' w/ alley	60' no alley 40' w/alley	60'	N/A
Maximum Number of Units to be Accessed	N/A	N/A	N/A	25 single family	15 single family	N/A

NOTE: Residential street standards that are underlined may be varied through Section 9-2-14, "Site Review," B.R.C. 1981.

(a) Parking: Parking is allowed both sides or, on residential streets where parking is restricted or prohibited, off-street parking courts providing parking spaces at a ratio of 0.5 spaces per dwelling unit shall be provided.

(b) Bicycle Facilities: Additional street and right-of-way width shall be provided where on-street bicycle lanes are required by a City-adopted subcommunity or area plan, the TMP, or the BVCP.

(c) Provision of Alleys: Where alleys are provided or required to be provided under a City-adopted subcommunity or area plan, onsite parking spaces shall be accessed from the alley and not the street.

(d) Emergency Response: Residential streets exceeding 500 feet from any intersection shall provide a secondary emergency access at 500-foot intervals.

(3) **Rural Residential Street:** The rural residential street is designed to provide access to individual properties as well as access to the higher classification street network. The rural residential street provides for neighborhood traffic and through ~~movements, and~~movements and is designed to carry traffic volumes in the range of 500 to 1,000 vehicles per day. The rural residential street shall be provided where prescribed by a c~~C~~ity-adopted subcommunity or area plan to maintain the rural character of an area or neighborhood. The rural residential street is a curbless paved street section, with gravel shoulders for parking and open roadside ditches for drainage. In addition to the requirements outlined in Table 213, "Residential Street Design Standards," and "Technical Drawing 2.65," Chapter 11, the rural residential street shall be designed to meet the following standards:

(a) Parking: Allowed on both sides of the street.

(b) Turnaround Standard (No Outlet Streets): If a "Y" or "T" turnaround is proposed in place of a standard cul-de-sac bulb turnaround, the "Y" or "T" turnaround shall be designed 60 feet long and 20 feet wide. The turnaround area (including sidewalks if required) shall be contained within the dedicated right-of-way.

(c) Provision for Future Sidewalks: If sidewalks are not required at the time of initial street construction, adequate space in the right-of-way shall be reserved for a future sidewalk and commitments from adjacent property owners to participate in assessment districts shall be obtained, so that sidewalks can be added and funded in the future when they are appropriate.

(d) Sidewalk Placement (Where Required): Sidewalks shall be required where vehicular traffic volumes are anticipated to exceed 1,000 trips per day, on routes to school, and as prescribed by a c~~C~~ity-adopted subcommunity or area plan. Sidewalks shall be placed outside of the paved roadway and drainage ditch, and inside the right-of-way line.

(e) Roadside Drainage Ditches: Side slopes along roadside drainage ditches shall be 4:1, and driveway culverts, at least 12 inches in diameter with flared end sections or headwalls, shall be installed by owners at driveways.

(f) Land Use Requirements: Lot frontages shall be at least 60 feet wide, unless alley access is provided. Lot frontages with alley access shall be at least 40 feet wide. Two onsite parking spaces, meeting all cCity requirements, shall be provided on each single-family lot.

(g) Provision of Alleys: Where alleys are provided or required to be provided under a cCity-adopted subcommunity or area plan, onsite parking spaces shall be accessed from the alley and not the street.

(h) Emergency Response: Rural residential streets exceeding 500 feet from any intersection shall provide a secondary emergency access at 500-foot intervals.

(4) **Access Street:** The access street provides public access to no more than 25 single-family dwelling units, where anticipated vehicular volumes would not exceed 400 trips per day. The access street is narrow, to ensure slower speeds for vehicular travel, and provides sidewalks along both sides of the street. In addition to the requirements outlined in Table 2-13, "Residential Street Design Standards," and "Technical Drawing 2.66," Chapter 11 of these Standards, the access street shall comply with the following minimum standards:

(a) Parking: Parking is allowed on both sides of the street or, if parking is not provided on-street, a parking court at a ratio of 0.5 spaces per dwelling unit is required.

(b) "L" Intersections: "L" intersections may be permitted as part of subdivision and are subject to approval by the Director. Where permitted, "L" intersections shall have at least a 150-foot-long tangent street section from the intersection to the closest curvature and a minimum corner radius of 50 feet.

(c) Circle or Loop Street: If a circle or loop street is proposed as part of subdivision, the street shall connect to a higher classification street, or connect to two separate perpendicular or offset higher classification streets.

(d) Turnaround Standard (No outlet streets): If a "Y" or "T" turnaround is proposed in place of a standard cul-de-sac bulb turnaround, the "Y" or "T" turnaround shall be designed with a 60-foot length, 20-foot width. The turnaround area (including sidewalks if required) shall be contained within dedicated right-of-way.

(e) Land Use Requirements: A residential access street shall connect to a higher classification street. Lot frontages shall be at least 60 feet wide, unless alley access is provided. Lot frontages with alley access shall be at least 40 feet wide. Two onsite parking spaces, meeting all cCity requirements, shall be provided on each single-family lot.

(f) Provision of Alleys: Where alleys are provided or required to be provided under a cCity-adopted subcommunity or area plan, onsite parking spaces shall be accessed from the alley and not the street.

(g) Emergency Response: Access streets exceeding 175 feet from any intersection shall provide a fire apparatus setup area at ~~150 foot~~150-foot intervals. The setup area shall provide at least 30 foot long, 25-foot-wide clear zone, and is subject to approval by the Fire Department.

(5) **Access Lane:** The access lane provides public access to no more than 15 single family dwelling units, where anticipated vehicular traffic volumes would not exceed 250 trips per day. The access lane is a narrow "shared street" for all modes of travel (vehicular, bicycle, and pedestrian), without curb and gutter or sidewalks, and must connect with a higher classification street. In addition to the requirements outlined in Table 213, "Residential Street Design Standards," and "Technical Drawing 2.67," Chapter 11, the access lane shall comply with the following minimum standards:

(a) Parking: Parking is allowed.

(b) "L" Intersections: "L" intersections shall have a minimum 150-foot long tangent street section from the intersection to the closest curvature and a minimum corner radius of 50 feet.

(c) Circle or Loop Street: A circle or loop street shall connect to a higher classification street or connect to two separate perpendicular or offset higher classification streets.

(d) Turnaround Standard (No outlet streets): A "Y" or "T" turnaround shall be designed with a 60-foot length, 20-foot width. The turnaround area (including sidewalks if required) shall be contained within dedicated right-of-way.

(e) Land Use Requirements: An access lane shall connect to a higher classification street. Lot frontages shall be at least 60 feet wide. Two onsite parking spaces, meeting all c~~C~~ity requirements, shall be provided on each single-family lot. If the minimum lot frontage requirement is not met, additional parking spaces shall be provided at a ratio of 0.5 spaces per dwelling unit as a part of the subdivision. These required spaces shall be located on private property.

(f) Right-of-Way Landscaping: Landscaping other than ground cover or low shrubbery shall be placed outside of the right-of-way.

(g) Emergency Response: Access streets exceeding 175 feet from any intersection shall provide a fire apparatus setup area at ~~150 foot~~150-foot intervals. The setup area shall provide a minimum 30-foot long, ~~25 foot wide~~25-foot-wide clear ~~zone, and~~zone, and is subject to approval by the Fire Department.

(6) **Residential Alley:** The residential alley is to provide secondary vehicular access to the rear of lots in detached single-family dwelling subdivisions with narrow street frontages, in order to limit curb cuts from the street and increase on-street parking. Alleys are most beneficial when lot widths are narrower than 50 feet. In addition to the requirements outlined in Table 2-13, "Residential Street Design Standards," and "Technical Drawing 2.68," Chapter 11 of these Standards, the residential alley shall be designed to meet the following minimum land use requirements: Backup distance for parking and garage

access from the alley shall be 24 feet, including the 16-foot alley right-of-way width, and the remaining backup distance shall be provided on the lot being served.

2.10 Emergency Access Lanes

(A) Emergency Access Required

All industrial, commercial, and residential developments shall provide adequate emergency vehicle access. Adequate emergency access is a minimum ~~20 foot wide~~20-foot-wide unobstructed fire apparatus access road with an unobstructed vertical clearance of 15 feet, and meets all applicable standards as set forth in Chapter 10-8, "Fire Prevention Code," B.R.C. 1981.

(B) When Emergency Access Lane is Required

When adequate emergency access is not available from a public street, an applicant for construction approval shall construct an emergency access lane. Emergency access lanes must accommodate all emergency vehicles, including fire equipment.

(C) Secondary Emergency Access

Secondary emergency access lanes shall be provided to structures whenever the distance to the nearest public street equals or exceeds 500 feet. Secondary access lanes shall conform to all design requirements specified for emergency access lanes.

(D) Local Emergency Access Lane Standards

In addition to the emergency access standards set forth in Chapter 10-8, "Fire Prevention Code," B.R.C. 1981~~.~~, an emergency access lane shall equal or exceed the following standards:

(1) **Direct Route:** Emergency access lanes shall provide the shortest practical direct access to points of concern, and be entirely contained within a minimum, continuous ~~20 foot wide~~20-foot-wide emergency access easement or public right-of-way.

(2) **Distance From Structure:** Emergency access lanes shall be provided whenever a structure is located more than 150 feet from fire apparatus access.

(3) **Surface:** An emergency access lane shall consist of either of the following:

(a) Two concrete strips at least 4 feet wide, with a 4-foot separation between them. Vegetation other than grass shall not be permitted in the separation area.

(b) A minimum continuous paved surface width of 12 feet.

(4) **Radius:** An emergency access lane shall provide a minimum turning radius of 25 feet, or the radius needed to accommodate an SU-30 vehicle.

(5) **Turnarounds:** If the length of the emergency access lane exceeds 150 feet (without an outlet accessible to emergency vehicles), then a turnaround with a minimum radius of 45 feet shall be provided.

(6) **Grade:** The grade for an emergency access lane shall not exceed five percent. Exceptions may be allowed with specific approval from the City of Boulder Fire Chief where this standard cannot be met due to topographical conditions.

(7) **Vertical Clearance:** Vertical clearance from the surface of the emergency access lane shall be at least 15 feet.

(E) Unobstructed Access

Emergency access lanes shall be kept free and clear of all obstructions. If the Director or Fire Chief determines that barriers are needed to prevent automobile traffic from using an emergency access lane, then the applicant for construction approval shall install traffic bollards. Traffic bollard designs shall provide for immediate access of emergency vehicles, without requiring these vehicles to stop and maneuver around, or unlock, any structures. The Director and Fire Chief shall have final approval of all bollard designs.

(F) Access Identification

Signs and pavement markings will be required if ~~necessary~~necessary, by the Director and Fire Chief to delineate and identify emergency access lanes. All signage for emergency access lanes shall conform with the specifications in the MUTCD.

2.11 Bicycle Facilities and Multi-Use Path Design

(A) Conformance with Low-Stress Walk and Bike Network Plan

The arrangement, type, and location of all bike lane and multi-use path facilities and routes shall conform with the "Low-Stress Walk and Bike Network Plan" section in the TMP. The Director shall specify the standards for design and construction of new bike lane and multi-use path facilities consistent with these Standards and considering public health, safety, and welfare and generally accepted engineering principles. The Director may refer to the Transportation References in these Standards. These ~~City~~ Sstandards ~~may~~hall shall also apply to ~~endorses~~ marked and signed contraflow bike lanes to meet bicycle connectivity goals identified in the Low-Stress Walk and Bike Network Plan ~~to meet connectivity goals~~ where the right-~~-~~of-~~-~~way is constrained.

(B) On-Street Bike Lanes - Streets Without On-Street Parking

An on-street bike lane is separated from the motor vehicle travel lane by a single white line. On-street bike lanes on new streets without on-street parking shall be at least 5 feet wide, exclusive of the curb pan, or 6.5 feet from the face of any curb. On existing streets where on-street bike lanes are being added and available right-of-way or improvements space is restricted, the Director ~~of Public Works~~ may approve a reduced width of the bike lane; the reduced width shall be at least 5 feet wide, inclusive of the curb pan.

(C) On-Street Bike Lanes - Streets With On-Street Parking

An on-street bike lane on a street with on-street parking is separated from the motor vehicle travel lane or parking lane by a single white line. On-street bike lanes on new streets with on-street

parking shall be at least 6 feet wide, exclusive of the parking lane. On existing streets where on-street bike lanes are being added and available right-of-way or improvements space is restricted, the Director ~~of Public Works~~ may approve a reduced width of the bike lane; the reduced width shall be at least 5 feet wide, exclusive of the parking lane.

(D) Buffered Bike Lanes

A buffered bike lane is separated from the motor vehicle travel lane by a painted buffer space creating a greater separation between the bike lane and adjacent travel lane. The buffer shall be marked with 2 solid white lines, and the markings shall otherwise conform with MUTCD standards. The buffered space shall be at least 2 feet wide. On streets without on-street parking the bike lane shall be at least 5 feet wide, or 6.5 feet from the face of the curb. Bike lanes on new streets with on-street parking shall be at least 5 feet wide, exclusive of the parking lane. On existing streets where buffered bike lanes are to be added and right-of-way or improvement space is limited, the Director may modify this standard considering safety concerns or approve an on-street bike lane.~~.~~

(E) Separated Bike Lanes (One-Way and Two-Way)

A separated bike lane is physically separated from the motor vehicle travel lane through vertical or horizontal elements and is distinct from the sidewalk. Separated bike lanes have different forms but all share common elements. Where on-street parking is allowed, the separated bike lane shall be located to the curb side of the parking (in contrast to on-street and buffered bike lanes). Separated bike lanes may be one-way or two-way and may be at street level, at sidewalk level, or at an intermediate level. If located at sidewalk level, a curb or median shall separate the separated bike lane from the motor vehicle travel lane, and different pavement color or type shall separate the separated bike lane from the sidewalk. If located at sidewalk level, the separation may include a landscaped area. If located at street level, the separated bike lane shall be separated from the motor vehicle travel lane by raised medians, on-street parking, or flexible delineators. Flexible delineators shall conform with MUTCD standards. Raised medians shall conform to "Technical Drawing 2.42C," Chapter 11 of these Standards. The Director may require additional markings, signage, and other improvements to ensure safe and efficient operation of the c~~C~~ity's transportation system.

On streets without on-street parking, a vertical separation shall create a buffer between the bike lane and the travel lane that is at least 3 feet wide, and the bike lane shall be at least 5 feet wide, or 6.5 feet from the face of the curb. On streets with on-street parking, the separation shall be a 3-foot-wide horizontal buffer between the bike lane and the parking lane, and the bike lane shall be at least 5 feet wide.

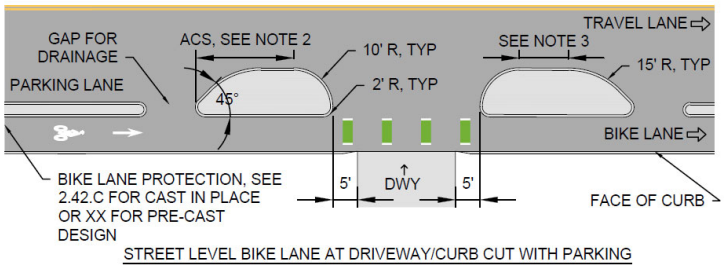
On existing streets where separated bike lanes are to be added and right-of-way or improvement space is limited, the Director may modify this standard considering safety concerns and the efficient operation of the c~~C~~ity's transportation system.

(F) Typical Bicycle Facility Layouts

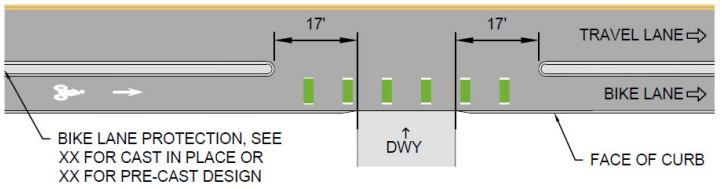
The following are examples of typical bicycle facility layouts and shall be used as guidance for separated bike lane facilities. The existing street context and site constraints of each location

shall be taken into account when designing these facilities and engineering judgement may be used to implement the intent of these example bicycle facility layouts.

(1) One-Way Street Level Separated Bike Lanes at Driveways

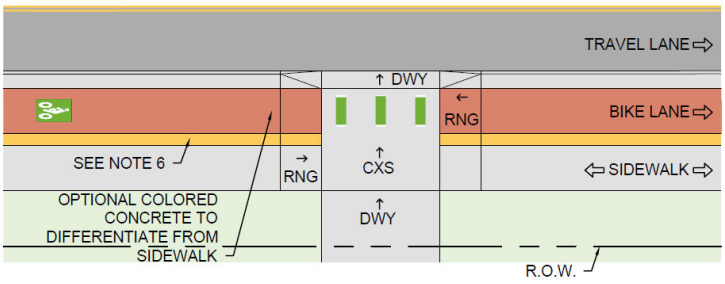


STREET LEVEL BIKE LANE AT DRIVEWAY/CURB CUT WITH PARKING

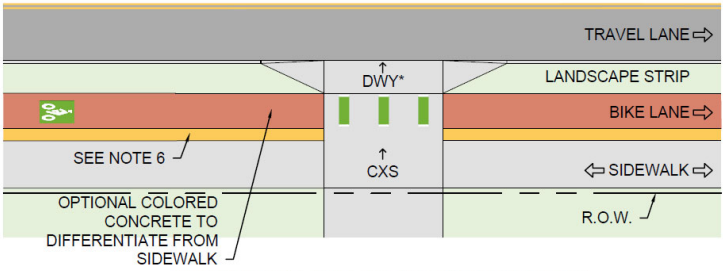


STREET LEVEL BIKE LANE AT DRIVEWAY/CURB CUT WITHOUT PARKING

(2) Sidewalk Level One-Way Separated Bike Lanes at Driveways



SIDEWALK LEVEL BIKE LANE AT DRIVEWAY/CURB CUT (CONSTRAINED)



SIDEWALK LEVEL BIKE LANE AT DRIVEWAY/CURB CUT

(a) Typical approach clear space (ACS) for driveways and alleys shall be 20 feet as shown; in constrained locations the approach clear space may be measured from edge of driveway.

(b) In constrained locations the far-side buffer tangent may be reduced to 5 feet.

(c) See Section 2.07, Table 2.5 of these Standards for standard lane widths.

(d) Bike lane tapers preferred at 7:1 shift, minimum 3:1 shift in constrained locations where speed is ≤ 13 mph.

(e) For bike lanes at sidewalk elevation without buffer treatment, 1-foot minimum directional indicator strip required within the sidewalk; typically located 1 foot from the edge of the bike lane.

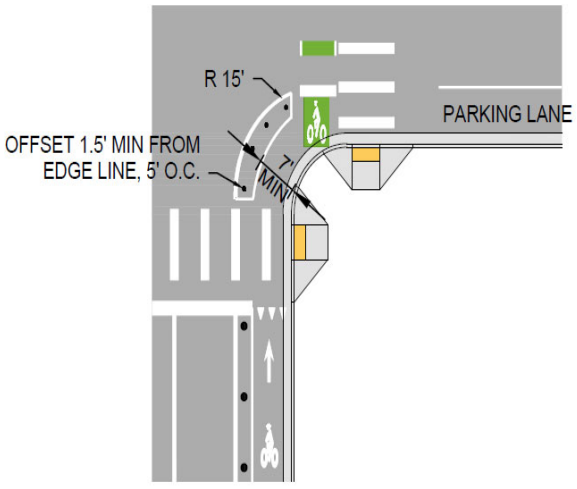
(f) Accessible ramp slope (RMP) = 7.8% (8.3% max).

(g) Accessible cross slope (CXS) = 0.5-1.5% (2% max).

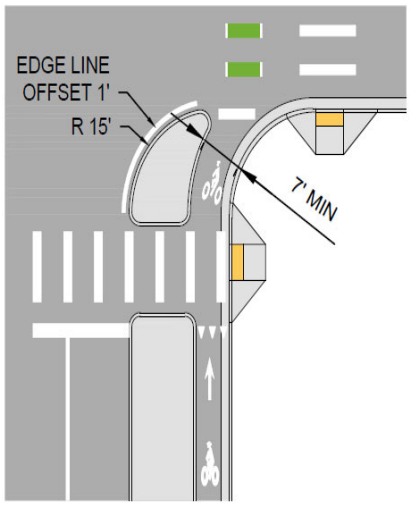
(h) Accessible running slope (RNG) = 5% max.

(i) Driveway slope (DWY) = 12% max.

(3) Street Level Separated Bike Lanes at Intersection in Retrofit Conditions

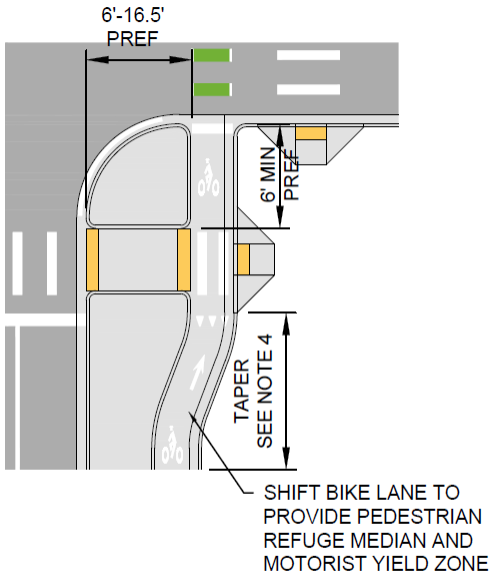


RETROFIT PROTECTED CORNER TREATMENT WITH PAINT AND POST

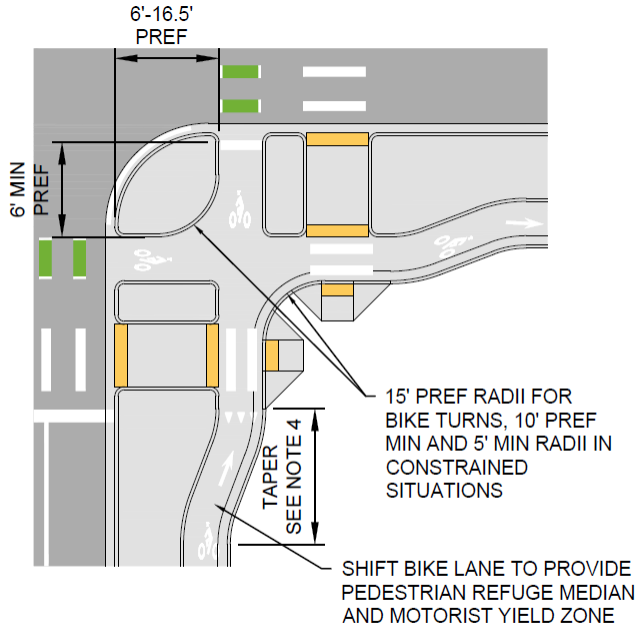


RETROFIT PROTECTED CORNER TREATMENT WITH CONCRETE

(4) Street Level Separated Bike Lanes at Intersections in New or Retrofitted Conditions



RECONSTRUCTED PROTECTED CORNER TREATMENT WITH CONCRETE



RECONSTRUCTED PROTECTED CORNER TREATMENT WITH CONCRETE (INTERSECTION BIKE FACILITIES)

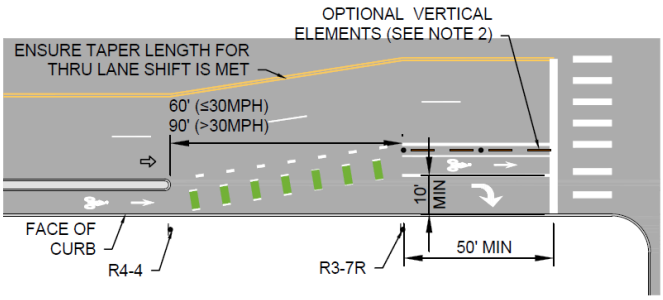
(a) Design plans shall be consulted for variations.

(b) Size and shape of corner treatments are dependent on intersection characteristics.

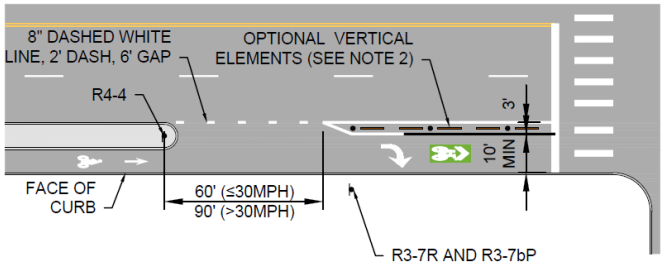
(c) See Section 2.07, Table 2.5 of these Standards for standard lane widths.

(d) Bike lane tapers preferred at 7:1 shift, minimum 3:1 shift in constrained locations here speed is ≤ 13 mph.

(5) One-Way Separated Bike Lane and Right Turn Lane

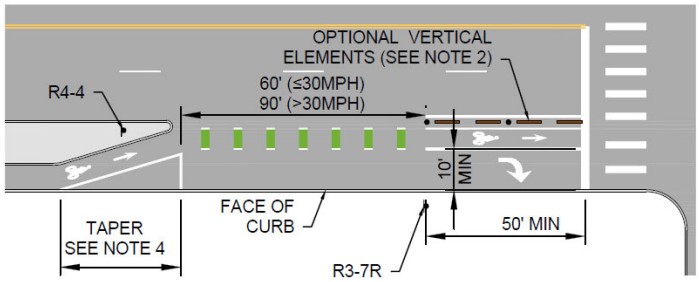


BIKE/TURN LANE - EXCLUSIVE TREATMENT (NO PARKING)

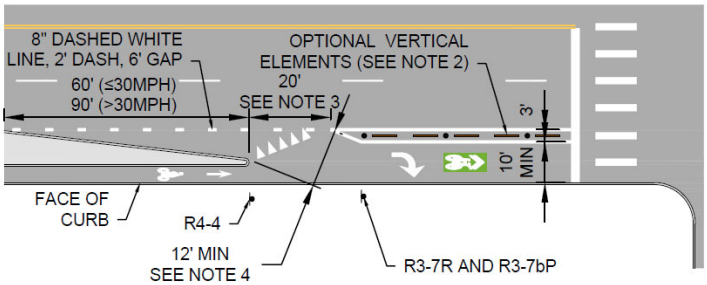


BIKE/TURN LANE - MIXING ZONE TREATMENT (NO PARKING)

(6) One-Way Separated Bike Lane and Right Turn Lane



BIKE/TURN LANE - EXCLUSIVE TREATMENT (WITH PARKING)



BIKE/TURN LANE - MIXING ZONE TREATMENT (WITH PARKING)

(a) Design plans shall be consulted for variations

(b) Vertical elements may be excluded or modified as needed to accommodate truck and/or transit vehicles, with a 13-foot minimum where high bus volume is anticipated.

(c) Bike lane tapers preferred at 7:1 shift, minimum 3:1 shift in constrained locations where speed is ≤ 13 mph.

(d) See Section 2.07, Table 2.5 of these Standards for standard lane widths.

(e) A ramp up to sidewalk may be provided for people on bicycles prior to vehicular mixing zone to provide a low stress alternative.

(GF) Off-Street Multi-Use Paths

Design for off-street multi-use paths shall conform to Chapter 5 of the AASHTO Guide for the Development of Bicycle Facilities, 4th edition. The paths shall be at least 10 feet wide with an inside edge radius of at least 15 feet and shall conform to "Technical Drawing 2.02D," Chapter 11, of these Standards.

(HG) Bicycle Parking

Bicycle parking ~~should~~shall be located in a visible and prominent location that is lit at night and physically separated from automobile parking to prevent vehicles from intruding into the bike parking area. All bicycle parking constructed in the City of Boulder shall conform to the provisions in the Section 9-9-6(g), "Bicycle Parking," B.R.C. 1981 or as adopted in any subcommunity or area improvement plan.

(1) **Bicycle Parking in Sidewalk Area of Public Right-of-Way:** Bicycle parking racks located in the sidewalk area of the public right-of-way shall be designed using either the inverted "U" rack standard or the inverted "U" racks on rails standard. A minimum aisle of 5 feet shall be provided for bikes to maneuver in when accessing the rack. All racks shall be attached to a concrete base using a high security tamper proof anchor such as a mushroom head carbon steel expansion anchor "spike" #5550 as manufactured by Rawl or an equivalent theft-proof device.

(a) Inverted "U" Rack: The inverted U rack is designed to park two bicycles, facing opposite directions, parallel to the rack. For the rack to meet its design specification of parking two bikes, it must be installed according to the specifications below, otherwise it will be considered to provide parking for one bike. The inverted "U" standard may be installed with the following conditions:

(i) Where the "U" rack is installed oriented parallel to a wall or curb, at least 3.0 feet shall be provided between the parallel wall or curb and the center of the rack. Where a bike rack is located near a curb with "head-in" automobile parking, a minimum distance of 5 feet from the curb to the center of the rack is required to avoid damage to bicycles or racks by

automobiles extending across the curb over the sidewalk.

(ii) Where the "U" rack is installed oriented perpendicular to a wall or curb, a minimum distance of 4 feet from the wall or curb to the center of the rack will be provided to allow two bikes to access and use the rack.

(iii) Where placed side-by-side, "U" racks shall be placed at least 3.5 feet apart to accommodate ease of access to the racks.

(iv) Where placed in a series of 2 or more and parallel to a wall, inverted "U" racks will be separated by a minimum distance of 10 feet between the centers of the racks to allow access to both sides of the rack.

(v) The location of a bike rack shall maintain a minimum unobstructed sidewalk width of 6 feet from any bicycle parked properly in the rack.

(vi) The location of a "U" rack shall maintain a minimum unobstructed distance of 3 feet from any pedestrian curb ramp to any bicycle parked properly in the rack.

(b) Inverted "U" Racks on Rails: The inverted "U" racks on rails are designed to park four to ten bicycles, with two bikes facing opposite directions parked on either side and parallel to each inverted "U" rack. These racks allow locking of frame and wheel with a U-lock and support bikes with two points of contact. For the rack to meet its design specifications of parking bikes from both sides, it must be installed according to the conditions of the inverted "U" rack listed above; otherwise it will be considered to provide no more than half of its designed parking capacity.

(2) **Onsite Bicycle Parking:** Bicycle parking should generally be provided within 50 feet of the main building entrance. Racks must be installed according to the guidelines in (1) above to reach their designed parking capacity. Otherwise, they shall be credited with no more than half their design capacity. Bicycle parking racks or lockers located on development or project sites or in parking lots outside of public right-of-way shall generally be selected from the following standards:

(a) Inverted "U" Rack: The inverted "U" rack is recommended for most bike rack installations and is one of the standards for bicycle parking in public rights-of-way as required in Subsection G.(1) above. Each rack provides space for two bicycles and allows flexibility in parking by providing two supports for attaching locks. The "U" rack may be used individually where space is limited, or, in circumstances requiring a larger amount of bike parking, inverted "U" racks on rails may be used to park four to ten bikes. Inverted "U" racks and inverted "U" racks on rails shall meet the specifications for the dimensions and installation shown in Chapter 11, "Technical Drawings," of these Standards

(b) Other Bike Rack Styles: Another rack style may be approved by the Director ~~of Public Works~~ if it meets the following criteria:

(i) Provides at least two contact points between the rack and the bike to securely support the bike;

(ii) Provides at least a 2 foot by ~~6 foot~~6-foot parking space for each bike without the need to lift the handlebars of one bike over those of another to park;

(iii) Allows the frame and one wheel to be locked to the rack with a standard high security, U-shaped shackle lock; and

(iv) The rack is uncomplicated and intuitively simple for the bicyclist to use.

(c) Lockers: Bicycle lockers provide secure weatherproof storage for bike parking. Lockers are recommended for employee and longer-term parking and require adequate space, since they require more area than bicycle racks.

(3) On-Street Bike Parking (Bike Parking Corrals): The Director may approve on-street bike corrals in commercial areas where sidewalk space is limited and in locations with high pedestrian volumes. In approving the design and construction of bike corrals, the Director shall consider public safety and the efficient operation of the c~~C~~ity's transportation system.

2.12 Street Lighting

(A) Scope

The provisions of this section shall apply to public ~~streets, and~~streets and are subject to the restrictions outlined in the Section 9-9-16, "Lighting, Outdoor," B.R.C. 1981.

(B) Guidelines for Street Lighting

(1) **Street Light Requests**

(a) Public Service Company (PSCo) of Colorado is responsible for providing street lighting as requested by the c~~C~~ity.

(b) Before considering new or additional local street light requests, the c~~C~~ity will require unanimous consent of all affected owners of property within 100 feet of proposed street light locations and the support of at least 51 percent of the total number of owners of properties within 500 feet of proposed locations.

(2) **Costs:** The installation costs of street light fixtures, excluding those that provide a demonstrated safety need, shall be paid by the applicant requesting the installation. The c~~C~~ity will assume continued maintenance and energy costs associated with new installations.

(3) **Priorities for Installation:** Streetlights may be provided on the basis of identified traffic need with priorities established as follows:

(a) Reduction of an identified ~~night time~~nighttime traffic accident problem correctable through street light installation.

(b) Major traffic corridors with significant turning movement conflicts and ~~night time~~nighttime pedestrian activity.

(c) Major traffic corridors with significant night-time turning movement conflicts.

(d) Arterial and collector intersections and/or horizontal or vertical alignment changes.

(e) Residential street lighting.

(f) Commercial alleys with significant night-time pedestrian activity.

(4) **Design:** Street lights installed in public rights-of-way shall be an energy efficient lighting source (LED unless otherwise approved by the Director) with a minimum of ambient or reflected light (full cut-off fixtures). Poles shall be located so that the center of the pole is three feet behind the face of the curb. The Director may approve a different pole location that is between three feet and six feet behind the face of the curb where necessary to accommodate the needs of other public right-of-way uses in the sidewalk area. The c~~C~~ity has adopted the Illuminating Engineering Society's (IES) American National Standard Practice for Roadway Lighting as the design standard for all city streets, with the following modifications:

(a) Expressway and Arterial: Street lighting shall be based on IES standards.

(b) Other Streets: Street lighting may be provided at intersections and identified pedestrian crossings only. Lighting may be considered at locations with demonstrated needs based on changes in horizontal or vertical alignments. Fixtures shall have 29-watt LED lighting unless street width or other conditions justify higher wattage.

(c) Alleys: Except for alleys in commercial areas with significant ~~night time~~nighttime pedestrian activity, the city will not provide alley lighting.

(d) Private Driveways: Street lighting installed at the intersection of private driveways and city streets shall be installed using c~~C~~ity standards, be located outside of the public right-of-way, and all costs for installation, maintenance, and continued energy expenditures shall be the responsibility of the applicant requesting the lighting installation.

(C) Easements

Adequate rights-of-way or utility easements shall be dedicated to the c~~C~~ity to allow PSCo of Colorado to install ~~street lights~~streetlights. Facilities with detached bike paths or sidewalks may use a combined signage, utility, and pedestrian easement for placement of the street lights between the curb and bikeway provided that the requirement for 2 feet of horizontal clearance from the sidewalk or bike path is met. Where a bike path or sidewalk is attached to the street

curb and gutter, ~~street lights~~streetlights shall be placed behind the sidewalk or path within a minimum 3foot wide utility easement. Utility easements for ~~street lights~~streetlights are not ~~exclusive, and~~exclusive and may be landscaped or used for parking subject to c~~C~~ity approval. If there is an exclusive gas easement behind an attached walk or path, the ~~street lights~~streetlights shall be located beyond that easement in an additional three-foot wide ~~easement~~easement, or the gas easement shall be relocated.

2.13 Transit Stop Facilities

New transit stops and enhancements to existing transit stops shall be designed in accordance with RTD's "Bus Infrastructure Standard Drawings" and with consideration of NACTO's "Transit Street Design Guide."

2.14 Traffic Calming Design

(A) Scope

This section includes guidelines for the implementation of traffic calming elements on public streets. All elements shall be designed and installed in accordance with the provisions of Chapter 2 of this document and in conformance with the MUTCD. The Vision Zero Action Plan shall be consulted when determining if and what traffic calming measures are implemented.

Traffic calming measures are intended to slow motorized vehicles and increase safety for bicycle and pedestrian users. Measures may also prioritize the movement of bicycles and pedestrians at crossing or conflict points.

(B) Traffic Circles

The Director may require the installation of a traffic circle where the Director finds that the operations or safety of the intersection or the adjoining streets would benefit from such device.

Figure 2-4 illustrates the typical layout and standard dimensions of a traffic circle and Table 2-14 Offset and Opening Width Dimensions and Table 2-15 Center Island Diameter Dimensions shall guide the design of the traffic circle. Final dimensions shall be approved by the Director based up site specific considerations for the safety of all users, the ability for all modes to traverse the intersection, and the efficient operation of the transportation system.

In locations where crossing streets are not the same width, curb extensions may be used on the wider street to create consistent approach widths.

In locations where the circulating width is less than 20 feet, the Director may require a mountable truck apron if the director finds that the expected truck traffic at the intersection will negatively impacts safety or intersection operations.

Any objects, including plantings and~~/or~~ trees, in the traffic circle shall provide a clear zone of visibility between 36 inches high and 80 inches high from the top of the travel path surface.

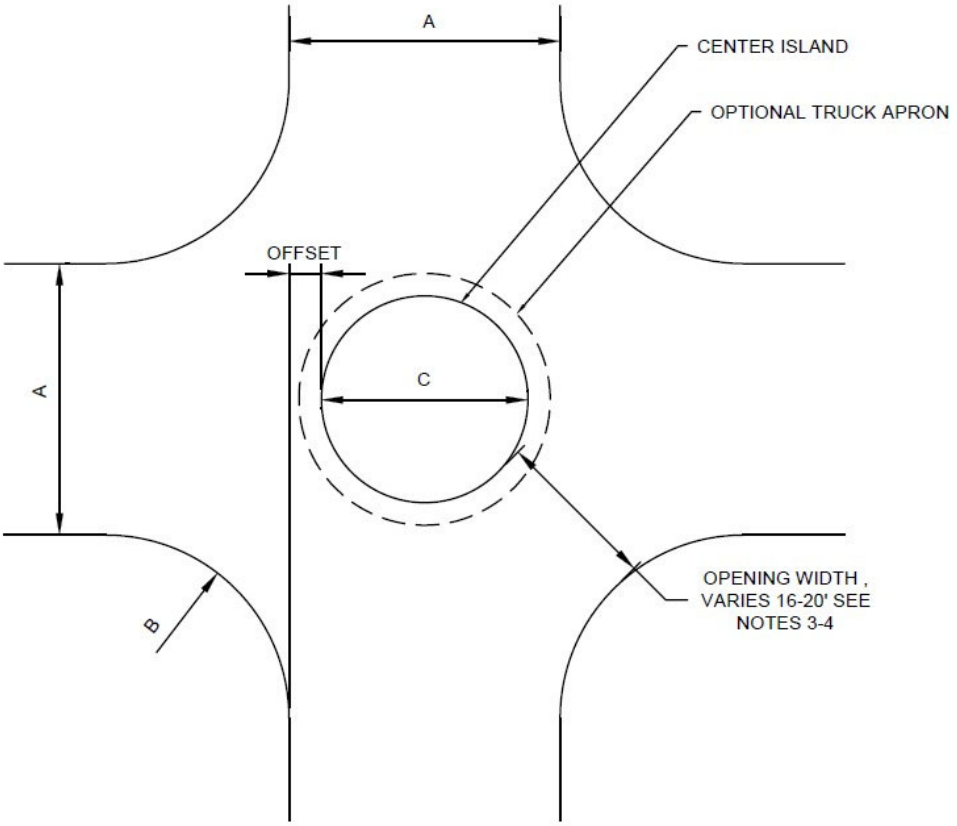


Figure 2-4 – Typical Layout and Standard Dimensions of Traffic Circle

Table 2-14 Offset and Opening Width Dimensions

Offset	Opening Width
5.5’ (Max)	16’ (Min)
5.0’	17’
4.5’	18’
4.0’	19’
3.5’ or less	20’ (Max)

Table 2-15: Center Island Diameter Dimension for Different Street Widths and Curb Return Radii

A Street Width	B Curb Return Radius	C Center Island Diameter
28’	15’ 20’	18’ 20’

	25’	22’
30’	15’ 20’ 25’	20’ 22’ 24’
36’	15’ 20’ 25’	27’ 29’ 33’
40’	15’ 20’ 25’	32’ 34’ 38’

(C) Raised Crossings

The Director may require the installation of a raised crossing where the Director finds that the crossing meets the criteria from the city’s Pedestrian Crossing Treatment Installation Guidelines for additional crossing treatments.

Figure 2-5~~XXX~~ through 2-7 illustrate typical layouts for raised crossings, Figure 2-8 illustrates typical section of a raised crossing, and Table 2-XXX Dimensions of Approach Ramp Length For Various Roadway Longitudinal Slopes and Target Grade Breaks and Table 2-16 Target Grade Breaks For Different Roadway Classifications shall guide the design of the raised crossing. Final dimensions and geometry shall be approved by the Director based up site specific considerations for the safety of all users, the ability for all modes to traverse the intersection, and the efficient operation of the transportation system.

The width of the top of raised crosswalks should match the width of the connecting sidewalk, shared use path, or desired crosswalk, and in no case be less than 10-feet in width.

Installation of a raised crossing shall include modifications to existing street paving, cold plane and~~/or~~ overlay asphalt, or reconstruction of paving to provide a smooth transition and street crown and shall match adjacent paving materials and thickness.

In locations where positive drainage cannot be achieved the design shall include drain inlet(s) as necessary to convey stormwater drainage and meet street drainage requirements of Chapter 7.

All crosswalks shall have a minimum of -2 feet spacing from poles, hydrants, and~~/or~~ other vertical obstructions.

Crosswalk cross slopes should be no greater than 2%, however, at mid-block locations the cross slope may match the existing street grade. Crosswalk ~~C~~cross slope may be 0% if longitudinal slope is sufficient to self-drain

Crosswalk longitudinal slopes should not exceed 5%

Grade breaks should be determined based on existing roadway speeds and desired speed reduction and should conform with Table 2-17. Generally, higher grade breaks correspond to higher speed reduction.

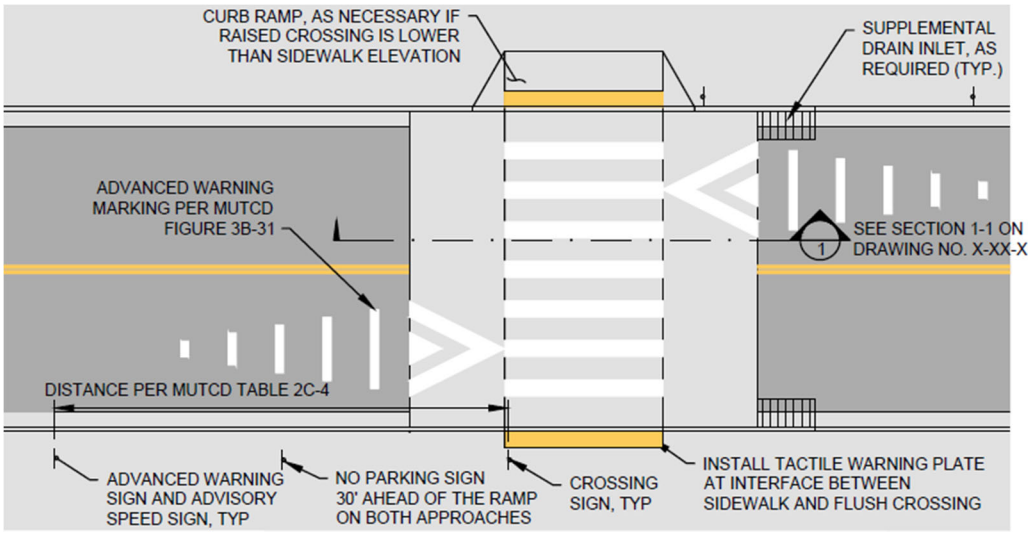


Figure 2-5 – Typical Layout of Raised Crossing at Mid-Block Location

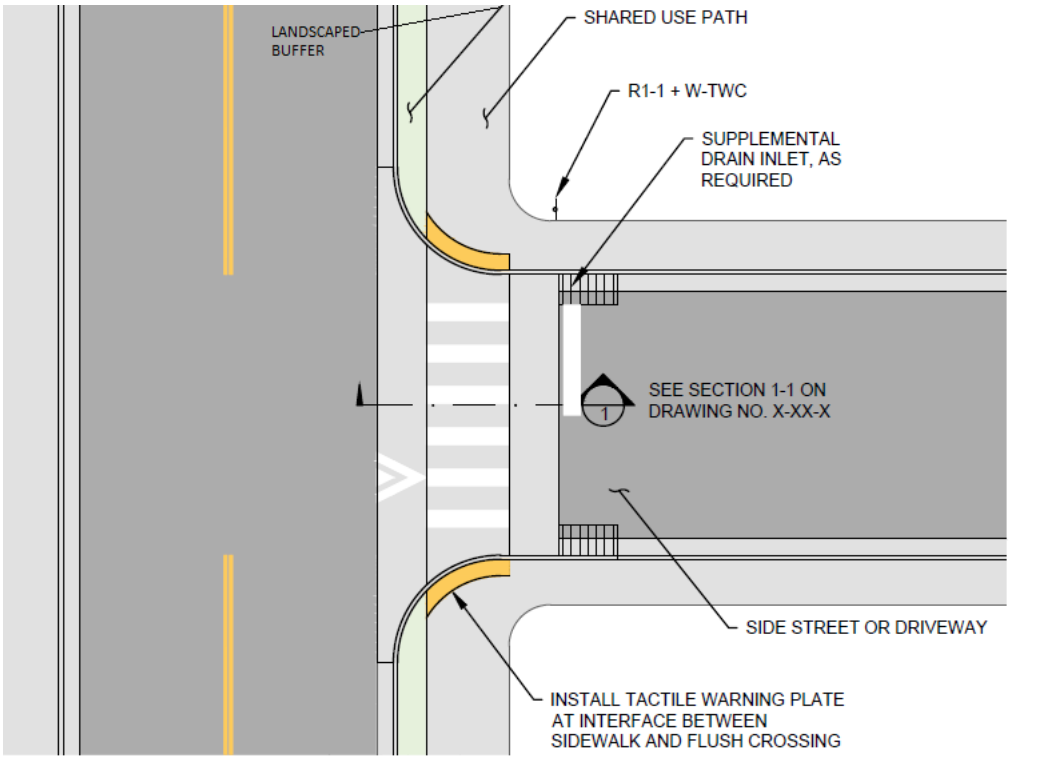


Figure 2-6 – Typical Layout of Raised Crossing at Intersection Leg Location

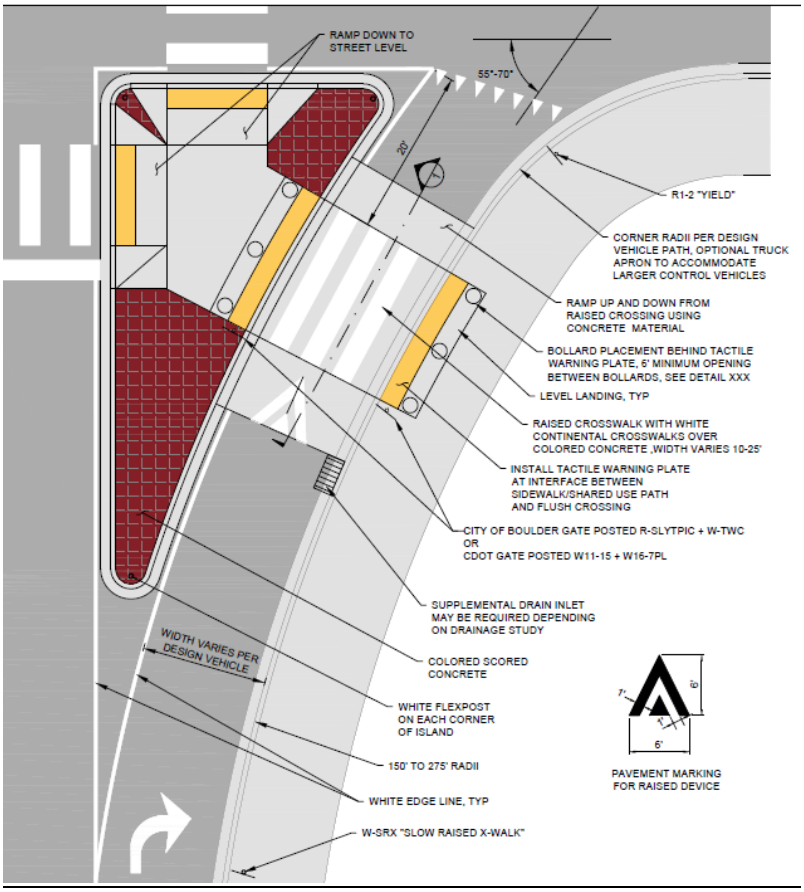


Figure 2 -7 – Typical Layout of Raised Crossing at Channelized Right Turn Location

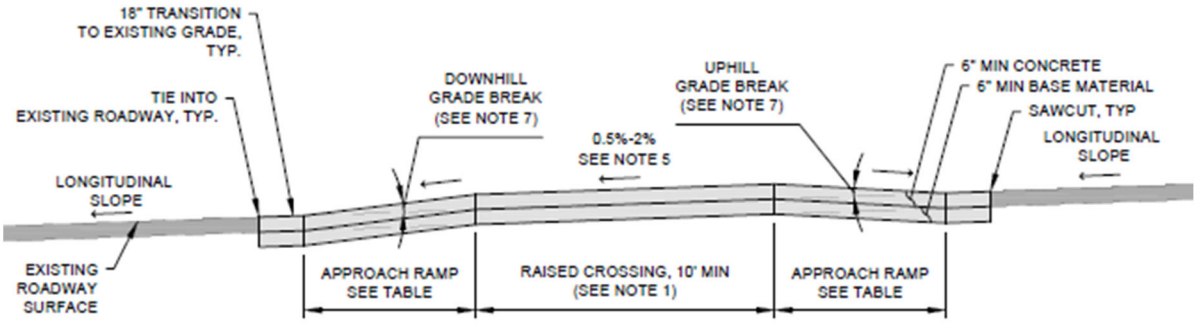


Figure 2-8 - Raised Crossing Typical Section

Table 2-16 Dimensions of Approach Ramp Length For Various Roadway Longitudinal Slopes and Target Grade Breaks

Roadway Longitudinal Slope	Approach Ramp Length			
	5-6% Grade Break		8-10% Grade Break	
	Uphill	Downhill	Uphill	Downhill
0%	5.0-5.5' (3.0'-4.0')	5.0-5.5' (3.0'-4.0')	3.0-3.5' (2.0'-2.5')	3.0-3.5' (2.0'-2.5')
2%	5.0-5.5' (3.0'-4.0')	5.0-5.5' (3.0'-4.0')	3.0-3.5' (2.0'-2.5')	3.0-3.5' (2.0'-2.5')
4%	5.0-5.5' (3.0'-4.0')	8.0-10.0' (6.5'-7.5')	3.0-3.5' (2.0'-2.5')	5.0'-6.0' (4.0'-5.0')
6%	5.0-5.5' (3.0'-4.0')	11.0-13.5' (9.5'-11.5')	3.0-3.5' (2.0'-2.5')	6.5'-8.5' (5.5'-7.0')
Note: Primary ramp lengths assume a 6-inch tall raised crossing. Ramp lengths in parenthesis assume a 4-inch tall raised crossing.				

Table 2-17 Target Grade Breaks For Different Roadway Classifications

Roadway Classification	Grade Break Range	
	Min	Max
Local	8%	10%
Collector	5%	6%
Arterial	5%	6%

CITY OF BOULDER
DESIGN AND CONSTRUCTION STANDARDS

CHAPTER 3
STREETSCAPE DESIGN AND TREE PROTECTION

TABLE OF CONTENTS

LIST OF TABLES

Number **Page**

3.01 General

(A) Intent

The Streetscape Design and Tree Protection Standards are intended to improve public safety by preventing sight distance and facility obstructions, mitigating ~~and~~ sidewalk and street damage, ~~to promote~~promoting suitable landscape species selection for streetscapes, ~~to minimize~~and minimizing tree and landscape maintenance costs.

(B) Scope

These Standards apply to public and private streetscapes and ~~private construction sites where specifiedcontaining existing trees proposed for preservation~~, ~~and~~ include the planting, maintenance, pruning and spraying, protection, and removal of trees and landscaping materials located, standing, or growing within or upon any City of Boulder public right-of-way. Tree p~~P~~rotection standards also apply to ~~private construction sites containing to~~ any existing private trees ~~proposed for preservation~~required to be preserved as a part of a development approval under Title 9 of the B.R.C. 1981. The requirements of this chapter are in addition to and ~~compliment complement~~supplement those set forth in Chapter 10, "~~Streetscaping~~ Streetscape & Landscape Standards," and applicable streetscape drawings in Chapter 11, "Technical Drawings," of these Standards and the B.R.C. 1981.

(C) Reference Standards

Where not specified in these Standards or the B.R.C. 1981, in order to protect the public health, safety, and welfare, the Director of Public Works in consultation with the Director of Parks and Recreation will specify the standards to be applied to the design and construction of streetscapes and the planting of trees and may refer to one or more of the references listed in the References Section of these Standards.

(D) City Approval Required

All work associated with the planting, maintenance, and removal of trees and landscaping materials located, standing, or growing within or upon any City of Boulder public right-of-way is subject to City of Boulder approval or permit issuance as set forth in Chapter 8-5, "Work in the Public Right-of-Way and Public Easements," and Chapter 6-6, "Protection of Trees and Plants," B.R.C. 1981.

3.02 Landscaping Plan

(A) Landscaping Plan Required

An applicant for construction approval involving a project or development where streetscaping improvements are to be provided or potentially impacted by the installation or construction of public improvements, or where prescribed by a C~~C~~ity-adopted subcommunity, area, or special improvement plan, shall submit a Landscaping Plan in compliance with these Standards and those set forth in Chapter 6-6, "Protection of Trees and Plants," Chapter 9-~~3.3~~9, "~~Site~~ Development Standards," and Chapter ~~9~~9--12~~5~~, "Subdivision~~s~~," B.R.C. 1981.

(B) Tree Protection

The Landscaping Plan shall include design details and notes, construction activity controls and measures, and any necessary provisions or restrictions to ensure the protection of existing trees as required in ~~Chapter~~ Section 6-6-6, "Protection of Trees and Plants," B.R.C. 1981, and Section 3.05, "Tree Protection for Construction Sites~~,~~" of these Design & Construction Standards. For ~~large or complicated sites~~projects larger than one single family dwelling, a separate Tree Protection Plan in addition to the required Landscaping Plan shall be required. ~~The city may require tree protection~~All tree protection measures

shall ~~to~~ be installed and monitored by a certified arborist.

(C) Landscaping Plan Requirements

The Landscaping Plan shall be prepared in compliance with the requirements in Section 1.03, "Submittal Requirements for Construction Approval~~,~~" of these Standards~~,~~ and Section 9-9-12, B.R.C. 1981, and shall include but are not limited to the following elements:

(1) Location, ~~type~~species, and size of all existing trees and landscaping materials, and identification of any required tree protection measures as outlined in Section 3.02(B), "Tree Protection~~.~~" of these Standards.

(2) Design location, ~~type~~species, and size of all trees and landscaping materials proposed to be planted, removed, or relocated.

(3) Location of existing and proposed public utilities and transportation improvements and public rights-of-way boundaries.

(4) When a drainage report is required in accordance with Chapter 7 of these Standards, the Landscaping~~e~~ Plan shall display drainage flow arrows and the location of open channels, storm inlets, and stormwater control measures to indicate the interaction between plantings and drainage.

(4~~5~~) Specifications and construction notes for proposed trees and landscaping materials, including without limitation, plant variety types, number and size of plants to be installed, location, sizing, and design details for irrigation systems, planting and maintenance requirements for specific species, tree protection systems and measures, and tree grate type and installation details.

3.03 Street Trees and Plants

(A) Tree Selection

(1) Trees proposed to be planted in non-paved public rights-of-way shall be selected from the ~~Table 31,~~ "Approved ~~Street~~ Tree List ~~List for Non-paved Medians and Landscape Planting Strips,~~" unless an alternative tree selection has been reviewed ~~with~~by the Director of Parks and Recreation and approved ~~by a Cityadopted subcommunity, area or special improvement planthe City of BoulderCity Manager~~by the Director of Public Works. ~~Other species and varieties of trees may be used, subject to City approval.~~ Alternative species and varieties should be thornless, cottonless, minimally fruiting, minimally seeding, and single-stem tree-form varieties.

~~(2) Tree species that are not to be placed in public rights- of- way include: Ash, Box Elder, Cottonwood, Chinese and Siberian Elm, Poplar, Russian Olive, Silver and Norway Maples, Tree of Heaven, Willow, evergreens that create sight obstructions, and clump forms or multistem trees.~~

(~~3~~2) Trees to be planted in non-paved medians or landscape planting strips shall be selected using the minimum planting strip width requirements for the tree species listed in the ~~Forestry a~~ "Approved Tree List" ~~table Table 31~~ for the available planting strip width.

~~(4) Trees selected for narrow (4'-5') planting strips must be upright forms of tree species under the small tree category. Upright varieties of~~ tree species such as ~~crabapple ('Centurion' and 'Red Barron') and pear ('Chanticleer') are recommended for a 4'-5' planting strip along arterial streets where a high volume of traffic is a concern. Other crabapple varieties can be planted in a 4'-5' planting strip along non-arterial streets or in a 6'-7' planting strip.~~

(~~5~~3) Trees shall not be planted in planting strips that are less than 4 feet in width ~~wide or where the planting strip is narrower than the required minimum planting strip width for specific tree species~~. For detached sidewalk landscaped planting strips, the planting strip width is measured from the back edge of curb to the front edge of the sidewalk.

(~~6~~4) Evergreen trees shall not be selected for placement in public rights-of-way medians or landscaping strips, due to the potential for overcrowding, ~~and~~ sight obstructions, and icing~~, unless these concerns can be mitigated and adequate planting strips at least 20 feet wide are provided~~.

(~~7~~5) Whenever possible, trees should be selected from species noted as having ~~"drought tolerant"~~xeric or minimum moisture level requirements as noted in the "Approved Tree List." ~~in consultation with the city forester~~ in Table 31.

(~~8~~6) A variety of trees, as required in Table 3-~~2~~1, "Limitations on Individual Tree Species," shall be selected for planting within any given site or street corridor, including street medians and curbside landscape strips, to prevent uniform insect or disease susceptibility associated with planting a single genus or species. A maximum of three~~3~~ plantings of the same tree species type are allowed to be planted in a row.

(~~9~~7) Trees proposed for the public rights-of-way in the Downtown Area shall follow the guidelines outlined in the most ~~current~~ recently adopted version of the Downtown Urban Design Guidelines~~, 199920022016~~.

Table 3-1: Approved Street Tree List for Non-paved Medians and Landscape Planting Strips

Trees on the following list will do well in our local environment provided the appropriate species is selected for a particular site. (see Table 3-6, "Tree Characteristics") The trees on this list offer a wide range of varieties and cultivars which fit into local landscapes. Tree names are followed by examples of acceptable tree varieties that may be used in streetscapes. Other available varieties of each tree type may be used, subject to City approval, if they are thornless, cottonless, minimally fruiting, minimally seeding, and tree-form varieties. Trees are listed in alphabetical order and are not prioritized according to their suggested use.

Small Maturing Trees **(Under 25' Mature Height)** **Required Planting Strip Width** **4'-5' Minimum** **Spacing Between Trees** **15' Minimum, 20' Recommended**	**Medium Maturing Trees** **(30'-45' Mature Height)** **Required Planting Strip Width** **6'-7' Minimum** **Spacing Between Trees** **25' Minimum, 30' Recommended**	**Large Maturing Trees** **(Over 45' Mature Height)** **Required Planting Strip Width** **8' Minimum** **Spacing Between Trees** **30' Minimum, 40' Recommended**
Crabapple - ***Malus spp.*** **(Fireblight resistant varieties, inc. 'Centurion,' 'Red Barron')**	**Cherry** - ***Prunus sargentii*** **(Sargent)**	**Ash, Green[1,2]** - ***Fraxinus pennsylvanica*** **('Marshall's Seedless,' 'Newport,' 'Patmore,')**
Goldenraintree[1] - ***Koelreuteria paniculata***	**Crabapple** - ***Malus spp.*** **(Fireblight resistant varieties, inc. 'Indian Magic', 'Indian Summer', 'Radiant', 'Spring Snow')**	**Ash, White[2]** - ***Fraxinus americana*** **('Autumn Applause,' 'Autumn Purple,' 'Rosehill')**
Hawthorn - ***Crataegus spp.*** **(thornless cockspur, 'Ohio Pioneer') - Tree Form**	**Hackberry, Common[1]** - ***Celtis occidentalis*** **('Prairie Pride')**	**Baldcypress** - ***Taxodium distichum***
Lilac, Japanese tree - ***Syringa reticulata*** **- Tree Form**	**Honeylocust[1]** - ***Gleditsia triacanthos var. inermis*** **('Imperial,' 'Sunburst')**	**Catalpa, Western[1]** - ***Catalpa speciosa***
Maple, Amur[1] - ***Acer ginnala*** **- Tree Form**	**Hop Hornbeam** - ***Ostrya virginiana***	**Coffeetree, Kentucky[1]** - ***Gymnocladus dioicus***
Maple, Norway - ***Acer platanoides*** **('Crimson Sentry')**	**Hornbeam, European** - ***Carpinus betulus***	**Elm, American** - ***Ulmus americana*** **('Brandon,' 'Valley Forge')**
Maple, Tatarian - ***Acer tataricum*** **- Tree Form**	**Linden, Littleleaf** - ***Tilia cordata*** **('Corinthian')**	**Hackberry, Common[1]** - ***Celtis occidentalis***
Oak, Gambel - ***Quercus gambelii*** **- Tree Form**	**Maple, Norway** - ***Acer platanoides*** **('Cavalier,' 'Drummondi')**	**Honeylocust[1]** - ***Gleditsia triacanthos var. inermis*** **('Shademaster,' 'Majestic')**
Pear - ***Pyrus calleryana 'Chanticleer'***	**Maple, Hedge** - ***Acer campestre***	**Horsechestnut, Common** - ***Aesculus hippocastanum***
Prunus - ***Prunus spp.*** **(Cherries, Plums, Almonds, Apricot[1]) - Tree Form**	**Maple, Wasatch[1]** - ***Acer grandidentatum*** **Tree Form**	**Linden, American** - ***Tilia americana*** **('Legend', 'Redmond')**
Redbud - ***Cercis canadensis*** **- Tree Form**	**Ohio Buckeye[1]** - ***Aesculus glabra***	**Linden, Littleleaf** - ***Tilia cordata*** **('Chancellor,' 'Greenspire')**
Serviceberry - ***Amelanchier spp.*** **- Tree Form**	**Pear** - ***Pyrus spp.*** **(Ussurian, Callery - avoid 'Bradford' variety)**	**Maple, Norway** - ***Acer platanoides*** **('Deborah,' 'Emerald Queen')**
	Turkish Filbert - ***Corylus colurna***	**Maple, Red** - ***Acer rubrum*** **('Northwood', 'Red Sunset')**
		Maple, Sugar - ***Acer saccharum*** **('Green Mountain', 'Legacy')**
		Oak - ***Quercus spp.*** **(Bur[1], English, Red, Shumard, Swamp White[1])**

1 Indicates drought-tolerant species.
2 Green/White ash should be used sparingly and not in large rows or groupings because of major problems with brownheaded ash sawfly and lilac/ash borer.

Table 3-1: Limitations on Individual Tree Species

(The following table applies to all genus and species unless otherwise approved by the ~~City Forester~~~~Manager~~Director)

Number of Trees in the Site or Corridor	Maximum Percentage of Any Genus or Species
≤3	100% Genus
4 to 8	50% Genus
9 to 15	33% Genus
16 to 50	20% Species, 30% Genus
≥51	10% Species, 20% Genus
Note: Any exceptions to the above diversity percentages must be approved by the City Manager. Tree availability at the time of construction may impact tree diversity requirements. Genus and species substitutes, as well as revisions to tree diversity requirements will be reviewed on a project by project basis by the City Manager.	

~~**Table 3-21: Limitations on Individual Tree Species**~~

~~*(The following table applies to trees in both Table 3-1 and Table 3-4all genus and species unless otherwise approved by the City Foresterstaff.)*~~

~~Number of Trees in the Site or Corridor~~	~~Maximum Percentage of Any OneGenus or Species~~
~~10-19~~	~~5033%~~
~~20-39~~	~~2533%~~
~~40 and Over~~	~~1525%~~

(B) Tree Placement in Non-paved Medians and Landscape Planting Strips

(1) Tree placement ~~of deciduous and evergreen trees~~ shall be designed and based on the expected mature height and canopy spread for the selected species, to prevent unnecessary competition or overcrowding of trees.

(2) Trees shall not be placed where the expected mature height and canopy spread could obstruct sight distance of any public sign, driveway, alley, or intersection, as set forth in Section 9~~-3.3-5~~9-7, "Sight ~~Distance~~Triangles," B.R.C. 1981, or where the physical obstruction of any sidewalk, trail, alley, or street lane could occur.

(3) New or transplanted trees shall not be placed within 10 feet of existing underground water, sewer, or storm water utility lines. New underground utilities should not be placed within 10 feet of existing trees without the prior review and approval of the Director.

(4) Trees shall not be placed within ~~20-~~10 feet of any utility pole, streetlight, or pedestal. When tree placement is allowed under overhead ~~power~~ utility lines, only those tree species listed as "Small Maturing Trees"~~-~~ on the "Approved Tree List"~~on Table 31, "Approved Street Tree List,"~~ shall be planted.

(5) Trees shall not be placed within 15 feet of any ditch embankment, and ditch owners should be consulted prior to any tree planting within ditch easements.

(~~5~~6) Trees ~~should~~ shall be located at least 10 feet away from buildings and offset from

building entrances. When available space is limited, only species with ~~columnshaped~~ columnar or ~~pyramidshaped~~ fastigiate forms shall be planted.

(~~6~~7) ~~Trees may~~ shall ~~be planted in right-of-way landscape planting strips adjacent to existing trees on private property only when all trees have enough space to grow to their expected mature size. Trees with narrow forms should be used in the right-of-way when there is the potential for overcrowding with existing trees.~~

(~~7~~8) Trees shall be planted in the center of right-of-way planting strips, or appropriately placed for mature height and spread, to ensure tree health, prevent root damage to sidewalks and street facilities, and to avoid a sight distance obstruction.

~~(8) Trees shall not be placed in medians or landscape planting strips less than 4 feet wide or where the planting strip is narrower than the required minimum planting strip width for specific tree species as listed in Table 3-1, "Approved Street Tree List for Non-paved Medians and Landscape Planting Strips."~~

~~**NOTE**: For detached sidewalk landscaped planting strips, the planting strip width is measured from the back edge of curb to the front edge of the sidewalk.~~

~~(9) Evergreen trees shall be placed at least 10 feet behind the edge of pavement, curbs or sidewalks, or far enough to permit clearance of the tree's mature canopy spread~~ if ~~previously approved by the City.~~

~~(10) Evergreens shall not be placed on the south sides of east-west running streets.~~

~~(11) Deciduous t~~Trees shall not be placed in the right-of-way where the planting strip ~~behind an attached sidewalk, edge of pavement, or curb along roadways without sidewalks~~ extends less than 4 feet to the property line from the back edge of ~~the~~ an attached sidewalk, the edge of the pavement, or the curb ~~to the property line~~.

(~~12~~9) Tree spacing for trees placed in landscaped planting strips shall comply with the "Spacing Between Trees" requirements listed in the species headings in ~~Table 3-21~~, "Approved ~~Street~~ Tree List ~~for Non-paved Medians and Landscape Planting Strips~~." Tree placement should meet the recommended tree spacing and shall not be less than the minimum tree spacing requirements unless approved by the Director.

(C) Tree Placement in Paved Areas Using Tree Grates and Planting Pits

(1) ~~Trees using t~~Trees within grates and planting pits shall be placed in compliance with the design standards for tree spacing and shall ~~generally~~ be planted in a 4 ft. x 10 ft. two piece Neenah Foundry, or approved equal, grate ~~unless otherwise approved through a variance request~~. Tree spacing for tree grates shall comply with the "Spacing Between Trees" requirements listed in the ~~species headings in Table 32,~~ "Approved ~~Street~~ Tree List."

Table 3-3: Tree Grates and Planting Pits Standards

Tree Species Size	Tree Spacing	Minimum Tree Grate Area (Width x Length)	Minimum Soil~~Tree Pit~~ Volume* ~~(Width x Length x Depth)~~
Small Tree	15~~0~~ Ft. minimum, ~~15 Ft. recommended~~	20 Sq. Ft. minimum, 4 Ft. min. width (Ex. 4 ft. x 5 ft.)	600 Cu. Ft. minimum, 3 Ft. min. depth ~~(Ex. 4 ft. x 5 ft. x 3 ft.)~~
Medium Tree	25~~15~~ Ft. minimum, ~~20 Ft. recommended~~	32 Sq. Ft. minimum, 4 Ft. min. width (Ex. 4 ft. x 8 ft.)	900~~6~~ Cu. Ft. minimum, 3 Ft. min. depth ~~(Ex. 4 ft. x 8 ft. x 3 ft.)~~
Large Tree	30~~20~~ Ft. minimum, ~~25 Ft. recommended~~	40 Sq. Ft. minimum, 4 Ft. min. width (Ex. 4 ft. x 10 ft.)	1200 Cu. Ft. minimum, 3 Ft. min. depth ~~(Ex. 4 ft. x 10 ft. x 3 ft.)~~

*–Where soil volumes between trees overlap, up to 25% of the required soil volume per tree may be shared.

~~Table 3-4: Approved Street Tree List for Paved Areas Using Tree Grates and Planting Pits~~

~~SMALL MATURING TREES (Under 25' Mature Height)~~	~~MEDIUM MATURING TREES (30'-45' Mature Height)~~	~~LARGE MATURING TREES (Over 45' Mature Height)~~
~~Crabapple - *Malus spp.* (Fireblight resistant varieties inc. 'Centurion, 'Red Barron')~~	~~Crabapple - *Malus spp.* Fireblight resistant varieties inc. 'Indian Summer, Indian Magic', 'Radiant', 'Spring Snow')~~	~~Ash, Green,[1,2] - *Fraxinus pennsylvanica* ('Marshall's seedless,' 'Newport,' Patmore,')~~
~~Goldenrain[1] - *Koelreuteria paniculata*~~	~~Hackberry[1] - *Celtis occidentalis* ('Prairie Pride')~~	~~Coffeetree, Kentucky[1] - *Gymnocladus dioicus*~~
~~Hawthorn - *Crataegus spp.* (thornless cockspur, 'Cruzam,' 'Ohio Pioneer') Tree Form~~	~~Honeylocust[1] - *Gleditsia triacanthos var. inermis* ('Imperial' 'Sunburst')~~	~~Hackberry, Common[1] - *Celtis occidentalis*~~
~~Lilac - *Syringa reticulata* (Japanese tree) Tree Form~~	~~Hop Hornbeam - *Ostrya virginiana*~~	~~Honeylocust[1] - *Gleditsia triacanthos var. inermis* ('Shademaster,' 'Majestic')~~
~~Maple, Amur[1] - *Acer ginnala* Tree Form~~	~~Hornbeam, European - *Carpinus betulus*~~	~~Linden, American - *Tilia americana* ('Legend', 'Redmond')~~
~~Maple, Tatarian - *Acer tataricum* Tree Form~~	~~Linden, Littleleaf - *Tilia cordata* ('Corinthian')~~	~~Linden, Littleleaf - *Tilia cordata* ('Chancellor,' 'Greenspire')~~
~~Oak, Gambel - *Quercus gambelii* Tree Form~~	~~Ohio Buckeye[1] - *Aesculus glabra*~~	~~Maple, Red - *Acer rubrum* ('Northwood', 'Red Sunset')~~
~~Pear - *Pyrus calleryana* 'Chanticleer'~~	~~Pear - *Pyrus spp.* (Ussurian, Callery - avoid 'Bradford' variety)~~	~~Oak - *Quercus spp.* (Bur[1], English, Red, Shumard, Swamp White[1])~~
~~Prunus - *Prunus spp.* (Cherries, Plums, Almonds, Apricot[1]) Tree Form~~	~~Turkish Filbert - *Corylus colurna*~~	
~~Serviceberry - *Amelanchier spp.* Tree Form~~		

~~1 Indicates **drought tolerant** species.~~
~~2 Green ash should be used sparingly and not in large rows or groupings because of major problems with brownheaded ash sawfly and lilac/ash borer.~~

(2) Tree grates, tree guards, and planting pits shall be provided in locations where a hard surface or paved area is required to adequately accommodate pedestrians, including without limitation downtown or commercial sidewalks, malls, and plazas. The tree grate allows air and moisture to reach tree roots and limits compaction of the soil around the tree to maintain healthy growth.

(3) Trees ~~using~~ within tree grates shall not be placed where the expected mature height and canopy spread could obstruct sight distance of any public sign, driveway, alley, or intersection, as set forth in Section 9-~~3.35~~9-7, "Sight ~~Distance~~Triangle," B.R.C. 1981, or where the physical obstruction of any sidewalk, trail, alley, or street lane could occur.

(4) Trees ~~using~~ within tree grates shall not be placed within 10 feet of any existing underground water, sewer, or storm water utility line or within ~~20~~ 10 feet of any utility poles or pedestal. When tree placement is allowed under overhead ~~power~~ utility lines, only those tree species listed as "Small Maturing Trees" ~~ion Table 3-42,~~on the "Approved ~~Street~~ Tree List ~~for Paved Areas Using Tree Grates and Planting Pits~~," shall be planted.

(5) Trees ~~using~~ within tree grates should be located at least 10 feet away from buildings and offset from building entrances. ~~When available space is limited, only species with column-shaped or pyramid-shaped forms shall be planted~~. Below grade parking structures are considered buildings and ~~must meet~~shall satisfy this requirement.

(6) Adequate growing space between the tree trunk and first ring of the tree grate shall be provided to allow the tree to grow properly without girdling. The opening in the center of the tree grate through which the tree grows shall provide 4-6 inches of clearance from the tree trunk and be at least 1~~8~~2 inches in diameter. The tree shall be centered within the tree grate opening.

~~(7) If large-area tree grates are not available or cannot be used, the required permeable surface area may be provided by using multiple tree grates that are at least 4 feet wide, or by providing a single tree grate around the tree trunk that is at least 4 feet wide in conjunction with natural permeable materials, such as landscaping pavers, over the remainder of the planting pit surface. Any non-standard tree grate frame installation shall have adequate structural support and be approved by the Director.~~

(~~8~~7) The soil surface within a planting pit and beneath a tree grate shall be level with the bottom of the sidewalk slab. This is to avoid problems with root flares lifting grates as the tree grows and allows the roots to find air and water. Trees are then to be planted so that the top of the root ball is 2" above the finished grade of the soil.

(~~9~~8) Planting pits shall be 3 feet deep and have the same surface area as the required tree grate area and may not be deepened unless warranted by the depth of the root ball of the tree to be planted. A planting pit shall not be deepened to increase pit volume as an alternative to providing the minimum tree grate surface area.

(~~10~~) ~~The growth of trees using tree grates shall be monitored to ensure that inner grate rings or the entire tree grate is removed as necessary to prevent girdling the tree.~~

(~~11~~9) Tree grates shall be flush with the finish grade of adjacent pavement ~~final surface grades~~.

(~~12~~10) All tree grates shall be installed per the manufacturer's specifications. Grates shall be supported by a frame which has anchors embedded in the surrounding concrete. Final frame dimensions shall be 1/16 to 1/8-inch larger than the grate dimension on all sides to allow the grate to drop into the frame seat. Frame sections are to be bolted together and cast into the surrounding concrete. Frames must be level and the seat for the grate must be in a true, flat, plane to prevent rocking of the grate. The seat for the grate shall be cleaned prior to setting the grate. To ensure proper fit, the grate or a template ~~should~~ shall be placed in the frame before concrete is poured so that the final installation will be square and level.

(~~13~~11) Tree grates are to be of the pedestrian safe style with slot openings 3/8-inch in width or less and designed to accommodate a tree guard.

(12) Tree guards shall have an 18" opening to match the tree grate and shall be installed per the manufacturer's specifications.

~~(D) Plant Selection and Placement for Landscaping in Medians~~

~~(1) Plants proposed to be planted in medians in the public right-of-way shall be selected from Table 3-1, "Approved Street Tree List for Non-paved Medians and Landscape Planting Strips, or Table 3-4, "Approved Street Tree List for Paved Areas Using Tree Grates and Planting Pits," or Table 3-5, "Approved Median Shrub List," unless an alternative plant selection has been approved by a City-adopted subcommunity, area or special improvement plan.~~the City

~~(2) Median plants selection and placement shall be designed and based on the expected mature height and spread of the selected species, to prevent unnecessary competition or overcrowding of plants and to ensure that the selected mature plants remain within the median width without requiring excessive or frequent pruning.~~

~~(3) Median plants shall not be placed where the expected mature height and spread could obstruct sight distance of any public sign, intersection, or crosswalk as set forth in Section 9-3.3-59-7, "Sight Distance~~Triangles," B.R.C. 1981.

~~(4) Plant species that are not well-suited for median environments and should not be placed in medians in the public right-of-way include: Junipers (select species including `Blue Pfitzer', `Blue Rug', `Calgary Carpet', `Pfitzers', `Sea Green', and `Tam') Bridal Wreath Spirea, Flowering Crabs, Forsythia, Ginnala Maple, Honeysuckle, Pyracantha, and Redtwig Dogwood.~~

~~Table 3-5: Approved Median Shrub List~~

~~*Amorpha, var.* ('Leadplant,' 'Indigo Bush,' etc.)*~~	~~Mountain Mohagany*~~
~~Apache Plume - *Fallugia paradoxa**~~	~~Potentilla - *Potentilla fruticosa*~~
~~*Artemisia* ('Powis Castle')*~~	~~*Prunus besseyi, tenella**~~
~~Barberry~~	~~Rabbitbrush* - *Chrysothamnus nauseosus*~~
~~Cliffrose, Mexican - *Cowania mexicana**~~	~~Sage, Russian - *Perovskia atriplicifolia**~~
~~Cotoneaster (various)~~	~~Sagebrush* - *Artemisia sp.* ('Big,' 'Sand')~~
~~Cranberrybush - *Virburnum opulus* ('Compactum')~~	~~Serviceberry - *Amelanchier alnifolia**~~
~~Fernbush - *Chamaebatiaria millefolium*~~	~~Shrub Rose (various)~~
~~Juniper ('Arcadia,' 'Blue Chip,' 'Broadmoor,' 'Buffalo,' 'Hughes,' 'Scandia')~~	~~Snakeweed - *Gutierrezia sarothrae**~~
	~~Spirea ('Bluemist*,' *bulmalda*, 'Mongolian')~~
~~Lilac* - ('Dwarf,' 'Littleleaf')~~	~~Sumac* - *Rhus aromatica* ('Grolow')~~

~~* Indicates **drought tolerant** species.~~

3.04 Tree Removal and Relocation

(A) Permit Required for Tree Removal or Relocation

(1) An applicant for construction approval shall not remove or relocate any tree existing within any public right-of-way without first having a Llandscaping Pplan approved, ~~and~~ obtaining a right-of-way permit under Chapter 8-5 "Work in the Public Right-of-way and Public Easements," B.R.C. 1981, and receiving any approvals required under Chapter 6-6, "Protection of Trees and Plants," B.R.C. 1981.

(2) An applicant for construction approval may not request C~~c~~ity approval nor propose as part of a Llandscaping Pplan for a project or development the removal or relocation of a tree in the public right-of-way unless:

(a) The site cannot feasibly be developed, through design or construction alternatives, without removing or relocating the tree, and the applicant mitigates the loss of the tree,

(b) The tree is determined by the c~~C~~ity to be undesirable as outlined in Section 3.04(B), "Undesirable Trees for Public Rights-of-Way," below, or

(c) The c~~C~~ity is requiring the removal of a tree as part of construction approval.

(3) Where tree mitigation is required for tree removal ~~per~~pursuant to Chapter 6-6~~-6~~, "Protection of Trees and Plants," B.R.C. 1981., trees required to be planted as part of standard project or development approval will not be counted towards the required mitigation.

(4) Mitigation shall be satisfied when all fees are paid and replacement trees are planted. Mitigation fees shall be determined by the Director and due prior to issuance of building permits. If replacement is appropriate, a Landscaping~~e~~ Plan showing the location,

species and size of all plant material shall be required.

(B) Undesirable Trees for Public Rights-of-Way

The cCity may determine that certain trees located within the public right-of-way are undesirable and may recommend or require removal of these trees if:

(1) The trees are less than 1 inch in caliper, usually representing volunteer trees or suckers that seldom conform to selection and placement standards and are smaller than would be required for new plantings.

(2) The trees are smaller than 12 inches in diameter and are ~~listed as trees not to be placed in the public right-of-way in Section 3.03(A)(2).~~ Cottonwood (any Poplar species), Siberian Elm, Russian Olive, Silver Maple, Tree-of-Heaven, Willow, and evergreens that create sight obstructions, ~~and~~ clump forms, or multi-stem trees.

(3) Trees that have been severely damaged or are in poor general health, as determined by the cCity under generally accepted forestry standards. ~~This determination will not apply if the damage or poor general health is the result of actions or inaction of the adjacent property owner or the applicant for construction approval.~~Trees damaged or in poor general health as the result of actions or inaction of the adjacent property owner requires the loss be mitigated by such property owner per Chapter 6-6, "Protection of Trees and Plants," B.R.C. 1981.

(4) Trees that, due to their species, location, or density would not conform to the existing streetscape standards for tree placement or spacing as outlined in these Standards.

(C) Tree Removal

(1) Trees shall only be removed in compliance with a Llandscaping Pplan, approved by the cCity as set forth in these Standards. Trees shall be required to be removed if greater than 40% of the canopy or root system is damaged or removed during construction as determined by the Director under generally accepted forestry standards.

(2) All trees to be removed shall be marked with an "X" in blue permanent marking and approved by the CCity prior to removal.

(3) All tree removal shall include stump grinding to a minimum depth of 12 inches.

(D) Tree Relocation (Transplanting)

(1) Trees with a "transplanting ease" rating of 1 or a 2, as defined in the *Tree and Shrub Transplanting Manual*, are considered eligible for transplanting, subject to cCity approval. All transplanting shall be in a location approved by the cCity.

(2) Trees eligible for transplanting shall meet the following requirements:

(a) Be 8 inches or less in caliper, unless approved by the cCity, and

(b) Have a root ball size of 1 foot per 1 inch of trunk caliper, evenly distributed on all sides from the center line of the trunk. For example, a tree with a 4-inch caliper shall have a root ball with a 4-foot diameter, evenly distributed with 2 feet on all sides from the centerline of the trunk.

(3) Transplanting shall be done only by a certified arborist with a valid contractor license pursuant to Chapter 4-28, "Tree Contractor License," B.R.C. 1981~~an experienced tree professionala licensed arborist or tree contractor per Chapter 4-28, B.R.C. 1981~~ and ~~according to~~in accordance with a L~~l~~andscaping P~~p~~lan approved by the c~~C~~ity.

(4) The applicant for construction approval shall ensure that the transplanted tree survives without significant loss of tree value in compliance with the tree protection standards set forth in Chapter 6-6, "Protection of Trees and Plants," B.R.C. 1981.

(5) Transplanting periods:

(a) Transplanting shall be done between ~~February 15~~December 1 and April 30 for all trees, except for trees identified in the *Tree and Shrub Transplanting Manual* as unsuitable for early spring transplanting.

(b) Trees identified as unsuitable for early spring transplanting shall be transplanted only between September 15 and October 30.

3.05 Tree Protection For Construction Sites

(A) Tree Protection Required

(1) An applicant for construction approval shall protect trees and plants in the public right-of-way and on any project or construction site where public improvements are proposed.

(2) An applicant for construction approval shall submit a landscaping plan incorporating proposed tree protection measures for any existing trees located in the public right-of-way and on site at any project or construction site where public improvements are proposed in compliance with these Standards. For projects larger than one single family dwelling, a separate Tree Protection Plan in addition to the required Landscaping Plan shall be required.

(3) The L~~l~~andscaping P~~p~~lan shall identify any potential detrimental effects to existing trees that might result from proposed construction activities within 20 feet of the dripline of any existing trees located on site or in the adjacent public right-of-way. The plan shall include the species, size, and location of all existing trees that are ~~1~~2-inches or larger caliper size. If no existing trees are present that require protection, this shall be noted on the Landscaping~~e p~~Plan. Existing trees approved to be removed or relocated shall be clearly identified on the ~~landscaping~~ L~~l~~andscaping~~e~~ Plan and ~~/~~Tree ~~p~~Protection P~~p~~lan.

(4) The applicant for construction approval shall notify the c~~C~~ity within 24-hours of any

suspected damage to trees resulting from construction activities. If damage occurs during construction, the applicant shall have the damaged tree ~~restored~~ evaluated immediately by a ~~City of Boulder licensed~~ certified ~~qualified~~ arborist with a valid contractor license pursuant to Chapter 4-28, "Tree Contractor License," B.R.C. 1981.

(5) If greater than 425~~0~~% of the canopy or root system is damaged or removed during construction, the tree shall be evaluated for safety and future health by a certified arborist with a valid contractor license pursuant to Chapter 4-28, "Tree Contractor License," B.R.C. 1981. A complete copy of the evaluation shall be submitted to the Director. Mitigation shall be required if the tree is deemed unsafe and is required to be removed.

(6) Prior to issuing a right-of-way permit or building permit or upon discovery of any damage to existing trees located in the public right-of-way and identified in the Landscaping Plan, the Director may require an applicant for construction approval to provide an escrow of funds or other financial guarantee that is acceptable to the Director for the full value of any such trees, as determined by the Director in accordance with the Guide for Plant Appraisal published by the Council of Tree and Landscape Appraisers, for the duration of construction activities and the public improvement warranty period. If, upon completion of construction activities and the public improvement warranty period, any damaged trees have not been restored by a qualified arborist or replaced by trees of an equivalent or greater value, the Director may cause such restoration or replacement to be completed and collect against the financial guarantee.

(7) Upon discovery of any violation of the Landscaping Plan or any damage to existing trees located in the public right-of-way and identified in the landscaping plan, the Director may issue a stop work order and halt all construction activities pending restoration, mitigation, or replacement of the damaged trees to the satisfaction of the Director.

(B) Tree Protection Procedures

(1) **Protective Maintenance:** An applicant for construction approval shall provide maintenance and care for existing trees required to be protected on site and in the public right-of-way adjacent to any project or construction site during construction activities and the public improvement warranty period, as provided in Section 9-12-14 "Public Improvement Warranty" B.R.C. 1981, to ensure that existing trees survive and are not damaged.

(2) **Watering**: The applicant for construction approval shall water trees identified for protection in the Tree Protection Plan in accordance with the following: Water trees 1"-3" in diameter weekly at a rate of 10 gallons/inch of diameter; water trees 4"-9" in diameter 3x per month at a rate of 10 gallons /inch of diameter; and water trees 10" in diameter or larger 2x per month at the rate of 15 gallons-/-inch of diameter. The above schedule shall be followed April –through September; October –through March the trees shall be watered once per month following the above amounts.

(~~2~~3) **Soil Compaction Prevention:**

(a) To prevent soil compaction, designated routes for equipment and foot traffic by

work crews shall be determined prior to commencing construction activities and as indicated in the Llandscaping Plan and / Ttree Pprotection Pplan.

(b) These planned routes shall be marked at the site before construction commences with durable fencing material that is at least 4 feet high. Flagging tape or any other material that may be torn down, moved, or evaded is not acceptable.

(c) The contractor shall inform all construction crew members on the site of access routes and will ensure that only these routes are used.

(d) To prevent tree root smothering, no soil stockpiles, supplies, equipment, portable toilets, or any other material shall be placed or stored within a tree dripline or within 15 feet of the tree trunk ~~for columnshaped and evergreen trees~~, whichever distance is greater.

(e) Soil around a tree dripline may be required to be aerated during and after construction activities. This is necessary even when compaction results from heavy foot traffic. A certified arborist with a valid contractor license pursuant to Chapter 4-28, "Tree Contractor License," B.R.C. 1981~~City of Boulder licensed certified professional arborist~~ shall perform ~~do~~ the vertical aeration or soil fracturing. ~~SOoil fracturing techniques comparable to using a "growgun" with Isolite material are acceptable~~. Conventional turf aeration is not acceptable.

(f) When foot traffic or equipment use is unavoidable within the dripline, the area within the dripline shall be mulched with wood chips to a depth of 6 inches before construction activity begins. A ~~6inch~~6-inch mulch depth shall be maintained for the duration of the project, then removed when construction activities are completed.

(~~3~~4) **Root Protection:**

(a) Tree roots shall not be cut unless cutting is unavoidable.

(b) When root cutting is unavoidable, a clean, sharp cut shall be made to avoid shredding or smashing. Root cuts should be made back to a lateral root.

(c) Root cutting shall only be performed by a certified arborist with a valid contractor license pursuant to Chapter 4-28, "Tree Contractor License," B.R.C. 1981.

(~~e~~d) Whenever possible, tree roots should be cut between late fall and bud opening, when root energy supplies are high, and conditions are least favorable for disease causing agents.

(~~d~~e) The ~~City Forester~~Manager Director shall be notified of any cutting of the following roots:

(i) Two roots having a diameter of more than 3 inches, or

(ii) Four roots having diameters between 2 and 3 inches.

(~~e~~f) Trenches shall be hand dug within the dripline ~~in areas where roots 2 inches and larger in diameter are present, and when low branches which may be damaged by equipment are present~~.

(~~f~~g) Whenever possible, roots 2 inches or larger in diameter shall be tunneled or bored under and shall be covered to prevent dehydration. Exposed roots shall be covered immediately with soil or burlap and kept moist.

(~~g~~h) Power tools shall not be used to prune roots, with the exception of arboriculturally approved root cutting- equipment used under the supervision of the City. Only the following approved tools shall be acceptable: scissorstype hand pruners and loppers, except -anviltypes, and -arboristtype- pruning saws.

(~~h~~i) ~~When more than one root 2 inches or larger in diameter on any public tree is cut, s~~Supplemental watering, in addition to the requirements of section 3.05 B-(2), shall be provided if the tree lacks an operational sprinkler system. The applicant or abutting landowner shall provide the watering. Watering shall commence immediately after roots have been cut or damaged at the following rates:

i. 1”-3” diameter: water weekly at a rate of 10 gallons/inch of diameter;

ii. 4”-9” diameter: water 3x per month at a rate of 10 gallons-/inch of diameter; and

iii. 10” diameter or larger apply water 2x per month at the rate of 15 gallons /-inch of diameter.

The above schedule should be followed April through– September; ~~for~~ October through March the trees shall be watered once per month following above amounts.

(~~i~~j) Sidewalk and paving surfaces shall be sufficiently contoured to avoid cutting surface tree roots. Whenever possible, tree roots ~~should be~~shall bridge~~ed~~ or float~~ed~~ over with walks.

(~~j~~k) To allow maximum aeration and water penetration to roots, walk materials other than concrete may be selected (e.g., brick, flagstone, honeycomb block, chips, gravel) subject to C~~C~~ity approval. Under no circumstances shall impervious material make contact with or completely encircle a tree trunk.

(~~k~~l) Auger tunneling, not trenching, shall be used ~~where possible~~ for utility placement within the dripline of ~~a mature trees (~~trees measuring over 6 inches in ~~DBH~~diameter~~)~~.

(~~l~~m) If roots are cut ~~between March and August~~, ~~trees~~ the Director may require~~need~~ supplemental deep root watering ~~at the discretion of the City ForesterManagerDirector. once per week for at least 2 months after the roots are cut. When roots are cut between September 1 and October 15, trees may need~~

~~supplemental watering once per week until at least October 31~~.

(~~m~~n) Trees impacted by construction activities~~ roots~~ shall not be fertilized for a period of 1 year following the cessation of construction activities. Thereafter, for the next 2 years, a light annual fertilization using a ~~slow release~~slow release nitrogen source is acceptable.

(4~~5~~) **Tree Fencing:**

(a) Fencing material shall encircle any tree, including those on adjacent properties, whose outer dripline edge is within 20 feet of any construction activities.

(b) Fencing material shall be a bright, contrasting color, durable, and at least 4 feet high. Fence posts shall be comparable to metal T-posts or heavier posts and placed at least 1.5~~2~~ feet below ground.

(c) Fencing material shall be placed at the dripline or at least 15 feet from any tree trunk, whichever distance is greater, and maintained in an upright position throughout the duration of construction activities.

(d) The applicant for construction approval shall indicate fencing locations on the landscaping tree protection plan.

(e) ~~Heavy~~ O~~o~~bjects, such as wood pallets or metal railings, shall not lean against or come into contact with any tree trunk.

(~~5~~6) **Grade Changes:** Grade changes, such as removing topsoil or adding fill material, shall not occur within the dripline of any existing tree. If necessary, as part of project or site development and ~~if~~ approved by the ~~C~~ityDirector, retaining walls and tree wells may be used to maintain the existing grade within the dripline of any tree ~~may be acceptable~~ when constructed prior to site grading changes near the tree. A landscaping plan containing an illustrated design scheme of the tree protection improvement shall be approved by the c~~C~~ity prior to initiating any grade changes near existing trees.

(~~6~~7) **Transplanting:** Any proposed or required transplanting shall conform with the requirements in Section 3.04(D), "Tree Relocation (Transplanting)."

(~~7~~8) **Chemical/Foreign Material Disposal:**

(a) Disposing of chemicals or foreign material anywhere on site or in the public right-of-way is prohibited. This shall include, but is not limited to: paint, stain, solvents, concrete or any construction material onsite, and rinse water from any cans or tools containing chemicals.

(b) Soil samples may be taken to determine the presence of chemicals or foreign materials for any planter containing proposed or existing plant material.

(~~8~~9) **Pruning:** Pruning shall not occur during construction activities or the public improvement warranty period, except to remove dead or damaged branches or to prevent

branch damage that could occur during construction, without the prior approval of the ~~City Forester~~Manager Director. Any approved pruning must be completed by a certified arborist with a valid contractor license pursuant to Chapter 4-28, "Tree Contractor License," B.R.C. 1981~~a c~~City of Boulder ~~licensed certified arborist.~~ ~~Pruning of healthy branches shall be delayed for a period of 2 years after construction activities are completed.~~

~~(9) **Watering**: For trees 1" 3" diameter water weekly at a rate of 10 gallons/inch of diameter; for trees 4" 9" diameter water 3x per month at a rate of 10 gallons /inch of diameter; for trees 10" diameter or larger apply water 2x per month at the rate of 15 gallons / inch of diameter. The above schedule should be followed April – September; for Oct – March apply water once per month.~~

3.06 General Landscaping and Maintenance Requirements

(A) Protecting Existing Improvements

An applicant for construction approval shall preserve and protect all trees, plants, monuments, structures, and public improvements from damage due to construction activities.

(1) **Utilities:** The applicant shall ask the appropriate utility company to stake exact locations and depths of all water, sewer, electric, gas, or telephone lines prior to excavation, and shall take the necessary precautions to protect underground lines from damage. If damage occurs, the applicant shall pay all repair costs.

(2) **Existing Trees:** Protection shall comply with Section 3.05, "Tree Protection for Construction Sites."

(3) **Responsibility for Damages:** The applicant shall be responsible for any damage to trees, plants, fences, buildings, roadways, sidewalks, and public and private property resulting from the applicant's activities. The c~~C~~ity may require an applicant to provide, at no cost to the c~~C~~ity, ~~devices~~ durable fencing to prevent damage to fragile plant materials or structures. Damage to trees in shall be calculated in accordance with the Guide for Plant Appraisal published by the Council of Tree and Landscape Appraisers. If the applicant or an agent thereof damages a tree to such an extent that it must be removed and replaced, the applicant shall be responsible for the cost of removing and replacing the damaged tree with a tree approved by the Director, plus the difference in value between the full appraised value of the removed tree minus the cost of removal and replacement.

(4) **Omissions and Discrepancies:** Omissions from any approved landscaping plan or specifications that affect the intent of the plans or specifications, or that are customarily performed, shall be performed as if fully and clearly set forth and described in the plans and specifications.

(B) Maintenance ~~of Landscaping~~

(1) ~~Landscaping~~ Landscape maintenance shall begin immediately after each area is planted and shall continue following ~~City~~ Director acceptance through the applicable warranty period, or in perpetuity, as set forth in Section ~~9~~3.34-9-12(d)(2)~~,~~ "Landscape and Screening Maintenance and Replacement," Section ~~9~~49-12-13 "Subdivider Financial

Guarantees ~~19-2-14, "Required Improvements and Financial Guarantees~~," ~~or~~ and Section 9-12-14~~,~~ "Public Improvement Warranty," B.R.C. 1981.

(2) ~~Landscaping~~ Landscape maintenance shall include, without limitation, watering, weeding, cultivating, mulching, tightening and repairing of guys, removal of guy wires and tree stakes after the first full growing season, removal of tree wrap prior to April 1, removing dead branches, resetting plants to proper grade or upright position, replacing dead plants and protecting the site from damage or vandalism. ~~Landscape maintenance also includes the removal of tree wrap and guy wires and tree stakes from all trees after the first full growing season.~~

(3) If required by the ~~City~~Director, the applicant for construction approval shall furnish written maintenance instructions to the ~~City~~ Director for the care and maintenance of all newly planted areas for the applicable warranty period. These instructions shall include, but are not limited to: irrigation, staking, pruning, insect and disease control, and fertilizing.

Table 3-6: Tree Characteristics

The following table describes the typical characteristics of trees on the Approved Street Tree List when planted in non-paved landscape planting strips. Trees growing in tree grates or planting pits will have an overall mature height of approximately 1/3 less than that of trees in non-paved areas.

Small Maturing Trees
(Under 25' Mature Height)

COMMON & SCIENTIFIC NAME	SIZE AND FORM	CHARACTERISTICS
Crabapple (*Malus 'Red Barron' or Malus 'Centurion'*	15-25' ht., 7-15' spread, broad upright	Adaptable water requirements once established, adapts well, attractive blossoms in early spring, very little to no fruit, resistant to fireblight, requires full sun
Goldenraintree (*Koelreuteria paniculata*)	20-25' ht., 15-20' spread, broadly globe-shaped	Drought tolerant once established, tolerates wide range of soil types, attractive yellow flowers in mid-summer, yellow fall color, grows in full sun or partial shade
Hawthorn (*Crataegus spp.* - thornless cockspur or 'Ohio Pioneer')	15-25' ht., 15-25' spread, broadly globe-shaped, plant tree form only	Adaptable water requirements once established, tolerates salt and alkaline soils, attractive blossoms in spring, thornless, resistant to fireblight but susceptible to rust, requires full sun
Lilac, Japanese tree (*Syringa reticulata*)	15-25' ht., 15-20' spread, moderately globe-shaped, plant tree form only	Adaptable water requirements, attractive white blossoms in late spring, golden fall color, grows in full sun or partial shade
Maple, Amur (*Acer ginnala*)	15-20' ht., 15-20' spread, broadly globe-shaped to irregular, plant tree form only	Drought tolerant once established, can become chlorotic in alkaline soils, brilliant red to orange or yellow fall color, requires full sun
Maple, Norway (*Acer platanoides* 'Crimson Sentry')	25' ht., 15' spread, dense and columnar	Adaptable water requirements once established, dark purple foliage in spring and summer, susceptible to sunscald, requires full sun
Maple, Tatarian (*Acer tataricum*)	20-25' ht., 15-20' spread, moderately globe-shaped, plant tree form only	Adaptable water requirements once established, seeds are a rosy red color, yellow to orange red fall color, grows in full sun or partial shade
Oak, Gambel (*Quercus gambelii*)	10-25' ht., 10-15' spread, broadly globe-shaped, plant tree form only	Tolerant of dry and alkaline soils, Colorado native, yellow to red fall color, requires full sun
Pear (*Pyrus calleryana* 'Chanticleer')	20-30' ht., 15-20' spread, narrow pyramidal shape	Adaptable water requirements once established, tolerates salt and alkaline soils, attractive white blossoms in spring, maroon fall color, resistant to fireblight, requires full sun
Prunus (*Prunus spp.*) Ex. Cherries, plums, almonds, apricot	20-25' ht., 20-30' spread, moderately globe-shaped, plant tree form only	Adaptable water requirements, most have attractive spring blossoms, bears fruit, grows in full sun or partial shade
Redbud (*Cercis canadensis*)	20-25' ht., 20-30' spread, moderately globe-shaped, plant tree form only	Moist to adaptable water requirements, needs protected location, pink to lavender blossoms in early spring, yellow fall color, prefers filtered shade to shade
Serviceberry (*Amelanchier spp.*)	25' ht., 10-20' spread, moderately ovate-shaped, plant tree form only	Adaptable water requirements once established, prefers acidic soils, attractive flowers in early spring, yellow to orange red fall color, plant

		varieties resistant to fireblight, grows in sun or shade

Medium Maturing Trees
(30-45' Mature Height)

COMMON & SCIENTIFIC NAME	SIZE AND FORM	CHARACTERISTICS
Cherry, Sargent (*Prunus sargentii*)	30-45' ht., 20-30' spread, moderately globe-shaped	Adaptable water requirements, attractive blossoms in spring, bears fruit, grows in full sun or partial shade
Crabapple (*Malus 'Indian Magic', 'Indian Summer', 'Radiant', 'Spring Snow'*)	15-30' ht., 15-30' spread, broad globe-shaped to rounded	Adaptable water requirements once established, adapts well, attractive blossoms in early spring, very little to no fruit, resistant to fireblight, requires full sun
Hackberry (*Celtis occidentalis* 'Prairie Pride')	45' ht., 30-40' spread, moderately pyramidal-shaped	Drought tolerant once established, tolerates a wide range of soil conditions, yellow fall color, does not develop witches broom, grows in full sun to partial shade
Hawthorn (*Crataegus spp.* - thornless cockspur or 'Ohio Pioneer')	15-25' ht., 15-20' spread, broadly globe-shaped	Adaptable water requirements once established, tolerates salt and alkaline soils, attractive blossoms in spring, thornless, resistant to fireblight but susceptible to rust, requires full sun
Honeylocust (*Gleditsia triacanthos* var. *inermis* 'Imperial' or 'Sunburst')	30-45' ht., 30-35' spread, moderately globe-shaped	Drought tolerant once established, tolerant of salt and alkaline soils, transplants easily, fruitless, thornless, yellow fall color, susceptible to many insect and disease problems, requires full sun
Hop Hornbeam (*Ostrya virginiana*)	30-45' ht., 20-35' spread, moderately ovate-shaped	Requires moist to moderately dry soils once established, prefers acidic soils, salt sensitive, grows in full sun or partial shade
Hornbeam, European (*Carpinus betulus*)	30-45' ht., 15-30' spread, dense, narrow pyramidal to oval-shaped	Adaptable water requirements once established, grows well in clay and alkaline soils, salt sensitive, yellow fall color, grows in full sun or partial shade
Linden, Littleleaf (*Tilia cordata* 'Greenspire' or 'Glenleven')	40-45' ht., 25-35' spread, broadly to moderately pyramidal-shaped	Tolerates alkaline soil, withstands compaction, salt sensitive, yellow fall color, young trees susceptible to sunscald, grows in full sun or partial shade
Maple, Norway (*Acer platanoides* 'Cavalier' or 'Drummondi')	35-45' ht., 30-40' spread, broadly globe-shaped	Adaptable water requirements, deep maroon leaf color, susceptible to sunscald, requires full sun
Maple, Hedge (*Acer campestre*)	25-45' ht., 25-35' spread, dense, moderately globe-shaped	Adaptable water requirements once established, tolerates compaction and alkaline soils, easily transplanted, yellow fall color, grows in full sun or partial shade
Maple, Wasatch (*Acer grandidentatum*)	20-30' ht., 20-25' spread, broadly globe-shaped	Drought tolerant once established, tolerant of alkaline soils, very slow to establish, Colorado native, yellow to red orange fall color, grows in full sun or partial shade
Ohio Buckeye (*Aesculus glabra*)	30-45' ht., 25-35' spread, broadly ovate to globe-shaped	Drought tolerant once established, large fruit, purple to red fall color, requires full sun
Pear (*Pyrus spp.* - Ussurian or Callery - avoid 'Bradford' variety)	30-40' ht., 25-35' spread, moderately columnar-shaped	Adaptable water requirements once established, tolerates salt and alkaline soils, attractive white blossoms in spring, maroon fall color, resistant to fireblight, requires full sun
	45' ht., 25-30' spread, moderately	Adaptable water requirements once

Turkish Filbert (*Corylus colurna*)	pyramidal-shaped	established, tolerates alkaline soil, difficult to transplant, free from insect and disease problems, requires full sun

Large Maturing Trees
(Over 45' Mature Height)

COMMON & SCIENTIFIC NAME	SIZE AND FORM	CHARACTERISTICS
Ash, Green (*Fraxinus pennsylvanica* 'Patmore' or 'Marshall's Seedless' or 'Newport')	50-60' ht., 35-45' spread, moderately to broadly ovate-shaped	Drought tolerant once established, tolerates salt and alkaline soils, transplants easily, yellow fall color, susceptible to both brownheaded ash sawfly and lilac/ash borer, requires full sun
Ash, White (*Fraxinus americana* 'Autumn Applause' or 'Autumn Purple' or 'Rosehill')	40-60' ht., 40-50' spread, moderately globe-shaped	Adaptable water requirements, purple to red fall color, susceptible to both brownheaded ash sawfly and lilac/ash borer, requires full sun
Baldcypress (*Taxodium distichum*)	50-60' ht., 20-40' spread, moderately pyramidal-shaped	Tolerates wet soils and moderate drought once established, deciduous conifer, golden yellow fall color, free from insect and disease problems, requires full sun
Catalpa, Western (*Catalpa speciosa*)	40-60' ht., 30-50' spread, moderately ovate-shaped	Drought tolerant once established, large attractive white blossoms in summer, produces pod fruit, requires full sun
Coffeetree, Kentucky (*Gymnocladus dioicus*)	50-70' ht., 40-50' spread, moderately globe-shaped	Drought tolerant once established, tolerant of alkaline soils, free from insect and disease problems, requires full sun
Elm, American (*Ulmus americana* 'Brandon' or 'Valley Forge')	45-55' ht., 40-50' spread, broadly vase-shaped	Adaptable water requirements once established, tolerant of salt and alkaline soils, fast growth rate, easily transplanted, yellow fall color, requires full sun
Hackberry, Common (*Celtis occidentalis*)	50-60' ht., 40-50' spread, moderately globe-shaped	Drought tolerant once established, tolerant of salt and a wide range of soil conditions, requires full sun
Honeylocust (*Gleditsia triacanthos* var. *inermis* 'Shademaster' or 'Majestic')	50-60' ht., 30-40' spread, moderately globe-shaped	Drought tolerant once established, tolerant of salt and alkaline soils, transplants easily, fruitless, thornless, yellow fall color, susceptible to many insect and disease problems, requires full sun
Horsechestnut, Common (*Aesculus hippocastanum*)	50-60' ht., 50-60' spread, broadly globe-shaped	Adaptable water requirements, has attractive large white blossoms in early summer, large fruit, requires full sun
Linden, American (*Tilia americana* 'Legend' or 'Redmond')	50-60' ht., 30-40' spread, moderately pyramidal-shaped	Adaptable water requirements once established, tolerant of alkaline soils, easily transplanted, young trees susceptible to sunscald, grows in full sun or partial shade
Linden, Littleleaf (*Tilia cordata* 'Greenspire' or 'Chancellor')	45-60' ht., 40-50' spread, broadly pyramidal-shaped	Adaptable water requirements, tolerant of alkaline soils and pollution, easily transplanted, yellow fall color, young trees susceptible to sunscald, requires full sun

Maple, Norway (*Acer platanoides* 'Deborah' or 'Emerald Queen')	45-60' ht., 40-50' spread, broadly globe-shaped	Adaptable water requirements, deep maroon leaf color for 'Deborah', yellow fall color for 'Emerald Queen', susceptible to sunscald, requires full sun
Maple, Red (*Acer rubrum* 'Northwood' or 'Red Sunset')	45-55' ht., 25-40' spread, moderately globe-shaped to upright	Adaptable water requirements once established, can become chlorotic in alkaline soils, salt sensitive, orange red to brilliant red fall color, requires full sun
Maple, Sugar (*Acer saccharum* 'Green Mountain' or 'Legacy')	50-60' ht., 30-40' spread, moderately ovate-shaped	Adaptable water requirements once established, prefers acidic soils, salt sensitive, red to orange fall color, can grow in full sun or shade
Oak, Bur (*Quercus macrocarpa*)	50-80' ht., 50-80' spread, broadly ovate to broadly globe-shaped	Drought and wind tolerant once established, tolerant of a wide range of soil types, yellow to brown fall color, requires full sun
Oak, English (*Quercus robur*)	50-80' ht., 50-80' spread, broadly ovate to broadly globe-shaped	Tolerant of a wide range of soil types, yellow to yellow-brown fall color, requires full sun
Oak, Shumard (*Quercus shumardii*)	50-80' ht., 50-80' spread, broadly ovate to broadly globe-shaped	Adaptable water requirements once established, tolerates compaction and salt, does better in alkaline soils than red oak, russet red to red fall color, requires full sun
Oak, Red (*Quercus rubra*)	50-80' ht., 50-80' spread, broadly ovate to broadly globe-shaped	Prefers acidic soils, can become chlorotic in alkaline soils, russet red to bright red fall color, requires full sun
Oak, Swamp White (*Quercus bicolor*)	50-80' ht., 50-80' spread, broadly ovate to broadly globe-shaped	Drought tolerant once established but can also withstand wet conditions, can become chlorotic in alkaline soils, yellow fall color, requires full sun

CITY OF BOULDER
DESIGN AND CONSTRUCTION STANDARDS

CHAPTER 10
~~STREETSCAPING~~ STREETSCAPE & LANDSCAPE STANDARDS

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10.01 General

(A) Intent

The ~~Streetscaping l~~Streetscape and Landscape Standards are intended to ~~compliment~~ ~~complement~~supplement the design standards specified in Chapter 3, "Streetscape Design and Tree Protection," of these Standards, and provide minimum standards for the construction and planting of streetscapes in public rights-of-way.

(B) Scope

These Standards apply to streetscapes and public landscapes located, standing, or growing within or upon any City of Boulder public right-of-way or park. The streetscape requirements of this chapter are in addition to those set forth in Chapter 3, "Streetscape Design and Tree Protection," and applicable streetscape drawings in Chapter 11, "Technical Drawings," of these Standards and the B.R.C. 1981.

(C) Reference Standards

Where not specified in these Standards or the B.R.C. 1981, in order to protect the public health, safety, and welfare, the Director of Public Works in consultation with the Director of Parks and Recreation will specify the standards to be applied to the design and construction of streetscapes and public landscapes ~~streetscapes~~ and the planting of trees, and may refer to one or more of the references listed in the References Section of these Standards.

(D) City Approval Required

All work associated with the planting, maintenance, and removal of trees and landscaping materials located, standing, or growing within or upon any City of Boulder public right- of- way is subject to City of Boulder approval or permit issuance as set forth in Chapter 8-5, "Work in the Public Right- of- Way and Public Easements," and Chapter 6--6, "Protection of Trees and Plants," B.R.C. 1981.

(E) Water Conservation

All landscaping shall be designed for maximum water efficiency, as specified in Section ~~93.33, "Landscape Design Standards,"~~9-9-12-9-12 "Landscaping and Screening Standards," B.R.C. 1981.

(F) Public Lands Other Than Public Rights-of-Way

Unless otherwise ~~approved~~required ~~noted in city standards~~by the Director in consultation with the Director of Parks and Recreation, all l~~L~~andscaping construction activities on public lands other than public rights-of-way, such as parks, open space and greenway corridors, are exempt from the construction and planting requirements of these Standards. However, these Standards may be used as a basis for construction and planting activities on all public lands.

10.02 Site Preparation

(A) Description

Site preparation includes, without limitation, layout, tree protection, demolition, clearing, excavation, fill and backfill, addition of topsoil~~ing~~, and finish-grading.

(B) Materials

Planting soil nutrient and mechanical compositions are unique to individual sites, species, and project conditions such as geotechnical recommendations and green infrastructure requirements. One soil type may not be viable across an entire project. The ~~below specifications are~~following requirements ~~guidelines, however, all planting conditions must be analyzed~~shall be satisfied to ensure proper soil nutrients and mechanical composition are provided.

(1) **Imported Fill:** Imported fill for landscaping shall be clean, fertile, sandy loam soil that is free from turf, lime, ashes, debris, noxious weeds, roots, stones over 4 inches in diameter, harmful chemicals, or other materials that are detrimental to plant growth. Fill shall have a pH of 6.0 to 8.0, salt of less than 2 mmhos/cm, sodium absorption ratio of less than eight, and at least an 85 percent germination rate for narrow and broadleaf plants. Fill shall not be hauled in a frozen, wet, or muddy condition. An agricultural suitability analysis of the proposed topsoil from an accepted, accredited t~~T~~esting a~~A~~gency at c~~C~~ontractor's cost ~~is~~shall be provided to the City ~~required~~ to confirm nutrient and mechanical requirements are met.

(2) **Native ~~Top~~Ssoil:** Surface soil in the areas designated on the soils plan as existing soil ~~, that is~~ shall not be altered, compacted to root limiting density, graded or contaminated before or during the construction process and shall be considered acceptable for planting and long-term health of the plants specified either as it exists or with only minor modification. An agricultural suitability analysis of the proposed topsoil from an accepted, accredited t~~T~~esting a~~A~~gency at c~~C~~ontractor's cost ~~is~~shall be provided to the City ~~required~~ to confirm nutrient and mechanical requirements are met.

(3) **Soil Requirements for Imported and Native Soil:**

(a) Topsoil shall be fertile, friable, sandy loam topsoil. Topsoil shall be ~~of any admixture of subsoil or slag and shall be~~ free of stones over 1~~½~~ inch~~es~~ in diameter, lumps, refuse, plants or their roots, sticks, noxious weeds, salts, soil sterilant~~s~~ or other material that is detrimental to plant growth. ~~If topsoil is delivered, it shall be obtained from a well-drained site that is free of flooding.~~ Topsoil shall not be delivered or used while in a frozen or muddy condition.

(b) Topsoil shall have an acidity range of pH 6.0 to ~~7.5~~8.0 and contain not less than 5 percent organic matter as determined by loss on ignition of moisture-free samples dried at 100 degrees Centigrade. Topsoil shall have salt of less than 2 mmhos/cm and a sodium absorption ratio of less than eight.

(c) Topsoil shall meet the mechanical analysis outlined in Table 10-1, "Topsoil Mechanical Analysis," of these Standards:

Table 10-1: Topsoil Mechanical Analysis

	Passing percent	Retained percent
1-inch screen	100%	0 - 0%
½-inch screen	97 - 100%	0 - 3%
No. 100 mesh sieve	60 - 40%	40 - 60%

~~(d) Topsoil shall have at least an 85 percent germination rate for narrow and broadleaf plants.~~

(C) Construction Requirements

(1) **Layout:**

(a) The contractor is responsible for:

(i) Establishing and recording all necessary boundary points, lines, elevations, grades, access points, and benchmarks onsite for proper control, landscape protection, coordination with subcontractors, and execution of the work.

(ii) Verifying all furnished survey and topographic data, all points, lines, and elevations.

(iii) Notifying the Director of any discrepancies between information on approved construction plans and actual site or field conditions or measurements and receive approval for required modification prior to continuing work.

(iv) Staking all cuts and fills on the sites as shown on the grading plan.

(b) Shoulders and toes of slopes shall be smoothly blended to the flat areas.

(c) No cut or fill is allowed within the dripline of existing trees without the prior approval of the ~~City Manager~~Director ~~per~~pursuant to S~~s~~ection 3.05(B)(5) of these Standards.

(2) **Clearing of Project Site:** The contractor is responsible for:

(a) Removing from the site all trees and shrubs, brush and weed growth, stumps, and root systems designated on the approved construction plans for removal.

(i) All trees to be removed shall be marked with an "X" in blue permanent marking and approved by the ~~City Manager~~Director prior to removal.

(ii) All other plant material not designated for removal shall be protected and maintained consistent with ~~the standards of~~ Chapter 3.05(B) of these Standards.

(iii) Stripped-off brush and weed growth shall be hauled offsite. No burning or nesting of materials shall be permitted onsite.

(b) Maintaining adequate fire protection while clearing operations are underway.

(c) Replacing any existing sod damaged by construction operations. Replacement sod shall meet the standards of Section 10.04, "Seeding/Sodding," of these Standards.

(d) If specifically required on the approved construction plans, scalping the top of soil, including grasses and roots, to a depth specified in the plans and stockpile onsite or remove as indicated.

(3) **Excavation:** The contractor is responsible for:

(a) Stripping, stockpiling, and replacing existing topsoil in areas of fill on the finished grade to at least 4 inches deep.

(b) Excavating so as to provide adequate drainage of the site at all times.

(c) Using hand methods of excavation within the dripline of trees ~~and per Root Protection~~pursuant to root protection requirements in ~~Chapter~~Section 3.05(B)(3) of these Standards.

(4) **Fill and Backfill Operations:** The contractor is responsible for the following:

(a) Obtaining the Director's approval of the subgrade before commencing soil preparation, ~~topsoiling~~adding of topsoil, finish grading or planting, and obtaining the Director's approval of the finish grade before commencing planting, mulching or other subsequent operations. The following grading tolerances shall be applied:

(i) Tolerances shall not exceed 0.1 feet above or below desired subgrade elevations in planted areas, and no tolerance will be allowed on subgrades prepared for paving or site improvements, or subgrades immediately adjacent to curbs or island pavements.

(ii) Settling of finish grade shall not exceed 0.1 feet.

(b) Completing clearing operations before beginning any filling or backfilling.

(c) If sufficient suitable fill or backfill material is not available on the project site, furnishing additional materials according to standards for hauled-in fill or topsoil, as required in these Standards.

(d) Placing fill and backfill in layers not to exceed 6 inches in compacted depth with the following compaction standards:

(i) Each layer shall be compacted to the specified density. Landscaping fill and backfill shall be compacted to no less than 80 percent and no more than 85 percent density in areas to be planted.

(ii) Compaction shall not occur when soil is wet.

(e) Ensuring that filling and backfilling shall provide adequate site drainage at all times. Fill or backfill shall not be placed on wet ground.

(5) **Finish Grading:**

(a) Work in this section shall consist of cutting, filling, shaping, and grading according to the lines, grades, elevations and cross sections on the approved landscaping or engineering plans.

(b) The contractor is responsible for the following:

(i) Completing all finish grading onsite. The top of the subgrade shall be the depth below the finish~~ed~~ grade as required for pavements, sod, walks, mulches and other site improvements.

(ii) Protecting the finish grade areas and regrading to correct any irregularities caused by hauling materials or by other operations over the finish~~ed~~ grade.

(iii) Repairing any erosion or other damage resulting from weathering action before final acceptance.

(c) Excavated and filled sections and adjacent transition areas shall be smooth, properly compacted and free from irregular surface changes. The degree of finish grading shall be that ordinarily obtained from either blade, grader, or scraper operations. Where finishing cannot be satisfactorily completed with power equipment, hand methods shall be used.

(d) Unless otherwise indicated, the subgrade shall be evenly sloped to provide drainage away from site improvements or the centerline of medians. Swales shall be cut as shown on the plans but shall not reduce the thickness of the topsoil specified.

(e) Finish grading shall conform to the grade elevations shown on an approved landscaping plan and shall be free from debris and other materials that would be detrimental to the subgrade. Settling of any finish grade shall not be more than 0.1 feet, and if settling is greater, the contractor shall bring the grade to specified elevations.

10.03 Planting

(A) Description

Planting includes, without limitation, the placement of live trees and shrubs, the placement of materials to protect and enhance plant growth, and the methods applied in planting and maintaining landscape plants.

(B) Materials

(1) **Edger:** Ryerson or approved equivalent steel edger, 1/8-inch by 4- inch steel with steel stakes, painted with rust-inhibiting black paint. The edger shall have a rolled or folded edge or be capped with plastic safety-edged material.

(2) **Filter Fabric:** Fabric shall not be used with any planting unless specifically approved as part of a detailed Landscaping Plan. Fabric shall not be used within the driplines of

any existing trees or within 10 feet of any newly planted trees. If approved, fabric shall be 30.1-mil DeWitt Weed Barrier or approved equivalent.

(3) **Pesticides:** Comply with the specifications of ~~Section~~ Chapter 6-10, "Pesticide Use," B.R.C. 1981.

(4) **Tree Wrapping Material:** New, 4-inch wide, bituminous impregnated tape, corrugated or crepe paper, brown in color, specifically manufactured for tree wrapping. Tree wrapping shall be fixed with pliable or nonbinding tape. No wire shall be used. If tree wrapping is used, the tree wrap shall be removed by April 1 of the following growing season.

(5) **Compost:** Well-weathered and weed-free cow or sheep manure or other composted materials. No mountain peat shall be used.

(6) **Stakes:** Green 8-foot steel tee posts with blade.

(a) Trees shall be secured to stakes using minimum 2-inch-wide nylon and cotton blend webbing with heat sealed ends, a tensile strength of 1000 pounds and brass grommets for attachment of wire between strap and stake.

(b) Grommets shall be 1 ¼ - inch in diameter with a ½ -inch diameter eye that is set at least ½ -inch from end of strap.

(c) Wire shall be 12-gauge galvanized steel covered with a PVC sleeve.

(d) Straps shall be of sufficient length in relation to tree caliper so that grommets do not touch trunk.

(e) A protective cap shall be secured to the top of all stakes.

(7) **Mulch:**

(a) Wood chip mulch shall be clean wood chips or fiber, free of soil or man-made debris, shredded into coarse pieces ranging in size from 1 inch~~es~~ to 3 inches. All ~~median~~ landscape plantings shall be mulched with ~~2-4 to 6~~4 3 to 4 inches of wood chips. ~~2 to 4 inches of "Squeegee" (1/4 inch minus washed sand) may be substituted for wood mulch for street median applications only.~~

(b) Rock, gravel, ~~or~~ cobblestone, or other inorganic material shall not be used in planting beds ~~mulch shall not be used in planting beds, except~~ as a temporary or permanent mulch. ~~until full plant coverage is achieved, or as permanent mulch under shrubs. Rocks used in the public right-of-way or adjacent to sidewalks must be 1 ½ to 3 inches in diameter. Gravel or cobblestone shall not be used as mulch~~ unless specifically approved as part of a detailed Landscaping Plan.

~~(c) For medians and bikeways, landscape fabric shall not be used as a weed barrier.~~

(8) **Plant Materials:**

(a) All plants shall be ~~"Colorado Grown," "Colorado Fielded," or~~ "Northern Grown" ~~as described below,~~ unless otherwise specified in these Standards, except for plants of the genus *Juniperus*.

~~(i) Colorado Grown: plants grown in Colorado nursery fields for the major portion of their lives.~~

~~(ii) Colorado Fielded: plants shipped in or collected that have grown in Colorado nursery fields for at least two full growing seasons prior to delivery.~~

~~(iii)~~(i) Northern Grown means~~:~~ plants grown in nurseries for at least two full growing seasons located in hardiness Zones 1 through 5, as shown on a United States Department of Agriculture map.

(b) All plants shall be appropriate for the local climate and site-specific growing conditions. All plants shall be of species identified under and allowed by these Standards and shall conform to the following:

(i) Selected to meet the goal of maximum water efficiency and zoned or grouped according to their water requirements in accordance with Section 9-9-12, ~~,~~"Landscaping and Screening Standards," B.R.C. 1981.

(ii) Individually identified on legible, weatherproof labels securely attached to the plants. Labels shall be durable and shall remain legible for at least 60 days from site delivery.

(iii) Labels shall include the correct genus, species, variety name, ~~and~~ accepted common name of the plant, ~~as well as the~~ size or grade of stock, and source nursery of the plant.

(iv) Labels shall remain until after City inspection and then shall be removed by the contractor.

(c) Tree selection and placement shall be in accordance with Section 3.03, "Tree Selection and Placement," of ~~the~~ these Standards.

(d) Trees shall conform to and have the following characteristics:

(i) A well-developed branch structure typical of the size and species with no "V" crotches, codominate stems, or included bark. The height of branching should bear a relationship typical of size and species so that the crown of the tree will be in balance as the tree grows.

(ii) Healthy buds, stems, and bark that are without mechanical, injury, insect, or disease signs or symptoms.

(iii) Healthy, vigorous, and free from visual defects, mechanical injuries, plant diseases, and all forms of insect infestation until final acceptance.

(iv) A -well-branched and vigorous root system typical of size and species and free from bent or kinked roots, roots girdling the trunk, and other defects.

(v) All trees shall be balled and burlapped. Root balls shall have a sufficient diameter for the fiberous and feeding root system necessary to provide for full recovery of the tree following planting. Minimum root ball sizes shall meet the following specifications outlined in Table 10-2,

Table 10-2: Minimum Root Ball Sizes

Caliper	Minimum Root Ball Diameter
1 ½"	20"
1 ¾"	22"
2"	24"
2 ½"	28"
3"	32"

(vi) Shrubs may be either balled and burlapped or container grown.

~~**Table 10-2: Minimum Root Ball Sizes**~~

~~Caliper~~	~~Minimum Root Ball Diameter~~
~~1 ½"~~	~~20"~~
~~1 ¾"~~	~~22"~~
~~2"~~	~~24"~~
~~2 ½"~~	~~28"~~
~~3"~~	~~32"~~

(e) All trees and shrubs shall be freshly dug at time of delivery, unless they are container-grown. ~~Plants other than bare root stock that have been heeled-in for more than 1 month or that exhibit roots outside the original ball shall not be accepted. Bare root stock placed in cold storage for more than 2 months or that exhibits new top growth will not be accepted.~~

~~(f) Moss rock shall be sandstone boulders with 75 percent or more exposed surface covered with lichens. Boulders shall have rounded natural edges and a character and shape consistent with native landscape rock settings. No split, bruised face, slab-type, layered, or slide rocks shall be used without prior approval and acceptance by the Right of Way inspector.~~

(C) Construction Requirements

(1) **Layout and Identification:** The contractor shall use stakes, flags, or containerized plants to locate all trees and shrubs according to an approved landscapinge plan.

(2) **Schedule:**

(a) Nothing shall be planted between October 15 and March 1 without prior written

approval of the ~~City Manager~~Director. Stock, other than container-grown stock, shall not be planted between June 1 and September 1 without prior written approval of the ~~City Manager~~Director. ~~Bare root stock shall not be planted after April 30 or if plants have begun to leaf out.~~

(b) Nothing shall be planted during freezing or excessively windy, hot, or wet weather or when the ground conditions cannot be properly worked for digging, mixing, raking, or grading.

(c) Nothing shall be planted until the adjacent site improvements, pavements, irrigation installation and finish grading is completed. ~~The contractor shall test the irrigation system in the presence of the Director.~~ The irrigation system shall be in approved, operating condition prior to any planting.

(3) **Plant Protection and Delivery:**

(a) The contractor shall protect all installed plant material from injury, excessive drying or winds, improper ventilation, over watering, freezing, high temperatures, or any other condition damaging to the plant until final acceptance. Any plants showing evidence of poor care or that are molded, mildewed, wilted, or dried-out shall be rejected. Colored waxes or other materials that coat the aerial parts of plants, or the removal of primary buds and/or shoots, including terminal buds and first order leaders, of plants are not acceptable.

(b) Plant materials shall be planted on the day of delivery if possible. All plants not planted on day of delivery shall be placed in a temporary nursery, kept moist, shaded and protected from sun and wind. If balled and burlapped plants are not planted on the day of delivery, they shall be heeled-in immediately in the temporary nursery, kept moist and protected with damp soil, mulch~~moss~~, or other acceptable material. All plants shall be planted within 48 hours after delivery. Plants shall not be bound with wire or rope that may damage the bark or break branches. Plants shall be lifted and handled from bottom of ball or container and shall not be dropped or lifted by the trunk, stem or foliage. Plants with balls that are loose, cracked, broken, man-made or completely dry or plants with trunks loose in the ball before or during planting operations shall not be accepted and shall be removed from the site at contractor's expense. ~~The root collar is not to be deeper than 4 inches below shall be flush with the top of the soilroot ball.~~

(c) The contractor shall deliver all packaged landscape materials to the site in original unopened containers bearing name, trade name, manufacturer, trademark, and conformance to State Law.

(d) Existing trees shall be protected per Section 3.05, “Tree Protection for Construction Sites,” of these Standards.

(4) **Excavation of Planting Pit:**

(a) All plant pits shall be centered on the plant location and excavated in a cylindrical shape with vertical sides and flat bottom. The depth of the plant pit

shall be measured from ~~the~~ adjacent finish~~ed~~ grade of the soil, not from the mulch. The base of all soil balls shall be placed on undisturbed soil.

(b) Trees: The diameter of all tree pits shall be at least two times the diameter of the ball or spread of the roots. Tree pits shall be excavated so that the top of the ball will be ~~3~~ 2 inches above finish~~ed~~ grade ~~grade when irrigated and 2 inches when not irrigated~~.

(c) Shrubs: The diameter of all shrub pits shall be at least two times diameter of the ball or spread of roots. Shrub pits shall be excavated so that the top of the ball will be 1 inch above finish grade.

(d) Vines and Ground Covers: The diameter of all vine and ground cover pits shall be two times the spread of roots. The planting pit shall be excavated so that the top of the ball is 1 inch above finish grade.

(e) All holes and pits shall be protected as specified in the General Conditions at all times when work is not being carried on at the site of excavation.

(5) Planting and Staking for Plant Installation:

~~(a) Plants shall be set in the center of the pit on the undisturbed subgrade. Immediately after setting in the pit, all materials shall be completely removed from the ball and trunk, including but not limited to plastic, metal, wire, wood, cardboard, paper, fiber, burlap, and twine. Container removal and plant handling shall minimize injury to the plant, the root system, and the soil ball. If the root system of a container grown plant has become container-bound, the outside of the root mass shall be cut with a hand saw on all four sides prior to planting.~~

~~(b) All plants shall be placed and kept plumb and straight as the pit is filled with backfill. Any plant that is not plumb prior to final acceptance shall be rejected.~~

~~(c) After placing plant in the pit, the hole around the plant root system shall be halfway backfilled and any large air pockets removed by hand with the blunt, handle end of a shovel or other such hand tool. If the ball is excessively dry, the contractor shall then insert a deep watering device into the ball at a 45 degree angle every 12 inches for 1 minute. The pit shall then be lightly filled with backfill mix and compacted again with the shovel. No mechanical compaction shall be allowed. The pit shall then be watered by thoroughly saturating the backfill with water to a minimum depth of 3 feet. No watering shall be done prior to this time. Watering shall be repeated once when all free water has disappeared; this second watering shall not be completed if the subgrade around the pit is already moist. After watering, the contractor shall add the necessary soil to establish the finish grade level before adding specified mulch. The contractor shall remove all surplus soil and debris, and stake and guy trees immediately after planting.~~

(a) For all trees, the contractor shall drive stakes 3 feet vertically into firm soil outside the planting pit with blade on tree side. The contractor shall run a double

strand of wire through one grommet in the strap, wrap the strap around the trunk at no more than one-third the height of tree, and run wire through other grommet and back to stake. Strap and wire attachment between the stake and tree shall be adjusted so that straps are under just enough tension to avoid visible sag in lines. Rigid guying shall not be accepted. Straps and wires shall be placed so as to be perpendicular to the trunk. Stakes shall be parallel or slightly angled away from the trunk.

(b) The contractor shall place stakes according to tree height or caliper as follows: deciduous trees under 2 inches in width - one stake oriented northwest; deciduous trees between 2 and 3 inches in width, and evergreen trees less than 5 feet in height - two stakes oriented northwest and southeast; deciduous trees 3 inches in width and larger and evergreen trees 5 feet in height and larger - three stakes with one oriented northwest and the other two oriented 120 degrees in either direction from northwest.

(c) All deciduous trees shall have a sod-free base at least 3 feet in diameter. All evergreen trees shall have a sod free base extending to the dripline. This sod free area shall be extended where necessary to include all stakes.

(d) The contractor shall return to the site and remove all stakes and guy wires between May 21 and June ~~7 after~~7 after one full growing season.

(e)~~(d)~~ Unless otherwise specified, all areas designated for mass planting such as for ground covers or vines shall be amended with 5~~6~~ cubic yards per 1,000 square feet of manure compost. The contractor shall first prepare the subgrade by discing or rototilling the subgrade to a depth of 8 inches. No ripping or chiseling shall be allowed. After preparing the subgrade, the amendments shall be thoroughly rototilled into the soil to a depth of 8 inches. The contractor shall remove any rocks, debris or foreign matter in excess of 1 inch in length or diameter encountered to an 8-inch depth or in a manner adequate to accommodate typical root depth of the specified plant material.

~~(e) For all trees, the contractor shall drive stakes 3 feet vertically into firm soil outside the planting pit with blade on tree side. The contractor shall run a double strand of wire through one grommet in the strap, wrap the strap around trunk at no more than one-third the height of tree, and run wire through other grommet and back to stake. Strap and wire attachment between the stake and tree shall be adjusted so that straps are under just enough tension to avoid visible sag in lines. Rigid guying shall not be accepted. Straps and wires shall be placed so as to be perpendicular to the trunk. Stakes shall be parallel or slightly angled away from the trunk.~~

~~(f) The contractor shall place stakes according to tree height or caliper as follows: deciduous trees under 2 inches and under - one stake oriented northwest; deciduous trees 2" and larger, than 2 inches but less than 3 inches and evergreen trees less than 5 feet in height - two stakes oriented northwest and southeast; deciduous trees 3 inches and larger and evergreen trees 5 feet and larger - three stakes with one oriented northwest and the other two oriented 120 degrees in~~

~~either direction form northwest. All deciduous trees shall have a sod-free base at least 3 feet in diameter. All evergreen trees shall have a sod free base extending to the dripline. This sod free area shall be extended where necessary to include all stakes. The contractor shall return to the site and remove stakes between May 21 and June 7 the following spring.~~

~~(g) The contractor shall remove all stakes and guy wires no more than one year from the date of tree installation.~~

(6) **Spraying, ~~Wrapping,~~ Pruning, Watering and Mulching for Plant Installation:**

~~(a) All deciduous trees shall be wrapped by the contractor from November 1 - 15 of the year in which they are planted. Specified tree wrap shall be cut in a continuous strip of sufficient length to wrap the tree. This wrapping shall begin at the ground line with overlapping wraps of 1½ inches terminating above the lowest main branch of the tree. Final wrap shall be secured with tape in at least three places. The contractor shall return to the site and remove wrap from April 1 - 15 of the following spring. The contractor shall notify the City at least 1 week prior to wrap removal.~~

~~(b) After inspection, and with the approval of the City, the contractor shall prune plants as necessary to remove only dead, injured, diseased, or crossing branches. All cuts shall be made just outside of the flare (branch collar) of the branch base. All pruning shall be executed so as to preserve the natural form and character of the plant. The contractor shall return to the site between May 21 and June 7 the following spring and prune all dead, diseased or injured branches from plants as specified above. The contractor shall notify the City at least 1 week prior to commencing pruning.~~

(~~c~~a) After watering on the day of planting, and throughout the maintenance period, the contractor shall ensure that all plants are sufficiently, but not over, watered. The contractor shall water each plant with a minimum of 10 gallons of water per diameter inch trunk width per week unless otherwise specified in an approved Tree Protection Plan.

(~~d~~b) Wood chip mulch shall be placed in all planting beds, shrub areas and the sod-free area of a 3-foot radius at the base of each tree. The mulch shall be spread carefully and evenly to a depth of 3-4 inches. Mulch shall be removed 2 inches back from the trunk. Shredded wood chip mulch shall be watered thoroughly two times to aid in matting the mulch in place. The mulched areas shall be graded so that the top of the mulch will be flush with the top of the curb, sidewalk, edging or sod.

~~(e) Rock mulch shall be placed evenly to a minimum depth of 2 inches.~~

(~~f~~c) The contractor shall be responsible for damage to any underground utility, irrigation line, paving, adjacent structures or other improvements. In the event a pipe, line, rock formation, or other obstruction interferes with a plant location,

the contractor shall notify the Director to receive approval for a new plant location.

~~(7) **Moss Rock Installation Procedure:**~~

~~(a) The contractor shall notify the Director prior to moss rock placement work in order to direct the contractor in a continuous operation of placing the rock with the designated quantities. The contractor shall provide manpower and equipment to place rock in 1 day and shall haul excess rock away from site.~~

~~(b) The contractor shall install rock boulders according to the layout and configuration of the rock work as shown on the plans. Moss rock shall be set on a compacted base (to 90 percent Proctor Density within 2 percent optimum moisture content). Rockwork joints shall be made tight by butting natural faces together in place. Soil grades shall be adjusted to stabilize rocks in position and regraded in place to establish the placement of each rock so that they blend into adjacent terrain. Rocks are to be placed by terracing or stepped layers to achieve a naturalized effect. Finish grades shall be re-established as necessary.~~

10.04 Seeding/Sodding

(A) Description

(1) Seeding/sodding includes, without limitation, the planting and installation of grasses (native or otherwise), preparation of soils and grading, and the methods to be applied in planting and maintaining of grasses until full establishment is achieved.

~~(2) Medians less than 12 feet wide shall be landscaped with materials other than irrigated turfgrass.~~

(B) Materials

(1) **Fertilizer:** Specified fertilizer shall be supplied in the original supplier's containers with label and order form showing composition and quantity. Fertilizer shall be intact, free-flowing, dry and in quantity, as specified for sodded or seeded areas, as shown on the plans. Fertilizer for sod and seeding soil preparation shall be a compound equivalent ~~to~~ to 18~~0~~-46-0 applied at the rate of 10 pounds per 1,000 square feet.

(2) **Bluegrass:** Bluegrass shall be Colorado-grown, 100 percent certified Kentucky Bluegrass, of three improved bluegrass varieties complying with applicable Colorado and Federal regulations. Newport, Park, Delta and Common Kentucky Bluegrass are not acceptable varieties for the sod mixture. The sod shall have a vigorous and healthy root system and top growth and shall have been regularly fertilized, watered, mowed, sprayed and shall be free from objectionable weeds and/or grasses. Sod strip shall have from 5/8 inch minimum to 1-inch maximum thickness of soil adhering to root system, cut into strips 18-inch maximum width by 4 feet minimum length. Sod that has dried out, or sod with adhering soil that breaks, tears or crumbles away will not be accepted. Sod cut for more than 24 hours shall not be accepted. Sod rolls shall be kept moist, protected from sun, heat or wind in transport and after delivery. Prior to cutting, the sod shall be evenly mowed for a blade length of at least 1 inch but not more than 2 inches.

(3) **Turf-type Tall Fescue:** Turf-type tall fescue seed or sod shall be purchased from a reputable seed dealer, complying with requirements specified. Seed mixture shall be of at least three varieties (a maximum of five) of dwarf type tall fescue (i.e., Monarch, El Dorado, Rebel Jr., Crew Cut, SR 8200, or other approved varieties).

(a) PLS shall not be less than 88 percent.

(b) Specified PLS shall be calculated as shown in Section (5)

(4) **Buffalo Grass:** Buffalo grass shall be either seed, plugs, or sod.

(a) Buffalo grass seed shall be purchased from a reputable seed dealer, complying with the requirements specified. Seed mixture shall be "Texoka" or "Sharp's Improved" or approved equivalent.

(i) PLS shall not be less than 75 percent.

(ii) Specified PLS shall be calculated as shown in Subsection (B)(5).

(b) Buffalo grass plugs or sod shall be 100 percent certified turf-forming variety 609, or approved equivalent. Buffalo grass imported from states south of Colorado may be approved due to the difficulty in establishing sod in the front range climate.

(i) All sod shall be healthy, in vigorous condition, of natural green color, free of disease and harmful insects. The sod shall be laid within 48 hours of harvest.

(ii) Plugs shall be cut from sod as described in this Section. Nursery grown plugs are acceptable with prior approval by the Director.

(c) If sod is to be used for medians larger than 12 feet wide, Buffalo grass is preferred.

~~(5) **Native Seed:** Native grasses and wildflowers for median plantings are listed in tables 10-3 and 10-4. Native grass seed shall be purchased from a reputable seed dealer, complying with requirements specified. Seed mixture shall be "Foothills" mix as provided by Arkansas Valley Seed Company (303.320.7500), or approved equivalent.~~

~~(a) PLS shall not be less than 80 percent (average for the seed mix).~~
~~(b) Quantity of bulk seed required to provide the specified PLS shall be calculated from purity and germination percentage rates listed on the lot tag of seed actually purchased, using the following two formulas:~~

$$\frac{\text{Purity Percentage} \times \text{Germination Percentage}}{\text{PLS Percentage}} = \text{PLS specified per 1000 square feet}$$

$$\frac{\text{PLS specified per 1000 square feet}}{\text{PLS percentage}} = \text{Bulk lbs. required per 1000 square feet}$$

~~**Table 10-4: Grasses**~~

~~Common Name~~	~~Latin Name~~	~~Type~~
~~Arizona fescue~~	~~*Festuca arizonica*~~	~~Turf~~
~~Big bluestem~~	~~*Andropogon gerardii*~~	~~Ornamental~~
~~Blue grama~~	~~*Chondrosum gracile (Bouteloua gracilis)*~~	~~Ornamental/Turf~~
~~Bluebunch wheatgrass~~	~~*Pseudoroegneria (Agropyron) spicatum*~~	~~Ornamental~~
~~Buffalograss~~	~~*Buchloe dactyloides*~~	~~Turf~~
~~Indian ricegrass~~	~~*Achnatherum (Orzyopsis) hymenoides*~~	~~Ornamental~~
~~Junegrass~~	~~*Koeleria macrantha*~~	~~Ornamental/Turf~~
~~Little bluestem~~	~~*Schizachyrium scoparium*~~	~~Ornamental~~
~~Mountain muhly~~	~~*Muhlenbergia montana*~~	~~Ornamental/Turf~~
~~Needle-and-thread~~	~~*Hesperostipa (Stipa) comata*~~	~~Ornamental~~
~~New Mexico feathergrass~~	~~*Hesperostipa (Stipa) neomexicana*~~	~~Ornamental~~
~~Prairie dropseed~~	~~*Sporobolus heterolepis*~~	
~~Prairie sandreed~~	~~*Calamovilfa longifolia*~~	~~Ornamental~~
~~Sand dropseed~~	~~*Sporobolus cryptandrus*~~	
~~Side-oats grama~~	~~*Bouteloua curtipendula*~~	~~Ornamental~~
~~Western wheatgrass~~	~~*Pascopyrum (Agropyron) smithii*~~	~~Turf~~

Table 10-~~5~~4: Soil Amendment Mix Mechanical Analysis

	Percent (%) Passing	Percent (%) Retained
2" Screen	100	0
1" Screen	90-100	0-10
½ " Screen	50-80	20-50
#100 Mesh Sieve	0-15	85-100

(5~~4~~) **Soil Amendment:** Soil amendment for sod and seed areas, shall be manure compost, and shall contain at least 50 percent organic matter. The mixture shall be free from clay subsoil, sawdust, commercial wood products, stones, lumps, plants, roots, sticks, weed stolons and seeds, high salt content, and other materials harmful to plant life. The materials shall be coarsely ground and thoroughly mixed together to ensure an even composition. Cow manure or mushroom compost shall be free from lumps, debris or chemicals harmful to landscape plantings. The soil amendment mix shall have an acidity from pH 5.5 to 8.0, and meet the mechanical analysis outlined in Table 10-~~3~~4, "Soil Amendment Mix Mechanical Analysis," of these Standards.

(6~~5~~) **Erosion Control Netting:** Jute mesh erosion control netting or approved equivalent shall be used.

(C) Construction Requirements

(1) Subgrade and Soil Preparation:

(a) The contractor shall lay out and stake the boundary of all areas to be sodded, seeded, or plugged prior to commencing any work. ~~After Director approval of finish grades, t~~The contractor shall prepare the subgrade of all seeded or sodded areas by discing or rototilling the soil to a depth of 6 inches. No ripping or chiseling shall be allowed. No rototilling or discing is to be done within the protection area of existing trees. After the subgrade has been completed, soil preparation shall begin by spreading the soil amendment evenly within the seeding or sodding limits at the rate of ~~3~~(~~5~~6) cubic yards per 1,000 square feet. ~~If topsoil is used as the subgrade for sod or seed, soil amendment will not be required. Soil amendment is not required in areas to be seeded with native grasses.~~

(b) For sod, ~~0-46-0~~-18-46-0 fertilizer shall then be spread uniformly over the entire area at the rates as specified for soil preparation. The area shall again be disced or rototilled at right angles to the first tillage, then formed by rolling to provide a proper seed bed or sodding surface. The sod or seed bed shall be totally free from rock, debris, vegetable matter, ~~noxious~~ weeds or clay clods over ½ inch diameter, prior to any sodding or seeding operations.

(2) Finish and Fine Grading:

(a) Positive Surface Drainage: The contractor shall finish and fine grade the project area to establish an even and well-matched grade over the entire surface. Positive surface drainage shall be assured, and there shall be no depressions, subsequent settling or irregularities in the finished grade.

(b) Transitional Areas: At any transitional point or line where one plane intersects another, such as from a sloping area or berm to a level area, a smooth and gentle transition shall be made. There shall be no abrupt changes in grade. There shall also be a smooth transition between existing turf and the new sod. The grade elevations of the two areas shall be matching.

(3) **Schedule:** All seeding shall be scheduled between March 1 and October 15 unless prior written approval from the Director has been obtained.

(a) No sodding and seeding shall take place during inclement weather.

(b) No sodding and seeding work shall commence until the adjacent site improvements, pavements, irrigation installation and finish grading is completed. The irrigation system shall have been tested and be in operating order prior to any seeding or sodding.

(c) The contractor shall barricade sodded area immediately after sod installation as

specified on the approved construction plans or in these Standards. The barricade shall include the following:

(i) Standard construction lath at 5-foot intervals connected with three tiers of colored plastic flagging.

(ii) "KEEP OFF THE SOD" signs attached to the barricading every 25 feet.

(4) **Seeding:**

(a) ~~Following approval of the seed bed by the Director,~~ Sseeding shall be done with a Brillion drill or approved mechanical seeder. Seed shall be evenly distributed on a still day into a slightly moist seed bed. Seed shall be drilled 1/8 inch into the prepared seed bed. If the slope is too steep to drill, seed shall be broadcast at double the application rate and covered with 1/8 inch of soil with a harrow or hand rake for small areas. The seeding shall be done in two separate applications crossing the area at right angles to guarantee proper coverage. Drill seed across slopes rather than up and down, following the contour to reduce erosion.

(i) Native grasses shall be seeded at a rate of 20 pounds PLS/acre when drilled and 35 pounds PLS/acre when broadcast.

(ii) Buffalo grass shall be seeded at a rate of 3 pounds PLS/1000 square feet when drilled and 5 pounds PLS/1000 square feet. when broadcast.

(iii) Turf type tall fescue shall be seeded at a rate of 6 pounds/1000 square feet when drilled and 9 pounds/1000 square feet when broadcast.

(b) After seeding operations have been completed, the entire seeded area shall be hydromulched with "Conwed 2000" or approved equal hydro mulch material. The hydro mulch shall be applied by using mechanical hydromulcher, evenly distributed on a still day. The hydro mulch material shall be applied at the rates recommended by the manufacturer. Within 12 hours after seeding, the sprinkler system shall be activated to moisten seeded areas to a depth of 1 inch. All seeded areas shall be kept so moistened by frequent light watering until final acceptance of the project or as required by City Land Use Regulations, and such watering shall be the responsibility of the contractor.

(c) Protect seeded slopes (greater than 2.5 horizontal to one vertical) with erosion control netting or other methods acceptable to the Director. Cover netting with straw or other acceptable mulch.

(d) Seeding is not complete and will not be accepted until 70% coverage is achieved with the intended species.

(5) **Bluegrass Sodding:**

(a) Sod shall be laid on a firm, premoistened bed with tight joints so that no voids occur under or between strips. All end joints shall be staggered, and the sod roll

length shall run perpendicular to all slope fall lines. Sod shall be tamped, rolled, and watered immediately after sodding operations are completed.

(b) No sod shall be installed within a radius of 3 feet around any tree within the project limits. Shredded wood chips shall be installed to a 3-inch depth in this 3 foot area. All rolls terminating at the project limits shall be cut in a straight line unless otherwise specified and the exposed edge covered with topsoil. All sod installed around planting beds shall be cut to conform to the shape of the bed as shown on plan or laid out onsite. Sod shall be laid flush with paving, curbs and irrigation heads and 1 inch below the top edge of steel edging.

(c) In the event that sod dries or shrinks, a mixture of screened topsoil and specified bluegrass seed shall be brushed into the cracks and tamped flush. Excessively shrunk sod (over 3/4-inch shrinkage) shall be replaced with new sod. Any sod laid on slopes steeper than 3:1 (33 percent) shall be laid at a ~~90 degree~~90-degree angle to the slope and held in place with two wooden dowels per sod piece.

(d) The contractor shall activate the sprinkler system to water sod immediately after each section of sod is laid. The contractor shall operate the sprinkler to soak all sod and the underlying soil to a depth of 2 inches and maintain this moisture level until final acceptance. The contractor shall water the sod in the early morning and late afternoon for the duration of this period.

(6) **Buffalo Grass Sod:**

(a) Prior to sodding, the site should be lightly irrigated to alleviate “sod-wicking” and desiccation. The sod shall be laid by staggering joints with all edges touching. Installation shall be performed between April 1 to August 31. Immediately following the laying of the sod, the sod should be rolled with a roller, weighing at least 150 pounds, heavy enough to imprint the sod into the soil.

(b) The contractor shall irrigate immediately after any sod installation, so that the sod and underlying soil is completely wetted to a depth of 4 to 6 inches (saturated). Subsequent irrigation shall be applied as necessary as determined by daily inspection of the sod panels. Daily inspection should consist of manually raising several sod panels and testing the level of moistness in the soil by pinching the soil together. If the soil remains 'pinched' together, and is moist, and the panel's sod pad is also moist, then the sod does not require watering that day. If the soil, after being pinched, falls apart, the sod shall be irrigated to retain the required moisture level. The sod soil pad and underlying soil should be moist at all times.

(c) Rainfall received during the establishment period may reduce the irrigation required. If temperatures exceed 95 degrees for periods of several days, the sod may have to be inspected more frequently and additional daily irrigation cycles may be required. If the soil that has been sodded is extremely hard, or compacted, and not easily saturated, or dries out quickly, the sod and soil shall be kept consistently moist the first ten days.

(d) Normal establishment should display the following characteristics. Within 48 hours of installation the sod should turn a straw color, which is called a dormant stage, although the roots would continue to grow while the top growth is dormant. Within 5 to 7 days feeder roots should begin appearing. Within 14 to 21 days new green top growth should be seen and the sod should be firmly rooted. Once this occurs, daily manual inspections would no longer be required. Sod should then be watered 1½ inches per week for 2 to three months, to prevent drought stress, until deeper rooting takes place.

(e) The contractor is to thoroughly discuss required installation, establishment and post-establishment methods, irrigation, and maintenance requirements with the sod supplier (specifically for sod maintenance - weed control/removal, i.e., what chemical can safely be used, etc.).

(7) **Buffalo Grass Plugs:**

(a) Plugs shall be planted on 12-inch centers with a requirement of at least nine (9) plugs per square yard of ground. Plugging machinery must convert 16 x 24-inch sod panels into plugs and plant in one operation. Each 16 x 24-inch sod panel yields 24 4-inch square plugs, with a total of 81 plugs cut from a yard of sod. At least 80 percent of the plugs shall be a 4-inch square plug (4 x 4 inches); minimum acceptable size for the remainder of the plugs is 2 x 4 inches, nor maximum size any larger than 4-inch x 4 inch. Coordinate equipment passes to maintain parallel, evenly spaced rows. Immediately following plugging, the plugs should be rolled with a roller, weighing at least 150 pounds, heavy enough to imprint the plugs into the soil.

(b) All plugs shall be planted within 48 hours of harvest of the sod. All plugs shall be healthy, in vigorous condition, of natural green color, free of disease and harmful insects. Water after any portion of the plugging is complete, within 4 hours of planting, so that the plugs are completely wetted and the underlying soil is wetted to a depth of 4 to 6 inches.

(c) All buffalo grass sod establishment, irrigation, and maintenance requirements shall apply to plugs. Plugs will require more frequent manual inspection and more frequent watering. After the initial establishment period, plugs should be watered 1 inches per week until desired coverage is achieved.

10.05 Permanent Underground Irrigation System

(A) Description

Underground irrigation includes, without limitation, installing a complete and permanent underground ~~permanent~~ irrigation system consisting of irrigation pipelines, sprinklers, valves, and controllers as part of any landscaping project.

(B) Materials

(1) **Sprinkler System Components:** All sprinkler system components shall be those of the manufacturers specified in these Standards, or be an approved equivalent, and shall be

installed in accordance with these Standards.

(2) **Sprinkler Heads:** Pop-up rotary impact or stream spray sprinklers shall be used to water sod ~~and shrub areas~~, using full and part circle heads as specified on any approved landscape plans. Requirements for the sprinklers include the following:

(a) Sprinklers shall provide coverage as specified on any approved landscape plans, plus or minus 5 percent of the flow rate and 2 ½ feet within the design radius during a low wind situation.

(b) Sprinkler heads shall meet the following specifications:

(i) Minimum pop-up height of ~~2 5/16~~ 6 inches for~~(~~pop ups and ~~/~~MP rotators~~)~~ or 5 inches for~~"~~ larger rotors with heavy retract spring;

(ii) Part circle sprinklers shall be adjustable for any arc between 20 and 340 degrees;

(iii) Have built-in check valves in the head to control low head drainage and reduce air compression in lines. The check valve shall be serviceable from the top of the head without requiring excavation and removal of the head from the riser.

(c) Sprinklers shall be vandal resistant and shall have vandal-resistant cover screws or no exposed screws in the cover.

(d) Sprinklers shall be tamper resistant to prevent changing the direction of throws by means of locking friction collars, gear drives, and limited access features.

(e) Sprinklers shall have a drive mechanism that will ensure proper and even rotation and coverage on 4:1 slopes.

(f) Sprinklers shall have rubber covers or similar protective devices.

(3) **Bubblers:** Requirements for bubbler heads shall include the following items:

(a) Heads shall operate properly between 10 psi and 80 psi;

(b) Heads shall have a molded plastic body with a ½ inch female pipe thread;

(c) Heads shall have a nozzle flow adjusting screw, providing fully open to completely closed positions;

(d) Heads shall have a plastic basket screen to protect nozzles from clogging.

(4) **Automatic Control Valves:**

(a) Automatic electric remote-control valves shall be slow acting diaphragm-type electric solenoid valves. Solenoids shall be two-watt running, current 24-volt

AC, 50/60 cycle operation. The valve shall be slow opening and closing by means of a "shunt" resistor to avoid damage from surge pressures. Valve flow range shall be 1 to 200 gallons per minute depending on size with a pressure range of 10 to 200 PSI.

(b) All valve bodies and bonnets shall be constructed of heavy case bronze with accurately machined valve seat surfaces and internal parts. Inlet part of diaphragm chamber shall have a removable screen for easy cleaning, accessible without removing bonnet from valve body. Valve bonnets shall be equipped with a slotted plug or bleed screw for manual operation of valves at any time without energizing the solenoid, and a manual flow control stem.

(5) **Isolation Gate Valves:** Isolation gate valves for installation on main lines shall be of brass construction, designed for 200 psi working pressures, and have solid disc, non-rising stems with a heel and screwed ends. Gate valves 3 inches or larger shall be brass or iron AWWA gate valves with rubber gaskets or mechanical joints.

(6) **Quick-Coupling Valves:** Anti-r~~-R~~otation q~~Q~~uick-coupling valves installed in main lines shall be of a cast brass body construction and have a self-closing and locking protective cover. The throat shall incorporate a single keyway with positions for regulation of water flow, with a flow range of 10 to 70 gallons per minute and a pressure range of 5 to 125 psi. Replaceable seals shall be provided at the valve seat and throat, and the internal parts shall be removable for service. Installation on a main line in shall include a 10-inch circular locking valve box over the coupler body. Size shall be 1 inch. Quick-coupling valve keys shall have 1-inch male top pipe threads. Swivel hose ells shall be 1-inch N.P.T. x 3/4-inch hose thread.

(7) **Manual Drain Valves:** The system shall be equipped with 3/4-inch curb stop manual globe drain valves at all low points on main lines. Valves shall be of bronze construction with threaded connections, cross handles, and operating keys. Install valves in a locking valve box. Angle valves will not be accepted.

(8) **Y-Strainers:** Y-Strainers for installation on main line shall be bronze "Y" type strainers with a screen mesh.

(9) **Wire Connectors:** All wire connections at electric control valves and all splices of wire in the field shall be made using "snap-tits," or an approved equivalent, wire connectors. Significant requirements for connectors include the following items:

(a) Connectors shall be rated at 600 volts for PVC insulated copper wire, Underwriters Laboratory listed, and water-resistant.

(b) Connectors shall consist of a PVC base socket, sealing plug, and wire crimping sleeve and shall provide a permanent waterproof joint by using a silicone sealer for joint makeup.

(10) **Controllers:**

(a) Automatic sprinkler controllers shall be completely automatic in operation and

shall electrically start all sprinkler cycles and time the individual stations. Controllers shall have standard 117-volt power inputs, 24.0 volt, 60 cycle outputs with separate independent timing stations, 14-day programming, and be capable of automatically starting a watering cycle at the beginning of any hour for 23 hours per day. Each station shall have an "OFF" switch for "0" time and individual incremental timing control for 0-to-60-minute station timing. Each station shall have an "ON-Repeat" switch for eliminating one or more stations from initiating a repeat cycle on any or all stations after the normal watering cycle has been completed. A 14-day clock shall be provided for maximum programming versatility and any timer pins shall be of the captive type to prevent loss. It shall be possible to operate controller manually and to select and operate manually any station. All controls shall be capable of being manipulated at any time in any sequence without damage to controller. The controller shall have the ability for dual programming and shall have soil moisture sensing equipment.

(b) Soil moisture sensing equipment shall have an adjustable control module with an override function, and at least two in-ground sensors/tensiometers. Sensors must buffer salinity and have the ability to withstand winter conditions without removal.

(c) A reset circuit breaker shall protect each controller from damage due to excessive current. A master "ON-OFF" switch shall provide for turning controller "OFF" during rainy weather, while allowing day and hour clocks to continue in operation. The controller shall have as standard built-in features an electrical circuit to operate a master valve and moisture sensor circuit to allow operation of controllers in conjunction with a moisture sensing device. Install valve output surge protection arresters for control wiring and common.

(d) All wiring to and from controllers shall be through color-coded plugs and sockets. Controller cabinets shall be locking, weatherproof type, constructed of heavy gauge steel with corrosion resistant enamel finish inside and out.

(e) Controllers shall conform to NEC Class 2 requirements of 24-volt valves. Controllers shall be for wall or pedestal mounting.

(11) **Valve Boxes:** Lockable v~~V~~alve boxes shall be sized to provide maintenance access to all valve and controller component. The underside of all control valve boxes shall be clearly marked to indicate controller numbers and valve numbers.

(12) **Pipe:**

(a) Main Line Pipes:

(i) Main pressure line pipe shall be NSF approved virgin polyvinyl chloride pipe or HDPE. Pipe shall be suitable for use at maximum hydrostatic working pressures of 200 PSI. Pipe shall be made from clean, virgin, NSF approved, type 1, grade 1 PVC, conforming to Astin Resin specification D1784-60 and project standard D2241 for PVC 1120 SDR 26 or SDR 21. PVC pipe is to be belled end and solvent weld. Solvent cement and primer shall be of the type prescribed by the manufacturer.

(ii) Gasket pipe and fittings shall be used for main lines 3 inches or larger. Gasketed pipe shall be of the type prescribed by the manufacturer. No insert gaskets or insert gasket fittings shall be accepted. Thrust blocks shall be provided in accordance with pipe manufacturer's recommendations.

(b) Marking and Declaration of Compliance: Pipe marking shall show the size, series, identification, and manufacturer's trade name at intervals of not more than 20 feet. Pipe shall include the seal of approval of the National Sanitation Foundation spaced at intervals required by NSF regulations.

(c) PVC Fittings: All pipe fittings shall be schedule 40 PVC (ASTM D2466 and D1784). Solvent cement shall conform to ASTM D2564.

(d) Brass Pipe and Fittings:

(i) Brass pipe shall be 85 percent red brass, (ANSI) Schedule 40.

(ii) Fittings shall be medium brass, 125-pound class, screwed type.

(iii) Dielectric unions shall be used wherever a copper-based metal (copper, brass, bronze) is connected to an iron based metal (iron, galvanized and stainless steel).

(e) Copper Pipe: Copper pipe shall meet the requirements of Type K, ASTM B88. Fittings shall be copper or cast bronze. Silver solder shall be used for joints.

(f) Lateral Line Pipes: Pipe for rotary sprinkler laterals shall be NSF approved HDPE polyethylene, rated at 8~~10~~0 PSI, using sch 40 ~~nylon~~ insert fittings and adjustable stainless-steel clamps with stainless steel screws. All piping shall be CS-256-63 ASTM D2239, PE 2306-100. 2~~3~~ inch or larger class 200 -1" sch 40 lateral piping shall meet the standards for main line pipes.

(g) Static Pressure Reduction: Static pressure on the main line shall be relieved by the installation of a "master" automatic control valve.

(13) **Risers:** Rotary pop-up sprinklers shall have an adjustable swing joint riser assembly consisting of Schedule 80 PVC nipples, and marlex and Schedule 40 PVC ells.

(14) **Irrigation Sleeves:** All horizontal sleeves under paved areas and vertical sleeves shall be PVC Class 200 pipe, or SDR 35 glue joint and glued 4-inch diameter for lines 2 inches and smaller, and 6-inch diameter for lines 2 ½ inches to 3 inches. A separate 2-inch diameter sleeve for control valve wires shall be laid under any new pavements. This sleeve shall be placed next to the main line sleeve.

(15) **Backflow Prevention Device:** Backflow prevention devices shall be installed in accordance with these Standards and B.R.C. 1981.

(16) **Electrical Copper Wires:** Electrical copper wires from valves to controller shall be

14 gauge or larger PVC-insulated copper and UNDERWRITERS LABORATORY approved for direct burial. Use 10-inch valve boxes for all wire splice locations. Control wires shall be red and common wires shall be white.

(17) **Drip Valve Assemblies:** Drip valve assemblies shall have strainers with a 120-mesh nylon screen and ½ inch blow-out. Pressure reducing valves shall have manual adjusting nuts.

(18) **Drip Emitters and Tubing:** Drip emitters shall use drip tubing conforming to ASTM D1248 and ASTM D3350. Capillary tubing shall have 1/8-inch i.d.

(19) **Drip Line Blow Out Stubs:** Drip line blow out stubs shall be installed at all ends of drip tubing.

(C) Construction Requirements

(1) **Applicable Standards:**

(a) All work involving standard plumbing systems shall be executed by a licensed and bonded plumber. Electrical services to controllers shall be installed by a licensed electrician. All work shall be executed according to the B.R.C. 1981, and these Standards. The contractor shall schedule inspection of electrical services to controllers with the City and allow at least 7 working days for subsequent approval and connection to the power source by the Public Service Company. The contractor shall furnish any additional material and labor when required to comply with the B.R.C. 1981, and these Standards.

(b) The contractor shall perform a leakage test on all systems on the site at normal working pressures.

(c) The contractor shall guarantee irrigation application in accordance with any approved landscape plan; any unwatered areas due to poor layout, placement of or insufficient sprinklers shall be corrected by the contractor at their expense.

(d) Work shall be in accordance with good practices prevailing in the piping trades.

(e) All work shall be protected from vandals or flooding during construction.

(2) **Layout of Work:** Before any installation operations are started, the contractor shall completely stake out the irrigation system on the site. Any discrepancies in irrigation water coverage shall be reported and corrected at this time.

(3) **Schedule:**

(a) No sprinkler system construction shall take place during wet weather or when temperatures are less than 340 degrees Fahrenheit.

(b) All required sleeving shall be performed prior to any paving operations. All procedures necessary for the insertion and installation of irrigation pipe and wires into sleeves shall be performed after paving operations have been completed.

(c) Installation of the system shall not take place until all earthwork has been substantially completed and compacted and all other site improvements, pavements, etc. have been completed.

(4) **Trenching and Piping:**

(a) The contractor shall perform all necessary excavation for installation of their work. Over-excavations shall be backfilled, and hand tamped prior to installing pipe. Any pumping, shoring, or bracing shall be provided by contractor.

(b) Manufacturer's specifications covering installation of their material shall be followed. Underground lines up to 2 inches shall have minimum horizontal clearance of 2 inches of each other, and larger lines shall have a clearance of 4 inches. No sprinkler lines shall be stacked vertically in a common trench. Lines shall have minimum horizontal clearance of 12 inches from the lines of other trades. There shall be a minimum 2-inch vertical clearance between any lines crossing 45 degrees - 90 degrees. Minimum cover over lateral piping shall be 12 inches, or to a depth to accommodate valves and other equipment, whichever is greater. All PVC main line shall be at 18-inch minimum depth of bury. PVC main line is to be encased in sand 4 inches on all sides.

(c) Where trenches and lines run adjacent to existing irrigation lines and properties, damage to these shall be avoided and shall be restored to their original condition

(d) When pipe laying is not in progress, or at end of each day, pipe ends shall be closed with tight plug, or cap, or taped with PVC pipe wrap. All work shall be performed in accordance with good practices prevailing in the piping trades.

(e) Tunneling will be permitted where the pipe must pass under any obstruction that cannot be removed. In backfilling the tunnel, the final density of the backfill must match that of the surrounding soil. It shall be acceptable to use a casing of suitable diameter that shall be installed first by tunneling or jacking, and the pipe shall then be laid through the casing, observing the same precautions as though it were installed in open trench.

(f) Trenches shall be cut to true line and grade and shall be excavated so that the pipe shall be supported uniformly. The contractor shall be responsible for staking the trench lines. Minimum grade of piping to drain shall be 3 inches/100 feet.

(g) If ground water is encountered during trench excavation above the elevation of the bottom of the pipe grade, such water shall be drained until the pipe has been installed. Pipe joints and open ends shall be plugged to prevent ground water from entering the pipe.

(h) Thrust blocks shall be installed behind all gasketed fittings, in line valves, and caps. Gasket pipe fittings shall be installed according to manufacturer's recommendations. Concrete for thrust blocks shall cure for 72 hours before pressure is applied to the system.

(5) **Threaded Joints:**

(a) Field-threading of plastic pipe or fittings shall not be permitted. Only factory-formed threads shall be used.

(b) Factory-made nipples shall be used wherever possible. Field-cut threads in metallic pipe will be permitted only where absolutely necessary. When field threading, cut threads accurately on axis with sharp dies.

(c) All threaded joints shall be assembled with pipe joint compound consisting of liquid Teflon. The compound is to be applied to male threads only.

(d) Where assembling soft metal (brass or copper) or plastic pipe, strap type friction wrenches shall be used; metal-jawed wrenches shall not be used.

(6) **Sleeves:**

(a) The contractor shall furnish and install sleeves of appropriate size, depth, and location to accommodate all irrigation pipe beneath any paved surfaces prior to pipe installation as specified herein, unless they have been previously installed. Where irrigation lines run under proposed paved surfaces, the contractor shall sleeve the lines a distance 2 feet beyond the edge of the surface. Sleeves shall be PVC Class 200 pipe/SDR 35 glue joint glued.

(b) Installation of sleeves shall precede construction paving. Sleeves shall be encased in sand 4 inches on all sides, with backfill compacted to 95 percent of standard Proctor density. Sleeves shall be buried at a depth of 18 inches. Separate sleeves placed at the 18 -inch bury depth shall be provided for wires passing under paved sections. All sleeves installed under a parking lot or street shall be flow-filled

(c) All sleeves shall be marked by the placement of nylon rope, or an approved equivalent marking material.

(7) **Backfilling:**

(a) Trenches shall not be backfilled until all required tests on the system have been completed and until the line has been inspected and approved by the Director. Trenches shall be carefully backfilled with suitable materials, free from stones larger than 2 inches in maximum dimension, by depositing the material in 6-inch layers and thoroughly compacting the backfill to 95 percent of standard Proctor density.

(b) Ponding and/or jetting may be used only if prior approval is obtained and only when the backfill material is sandy or gravelly. An excess of water shall be avoided in order to prevent disturbance of the earth under and around the pipe. Likewise, the amount of water used shall be controlled so as not to risk "floating" the pipe out of position. Adequate dikes shall be constructed along the trench to retain and guide the water. When jetting is used, jets shall be of an approved

design and of sufficient length to reach the bottom of each layer and the water supply shall be continuous.

(c) Site excavation material will generally be considered satisfactory for backfill purposes provided that backfill materials are free from rubbish, vegetable matter, frozen materials, or stones larger than 2 inches in maximum dimension. Any material not meeting these specifications for backfill shall be removed from site.

(d) Backfilling shall not be performed in freezing weather. All trenches shall be left slightly mounded to allow for settlement after the backfilling is completed. If sinking of the trenches occurs, it is the responsibility of the contractor to correct such conditions.

(8) **Manual Drain Valves:** Manual drain valves shall be located, furnished, and installed by the contractor at all low points on sprinkler lines. A drain sump of not less than 6 cubic feet of 1/2~~3/4~~ inch washed gravel shall be installed surrounding each drain valve. All manual drain valves are to be installed with drain valve sleeves.

(9) **Electric Control Valves:**

(a) Electric control valves shall be automatic and purchased from the manufacturer specified, or be an approved equivalent, matching size, model and quantity as listed on an approved landscape plan. All control valves shall be installed at the locations shown on the approved landscape plan.

(b) Electric control valves shall be installed in accordance with the manufacturer's recommendations. All valves shall have sufficient clearance from adjacent obstructions to provide accessibility for maintenance. All valves shall be installed at sufficient depth to provide at least 6 inches cover to finished grade. Only one control valve per valve box shall be installed.

(c) Control wire shall have an 18-inch expansion loop at each valve and elsewhere as necessary to prevent possible wire breaks. Where more than one control wire is located in the trench, the wires shall be taped together at 20-foot intervals to maintain orderly and efficient installation. All control wires shall be placed carefully alongside and slightly below the main line for protection. Control wires not protected by the irrigation main shall be laid in a 2-inch PVC class 200 sleeve. Electrical control wires shall be extended along the irrigation main and connected to the controller.

(d) Electrical control wires shall be connected with snap-tite~~s~~ connectors. Splicing will be permitted only on runs exceeding 500 feet in length and shall be located at valve locations. Wires shall be bundled and taped at 20-foot intervals. A minimum wire loop of 24 inches shall be provided at each control valve, splice, and every 100 feet of wiring. Two spare #14-1 wires, blue in color, shall be installed along the entire length of the main line from the controller to farthest control valve on each and every branch of the main line.

(10) **Pressure Reducing Valves:** Pressure reducing valves (PRV) shall be installed to ensure proper operating pressures at sprinkler locations.

(11) **Valve Boxes:** All automatic control valves, pressure reducing valves, backflow prevention devices, isolation gate valves, manual drain valves, and quick-coupling valves are to be installed in valve boxes. The valve box and cover shall be flush with the final grade and level. The valve box shall be installed with a 4~~2~~ inch layer of 1 ~~1/2~~½ inch washed gravel on the sides and below the box. If the box encloses a double check valve assembly, the gravel layer below the box shall be equal in volume to the volume of the box.

(12) **Quick-Coupling Valves:** Quick-coupling valves shall be installed in conformance with these Standards. Additional quick-coupling valves shall be located every 200 feet along the main line. All valves shall be installed in separate 10-inch circular valve boxes placed flush with the final grade and level.

(13) **Isolation Gate Valves:** Isolation gate valves on the main line shall be plumb with finished grade and installed in a valve box placed flush with the final grade and level. Extensions may be added onto the valve box as necessary to level box with finish grade.

(14) **Sprinklers:**

(a) Installation of sprinklers includes furnishing, installing, and testing, risers, fittings, sprinkler heads, bubblers, and other sprinkler system components in accordance with an approved L~~l~~andscapinge P~~p~~lan. Sprinkler piping shall be thoroughly flushed before the installation of the sprinkler heads and bubblers.

(b) Sprinkler heads shall be set plumb and level with finished grade at locations shown on an approved L~~l~~andscapinge P~~p~~lan. Sprinklers shall be set 12"~~3~~ inches behind concrete improvements such as curb and gutter or sidewalks. Sprinklers installed where grass has not been sodded shall be installed on temporary risers extending minimum 3 inches above grade. After finished grades are established and the ground has settled, the contractor shall lower sprinklers to finished grade.

(c) Bubblers shall be set plumb and level before mulch is installed.

(d) Rotary pop-up sprinklers on swing joint risers shall be installed as shown in these Standards and may be adjusted in the field as necessary.

(15) **Drip Valve Assemblies:** Installation of drip valve assemblies shall in conformance with these Standards.

(16) **Drip Emitters and Tubing:** Installation of drip emitters and tubing shall be installed in conformance with these Standards at a depth of 4 inches below top of grade. For this purpose, top of grade does not include mulch or rock layers. Drip line blow-out stubs are to be installed at all ends of drip tubing. Drip tubing may be installed in turf areas as lateral piping.

(17) **Controllers and Related Work:** The controller shall be mounted on three wolmanized CCA 6-inch x 6-inch ties, set at least 24 inches below grade and a maximum of 18 inches above grade. The controller shall be located as shown on an approved landscape plan, and be mounted inside a locking, weather-proof metal cabinet. The contractor shall provide and install a 15-amp electrical circuit breaker in a locking, weatherproof box. The contractor shall wire the circuit breaker and controller and run wire to the Public Service Company pull box, leaving an 18-inch tail of wire in the pull box or sleeve. After connection, the contractor shall notify the City's Inspection Services to inspect controller and circuit breaker wiring prior to notifying Public Service Company to connect power to the wiring. The contractor shall be responsible for manual operation of the sprinkler system until power is connected. All wiring shall be performed by a licensed electrician.

(18) **Testing and Adjusting:**

(a) All main lines having continuous pressure shall be tested at a minimum pressure of 12~~0~~0 psi. Visual inspection shall be performed, and any leak shall be repaired. Repaired lines shall be retested until no leakage is occurring.

(i) Zone lateral lines shall be tested at the design operating pressure of the zone. Any leaks found shall be repaired and the zone retested. All sprinklers shall be operating at the same pressure plus or minus 7 percent.

(ii) The entire irrigation system shall be tested at normal working pressure for leaks in the system and retested until no leakage is occurring. The pressure test shall be performed under the observation of the Director for final approval.

(iii) After testing, the entire irrigation system shall be thoroughly flushed with at least 100 percent of operating flow passing through each pipe, beginning with larger mains and continuing through smaller lines in sequence.

(b) The entire system shall be "fine-tuned" by regulating valves, adjusting patterns and breakup arms, setting pressure reducing valves at proper pressure and similar, to provide optimum and efficient coverage.

(c) Final inspection shall include observation and approval by the Director of the performance,- method of operation, and coverage of the irrigation system.

(d) The contractor shall furnish two sets of keys for all quick-couplers, manual drain valves, gate valves, and controllers as well as padlocks and keys for controller circuit breaker boxes, two sprinklers and nozzles of each type, hose ells for all quick couplers, and all related loose parts necessary to operate the system, as part of the final acceptance by the Director.

(19) **Record Drawings (As-Builts):** Upon completion of improvements and prior to final acceptance, the contractor shall submit as-built drawings of the irrigation system to the

Director. The as-built drawings shall comply with the requirements of Subsection 1.03(G), "As-Built Drawings," of these Standards, and shall include the location of following items:

(a) Connection to existing water lines.

(b) Routing of sprinkler pressure lines (maximum 100 feet along routing).

(c) Sprinkler control valves.

(d) Quick coupling valves.

(e) Drain valves.

(f) Drip line blow-out stubs.

(g) Control wire routing if not with pressure main line.

(h) All gate valves.

(i) Other related equipment as directed by the City Manager.

(20) **Operation Instruction:** Prior to final acceptance of improvements, the contractor shall submit three written sets of operating instructions, with cut sheets of all products, and a guideline summer watering program.

(21) **Controller Charts:**

(a) Controller charts shall be prepared for the Director once record (as-built) drawings have been accepted.

(b) A controller chart shall be provided for each automatic controller installed.

(c) The controller chart may be a reproduction of the record drawing if scale permits fitting of the chart to the controller door. If photo reduction prints are required, the reductions shall be sized to ensure full legibility.

(d) The controller chart shall represent the actual "as-built" system, showing the specific area covered by that controller.

(e) The controller chart shall identify the area of coverage of each remote-control valve, using a distinctly different pastel color on drawing over the entire area of coverage.

CITY OF BOULDER
DESIGN AND CONSTRUCTION STANDARDS

GLOSSARY

SECTION 1: ABBREVIATIONS

Wherever the following abbreviations are used in these Design and Construction Standards (Standards), or in association with these Standards, the intent and meaning shall be as follows:

AAN	American Association of Nursery-men
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ABC	Aggregate Base Course
AC	Asphaltic Cement
ACI	American Concrete Institute
ADT	Average Daily Trips
AGCA	Associated General Contractors of America
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute, Inc.
APWA	American Public Works Association
ARA	American Railway Association
AREA	American Railway Engineering Association
ARTBA	American Road and Transportation Builders Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATSSA	American Traffic Safety Services Association
AWG	American Wire Gauge
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
BFD	Boulder Fire Department
BMP	Best Management Practices
BRC	Boulder Revised Code, 1981
CCA	Colorado Contractors Association
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CDPS	Colorado Discharge Permit System
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CLOMA	Conditional Letter of Map Amendment
CLOMR	Conditional Letter of Map Revision
CMP	Corrugated Metal Pipe

CP	Colorado Procedure
CPUC	Colorado Public Utilities Commission
CRS	Colorado Revised Statutes, 1973, as amended
CRSI	Concrete Reinforcing Steel Institute
CUHP	Colorado Urban Hydrograph Procedure
DHV	Design Hour Volume
DIP	Ductile Iron Pipe
DRCOG	Denver Regional Council of Governments
DWG	Drawing
EDLA	Equivalent Daily Load Applications
EIA	Electronic Industries Association
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FL	Flowline
FPS	Feet Per Second
FSS	Federal Specifications and Standards
GIDM	Gallons Per Inch Diameter Per Mile
GPAD	Gallons Per Acre Per Day
GPCD	Gallons Per Capita Per Day
GPM	Gallons Per Minute
HCM	Highway Capacity Manual
HBP	Hot Bituminous Pavement
HGL	Hydraulic Grade Line
HSG	Hydrologic Soil Group
ICBO	International Conference of Building Officials
IFC	International Fire Code
IPC	International Plumbing Code
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IMSA	International Municipal Signal Association
IPCEA	Insulated Power Cable Engineers Association
ISO	Insurance Service Office
ITE	Institute of Transportation Engineers
LID	Low-Impact Development
LLD PE	Linear low-density polyethylene
LOMA	Letter of Map Amendment
LOMR	Letter of Map Revision
LOS	Level of Service
MDCIA	Minimizing Directly-Connected Impervious Areas
MIL	Military Specifications
MPH	Miles Per Hour
MUP	Master Utility Plan
MUTCD	Manual on Uniform Traffic Control Devices
NACTO	National Association for Transportation Officials
NCAR	National Center for Atmospheric Research
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NPK	Nitrogen-Phosphorus-Potassium
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PC	Point of Curve
PCC	Portland Cement Concrete or

PLS	Point of Compound Curve Pure Live Seed
PMR	Physical Map Revision
POTW	Publicly Owned Treatment Works
PRC	Point of Reverse Curve
PRV	Pressure Reducing Valve
PT	Point of Tangent
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
ROW	Right of Way
RPA	Receiving Previous Area
RTD	Regional Transportation District
SAE	Society of Automotive Engineers
SCM	Stormwater Control Measure or Control Measure for Post-Construction Stormwater Quality
SDR	Standard Dimensional Ratio
SEO	State Engineer's Office
SHAC	State Highway Access Code
SWMP	Stormwater Management Plan
TC	Top of Curb
TIA	Telecommunications Institute of America
TMDL	Total Maximum Daily Load
TMP	Transportation Master Plan, City of Boulder
UBC	Uniform Building Code
UDFCD	Urban Drainage and Flood Control District
UIA	Unconnected Impervious Area
UL	Underwriters Laboratories, Inc.
UMC	Uniform Mechanical Code
USDCM	Urban Storm Drainage Criteria Manual
USGS	United States Geological Survey
VPC	Vertical Point of Curve
VPI	Vertical Point of Intersection
VPT	Vertical Point of Tangent
WQCV	Water Quality Capture Volume

SECTION 2: DEFINITIONS

Words and phrases contained in these Standards shall be read in context and construed according to the rules of grammar and common usage. Words and phrases that have acquired a technical or particular meaning, whether by definition, adoption herein, or otherwise, are intended to be construed accordingly.

Wherever the phrases **"as directed"**, **"as required"**, **"as permitted"**, or phrases of like meaning are used, it shall be understood that the direction, requirements or permission of the Director of Public Works (Director) is intended. Similarly, use of the words **"approved"**, **"acceptable"**, and **"satisfactory"** shall refer to approval of the Director.

The definitions in this Glossary apply throughout these Standards. The words or phrases presented have the following meaning unless the context clearly indicates otherwise:

"Alteration" means a request to use a substitute or alternative material, method, or process which will perform the same function as that provided in a particular standard.

"Approach" means the portion of an intersection leg which is used by traffic approaching the intersection.

"Approved plan" means the engineering design and construction drawings for public improvements, prepared by an engineer, which has been granted final approval by the Director of Public Works in accordance with these standards.

"Approved Tree List" means a list of trees published annually by the Director, in consultation with the Director of Parks and Recreation, that are suitable to the local environment and provides for a wide range of varieties and cultivars which fit into local landscapes.

"As-built" means an engineering drawing of record, prepared under the direction of a licensed Colorado registered professional engineer, reflecting the actual construction of public improvements in the service area, including, but not limited to, final grading, alignments, dimensioning, elevations, locations and materials sizing and type.

"Average Daily Trips (ADT)" means the volume of traffic passing through a given point during a given time period, divided by the number of days in that time period.

"Backflow" means the reversal of the direction of flow of water or mixtures of water and other liquid, gases, or other substances into the distribution pipes of a potable water supply from any source or sources caused by backpressure and/or back-siphonage.

"Backflow prevention assembly" means any approved assembly, method, or type of construction designed to prevent backflow or back-siphonage into a public water supply by isolating the owner's water system from the public water system. In addition, see Section I. of these rules.

"Caliper" means a diameter measurement of a tree's trunk, and is measured around the trunk of the tree, six inches above tree base grade for one to four inch caliper trees and 12 inches above tree base grade for five to eight inch caliper trees. Trees measuring between four and five inch caliper shall be rounded off to the nearest inch.

“Capacity” means the maximum number of vehicles that have a reasonable expectation of passing over a given roadway or section of roadway in one direction during a given time period.

“Certified Backflow Prevention Device Tester” means any person who has passed a State of Colorado approved or sponsored certification examination, and who is listed as a certified backflow prevention device tester with the Colorado Department of Public Health and Environment.

"City" means the City of Boulder, a Colorado home rule city in Boulder County, Colorado.

"City water system" means the source and distribution facilities of the water system to the point of delivery to the owner water system. The source includes all components of the facilities utilized in the production, treatment, storage, and delivery of water to the distribution system. The distribution system includes the network of conduits used for the delivery of water from the source to the owner water system.

"Contractor" means a person, firm, partnership, subcontractor or corporation, licensed by the City that is responsible for the construction of approved public improvements associated with a specific project, or projects, within the City of Boulder service area. This term also includes the contractor’s superintendent and on-site manager.

"Colorado Cross Connection Control Manual" means a manual published by the Colorado Department of Public Health and the Environment addressing cross connection control practices, Fourth Edition - Revised.

"Cross connection" means any physical arrangement whereby the city’s water supply system is connected, directly or indirectly, with any other water supply system, sewer, drain, conduit, pool, storage reservoir, plumbing fixture, or other device which contains, or may contain, contaminated water, sewage, or other waste or liquid of unknown or unsafe quality which may be capable of imparting contamination to the public water supply as a result of backflow. Bypass arrangements, jumper connections, removable sections, swivel or changeover assemblies, and other temporary or permanent assemblies through which, or because of which, backflow could occur are considered to be cross connections.

“Delay” means the stopped time per approach vehicle, in seconds per vehicle.

“Design Hour Volume” means the hourly traffic volume used for street design and capacity analysis, usually one (1) or more peak hours during a 24 hour period.

“Design Speed” means five (5) to 10 miles per hour above the proposed or desired speed limit of the facility under design.

“Design Vehicle” means that all public and private streets must be designed to accommodate an SU-30 vehicle. The definition of this vehicle type is found in AASHTO’s Geometric Highway Design Standards.

"Developer" means the person, owner, firm, or corporation responsible for the development and completion of all public improvements associated with a proposed project in accordance with these standards.

“Diameter” means the diameter size measurement of a tree's trunk, and is measured around the trunk at 4.5 feet above the tree base grade for trees greater than eight (8) inch caliper.

“Director” or "Director of Public Works" ~~means the authorized City employee, or his/her designee,~~ means the city manager of the City of Boulder, Colorado or the manager’s authorized representative responsible for the enforcement of these standards and approval of the design and construction of public improvements within the City of Boulder service area, and the overall management and direction of the Public Works Department.

“Dripline” means the outermost edge of a tree's canopy, projected on the ground.

"Engineer" means the Colorado registered professional engineer responsible for the design of all public improvements submitted to the City for a proposed project in accordance with these standards, including all plans, calculations, specifications, and coordination of field surveys.

"Construction plan" means the engineering design and construction drawings for public improvements, prepared by an Engineer which has been submitted for final approval by the Director of Public Works in accordance with these standards.

“Hourly Volume” means the number of vehicles that pass over a given section of a lane or roadway during one hour.

"Inspector" means the Director of Public Works, or his/her designee, responsible for the inspection of public improvements construction.

“Level of Service (LOS)” refers to the definitions of LOS provided in the Highway Capacity Manual, “Definitions and Concepts.”

"May" means is authorized to, or a permissive condition which indicates a choice between two (2) or more alternatives.

“Modification” means a request to change or modify a standard or the parameters of a standard because the particular application may not require the degree of rigor which the standard requires.

“Peak Hour” means the concept referring to the hour of a day when the highest volume of traffic occurs on a transportation facility.

“Planting Strip” means the landscape area within a street median, the landscape planting strip between the curb and detached sidewalk, or the landscape area between the back edge of a public sidewalk (attached or detached) and the right-of-way/property line.

"Public improvements" means any public facility, system or infrastructure in the City of Boulder service area including, but not limited to: earthwork or landscaping, streets, sidewalks, bike paths, trails, parking and traffic control devices; water supply, treatment, storage and distribution systems; wastewater collection and treatment systems; and stormwater and flood control collection and conveyance systems in public easements or right-of-way.

“Public Sign” means any sign that is posted by a governmental entity within the right-of-way for the purpose of directing traffic or parking.

"Record Set" means the engineering design and construction drawings for public improvements, sealed and signed by an engineer, approved by the Director of Public Works in accordance with these standards, and maintained on file in public records as the final approved construction document.

“Root Protection Zone” means the ground area surrounding the entire tree that extends from trunk to dripline, or a minimum of fifteen feet for column-shaped trees, whichever is greater.

"Shall" means a mandatory duty to conform to the specified standard. Where certain requirements in these standards are described with the "shall" stipulation, it is mandatory that these requirements be met or exceeded.

"Should" means an advisory condition. Where "should" is used, it is considered to be recommended or advisory, but not mandatory.

“Sidewalk, Attached” means a sidewalk and curb that are attached as one (1) continuous element.

“Sidewalk, Detached” means a sidewalk that is separated from the curb by a landscape planting strip.

“Sight Distance” means the length of roadway ahead visible to the driver. The minimum sight distance available must be long enough to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path.

“Speed Change Lane” means a separate lane for the purpose of enabling a vehicle entering or leaving a roadway to increase (acceleration lane) or decrease (deceleration lane) its speed to a rate at which it can more safely merge or diverge with through traffic. Includes tapered areas.

"Standards" means the "Design and Construction Standards" manual for the City of Boulder.

“Storage Lane” means additional length added to a deceleration lane, to store the maximum number of vehicles likely to accumulate during a critical period without interfering with the through lanes.

“Street Tree” means any tree in the public right-of-way.

“Streetscape” means landscaping design for any streetside area, generally including but not limited to

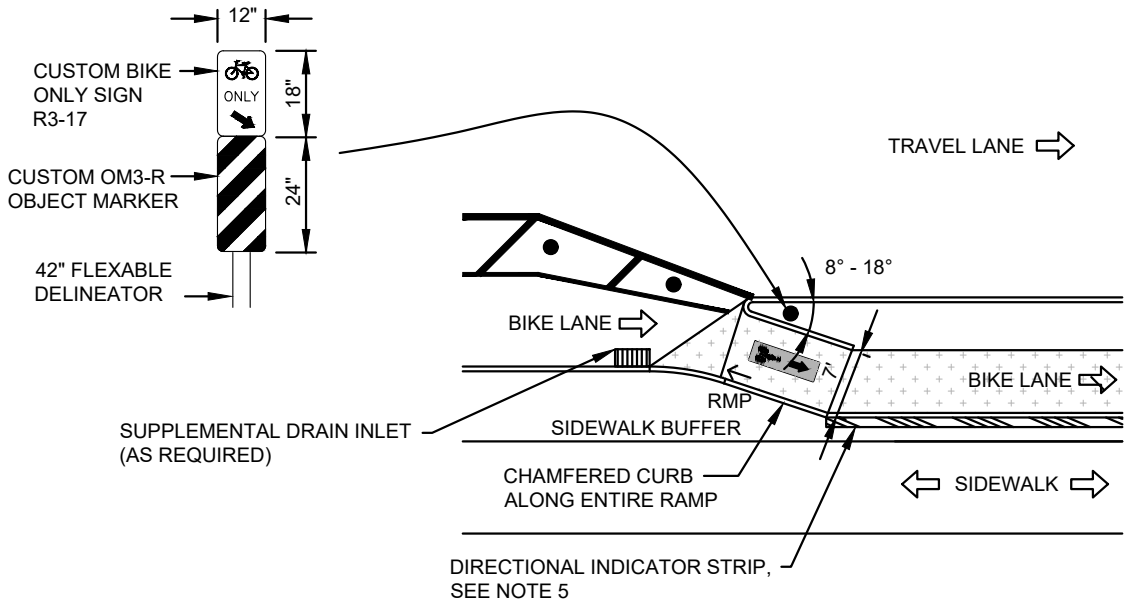
planting strips and medians.

“Transportation Demand Management” means any action or set of actions aimed at reducing the impact of traffic by influencing people’s travel behavior.

“Trips” means a vehicle moving from an origin point to a destination point. Trips are one-way.

“Waiver” means a request to delete or omit the application of a particular standard.

"Work" means any activity involved in the performance of constructing, installing, repairing or maintaining public improvements.



LEGEND:

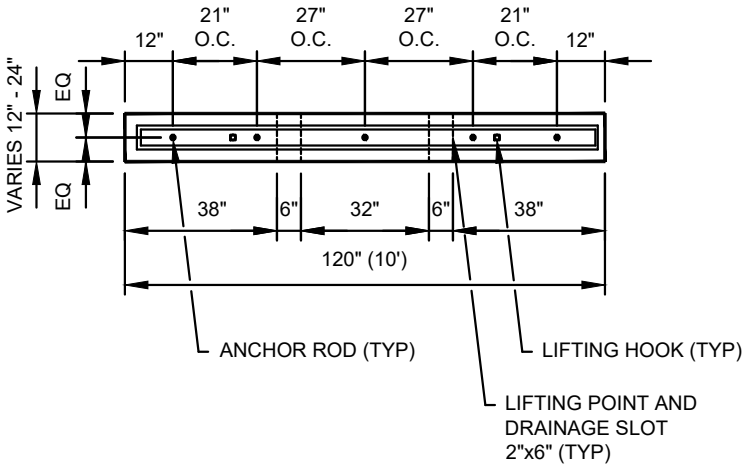
- FLEX POST DELINEATOR
- GREEN PAVEMENT MARKING WITH EMBEDDED WHITE BIKE SYMBOL
- DIRECTIONAL INDICATOR STRIP (SEE DRAWING NO. X.XX.X)

ACCESSIBLE RAMP SLOPE (RMP) = 7.8% TYP (8.3% MAX, 4% MIN)

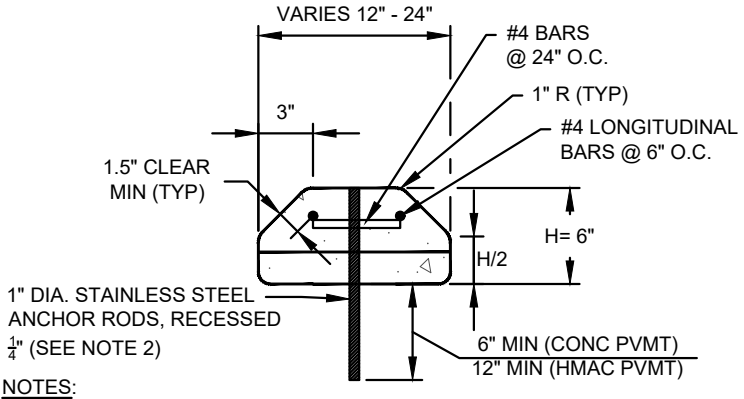
NOTES:

1. DESIGN PLANS SHOULD BE CONSULTED FOR VARIATIONS
2. SEE CITY OF BOULDER DESIGN AND CONSTRUCTION STANDARDS, SECTION 2.07, TABLE 2.5 FOR STANDARD LANE WIDTHS
3. BIKE LANE TAPERS PREFERRED AT 7:1 SHIFT, MINIMUM 3:1 SHIFT IN CONSTRAINED LOCATIONS WHERE SPEED IS ≤ 13 MPH
4. BIKE RAMPS PREFERRED TO HAVE ACCESSIBLE SLOPE, BUT NOT REQUIRED
5. FOR BIKE LANES AT SIDEWALK ELEVATION WITHOUT BUFFER TREATMENT, 1' MINIMUM DIRECTIONAL INDICATOR STRIP WITHIN THE SIDEWALK; TYPICALLY THIS IS LOCATED 1' FROM THE EDGE OF THE BIKE LANE

BIKE RAMP



PRE-CAST CONCRETE CURB PLAN VIEW



NOTES:

1. DESIGN PLANS SHOULD BE CONSULTED FOR VARIATIONS
2. DRILL AND EPOXY SMOOTH 1" DIA. STAINLESS STEEL ANCHOR RODS. FOR CONCRETE PAVEMENT, ANCHORS SHALL BE A MINIMUM OF 3" CLEAR FROM ALL JOINTS

PRE-CAST CONCRETE CURB SECTION VIEW

DRAWN BY: TW

CHECKED BY: CS

APPROVED BY:
DIRECTOR OF PUBLIC WORKS

CITY OF BOULDER, COLORADO

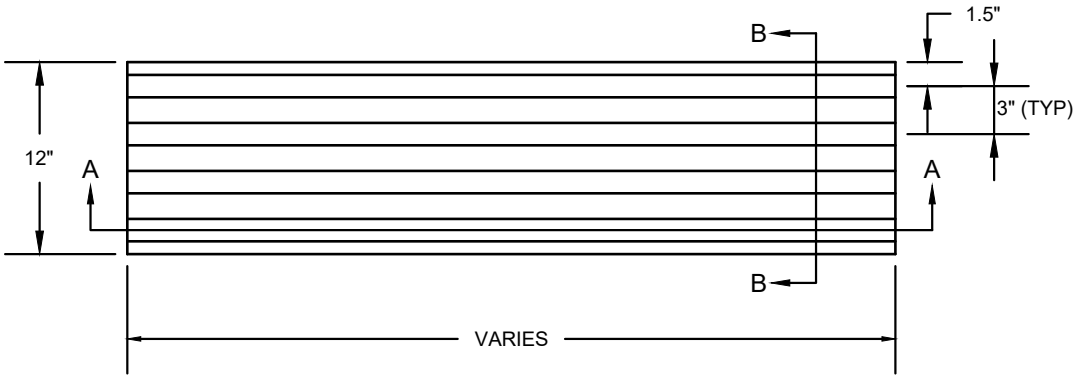
BIKE RAMP & PRE-CAST CURB BUFFER

ISSUED: XXX XX, 2022

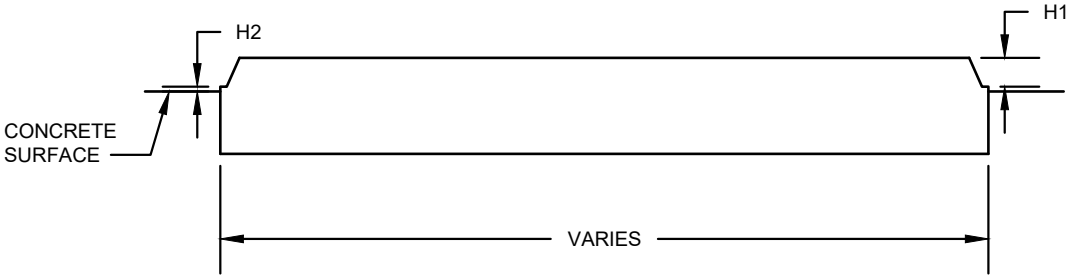
REVISED: XXX XX, 2022

DRAWING NO.

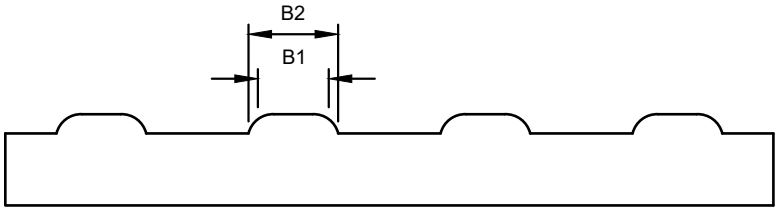
2.43a



PLAN



SECTION A-A



SECTION B-B

DIMENSION	RANGE (IN.)
B1	0.90 - 1.20
B2	B1 + 0.20
H1	0.18 - 0.20
H2	0.05 MAX.

NOTES:

1. DETECTABLE DIRECTIONAL STRIP MUST BE "FEDERAL YELLOW", UNLESS OTHERWISE APPROVED BY THE ENGINEER OF RECORD.
2. STRIP CENTERLINE MUST BE PARALLEL TO THE ALIGNMENT OF THE PEDESTRIAN ACCESS ROUTE.
3. DESIGN PLANS SHOULD BE CONSULTED FOR VARIATIONS

DRAWN BY: TW
CHECKED BY: CS

APPROVED BY:
DIRECTOR OF PUBLIC WORKS

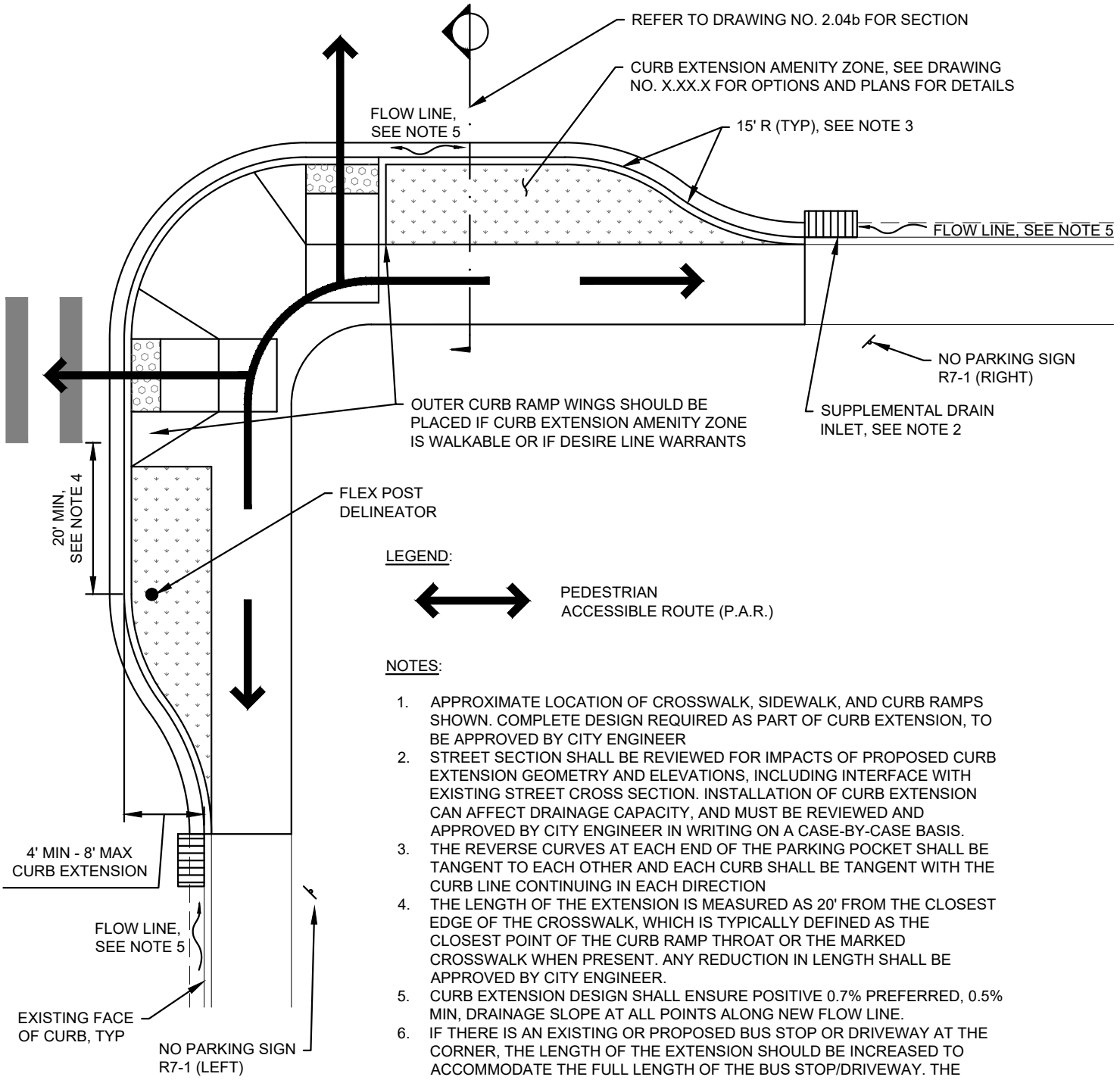
CITY OF BOULDER, COLORADO

DIRECTIONAL INDICATOR STRIP

ISSUED: XXX XX, 2022
REVISED: XXX XX, 2022

DRAWING NO.

2.43b



LEGEND:

PEDESTRIAN ACCESSIBLE ROUTE (P.A.R.)

NOTES:

1. APPROXIMATE LOCATION OF CROSSWALK, SIDEWALK, AND CURB RAMPS SHOWN. COMPLETE DESIGN REQUIRED AS PART OF CURB EXTENSION, TO BE APPROVED BY CITY ENGINEER
2. STREET SECTION SHALL BE REVIEWED FOR IMPACTS OF PROPOSED CURB EXTENSION GEOMETRY AND ELEVATIONS, INCLUDING INTERFACE WITH EXISTING STREET CROSS SECTION. INSTALLATION OF CURB EXTENSION CAN AFFECT DRAINAGE CAPACITY, AND MUST BE REVIEWED AND APPROVED BY CITY ENGINEER IN WRITING ON A CASE-BY-CASE BASIS.
3. THE REVERSE CURVES AT EACH END OF THE PARKING POCKET SHALL BE TANGENT TO EACH OTHER AND EACH CURB SHALL BE TANGENT WITH THE CURB LINE CONTINUING IN EACH DIRECTION
4. THE LENGTH OF THE EXTENSION IS MEASURED AS 20' FROM THE CLOSEST EDGE OF THE CROSSWALK, WHICH IS TYPICALLY DEFINED AS THE CLOSEST POINT OF THE CURB RAMP THROAT OR THE MARKED CROSSWALK WHEN PRESENT. ANY REDUCTION IN LENGTH SHALL BE APPROVED BY CITY ENGINEER.
5. CURB EXTENSION DESIGN SHALL ENSURE POSITIVE 0.7% PREFERRED, 0.5% MIN, DRAINAGE SLOPE AT ALL POINTS ALONG NEW FLOW LINE.
6. IF THERE IS AN EXISTING OR PROPOSED BUS STOP OR DRIVEWAY AT THE CORNER, THE LENGTH OF THE EXTENSION SHOULD BE INCREASED TO ACCOMMODATE THE FULL LENGTH OF THE BUS STOP/DRIVEWAY. THE WIDTH AND LENGTH OF THE EXTENSION WILL BE APPROVED BY CITY ENGINEER.
7. LIMITS OF STREET CUT AND PATCHING SHALL BE SET TO ENSURE THAT THE PEDESTRIAN ACCESSIBLE ROUTE (P.A.R.) WITHIN THE STREET (THE CROSSWALK) IS NOT ADVERSELY AFFECTED BY CAUSING ANY P.A.R. DESIGN ELEMENTS TO BE EXCEEDED.
8. REFER TO DRAWING NO. 2.07 A-K FOR CURB RAMP DETAILS

DRAWN BY: TW

CHECKED BY: CS

APPROVED BY:
DIRECTOR OF PUBLIC WORKS

CITY OF BOULDER, COLORADO

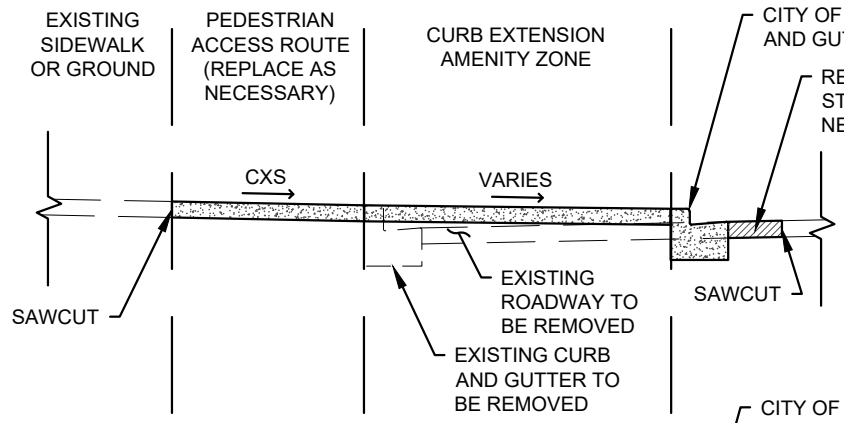
CURB EXTENSION DETAIL

ISSUED: XXX XX, 2022

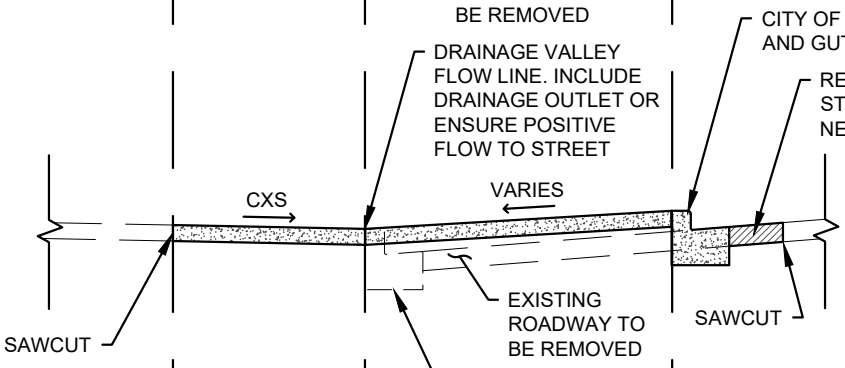
REVISED: XXX XX, 2022

DRAWING NO.

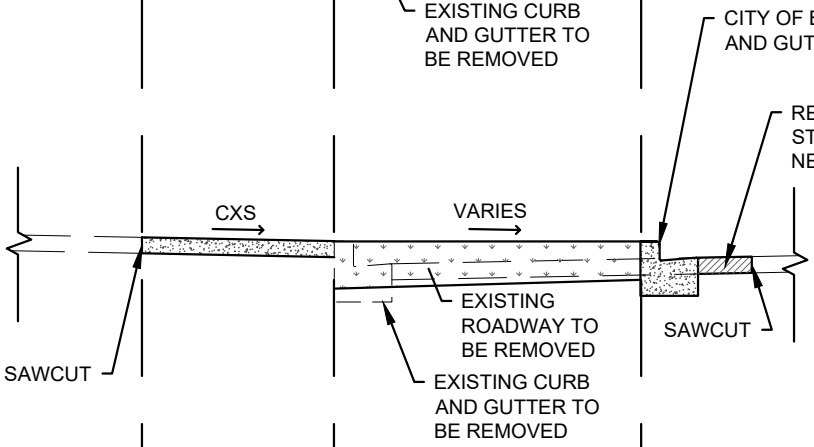
2.04a



CURB EXTENSION SECTION W/ SHALLOW ROAD CROSS SLOPE AND WALKABLE EXTENSION AREA



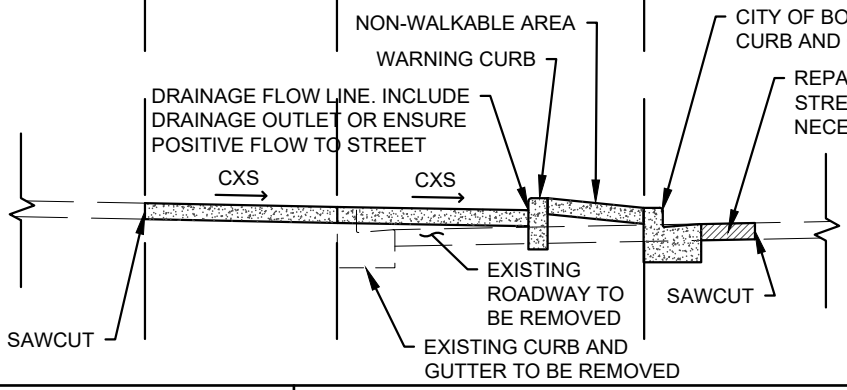
CURB EXTENSION SECTION W/ STEEP ROAD CROSS SLOPE AND WALKABLE EXTENSION AREA



NOTES:

1. MAY BE APPLIED TO BOTH SHALLOW AND STEEP ROAD CROSS SLOPE SCENARIOS
2. LANDSCAPED AREA MAY BE USED FOR STORMWATER TREATMENT, WHICH MAY REQUIRE ADDITONAL TOPOGRAPHIC AND UNDERGROUND UTILITY

CURB EXTENSION SECTION W/ LANDSCAPED EXTENSION AREA



CURB EXTENSION SECTION W/ PARTIAL WALKABLE EXTENSION AREA AND RAISED CURB RETURN

ACCESSIBLE CROSS SLOPE (CXS) = 0.5-1.0% (2% MAX)

DRAWN BY: TW

CHECKED BY: CS

APPROVED BY:
DIRECTOR OF PUBLIC WORKS

CITY OF BOULDER, COLORADO

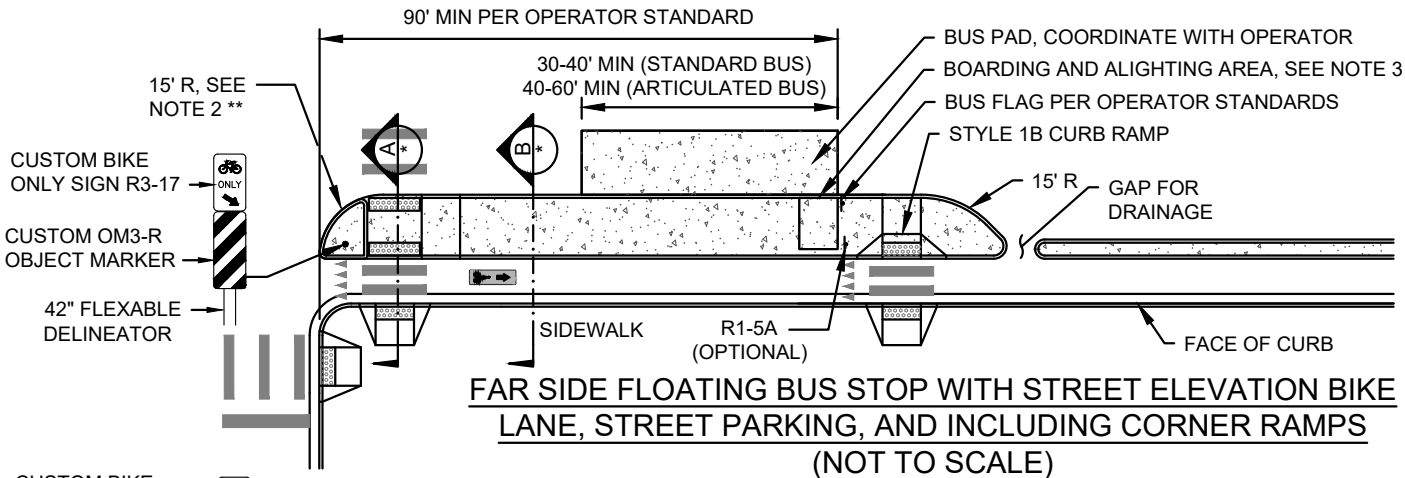
CURB EXTENSION CROSS SECTIONS

ISSUED: XXX XX, 2022

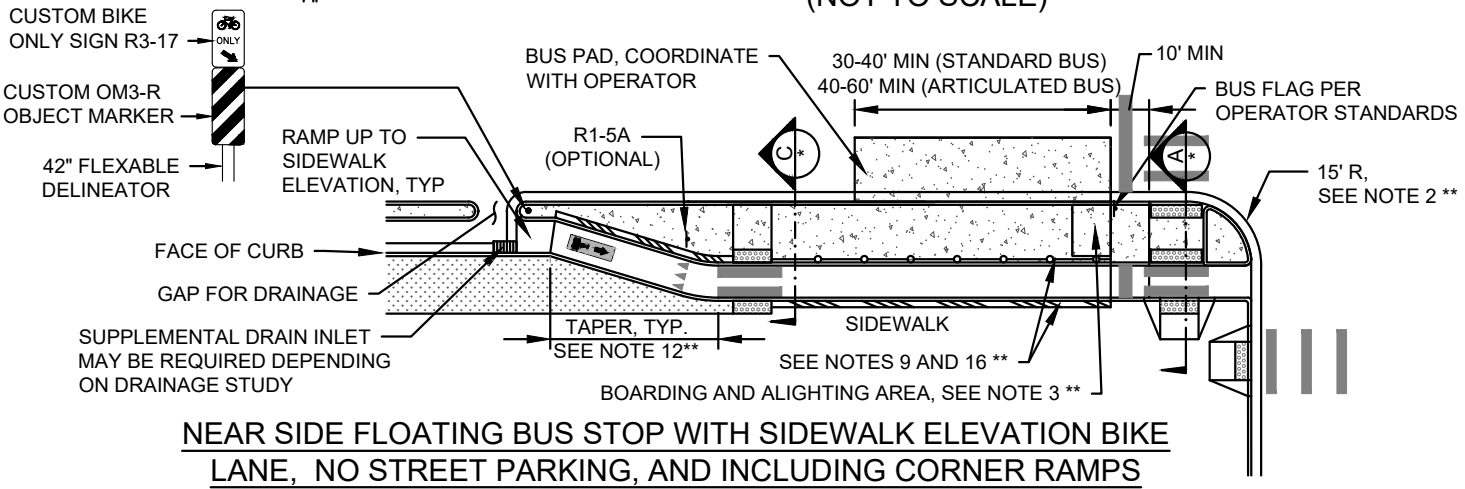
REVISED: XXX XX, 2022

DRAWING NO.

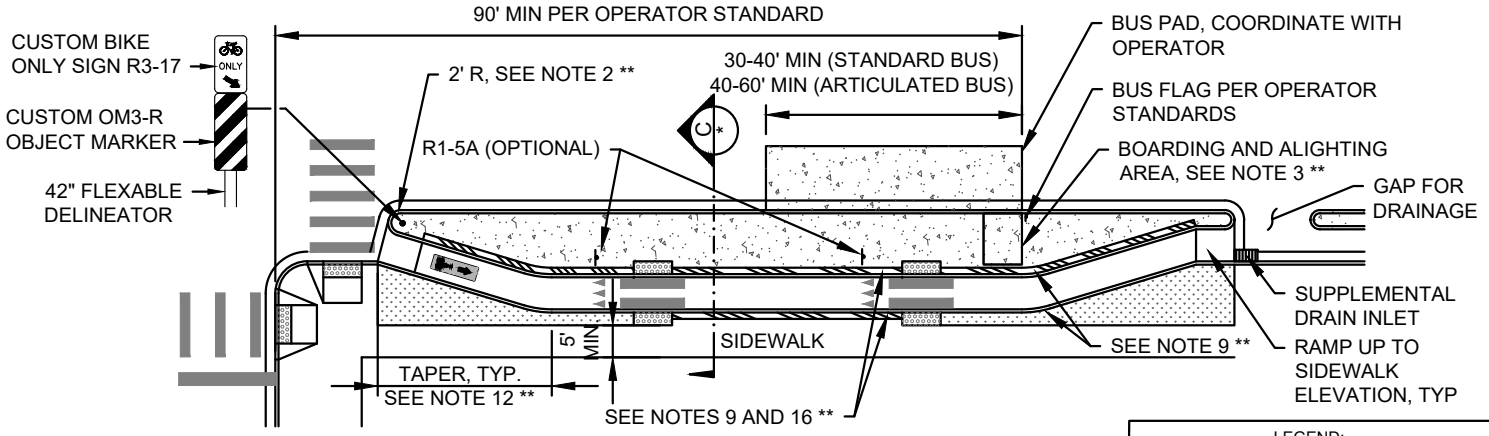
2.04b



FAR SIDE FLOATING BUS STOP WITH STREET ELEVATION BIKE LANE, STREET PARKING, AND INCLUDING CORNER RAMPS
(NOT TO SCALE)



NEAR SIDE FLOATING BUS STOP WITH SIDEWALK ELEVATION BIKE LANE, NO STREET PARKING, AND INCLUDING CORNER RAMPS
(NOT TO SCALE)



FAR SIDE BUS STOP WITH SIDEWALK ELEVATION BIKE LANE NO STREET PARKING, AND EXCLUDING CORNER RAMPS
(NOT TO SCALE)

* = SECTIONS ARE FOUND ON DRAWING NO. 2.44b

** = NOTES ARE FOUND ON DRAWING NO. 2.44c

LEGEND:

- RAILING
- DIRECTIONAL INDICATOR STRIP
- YIELD LINE 12"x18" WITH 3" TO 12" SEPARATION

DRAWN BY: TW

CHECKED BY: CS

APPROVED BY:
DIRECTOR OF PUBLIC WORKS

CITY OF BOULDER, COLORADO

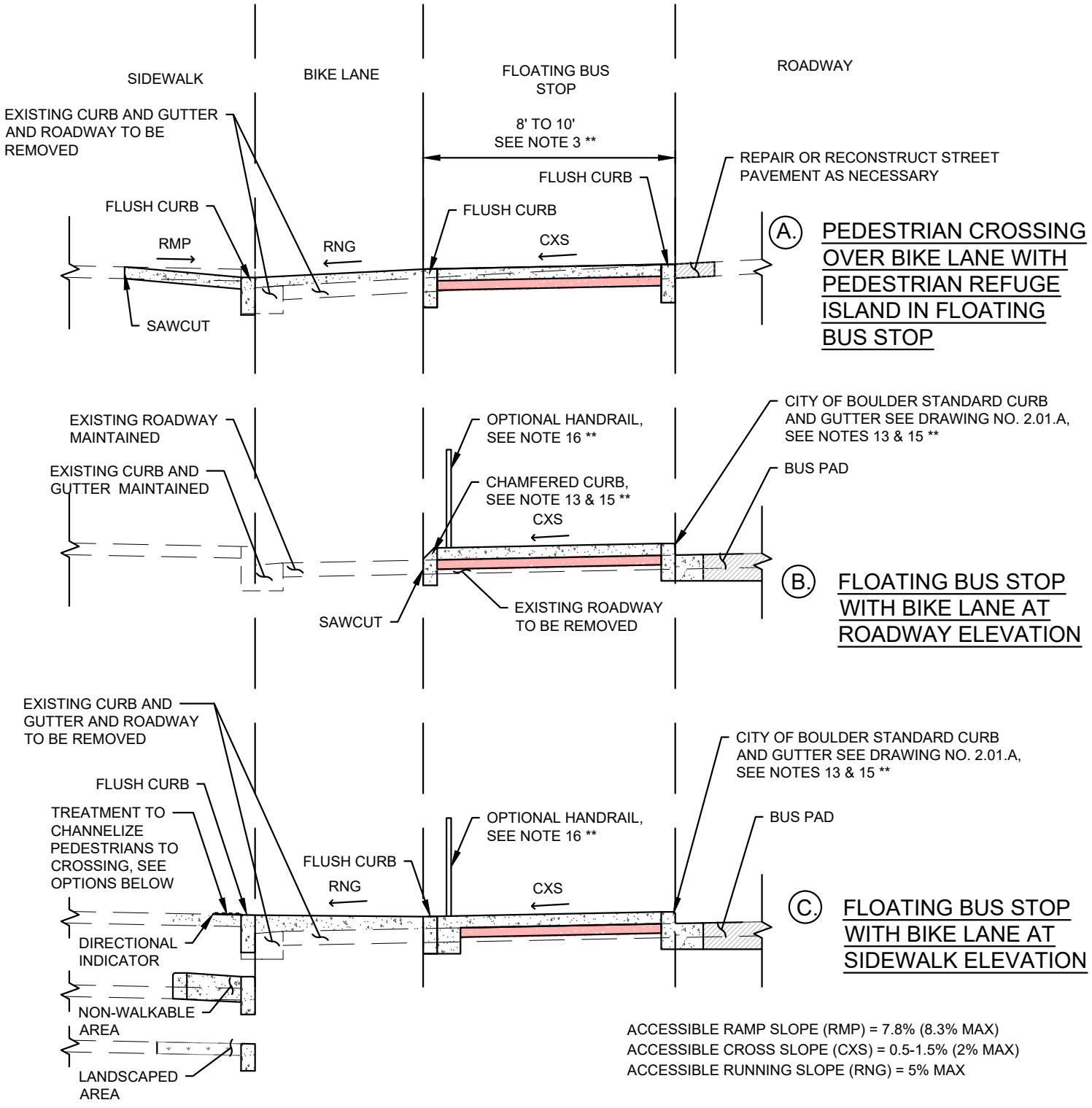
FLOATING BUS STOP DETAIL

ISSUED: XXX XX, 2022

REVISED: XXX XX, 2022

DRAWING NO.

2.44a



ACCESSIBLE RAMP SLOPE (RMP) = 7.8% (8.3% MAX)
ACCESSIBLE CROSS SLOPE (CXS) = 0.5-1.5% (2% MAX)
ACCESSIBLE RUNNING SLOPE (RNG) = 5% MAX

** = NOTES ARE FOUND ON DRAWING NO. 2.44c

DRAWN BY: TW
CHECKED BY: CS

APPROVED BY:
DIRECTOR OF PUBLIC WORKS

CITY OF BOULDER, COLORADO

FLOATING BUS STOP CROSS SECTIONS

ISSUED: XXX XX, 2022
REVISED: XXX XX, 2022

DRAWING NO.
2.44b

NOTES:

1. DESIGN PLANS SHOULD BE CONSULTED FOR VARIATIONS.
2. NOSE OF FLOATING BUS STOP CAN BE DESIGNED AS MOUNTABLE TRUCK APRON, IF NECESSARY TO ACCOMMODATE LARGE VEHICLE TURNING MOVEMENTS.
3. A MINIMUM 5-FOOT WIDE BY 8-FOOT DEEP BOARDING AND ALIGHTING AREA, WITH A MAXIMUM SLOPE OF 2% IN ANY DIRECTION, IS REQUIRED AT FORWARD LOADING AREA ADJACENT TO THE BUS DOOR. THE 8-FOOT DEPTH MAY INCLUDE THE ADJACENT CURBLINE, BUT IS EXCLUSIVE OF ANY RAILING OR CHAMFERED CURB SPACE. A 4-FOOT MINIMUM CLEAR ACCESSIBLE ROUTE MUST BE PROVIDED BETWEEN THE BOARDING AND ALIGHTING AREA AND THE SIDEWALK. AN ACCESSIBLE ROUTE MUST ALSO BE PROVIDED BETWEEN ANY PROVIDED BUS SHELTERS AND THE BOARDING AND ALIGHTING AREA. IF A FLOATING BUS STOP SERVES MULTIPLE TRANSIT VEHICLE STOPS SIMULTANEOUSLY, BOARDING AND ALIGHTING AREAS MUST BE PROVIDED AT EACH VEHICLE DOOR AND ACCESSIBLE ROUTES PROVIDED ACCORDINGLY.
4. THE PREFERABLE FLOATING BUS STOP LENGTH IS BASED ON THE LENGTH OF THE BUS(ES) EXPECTED TO USE THE BUS STOP. IF MULTIPLE BUSES ARE EXPECTED TO USE THE STOP AT THE SAME TIME, THE LENGTH SHOULD BE BASED ON THE BUS LENGTH(S) WITH 20-FEET OF SEPARATION BETWEEN THE BUSES. THE LENGTH OF A FLOATING BUS STOP IS EXCLUSIVE OF ALL PEDESTRIAN RAMPS.
5. LENGTH OF SIDEWALK REPLACEMENT WILL VARY BASED THE WIDTH OF THE FLOATING BUS STOP, EXISTING ROADWAY CROSS SLOPES, CURB REVEAL, AND THE SLOPE AND GRADE OF EXISTING SIDEWALKS.
6. PEDESTRIAN CROSSINGS FROM THE SIDEWALK TO THE FLOATING BUS STOP MAY BE PROVIDED AT INTERSECTIONS, AT LOCATIONS SEPARATE FROM THE INTERSECTION, AND/OR AT THE ENDS FURTHEST FROM INTERSECTIONS. TWO PEDESTRIAN CROSSINGS ARE PREFERABLE BASED ON NATURAL PEDESTRIAN DESIRE LINES.
7. WHERE POSITIVE DRAINAGE CANNOT BE ACHIEVED ALONG CURBLINES, INSTALL NEW STORM DRAIN STRUCTURES AND CONNECT TO EXISTING STORMWATER CONVEYANCE SYSTEM.
8. THIS NOTE INTENTIONALLY LEFT BLANK.
9. THE USE OF DIRECTIONAL INDICATOR STRIPS MAY ONLY BE CONSIDERED WHERE THE USE OF AN UNWALKABLE, VEGETATED AREA, OR HANDRAIL BETWEEN THE BIKE LANE AND SIDEWALK WOULD RESULT IN A SIDEWALK WIDTH OF LESS THAN 5-FEET, OR IS OTHERWISE NOT PREFERRED.
10. A MINIMUM 12-FOOT x 4-FOOT CLEAR SPACE, WITH A MAXIMUM SLOPE OF 2% IN ANY DIRECTION IS RECOMMENDED AT ALL REAR BUS DOORS. IF THE REAR DOOR SERVES AS THE WHEELCHAIR ACCESSIBLE LOADING DOOR, A 5-FOOT X 8-FOOT LOADING AREA IS REQUIRED.
11. SEE CITY OF BOULDER DESIGN AND CONSTRUCTION STANDARDS, SECTION 2.07, TABLE 2.5 FOR STANDARD LANE WIDTHS
12. BIKE LANE TAPERS PREFERRED AT 7:1 SHIFT, MINIMUM 3:1 SHIFT IN CONSTRAINED LOCATIONS WHERE SPEED IS ≤ 13 MPH
13. STANDARD 6 INCH CURB HEIGHTS ARE PREFERRED AND MAY REQUIRE PARTIAL OR FULL ROADWAY REGRADING. CURB HEIGHTS OF 4 INCHES OR LESS MAY BE USED TO ACHIEVE POSITIVE DRAINAGE WITHOUT ROADWAY REGRADING. THE USE OF CURB HEIGHTS BELOW 4" REQUIRES THE APPROVAL BY ENGINEER.
14. SLOPE TO REMAIN TRAVERSABLE AND DRAIN TOWARDS THE GUTTER. SLOPES NOT TO EXCEED 2%.
15. OVERALL CURB HEIGHT WILL VARY BASED ON EXISTING GRADES, CURB REVEALS, AND OPPORTUNITIES TO ADJUST THE CURBLINE ELEVATION AT THE EDGE OF ROAD. ENSURE THAT THE CURB DEPTH EXTENDS AT LEAST 8 INCHES BELOW FINISHED GRADE. FOR CURB REVEAL HEIGHTS THAT EXCEED 9 INCHES, DESIGN CURB AS AN ISOLATED REINFORCED CONCRETE RETAINING CURB.
16. A HANDRAIL IS REQUIRED IF THE CURB HEIGHT EXCEEDS 8 INCHES. A HANDRAIL SHOULD BE CONSIDERED FOR ANY CURB REVEAL OR ADJACENT TO SIDEWALK LEVEL BIKE LANES TO CHANNELIZE PEDESTRIANS TO THE CROSSWALKS. ALTERNATIVELY, A NON-WALKABLE AREA OR DIRECTIONAL INDICATOR STRIP MAY BE CONSIDERED.
17. ADJUSTMENTS TO THE BIKE LANE ELEVATION MAY BE NECESSARY IF ROADWAY CROSS SLOPES EXCEED 2%. IF ADJUSTING GRADE, ENSURE THAT POSITIVE DRAINAGE IS MAINTAINED ALONG THE CURB LINE OR PROVIDE ADDITIONAL DRAINAGE STRUCTURES.
18. VALLEYS CREATED FROM REVERSE SLOPES SHALL BE DRAINED BACK TO THE CURB WHEN POSSIBLE TO AVOID PONDING ON THE FLOATING BUS STOP. TRENCH DRAINS WITH ADA COMPLIANT GRATES ARE ALSO APPROPRIATE.
19. LIGHTING SHOULD BE PLACED TO ILLUMINATE ENTIRE FLOATING BUS STOP LOADING AREA.
20. WHERE PARKING IS PROVIDED ALONG THE STREET, FOLLOW RTD STANDARDS FOR TAPER LENGTHS APPROACHING AND DEPARTING BUS STOPS.

DRAWN BY: TW

CHECKED BY: CS

APPROVED BY:
DIRECTOR OF PUBLIC WORKS

CITY OF BOULDER, COLORADO

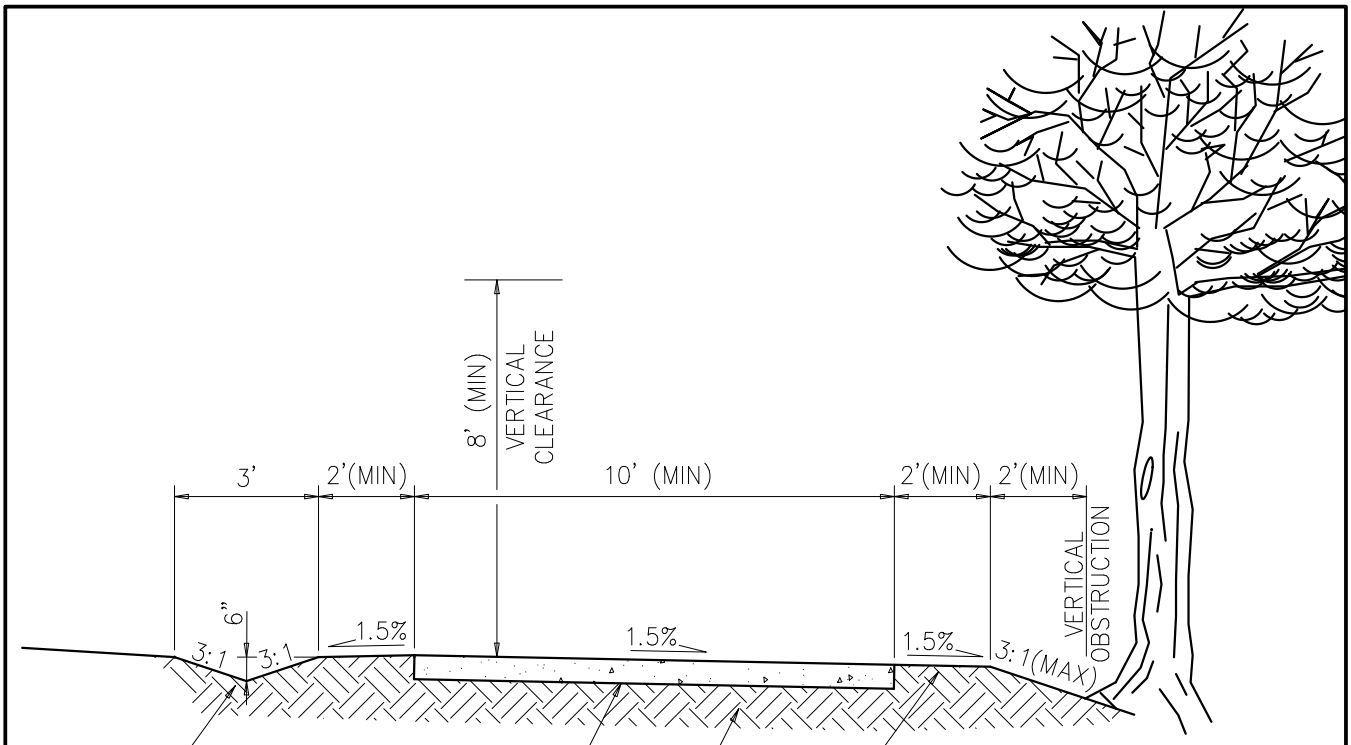
FLOATING BUS STOP NOTES

ISSUED: XXX XX, 2022

REVISED: XXX XX, 2022

DRAWING NO.

2.44c



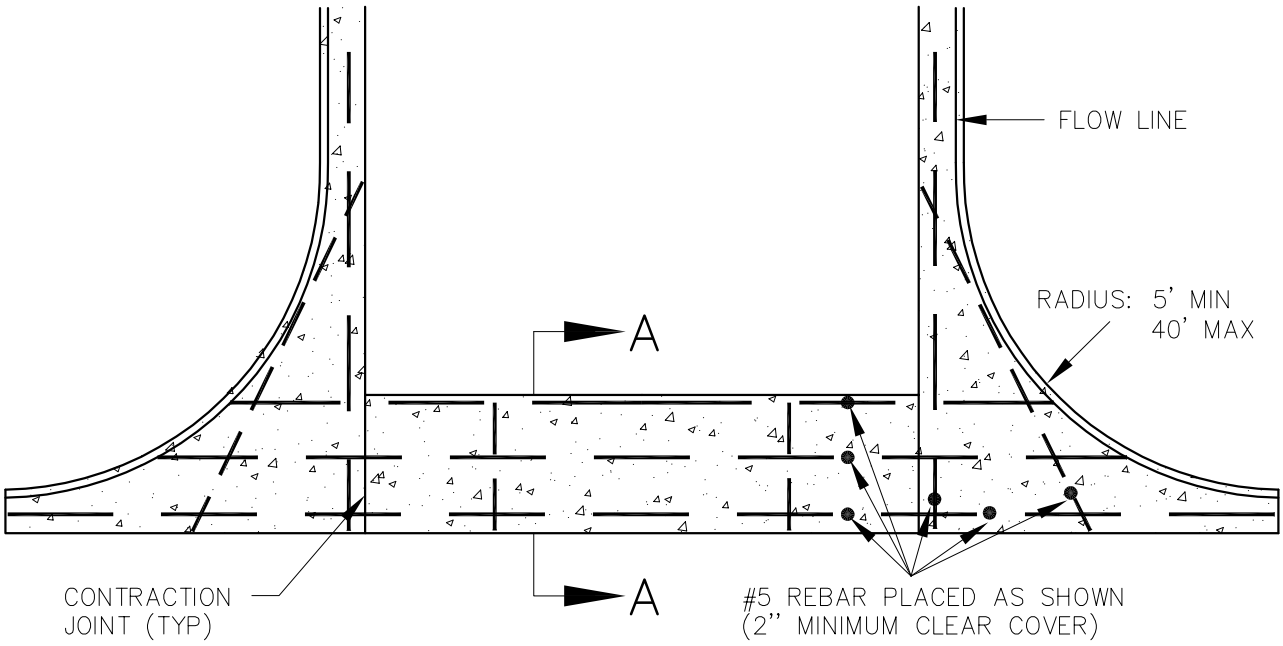
DRAINAGE SWAIL
WHERE NECESSARY

BACKFILL EDGE WITH TOPOIL. FINISHED GRADE TO BE FLUSH WITH PATH EDGE (TYPICAL). RESTORE LANDSCAPING TO PRE-EXISTING CONDITION.

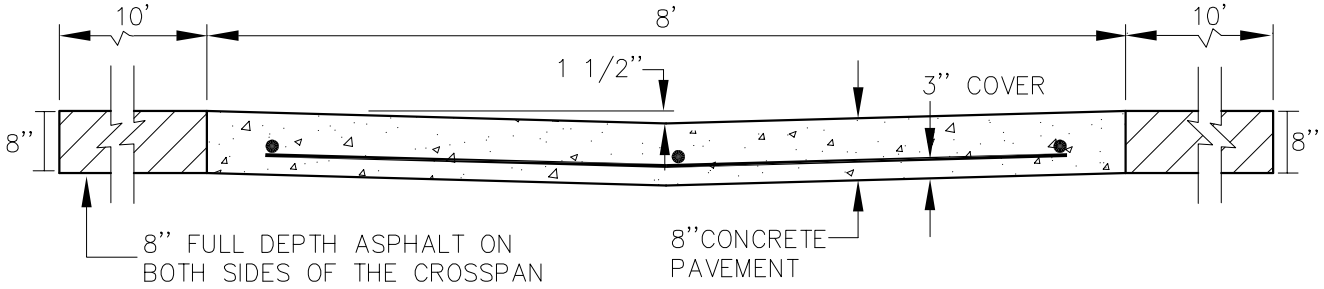
PREPARED SUBGRADE:
COMPACTED ROADBASE OR USE ON-SITE GRAVEL MATERIAL WHERE APPROVED BY THE ENGINEER. OVER EXCAVATE IF UNSTABLE SUB SOILS ARE ENCOUNTERED AND REPLACE WITH SUITABLE FILL MATERIAL. COMPACT ALL FILL AREAS TO 95% STANDARD PROCTER AT 2% OPTIMUM MOISTURE. REMOVE ALL TOPSOIL PRIOR TO SUBGRADE PREPARATION.

6" THICK (MIN) CONCRETE. APPLY BROOM FINISH PERPENDICULAR TO PATH. SAWCUT $\frac{1}{4}$" JOINTS, 1 $\frac{1}{2}$" DEEP (MINIMUM) EVERY 10' ALONG TRIAL. NO TOOLED JOINTS ALLOWED ON MULTI-USE PATH.

DRAWN BY: CHECKED BY: APPROVED BY: DIRECTOR OF PUBLIC WORKS	CITY OF BOULDER, COLORADO MULTI-USE PATH SECTION DETAIL	ISSUED: JULY 2, 1998 REVISED: MAR. 15, 2022 DRAWING NO. 2.02D



TYPICAL VALLEY GUTTER WITH RADII AND STEEL PATTERN SHOWN

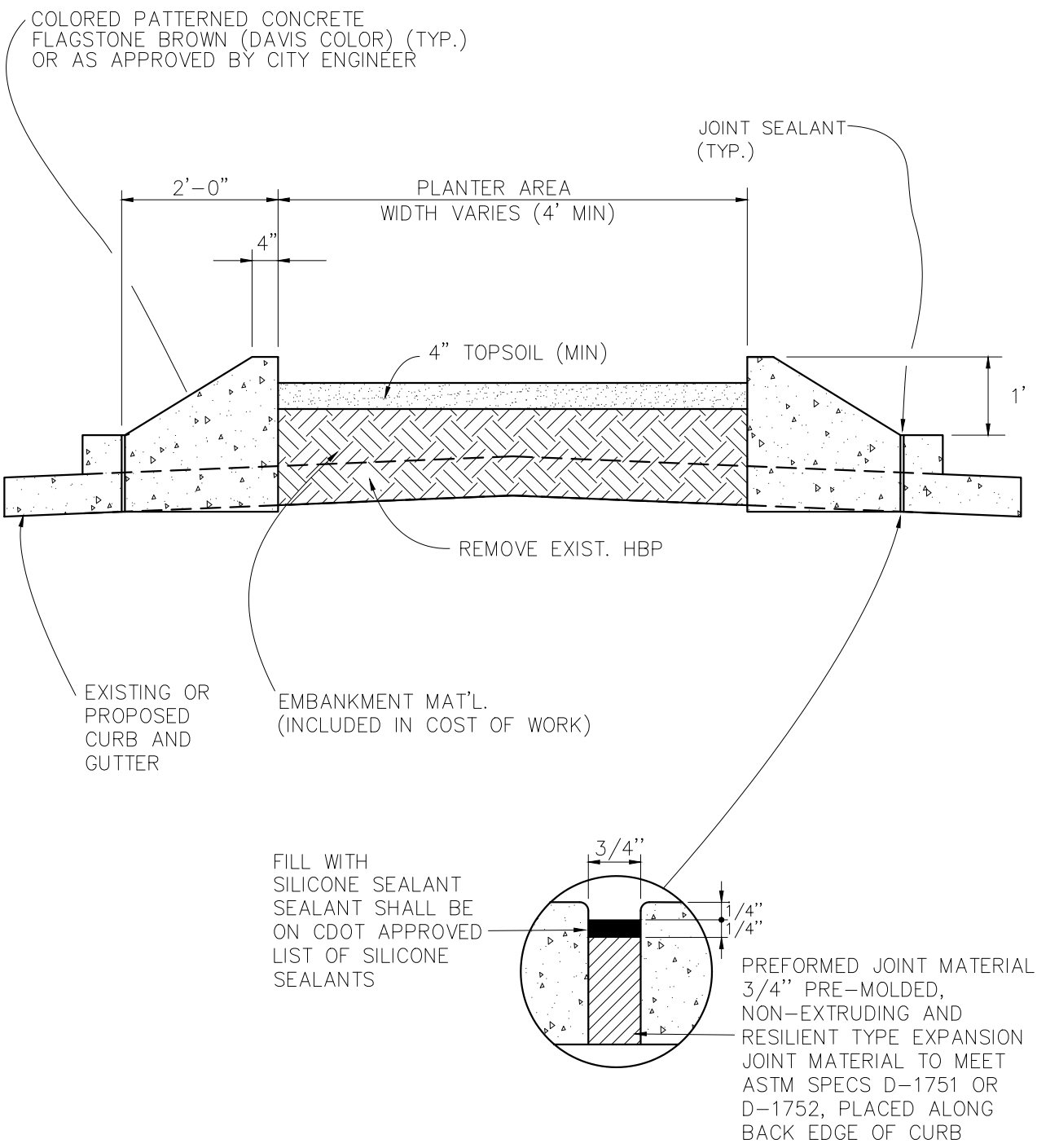


SECTION "A–A" OF PAN

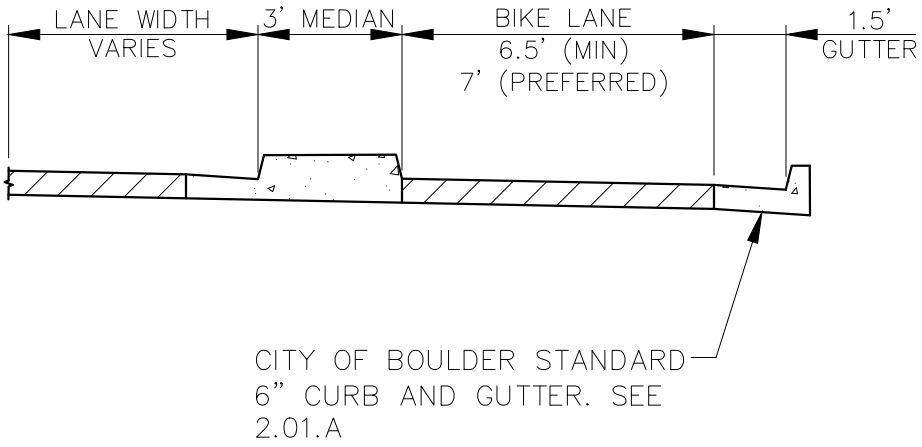
NOTES:

1. THE LONGITUDINAL GRADE ALONG THE FLOWLINE OF THE CURB RETURN SHALL BE 0.50% MINIMUM.
2. WHEN CONSTRUCTING DIFFERENT WIDTH STREETS, REINFORCING STEEL LENGTHS WILL CHANGE ACCORDINGLY BUT THE PATTERN WILL REMAIN THE SAME.

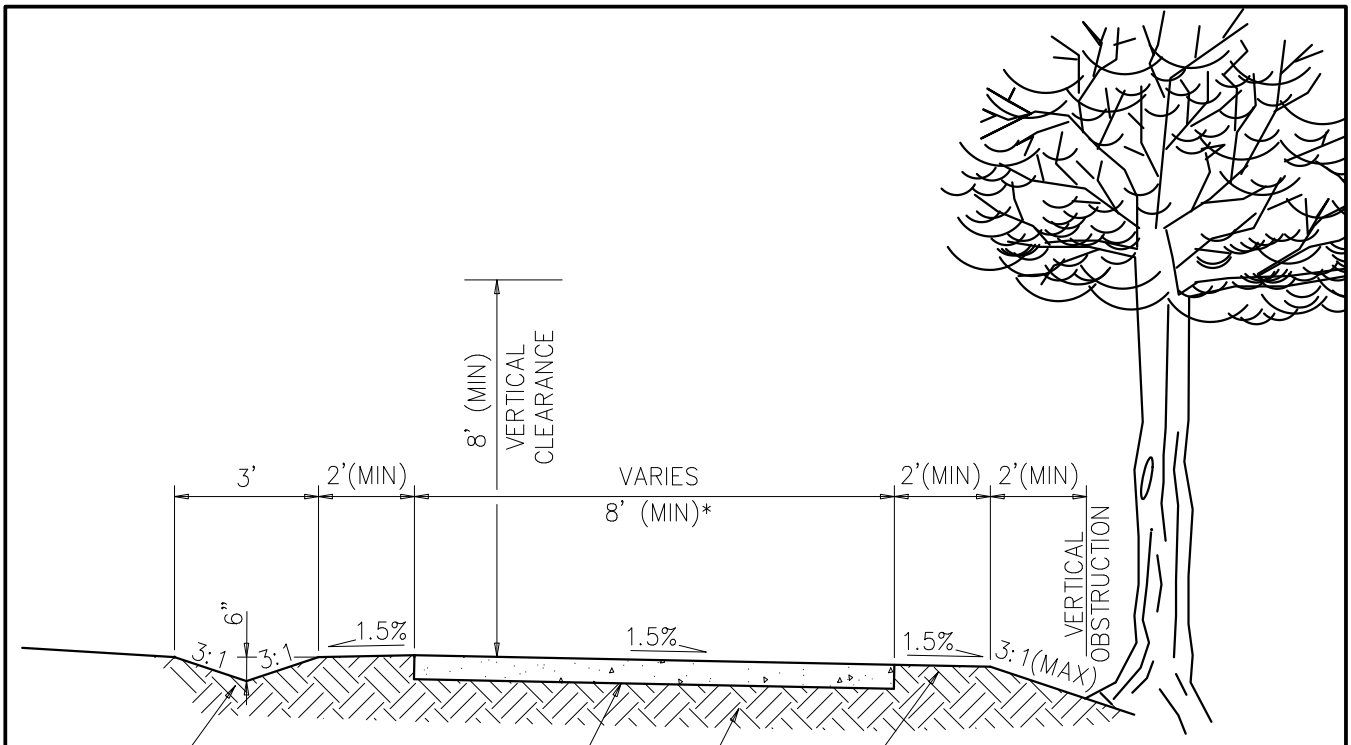
DRAWN BY: JSH CHECKED BY: RJH APPROVED BY: DIRECTOR OF PUBLIC WORKS	CITY OF BOULDER, COLORADO CROSSPAN AND RADII CURB RETURN ACCESSES	ISSUED: JULY 2, 1998 REVISED: MAR. 16, 2022 DRAWING NO. 2.03



DRAWN BY: JSH CHECKED BY: RJH APPROVED BY: DIRECTOR OF PUBLIC WORKS	CITY OF BOULDER, COLORADO MEDIAN PAVED CURB SKIRT	ISSUED: JULY 2, 1998 REVISED: MAR. 15, 2022 DRAWING NO. 2.42.A



DRAWN BY: JSH CHECKED BY: RJH APPROVED BY: DIRECTOR OF PUBLIC WORKS	CITY OF BOULDER, COLORADO MEDIAN/CURB SEPARATED BIKE LANE	ISSUED: DEC. 17, 2019 REVISED: MAR. 8, 2022 DRAWING NO. 2.42.C



DRAINAGE SWAIL
WHERE NECESSARY

BACKFILL EDGE WITH TOPOIL. FINISHED GRADE TO BE FLUSH WITH PATH EDGE (TYPICAL). RESTORE LANDSCAPING TO PRE-EXISTING CONDITION.

PREPARED SUBGRADE:
COMPACTED ROADBASE OR USE ON-SITE GRAVEL MATERIAL WHERE APPROVED BY THE ENGINEER. OVER EXCAVATE IF UNSTABLE SUB SOILS ARE ENCOUNTERED AND REPLACE WITH SUITABLE FILL MATERIAL. COMPACT ALL FILL AREAS TO 95% STANDARD PROCTER AT 2% OPTIMUM MOISTURE. REMOVE ALL TOPSOIL PRIOR TO SUBGRADE PREPARATION.

6" THICK (MIN) CONCRETE. APPLY BROOM FINISH PERPENDICULAR TO PATH. SAWCUT $\frac{1}{4}$" JOINTS, 1 $\frac{1}{2}$" DEEP (MINIMUM) EVERY 10' ALONG TRIAL. NO TOOLED JOINTS ALLOWED ON BICYCLE PATH.

* 12' (MIN) FOR BICYCLE AND PEDESTRIANS. WHERE EVER POSSIBLE, PEDESTRIAN AND BICYCLE FACILITIES SHALL BE SEPARATED.

DRAWN BY:

CHECKED BY:

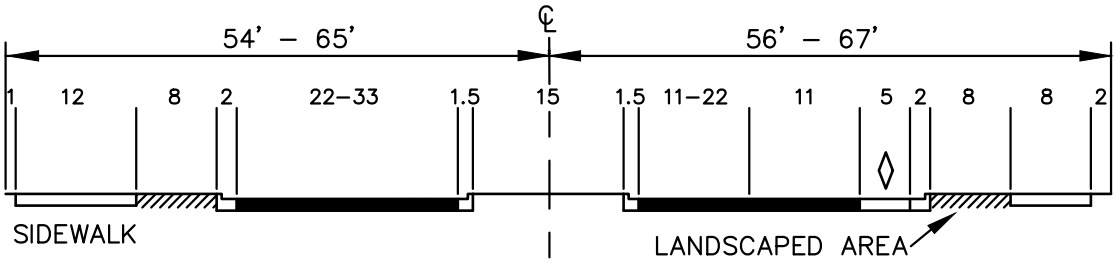
APPROVED BY:
DIRECTOR OF PUBLIC WORKS

CITY OF BOULDER, COLORADO

BICYCLE PATH CROSS-SECTION

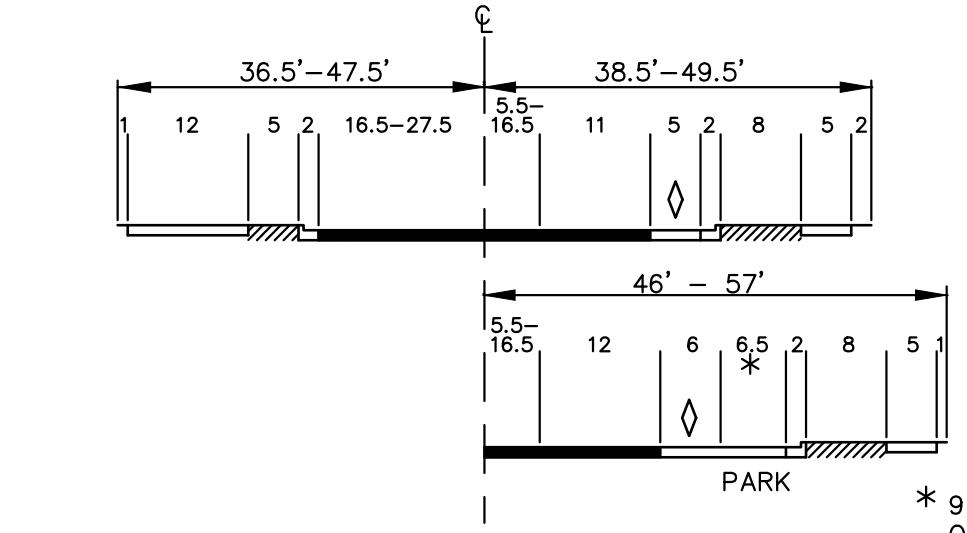
ISSUED: JULY 2, 1998
REVISED: MAR. 15, 2022

DRAWING NO.
2.51



ALTERNATIVE

PRINCIPAL ARTERIAL



ALTERNATIVE

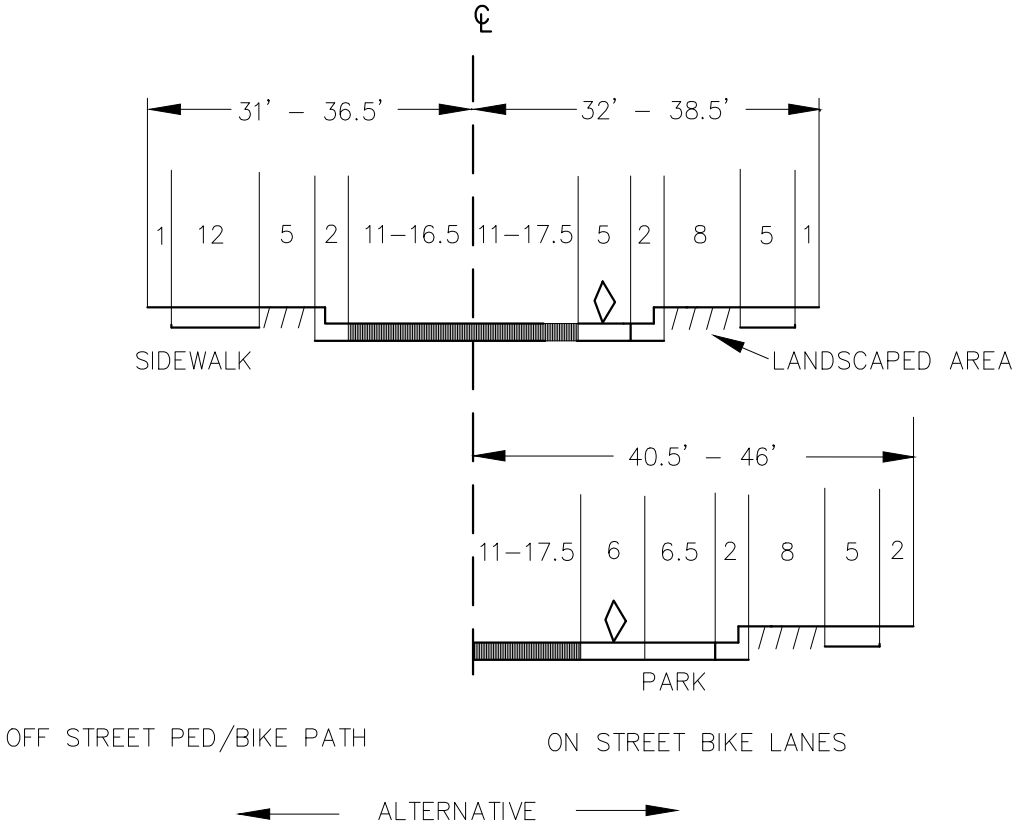
MINOR ARTERIAL

NOTES:

1. ALL RIGHT–OF–WAY WIDTHS AND CROSS SECTIONS SHOWN ARE FROM INTERSECTIONS AND TURN LANES. ADDITIONAL RIGHT–OF–WAY AND LANE WIDTHS MAY BE REQUIRED FOR INTERSECTIONS AND TURN LANES.

2. VERIFY IF ROUTE SELECTED FOR BIKE LANES IS COINCIDENT WITH BOULDER'S MOST RECENTLY PUBLISHED LOW STRESS WALK AND BIKE NETWORK PLAN. IF THE PLAN PRESCRIBES A VERTICALLY SEPARATED BIKE LANE, THIS DETAIL DOES NOT APPLY; INSTEAD REFER TO STD DWG 2.42.C. IF THE PLAN PRESCRIBES BIKE LANES PREFERABLY BUFFERED, THIS DETAIL MAY APPLY.

DRAWN BY: JSH CHECKED BY: MGS APPROVED BY: DIRECTOR OF PUBLIC WORKS	CITY OF BOULDER, COLORADO NON–RESIDENTIAL STREET CROSS–SECTION EXAMPLES	ISSUED: JULY 2, 1998 REVISED: MAR. 8, 2022 DRAWING NO. 2.61.A



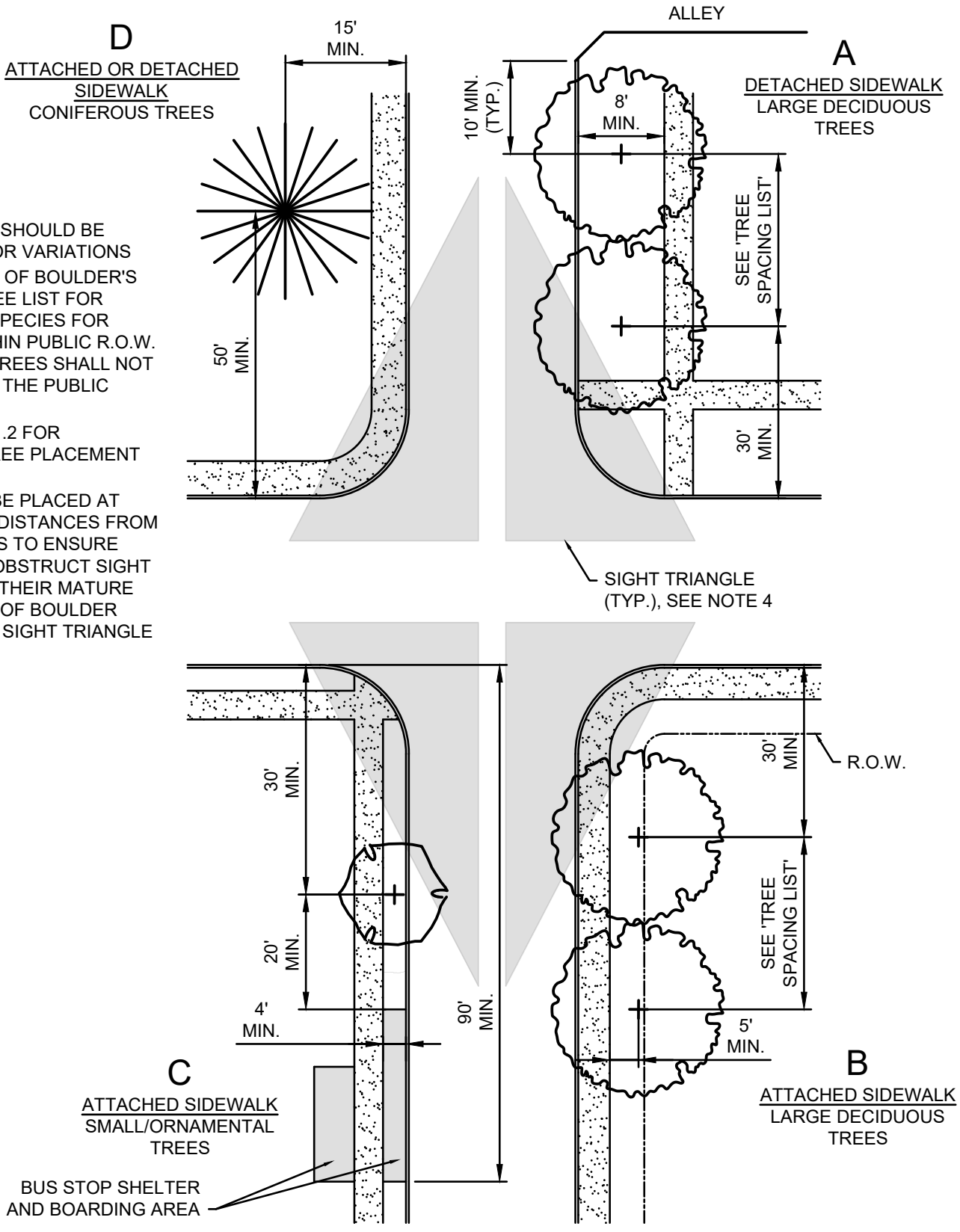
COLLECTOR

NOTES:

1. ALL RIGHT–OF–WAY WIDTHS AND CROSS SECTIONS SHOWN ARE FROM INTERSECTIONS AND TURN LANES. ADDITIONAL RIGHT–OF–WAY AND LANE WIDTHS MAY BE REQUIRED FOR INTERSECTIONS AND TURN LANES.

2. VERIFY IF ROUTE SELECTED FOR BIKE LANES IS COINCIDENT WITH BOULDER'S MOST RECENTLY PUBLISHED LOW STRESS WALK AND BIKE NETWORK PLAN. IF THE PLAN PRESCRIBES A VERTICALLY SEPARATED BIKE LANE, THIS DETAIL DOES NOT APPLY; INSTEAD REFER TO STD DWG 2.42.C. IF THE PLAN PRESCRIBES BIKE LANES PREFERABLY BUFFERED, THIS DETAIL MAY APPLY.

DRAWN BY: JSH CHECKED BY: MGS APPROVED BY: DIRECTOR OF PUBLIC WORKS	CITY OF BOULDER, COLORADO NON–RESIDENTIAL STREET CROSS–SECTION EXAMPLES	ISSUED: JULY 2, 1998 REVISED: MAR. 8, 2022 DRAWING NO. 2.61.B



NOTES:

1. DESIGN PLANS SHOULD BE CONSULTED FOR VARIATIONS
2. REFER TO CITY OF BOULDER'S APPROVED TREE LIST FOR ACCEPTABLE SPECIES FOR PLANTING WITHIN PUBLIC R.O.W. CONIFEROUS TREES SHALL NOT BE PLANTED IN THE PUBLIC R.O.W.
3. SEE DETAIL 301.2 FOR ADDITIONAL TREE PLACEMENT GUIDANCE
4. TREES SHALL BE PLACED AT APPROPRIATE DISTANCES FROM INTERSECTIONS TO ENSURE THEY DO NOT OBSTRUCT SIGHT TRIANGLES AT THEIR MATURE SIZE. SEE CITY OF BOULDER DETAIL XX FOR SIGHT TRIANGLE GUIDANCE.

DRAWN BY: KW

CHECKED BY: JC

APPROVED BY:
DIRECTOR OF PUBLIC WORKS

CITY OF BOULDER, COLORADO
STREETSCAPE
TREE SPACING AND LOCATION

ISSUED: XXX XX, 2021

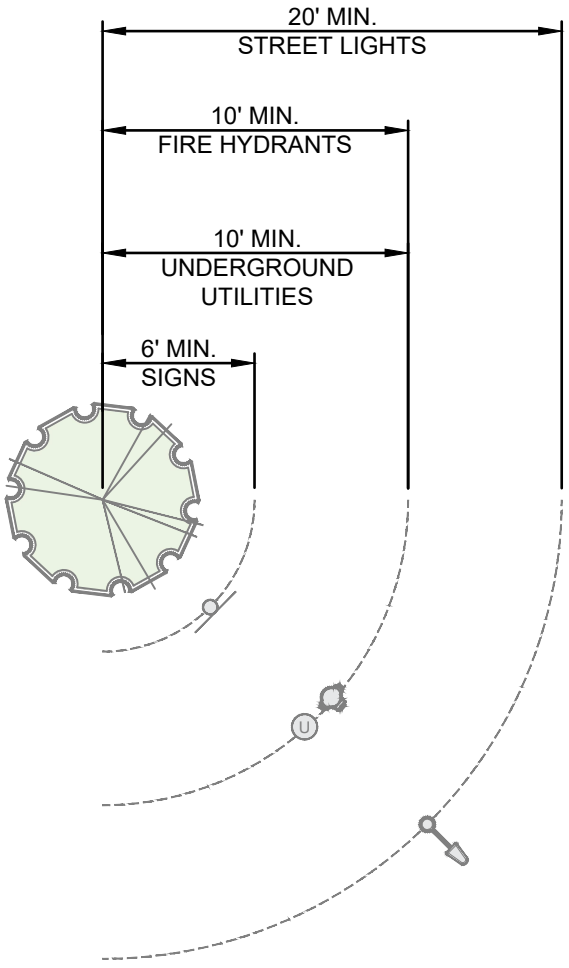
REVISED: XXX XX, 2021

DRAWING NO.

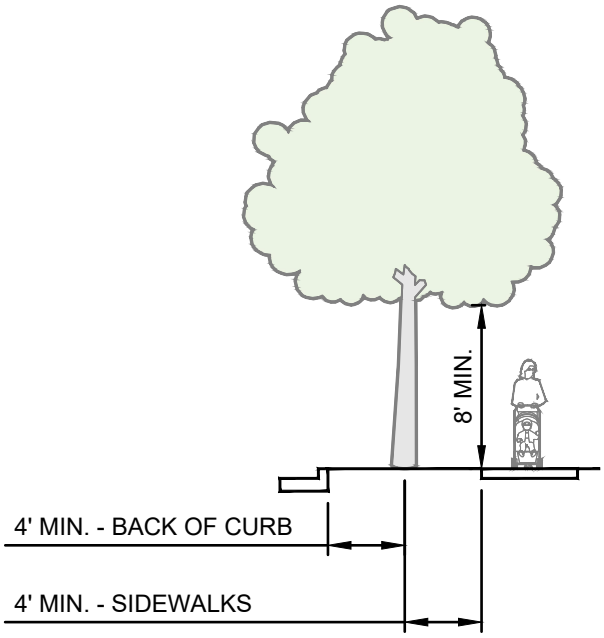
3.01a

NOTES:

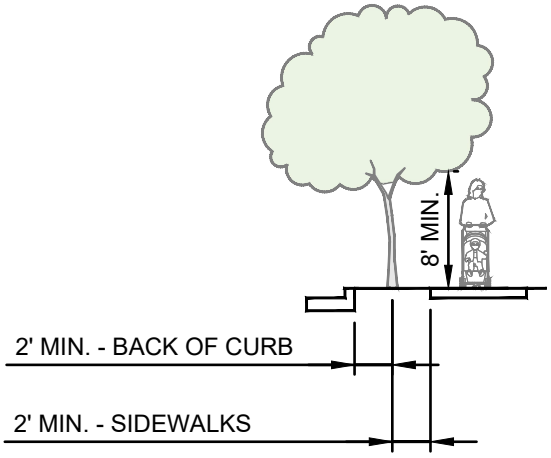
1. REFER TO CITY OF BOULDER'S APPROVED TREE LIST FOR ACCEPTABLE SPECIES FOR PLANTING WITHIN PUBLIC R.O.W. CONIFEROUS TREES SHALL NOT BE PLANTED IN THE PUBLIC R.O.W.
2. TREE SPECIES SHALL BE SELECTED TO ENSURE MINIMUM VERTICAL CLEAR SPACE OF 8' CAN BE MAINTAINED WITHIN SIDEWALKS. IN CONSTRAINED URBAN SETTINGS, SPECIES SHALL BE SELECTED TO ENSURE ADEQUATE PEDESTRIAN SPACE.
3. SEE DETAIL XX.X FOR TREE PLACEMENT AT INTERSECTIONS AND TYPICAL TREE SPACING



TREE PLANTING BUFFERS



MEDIUM/LARGE TREE



SMALL/ORNAMENTAL TREE

DRAWN BY: KW

CHECKED BY: JC

APPROVED BY:
DIRECTOR OF PUBLIC WORKS

CITY OF BOULDER, COLORADO
STREETSCAPE
TREE SPACING AND LOCATION

ISSUED: XXX XX, 2021

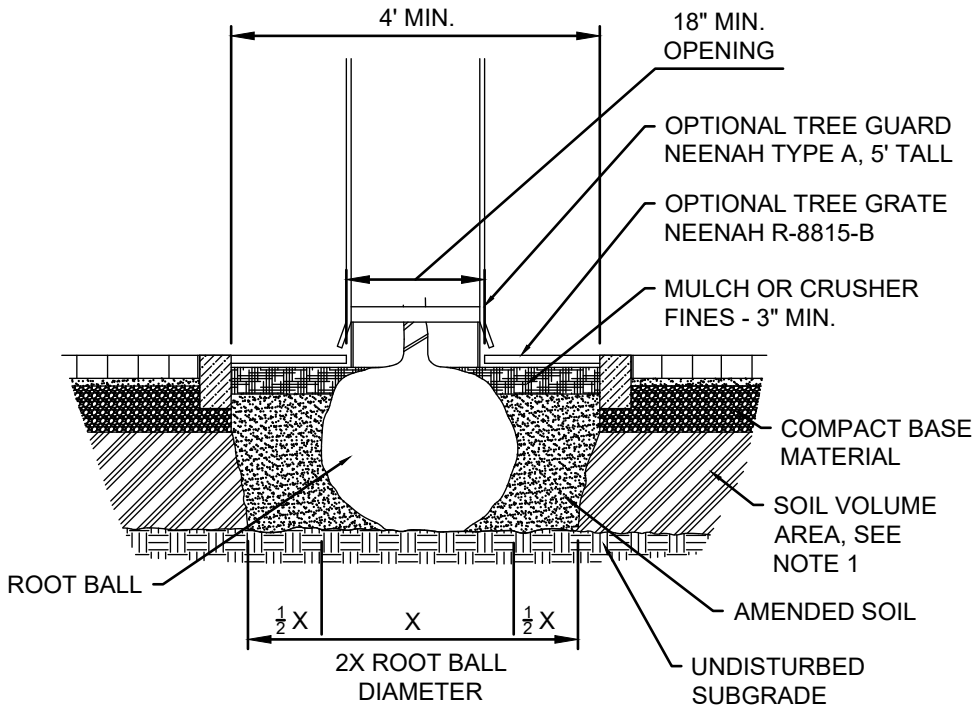
REVISED: XXX XX, 2021

DRAWING NO.

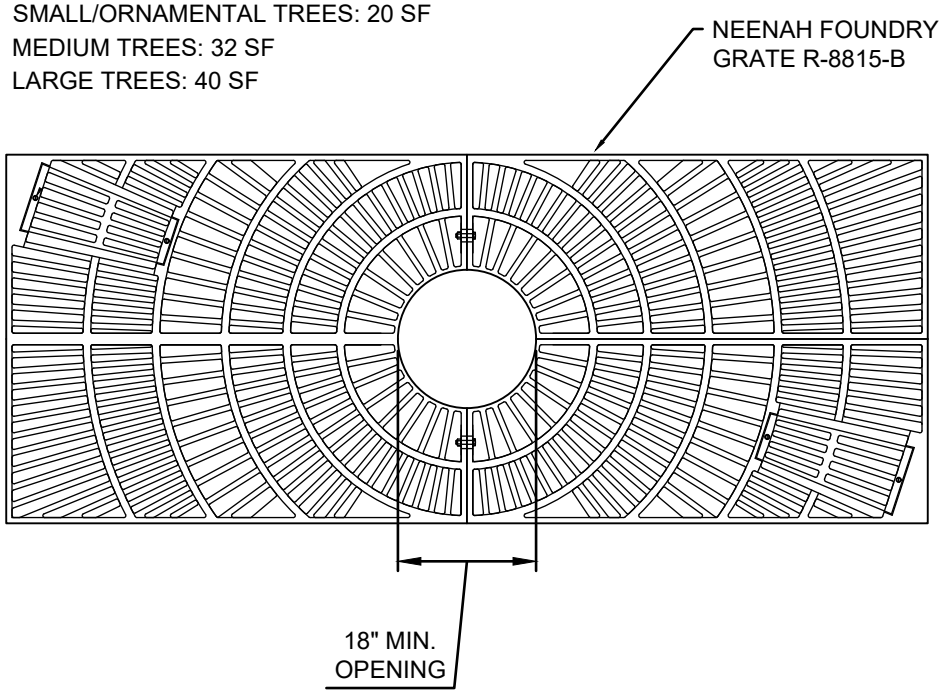
3.01b

NOTES:

1. ADDITIONAL SOIL VOLUME AREAS ARE ENCOURAGED TO OBTAIN MINIMUM SOIL VOLUME AND ENSURE LONG TERM TREE VIABILITY. UTILIZE STRUCTURAL CELLS, SOIL TRENCHES, OR OTHER UNCOMPACTED SOIL TECHNIQUES TO PROVIDE MAXIMUM SOIL VOLUME BENEATH PAVED SIDEWALKS AND PLAZAS.
2. RECOMMENDED SOIL VOLUMES:
   A. SMALL/ORNAMENTAL TREES - 600 CF
   B. MEDIUM TREES - 900 CF
   C. LARGE TREES - 1,200 CF
3. SEE DETAIL X.XX FOR TREE SPACING AND PLACEMENT REQUIREMENTS
4. FOLLOW MANUFACTURE'S INSTRUCTIONS FOR GRATE FRAME INSTALLATION.



MINIMUM GRATE OR WELL AREA
SMALL/ORNAMENTAL TREES: 20 SF
MEDIUM TREES: 32 SF
LARGE TREES: 40 SF



DRAWN BY: KW
CHECKED BY: JC

APPROVED BY:
DIRECTOR OF PUBLIC WORKS

CITY OF BOULDER, COLORADO

TREE GRATE FOR SIDEWALK PLANTING

ISSUED: XXX XX, 2021
REVISED: XXX XX, 2021

DRAWING NO.
3.03