



**CITY OF BOULDER
CITY COUNCIL AGENDA ITEM**

MEETING DATE: January 7, 2020

AGENDA TITLE

Third reading and consideration of a motion to adopt Ordinance 8370 (see Attachment A), 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 Phase 1 of updates to the transportation design standards of the City of Boulder.

PRESENTER/S

Jane S. Brautigam, City Manager
Bill Cowern, Interim Director of Public Works for Transportation
Trish Jimenez, Deputy Director of Public Works for Development Services
Edward Stafford, Development Review Manager, Public Works
Gerrit Slatter, Principal Transportation Projects Engineer

EXECUTIVE SUMMARY

The City of Boulder is currently engaged in a process to update the [Design and Construction Standards](#) (DCS). The DCS is used to prescribe minimum standards to be used in the design and construction of public infrastructure located in public right-of-way and easements within the city of Boulder, as well as private transportation and utility improvements that connect or impact public infrastructure.

This purpose of this memorandum is to provide background information and a summary of the proposed transportation related updates. The initial approach was to take a set of transportation-related proposed changes forward simultaneously with updates to the utilities and stormwater portions of the DCS. Staff later identified that additional work on the transportation sections was necessary to address community and stakeholder feedback, therefore these updates were separated from the utility updates.

City Council is being asked to consider changes to DCS chapter 2 and transportation-related technical drawings in chapter 11. These standards are used to implement capital projects conducted by the city as well as provide a standard for implementation of public infrastructure within the context of private development. The transportation related changes being proposed in this DCS update are in response to several years of community concerns regarding current transportation related design and construction standards. The goal of this update is to develop transportation standards which align with industry best practices, increase travel safety, and implement approved Transportation Master Plan policies. The proposed Ordinance 8370 can be found as Attachment A to this memo. A redline version showing the proposed changes to the DCS can also be found in Attachment A.

Staff have identified other transportation related changes that are outside the scope of the current update and these will be considered in Phase 2, a future DCS update. A description of the proposed changes is included in a chart below.

STAFF RECOMMENDATION

Suggested Motion Language:

Motion to adopt on third reading Ordinance 8370, 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.

COMMUNITY SUSTAINABILITY ASSESSMENTS AND IMPACTS

- Economic – The revisions in the DCS accommodate implementation of the low-stress walk and bike network, enhancing the community appeal of being a safe place to use non-motorized travel.
- Environmental – Encouraging non-motorized travel through an enhanced walk and bike network services to accomplish city goals regarding GHG reduction and climate action.
- Social – The revisions in the DCS will provide greater clarification regarding implementation of walking and biking facilities to provide better transportation choices for all ages and abilities.

BOARD AND COMMISSION FEEDBACK

Transportation Advisory Board

The TAB approved a motion (5-0) on September 9, 2019 to recommend approval of the proposed Chapter 2 and ADA technical drawing revisions to the DCS. The motion

followed an informational item regarding the DCS on March 11, 2019 and a public hearing on September 9, 2019. During both of these meetings TAB expressed strong interest in continuing efforts in the future to update other subsections of Chapter 2 to be more consistent with the 2019 Transportation Master Plan update, including the Low-Stress Walk and Bike Network plan.

Planning Board

The Planning Board approved a motion (7-0) on November 7, 2019, to recommend approval of the proposed revisions to Chapter 2 and ADA technical drawings in the DCS.. The motion language is as follows:

*On a motion by **B. Bowen**, seconded by **H. Zuckerman**, the Planning Board voted 7-0 to recommend approval of the proposed revisions to the DCS to the City Council.*

*Friendly amendment by **H. Zuckerman** to further recommend that City Council consider increasing minimum sidewalk widths in general and, in particular, increasing the Residential Street Sidewalk width (found in Table 2-13: Residential Design Standards) from 4' to 5'. Under Section 2.09 (C)(2)(a), the criteria for alternative design, Planning Board recommends that it be amended to read "Streets shall be designed with due attention to building spacing and setbacks, green spaces, attractive materials, plantings and landscaping, as well as pedestrian safety, utility, multimodal use and walkability, and alternative designs." **B. Bowen** accepted. The board voted 7-0.*

*On a motion by **B. Bowen**, seconded by **S. Silver**, the Planning Board voted 7-0 to recommend to City Council to consider the "Twenty is Plenty" movement and to reduce the speed limit within the city limits from 25 mph to 20 mph.*

PUBLIC FEEDBACK

Staff from the Transportation Division held one-on-one meetings with various interested community and stakeholder groups to get feedback regarding proposed revisions to the DCS. Based upon feedback received in early 2019 from these stakeholder groups staff made the decision to break the DCS update into two parts, with Phase 1 focused on a smaller set of targeted updates Phase 2 being more of a comprehensive update. Community stakeholders provided helpful feedback regarding the DCS update and had a positive reaction to the opportunity to provide input and understand the process.

BACKGROUND

The current DCS were adopted in 1998 with a major update in 2000 to prescribe minimum standards to be used in the design and construction of public infrastructure located in public right-of-way and easements in the city of Boulder, as well as private transportation and utility improvements that connect or impact public infrastructure. The scope of the current DCS update as it pertains to transportation related changes includes:

- Changes to implement current best engineering design, construction and maintenance processes, new and improved materials and technical details
- Alignment with other adopted policy documents, such as the Transportation Master Plan (TMP) and Boulder Valley Comprehensive Plan

Staff has heard feedback from community members and stakeholders, specifically, Community Cycles and has considered and incorporated parts of their feedback in the proposed changes below. Staff appreciates Community Cycles' interest, input and coordination on this matter. A detailed summary of proposed changes in these chapters are explained below.

ANALYSIS

At the November 7 Planning Board meeting, the board amended the staff recommendation to include a motion that sidewalk minimum widths be increased as a part of the Phase 1 update. Further Planning Board recommended that street criteria standards under Section 2.09 (C)(2)(a) be modified to allow for greater pedestrian safety, multimodal use, walkability and alternative designs as well as other considerations. Staff position is that this recommendation from Planning Board be addressed in the Phase 2 DCS Update effort as a change of this type should entail working with community and stakeholder groups in the addition and/or modification of a change in this standard.

Planning Board also recommended City Council consider the “Twenty is Plenty” movement. The consideration of local street speed limits will be a work program item for the Transportation Division in 2020.

The following table denotes the modifications to the DCS that are proposed in this update and the related details to each change.

Proposed technical modification for consideration in current update	Description of proposed modification
2.04 (E)(1)(b) Access with Barrier Island – language added to require “raised crossing”	The installation of a raised crossing in a location where a right turn bypass island is present improves safety by slowing vehicles down through the intersection and increasing bicycle and pedestrian visibility.
2.04 (H) – Speed Change Lanes – added language to provide flexibility on whether Speed Change Lanes should be considered on collectors and arterials.	This provision allows more flexibility for staff to determine whether speed change lanes should be installed on collectors and arterials. The city strives to create roadway conditions that are designed to discourage speeding.
2.04 (J) – Access and Curb Cut Width – added language – roadways shall be designed using vehicle turning template and using 10 mph design speed.	The turning template will result in slower speed for turning vehicles which should decrease the severity of injury for vulnerable users if a collision occurs.

2.07 (C) – Lane Width – added dimensions for buffered bike lanes, separated bike lanes and flexibility for bike lanes and parking lanes.	The current DCS does not provide dimensions for contemporary bicycle facilities that are consistent with NACTO’s Urban Bike Design Guide.
2.07 (D)(5)(c) – Street Spacing for Signalized Intersections – added language: “Shall be approved by the Director”.”	This clarifies that regardless of spacing any new or relocated traffic signals must be approved by the Director. It aligns the DCS language with current practice and BRC requirements.
2.07 (G) Medians – added language to extend and include space for pedestrian refuge crossing when feasible.	Pedestrian refuge space is a desired component for crossing roadways both from a pedestrian safety and a pedestrian efficiency standpoint.
2.09 (D) (2) Residential Street – remove reference to 500-1000 vehicles per day to define residential street.	The reference of 500-1000 vehicles a day is not needed when defining the characteristics of a residential street. Residential streets can have a wide range of traffic volume.
2.11 Bicycle Facilities and Multi-Use Path Design – added design standards for separated bike lanes and buffered bike lanes, consistent with NACTO design guidelines.	The current DCS do not have standards for contemporary bicycle facilities (buffered and separated bike lanes) that are described in NACTO’s Urban Bike Design Guide.
2.11 (G) (3) On-Street Bike Parking (Bike Parking Corrals) – added language to clarify the standards by which on-street bike parking may be approved.	The current DCS do not provide a standard for bicycle parking facilities located on streets such as a Bike Corral. The new standards reference the APBP Bicycle Parking Guidelines.
2.12 (B) (4) Street Lighting Design – updated to require energy efficient street lighting and added set back distance from the curb for installation of poles.	The updated language implements best practices for installing of energy efficient street lighting at a safe distance from the curb.
2.13 Added section on Transit Facilities - reference to NACTO Transit Street Design Guide and added language regarding transit stop design practices.	The current DCS does not include standards for the design and construction of transit facilities. The NACTO guidelines are considered a “best practice.”
Ch. 11 – Curb Ramp revisions to meet ADA specifications.	These updated schematics which reflect specific ADA design requirements are not included in the current DCS.

ATTACHMENTS

Attachment A – Proposed Ordinance 8370

ORDINANCE 8370

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 hereby 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, and 8324), to read as shown in **Exhibit A** attached to and hereby incorporated into this ordinance:

- Chapter 2, Transportation Design;
- Glossary; and
- References.

Section 2. Chapter 11 of the *City of Boulder Design and Construction Standards* is further amended by the addition of technical drawing 2.42C, Median, Separated Bike Lane and by the replacement of the existing technical drawing 2.07 with technical drawings 2.07A through 2.07K, as shown in **Exhibit B** attached hereto and incorporated into this ordinance.

Section 3. Table 4-1: Utility Separation Requirements, in Section 4.06 of the *City of Boulder Design and Construction Standards*, shall be revised as shown in **Exhibit C** attached hereto and incorporated into this ordinance.

Section 4. 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

1 application date shall be the date that the fee required by Section 4-20-43, "Development
2 Application Fees," B.R.C. 1981, has been paid. Complete site review and form-based code
3 review applications that have been submitted to the city prior to the effective date of this
4 ordinance will be permitted to continue through the process under the standards in effect at the
5 time such application is made. Such applicants shall be required to pursue such approvals and
6 meet all requirements and deadlines set by the city manager and the Boulder Revised Code.
7 Technical document review applications and permits applied for prior to the effective date of this
8 ordinance may proceed under the standards in effect at the time of application. The city council
9 intends that any project approved under the standards of the *City of Boulder Design and*
10 *Construction Standards* effective prior to the effective date of this ordinance be built and
11 otherwise constructed and maintained in accordance with those standards.
12

13 Section 5. The city council orders and directs the city manager to make any additional
14 citation, reference, and formatting changes to the *City of Boulder Design and Construction*
15 *Standards* not included in this ordinance that are necessary to properly implement these
16 amendments to the *City of Boulder Design and Construction Standards*.

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

19 Section 7. The city council deems it appropriate that this ordinance be published by title
20 only and orders that copies of this ordinance be made available in the office of the city clerk for
21 public inspection and acquisition.
22
23
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25

1 INTRODUCTION, READ ON FIRST READING, AND ORDERED PUBLISHED BY
2 TITLE ONLY this 3rd day of December 2019.

3
4
5 _____
6 Sam Weaver,
7 Mayor

8 Attest:

9 _____
10 Lynnette Beck,
11 City Clerk

12 READ ON SECOND READING, AMENDED, AND ORDERED PUBLISHED BY
13 TITLE ONLY this 17th day of December 2019.

14 _____
15 Sam Weaver,
16 Mayor

17 Attest:

18 _____
19 Lynnette Beck,
20 City Clerk

1 READ ON THIRD READING, PASSED AND ADOPTED this 7th day of January 2020.

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4 _____
Sam Weaver,
Mayor

5 Attest:

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Lynnette Beck,
8 City Clerk
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CITY OF BOULDER
DESIGN AND CONSTRUCTION STANDARDS

CHAPTER 2
TRANSPORTATION DESIGN

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Effective: TBD

DESIGN AND CONSTRUCTION STANDARDS

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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, 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 shall include the information required in Subsections (A) through (T), 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 City 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 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 City'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 City'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 City, 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 City 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 City.

(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 City, and will be applied as necessary to ensure safe and efficient operation of the

City'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 City standards and policies.
- (2) **Traffic Signals:** The installation of new traffic signals is not encouraged by the City 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 City 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 State 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 City 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 City'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 City or 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 analyze whether speed change lanes are necessary to serve a proposed project or 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 City'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 City 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
- (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 City 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 2-1, "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 City 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 City 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 City, 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 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 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 City 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 2-1, “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 12-foot 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 Street Lane Widths,” of these Standards.

Table 2-5: Minimum Street Lane Widths

Design Criteria	Travel Lanes*	Auxiliary Lanes*	On-Street Bike Lanes	Buffered Bike Lanes	Separated Bike Lanes	Parking Lanes
With Parking Lane	10'	9'	6'	2' buffer plus 5' bike lane	3' vertical buffer plus 5' bike lane, buffer is between curbside of parking lane and bike lane	7' (measured from curb face)
Without Parking Lane	10'	9'	6.5' (measured from curb face)	2' buffer plus 6.5' bike lane (measured from curb face)	3' vertical buffer, plus 6.5' bike lane (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 City 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

- (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)
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 is generally desired and may be approved by the Director based on context-sensitive design.
- (d) **Corner Radii:** The minimum property line corner and flowline radii at intersections shall meet or exceed the minimum radii specifications shown in Table 2-8, “Minimum Intersection Radii,” of these Standards.

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

- (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.

(7) **Left Turn Lanes**

- (a) **Storage Length:** Left turn lane storage length 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. Where dual left turn lanes are provided, the lane storage length shall be based on at least 60 percent of the single lane storage length.
- (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:

$$L = WS / 3$$

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:

$$L = WS^2 / 60$$

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.

(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
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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 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 refuse disposal; and
 - (e) Postal and other delivery services.
- (2) These 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.

Effective: TBD

DESIGN AND CONSTRUCTION STANDARDS

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- (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 2-13, “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 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 collectors exceeding 500 feet in length from any intersection shall provide a secondary emergency access at 500-foot intervals.
- (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	<u>32'</u>	<u>30'</u>	22' plus 2' gravel shoulders	26'	20'	12'
Sidewalk	5'	<u>4'</u>	4' where required	4'	N/A	N/A
Streetscape Planting Strip	8'	<u>8'</u>	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	<u>500'</u>	500'	500'	<u>350'</u>	<u>350'</u>	<u>N/A</u>
Maximum Street Length - No Outlet	500'	500'	500'	<u>150'</u>	<u>150'</u>	500'
Maximum Street Length - Loop or Circle Street	<u>500'</u>	<u>500'</u>	<u>500'</u>	<u>500'</u>	<u>500'</u>	<u>500'</u>
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	<u>Attached</u>	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	<u>60'</u> no alley <u>40'</u> w/alley	<u>60'</u>	N/A
Maximum Number of Units to be Accessed	N/A	N/A	N/A	<u>25 single family</u>	<u>15 single family</u>	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 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 City-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 2-13, "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 City-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: Sideslopes 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 City requirements, shall be provided on each single-family lot.
 - (g) 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.

- (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, 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 City requirements, shall be provided on each single-family lot.
 - (f) 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.
 - (g) Emergency Response: Access streets exceeding 175 feet from any intersection shall provide a fire apparatus setup area at 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 2-13, “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 City 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 intervals. The setup area shall provide a minimum 30-foot long, 25 foot wide clear 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, 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 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 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 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.

(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 street 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 City’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 City’s transportation system.

(F) 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.

(G) Bicycle Parking

Bicycle parking should 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 (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 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 City’s transportation system.

2.12 Street Lighting

(A) Scope

The provisions of this section shall apply to public 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 (PSC) of Colorado is responsible for providing street lighting as requested by the City.
- (b) Before considering new or additional local street light requests, the City 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 City 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 traffic accident problem correctable through street light installation.
 - (b) Major traffic corridors with significant turning movement conflicts and night time 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 City 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 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 City 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 City to allow PSC of Colorado to install street lights. 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 shall be placed behind the sidewalk or path within a minimum 3-foot wide utility easement. Utility easements for street lights are not exclusive, and may be landscaped or used for parking subject to City approval. If there is an exclusive gas easement behind an

attached walk or path, the street lights shall be located beyond that easement in an additional three-foot wide 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."

**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	ASME	Architects American Society of Mechanical Engineers
AAR	Association of American Railroads	ASTM	American Society for Testing and Materials
AASHTO	American Association of State Highway and Transportation Officials	ATSSA	American Traffic Safety Services Association
ABC	Aggregate Base Course	AWG	American Wire Gauge
AC	Asphaltic Cement	AWPA	American Wood Preservers Association
ACI	American Concrete Institute	AWS	American Welding Society
ADT	Average Daily Trips	AWWA	American Water Works Association
AGCA	Associated General Contractors of America		
AI	Asphalt Institute	BFD	Boulder Fire Department
AIA	American Institute of Architects	BMP	Best Management Practices
AISC	American Institute of Steel Construction	BRC	Boulder Revised Code, 1981
AISI	American Iron and Steel Institute	CCA	Colorado Contractors Association
AITC	American Institute of Timber Construction	CDOT	Colorado Department of Transportation
ANSI	American National Standards Institute, Inc.	CDPHE	Colorado Department of Public Health and Environment
APWA	American Public Works Association	CDPS	Colorado Discharge Permit System
ARA	American Railway Association	CFR	Code of Federal Regulations
AREA	American Railway Engineering Association	CFS	Cubic Feet per Second
ARTBA	American Road and Transportation Builders Association	CLOMA	Conditional Letter of Map Amendment
ASCE	American Society of Civil Engineers	CLOMR	Conditional Letter of Map Revision
ASLA	American Society of Landscape Architects	CMP	Corrugated Metal Pipe

CP	Colorado Procedure	IMSA	International Municipal Signal Association
CPUC	Colorado Public Utilities Commission	IPCEA	Insulated Power Cable Engineers Association
CRS	Colorado Revised Statutes, 1973, as amended	ISO	Insurance Service Office
CRSI	Concrete Reinforcing Steel Institute	ITE	Institute of Transportation Engineers
CUHP	Colorado Urban Hydrograph Procedure	LID	Low-Impact Development
		LLD PE	Linear low-density polyethylene
		LOMA	Letter of Map Amendment
		LOMR	Letter of Map Revision
		LOS	Level of Service
DHV	Design Hour Volume		
DIP	Ductile Iron Pipe		
DRCOG	Denver Regional Council of Governments		
DWG	Drawing		
EDLA	Equivalent Daily Load Applications	MDCIA	Minimizing Directly-Connected Impervious Areas
EIA	Electronic Industries Association	MIL	Military Specifications
EPA	Environmental Protection Agency	MPH	Miles Per Hour
		MUP	Master Utility Plan
		MUTCD	Manual on Uniform Traffic Control Devices
FEMA	Federal Emergency Management Agency	<u>NACTO</u>	<u>National Association for Transportation Officials</u>
FHWA	Federal Highway Administration		
FL	Flowline	NCAR	National Center for Atmospheric Research
FPS	Feet Per Second	NEC	National Electrical Code
FSS	Federal Specifications and Standards	NEMA	National Electrical Manufacturers Association
GIDM	Gallons Per Inch Diameter Per Mile	NESC	National Electrical Safety Code
GPAD	Gallons Per Acre Per Day	NFPA	National Fire Protection Association
GPCD	Gallons Per Capita Per Day		
GPM	Gallons Per Minute	NIST	National Institute of Standards and Technology
		NOAA	National Oceanic and Atmospheric Administration
HCM	Highway Capacity Manual		
HBP	Hot Bituminous Pavement		
HGL	Hydraulic Grade Line		
HSG	Hydrologic Soil Group		
ICBO	International Conference of Building Officials	NPK	Nitrogen-Phosphorus-Potassium
		NSF	National Sanitation Foundation
IFC	International Fire Code		
IPC	International Plumbing Code	OSHA	Occupational Safety and Health Administration
IEEE	Institute of Electrical and Electronics Engineers		
IES	Illuminating Engineering Society	PC	Point of Curve
		PCC	Portland Cement Concrete or

PLS	Point of Compound Curve Pure Live Seed	VPC	Vertical Point of Curve
PMR	Physical Map Revision	VPI	Vertical Point of Intersection
POTW	Publicly Owned Treatment Works	VPT	Vertical Point of Tangent
PRC	Point of Reverse Curve	WQCV	Water Quality Capture Volume
PRV	Pressure Reducing Valve		
PT	Point of Tangent		
PVC	Polyvinyl Chloride		
RCP	Reinforced Concrete Pipe		
ROW	Right of Way		
RPA	Receiving Previous Area		
<u>RTD</u>	<u>Regional Transportation District</u>		
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		

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.

"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, 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 street_side 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.

**CITY OF BOULDER
DESIGN AND CONSTRUCTION STANDARDS**

REFERENCES

Where not specified in these Standards or the Boulder Revised Code (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 public improvements and may refer to one or more of the following references:

GENERAL REFERENCES

Code of Federal Regulations (CFR)

Colorado Revised Statutes (CRS)

TRANSPORTATION REFERENCES

Guide for the Development of Bicycle Facilities, American Association of State Highway and Transportation Officials

Public Rights-of-Way Accessibility Guidelines, United States Access Board

Urban Bikeway Design Guide, National Association of City Transportation Officials

Urban Street Design Guide, National Association of City Transportation Officials

Bicycle Parking Guidelines, Association of Pedestrian and Bicycle Professionals

Institute of Transportation Engineers (ITE) *Guidelines for Major Urban Street Design*

ITE Trip Generation Manual

Manual on Uniform Traffic Control Devices (MUTCD)

STREETSCAPE AND TREE PROTECTION REFERENCES

American Standard for Nursery Stock, American Association of Nurserymen.

Guide for Plant Appraisal, International Society of Arboriculture.

Species Ratings and Appraisal Factors Guide, Rocky Mountain Chapter, I.S.A.

Standard Practices for Trees, Shrubs, and Other Woody Plant Maintenance (ANSI. A300), American National Standard Institute.

Streetscape Standards for the Boulder Valley Regional Center.

Himelick's Tree and Shrub Transplanting Manual, International Society of Arboriculture.

Valuation of Landscape Trees, Shrubs, and Other Plants, International Society of Arboriculture.

UTILITIES REFERENCES

Manual of Water Supply Practices, American Water Works Association (AWWA)

Insurance Services Office (ISO)

Denver, Colorado, Board of Water Commissioners, Engineering Standards

Colorado Cross Connection Control Manual

American Society of Civil Engineers (ASCE) *Manuals and Reports on Engineering Practice - Gravity Sanitary Sewer Design and Construction*

Colorado Department of Health *Design Criteria for Wastewater Treatment Works*

International Plumbing Code (IPC)

International Fire Code (IFC)

CDOT Standard Specifications for Road and Bridge Construction. 2017

Installation Guide for Ductile-Iron Pipe, Ductile Iron Pipe Research Association

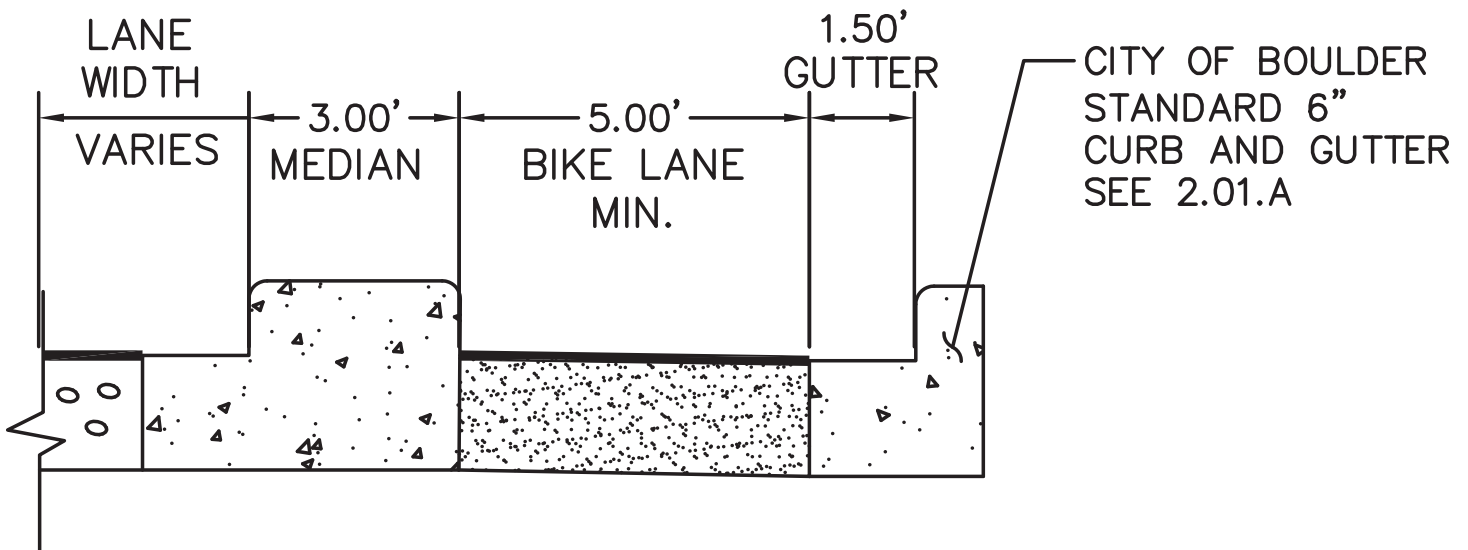
Handbook of Steel Drainage and Highway Construction Projects, American Iron and Steel Institute

STORM WATER REFERENCES

Urban Drainage and Flood Control District (UDFCD) *Urban Storm Drainage Criteria Manual, Volumes 1, 2, and 3.*

US Army Corps of Engineers *Users and Programmers Manuals for HEC-1 (Flood Hydrograph Package), HEC-2 (Water Surface Profiles), and HEC-RAS.*

State of Colorado Department of Public Health and Environment §303(d) List of Water-Quality-Limited Segments Requiring TMDLs or for which a Total Maximum Daily Load (TMDL) (Note: with this list, adopted in 5 CCR 1002-93, the State of Colorado implements the requirements of §303(d) of the federal Clean Water Act.)



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: DEC. 17, 2019

DRAWING NO.

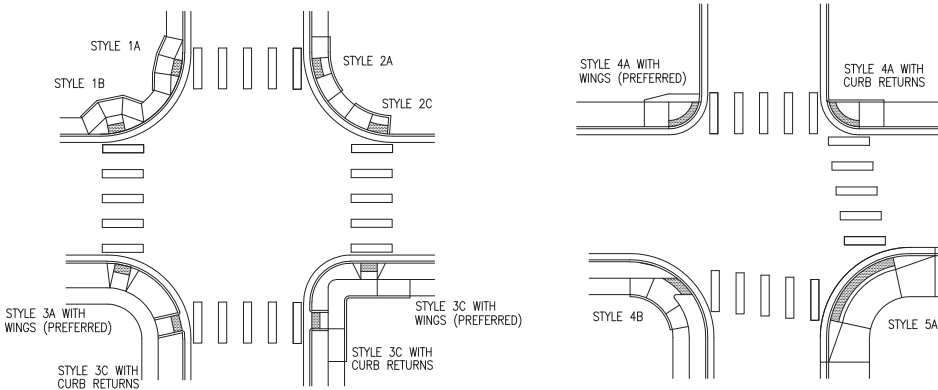
2.42.C

Exhibit B to Proposed Ordinance 8370 GENERAL NOTES

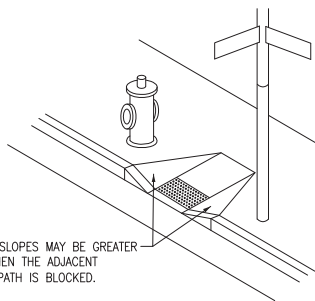
1. THE DETECTABLE WARNINGS SHALL BE INSTALLED AT SIDEWALK TO STREET TRANSITIONS. THEY SHALL HAVE A TRUNCATED DOME SURFACE. THE DOMES SHALL BE IN A SQUARE GRID PATTERN AND ALIGNED WITH PEDESTRIAN TRAFFIC.
2. ALL DETECTABLE WARNING SURFACES SHALL START A MINIMUM OF 6 INCHES FROM THE FLOWLINE OF THE CURB AND NOT BE MORE THAN A MAXIMUM OF 8 INCHES FROM ANY POINT ON THE FLOWLINE OF THE CURB, WITH THE EXCEPTION OF RAMP CONFIGURED SIMILAR TO TYPE 4A AS THIS DIMENSION MAY BE GREATER THAN 8 INCHES ON ONE SIDE OF THE RADIUS.
3. THE RAMP SLOPE, INCLUDING THE DETECTABLE WARNING SURFACE SHALL BE 8.3% OR FLATTER (SEE NOTE 4).
4. THE CITY OF BOULDER DOES NOT ALLOW A TOLERANCE THAT EXCEEDS 8.3% RUNNING SLOPE. RUNNING SLOPES ON NEW RAMPS THAT EXCEED 8.3% MAY REQUIRE REMOVAL AND REPLACEMENT AT THE CONTRACTORS EXPENSE. TO AVOID CHASING GRADE INDEFINITELY, THE RAMP LENGTH MAY BE LIMITED TO 15 FEET. ADJUST THE RUNNING SLOPE TO PROVIDE ACCESS TO THE MAXIMUM EXTENT TECHNICALLY FEASIBLE. THE RESULTING RUNNING SLOPE MAY EXCEED 8.3% AND WOULD REQUIRE A PROFESSIONAL ENGINEER IN CHARGE OF THE RESPECTIVE PROJECT.
5. PEDESTRIAN ACCESS ROUTES AT RAMPS SHALL BE CONSTRUCTED IN COMPLIANCE WITH THE LATEST PROPOSED RIGHT-OF-WAY ACCESS GUIDELINES (PROWAG), ISSUED BY THE UNITED STATES ACCESS BOARD. DEVIATING FROM PROWAG WILL REQUIRE THAT A CITY OF BOULDER CURB RAMP VARIANCE BE SUBMITTED TO, AND APPROVED BY THE CITY OF BOULDER PROFESSIONAL ENGINEER IN CHARGE OF THE RESPECTIVE PROJECT.
6. DRAINAGE STRUCTURES, TRAFFIC SIGNAL EQUIPMENT, OR OTHER OBSTRUCTIONS SHALL NOT BE INSTALLED IN THE CURB RAMP OR TURNING SPACE AREAS.
7. CONSTRUCTION OF PEDESTRIAN CURB, WHERE REQUIRED, SHALL BE PAID AS PEDESTRIAN CURB (LINEAR FEET).
8. IF THE PLACEMENT OF THE PEDESTRIAN PUSH BUTTON POST ASSEMBLY (PPBPA) ON A TRAFFIC SIGNAL POLE WILL NOT BE WITHIN EASY REACH (10 INCHES OR LESS AND UNOBSTRUCTED) OF ALL PEDESTRIANS (IN ACCORDANCE WITH THE AMERICANS WITH DISABILITIES ACT (ADA)), THEN A SEPARATE PPBPA SHALL BE INSTALLED WITHIN ADA REACH RANGES. THE PPBPA SHALL MEET THE PROVISIONS FOUND IN "SECTION 4E.08 THROUGH 4E.13 - PEDESTRIAN DETECTORS" OF THE 2009 MUTCD MANUAL WITH REVISIONS 1 AND 2.
9. DIAGONAL CURB RAMPS (ON THE APEX) ARE NOT ALLOWED IN NEW CONSTRUCTION. A SINGLE DIAGONAL CURB RAMP (ON THE APEX) WILL ONLY BE PERMITTED DURING RECONSTRUCTION OR ALTERATION WHERE PHYSICAL OR SITE CONSTRAINTS PREVENT TWO CURB RAMPS FROM BEING INSTALLED. A CITY OF BOULDER CURB RAMP VARIANCE FORM MUST BE SUBMITTED TO, AND APPROVED BY THE CITY OF BOULDER PROFESSIONAL ENGINEER IN CHARGE OF THE RESPECTIVE PROJECT IN ORDER TO CONSTRUCT A SINGLE DIAGONAL CURB RAMP (ON THE APEX).
10. CURB RAMPS (EXCLUDING FLARED SIDES OR BLENDED TRANSITIONS) SHALL BE WHOLLY CONTAINED WITHIN THE WIDTH OF THE CROSSWALK AND/OR THE PEDESTRIAN STREET CROSSING THEY SERVE.
11. ALL CURB RAMP JOINTS AND GRADE BREAKS SHALL BE FLUSH ($0'' \pm \frac{1}{8}''$). THE JOINT BETWEEN THE ROADWAY SURFACE AND THE GUTTER PAN SHALL BE FLUSH ($0'' \pm \frac{1}{8}''$).
12. THE CONTRACTOR SHALL VERIFY REMOVAL LIMITS ARE SUFFICIENT TO PROVIDE POSITIVE DRAINAGE, MAINTAIN EXISTING DRAINAGE PATTERNS AND AVOID PONDING IN THE FINAL CONFIGURATION.
13. FLARED SIDE SLOPES MAY EXCEED 10% ONLY WHERE THEY ABUT A NON-WALKABLE SURFACE OR THE ADJACENT CIRCULATION PATH IS BLOCKED. A VERTICAL PEDESTRIAN CURB MAY ALSO BE USED IN THIS SITUATION, IF REQUIRED, TO IMPROVE ACCESS TO A PPBPA.
14. THE STANDARD TURNING SPACE IS 4 FEET BY 4 FEET. WHERE THE TURNING SPACE IS CONSTRAINED, THE TURNING SPACE SHALL BE 4 FEET BY 5 FEET MINIMUM. THE 5 FOOT DIMENSION SHALL BE PROVIDED IN THE DIRECTION OF THE RAMP RUN.
15. THE SLOPES INDICATED IN THESE DETAILS SHOW THE MAXIMUM SLOPES ALLOWABLE. PREFERRED VALUES TO BE USED DURING DESIGN, LAYOUT AND CONSTRUCTION ARE:
 - RAMP RUNNING SLOPE 7.5%
 - RAMP CROSS SLOPE 1.5%
 - TURNING SPACE RUNNING SLOPE 1.5%
 - TURNING SPACE CROSS SLOPE 1.5%
 - FLARE SLOPE 8.0 TO 9.0%

▲ THE CHANGE IN GRADE AT THE BOTTOM OF THE CURB RAMP AND THE CURB PAN (OR ADJOINING ROAD SURFACE WHEN NO PAN EXISTS) SHALL NOT EXCEED AN ALGEBRAIC DIFFERENCE OF 13.33%. THE COUNTER SLOPE OF THE GUTTER OR ROAD AT THE FOOT OF A CURB RAMP, TURNING SPACE, OR BLENDED TRANSITION SHALL TYPICALLY NOT EXCEED 5%. IF A GUTTER SLOPE GREATER THAN 5% IS REQUIRED TO MAINTAIN PROPER DRAINAGE, THE RAMP SLOPE MUST BE REDUCED AN APPROPRIATE AMOUNT TO RETAIN AN ALGEBRAIC DIFFERENCE OF 13.33% AT THE BREAK LINE.

★ SEE DETECTABLE WARNING DETAILS DRAWING 2.07-H AND 2.07-I.



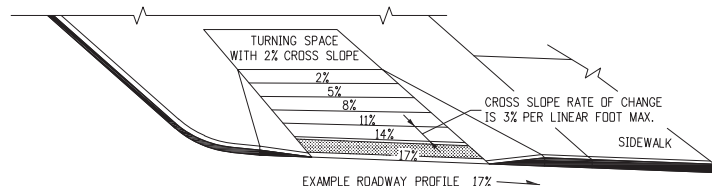
RAMP STYLES



FLARED SIDE SLOPES MAY BE GREATER THAN 10% WHEN THE ADJACENT CIRCULATION PATH IS BLOCKED.

STEEP FLARED SIDE SLOPES

SEE NOTE 13.
(THIS SHEET)



CURB RAMP CROSS SLOPES SHALL BE:

- 2% MAX. WHEN YIELD OR STOP CONTROL IS PRESENT
- PERMITTED TO EQUAL THE ROADWAY GRADE WHEN THERE IS NO YIELD OR STOP CONTROL, WHEN A TRAFFIC SIGNAL IS PRESENT, OR AT A MIDBLOCK CROSSING LOCATION.

RAMP CROSS SLOPE TRANSITION TO MATCH ROADWAY PROFILE

APPLICABLE TO ALL CURB RAMP TYPES

ADAPTED/MODIFIED FROM COLORADO DEPARTMENT OF TRANSPORTATION
STANDARD PLAN NUMBER M-608-1 SHEET NUMBER 1 OF 10 (LAST
MODIFICATION DATE: 2/23/17 BY LTA)

Modified by: P Sanders
Checked by: R Rindal
Approved by: Director of Public Works

DESCRIPTION	DATE:
ISSUED	XX/XX/20XX

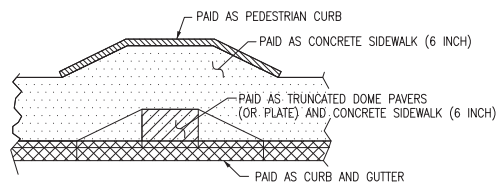
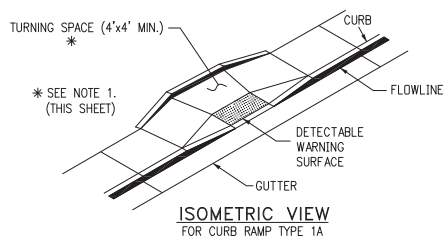


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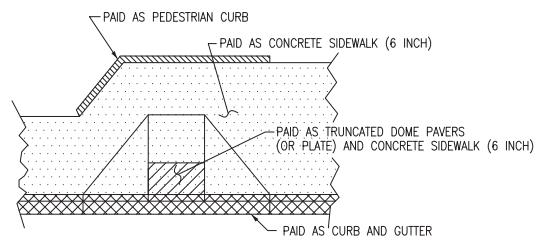
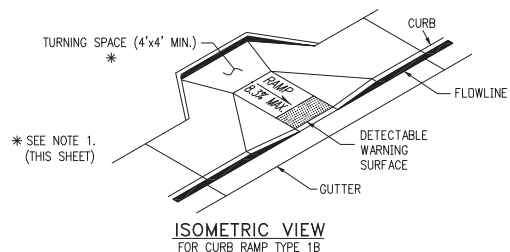
CURB RAMP
DETAILS AND
GENERAL NOTES

NOT TO SCALE

DRAWING NUMBER: 2.07-A



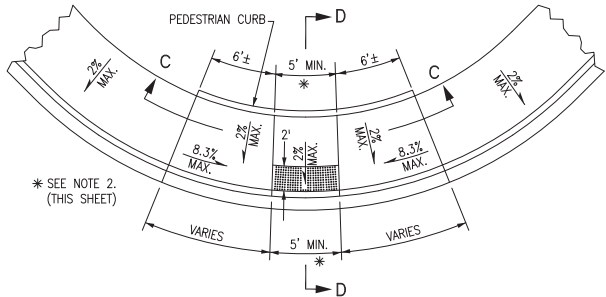
RAMP PAY AREA
FOR CURB RAMP TYPE 1A



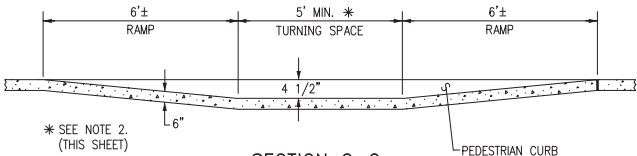
RAMP PAY AREA
FOR CURB RAMP TYPE 1B

1. THE STANDARD TURNING SPACE IS 4 FEET BY 4 FEET. WHERE THE TURNING SPACE IS CONSTRAINED, THE TURNING SPACE SHALL BE 4 FEET BY 5 FEET MINIMUM. THE 5 FOOT DIMENSION SHALL BE PROVIDED IN THE DIRECTION OF THE RAMP RUN.
- ▲ THE CHANGE IN GRADE AT THE BOTTOM OF THE CURB RAMP AND THE CURB PAN (OR ADJOINING ROAD SURFACE WHEN NO PAN EXISTS) SHALL NOT EXCEED AN ALGEBRAIC DIFFERENCE OF 13.33%. THE COUNTER SLOPE OF THE GUTTER OR ROAD AT THE FOOT OF A CULVERT, RAMP, TURNING SPACE, OR SLOPED TRANSITION SHALL TYPICALLY NOT EXCEED 5%. A GUTTER SLOPE GREATER THAN 5% IS REQUIRED TO MAINTAIN PROPER DRAINAGE. THE RAMP SLOPE MUST BE REDUCED AN APPROPRIATE AMOUNT TO RETAIN AN ALGEBRAIC DIFFERENCE OF 13.33% AT THE BREAK LINE.
- ★ SEE DETECTABLE WARNING DETAILS DRAWING 2.07-H AND 2.07-I.

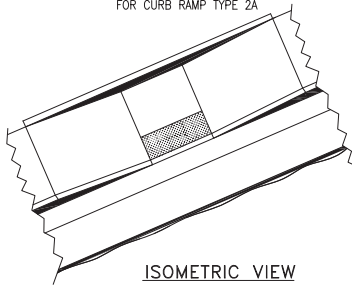
Item 3G - Third Reading Ordinance 8370 - Design and Construction Standards - Transportation - Phase 1 Page 59



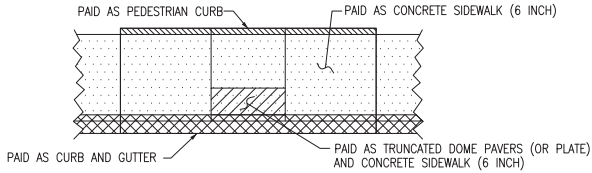
CURB RAMP TYPE 2A DETAIL



SECTION C-C
FOR CURB RAMP TYPE 2A



ISOMETRIC VIEW
FOR CURB RAMP TYPE 2A



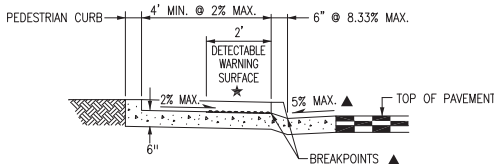
RAMP PAY AREA
FOR CURB RAMP TYPE 2A

NOTES

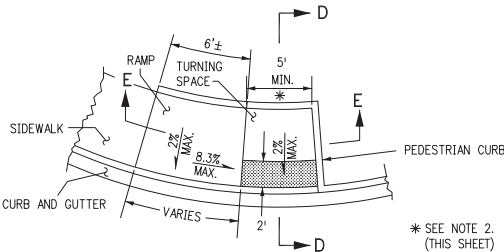
1. THE USE OF CURB RAMP TYPE 2A OR 2C, WHILE COMPLIANT WITH THE AMERICANS WITH DISABILITIES ACT (ADA), IS DISCOURAGED BY THE CITY OF BOULDER DUE TO POTENTIAL ISSUES WITH PONDING WATER, DEBRIS COLLECTION AND ICE. TYPE 2 SERIES RAMP WILL ONLY BE ALLOWED WHEN NO OTHER ADA COMPLIANT RAMP IS FEASIBLE. A CITY OF BOULDER CURB RAMP VARIANCE FORM MUST BE SUBMITTED TO, AND APPROVED BY THE PUBLIC WORKS PROFESSIONAL ENGINEER IN CHARGE OF THE RESPECTIVE PROJECT IN ORDER TO CONSTRUCT A TYPE 2 SERIES RAMP.
2. THE STANDARD TURNING SPACE IS 4 FEET BY 4 FEET. WHERE THE TURNING SPACE IS CONSTRAINED, THE TURNING SPACE SHALL BE 4 FEET BY 5 FEET MINIMUM. THE 5 FOOT DIMENSION SHALL BE PROVIDED IN THE DIRECTION OF THE RAMP RUN.

▲ THE CHANGE IN GRADE AT THE BOTTOM OF THE CURB RAMP AND THE CURB PAN (OR ADJOINING ROAD SURFACE WHEN NO PAN EXISTS) SHALL NOT EXCEED AN ALGEBRAIC DIFFERENCE OF 13.33%. THE COUNTER SLOPE OF THE GUTTER OR ROAD AT THE FOOT OF A CURB RAMP, TURNING SPACE, OR BLENDED TRANSITION SHALL TYPICALLY NOT EXCEED 5%. IF A GUTTER SLOPE GREATER THAN 5% IS REQUIRED TO MAINTAIN PROPER DRAINAGE, THE RAMP SLOPE MUST BE REDUCED AN APPROPRIATE AMOUNT TO RETAIN AN ALGEBRAIC DIFFERENCE OF 13.33% AT THE BREAK LINE.

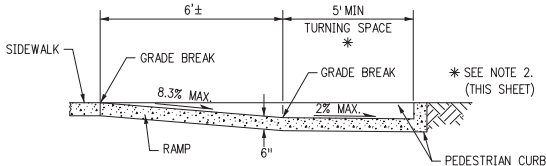
★ SEE DETECTABLE WARNING DETAILS DRAWING 2.07-H AND 2.07-I.



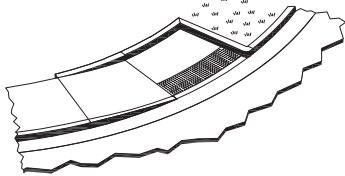
SECTION D-D
FOR CURB RAMP TYPE 2A & 2C



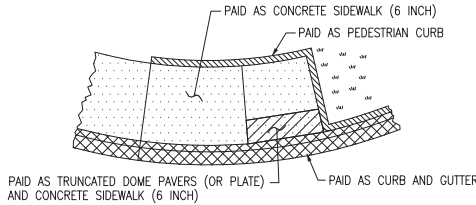
CURB RAMP TYPE 2C DETAIL



SECTION E-E
FOR CURB RAMP TYPES 2C



ISOMETRIC VIEW
FOR CURB RAMP TYPES 2C



RAMP PAY AREA
FOR CURB RAMP TYPES 2C

ADAPTED/MODIFIED FROM COLORADO DEPARTMENT OF TRANSPORTATION
STANDARD PLAN NUMBER M-608-1 SHEET NUMBER 2 OF 10 (LAST
MODIFICATION DATE: 2/23/17 BY LTA)

Modified by: P Sanders
Checked by: R Rindal
Approved by: Director of Public Works

DESCRIPTION	DATE:
ISSUED	XX/XX/20XX

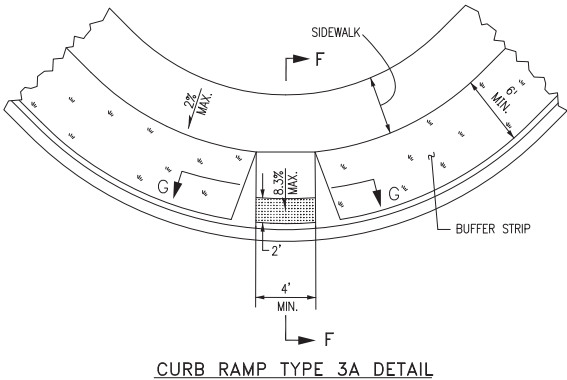


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Standard

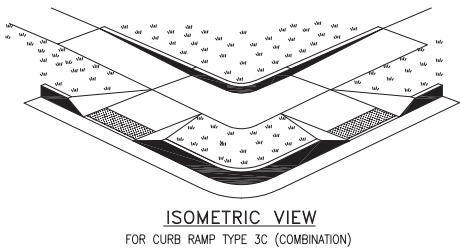
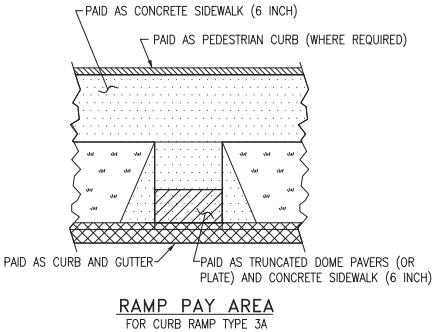
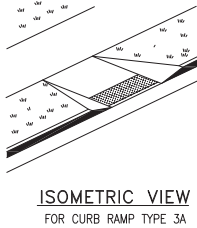
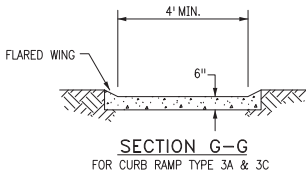
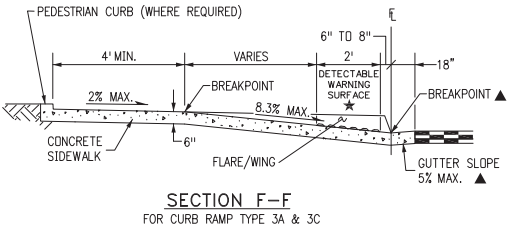
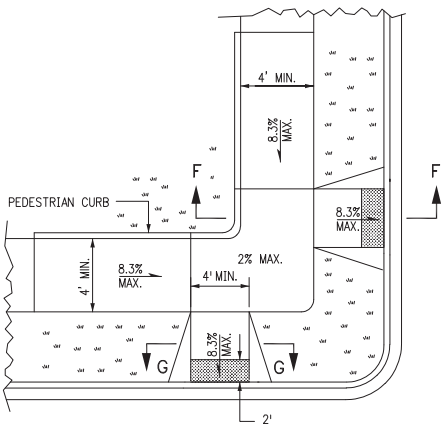
CURB RAMP TYPE 2
DETAILS

NOT TO SCALE

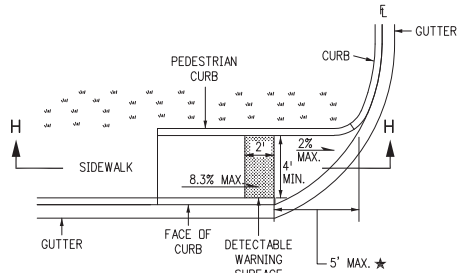
DRAWING NUMBER: 2.07-C



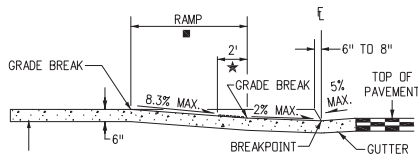
- ▲ THE CHANGE IN GRADE AT THE BOTTOM OF THE CURB RAMP AND THE CURB PAN (OR ADJOINING ROAD SURFACE WHEN NO PAN EXISTS) SHALL NOT EXCEED AN ALGEBRAIC DIFFERENCE OF 13.33%. THE COUNTER SLOPE OF THE GUTTER OR ROAD AT THE FOOT OF A CURB RAMP, TURNING SPACE, OR BLENDED TRANSITION SHALL TYPICALLY NOT EXCEED 5%. IF A GUTTER SLOPE GREATER THAN 5% IS REQUIRED TO MAINTAIN PROPER DRAINAGE, THE RAMP SLOPE MUST BE REDUCED AN APPROPRIATE AMOUNT TO RETAIN AN ALGEBRAIC DIFFERENCE OF 13.33% AT THE BREAK LINE.
- ★ SEE DETECTABLE WARNING DETAILS DRAWING 2.07-H AND 2.07-L



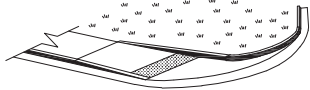
ADAPTED/MODIFIED FROM COLORADO DEPARTMENT OF TRANSPORTATION STANDARD PLAN NUMBER M-608-1 SHEET NUMBER 3 OF 10 (LAST MODIFICATION DATE: 2/23/17 BY LTA) Modified by: P Sanders Checked by: R Rindal Approved by: Director of Public Works	DESCRIPTION	DATE:		City of Boulder, CO Design and Construction Standard	CURB RAMP TYPE 3 DETAILS	NOT TO SCALE
	ISSUED	XX/XX/20XX				
						DRAWING NUMBER: 2.07-D



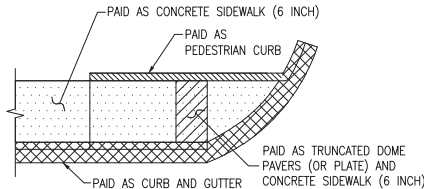
CURB RAMP TYPE 4A DETAIL



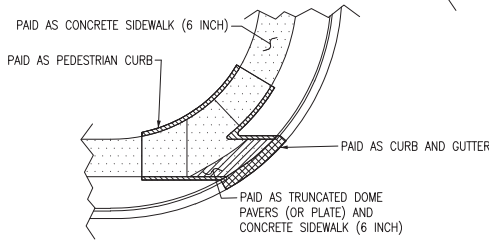
SECTION H-H
FOR CURB RAMP TYPE 4A



ISOMETRIC VIEW
FOR CURB RAMP TYPE 4A



RAMP PAY AREA
FOR CURB RAMP TYPE 4A



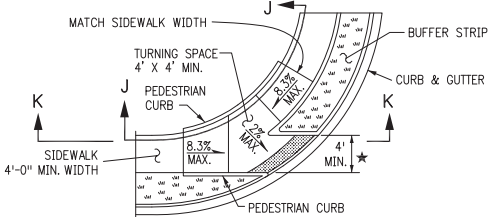
RAMP PAY AREA
FOR CURB RAMP TYPE 4B

NOTES

1. RAMP GRADE BREAKS SHALL BE PERPENDICULAR TO THE RUNNING SLOPE.
2. THE USE OF CURB RAMP TYPE 4B, WHILE COMPLIANT WITH THE AMERICANS WITH DISABILITIES ACT (ADA), IS DISCOURAGED BY THE CITY OF BOULDER DUE TO POTENTIAL ISSUES WITH PONDING WATER, DEBRIS COLLECTION AND ICE. TYPE 4B RAMPS WILL ONLY BE ALLOWED WHEN NO OTHER ADA COMPLIANT RAMP IS FEASIBLE. A CITY OF BOULDER CURB RAMP VARIANCE FORM MUST BE SUBMITTED TO, AND APPROVED BY THE CITY OF BOULDER PUBLIC WORKS PROFESSIONAL ENGINEER IN CHARGE OF THE RESPECTIVE PROJECT IN ORDER TO CONSTRUCT A TYPE 2 SERIES RAMP.

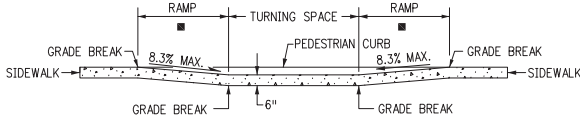
★ SEE DETECTABLE WARNING DETAILS DRAWING 2.07-H AND 2.07-I.

■ SEE GENERAL NOTE 4 ON SHEET 2.07A

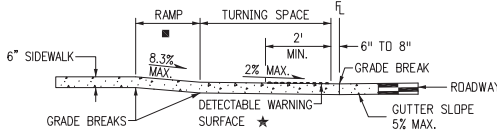


CURB RAMP TYPE 4B DETAIL

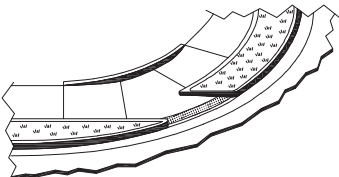
FOR USE WHERE PEDESTRIAN CROSSING IS IN ONE DIRECTION ONLY.



SECTION J-J
FOR CURB RAMP TYPE 4B



SECTION K-K
FOR CURB RAMP TYPE 4B



ISOMETRIC VIEW
FOR CURB RAMP TYPE 4B

ADAPTED/MODIFIED FROM COLORADO DEPARTMENT OF TRANSPORTATION
STANDARD PLAN NUMBER M-608-1 SHEET NUMBER 4 OF 10 (LAST
MODIFICATION DATE: 2/23/17 BY LTA)
Modified by: P Sanders
Checked by: R Rindal
Approved by: Director of Public Works

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ISSUED	XX/XX/20XX



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Design and Construction
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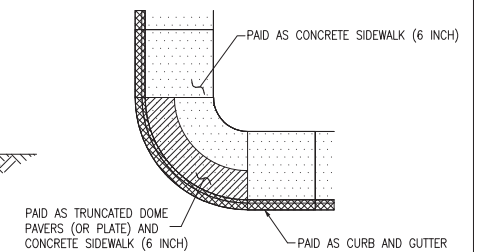
CURB RAMP TYPE 4
DETAILS

NOT TO SCALE

DRAWING NUMBER: 2.07-E



SECTION L-L
FOR CURB RAMP TYPE 5A



RAMP PAY AREA
FOR CURB RAMP TYPE 5A

ADAPTED/MODIFIED FROM COLORADO DEPARTMENT OF TRANSPORTATION
STANDARD PLAN NUMBER M-608-1 SHEET NUMBER 5 OF 10 (LAST
MODIFICATION DATE: 2/23/17 BY LTA)

Modified by:	P Sanders
Checked by:	R Rindal
Approved by:	Director of Public Works

DESCRIPTION	DATE:
ISSUED	XX/XX/20XX



CURB RAMP TYPE 5 DETAILS

NOT TO SCALE

DRAWING NUMBER: 2.07-F



Diagram illustrating the required dimensions and features for a triangular intersection:

- 2'-0" MIN.**: Minimum width of the curb ramp.
- CURB RAMP TYPE 1B OR 3B**: Specification for the curb ramp type.
- TURNING SPACE 5'-0" MIN.**: Minimum turning space for vehicles.
- DETECTABLE WARNING SURFACE (TYP.)**: Typical detectable warning surface.
- 4' MIN. SEE NOTE 1**: Minimum width of the detectable warning surface, with a reference to Note 1.

INTERSECTION ISLAND WITH RAMPS

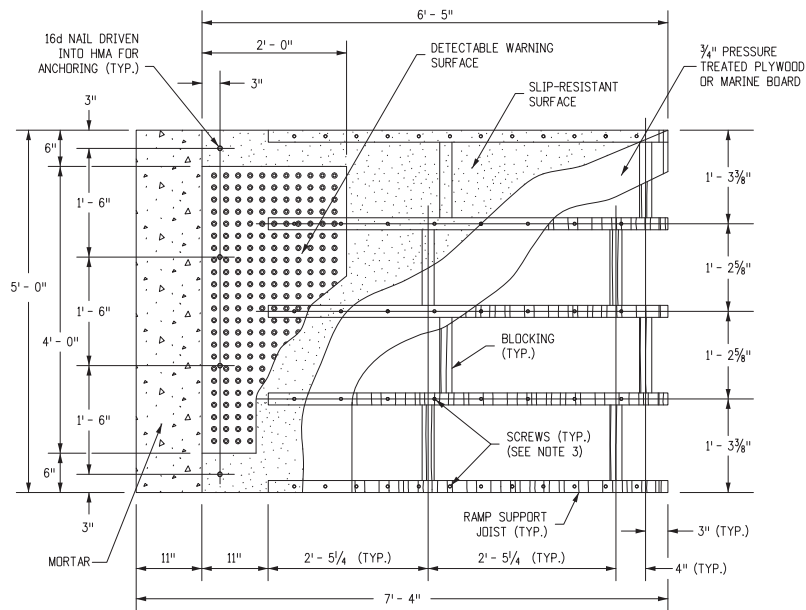
MEDIAN ISLAND WITH CUT-THROUGH

The figure consists of two side-by-side diagrams illustrating the minimum width of a curb ramp. Both diagrams show a cross-section of a curb ramp with a 5'-0" MIN. width. The left diagram shows a curb ramp with a 5'-0" MIN. width, a turning space, and a curb ramp type 1B. The right diagram shows a curb ramp with a 5'-0" MIN. width, a turning space, and a curb ramp type 1B.

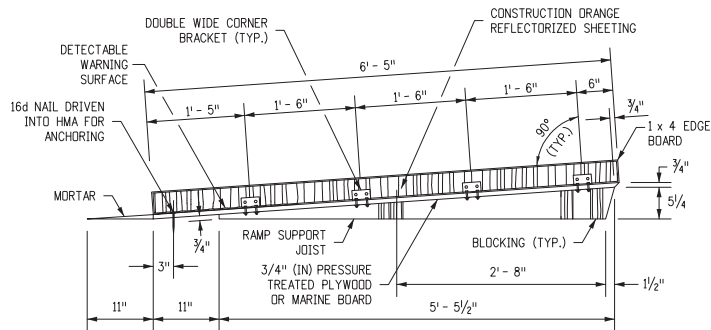
MEDIAN ISLAND WITH RAMP CROSSING

FOR MEDIAN ISLANDS WITH RAMPS, THE DETECTABLE WARNING SURFACE SHALL BE 6 TO 8 INCHES BACK FROM THE FLOWLINE. FLARED SIDES ARE PREFERRED ON MEDIAN ISLANDS WITH RAMPS AND SHOULD BE PROVIDED WHEN MEDIAN ISLANDS SERVE MULTI-USE PATHS OR ARE LOCATED WHERE BICYCLE USE IS EXPECTED.

Item 3G - Third Reading Ordinance 8370 - Design and Construction Standards - Transportation - Phase 1 Page 64

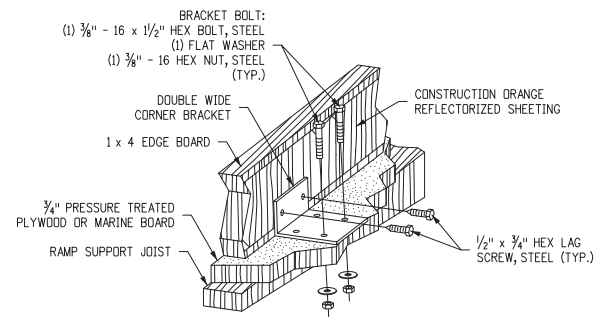


PLAN VIEW

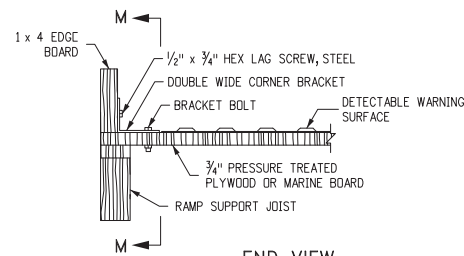


SIDE VIEW

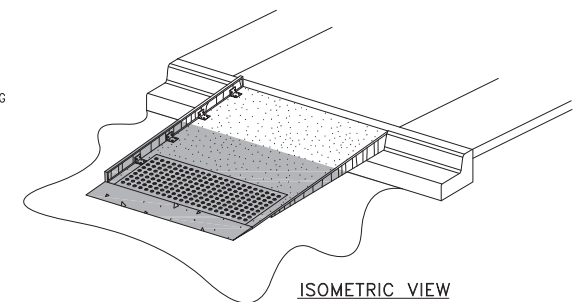
- NOTES**
1. A TEMPORARY PEDESTRIAN ACCESS ROUTE SHALL BE PROVIDED WHENEVER THE EXISTING PEDESTRIAN ACCESS ROUTE IN THE PUBLIC RIGHT-OF-WAY IS BLOCKED BY CONSTRUCTION, ALTERATION, MAINTENANCE, OR OTHER TEMPORARY CONDITIONS. FOR FURTHER WORK ZONE INFORMATION, PLEASE REFER TO CDDT'S WEBSITE TITLED "ADA IN WORK ZONES".
 2. THIS DESIGN ASSUMES OPTIMAL CONDITIONS AND A STANDARD CURB HEIGHT OF 6 INCHES. INSTALLED RAMPS SHALL BE NO STEEPER THAN 8.3% AND SHALL HAVE A CROSS-SLOPE OF 2.0% OR LESS. USE SHIMS OR GROUT AS REQUIRED TO ADJUST FOR EXISTING CONDITIONS AND TO PREVENT ROCKING. SHIMS SHALL BE NO HIGHER THAN 1 INCH AND SHALL BE SECURED TO THE RAMP. FOR CURBS SHORTER THAN 6 INCHES, INSTALL A RAMP ON THE SIDEWALK NO STEEPER THAN 8.3% AND MADE OF GROUT OR AS APPROVED BY THE ENGINEER. ADJUSTMENTS TO THE RAMP DIMENSIONS SHOWN MAY BE REQUIRED TO MATCH EXISTING CONDITIONS.
 3. SCREWS SHALL BE USED TO SECURE THE RAMP SURFACE. SPACING SHALL BE IN ACCORDANCE WITH THE CURRENT BUILDING CODE.
 4. USE A SLIP-RESISTANT TREATMENT FOR THE SURFACE OF RAMP.
 5. ALL FASTENERS SHALL BE GALVANIZED.
 6. DO NOT INSTALL A HAND RAILING IF USING THE EDGE BOARD OPTION.



PERSPECTIVE M-M



END VIEW



ISOMETRIC VIEW

ADAPTED/MODIFIED FROM COLORADO DEPARTMENT OF TRANSPORTATION
STANDARD PLAN NUMBER M-608-1 SHEET NUMBER 9 OF 10 (LAST
MODIFICATION DATE: 2/23/17 BY LTA)

Modified by: P Sanders
Checked by: R Rindal
Approved by: Director of Public Works

DESCRIPTION	DATE:
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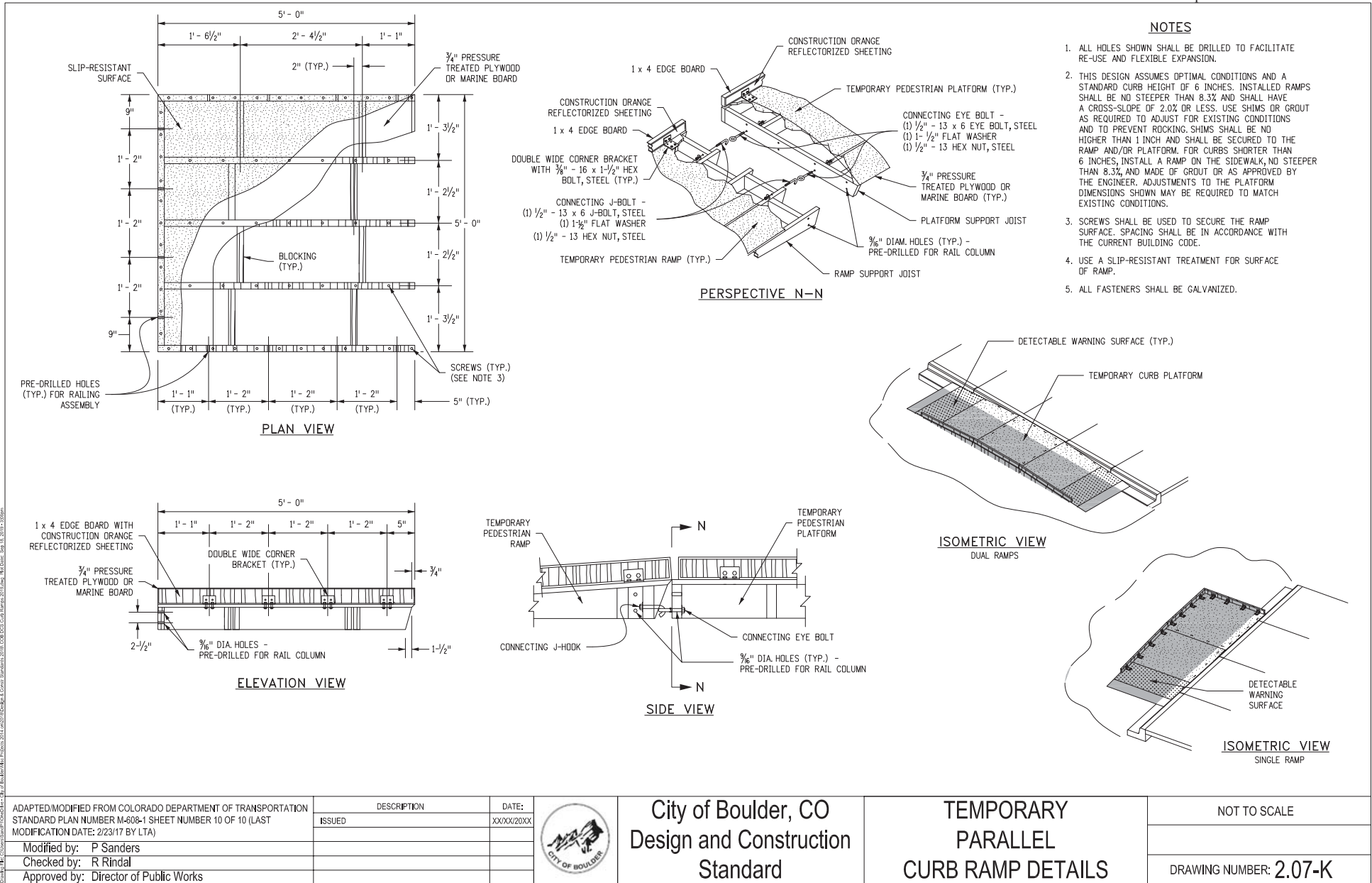


City of Boulder, CO
Design and Construction
Standard

TEMPORARY
PERPENDICULAR
CURB RAMP DETAILS

NOT TO SCALE

DRAWING NUMBER: 2.07-J



mains would otherwise dead-end.

- (2) Installation of fire hydrants.
- (3) Continuing a wastewater main that would otherwise dead-end in cul-de-sac type applications.
- (4) Conveying storm water drainage and overflows from back-draining cul-de-sac or street sump type applications.

4.05 Pipe Strength

All utility pipe shall be of adequate strength to support the trench and AASHTO HS-20 highway loadings.

4.06 Separation of Utilities

(A) Parallel (Horizontal) Separation

Parallel separations between utility mains and services to provide for adequate trench excavations and maintenance operations shall be as follows. All distances are measured from outside of pipe to outside of pipe:

Table 4-1: Utility Separation Requirements

	Water	Sewer	Storm	Electric, Telecommunications, and/or Gas
Water		10-ft	5-ft	5-ft
Sewer	10-ft		10-ft	10-ft
Storm	5-ft	10-ft		5-ft
Electric, Telecommunications, and/or Gas	5-ft	10-ft	5-ft	<u>18 inches</u>

(B) Pipe Crossings (Vertical) Separation

- (1) The minimum vertical separation between water and wastewater line crossings, as measured outside of pipe to outside of pipe, shall be 18 inches. The water line shall be constructed above the wastewater line.
- (2) The minimum vertical separation between water and storm drainage line crossings shall be 18 inches, measured from outside of pipe to outside of pipe.
- (3) The minimum vertical separation between wastewater and storm drainage line crossings, as measured outside of pipe to outside of pipe, shall be 6 inches. In addition, the following applies:
 - (a) If the storm drainage line is constructed below the wastewater line, pressure-class pipe will be required for both utility lines to prevent possible wastewater contamination of storm drainage.
 - (b) If the vertical separation between the wastewater and storm drainage line is less than 18 inches, structural support will be required, subject to the Director's approval.
- (4) The minimum vertical separation between City public utility pipelines or conduits and all gas, electric, and telecommunications utilities shall be 12 inches.