CHAPTER 5
STREET STANDARDS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS – APPENDIX C

5.1 INTRODUCTION

Street design addresses safe and efficient movement of vehicles, pedestrians, bicycles, and transit while also incorporating landscaping, utilities, and storm drainage. Low impact drainage systems are encouraged where feasible. The street and trails network create multiple travel routes and minimize the distance required for pedestrians and bicycles to access primary activity sites. This section sets forth the minimum standards for street design and construction. Developers and engineers are encouraged to design above the minimum standards and in some cases due to site specific conditions the Town Engineer may require design above the minimum standards. The purpose and intent of this chapter is to provide safe travel for vehicles and pedestrians, efficient traffic flow which minimizes traffic congestion, and minimizes maintenance concerns.

Chapter 5 also includes access management, which is the coordinated planning, regulation, and design of access between roadways and land development. It involves the systematic control of the location, spacing, design, and operation of accesses, median openings, interchanges, and street connections. Access management provides the means to balance good mobility along the street network with local access needs of businesses and residents. Implementation of access management principles and techniques on transportation networks can provide the following long-term benefits for highway users, communities, and businesses.

These standards apply to the design, construction, and maintenance of both public and private streets, driveways, pedestrian paths, and on-street parking in the Town of Breckenridge. These standards also apply to all construction, whether completed by a private Developer or the Town of Breckenridge. All Town streets, whether new construction or upgrading of existing infrastructure, shall be built in accordance with these standards.

5.2 OTHER STANDARDS

A significant portion of the criteria used by the Town for Street Standards is taken from the 2018 edition of the American Association of State Highway and Transportation Officials (AASHTO) publication *A Policy on Geometric Design of Highways and Streets*. Throughout the rest of Chapter 5, this document will be referred to as the *AASHTO Green Book*. Where no requirement is given in this chapter, the newest additions of the following standards shall govern, unless otherwise approved by the Engineering Division:

1. AASHTO Green Book
2. AASHTO Roadside Design Guide
3. Manual of Uniform Traffic Control Devices (MUTCD)
4. CDOT Roadway Design Guide
5. CDOT Bridge Design Manual
6. CDOT Pavement Design Manual
7. CDOT Drainage Design Manual
8. United States Access Board (PROWAG and ADAAG)

Construction standards for street related improvements are outlined in Chapter 9 of the standards. Right of Way requirements for work within existing streets and Right of Ways are outlined in Chapter 3 of these standards. Off-street parking requirements are outlined in the Town Code.

5.3 GENERAL DESIGN GUIDELINES

The Town of Breckenridge is located in a mountainous valley with heavy annual snowfall. Due to the terrain, street design poses unique challenges to meet design requirements. The following guidelines shall be followed for designing in this unique environment:

1. Streets are encouraged to be designed to maximize southern exposure and minimize north facing or shaded areas, especially on steeper slopes.
2. Street grades shall be minimized to the extent possible, while also minimizing switchbacks and site disturbance.
3. Streets shall be designed to avoid impacting wetlands and other environmentally sensitive areas. Design shall minimize impacts to the environment.
4. Streets shall be designed to retain as many trees and vegetation as possible. Design shall strive to retain or create vegetative buffers between streets and adjacent properties.
5. Drainage in winter shall be considered and icing of roadways and pedestrian routes shall be considered in the design.
6. Impacts of snow and ice to striping, parking, signage, signal sensors and other improvements shall be considered in the design.

5.4 STREET CLASSIFICATION

Town streets are classified according to function. Functional classifications shall be established by the Town Engineer. The Town Engineer has the authority to make the determination for road classification. For planning purposes, the town uses the following functional categories to classify its roads.

5.4.1 Arterial

An arterial street is a high-capacity roadway. The primary function of an arterial street is to deliver traffic from collector streets to freeways or expressways and provide for travel through and between communities. These streets primarily serve through traffic, and access to adjacent property is limited.

An arterial street generally has the following characteristics:

1. Posted speed limit greater than or equal to 35 mph
2. 4-lane minimum width, plus additional turn lanes
3. 10,000 vehicles per day (vpd) expected minimum traffic volume when the land served by the arterial is fully developed
4. Limited access to adjacent parcels of land
5. No back-out drives are permitted

The only arterial street within the Town is Colorado State Highway 9. Since the Town has no existing or planned arterial streets, the design standards in this chapter will not cover their design. Consult the Colorado Department of Transportation Roadway Design Guide for design of arterial streets on the Colorado State Highway System.

5.4.2 Major Collector

A major collector street is a moderate-capacity street which serves to move traffic from local streets and minor collector streets to arterial streets. The major collector balances both through-travel needs and access to adjacent property favoring more access control and higher speeds.

A major collector street generally has the following characteristics:

1. Posted speed limit from 30 mph to 40 mph
2. Traffic volumes generally between 3,000 and 10,000 vehicles per day when the land served by the major collector is fully developed
3. Designed to handle traffic volumes loading from and onto local, other collector, and arterial streets

4. No back-out drives are permitted

Refer to typical section in Standard Details.

5.4.3 Minor Collector

A minor collector street is a low-to-moderate-capacity street which serves to move traffic from local streets and major collector streets to arterial streets. The minor collector balances both through-travel needs and access to adjacent property favoring a higher level of access and lower speeds than a major collector.

A minor collector street generally has the following characteristics:

1. Posted speed limit from 25 mph to 35 mph
2. Traffic volumes generally between 1,000 and 3,000 vehicles per day when the land served by the major collector is fully developed
3. Designed to handle traffic volumes loading from and onto local, other collector, and arterial streets
4. No back-out drives are permitted

Refer to typical section in Standard Details.

5.4.4 Local

A local street provides direct access from abutting properties to alley, major collector, minor collector, or arterial streets. While it provides for some through travel, the primary purpose is to provide access to individual properties.

A local street generally has the following characteristics.

1. Posted speed limit from 15 mph to 25 mph
2. Traffic volumes up to 1,000 vehicles per day
3. Designed for the safety of pedestrians, bicyclists, and the ease of access to adjacent parcels of land
4. Back-out drives may be permitted for single family homes and duplexes

Refer to typical section in Standard Details.

5.5 DESIGN CONTROLS

5.5.1 Design Vehicles

The street design shall accommodate the turning movements of the design vehicle as listed in

Table 5 below. The design should allow the design vehicle to make turns at intersections without encroaching into the oncoming lanes. The need for vehicles greater than the design vehicle to turn into oncoming lanes shall be reviewed and the design modified if appropriate based on nearby land use or business operations. Existing, proposed, or potential future transit routes as determined by the Transit Superintendent shall be designed to accommodate the design transit vehicle. The design engineer shall confirm that any local fire district turning requirements are also met.

Table 5.1. Design Vehicles

Street Classification	Design Vehicle
Major Collector	Intermediate Semitrailer (WB-40)
Minor Collector	Intercity Bus (BUS-45)
Local	Single-Unit Truck (SU-30)
Transit Facilities	Intercity Bus (BUS-45)
Commercial Access	Single-Unit Truck (SU-30)*
Multi-family Residential Access	Single-Unit Truck (SU-30)
Single-family Residential Access	Passenger Car (P)

* Commercial accesses that routinely use vehicles larger than a SU-30 should select and appropriate design vehicles for the onsite operations.

Additional details on these and other design vehicles can be found in Chapter 2 of the *AASHTO Green Book*.

5.5.2 Design Speed

The choice of design speed is influenced principally by the character of terrain, roadway classifications, and traffic volume. A roadway in the valley floor justifies a higher design speed than a roadway through steep mountainous terrain.

The design speed for streets in the Town will generally be equal to the posted speed. Under certain conditions, the Town Engineer may require that a design speed exceed the posted speed. Refer to Section 5.2 for the posted speed ranges of each street classification.

5.5.3 Right-of-Way Widths

The width of right-of-way depends on the street cross section to be used, topography in the area, and other physical controls. It is important to acquire sufficient right-of-way to facilitate future widening and other improvements as traffic warrants.

Minimum right-of-way widths to be dedicated for street construction in the Town are listed in Table 5.2 below. These minimums may be increased where necessary to meet side slope requirements, roadside drainage ditch requirements, transit facilities, roundabouts, intersection improvements, and other considerations requiring additional public right-of-way for the street.

The minimum clearance from the right-of-way line to the catch point of a cut or fill slope should be 5 feet for all types of cross sections. When feasible, 10 feet of clearance should be provided. Restrictive easements may be provided in lieu of dedicated right-of-way if approved by the Town Council.

Table 5.2. Right-of-Way Widths

Street Classification	Minimum Right-of-Way Width (feet)
Major Collector	80
Minor Collector	70
Local	50

5.5.4 Traffic Considerations

The design of a street and its features should be based upon consideration of the traffic volumes and characteristics to be served. In urban areas, these characteristics usually are dominated by vehicular traffic demands, but the design should also consider pedestrian, bicycle, and transit uses. Information for all current and projected user modes should be considered jointly. Vehicular traffic volumes typically drive the need for street improvements and will affect the geometric design.

5.5.5 Capacity Considerations

The level of congestion that is considered acceptable for a street or intersection will vary. The Level of Service (LOS) is intended to characterize the operating condition of a street or intersection in terms of speed, travel time, freedom to maneuver, traffic interruptions, comfort, and convenience. The results of the LOS should be a key consideration in the design process. Consult Chapter 4 of this manual for more information regarding traffic considerations for street projects.

5.6 DESIGN ELEMENTS

The alignment of a street produces a great impact on the environment, the fabric of the community, and the street user. The alignment consists of a variety of design elements that combine to create a facility that serves traffic safely and efficiently, consistent with the facility's intended function. Principal elements of design include sight distance, horizontal alignment, superelevation, vertical alignment, and cross section elements.

5.6.1 Sight Distance

Sight distance is the length of roadway visible to a driver. Sight distance is required for safe and efficient operation of a vehicle on a highway. The path and speed of motor vehicles on streets are subject to the control of drivers whose ability, training and experience vary greatly. The available sight distance on a roadway should be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching an object in its path.

5.6.1.1 Stopping Sight Distance

Stopping sight distance is the sum of two distances: (1) the distance traversed by the vehicle from the instant a driver sights an object necessitating a stop to the instant the brakes are applied, and (2) the distance needed to stop the vehicle from the instant the brakes application begins. These are referred to brake reaction distance and braking distance, respectively. Table 5.3 contains the stopping sight distances on level roadways based on design speed.

Table 5.3. Stopping Sight Distance on Level Roadways

Design Speed (mph)	Brake Reaction Distance (ft)	Braking Distance on Level (ft)	Stopping Sight Distance	
			Calculated (ft)	Design (ft)
15	55.1	21.6	76.7	80
20	73.5	38.4	111.9	115
25	91.9	60.0	151.9	155
30	110.3	86.4	196.7	200
35	128.6	117.6	246.2	250
40	147.0	153.6	300.6	305
45	165.4	194.4	359.8	360

The roadway grade has a significant effect on the braking distance due to gravity. The braking distances are longer for downgrades and shorter on upgrades compared to a level roadway. Table 5.4 contains the revised stopping sight distances based on grades that exceed an upgrade or downgrade of 3 feet rise or fall per 100 feet longitudinally, or 3%. For grades steeper than 9%, stopping sight distance shall be calculated using equations in the AASHTO green book.

Table 5.4. Stopping Sight Distance on Grades

Design Speed (mph)	Stopping Sight Distance (ft)					
	Downgrades			Upgrades		
	3%	6%	9%	3%	6%	9%
15	80	82	85	75	74	73
20	116	120	126	109	107	104
25	158	165	173	147	143	140
30	205	215	227	200	184	179
35	257	271	287	237	229	222
40	315	333	354	289	278	269
45	378	400	427	334	331	320

5.6.1.2 Sight Distance Measurement Criteria

Sight distance is the distance along a roadway throughout which an object of specified height is continuously visible to the driver. This distance is dependent on the height of the driver's eye above the road surface, the specified object height above the road surface, and the height and lateral position of sight obstructions within the driver's line of sight.

5.6.1.2.1 Height of Driver's Eye

For all sight distance calculations involving passenger vehicles, the height of the driver's eye is considered to be 3.50 feet above the road surface. For large trucks, including single-unit trucks and semi-trailers, the recommended value of a truck driver's eye height is 7.60 feet above the road surface.

5.6.1.2.2 Height of Object

For stopping sight distance calculations, a 2.00 feet object height is used. For intersection sight distance calculations, an object height of 3.50 feet is used.

5.6.1.3 Sight Distance on Horizontal Curves

For general use in design of a horizontal curve, the sight line is a chord of the curve, and the stopping sight distance is measured along the centerline of the inside lane along the curve. The value of the horizontal sight line offset (HSO) are determined by setting S, as shown in the diagrammatic sketch in Figure 5.1 and Equation 5.1, equal to the stopping sight distance (SSD). Alternatively, horizontal sight distance for existing conditions can be measured graphically using a computer automated drafting (CAD) program.

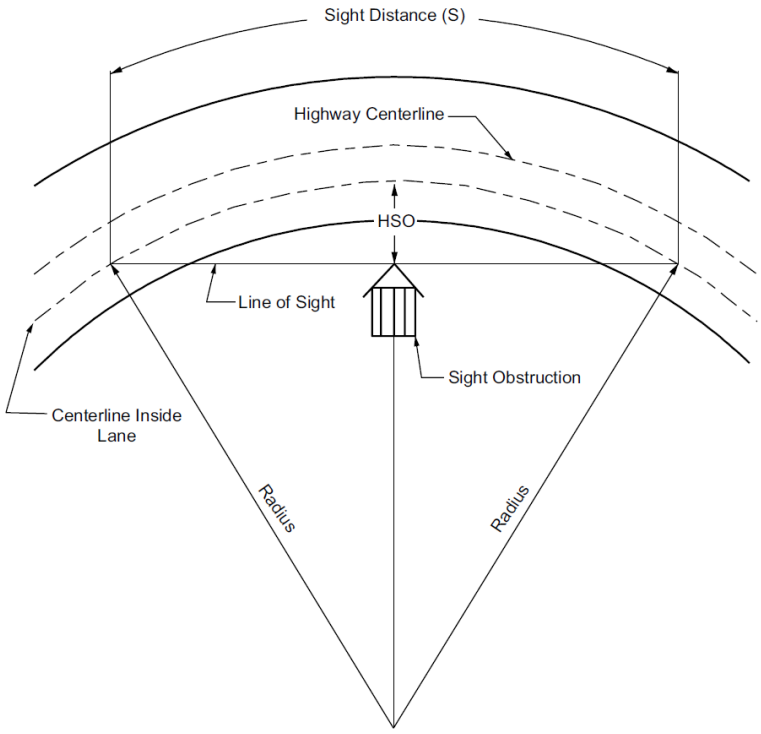


Figure 5.1. Diagram Illustrating Components to Determine Sight Distance

$$\mathrm{HSO} = \mathrm{R}\left[1 - \cos\left(\frac{28.65\ \mathrm{S}}{\mathrm{R}}\right)\right] \qquad (0.1)$$

Where:

HSO = horizontal sight offset (ft)

S = sight distance (ft)

R = radius of curve (ft)

5.6.1.4 Sight Distance on Vertical Curves

The controlling vertical curve design criteria found in Section 5.6.3.3 is based on sight distance. Vertical sight distance for existing conditions can be measured graphically using a computer automated drafting (CAD) program.

5.6.1.5 Intersection Sight Distance

Each intersection has the potential for several different types of vehicular conflicts. The possibility of these conflicts actually occurring can be greatly reduced through the provision of proper sight distances and appropriate traffic controls. The avoidance of conflicts and the efficiency of traffic operations still depend on the judgement, capabilities, and response of each individual driver.

Stopping sight distance is provided continuously along each roadway so that drivers have a view of the roadway ahead that is sufficient to allow drivers to stop. The provision of stopping sight distance at all locations along each roadway, including intersection approaches, is fundamental to intersection operation.

Mid-block or uncontrolled crosswalks shall meet minimum intersection sight distance requirements. Case B1 (Table 9-6 of AASHTO Greenbook) shall be used for minimum values.

5.6.1.5.1 Sight Triangles

Specified areas along intersection approach legs and across their included corners should be clear of obstructions that might block a driver's view of potentially conflicting vehicles. These specified areas are known as clear sight triangles. The dimensions of the legs of the sight triangles depend on the design speeds of the intersection roadways and the type of traffic control used at the intersection. These dimensions are based on observed driver behavior and are documented by space-time profiles and speed choices of drivers on intersection approaches. Two types of clear sight triangles are considered in intersection design-approach sight triangles and departure sight triangles.

5.6.1.5.2 Approach Sight Triangles (Uncontrolled or Yield-Controlled Intersection)

Each quadrant of an intersection should contain a triangular area free of obstructions that might block an approaching driver's view of potentially conflicting vehicles. The length of the legs of this triangular area, along both intersection roadways, should be such that the drivers can see any potentially conflicting vehicles in sufficient time to slow or stop before colliding within the intersection. Figure 5.2 shows typical clear sight triangles to the left and to the right for a vehicle approaching an uncontrolled or yield-controlled intersection.

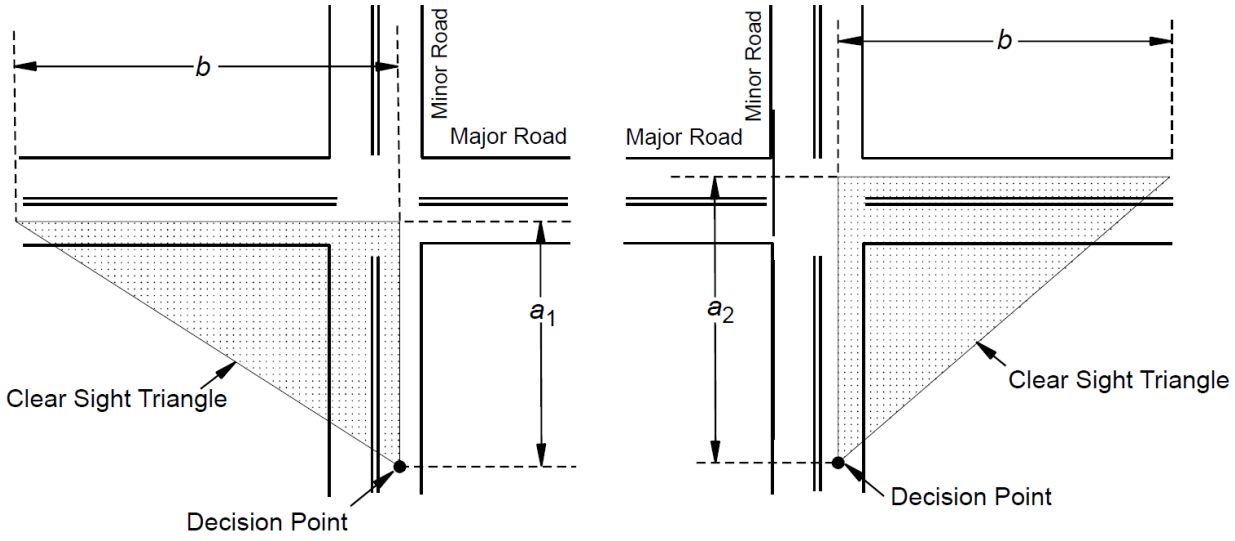
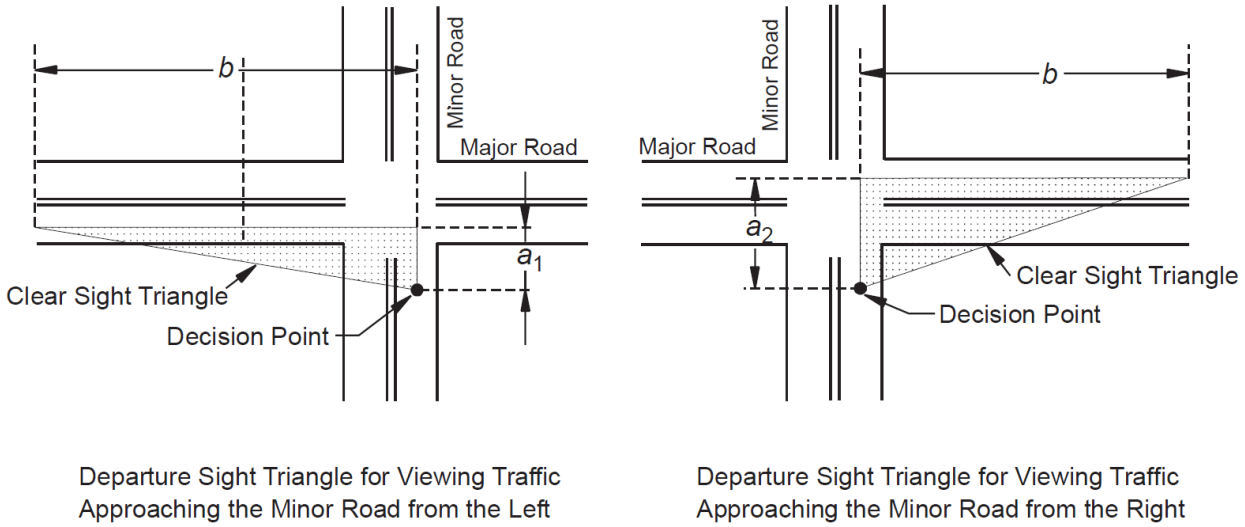


Figure 5.2. Approach Sight Triangles at Intersections (Uncontrolled or Yield-Controlled)

The length of the legs of the approach sight triangle shall be determined in accordance with the practices and standards established in Chapter 9 of the *AASHTO Greenbook.*

5.6.1.5.3 Departure Sight Triangles (Stop Controlled Intersection)

A second type of clear sight triangle provides sight distance sufficient for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. Figure 5.3 shows typical departure sight triangles to the left and to the right of the location of a stopped vehicle on the minor road. Departure Sight Triangles should be provided in each quadrant of each intersection approach controlled by stop or yield signs. Departure sight triangles should also be provided for some signalized intersection approaches.



Departure Sight Triangle for Viewing Traffic Approaching the Minor Road from the Left

Departure Sight Triangle for Viewing Traffic Approaching the Minor Road from the Right

Figure 5.3. Departure Sight Triangles at Intersections (Stop-Controlled)

The length of the legs of the approach sight triangle shall be determined in accordance with the practices and standards established in Chapter 9 of the *AASHTO Greenbook.*

5.6.1.5.4 Identification of Sight Obstructions within Sight Triangles

The profiles of the intersection roadways should be designed to provide the recommended sight distances for drivers on the intersection approaches. Within a sight triangle, any object at a height above the elevation of the adjacent roadways that would obstruct the driver's view should be removed or lowered, if practical. Such objects may include buildings, parked vehicles, roadway structures, roadside hardware, hedges, trees, bushes, unmowed vegetation, tall crops, walls, fences, stored snow and the terrain itself. No objects or improvements shall be allowed over 3.5 feet tall within the sight triangles, with the exception of regulatory signs, signals, or street lights. If landscaping elements are proposed within the identified sight triangles, landscaping must be maintained so that it does not become an obstruction over 3.5 feet tall. Maintenance responsibilities must be agreed upon with the Town Engineer. Sight triangles shall be shown on all roadway and site design plans.

5.6.2 Horizontal Alignment

Street layout is designed to bear a logical relationship with the topography, connect to existing and planned area streets, and provide reasonable access to adjacent parcels. Street layout shall be designed to fit the context of the development and serve vehicle, pedestrian, transit, and bicycle users. Street layout shall avoid long, straight sections to minimize the potential for speeding.

5.6.2.1 Traffic Calming

ITE defines traffic calming as "the combination of mainly physical measures that reduced the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users." Local roads in residential neighborhoods shall be designed with traffic calming features. Intersection improvements and pedestrian crossing enhancements are encouraged for pedestrian safety. Major and minor collectors shall be analyzed for traffic calming and may require traffic calming features. Traffic calming encompasses a wide range of different features and methods; the appropriate features for a specific roadway is dependent on a variety of project specific features such as the design speed, traffic volume, development type, maintenance concerns, location within Town, and site constraints. The following hierarchy of traffic calming methods are listed in order from the generally most preferred method to the least preferred method.

1. Horizontal geometry (appropriate radius curves, chicanes, lane narrowing, and other geometry features to promote use of the roadway at the design speed)
2. Raised crosswalks at intersections
3. Intersection bulb-outs
4. Rectangular Rapid-Flashing Beacon or other light emitting hardware at pedestrian crossings
5. Roadway signage per MUTCD
6. Radar speed signs
7. Striping & thermoplastic markings
8. Median islands
9. Speed Humps

All traffic calming features shall be designed per MUTCD, ADA, and all other relevant standards. Features shall accommodate drainage and shall consider maintenance issues and effectiveness during winter conditions.

Traffic calming requests, studies, and design shall comply with the Town of Breckenridge Traffic Calming Policy, which may be obtained from the Engineering Division. Refer to Section 5.14 for traffic calming measures related to uncontrolled pedestrian crossings.

5.6.2.2 Horizontal Curves

Horizontal curve design should be based on an appropriate relationship between design speed, right-of-way, profile grades, and construction costs—and on their joint relationships with superelevation and side friction. Curves are not required when the delta angle (total central angle of the circular curve) is less than 1 degree. Curves should be at least 500 feet long for a central angle of 5 degrees, and the minimum length should be increased 100 feet for each 1 degree decrease in the central angle. The formula can be found in the *AASHTO Greenbook* and the CDOT M & S Standard Plans. Designers should use every effort to exceed the minimum curve radius when practical. Broken back, compound, spirals, or reverse curves are not recommended. Table 5.5 below gives the minimum horizontal curve radius for a normal crown of 2%. For superelevated roadways, refer to Section 5.4.2.3.

Table 5.5. Minimum Horizontal Curve Radius (Normal Crown)

Design Speed (mph)	Minimum Horizontal Curve Radius (ft)
15	50
20	110
25	200
30	335
35	510
40	765
45	1000

5.6.2.3 Superelevation

Local streets utilize standard crown sections and do not require superelevation. Superelevation may be considered on collector streets to address unique horizontal geometry, drainage, or grade issues. At intersections, grades of the minor street shall be warped to transition to the grades of the major street. If a street design requires the use of superelevation, factors controlling the use of

superelevation include climate conditions, terrain conditions, classification of the street, and the frequency of slow-moving vehicles on the roadway. In general, a lower rate of superelevation is used in urban areas. The maximum allowable superelevation rate is 6%.

The superelevation transition section consists of the superelevation runoff and tangent runout sections. The superelevation runoff is the length of roadway needed to accomplish a change in outside lane cross slope from zero to full superelevation, or vice versa. The tangent runout section is the length of roadway needed to accomplish a change in outside lane cross slope from normal cross slope rate to zero, or vice versa. Additional information pertaining to the lengths and use of transitions for simple and spiral curves can be found in the *AASHTO Greenbook*. Refer to *CDOT M Standard – Superelevation Streets* for design requirements.

5.6.3 Vertical Alignment

The design should take into consideration the impact the vertical grade has on the operation of the facility. Designers should consider stopping sight distance requirements for the given speed limit and the challenges of large cut-and-fill sections. Vertical curves are classified as either sag or crest curves. Typically, sag curves are controlled by nighttime driving conditions with headlight visibility restrictions, and crest curves are controlled by stopping sight distances. Vertical curves should be simple in application and should result in a design that is safe and comfortable in operation, aesthetically pleasing, and adequate for drainage—especially when a curb and gutter are used.

5.6.3.1 Terrain

Proposed roads shall follow the natural terrain of the existing area whenever possible.

5.6.3.2 Grades

Grade lines are typically controlled by topography and structure clearances, but very flat grade can be controlled by drainage considerations. Other factors that should be considered are street classifications, design speed, safety, and construction costs. A minimum value of 1.0% should be used for street sections with curbs and gutters. In certain conditions, 0.5% may be used. The designer should consider the ultimate design of the roadway, recognizing if a curb and gutter may be required in the future, and design for those conditions during the interim design. Grades 4% or steeper may require special consideration for drainage or erosion protection.

Maximum grades of streets shall not exceed 6%. Major collectors shall flatten to 2% slope for intersections and shall meet the requirements of vertical curves at the intersections. Minor collectors and local roads shall flatten to 4% slope at intersections and shall meet the requirements of vertical curves at the intersections.

5.6.3.3 Vertical Curves

When using combinations of horizontal and vertical curves, it is important to recognize the driver's perspective. Sharp horizontal curvature should not be introduced at or near the top of a pronounced crest vertical curve. If unavoidable, the horizontal curve should be made longer than the vertical curve to help minimize the driver's inability to perceive the horizontal change, especially at night (For further details, see *AASHTO Greenbook* and the *CDOT Roadway Design Guide*). The length of vertical curves can be determined by dividing the rate of vertical curvature by the grade change or algebraic difference in intersecting grades.

$$L = K/A \quad (5.2)$$

Where:

L = length of the vertical curve (ft)

K = rate of curvature

A = grade change (%)

A vertical curve is not required when a grade change or the algebraic difference is equal to or less than 0.2%. The preferred minimum length of a vertical curve is 300 feet. The allowed minimum is 3 times the roadway design speed. Table 5.6 below gives the minimum K values based on design speed.

Table 5.6. Minimum K Values for Vertical Curves

Design Speed (mph)	Minimum K Value (Crest)	Minimum K Value (Sag)
15	3	10
20	7	17
25	12	26
30	19	37
35	29	49
40	44	64

5.6.3.4 Vertical Clearance to Obstructions

Private overhead structures are not permitted in the public ROW and consideration of such structures shall be limited. Signal height clearances shall be per the current MUTCD. For other structures, there shall be a minimum 18-foot clearance on streets. For sidewalks and shared use paths, there shall be a minimum 10-foot clearance.

5.6.4 Cross Section Elements

5.6.4.1 Traveled Way

5.6.4.1.1 Cross Slope

Cross slope is necessary to ensure adequate drainage. The preferred value for a cross slope is 2% for paved streets. Undivided streets should have a normal crown that is a two-way cross slope, with the high point of the cross section located on the street centerline. Divided streets should have a cross slope on each side of the divide, with the high point of each section located where the pavement meets the median. Cross slopes of 2% are permissible on concrete roadways. Intersections of streets with curbs and gutters sometimes require the use of cross-pans for drainage. At these areas, the normal two-way 3% cross slope shall transition to a one-way slope adjacent to the cross pan, with a slope range of 1% to 2%. Cross-pans shall not be allowed on major collectors and are discouraged on minor collectors.

5.6.4.1.2 Lane Widths

Lane widths shall be 11 feet minimum asphalt width in the Town of Breckenridge historic district, and 12 feet minimum asphalt width outside of the historic district, unless a variance is granted by the Town Engineer. The Breckenridge Historic District is defined in Title 9 of the Town Code and the "Breckenridge Handbook of Design Standards. The limits of the Historic District are shown on the Town's website. The curb, valley pan, or shoulder is not counted in the lane width dimension.

5.6.4.2 Shoulders

Shoulder width shall be 2 feet minimum of compacted aggregate base course plus 4 feet of recoverable zone with only grass vegetation (6-foot wide total clear zone).

Shoulder width for Major Collectors and Arterials shall 4 feet minimum of aggregate compacted base course plus 10 feet of recoverable zone with only grass vegetation (14-foot wide total clear zone).

5.6.4.3 Roadside Design

5.6.4.3.1 Cut and Fill Slopes

Cut and fill slopes for roadway embankment of 3:1 or flatter are preferred. Maximum cut and fill slopes shall be 2:1. Consideration should be given to snow removal problems and snow storage in slope design. It is considered advisable to use flatter slopes in cuts on the southerly side of the roadway where this will provide additional exposure of the pavement to the sun. Flatter slopes shall be considered to reduce erosion, maintenance costs, and to facilitate vegetation. If steeper slopes are needed, side slope material shall be evaluated based on drainage needs to determine appropriate material for stabilization of the slope. See Chapter 7 of these standards for further guidance on temporary and permanent stabilization measures.

The tops of all cut slopes shall be rounded where the material is other than solid rock. A layer of earth overlying a rock cut shall also be rounded.

5.6.4.3.2 Roadside Ditches

See Chapter 6 for Roadside ditch information and design.

5.6.4.3.3 Clear Zone

All fixed objects should be located outside the clear zone as defined in the *AASHTO Roadside Design Guideline*s. The design should provide a clear zone as wide as practical within constraints per the latest version of the *AASHTO Roadside Design Guidelines.* For low speed, low volume roadways a minimum clear recovery zone area of 7 feet in width shall be provided for roadways without curb and 2 feet in width for all roadways with curb.

5.6.4.3.4 Obstructions

Mailboxes, address monuments, landscaping, stone headwalls, and other objects shall not be located within the right of way. If any improvements are allowed in the ROW, an encroachment license shall be filed prior to issuance of permit.

5.6.4.3.5 Roadside Barriers

The installation of roadside barriers on embankments and adjacent to fixed objects may reduce the combined effect of severity and frequency of “run-off-road” type crashes. Roadside barriers reduce crash severity only when the overall severity of striking the guardrail is less than the severity of going down an embankment or striking a fixed object. They should not be installed if they are likely to create a greater hazard than running off the street. To the extent possible, streets shall be designed to eliminate the need for roadside barriers by eliminating obstructions, steep grades, and other hazards from the clear zone. Evaluating installation of roadside barriers shall consider crash experience, street objectives, functional classification of streets, design speed, traffic volume and type, street cross section, height of embankment, steepness of fill slope, horizontal curvature, gradient or profile conditions, street side conditions, climatic conditions, and degree of projected injury from traveling off the street. Special consideration shall be given to winter and icy conditions which might necessitate a roadside barrier that would not be needed under normal conditions. Refer to the *AASHTO Roadside Design Guide* for roadside barrier best practices. Refer to the *CDOT M Standards* for roadside barrier installation and construction requirements.

Guardrails and concrete barriers shall typically be colored brown and rails shall not be made of galvanized or reflective materials (reflector tabs and other reflective devices shall be installed per

AASHTO and CDOT standards). Custom guardrails or barriers utilizing natural materials shall meet AASHTO and CDOT standards and be impact rated.

When roadside barrier is considered for installation, especially in extended lengths, provisions shall be made for adequate snow storage and removal. Flared end treatments are preferred over non-flared end treatments for snow removal operations.

5.6.4.3.6 Retaining Walls

Retaining walls and abutments are discouraged within the publicly maintained right-of-way. All designs of retaining walls, foundations, and abutments exceeding 48 inches in height (measured from finished grade) will require a sealed geotechnical design and a sealed structural design. Both designs will need to be prepared by registered professional engineers in the State of Colorado prior to the any approval of the retaining wall and abutment. Retaining wall and abutments retain earth with lateral support or at the end of a bridge span, respectively. The design of these structures depends upon type, function, and anticipated service life of retaining wall, earth pressure exerted on the wall by the retained backfill, geometry, strength and deformability of the ground, groundwater, and welling pressure in clay backfills. Four types of retaining wall systems are discussed in this section: conventional retaining walls and abutments, anchored walls, mechanically stabilized earth walls, and prefabricated modular walls.

Wall aesthetics shall be approved by the Town Engineer. Local Home Owner's Association (HOA) requirements may apply in certain instances.

Retaining walls needed to support private improvements shall not be located in the public right-of-way.

Full or partial height walls shall not be located closer than the outer edge of shoulder. When the top of the retaining wall is at the level of a roadway, the face of the parapet wall or rail shall be at least 4 feet from the edge of the traveled way.

1. Conventional Retaining Walls and Abutments: Conventional retaining walls and abutments are proportioned to provide stability against bearing capacity failure, overturning, and sliding. Retaining walls are discouraged within the public right-of-way. They will be allowed only when necessary to support public improvements. Design of conventional retaining walls and abutments shall satisfy the following loading factors:
    a. Lateral earth and water pressures, including any live and dead load surcharges.
    b. The weight of the wall.
    c. Temperature and shrinkage effects.
    d. Seismic loads.

2. Anchored Walls: Anchored walls provide additional lateral resistance with the use of anchors. Their design is based on the suitability of the subsurface soil and rock conditions. Design of anchored walls shall satisfy the following loading factors:
    a. Lateral earth and water pressures, including any live and dead load surcharges.
    b. The weight of the wall.
    c. Seismic loads.

3. Mechanically Stabilized Earth Walls: Mechanically Stabilized Earth Walls (MSEW) are flexible composites of granular soil and tensile inclusions that behave as earth embankments with vertical or nearly vertical faces. MSEW are proportioned to provide stability against overturning and sliding. Bearing pressure generally governs design. An MSEW should be used where substantial total and differential settlement is expected. This type of wall may also be used

where conventional gravity, cantilever, or counterforted concrete retaining walls are considered. An MSEW shall not be used where utilities other than highway drainage are to be constructed within the reinforced zone or floodplain erosion or scour may undermine the reinforced fill zone or any supporting footing. An MSEW shall not be used where surface or groundwater contaminated by acid mine drainage or other industrial pollutants is present. Design of MSEWs shall satisfy the following loading factors:

a. Lateral earth and water pressures, including any live and dead load surcharges.

b. The weight of the wall.

c. Seismic loads.

4. Prefabricated Modular Walls: Prefabricated modular walls employ soil-filled interlocking modules to resist earth pressures. Stability of modular walls depends upon the weight and strength of the fill soil. Each module level shall be investigated for sliding and overturning. A prefabricated modular wall may be used where conventional gravity, cantilever, or counterforted concrete retaining walls are considered. A prefabricated modular wall shall not be used on curves with radius less than 800 feet, unless the chord can be substituted with a series of chords, or where groundwater or surface runoff is contaminated with acid. Design of prefabricated modular walls shall satisfy the following loading factors:

   a. Lateral earth and water pressures, including any live and dead load surcharges.

   b. The weight of the wall.

   c. Seismic loads.

   d. Earth pressure shall be computed on a plane surface where modules form an

   e. irregular, stepped surface. Ka, used to compute lateral thrust, shall be computed based on the friction angle of the backfill behind the modules.

5.6.4.4 Curbs

Curb and gutter is required at the following locations:

1. On all streets in flat or rolling terrain within subdivision or any similar-type developments where high densities have been planned.
2. Where required by drainage, traffic, or public safety.
3. To replace existing curb.

Refer to the Street Standard Drawings for approved curb and gutter types.

5.6.4.5 Medians

Medians other than those listed within the street cross-sections are generally not permitted on new Town streets and must be approved by the Town Engineer. Medians shall be designed with plowable noses.

5.7 INTERSECTIONS

See Section 5.4.1.5 for intersection sight distance requirements.

5.7.1 Alignment and Profile

Streets must intersect one another at 90-degree angles or as close to 90 degrees as the topography allows. Angles less than 90 degrees must be approved by the Town Engineer. Angles less than 80

degrees are not permitted. Intersecting streets shall remain perpendicular for a minimum of 50 feet from the intersection.

In general, grades for intersecting roads should be as flat as possible to provide for storage platforms and sight distance. Grades shall not exceed 2 percent across a pedestrian access route (PAR) if the intersection is controlled by a stop sign or yield condition. Grades exceeding 2% across a PAR are permissible at signalized intersections or uncontrolled intersection legs, but every effort should be made to minimize the grade to meet 2%. Approach grades greater than 4 percent should be avoided. Grades that may need to be steeper to accommodate cases where the existing terrain does not allow for flatter intersections must be approved by the Town Engineer.

Parking shall not be located within 20 feet of an intersection.

5.7.2 Corner Radii

Radii of 15 to 25 feet are adequate for passenger vehicles. These radii may be provided at minor cross streets where there is little occasion for trucks to turn or at minor intersections where there are parking lanes. Where the street has sufficient capacity to retain the curb lane as a parking lane for the foreseeable future, parking should be restricted for appropriate distances from the crossing.

Radii of 15 feet or more at minor cross streets should be provided on new construction and on reconstruction where space permits.

Radii of 20 feet or more at major cross streets should be provided where feasible so that an occasional truck can turn without too much encroachment.

Radii of 30 feet or more should be provided where large truck combinations and buses turn frequently. Longer radii are also desirable where speed reductions would cause problems.

Curb radii should be coordinated with crosswalk distances or special designs to make crosswalks safe for all pedestrians. Designs which can minimize the corner radii for pedestrians and passenger vehicles, while still allowing trucks to make turning movements, are encourages. Examples include truck blisters, rollover curb, and eliminating any structures or other objects behind the curb but within the truck radius.

5.7.3 Functional Intersection Area

Functional intersection area is the area upstream and downstream of an intersection where intersection operation and conflicts influence driver behavior, vehicle operations, or traffic conditions. Separation of access points should not be less than the functional area of the intersection.

The upstream distance is a combination of the storage length, deceleration and taper length, and the perception-reaction distance required for the speed of the segment. The downstream distance is measured as either acceleration length or decision sight distance. Providing acceleration length allows vehicles to accelerate to normal speed without conflict. Providing decision sight distance allows drivers to pass through an intersection before considering potential conflicts at the next intersection. Functional intersection area is demonstrated below in Figure 5.4.

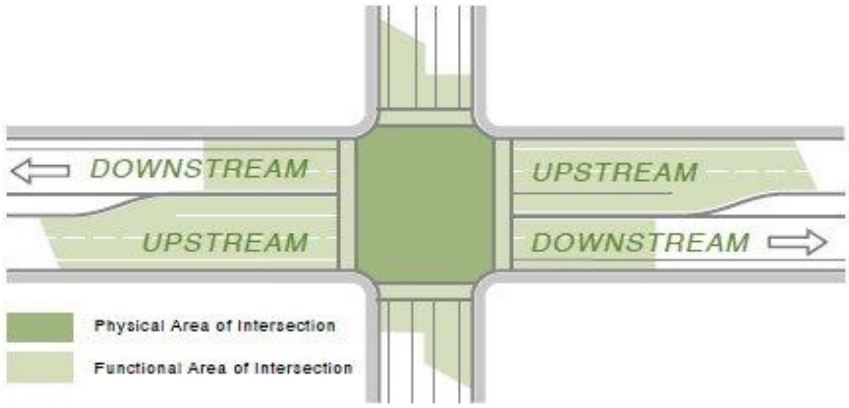


Figure 5.4. Functional Intersection Area

5.7.4 Channelization

5.7.4.1 Islands

Islands are general not permitted on new Town streets, and must be approved by the Town Engineer. Exceptions are made for roundabouts. Islands shall be designed with plowable noses.

5.7.4.2 Medians

Medians are generally not permitted on new Town streets and must be approved by the Town Engineer. Exceptions are made for roundabouts. Medians shall be designed with plowable noses.

5.7.5 Auxiliary Lanes

Auxiliary lanes are useful in maintaining the safety, traffic flow, and operation of a roadway or access. When auxiliary lanes are required by the Town or warranted by information obtained during the development review process, the applicant is responsible for design, installation, and any purchase of right-of-way to accommodate the required lane width. Auxiliary lanes are required when unique location factors (e.g., roadway speed and traffic density, access volume, the volume of commercial trucks, the influence of nearby accesses, existing auxiliary lanes close to the proposed access, nearby traffic control devices, available stopping sight distance, and other topographic or roadway design factors) exist that determine the need for auxiliary lanes. Auxiliary lanes are required to mitigate specifically identified and documented locations with safety and operation issues.

5.7.5.1 Deceleration Lanes

A left deceleration lane, also called a left-turn lane, with storage length plus taper length, is required for any access with a projected peak hour left ingress turning volume greater than 25 vph. If the posted speed is greater than 40 mph, a deceleration lane and taper is required for any access with a projected peak hour left ingress turning volume greater than 15 vph. The taper length will be included within the deceleration length. A left deceleration lane is not required when the opposing projected peak hour traffic volume is less than 150 vph.

A right deceleration lane, also called a right-turn lane, with storage length plus taper length, is required for any access with a projected peak hour right ingress turning volume greater than 50 vph. If the posted speed is greater than 40 mph, a right turn deceleration lane and taper is required for any access with a projected peak hour right ingress turning volume greater than 25 vph. The taper length will be

included within the deceleration length. A right deceleration lane is not required when the advancing projected peak hour traffic volume is less than 400 vph.

5.7.5.1.1 Storage Length

The storage length for an auxiliary lane can be determined by the information summarized in Table 5.7. These lengths are based on the average length of a passenger vehicle and the estimated turning vehicles per hour. Estimated lengths for buses, larger trucks, and recreational vehicles must be determined and submitted to the Town for review. The basis for designing the length of required storage is to provide sufficient length for vehicles to queue within the lane without affecting other movements. Table 5.8 provides the required storage lengths for stop-controlled and signal-controlled intersections. If the Department of Public Works determines that meeting the required storage length is impractical or will result in an unsafe condition, the minimum storage length shall be based on the mean arrival rate. But in no case shall the minimum auxiliary lane length be less than 50 feet.

Table 5.7. Acceleration/Deceleration Lane Design Criteria

Posted Speed Limit (mph)	25	30	35	40	45
Deceleration length (ft)	180	250	310	370	435
Acceleration length (ft)	N/A	190	270	380	550
Transition taper (ratio)	7.5:1	8:1	10:1	12:1	13.5:1
Straight taper (ratio)	15:1	15:1	20:1	30:1	45:1

Table 5.8. Auxiliary Lane Storage Lengths

Turning vehicles per hour	<30	30-59	60-100	>100
Minimum required storage length (ft)	25	40	50	100

5.7.5.1.2 Tapers

Auxiliary lanes typically consist of one or more of the following: transition taper, full width auxiliary lane, and storage length. The use of these components varies based on the type of access, through street classification, and site-specific conditions (grades). To determine the required acceleration and deceleration lane and transition taper length, see design criteria presented in Table 5.7. The length of the required transition taper is determined by multiplying the distance offset by the transition taper ratio value associated with the posted speed. The beginning and ending point of all tapers shall be rounded.

Transition tapers: The purpose of a transition taper is to provide sufficient length for a vehicle to accelerate or decelerate to the appropriate speed and merge into and out of the through traffic lanes without disrupting traffic flow. The length of a transition taper is calculated by multiplying the width of the lane by a standard ratio. The beginning and ending point of all tapers shall be rounded.

Redirect or straight tapers: Redirect tapers shall be used where an exclusive turn lane, median, or other redirection of vehicles is necessary and where redirection of the flow of traffic is necessary to accommodate the exclusive turn lane or median. If the redirect taper would result in a horizontal curve design deficiency for the through movement, the horizontal curve shall be corrected. Redirect tapers should be designed as straight tapers with the beginning and ending points rounded.

5.7.5.2 Acceleration Lanes

Acceleration lanes are required at any access with a project peak hour right turn volume of greater than 50 vph and a posted speed of 40 mph or greater. The purpose of an acceleration lane and

transition taper is to provide sufficient length for a vehicle to accelerate to the appropriate speed and merge into the through traffic lanes without disrupting traffic flow. Table 5.7 above provides the required acceleration lane and transition taper lengths by design speed. Acceleration lane lengths shall be adjusted for a grade of 3% or more. The total length of the acceleration lane includes the values of both the lane and transition taper. Shorter acceleration lanes are not permitted, as they are not used properly by most of the traveling public.

5.7.5.3 Two-way Left Turn Lanes

Two-way left turn lanes should be used sparingly. Two-way left turn lanes may be considered on arterial roadways in areas where several low-volume commercial accesses are closely spaced. Two-way left turn lanes shall be 12-16 feet wide.

5.8 DEAD END STREETS (CUL-DE-SACS)

Dead-end streets are discouraged and shall be avoided unless topographic or other unique site constraints limit construction of interconnected streets. The design of cul-de-sacs will be reviewed following the Street Standard Drawings. Any public street or private street that dead ends shall terminate in a cul-de-sac. All cul-de-sacs shall include signage within fifty feet of the inlet indicating that the street is a dead-end street.

5.9 BRIDGES

Bridges, arch culverts, and other structures shall be designed per the CDOT Bridge Design Manual and AASHTO standards. Bridges shall be designed to accommodate the full lane widths, shoulders, curbs, sidewalks, ROW widths, and other improvements detailed in this chapter. Future development and improvements shall be considered when designing bridges. Pedestrian bridges shall exceed the width of the pedestrian route it is serving and shall be 8’ minimum width for shared use paths and 12’ minimum width for shared use paths.

See Town of Breckenridge Open Space and Trail standards for requirements on bridges for soft surface trails.

See Chapter 6 of these standards for hydrologic requirements of bridge structures.

5.10 ACCESS CONTROL AND MANAGEMENT

An access is defined as a privately owned connection to a Town street or right-of-way and may also be referred to as an access road or driveway. A Town, County, or CDOT owned roadway is not classified as an access. Establishing access criteria and the application of access management techniques is highly desirable on public streets. Effective access management enhances the capacity and safety of a street and preserves those elements as the corridor develops further. While access to adjacent properties are required, the Town should attempt to limit the number of access points and their locations, especially on intersection approaches.

5.10.1 Private Access

Private accesses service four or less single-family homes, one multi-family property, or one commercial property. An access serving five or more homes shall be classified as either a public or private street and not an access (see Section 5.19.1). Private accesses are not owned, maintained, or plowed by the Town. They are the sole responsibility of the property owner. A private access that serves multiple lots shall be located in an easement or common area. The easement or common area width shall accommodate the access width, drainage, construction requirements (slopes, etc.), snow storage, and other appropriate design elements. Cross parcel access easement shall not be less than 30 feet wide. Private access design shall also incorporate International Fire Code (IFC), Red, White,

and Blue Fire Department, and development code parking lot design requirements, which are listed those respective standards and codes.

5.10.1.1 Commercial

A commercial private access is the paved vehicle access route for a commercial lot or development and may include the access driveways and parking areas that serve the development.

5.10.1.2 Residential

A residential private access is the paved vehicle access route for four or less single-family homes, two duplexes, one triplex, or a multi-family development and may include the access driveways, and parking areas that serve the development. An access to multiple duplexes or townhomes shall be a public road.

5.10.2 Access Changes

Access changes on Town of Breckenridge streets will typically require a Town Development Permit and a Right of Way permit. Access changes on State Highway 9 will require a CDOT access permit. Access changes on a Town Street (not directly located on a State Highway), but increasing traffic at the nearest State Highway 9 intersection by at least 20%, will also require a CDOT access permit.

5.10.2.1 Number of Accesses

Only one access shall be provided per lot for safe ingress and egress. Where topographic or other site conditions exist, shared access between lots may be required.

Additional accesses may be approved off local streets that meet the minimum spacing requirements shown in Table 5.9. Accesses for a collector or arterial street frontage wherein a traffic impact study demonstrates a need for a second access based on traffic volumes, unique site or constraints or site requirements that generates the need for the second access; No feasible design alternatives are available to eliminate the need for a second access. Additional accesses may be allowed if required per IFC code requirements, or for large commercial developments. If an additional access is allowed, the second access shall be added from the minor street. Access from the major street shall be limited to the greatest extent possible.

Where an existing access is required to be removed, the owner is required to remove the driveway, the driveway connection to the public road, driveway apron, and other associated driveway improvements. Where the access crosses a sidewalk, owner will be required to remove the driveway cut and construct curb across the access. Owner will also be required to add any landscaping or block vehicle access with grading, landscaping, or other obstructions.

5.10.2.2 Location

Access shall be from the lowest classification street. Lots with alley frontage shall have access from the alley only. When sites adjacent to an alley redevelop, propose a significant remodel or addition, or add a secondary unit, accesses and parking on an adjacent street shall be removed and access shall be solely from the alley. Accesses on a cul-de-sac shall be located to provide room for snow storage and shared access may be required. Exception: where there is an existing garage served by the street that shall remain without changes, the street access can remain to serve the garage. If feasible that access should be upgraded to meet current standards.

One driveway shall be allowed per lot unless otherwise permitted by the Town Engineer. Circular driveways, consisting of two curb cuts onto a street, are not permitted. A second driveway access is only allowed when required by IFC or RWB fire requirements.

All intersection and driveway accesses shall intersect the roadway at a ninety-degree angle.

No backout movements shall be permitted on arterial, major collectors, and minor collectors. Driveways on minor collector streets and above shall have internal circulation provided to allow turnaround movements within the driveway.

One-way accesses are discouraged.

Access location shall be configured to optimize sight distance, separation from adjacent intersections and driveways, and grade at the intersecting road (avoid steeper portions of adjacent roadway).

Commercial or multi-family residential accesses may not be allowed on roadway grades exceeding 6%. On roads exceeding 6%

5.10.3 Access Management Techniques

Several access management techniques may be used to implement best management practices. Techniques include, but are not limited to the following:

1. Consolidate access by reducing the number of access points that serve a single property or by providing joint access for multiple properties at or near a shared property line.
2. Connect adjacent properties to provide circulation between properties and increase access opportunities for multiple properties.
3. Define driveways to provide clear identification of entrance and exit locations.
4. Locate access to a side street (local road) instead of a major road (arterial or collector) to reduce vehicle conflict on the major road.

5.10.4 Sight Distance

Sight distance at accesses must comply with Chapter 9 of the *AASHTO Greenbook*. Table 5.9 identifies the appropriate design vehicle to be used for sight distance calculations. Where existing objects obstruct the AASHTO sight distance for single family or duplex homes, the sight distance triangle may be reduced from 14 feet to 10 feet from the edge of the roadway.

Table 5.9 Design Vehicle Selection for Access Sight Distance

Land Uses Served by Access	Design Vehicles (for sight distance calculations)
Residential (Non-School Bus Route)	Passenger Cars, Pickup Trucks
Part of Any School Bus Route Regardless of Land Use	No Less Than Single Unit Trucks
Office	Single Unit Trucks
Recreational	Single Unit Trucks
Commercial/Retail	Multi-Unit Trucks*
Industrial	Multi-Unit Trucks*
Municipal Streets & County Roads	Multi-Unit Trucks*
Agricultural Field Approaches <1 Per Day	Single Unit Trucks

*If Less Than 2 Multi-Unit Truck Trips Per Day (Average), Use Single Unit Truck

5.10.5 Access Spacing

Table 5.10. provides access spacing requirements based on street classification. Access spacing and offset requirements shall be measured from the edges of the nearest curb returns or pavement radii terminations.

Table 5.10 Access Spacing Requirements

	Street Classification of Road being accessed by Driveway			
Design Element	**Arterial**	**Major Collector**	**Minor Collector**	**Local**
Offset between Street Intersections	¼ Mile	1000’	500’	300’
Offset between adjacent Major Access Driveways (≥100 trips per day)	300’	150’	100’	50’
Offset between adjacent Minor Access Driveways or one Major Access Driveway and one Minor Access Driveway (<100 trips per day)	150’	75’	50’	30’
Offset between Major or Minor access and street intersection	300’	150’	100’	50’

5.10.6 Access Width

Table 5.11 provides access width requirements.

Table 5.11 Access Width Requirements

Layout Parameters	Residential-1 Unit	Residential-2 Units	Residential-3-4 Units	Residential (Multi-Family Greater than 4 units)	Residential Private Street	Commercial or Industrial Private Access
Minimum Width	12’	12’	12’	12’	24’	12’
Maximum Width (Includes flared pavement radius at edge of roadway)	20’**	20’**	24’	24’	24’	32’*
Pavement Return Radius	0’-5’	0’-5’	0’-10’	0’-10’	10’-20’	10’-20’
Maximum Slope (Centerline)	8%	8%	8%	8%	6%	8%

*Utilization of maximum width shall be approved by the Town Engineer.
**Maximum width shall include pavement return radius

5.10.7 Access Type

5.10.7.1 Curb Cut Driveway

In general, if there is a pedestrian sidewalk path along the roadway where an access is proposed, the sidewalk shall continue across the driveway. Refer to the Street Standard Drawings for curb cut driveway requirements and details. Exceptions can be made when the single unit and multi-unit truck peak hour volume is greater than 5.

5.10.7.2 Radius Driveway

A radius driveway is defined as an access with curb ramps and without a continuous sidewalk across the access. Radius driveways shall be designed in accordance with intersection requirements of this chapter. With a radius driveway, access radii shall be per Table 5.11. If the design vehicle intended to use the access daily is a single-unit exceeding 30 feet, multi-unit, or another vehicle requiring a larger radius, the minimum turn radius accommodating this design vehicle shall be used. Access radii shall allow safe maneuvers without intrusion into adjacent highway travel lanes. In instances where multiple larger vehicles are likely to oppose each other at the access, the radii should be adequate to accommodate both vehicles without conflict. Radius shall balance vehicle access while also promoting slowing of vehicles. Smaller radii should be used where an access crosses a pedestrian route to encourage slower speeds.

5.10.8 Access Design Details

5.10.8.1 Access Profile

Driveways shall match the roadway cross-slope for the first five feet, shall not exceed 4% for the following 15 feet, and shall not exceed 8% for the remainder of the driveway.

If a pedestrian access route crosses the driveway, the driveway cross-slope shall be a maximum of 2% for the width of the pedestrian access route (minimum 4 feet wide).

5.10.8.2 Access Geometry

Driveways shall meet adjacent streets, alleys, or driveways at a ninety degree angle and remain perpendicular for a minimum of 10 feet from the intersection. Driveways shall have a minimum inside turning radius of 26 feet and outside radius of 38 feet for fire department access, unless an alternate fire access is provided.

5.10.8.3 Access Surfacing

All accesses shall be paved. Pavement placement shall occur prior to issuance of certificate of occupancy or sooner if required to meet Fire Department or utility requirements. All accesses serving more than four units or lots shall be maintained in proper working condition to prevent potholes and overall surface deterioration. All access and parking areas shall be paved with asphalt, concrete, recycled asphalt, or other all-weather drivable surface approved by the Town Engineer. Access flexible pavement sections shall match the roadway pavement section for a minimum of 10 feet from the edge of the traveled way. Concrete accesses shall either terminate 4 feet from the edge of asphalt on Public Streets with a 3-inch thick minimum asphalt apron constructed between the concrete access and the public street., or concrete can be placed to the edge of asphalt if it is even with or 1 inch lower than the top of asphalt and an expansion joint is provided between the asphalt/concrete interface.

Asphalt pavement shall be a minimum of 3” asphalt on 4” aggregate base course between the roadway and edge of right of way.

5.10.8.4 Access Drainage

Any access connecting to a road with curb and gutter or valley pans shall have a concrete cross-pan installed across the driveway. Any access connecting to a road with an existing road side ditch shall have an 18 inch culvert installed beneath the driveway. The roadside ditch shall be re-graded as needed from the ends of the culvert until the ditch daylights at a 1% slope. Where an access is added to the downhill side of a road and there is no curb, valley pans, or ditches on the existing road, the access may be exempted from the cross pan and culvert requirement.

5.10.9 Access Maintenance

An access does not typically require an encroachment license in the right-of-way. The access and all associated improvements (pavement, culvert, cross pan, flared end sections) shall not be owned or maintained by the Town. All ownership, maintenance, and replacement work shall be the responsibility of the owner. The Town is not liable for any damage incurred by the Town or others to driveway improvements within the right-of-way. The Town shall not be responsible for any damage caused by snow removal, Town vehicles, maintenance, or any other causes. The Town shall have the right to work on the access improvements within the right-of-way as required, such as clearing sediment from culverts and connecting to the access pavement when re-paving the public road, but the Town shall be under no obligation to complete any repair or maintenance.

5.11 PARKING AREAS (ON-STREET PARKING WITHIN RIGHT-OF-WAY)

Section 5.11 sets minimum standards for on-street parking. See Chapter 3 of Title 9 of the Town Code for off-street parking requirements.

On-Street Parking shall be provided as shown within the street classification cross sections. On-street parking may be provided along streets when approved as part of the Development permit approval. All eligible on-street parking areas shall be clearly depicted on a plan. Such parking areas shall not conflict with any turning movements or obstruct access to any street, sidewalk, crosswalk, alley, access, or fire hydrant.

5.11.1 Parking Area Surfacing

All parking areas shall be paved with asphalt, concrete, recycled asphalt, or other all-weather drivable surface approved by the Town Engineer.

5.11.2 Parking Grades

Parking areas shall have a maximum grade of 4% and a minimum grade of 1%. ADA parking spaces shall have a maximum grade of 2% in any direction.

5.11.3 Parking Stall Requirements

Minimum parking stall size requirements are described below. Parking shall not encroach onto sidewalk, bike lanes, or other pedestrian facilities.

1. The minimum stall size shall be 18 feet long by 9 feet wide for 90 degree or angled parking. Actual striping dimensions shall be adjusted for angled parking to fit the minimum stall size.
2. Parallel parking: 25 feet long by 8 feet wide. Parallel parking stall at the end of a block may be reduced to 20 feet. Accessible parallel parking spaces shall be located near a curb ramp and shall be in an area that is not obstructed by trees or other objects behind the curb.
3. Accessible parking: 18 feet long by 8 feet wide, with a 5- to 8-foot accessibility lane (8 feet is required for van parking). An ADA accessible route shall be provided from the accessible stalls to the businesses being served or the nearest pedestrian route. ADA parking space location, frequency, slopes, and other requirements shall meet PROWAG standards.

5.11.4 Parking Construction Requirements

Construction of on street parking shall meet all standards and specifications of the adjacent street, including pavement thickness, compaction, and other construction specifications. See Chapter 9 of these standards for additional construction requirements.

5.12 PEDESTRIAN AND BICYCLE FACILITIES

Increasing congestion and mode conflict is accompanied by growing public awareness of the need of safe and convenient multi-modal facilities to promote alternative transportation and healthy lifestyles. This section provides for the design of pedestrian, bicycle and transit facilities that play a key role in providing improved accessibility, mobility, and transportation system continuity.

This section shall be used in combination with the AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities, AASHTO Guide for the Development of Bicycle Facilities, CDOT Roadway Design Guide (Chapters 12 and 14), Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG), and ADA Accessibility Guidelines (ADAAG) for the design and installation of all pedestrian and bicycle facilities. Where no requirement is given, the current edition of the design standards listed above shall govern.

Section 5.12 applies to both public and private streets. Internal circulation (outside of right-of-way or private street) for individual single family homes or duplexes, and other private development, as determined by the Town Engineer, may be exempted from the requirements of 5.12.

5.12.1 Pedestrian Facilities

All local, minor collector, and major collector roads shall have a minimum of one sidewalk. Town Engineer may require additional sidewalks, shared use paths, and other pedestrian facilities. Sidewalks and other pedestrian facilities shall be installed per the Town's Sidewalk Master Plan, these standards, and as determined by the Town Engineer.

5.12.1.1 Pedestrian Environmental Impact

Sidewalks shall be designed to fit the existing topography and vegetation and minimize site disturbance, removal of vegetation, and disturbance to sensitive environmental areas.

5.12.1.2 Pedestrian Facility Widths

Sidewalks shall be a minimum of 5 feet wide for local roads. Major and minor collector pedestrian facilities shall be a minimum of 6 feet wide.

Soft surface trails intended for ADA accessibility shall have a minimum width of 4 feet wide.

5.12.1.3 Pedestrian Pavement Thickness

Concrete sidewalks shall be a minimum of 5 inches thick. Sidewalks within a driveway shall be a minimum of 6 inches thick and reinforced with welded wire reinforcement. Sidewalks crossing a driveway with heavy commercial loading shall be a minimum of 8 inches thick. All concrete sidewalk pavement shall be placed on a minimum thickness of a 4 inch aggregate base course layer.

5.12.1.4 Horizontal and Vertical Clearance

Sidewalk vertical clearance shall be a minimum of 8 feet. Sidewalk horizontal clearance shall be 3 feet preferred and 2 feet minimum. No structures or other objects shall extend into the clearance offsets.

5.12.1.5 Sidewalk Widening

When a sidewalk is required to be widened, the widening must be a minimum width of 4 feet or more. If the required added width is less than 4 feet, the existing sidewalk shall be removed and reconstructed to the required width.

5.12.1.6 Slope

The minimum cross slope of a sidewalk is 1% and the maximum cross slope is 2%, measured perpendicular to the sidewalk or path alignment. The cross-slope shall generally be towards the roadway, unless drainage facilities are provided behind the sidewalk. The maximum running slope for sidewalk not aligned with a roadway is 5%. If the sidewalk is aligned with the roadway, the sidewalk may match the slope of the roadway. See Section 5.13 of this chapter for ADA requirements of sidewalks and curb ramps. Sidewalks shall be accessible and shall have directional curb ramps.

5.12.1.7 Sidewalk Shouldering

Sidewalks shall have a compacted aggregate base course shoulder of 1-foot minimum width. The shoulder shall be sloped at a minimum of 1% away from the sidewalk. Landscaping may extend to the edge of the sidewalk only if the area is graded at 1%, grass or plantings are selected that do not cause maintenance issues, and the landscaping does not extend horizontally into the landscaping. Short grasses are typically the only landscaping allowed in the shoulder area.

5.12.1.8 Sidewalk Stormwater

Sidewalk shall be designed to handle runoff and provide positive drainage away from the sidewalk, typically towards the roadway. Obstructions shall not be placed at the edge of the sidewalk which obstruct stormwater flow. Low points in the sidewalk should be avoided to the extent possible due to ponding and freezing conditions in the winter.

5.12.1.9 Sidewalk Alignment

Standalone sidewalks and trail connections are encouraged in developments where their additions provide a shorter connection for pedestrians. Sidewalk alignments shall strive to provide the shortest distances between locations in order to promote efficiency of pedestrian transportation and to prevent pedestrians from walking outside the sidewalks.

5.12.1.10 Heated Sidewalks

This section only applies to heated sidewalks located within the Town right-of-way. For private snow melt systems, see Section 5.19.2 of this chapter and section 9-1-19-33A and 33R of the Town Code. Heated sidewalks located within Town right-of-way shall be designed by a Colorado licensed Professional Engineer. Heated sidewalks shall be designed with the following requirements:

- Snowmelt systems shall be hydronic snowmelt systems designed to produce a minimum of 125 BTU/SF and hydronic tubing loops shall be a maximum of 300 linear feet, unless an alternate design of acceptable performance is submitted by a Professional Engineer.
- Manifolds shall be located in traffic rated boxes placed outside of the concrete pavement.
- Concrete shall be a minimum of 5” thick.
- High PSI (60 psi) board insulation shall be placed beneath sidewalks which do not receive heavy traffic loads. In areas are expected to experience heavy truck traffic, astrofoil or other non-compressible insulation shall be placed beneath pavement.
- Welded wire mesh or other reinforcement shall be installed in traffic areas.
- Cold joints, where heated pavement meets non-heated pavement, shall be filled with backer rod and sealant to limit moisture infiltration.

- Heated pavement shall be doweled or connected by other means to non-heated pavement to minimize differential settlement and prevent trip hazards. Doweling is not required adjacent to curb, buildings, walls, or other locations that are not within the pedestrian path.
- Heated pavement shall be graded with a cross-slope and shall not drain onto non-heated pavement, creating any icing or safety hazards. Drainage shall be directed to an inlet, swale, drywell, or other approved connection point.

5.12.1.11 Trail Connections

Soft surface trail connections are encouraged and shall be installed per the Breckenridge Open Space and Trails Master Plan and as required by the Town Engineer. Soft surface trails provide connections to existing trails, open spaces, parks, and other community destinations for pedestrians, bicyclists, and other non-motorized uses. Soft surface trails shall be designed and installed to limit grading impacts, tree removals, and other disturbance. Additional design and install details shall be coordinated and approved by the Town of Breckenridge Open Space and Trails Division.

5.12.1.12 Pedestrian Bridges

Pedestrian bridges shall be a minimum width of 8 feet. Pedestrian bridges on the Blue River Rec Path shall be a minimum of 14 feet. Pedestrian railings shall be provided along bridges. See Chapter 6 for hydrologic requirements of pedestrian bridges. Pedestrian bridges on the Blue River Rec Path or bridges being maintained by the Town shall be designed to accommodate a 20 TON design vehicle. All pedestrian bridges shall be designed for the snow loads per Breckenridge Building Code. See Open Space and Trail standards for bridge requirements serving soft surface trails.

5.12.1.13 Pedestrian Railings

Hazards located near a sidewalk shall require a pedestrian railing or other barrier at the edge of the path. Examples of hazards include 2:1 slopes and vertical drops exceeding 30 inches.

5.12.1.14 Pedestrian Easements

All pedestrian facilities and trails not located within ROW shall be located within an access easement. Pedestrian facilities and trails shall have a 5-foot minimum distance from back of sidewalk/trail to edge of ROW/easement to accommodate drainage, signage, lighting, and utilities.

5.12.2 Bicycle & Shared-use Facilities

Bicycle & Shared-use facilities shall be installed per the Breckenridge Open Space and Trails Master Plan, Sidewalk Master Plan, and by the direction of the Town Engineer, and any other applicable requirements. Bicycle facility design shall follow the AASHTO Guide for the Development of Bicycle Facilities, current edition and the CDOT Roadway Design Guide for Bicycle and Pedestrian Facilities. Sight distance, vertical geometry, and horizontal geometry shall meet the requirements of AASHTO and CDOT.

For this chapter, the term shared-use will apply to both shared-use facilities and bicycle facilities.

5.12.2.1 Shared-use Environmental Impact

Shared-use paths shall be designed to fit the existing topography and vegetation and minimize site disturbance, removal of vegetation, and disturbance to sensitive environmental areas.

5.12.2.2 Design Speed

The design speed for shared-use paths on grades of 4% or less shall be 20 mph. The design speed for sections of shared use-paths exceeding 4% shall be 30 mph. For shared-use paths near

intersections, underpasses, or other hazards where traffic calming is warranted, a lower design speed may be submitted to the Town Engineer for approval.

5.12.2.3 Shared-use Facility Widths

Shared use paths shall be at least 10 feet wide; the Blue River Recreation Path shall be at least 14 feet wide. Underpass widths shall be at least 14 feet wide.

5.12.2.4 Shared-use Pavement Thickness

Concrete shared-use paths shall be a minimum of 5 inches thick. Shared-use paths within a driveway shall be a minimum of 6 inches thick and reinforced with welded wire reinforcement. Shared-use paths crossing a driveway with heavy commercial loading shall be a minimum of 8 inches thick. Longitudinal joints in the concrete shall not be allowed in shared use paths. Transverse joints shall be sawcut and shall not be tooled.

Asphalt pavement for shared-use paths shall be a minimum of 3 inches thick and placed in two lifts. Asphalt shared-use paths within a driveway shall be a minimum of 4 inches thick.

All concrete sidewalk pavement shall be placed on a minimum thickness of a 4 inch aggregate base course layer.

Concrete and asphalt pavements for shared use paths shall be designed by a professional engineer licensed in the state of Colorado.

5.12.2.5 Shared-use Horizontal and Vertical Clearance

Shared-use paths shall have a minimum vertical clearance of 10 feet. Shared-use paths shall have a minimum horizontal clearance of 3 feet from the edge of pavement. No structures or other objects shall extend into the clearance offsets.

5.12.2.6 Shared-use Widening

When a shared-use path is to be widened or a pavement cut is planned, the full width of pavement shall be removed and replaced. No longitudinal joints will be allowed in concrete or asphalt shared-use paths.

5.12.2.7 Shared-use Slope

The minimum cross slope of a shared-use path is 1% and the maximum cross slope is 2%. The maximum running slope for a shared-use path not aligned with a roadway is 5%. If the shared-use path is aligned with the roadway, the sidewalk may match the slope of the roadway. See Section 5.13 of this chapter for ADA requirements of curb ramps. Shared-use paths shall be accessible and shall have directional curb ramps.

5.12.2.8 Shared-use Shouldering

Shared-use paths shall have a compacted shoulder with a minimum width of 2 feet wide. The shoulder shall be sloped at a minimum of 1% and a maximum of 16% away from the shared-use path.

5.12.2.9 Shared-use Stormwater

Shared-use path design shall consider runoff and provide positive drainage away from the path. Obstructions shall not be placed at the edge of the path which obstructs stormwater flow. Low points in the path should be avoided to the extent possible due to ponding and freezing conditions in the winter.

5.12.2.10 Shared-use Alignment

Standalone shared-use paths and trail connections are encouraged in developments where their additions provide a shorter connection for pedestrians. Shared-use alignments shall strive to provide the shortest distances between locations in order to promote efficiency of pedestrian transportation and to prevent pedestrians from walking outside the sidewalks.

5.12.2.11 Shared-use Bridges

Shared-use bridges shall be a minimum width of 10 feet. Bridges on the Blue River Rec Path shall be a minimum width of 14 feet. Pedestrian railings shall be provided along bridges. See Chapter 6 for hydrologic requirements of pedestrian bridges.

5.12.2.12 Shared-use Railings

Hazards located within the clear zone of the shared-use path shall require a pedestrian railing or other barrier at the edge of the path. Examples of hazards include 2:1 slopes, vertical drops exceeding 30 inches, and structures in the clear zone.

5.12.2.13 Shared-use Easements

All shared-use facilities and trails not located within ROW shall be located within an access easement. Pedestrian facilities and trails shall have a 5-foot minimum distance from back of shared-use path/trail to edge of ROW/easement to accommodate drainage, signage, lighting, and utilities.

Where outside of the ROW, the bicycle facility shall be in a public access easement of sufficient width to allow for repairs to the facility, accommodate any drainage, and allow for installation of any required signs.

All arterial and collector street cross sections include bike lanes on both sides of the street or a shared use path. The minimum width of the bike lanes is 5 feet.

Bicycle lanes on streets without on-street parking shall be at least 5 feet wide, exclusive of the curb pan, or 6.5’ 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 width of the bicycle lane may be reduced to at least 5 feet wide, inclusive of the curb pan. Bicycle lanes on streets with on-street parking shall be at least 5 feet wide, exclusive of the parking lane, or 13 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 width of the bicycle lane may be reduced to at least 4 feet wide, exclusive of the parking lane, or 12 feet from the face of any curb.

5.13 ACCESSIBLE PEDESTRIAN DESIGN

Curb Ramps on sidewalks shall be designed to comply with *Public Rights-of-Way Accessibility Guidelines* including detectable warnings. Where feasible separate ramps shall be provided for each crossing direction. Where site constraints prohibit separate ramps, a single multidirectional ramp may be used. Refer to *CDOT M & S Standard Plans* for ramp details. The standard detectable warning shall be cast iron, natural finish plates or approved equal.

5.13.1 ADA Accessibility Requirements, Standards, and Guidelines

The ADAAG and the PROWAG are not requirements of the ADA but serve as the standards and guidelines by which compliance of the law is measured. Generally, the ADA law requires:

1. New construction to be accessible

2. Alterations to existing facilities that are within the scope of a project to provide accessibility to the maximum extent feasible
3. Existing facilities that have not been altered shall not deny access to persons with disabilities

All new construction projects where a pedestrian demand is exhibited shall incorporate appropriate pedestrian facilities that are accessible to persons with disabilities. New construction projects have the ability to mitigate constraints through good planning and design practices. Project budget or limited scopes are not an acceptable reason to fail to provide compliant accessible facilities during new construction.

5.13.2 Technical Requirements for Accessible Design

The pedestrian access route (PAR) is a continuous and unobstructed path of travel provided for pedestrians with disabilities within or coinciding with a pedestrian circulation path.

The continuous width of the PAR shall be 5 feet minimum, exclusive of the curb. Where a pedestrian access route makes a 90-degree turn, it should be widened to 5 feet to accommodate the continuous passage of a wheelchair (i.e. pedestrian design vehicle). If the clear width of the PAR is less than 5 feet, passing spaces shall be provided at a maximum of 200-foot intervals. If passing spaces are provided, they shall be 5 feet by 5 feet minimum. The clear width of a pedestrian refuge island shall be 5 feet minimum.

Pedestrian facilities shall have a maximum running slope of 5%. If the grade of the roadway is steeper than 5%, then running slopes are permitted to match the grade of the roadway.

Pinch points should generally be avoided. Pinch points within the PAR shall not be less than 34 inches in width and not exceed 24 inches in the direction of pedestrian travel.

5.13.3 Curb Ramp Types

See the Street Standard Details for approved curb ramp types.

5.13.4 Curb Ramp Technical Requirements

5.13.4.1 Ramps

Curb ramps shall have a maximum running slope of 8.33%. The running slope of a curb ramp is measured in the center of the ramp run in the direction of pedestrian travel. If the surrounding terrain requires a ramp to chase grade, the ramp is required to be no longer than 15 feet, regardless of the resulting slope.

5.13.4.2 Landings and Turning Spaces

Landings and turning spaces allow users to maneuver on and off the curb ramp and are required at the top or bottom of a curb ramp. Turning spaces are required at the top of a perpendicular curb ramp and at the bottom of a parallel curb ramp. The maximum running slope and cross slope of landings and turning spaces shall be 2.0%. At mid-block crossings or locations without yield or stop control, the cross slope of the turning space can equal the street or highway grade. Turning spaces shall be 4 feet by 4 feet minimum. If the turning space is constrained by a vertical element on one or more sides, provide 5 feet in the direction of the street crossing.

When the profile of the roadway being crossed has an excessive slope, the curb ramp cross slope should be transitioned slowly to the turning space. The transition shall be spread evenly over the length of the curb ramp. See Curb Ramp Standard Details.

5.13.4.3 Cross Slopes

Cross slopes of all pedestrian facilities shall be a minimum of 1% and shall not exceed 2%.

5.13.5 Detectable Warning Surfaces

Detectable warning surfaces shall be made of untreated steel plates. Brick pavers are not permitted for detectable warnings. See CDOT M-Standards for Curb Ramps for detectable warning requirements.

5.13.6 Pedestrian Crossings at Controlled Intersections

Refer to Section 5.10 for Pedestrian Crossings at uncontrolled or mid-block crossings.

5.13.6.1 Signalized Intersection Crossing Controls

If an intersection under signal control has sidewalks, then marked crosswalks should be provided. In urbanized areas pedestrian signals are recommended at all intersections where sidewalks are provided on the approaches to a signalized intersection. STOP lines shall be placed a minimum of 4 feet in advance of the crosswalks. Consideration may be given to providing advance right turn STOP lines to improve the visibility of pedestrians coming from the motorist's left.

Pedestrian push buttons shall be accessible to pedestrians via an accessible pedestrian route in compliance with the ADA.

The draft PROWAG requires that whenever pedestrian signals are installed, accessible pedestrian push buttons be installed. Push buttons shall be connected to a fully-accessible pedestrian signal that complies with the *2009 MUTCD with amendments,* with the ability to enable or disable accessible features*.* The Town Engineer will decide on which functions to activate at each accessible pedestrian crossing on a case-by-case basis.

At intersections with high volumes of pedestrians, consideration should be given to restricting the right turn on red movement.

5.13.6.2 Stop and Yield Crossing Controls

At a minimum, marked crosswalks should be provided wherever a sidewalk crosses a street under stop or yield control. STOP or YIELD lines shall be placed a minimum of 4 feet in advance of the crosswalks.

5.13.6.3 Roundabout Crossing Controls

Requirements for roundabout crossings shall reference the latest version of *NCHRP Report 672 – Roundabouts: An Informational Guide* and the PROWAG.

5.13.7 ADA Curb Ramp Variance Process

It can be impractical to make facilities fully compliant with the standards due to existing site constraints. Improvements at locations can be deemed "Technically Infeasible" when sound engineering judgement is exercised. When full compliance is deemed technically infeasible, facilities being altered should be made accessible to the maximum extent practicable. If a site cannot meet accessibility standards, the proper documentation procedures should be followed.

Examples of site constraints that may make it technically infeasible to make a facility fully compliant include:

1. Adjacent development or buildings that would need to be moved or altered to make a facility fully compliant.
2. Required improvements that would alter the status of a Historic property.
3. Drainage that could not be maintained if an area is made fully accessible.
4. Underlying terrain that would require significant expansion of the project scope to achieve full compliance. An example would be altering a roadway profile to make the cross slope of a crosswalk fully compliant.

Project scope, not cost, should determine when existing constraints make an item technically infeasible.

To submit a curb ramp variance, the Town's Variance Request Form must be completed and signed by a licensed professional engineer documenting why the curb ramp was deemed technically infeasible and every effort was made to design the curb ramp to meet ADA compliance. The request will be reviewed by the Town Engineer, and once approved, will be filed with the Town in the instance that an ADA complaint is received by the Town.

5.14 PEDESTRIAN CROSSING CRITERIA FOR UNCONTROLLED OR MID-BLOCK CROSSINGS

The purpose of Section 5.14 is to serve as a policy to determine where uncontrolled pedestrian crossings should be located, and how to improve existing uncontrolled pedestrian street crossings within the Town.

5.14.1 Definitions

Uncontrolled pedestrian crossings are defined as:

1. Legal crossings that are located at an intersection without a traffic signal
2. Legal crossings without STOP or YIELD signs.

Mid-block crossings are defined as crossings that do not occur at an intersection and are marked to indicate that the location is a legal crossing.

Crossings can be marked with traffic control markings or unmarked with no traffic control markings present.

5.14.2 References

The newest versions of the following references shall be used for guidance in determining location, design elements, and requirements:

1. *The Manual on Uniform Traffic Control Devices 2009 Edition* including Revisions 1 and 2.
2. *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations (FHWA, 2018)*.
3. *NCHRP Research Report 841 Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments (2017).*
4. *Evaluation of R1-6 Gateway Treatment Alternatives for Pedestrian Crossings: Follow-Up Report (Roadway Safety Institute, 2017).*
5. *TCRP Report 112 / NCHRP Report 562 Improving Pedestrian Safety at Unsignalized Crossings (2006).*
6. *CDOT Roadway Design Guide, Chapter 14 (2018)*

7. *CDOT Standard Plan S-614-14 for Rectangular Rapid Flashing Beacon requirements (hard-wired only)*

References listed above can be utilized in instances where this document does not specifically include requirements or guidance on a particular topic.

5.14.3 Pedestrian Traffic Analysis and Recommendations

An engineering study should be performed at the discretion of the Town Engineer before a crosswalk is installed at a location away from a traffic signal or an approach controlled by a STOP or YIELD sign. If a pedestrian crossing is part of a development application, then a traffic study may also be required as described in Chapter 4 and the traffic studies may be combined. The engineering study shall be stamped by a professional engineer. The following steps are required as part of the Pedestrian Traffic Analysis:

1. Complete the worksheet shown in Table 5.12. If worksheet result is yes, proceed with developing the Pedestrian Traffic Analysis. If the worksheet result is no, no additional analysis is required.
2. Include number of lanes, presence of a median, distance from adjacent signalized intersections, average daily traffic (ADT), posted or statutory speed limit (85th-percentile or mean speed), crash history, geometry of the location, possible consolidation of multiple crossing points, availability of street lighting, and any other factors deemed appropriate by engineering judgement.
3. Provide pedestrian volumes and delays (see Section 5.10.3.1)
4. Crossing treatment recommendations based on criteria and sound engineering judgement (see Section 5.10.3.2)
5. Conclusion of results.

5.14.3.1 Pedestrian Volumes and Delays

Pedestrian volumes and delays will typically involve AM, mid-day, and PM peak hours. Locations near schools may only require two hours of data collection (AM and PM peak hours corresponding to school opening and closing times). All pedestrian volumes should include and differentiate between pedestrians and bicyclists and should note separately the number of young, elderly, and/or disabled pedestrians. For locations where school crossing traffic is anticipated, the volume of student pedestrians (school age pedestrians on their way to/from school) should also be separately noted.

Whenever possible, pedestrian and bicycle volumes should be collected in the appropriate season when volumes may be close to or at their peak. Counts should be scheduled at a time when nearby businesses are open. If school traffic is an issue, the counts should be scheduled on school days when classes are in session. Given the potential fluctuation in pedestrian traffic from day to day, it may be necessary to collect up to three days of data to determine if an enhanced pedestrian crossing treatment is warranted as follows:

1. Collect pedestrian data on day one. If the minimum pedestrian volume threshold (20 pedestrians per hour accounting for a 1.33 multiplier used if vulnerable populations are present) is exceeded, no further pedestrian data collection is needed. If the threshold has not been exceeded, but at least 50% of the minimum pedestrian volume was observed, proceed to a second day of data collection.
2. Collect pedestrian data on day two. If the minimum pedestrian volume threshold is exceeded, no further pedestrian data collection is needed. If the threshold has not been met but again the volume is at least 50% of the minimum threshold, proceed to a third day of data collection.

3. Collect pedestrian data on day three. If the minimum pedestrian volume still has not been met, then no marked pedestrian crossing treatment is warranted by pedestrian crossing volume.

Pedestrian delays should be measured using procedures from the latest version of the Highway Capacity Manual.

5.14.3.2 Crossing Treatment Criteria

The following criteria shall be used in determining if crossing treatments are to be considered and shall be used to complete the worksheet shown in Table 5.12. If a crossing treatment should be considered, Section 5.10.5 shall be used to determine what type(s) of treatment is/are appropriate.

5.14.3.2.1 Criterion A

When vehicle volume is less than 5,000 vehicles per day or the average vehicle speed does not exceed 10 mph over the posted speed, crosswalk enhancements will be considered when there is a crossing pedestrian volume of at least 20 pedestrians per hour. When vehicle volume is greater than or equal to 5,000 vehicles per day or the average vehicle speed is 10 mph greater than the posted speed limit, crosswalk enhancements will be considered when there is a crossing pedestrian volume of at least 10 pedestrians per hour. A multiplication factor of 1.33 can be applied to the hour pedestrian volume if the volume consists of vulnerable populations (children, elderly, persons with disabilities, etc.). See lines (1) through (3) of Table 5.12.

5.14.3.2.2 Criterion B

Crosswalks enhancements will be considered when they could directly service or are adjacent to an existing shared-use path or trail, park, school, hospital, senior center, recreation center, library, or other facility with sensitive populations as determined by the Town Engineer. The minimum hourly pedestrian volume criterion may be waived if this criterion is satisfied. See line (4) of Table 5.12.

5.14.3.2.3 Criterion C

Crosswalk enhancements will be considered in locations where there are greater than 1 non-motorized (vehicle to pedestrian or vehicle to bicycle) crashes within the last 3 years. The minimum hourly pedestrian volume criterion may be waived if this criterion is satisfied. See line (5) of Table 5.12.

5.14.3.2.4 Criterion D

If criterion A, B, or C is met, the location must then also meet the following criteria:

1. The minimum stopping sight distance is available and free from obstructions. The minimum stopping sight distance shall be calculated using intersection sight distance per Section 5.6.1.5.
2. The crossing should match the grade of the existing roadway. More detail regarding maximum roadway grade can be found in Section 5.4.3.2.
3. The distance to the nearest existing marked or controlled crosswalk is at least 300 feet. If an existing marked or controlled crosswalk is within 300 feet, care should be given to direct pedestrian traffic to said crosswalk.
4. The existing roadway shall have a maximum slope of 6% in the downhill direction for a minimum distance of 200 feet. If the slope exceeds 6%, a crossing will not be allowed or the road must be re-graded to reduce the slope.

See lines (6) through (9) of Table 5.12.

5.14.4 Crossing Enhancement Eligibility Worksheet

The following table shall be used to determine if an uncontrolled or mid-block crossing is eligible for enhancement. A blank version of this worksheet can be found in Appendix E to assist with documentation of location decisions at the discretion of the Town Engineer.

Table 5.12 Crossing Enhancement Eligibility Worksheet

Criterion	Line	Criteria	Value	Eligibility Requirement
A	(1)	Average daily vehicle traffic	#	*See (5)*
	(2)	Mean vehicle speed differential from posted speed limit	#	*See (5)*
	(3)	Number of pedestrians per hour	#	*See (5)*
	(4)	Does the location serve a vulnerable population (children, elderly, persons with disabilities, etc.)?	Yes/No	*See (5)*
	(5)	Adjusted number of pedestrians per hour	#	*If (4) is Yes, then value = (3)*1.33, otherwise value = (3)* *Eligibility Requirement: When (1) < 5,000 or (2) < 10, then ≥ 20* *When (1) ≥ 5,000 or (2) ≥ 10, then ≥ 10*
B	(6)	Does the location directly serve or is adjacent to one of the following: Existing shared-use path or trail; park; school; hospital; senior center; recreation center; library?	Yes/No	*If Yes, then (5) eligibility requirement is waived*
C	(7)	Number of non-motorized crashes in the last three years	#	*If ≥6, then (5) eligibility requirement is waived*
D	(8)	Is the minimum stopping sight distance available (see Section 5.6.1.5)?	Yes/No	*Eligibility Requirement: Yes*
	(9)	Will the crossing match the existing roadway grade or less?	Yes/No	*Eligibility Requirement: Yes, cannot be greater*
	(10)	Distance to nearest existing marked or controlled crossing (feet)	#	*Eligibility Requirement ≥300'*
	(11)	Is the maximum grade of the roadway 6% or less in the downhill direction for a minimum 200' distance?	Yes/No	*Eligibility Requirement: Yes, or the road can be re-graded to meet*
	(12)	**Eligible for Treatment?**	**Yes/No**	*Yes = Criterion A, B, or C is met and Criterion D is met*

If eligible for treatment, see Section 5.10.5 for applicable crosswalk enhancements.

5.14.5 Pedestrian Crossing Enhancements

Once a determination has been made that a pedestrian crossing enhancement is recommended at a particular location, several design treatments can be considered.

Roadway traffic calming treatments should be considered in conjunction with pedestrian crossing enhancements as a means to enhance the effectiveness of one another. See Section 5.6 for more information on traffic calming treatments.

5.14.5.1 Pavement Markings and Conventional Signs

NCHRP Research Report 841 Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments (2017) states, “Recent research has found no safety benefit associated with various types of crosswalk markings, and the inappropriate use of marked crosswalks alone (without other substantial safety measures) can increase crash risk for pedestrians.” This shall be considered when choosing to implement crosswalk markings at uncontrolled intersections or mid-block locations.

5.14.5.1.1 Standard Continental Crosswalk Markings

Standard continental crosswalk markings are pavement markings rectangular in shape. They shall be a minimum of 6 feet long and 1 to 2 feet wide. The alignment of the markings shall connect the curb ramps and be oriented so that they are parallel with the direction of travel. Markings shall be recessed into the pavement placed so that they avoid the anticipated vehicle wheel path to improve longevity of the markings. They can be spaced 1 to 5 feet apart. Crosswalk markings are to be used in conjunction with appropriate signing as defined in this section, because research shows that markings alone do not improve pedestrian crash rates. Decorative crosswalk markings are not recommended. Crosswalk markings shall be made retroreflective with glass beads or other approved methods. See Chapter 9 for construction requirements.

5.14.5.1.2 High Visibility Markings

High Visibility Markings are wider pavement markings that can be applied in the area of a crossing if the area is unlit and peak pedestrian traffic volumes occur during unlit times.

5.14.5.1.3 Advanced Yield or Stop Markings and Signs

Advanced yield or stop markings and signs may be used in conjunction with a crosswalk marking on major collector roadways with speeds of 40 mph and where placement of advanced markings and signs does not conflict with other intersections or traffic control. Refer to Section 3B.16 of the MUTCD for further standards and guidance.

5.14.5.1.4 Pedestrian Sign Assembly

The following list includes pedestrian signing options that should be utilized in combination with pedestrian markings listed in section

1. Pedestrian Crossing Sign Assembly (W11-2 with W16-7P) - shall be used in combination with crosswalk marking treatment. Sign structure shall be mounted at the roadside in accordance with MUTCD 2C.50.
2. Yield/Stop Here for Pedestrians Signs (R1-5) - may be used in conjunction with a crosswalk marking, advanced yield or stop markings, and a typical pedestrian crossing sign assembly on roadways with multiple lanes. Refer to Section 2B.11 of the MUTCD for further standards and guidance.
3. In-Street Pedestrian Crossing Signs (R1-6) - may be used when pedestrian crossing volumes are greater or equal to 20 pedestrians per hour OR when the mean vehicle speed at the crossing location is 5 mph greater than the posted speed limit. This treatment shall be used in conjunction with a crosswalk marking, a pedestrian crossing sign assembly, and a roadway centerline marking.

5.14.5.2 Physical Geometric Treatments

The following physical roadway geometric treatments can be considered to provide additional crossing safety and visibility as approved by the Town Engineer. Refer to the Town of Breckenridge's *Traffic Calming Policy* for additional treatment information regarding coordination and design considerations.

5.14.5.2.1 Refuge Islands

Refuge islands provide a space in the center of the traveled way for pedestrians to rest as they wait to cross each direction of vehicular travel independently. Refuge islands should be considered at pedestrian crossing locations on roads where one or both directions of travel are high volume, and see the most benefit with four or more lanes of traffic and speeds of 35 mph or greater. They can be paired with additional crossing enhancements provided in this section. Refuge islands shall be a minimum 10 feet wide from back of curb to back of curb. They shall be designed to allow for positive drainage and for adequate snow removal around the island and be ADA compliant. If the installation of a refuge island requires a shift in the traveled way, appropriate lane transition rates shall apply for the redirection of traffic around the island. Delineation markers may be required for snow removal activities.

5.14.5.2.2 Curb Extensions (Bulb-Outs)

Curb extensions extend the pedestrian sidewalk and curb out into the shoulder or parking lane of the roadway to reduce the crossing distance. This reduces the amount of time that pedestrians need to cross the traveled way, and provide additional space for curb ramps. They also can assist in reducing speeds of vehicular traffic. Curb extensions should allow for a minimum 11-foot travel lane. Curb extensions shall be designed to allow for positive drainage and for adequate snow removal around the extension. Delineation markers may be required for snow removal activities.

5.14.5.2.3 Raised Crosswalks

Raised crosswalks are ramped speed tables placed at mid-block crossing locations that assist with driver visibility of pedestrian crossings. They also provide traffic calming benefits. Raised crosswalks shall be flush with the sidewalk it is connecting on either side of the crossing, and shall be a minimum of 10 feet wide. They can be considered on minor collector and local roadways with a speed of 30 mph or less. Raised crosswalks shall generally be 6" tall, wings shall be 8% max, cross slopes shall be 2% maximum and meet ADA requirements, and storm sewer inlets shall be installed on the uphill side of the crosswalk. Raised crosswalks shall be designed to allow for positive drainage, and noise considerations should be made prior to proposing a location. Delineation markers may be required for snow removal activities.

5.14.5.3 Rectangular Rapid Flashing Beacon (RRFB)

RRFBs should be used sparingly and are typically only installed when other crossing enhancements have proven ineffective. An RRFB may be installed when all of the following criteria are met:

1. Marking and signing enhancements in Section 5.10.5.1 have been implemented but a perceived or actual pedestrian/vehicle conflict issue still persists
2. Pedestrian crossing volumes are between 60 and 160 pedestrians per hour
3. Crosswalk length from curb to curb is greater than 32 feet.
4. Roadway speeds are between 30 mph and 45 mph, or mean vehicle speed at the crossing location is 5 mph greater than the posted speed limit.
5. Roadway volume is greater than 6,700 vehicles per day.

The RRFB treatment is a combination of signing, markings and pedestrian activated strobe and feedback devices at uncontrolled pedestrian crossings. Refer to CDOT Standard Plan S-614-14 for requirements. RRFBs shall be hard-wired. Solar is not permitted. Signing for the RRFB typically includes advance PEDESTRIAN WARNING signs (W11-2) with AHEAD supplemental plaques (W16-9p), and PEDESTRIAN WARNING signs (W11- 2) with down arrow supplemental plaques (W16-7p). Pavement markings include yield lines. The pedestrian activated treatments would be the W11-2 signs with built in rectangular strobe flashers. Additionally, pedestrian visible strobes and a recorded message inform pedestrians when the crossing is activated and instruct them to wait for motorists to yield. The R1-5 (YIELD HERE TO PED) shall be placed so that it does not restrict motorists' visibility of the RRFB at the crosswalk. For the placement of advance stop lines and advance warning signs, refer to the MUTCD. High visibility crosswalks are to be used with the RRFB crossing treatment. Timing of the flashing beacon should allow for pedestrians to scan for motorists, step from the side of the road and completely cross the street. Depending upon pedestrian volumes, 5 to 10 seconds should be provided for pedestrians to scan for gaps and enter the roadway. For areas with very high pedestrian volumes (more than 10 pedestrians crossing simultaneously), additional startup time should be provided. A minimum of 3.5 feet per second crossing speed should be assumed for pedestrians.

A median refuge area should be considered, refer to Section 5.10.5.2.1.

5.14.5.4 Pedestrian Hybrid Beacon

Pedestrian hybrid beacons are not generally recommended in the Town of Breckenridge. This treatment may be applied if all of the following criteria are met:

1. Warrants and guidance from Chapter 4F of the MUTCD deem a PHB may be appropriate, and
2. Written approval has been given by the Town Engineer.

5.14.5.5 Grade Separated Crossing

A grade separated crossing treatment is typically applied for roadways meeting one of the following requirements:

1. Posted speeds greater than 40 mph, crossing lengths greater than 48 feet, and average daily traffic volumes greater than 10,000 vehicles per day
2. When removing sight distance obstructions is not feasible
3. The majority of users are expected to be non-traditional pedestrians (skiers, snowboarders, bicyclists, skateboards, etc.)
4. The proposed crossing is within CDOT ROW and the pedestrian volume exceeds 60 pedestrians per hour
5. Pedestrian volumes exceed 200 pedestrians per hour.
6. An at-grade crossing is expected to cause traffic impediment along the roadway and lower the LOS of the roadway.

Within CDOT ROW, new crossings with pedestrian volumes exceeding 60 pedestrians per hour will require a grade separated crossing. If the pedestrian volume is less than 60 pedestrians per hour, the Town Engineer will review the proposed crossing and determine if an at-grade crossing will be allowed.

Prior to implementing a grade separated crossing, additional study should be performed to determine if other at-grade solutions may be preferable. Written approval from the Town Engineer is required for all grade separated crossings.

Grade separated crossings shall generally be designed for ADA compliance, include physical barriers to prevent at-grade crossing, light enhancements inside the crossing, and include pedestrian routes

entering and exiting the crossing which are intuitive and natural routes for pedestrians resulting in high compliance of use.

5.15 TRANSIT FACILITIES

Streets shall be designed to accommodate transit facilities where transit routes are identified during the development process. Transit facilities, including transit stops, waiting areas, transit shelters, and other transit improvements are encouraged and may be required as determined by the Town Engineer. Transit stops shall be located to minimize impact on through traffic, provide efficient arrival and departure for the transit vehicle, and bear a logical relationship to the population served. New transit stops and facilities shall be connected to the adjacent developments via sidewalks and trails.

Where required by the Town Engineer, transit stops shall be located where direct pedestrian access is provided from the street and adjacent sidewalk or surrounding area to the stop. Transit stops shall include a paved waiting area with a direct connection to the adjacent sidewalk. As each site is unique, the waiting area dimensions shall be determined by the Town Engineer.

Bus pull outs shall be located on the downstream side of an intersection wherever possible designed to provide a 30-foot loading area per bus and a 3:1 exiting taper. The pavement in the bus pull out lane shall be designed per a pavement evaluation report to account for the expected bus traffic; minimum concrete thickness of 10 inches shall be provided. Bus pullouts shall be per the standard detail and shall be a minimum of 10 feet wide, 40- to 60-foot long tapers with a 50-foot minimum radius and 2% cross slope.

5.16 PAVEMENT DESIGN

This section provides the criteria used for the design of pavements and will ensure adequate strength and durability to carry the predicted traffic loads for the design life of each project. The street pavement design evaluation shall be established for each project in a geotechnical report following the latest *CDOT M-E Pavement Design Manual*. The pavement design will be based on a Design Equivalent Single Axle Loads (ESAL) which is determined on average daily traffic count (ADT), vehicle classification, traffic equivalence load factors, traffic growth rate, design period, and lane factor. Private streets and accesses may be asphalt, concrete, or other impervious surface approved by the Town Engineer. Sidewalks and bus pullouts shall be concrete.

5.16.1 Soils Testing for Pavement Design

To design pavements for approval and acceptance by the Town, sampling and testing must be performed under the direct supervision of a registered Professional Engineer to evaluate the soil characteristics. Samples shall be taken at least 5 feet below proposed subgrade (10 feet on arterial roadways) at spacing of 250 feet or less, unless specified by a geotechnical engineer. Test holes shall properly evaluate all changes in soil character. Samples shall be taken at the minimum depth which will serve as subgrade for new street construction.

When joining to an existing paved street, cores of the existing pavement and base structure shall be made and analyzed to determine whether overlayment is feasible or reconstruction is necessary.

5.16.2 Flexible Pavement Design

Flexible pavements shall be designed, installed, constructed, maintained and repaired in accordance with these standards and with the latest editions of the *CDOT M-E Pavement Design Manual* and Standard Specifications for Road and Bridge Construction or the AASHTO Guide for the Design of Pavement Structures. In the event of discrepancies between these standards and the referenced publications, the more stringent shall take precedence.

A minimum of four inches of aggregate base course (ABC) shall be used as a base on roadways. If the design truck traffic is greater than 500 trucks per day, a minimum of six inches of ABC shall be used as a base. The minimum pavement thickness for all roadways shall be four inches. However, each roadway pavement section proposed in the Town shall be designed per a geotechnical report to determine actual recommended thickness and pavement mix. The minimum pavement thickness shall be per Table 5.13 below. These values only provide preliminary minimum values; the final pavement thickness shall be designed per the geotechnical report.

Table 5.13 Pavement Thickness Minimums

Street Type	Min. Asphalt Depth (Inches)	Min. Class 6 Aggregate Base Course Depth (Inches)
Private Roadway	4	4
Local	4	4
Minor Collector	5	6
Major Collector	6	6

The minimum lift thickness of flexible pavement shall be 1.5 inches and the maximum lift thickness shall be three inches.

5.16.3 Rigid Pavement Design

Rigid pavements shall be designed, installed, constructed, maintained and repaired in accordance with these standards and with the latest editions of the *CDOT M-E Pavement Design Manual* and Standard Specifications for Road and Bridge Construction or the AASHTO Guide for the Design of Pavement Structures. In the event of discrepancies between these standards and the referenced publications, the more stringent shall take precedence.

Rigid pavement shall have a minimum ABC thickness of six inches and a minimum concrete pavement thickness of seven inches.

5.17 Traffic Control Devices

Traffic control device designs shall be prepared by a Colorado licensed professional engineer experienced in traffic engineering. The designs shall be prepared in accordance with the latest version of the *Manual on Uniform Traffic Control Devices (MUTCD)*.

Striping plans are required for Collectors and Arterials, but may not be required for local subdivision streets. However, sign plans are required for all subdivisions. All signing and striping plans shall conform to the most current edition of the *MUTCD*. All traffic control devices shall be fabricated and installed in accordance with the *MUTCD*. Permanent signage and striping shall be complete and in place before any new roadway is opened to the public for use.

5.17.1 Street Name Signs

New streets in the Town of Breckenridge shall be named by the Town of Breckenridge in accordance with Town and Summit County naming procedures. The Town and County GIS Departments shall be used to ensure that each street name is unique and does not match or closely resemble another street name in the Town of Breckenridge or within Summit County.

Street name signs are required at the intersections of all public and private (serving four or more units) streets. Driveways serving three or less units may not install street name signs in the right of way.

Street name signs shall be fabricated to match existing Town of Breckenridge street signs. Color, size, font, and dimensions of the signs shall match existing Town street signs. The Town of Breckenridge Streets Department shall be consulted for street sign specifications.

5.17.2 Stop Signs

Stop signs or other traffic control devices shall be installed at the intersections of all public and private streets (access serving four or more units) and shall meet MUTCD requirements. Stop signs are not required at driveways serving three or less units.

5.17.3 Private Signage

No private signage shall be permitted within the ROW. No private signage shall be permitted on private property which attempts to direct traffic or parking. Business name signs and address signs may be installed outside of the ROW per requirements in the Town Code.

5.17.4 Public Illuminated Signage

No public illuminated signage (variable message trailers, marquee sign boards, etc.) shall have luminance levels exceeding 100 nits (100 candelas per square meter) as measured under conditions of a full white display. All signs must be extinguished completely by 10 p.m., and remain off until one (1) hour before sunrise. Additionally, the luminous/illuminated surface area of an individual sign shall not exceed 200 square feet (18.6 square meters.)

5.17.5 Signage Requests

Requests for additional signage for traffic calming, speed limit signs, children playing signs, parking signs, and other signage will be considered based on MUTCD standards, proximity to other signage, and local conditions. However, additional signage can create “signage clutter”, a term for a condition when there is too much competing signage along a street causing driver confusion, reduced effectiveness of signage, distraction, and decreased aesthetics of a street. The Town of Breckenridge approves signage at that minimum level required to provide for safe and efficient travel of vehicles of pedestrians.

All new street signage shall meet the following requirements:

1. Signage posts shall be 11 feet tall, 2-3/8” diameter, and black powder coated.
    a. Approved supplier: J & S Supply Co. or approved equal.
2. Street Name signs shall be 6” x 30” aluminum sign sheeted with 3M™ Diamond Grade™ DG³ Reflective Sheeting (4090 White). A 3M™ 7725-58 Bergundy sheeting shall go over the top to the outer edges with street name lettering cutout to show street name in white. Street name font shall be Clarendon Hv Bt. Letters, 3” tall, but height and length can be adjusted to fit the 6” x 30” sign depending on length of the street name.

5.18 STREET LIGHTING

The purpose of streetlight installations shall be to illuminate the public traveled ways to a level that provides for the safe passage of public traffic, both vehicle and pedestrian while making best efforts to preserve the night sky. Arterial and Collector streets shall require street lighting at intersections. Pedestrian lighting will be required near all sidewalks, pedestrian routes & facilities, crosswalks, parking lots and garages, and transit facilities. The frequency and amount of lighting will take into consideration the need based on the intensity of roadway and pedestrian route usage for the location. All fixtures, poles, and designs will be reviewed and approved by the Engineering Division and the power provider.

5.18.1.1 Equipment Type and Location

The Town's standard Providence Fixture or Promenade Fixture shall be installed depending on the location within the Town. The Providence Fixture is the typical fixture installed in the Town, while the Promenade fixture is typically reserved for SH 9 and critical intersections or crosswalks. The Welsbach fixture (also called a Newport fixture) is installed in various locations throughout Town however no new Welsbach (Newport) fixtures will be installed unless a variance is granted by the Town Engineer. Town owned Welsbach fixtures are planned to be replaced within five years with the Providence fixture to support dark sky initiatives and goals. The Town Engineer will determine the appropriate light fixture depending on the location of the development. Standard details for foundations, poles, fixtures, and luminaires are included in the standard details attached to Chapter 9 of these Standards.

All new fixtures shall be dark sky compliant and shall have the capability to be automatically dimmable and have individual timers in each fixture. All new street lights shall meet the following requirements:

3. Fixtures shall be certified dark sky compliant by the Dark Sky International.
4. Fixtures shall be automatically dimmable. Fixtures in residential areas shall be programmed to dim at 10:00 pm and commercial areas shall be programmed to dim at 2:30 am unless otherwise approved for an alternative time. Fixtures at intersections, crosswalks, other in high pedestrian and vehicular traffic areas and other areas identified by the Town as a pedestrian/ vehicular conflict area shall have the capability to dim, but shall be programmed to dim as identified by the Town Engineer based on location and need.
5. Developments shall be designed to have a maximum 50,000 lumens/acre in commercially zoned areas and a maximum of 25,000 lumens/acre for residentially zoned areas. All lights must not exceed 3,000 kelvins in correlated color temperature. Areas with traffic safety concerns, major collector roads, roundabouts, high pedestrian areas, crosswalks, parking lots and garages, and other areas of safety concern as determined by the Town Engineer may be exempted from the maximum lumen requirements if deemed necessary.
6. Light pole spacing shall be 75 feet along pedestrian routes. Light pole spacing may be increased to 110 feet on roads classified as Local. On residential local roads without a sidewalk, street light spacing may be increased to 300 feet. Light pole spacing may be modified for safety concerns or guidance from a photometric analysis or as determined by the Town Engineer.
7. Pole height shall be 9 feet tall along pedestrian routes. Pole height shall be 12 feet tall at intersections and crosswalks. Pole height shall be at minimum 25 feet within SH9 roundabouts and other locations as determined by the Town Engineer. Pole height may be further increased or altered for safety concerns with a photometric analysis, small cell installations, smart poles approved by the Town, or as determined by the Town Engineer
8. Fixtures and poles shall meet all requirements of Title 9, Chapter 12 (Exterior Lighting Regulations) or Procedures and Design Guidelines for Small Cells located in a Town Right of Way, if applicable.
9. Each street light breaker shall be 20amp.
10. Electrical wire from the breaker to each light shall be run through 1 ½" Schedule 80 PVC conduit.
11. Electrical wire run from breaker through conduit to each light base shall be braided 6 AWG. The wire size may be decreased to 8 AWG if designed by a certified electrician and approved by the Town Engineer.
12. Each conduit shall have 4 wires (black, red, white, and green) pulled through – the red wire will serve as a spare or for future power needs.

13. Three wires shall be pulled from the concrete base up the pole to the fixture (black, white, green) all braided 12 AWG.
14. Photo cell shall be mounted on top of the electrical panel or pedestal.
15. Photometric analysis (if determined necessary by Town Engineer).
16. Record drawings of streetlight projects shall be submitted in accordance with Section 8.7.
17. Additional requirements as determined by the Town Engineer due to vehicle or pedestrian traffic, safety concerns, intersections, or other reasons.

5.18.1.2 Positioning at Intersections

In general, the nighttime visibility of a pedestrian or hazardous object within an intersection is enhanced by increased contrast between the object and the surrounding street area. Street lights at intersections are required to be placed on the upstream or approach side of the intersecting street, as viewed by a motorist approaching the intersection in the lane directly beneath the luminaires. The positioning of light standards at intersecting streets shall be up to two street lights per corner of intersection, depending on street geometry and crosswalk location.

5.18.1.3 Roundabout Lighting

Lighting columns should be arranged around the perimeter of the roundabout in a simple ring, with the lights equidistant from the center and from each other. Lighting should extend at least 197 feet back along each approach road. Mounting height should be uniform throughout the intersection and not less than on any approach road. The minimum illuminance required should not be less than the highest level of lighting for any of the approach roads. Lights near roundabouts shall not be located closer than 6 feet from the face of curb and shall not be located in the center of median islands.

5.18.1.4 Light Pole Offset Distances

Distance behind back of walk for local streets shall be at least 3 feet and must be within easements or right-of-way on Local residential streets. For Collector and Arterial streets, the light must be offset at least 3 feet from the back of curb and provide a clearance space between the light pole and edge of walk that equals or exceeds the required sidewalk width.

5.18.1.5 Underground Service

Street lighting shall be installed with underground electric service on all newly developed dedicated public streets in the Town. The Developer is responsible for coordinating with the appropriate utility company all aspects of design and installation. Junction boxes and other structures shall not be installed in roadways, sidewalks, curbs, or curb ramps.

5.18.2 Pedestrian Lighting

Install street lighting behind sidewalks where sidewalks attached to the curb are used. For sidewalks detached from the curb, install street lighting with a minimum of 3 feet clearance from back of curb to roadway side of support pole and 3 feet clear from all walks. All bridge underpasses, where vehicles, pedestrians, bicyclists, or equestrians may be present, shall require lighting.

Lighting for trails should be evaluated based on safety and the type of trail. Lighting will generally be required for primary trails at primary trailheads, underpasses, mid-block crossings. Where sidewalks and trails are located near or adjacent to streets, lighting shall be coordinated with street lighting requirements.

All fixtures for pedestrian lighting must certified by DarkSky International and must not exceed 3000 kelvins in correlated color temperature in temperature and be less than 25,000 lumens/acre. Exemptions may be granted based on safety or other concerns as identified by the Town Engineer.

5.18.3 Dark Skies

The Town has adopted an exterior lighting policy adhering to DarkSky International policies and guidance. See *Exterior Lighting Regulations* in Title 9, Chapter 12 of the Town Code.

5.18.4 Residential Areas

Street lights shall be shielded with house side shields or other measures to minimize light shining on residential areas or landscaped areas.

5.19 PRIVATE FACILITIES

Private streets, alleys, and accesses are typically utilized by an individual, group of individuals, or private business to access private property. It is the responsibility of the private landowner to maintain the private facility.

5.19.1 Private Streets

A private street is an access serving five or more units or lots. Private streets are discouraged because they create a cost burden to residents. Private streets shall meet the same design standards as public streets. Private streets are not owned, maintained, or plowed by the Town. They are the sole responsibility of the property owner. A private street requires the approval of a variance request form by the Town Engineer.

5.19.2 Private Snow Melt Systems

Private heated pavement systems, also called snowmelt systems, shall terminate at the property line with no components located in the right-of-way. See section 9-1-19-33A and 33R of the Town Code for additional regulations. The following requirements shall be met for snowmelt systems:

1. Infrastructure permit shall be submitted for any private snowmelt system (even if located entirely on private land).
2. The snowmelt system shall stop 5 feet from the edge of a public roadway or 1 foot from the back of public sidewalk.
3. Drainage from the snowmelt system shall be captured on the premises and shall not drain across public pedestrian facilities or roadways. The drainage shall be designed to infiltrate or runoff without freezing. Examples include heated trench drains and inlets to storm pipes and drywells. Drywells shall be designed appropriately to infiltrate all runoff. Drainage shall not drain across public pedestrian facilities or roadways.

If the Town Engineer allows the snow melt system to encroach into the right-of-way, the following conditions shall be met in addition to the conditions above:

1. A separate mechanical zone shall be dedicated for the portion of the snowmelt system within the right-of-way
2. Expansion joint material shall be installed at the edge of heated concrete
3. A revocable encroachment license agreement, acceptable in form and substance to the Town Attorney for the components of the system extending into the ROW, must be approved by the Town and executed prior to the issuance of building permit
4. Other requirements as determined by the Town Engineer to reduce the impacts of the snow/melted interface

5.20 UTILITIES

Utilities in ROW shall be located to minimize roadway disturbance. Utility lines shall be located to minimize the need for future adjustment and shall consider future extensions of the street system. Utility structures above grade shall be placed in easements outside of the ROW, or as close to the edge of the Right of Way as possible, and at least 6 feet from the edge of roadway and 3 feet from the edge of sidewalk. Utilities shall be buried a minimum of 2 feet below finished grade. Utility rings and covers within pavement areas shall be 0.25 to 0.50 inches below top of pavement. Manholes, valves, junction boxes, and other structures shall not be located in curbs or sidewalks.

Utilities shall typically be installed in the roadway shoulder to avoid pavement removal. If the utility must be placed beneath pavement, the utility should be installed at the center or at the edge of travel lanes. Utilities shall not be placed beneath wheel paths of roads. Utilities shall not be located in drainage swales. Utilities shall be installed to meet all applicable standards and requirements for bury depths, offsets, crossings, separation, and insulation. Utility crossings shall be perpendicular to street and pavements cuts shall be perpendicular to roadway. Pavement patches shall extend 1' minimum beyond trench and edge of patch shall not be located within wheel paths. See Chapter 3 of these standards for additional trenching and patching details.

All utilities (including storm sewer) shall be electronically locatable for the entire length of the utility. All wires and cables shall be buried in rigid conduits and backfilled with warning tape placed 1 foot above the conduits. Utilities and utility structures shall be located outside of ROW and within utility easements where feasible.

5.21 DESIGN CRITERIA TABLE BY STREET CLASSIFICATION

Table 5.14 Design Criteria by Street Classification

Street Classification						
	Major Collector					
		Minor Collector				
				Local		
Posted Speed	40 mph	35 mph	30 mph	25 mph	20 mph	15 mph
Design Speed	40 mph	35 mph	30 mph	25 mph	20 mph	15 mph
Min. Horizontal Curve Radius (normal crown)	770'	510'	350'	200'	110'	50'
Min. Tangent Between Curves	150'	150'	100'	50'	20'	20'
Max. Super Elevation	6%	6%	6%	N/A	N/A	N/A
Cross-slope	2%	2%	2%	2%	2%	2%
Minimum Stopping Sight Distance	305'	250'	200'	155'	115'	80'
Min. Grade	1%	1%	1%	1%	1%	1%
Max. Grade	6%	6%	6%	6%	6%	6%
Min. K-Crest	44	29	19	12	7	3
Min. K-Sag	64	49	37	26	17	10