Missoula City Public Works
Standards and Specifications Manual

CHAPTER 7 – TRANSPORTATION SYSTEM

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CHAPTER 7 – TRANSPORTATION SYSTEM

7.1 Introduction

7.1.1 References

A. Activate Missoula 2045

B. American Association of State Highway and Transportation Officials - *AASHTO Guide for the Development of Bicycle Facilities* - by purchase only

C. American Association of State Highway and Transportation Officials (AASHTO) *Geometric Design of Highways and Streets* – by purchase only

D. ANSI A117.1: Accessible and Usable Buildings and Facilities

E. City of Missoula Subdivision Regulations

F. International Fire Code (IFC) Appendix D

G. *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD)

H. *Missoula Active Transportation Plan*

I. Missoula Parking Commission - *Parking Structure Design Guidelines*

J. *Missoula Parks and Recreation Design Manual*

K. Montana Department of Transportation (MDT) Manuals

L. MDT *Standard Specifications for Road and Bridge Construction*, latest edition

M. *Montana Public Works Standard Specifications* (MPWSS), latest edition – by purchase only

N. *NACTO Urban Bikeway Design Guide*

O. National Association of City Transportation Officials (NACTO) - *Urban Streets Design Guide*

P. NESC – National Electrical Safety Code – by purchase only

Q. NFPA 70 – National Electrical Code – by purchase only

R. United States Access Board - *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way* (PROWAG)

S. Uniform Vehicle Code

Note: The City of Missoula adopts the most current version of the above documents.

7.1.2 Appendices

7.1.3 Standard Modifications to MPWSS

A. Specifications not specifically contained herein related to transportation improvements shall be in conformance with the *Montana Public Works Standard Specifications* (MPWSS),and the following City of Missoula Modifications to the MPWSS, which are all located in Appendix 2-A:

1. SECTION 01400 Contractor Quality Control and Owner Quality Assurance
2. SECTION 02110 Geotextiles
3. SECTION 02234 Sub Base Course
4. SECTION 02235 Crushed Base Course
5. SECTION 02510 Asphalt Concrete Pavement

6. SECTION 02528 Concrete Curb and Gutter
7. SECTION 02529 Concrete Sidewalks, Driveways, Approaches, Curb Turn Fillets, Valley Gutters and Miscellaneous New Concrete Construction

7.1.4 Standard Drawings

Standard drawings related to transportation system improvements shall be in conformance with the *Montana Public Works Standard Specifications* (MPWSS), Standard Drawings; Montana Department of Transportation Detailed Drawings; City of Missoula Standard Drawings 700-series; and *Missoula Parks and Recreation Design Manual*, Appedix I - Standard Details. The particular Standard Draw applicable is dependent on the project jurisdiction.

7.2 General Requirements

7.2.1 Design Standards

A. Standards for transportation systems design shall follow current editions of the references, ppendices, standard modifications, and standard drawings listed in Section 7.1 of this chapter. Designs shall:

1. Provide minimum standards to safeguard life, health, and public safety.
2. Promote safe, efficient, connected, and convenient transportation corridors for motorists, pedestrians, bicyclists, and bus riders of all ages and abilities, as outlined in the 2011 Missoula Active Transportation Plan and the Missoula Complete Streets Resolution #8098 while providing access for emergency and other urban service vehicles and equipment.
3. Provide requirements for the design and construction of complete streets, including bike lanes, parking, sidewalks, and trails commensurate with anticipated increase in population, dwelling unit densities, and multi-modal service requirements.
4. Provide a reasonable and comprehensive transportation system to ensure the design and construction of a high-quality environment.

B. Design and construction of transportation systems within MDT rights of way shall comply with MDT standards.

7.2.2 Plan Requirements

A. Plans, specifications, and reports as required in connection with transportation improvements shall be prepared by a professional engineer licensed in Montana.

B. Design limits shall include plan design from street intersection to street intersection or end of street, development phasing, or match line, and may be expanded to include drainage structure to drainage structure; ensuring appropriate project design and use of the infrastructure.

C. Improvement plans shall comply with the general requirements of Section 3.2 of this Manual and shall at a minimum include:

1. **Street Plans**
    - **a.** Right of way limitations
    - **b.** Street width – existing and proposed
        1. Back-of-curb to back-of-curb

2. Back-of-curb to edge-of-asphalt
3. Edge-of-asphalt to edge-of-asphalt

c. Centerline of street and of right-of-way, including street names
d. Asphalt paving match lines
e. Asphalt design thickness
f. Thickness of existing and proposed pavement and base materials, as appropriate
g. Sidewalk width and thickness
h. Curb ramps and truncated domes at intersections
i. Street plan and profiles
j. Cross-sections for the entire right-of-way and public easement prism, property line to property line
1. Design limits and every 25 feet in between
2. All Point-of-Curvature (PC) and Point-of-Tangency (PT)
3. All Vertical Curves (VC) - grade breaks

k. Boulevard width(s) and material(s)
l. Design and construction material quantities:
1. Lineal feet of concrete curb and gutter
2. Square feet of sidewalk
3. Square feet of driveway approaches and aprons
4. Square feet of asphalt paving

m. Profile data at:
1. Centerline of street section
2. Design limits and at PC, PT, PI, PVI, PVC, etc.
3. Curb and gutter, where applicable
4. Edge of asphalt , where applicable

2. **Grading and Drainage.** Spot elevations and grades of features
a. Back of curb and sidewalk where applicable.
b. Street intersection monuments
c. Bench marks
d. Existing and proposed storm water structures
e. Catch and spill curb and gutter including transitions
f. Flow grades on street and gutter, where applicable.
g. Incorporation of LID/Green Infrastructure for storm water treatment is encouraged. See Chapter 6 of this Manual.
3. **Landscaping.** Existing and proposed boulevard trees and landscaping.
4. **Signing and Striping.** Curb marking, pavement marking, street signs, and traffic signs.
5. **Accessibility.** Show spot elevations and grades for all ramps,accessible spaces, features, and facilities.
6. **Street Lighting** (See also Section 7.3.6 of this chapter)
a. Proposed Lighting: Luminaire locations, types, poles, conduit size and type, utility service panels, mounting heights, pull boxes, transformers, point of connections,

and aiming instructions as required providing a clear expression of the proposed outdoor light fixture system design.

b. Lighting Fixtures Schedule: Fixture manufacturer specification sheets, model number, lamp type, wattage, voltage, cut-sheets, catalog sheets, or manufacturer provided information.

c. Panel Schedule: Shall designate circuits with the number of devices being served, voltage, number of phases, short circuit rating, load continues amperage, etc.

d. An ISO foot-candle plot or contour drawing on paper showing calculated light levels for the area of proposed work. The ISO foot-candle plot shall extend no less than 10 feet beyond the property line and to the middle of the street to indicate compliance with light spillover requirements of City of Missoula Outdoor Lighting Ordinance #3341.

7.2.3 Design Reports

A. Traffic Impact Study

1. Developments that will contribute 200 or more average daily (weekday) trips to city streets based on the latest edition of the *Institute of Transportation Engineers' Trip Generation Manual* shall submit a traffic impact study.

2. The traffic impact study shall be submitted with the improvement plans through the normal application processes (site development and public infrastructure).

3. Prior to submittal of the traffic impact study, a meeting with City Engineer shall be conducted to establish study intersections and any adacent developments or City improvement projects that should be accounted for in the traffic impact study. This meeting will determine the required content and assumptions for the traffic impact study.

4. The traffic impact study shall include analysis and impacts to all transportation facilities, including adversely affected nearby streets and intersections, public transit, bicyclists, and pedestrians.

5. The traffic study shall provide adequate information to assess the impacts of the proposed development on the transportation facilities. It shall include considerations for access management, traffic calming, transporation demand, and/or other mitigation measures.

a. Submittal information shall at minimum include:

1. Proposed site description

2. Peak-hour volume development as follows (include figures and text description in TIS body):

a. Existing volumes

i. Existing turning movement counts shall be collected for the entire peak hour periods from 7am-9am and 4pm-6pm in order to ensure the correct peak hour is captured. Justification must be provided during item 3 above to count a shorter time period, or time period other than the traditional peak periods.

b. Adjacent development (if necessary)

c. Grown traffic (if necessary)
d. No build
e. Diversion due to changes in transportation network (if necessary)
f. Arrival-departure patterns
g. Pass by trips (if necessary)
h. Site generated primary trips – build volumes

3. Capacity analysis shall compare no-build to build per intersection and per movement
4. Report summary, conclusions, and recommendations
5. Queueing data may be requested at the discretion of the City Engineer
6. Crash analysis may be requested at the discetion of the City Engineer

6. The City Engineer may require traffic infrastructure improvements, including but not limited to off-site access and traffic control, and may require the applicant to design, finance, and construct those improvements in whole or in part.
7. When development is adjacent to or within 0.25 mile of an established public transit route, the City Engineer may require applicant to finance and construct Mountain Line approved public transit improvements, including bus pull outs and transit facilities such as shelters, benches, bike parking, map cases, and signage along established bus routes. Factors that may preclude transit improvements include but are not limited to availability of Right-of-Way and review of the transit master plan.
8. If the development affects infrastructure under MDT's jurisdiction, those plans and the traffic impact study may need MDT review and approval.

B. Geotechnical Report

1. Street sections that are proposed below the minimum standards in Section 7.3.1 of this chapter shall submit a geotechnical report to support the design. A deviation must be granted or the minimum standards in Section 7.3.1 will be required.
2. The geotechnical report shall be submitted with the improvement plans through the normal application process.
3. The geotechnical report shall include a description of the project, a soil survey, laboratory testing, subsurface conditions, groundwater locations, traffic counts and/or projections including vehicle type and percentage use, and recommended street sections (asphalt, base course, sub-base course, subgrade).

7.2.4 Intersection Sight Distance

Sight visibility shall be based on Chapter 9.5in the American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*.

7.2.5 Traffic Control

NOTE: To be updated

7.2.6 Traffic Calming

A. Traffic calming features, including but not limited to speed tables, curb extensions or bulb-outs, traffic calming circles, and pedestrian refuge islands, may be required.

1. Traffic calming circles shall comply with City of Missoula Standard Drawings 709 and 710 and the following:
    - **a.** Contain an 8-inch thick mountable concrete curb with two #4 reinforcing bars 5 inches back from edges and spaced 14 inches apart
    - **b.** Sign bases facing intersecting streets placed 24 inches behind back of curb
    - **c.** Minimum 4 foot wide asphalt patch matching thickness of street
    - **d.** Four joints for less than 20-foot diameter circles not to exceed 10 feet in length
    - **e.** Eight joints for 20-foot and greater diameter circles not to exceed 10 feet in length
    - **f.** May include landscaping in the center
2. Traffic calming devices, unless otherwise noted herein, shall meet AASHTO design standards.

7.2.7 Accessibility

A. Accessibility for persons with disabilities shall be considered in the design of all transportation infrastructure to include site accessibility, exterior accessible routes, and parking requirements.

B. Missoula has adopted the ARM 24.301.9 as MMC 15.38 Accessibility Standards.

C. Additionally, 2009 ANSI A117.1: Accessible and Usable Buildings and Facilities has been adopted to address site accessibility requirements.

D. The Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG) shall be used for accessibility standards within the right of way and public access easements.

E. Pedestrian pathways, facilities, and elements located within the right of way or public access easement shall be made accessible.

F. Accessible route clear space shall be a minimum of 5 feet, or 4 feet around fixed obstructions, in width on sidewalks (6 feet in width within the Central Business District.

G. Refer to City of Missoula Standard Drawings 782-787 for parking lot accessibility standards.

7.3 Design Standards

7.3.1 Streets

A. All streets and alleys (private or public) shall be designed to the current standards of the American Association of State Highway and Transportation Officials (AASHTO) *Geometric Design of Highways and Streets*.

1. Horizontal alignment of streets must ensure adequate sight distances.
2. When street center lines deflect more than 1^{o}, construction must be made by horizontal curves.
3. Vertical curves shall be symmetrical and required with a grade differential of 3% or greater.

B. Chip and seal, pavement, and curb markings must be installed by the developer or be sucured by an acceptable financial instrument based on an estimate of probable cost.

C. City of Missoula street classification, MDT routes, and truck routes are available on the City of Missoula Roadway Map.

D. All streets and new alleys shall follow Table 7-1 through 7-4 and City of Missoula Standard Drawings 701-707:

1. Asphalt Paving

a. Asphalt pavement material shall comply with City of Missoula Modification to MPWSS Section 02510.

b. Asphalt pavement shall be applied per Table 7-1.

Table 7-1 – Minimum Asphalt Paving Thickness

Classification	Subgrade	Minimum Thickness
Arterial/Collector	Poor (CBR 5-9)	6 inches
	Medium/Good (CBR 10+)	4 inches
Local*	Poor (CBR 5-9)	4 inches
	Medium/Good (CBR 10+)	3 inches
Alley	All	2 inches**

*Local classification includes short courts, woonerfs, and home zones.

**Alley asphalt may require additional thickness with heavy traffic loads.

2. Base Course

a. Base course material shall comply with City of Missoula Modification to MPWSS Section 02235.

b. Base course shall consist of crushed ¾-inch minus material placed to a depth of 6 inches in all applications per Table 7-2.

Table 7-2 – Minimum Base Course Thickness

Classification	Subgrade	Minimum Thickness
Arterial/Collector	All	6 inches
Local*	All	6 inches
Alley	All	6 inches

*Local classification includes short courts, woonerfs, and home zones.

3. Sub Base Course

a. Sub base course material shall comply with City of Missoula Modification to MPWSS Section 02234.

b. Sub base course shall consist of crushed 3 inch minus material per Table 7-3.

Table 7-3 – Minimum Sub-Base Course Thickness

Classification	Subgrade	Minimum Thickness
Arterial/Collector	Poor (CBR 5-9)	16 inches
	Medium (CBR 10-19)	12 inches
	Good (CBR 20+)	8 inches
Local*	Poor (CBR 5-9)	12 inches
	Medium (CBR 10-19)	8 inches
	Good (CBR 20+)	6 inches
Alley	All	dependent on existing sub-grade material

*Local classification includes short courts, woonerfs, and home zones.

4. All base, sub base, and the top 6 inches of sub grade shall be compacted to 95% proctor density.
5. Geotextile material and installation may be used and will be based on a geotechnical report and shall comply with City of Missoula Modification to MPWSS Section 02110.
    a. City shall approve the geotexttile material prior to installation.

E. All streets and new alleys shall be designed with the following :

1. Cross-slope
    a. Minimum 2% from centerline (this is the default standard).
    b. Cross slope above 5% requires City Engineer approval.
    c. Intersection grading may allow for different minimum standards.
2. Minimum widths for street elements are provided in Table 7-4.

Table 7-4 – Street Design Widths

	Arterial (feet)	Collector (feet)	Local (feet)	Alley (feet)
Right of way width(1)	100	80	60	20
Drive/Turn Lane(2)	10	10	10	12
Bike Lane(3)	6	6	-	-
Parking Lane(4)	8	8	7	-
Boulevard (min)(5)	10	8	7	-
Sidewalk (min)	6	5	5	-

(1) The actual right of way width is dependent on required width of all street infrastructure elements. The total width shall provide a minimum of 1 foot outside all elements on each side.

(2) The drive lane/turn lane width refers to asphalt, does not include gutter/pan section.

(3) Bicycle lanes or facilities are typically required on streets that are functionally classified as collector streets or greater.

(4) Parking lane width can include the gutter/pan section. Parking is required on both sides unless deviation approved by City Engineer.

(5) Boulevards shall be designed to the largest extent dependent on existing right of way width and neighborhood character

3. Grade
    a. Shall substantially follow natural contours.
    b. Shall not exceed a maximum grade of 8%.
    c. A maximum grade up to 10% may be allowed for a distance of up to 50 feet, when approved by the City Engineer and the City Fire Marshall.
    d. All utility appurtenances shall be adjusted to be between flush and ¼ inch below and match grade and cross slope of street with use of tapered grade rings.

F. Locations

1. Street connections shall be provided to any existing or approved public street or right of way extension adjacent to the development, nearby destinations such as schools, parks, transit stops, employment centers, and commercial areas as well as collector and arterial transportation corridors, non-motorized transportation corridors, and future phases of development.
2. The circulation pattern for the development must be designed to take advantage of the topography of the site to accommodate the circulation demands of the proposed development, adjacent transportation facilities, adjacent land uses, parcels of land in the immediate area, and be designed in accordance with area-wide transportation plans. The circulation system must provide for complete multi-modal transportation, such as automobiles, pedestrians, bicycles, buses, and emergency vehicles.
3. When development is adjacent to or within ¼ mile of an established or planned public transit stop or school bus route, the developer may be required by the City Engineer to construct bus stop facilities along with accessible routes, meeting accessibility standards, to those facilities.

G. Cul-de-Sacs, Loop and Circle Streets, Dead-End Streets, and Turnarounds

1. Cul-de-sacs, loop and circle streets, and dead-end streets are prohibited unless a deviation is approved by the City Engineer.
2. If approved, turnarounds shall be per IFC Appendix D.
3. If approved, the maximum length of a cul-de-sac street is 600 feet

H. Private Streets

1. Shall be designed and constructed to City street standards.
2. Shall be located within a public access with private maintenance easement.

I. Short Courts

1. Shall not be used where a through street is possible.
2. Shall be placed within a public access with private maintenance easement.
3. Shall have a minimum unobstructed width and turnarounds per IFC Appendix D.
4. Shall have a maximum length of 200 feet.

J. Home Zones/Woonerfs

1. Shall provide a connection between two streets or vehicle access system and be 300 feet or less in length.
2. Shall have a minimum unobstructed clear space per IFC Appendix D.
3. Shall provide circulation plan showing pedestrian and vehicular movement system, pedestrian scaled lighting, required off street parking access, and multi-use zones. The

circulation plan must be designed with street accessories, trees, and bollards placed to reduce traffic speeds which are reduced to a walking pace.

4. Shall be surfaced with at least 25 % scored, textured, or colored concrete; paving blocks or bricks; or other similar materials approved by the City Engineer, and 15% of the woonerf must be non-drivable landscape arranged to modulate the vehicle travel lane.
5. Shall provide a snow removal and maintenance plan that meets City of Missoula sidewalk maintenance standards. Include agreement that the property owners shall be responsible for the costs associated with the maintenance, repair, and replacement of all surface infrastructure.

7.3.2 Alleys

A. New alleys shall be designed to City of Missoula Standard Drawings 705-707.

B. If pavement is required, the minimum pavement width is 12 feet with 2 feet of ¾-inch minus crushed base course shoulders on both sides.

C. Existing unpaved alleys may use a 2-inch depth of asphalt millings in leiu of pavement.

D. The minimum right-of-way dedication or public access easement width for alleys shall be 20 feet.

E. Homeowners associations are responsible for alley maintenance when alleys are planned for new subdivisions.

7.3.3 Other Infrastructure Design Provisions

A. Streets must intersect at right angles except when topography dictates otherwise, and in no case may the angle of intersection be more than 30 degrees from perpendicular.

B. Half street improvements require curb, gutter, and sidewalk on one side as well as enough pavement for two drive lanes and bike lanes on a collector or artieral street. The full width of right of way or public easement may still be required.

C. Where primary access to a development is to be provided by a street(s) not contained within the boundaries of the development, access to the nearest publicly-maintained paved street must meet the standards in Section 7.3 of this chapter for transportation systems as well as grading and drainage requirements.

D. Provisions must be made for service access, such as off-street loading or unloading and parking, that is adequate for the uses proposed.

E. All fire access shall comply with IFC Appendix D and requires approval from the City Fire Marshall.

F. Bus stop pull-outs shall comply with City of Missoula Standard Drawings 712-1, 712-2, 712-3, PROWAG, and the following:

1. Accessible landing zone
    - **a.** Shall be a minimum of 5 feet wide by 8 feet deep and located directly adjacent to the curb to accommodate ADA compliant lift equipment.
    - **b.** Shall be constructed so as to not exceed 2% grade in any direction.

G. Mailbox pull-outs shall comply with City of Missoula Standard Drawing 713-1, 713-2, and 713-3 and the following:

1. Mailbox stops for single-gang cluster-type mailboxes shall be a concrete pad 48 inches wide by 24 inches deep. Mounting details shall be based on USPS and Manufacturer specifications.
2. Mailboxes placed in the right of way or in public easements shall comply with City of Missoula Standard Drawing 760 and shall not be located so as to obstruct the public sidewalk. If placed in the sidewalk, a minimum 4-foot path around the mailbox shall be maintained clear of all obstructions to pedestrians.

7.3.4 Signing

A. All signs located in the right of way or in public easements shall comply with the current edition of the MUTCD for material, size, thickness, shape, color, message, symbology, location, placement, and retro reflectivity.

B. Sign bases and poles shall comply with City of Missoula Standard Drawing 720.

C. Sign mounting shall comply with City of Missoula Standard Drawing 721.

D. Sign placement shall comply with City of Missoula Standard Drawing 722.

E. Accessible parking signs shall comply with 2009 ANSI A117.1: Accessible and Usable Buildings and Facilities and City of Missoula Standard Drawing 787.

7.3.5 Striping

A. All street marking shall comply with MUTCD for dimension, placement, color, message, symbology, and retro reflectivity.

B. Epoxy pavement markings shall be per the Montana Department of Transportation *Standard Specifications for Road and Bridge Construction*.

C. Epoxy paint layout shall comply with City of Missoula Standard Drawing 730.

D. Epoxy pavement marking shall include epoxy paint and glass beads. Other marking materials may be used at the discretion of the City Engineer.

E. Centerline striping shall consist of two 4-inch yellow lines with a 4-inch gap. White skip lines shall be 4 inches wide and 10 feel long with a 15-foot gap. Dotted extension lines (turkey tracks) shall be 2 feet long with a 4-foot gap and can vary in width from 6 to 8 inches depending on application. Bike lane striping shall consist of white lines with the closest to lane 6 inches wide and the outer line 4 inches wide.

F. Crosswalks may be required to be striped at the discretion of the City Engineer.

G. Stop bars and yield lines shall be marked 4 feet back from striped crosswalks and be the full width of the drive lane(s) and bike lane (excluding the parking area if present).

H. “No parking” areas shall be marked on the curb with yellow marking from the bottom of the curb face to the top back of curb and at the lengths listed in Table 7-5. The distance referenced in Table 7-5 for driveways/entrances is measured from the start of the laydown.

Table 7-5 – No Parking Areas

Location	Distance (feet)	Requirement
Residential Driveway	5	Discretional
Commercial Driveway	10	Required
Fire Station Entrance	20	Required
Street Opposite Fire Station Entrance	75/Ea Direction from outside edges of approach	Required – w/signage
Fire Hydrant	15/Ea. Direction	Required
Crosswalk-Uncontrolled Intersection	20	Required
Crosswalk-Controlled Intersection	30	Required
Railroad Crossing	50	Required

7.3.6 Lighting

A. The following standards apply to all street lighting, pedestrian lighting, and pathway lighting installations within the City of Missoula public right-of-way, with the exception of historic streetlights, as defined by City of Missoula Lighting Ordinance, MMC 8.64, traffic signals, and other traffic safety devices.

B. The need for lighting shall be considered for all new or reconstructed streets. Design considerations include functional classifications, traffic volumes (vehicular and pedestrian), intersections, turning movements, signalization, channelization, and geometrics.

C. Standards. All lighting shall comply with the City of Missoula Lighting Ordinance, MMC 8.64 and shall consider the combined effect of all lighting present to avoid overlighting.

1. Illumination standards for street lighting shall follow the MDT *Traffic Engineering Manual*, Chapter 13.
2. Illumination standards for pedestrian and pathway lighting shall follow the *Missoula Parks and Recreation Design Manual*, Part 5, Section 3.
3. MDT *Standard Specifications for Road and Bridge Construction*, latest edition.
4. *Manual of Uniform Traffic Control Devices* (MUTCD), latest edition.
5. NFPA 70 – National Electrical Code, latest edition.
6. NESC – National Eletrical Safety Code.
7. All lighting installations require a City electrical permit prior to the start of work.

D. Locations

1. Lighting shall be required at the following locations:
   - **a.** Along arterial streets
   - **b.** At trail crossings of collector and arterial streets
   - **c.** At signalized and roundabout intersections
   - **d.** At raised medians
2. Lighting shall be considered at the following locations:
   - **a.** Along streets with complex geometry

b. At intersections that incorporate channelization or traffic circles
c. At high-conflict locations, such as commercial developments with numerous driveways or high truck traffic
d. At high crash locations attributable to lack of lighting
e. At underpasses, tunnels, commuter park-and-ride lots, bike paths, pedestrian walkways, and pedestrian overpasses where sufficient benefit to convenience, safety, security, and public perception exists.

3. Lighting shall be positioned to provide uniform distribution while minimizing glare and light spillover on private property.
4. To the extent feasible, lights should be located ahead of intersections and crosswalks to minimize backlighting.

E. Materials

1. Street light poles and fixtures shall be black and designed to closely match the style of other streetlights used in the area.
2. Street light fixtures shall be LED, 3000K, CRI 70 min and equipped with full cutoff optics.
3. Street light lighting module and driver shall provide a minimum lumen output of 70% at 70,000 hours.
4. Street lights shall have a minimum 10-year warranty.
5. Street lights shall have internal surge suppression rated at 10KV/10KA minimum.
6. Street lights shall have a minimum lumen efficiency of 105LPW.
7. Each street light shall have programmable dimming, using 0-10V dimming control.
8. Street lighting system shall be 240VAC, controlled by a photo eye and contactor with an off/hand/auto switch mounted in a NEMA type III enclosure.
9. The control photo eye should be mounted on the luminaire nearest the lighting service.

F. Height

1. Street light fixtures shall not exceed 30 feet in height.
2. Pedestrian and pathway lighting shall not exceed 20 feet in height.
3. Where a wide street or boulevard is illuminated such that a fixture mounted at 30 feet precludes proper illumination, a design deviation may be granted to allow lighting up to 45 feet in height.

G. Operation and Maintenance

All street lighting shall be operated and maintained through the creation of a new street light improvement district (SLID), through annexation into an existing SLID, or other equivalent means approved by the City's Public Works Department.

7.3.7 Traffic Signals

Standards for traffic signals can be found in the MDT *Traffic Engineering Manual*, Chapter 12. All traffic signals shall be designed to these standards.

A. Radar Detection

1. Any roadway approach that has a vehicle detection loop exposed by excavation, radar vehicle detection shall be installed to detect all movements on that approach.
2. Any roadway approach that has driving lanes shifted more than 12 inches, radar vehicle detection installed to detect all movements on that approach.
3. Radar vehicle detection equipment must be installed by qualified signal personnel.
4. Radar vehicle detection plans and installations must be approved by City of Missoula Traffic Signal and Communication shop.

7.3.8 Curb and Gutter

A. Shall follow the requirements of City of Missoula Standard Drawings 740-745.

B. Construction materials and procedures shall comply with City of Missoula Modification to MPWSS Section 02528.

C. Shall contain a minimum of 6 inches of subgrade compacted to 95% proctor density.

D. Shall ensure the full road section is built to a minimum of 1 foot beyond back of curb.

E. For curb and gutter replacement, the top 6 inches of existing base and/or subgrade course shall be removed and replaced with new base and compacted to 95% proctor density.

F. Contraction joints shall be placed every 10 feet to a depth of $1/4^{th}$ the concrete thickness.

G. Expansion joints with ½-inch mastic material shall be placed at:

1. PCs and PTs of curves
2. Grade breaks
3. 4 feet on either side of a drainage structure
4. Changes in concrete thickness

H. Minimum gutter flow line shall be five-tenths (0.5%) percent slope.

I. Minimum curb taper rate shall be 3:1

J. Gutter pans shall be 8 inches minimum thickness from PC to PT at collector and arterial intersections, roundabouts and splitter islands, through commercial and industrial approaches, or where truck traffic is assumed.

K. Gutters shall include storm water facilities.

L. Shall include a cove gutter where a flow line drains through a street intersection, commercial driveway approaches, bus or mail pullout, or within an inverted alley per City of Missoula Standard Drawings 706, 708, 712-1, 712-2, 712-3, 713-1, 713-2, 713-3, 774, and 775.

1. Shall be a minimum of 8 inches thick.
2. Shall be a minimum of 2 feet in width with a 1-inch cove through the center.
3. Shall contain three #4 rebar at a depth of 4 inches minimum equally spaced with #4 spreaders tied every 5 feet equally spaced.

M. Shall indicate spill/ catch gutter pan.

1. When designing spill curb, rotate curb at top front of gutter pan hinge point, not top back of curb.

N. Shall include street asphalt paving patch-back to cross-slope, thickness, and base material standards per Section 7.3.1 of this Manual and City of Missoula Standard Drawing 744.

1. Asphalt surface shall be square cut a minimum of 48 inches from thelip of the curb up to a maximum of the centerline of the street in order to reach a 2 to 5% cross-slope.
2. Existing asphalt edge may NOT be used as a front form.
3. Final asphalt patch cut line shall be adjusted to ensure proper compaction of the base layer.
4. The top 6 inches of existing base course shall be removed and replaced with new base course and compacted to 95% proctor density.
5. Asphalt patch seams shall be sealed with a mineral-filled or fiberized asphalt sealant.
6. Any over excavation shall be back-filled with ¾-inch minus and compacted to 95% proctor density.
7. Existing asphalt face shall be tack-coated prior to asphalt patch.

7.3.9 Sidewalks

A. Construction materials and procedures for sidewalks shall comply with City of Missoula Modification to MPWSS Section 02529.

B. Sidewalks shall be designed per City of Missoula Standard Drawings 750-754.

C. Boulevard sidewalks shall be provided adjacent to all streets unless granted a postponement or variance per MMC 12.10, Right-of-Way Improvements.

D. Shall include sight distance requirements in Section 7.2.4 of this chapter for intersections and 10 foot x 10 foot at driveway and alley locations

E. Shall minimize obstructions within the sidewalk such as utility access, mailboxes, or signs.

F. Bollards design shall comply with City of Missoula Standard Drawing 788.

G. Curb ramps or blended transitions shall comply with City of Missoula Standard Drawings 751-1, 751-2, 751-3, and 751-4; PROWAG; and the following:

1. Maximum grade for blended transitions shall be 5%.
2. Shall be provided at each street crossing, T-intersection, or mid-block crossing.
3. Shall be contained entirely within the width of the street crossing served.
4. Shall have a minimum 5-foot by 5-foot landing not to exceed 2% cross-slope in any direction.
5. Curb ramp flares are required to be 1 foot adjacent to landscaping or a maximum of 10% adjacent to hardscape.
6. Handrail or guardrails are not typically required for public sidewalks within the right of way. Private pedestrian routes from the public sidewalk serving private property require handrail or guardrails per United States Access Board - *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way* (PROWAG).
7. Shall include detectable warning panels per City of Missoula Standard Drawing 750 at:
    - **a.** Street crossings,
    - **b.** Refuge islands, except at-grade less than 6 feet in length in the direction of travel,
    - **c.** At-grade rail crossings, and
    - **d.** Boarding platforms.
8. Detectable warning panels:
    - **a.** Shall be cast iron,
    - **b.** Placed full width of the curb ramp and 2 feet deep,

c. Placed on-grade to match the sidewalk or ramp,
d. Shall not exceed 2% cross-slope or 8.3% running slope,
e. Typically placed perpendicular with the direction of pedestrian travel,
f. Placed 2 inches maximum from back edge of curb on a minimum of one edge, and
g. Shall contrast visually with adjoining surface.

H. Sidewalk width shall be a minimum of 5 feet and shall include a minimum 4 feet of continuous clear width free of fixed obstructions for an accessible pedestrian route. Refuge islands shall require 5 feet of clear width.
1. The City's Central Business District requires 10 feet minimum width (6 feet of clear space).
2. If new curbside sidewalks are approved, the sidewalk width must be 6 feet in predominantly residential areas and 7 feet in all other areas.
3. Wider sidewalks may be required in commercial areas based on use as determined by City Engineering.
4. Existing sidewalks that are being removed or replaced may match existing width, unless additional width is required by the City Engineer.

I. Running grade
1. Shall not exceed 5% where an adjacent street does not exist,
2. Shall not exceed the general grade of the adjacent street, and
3. Shall not exceed 5% in pedestrian street crossings.

J. Cross slope
1. Shall not exceed 2%,
2. Shall not exceed 5% in street crossings without yield or stop control, and
3. Shall not exceed the street grade in midblock crossings.

K. Surfaces shall be firm, stable, slip resistant, planar, smooth, and flush at grade breaks.

L. Maximum vertical displacement is 1/4 inch and 1/2 inch with a 50% bevel.

M. Maximum horizontal displacement is 1/2 inch perpendicular to the direction of travel.

N. Objects such as utility covers, vault frames, and gratings shall be minimized on curb ramps, blended transitions, turning spaces and landings, or gutter areas within an accessible route.

O. End-of-sidewalk barricades, where required, shall comply with City of Missoula Standard Drawing 762.

7.3.10 Parking

A. General
1. Parking facilities include, but are not limited to, driveways, parking lots, parking garages, public and private (access) streets, and associated motorized and non-motorized facilities.
2. Vehicle loading and unloading shall occur off-street and on-site and shall not be accessed by backing into the private property from an alley or street.
3. Pin-down curbs or wheel stops shall not be used to separate parking spaces from an at-grade sidewalk or walkway unless an approved bollard or "B" curb is installed. Sidewalks and walkways next to paved vehicular areas shall be grade separated by a minimum of 4 inches or separated by bollards. Bollard spacing shall be no more than 12 feet apart where parallel to drive lanes or 5 feet apart where perpendicular to parking spaces.

4. For bollard standards, see to City of Missoula Standard Drawing 788.

B. Driveway Approaches/Driveways

1. Construction materials and procedures shall comply with City of Missoula Modification to MPWSS Section 02529.
2. Driveways shall be designed per City of Missoula Standard Drawings 771-776.
3. All driveway, parking lot, parking garage approach, or apron improvements shall be constructed at 90° or perpendicular to the adjacent right of way or public easement.
4. Property frontage referred to in this section includes all private property immediately adjacent to right-of-way or property which is under the control of the applicant and any such area as may be adjoining which is used for approach purposes by right of recorded access easement. Approach width or 'throat' is measured at the curb line or edge of street asphalt, not including the width of the transition, or radius on each side of the approach,
5. Approaches for new driveways shall meet the following
    a. The minimum width shall be nine (9) feet.
    b. The maximum width shall be twelve (12') feet for single driveways.
    c. The maximum width shall be twenty-four (24) feet for double driveways.
    d. The approach width may equal the driveway width when greater than twenty-four (24) feet wide, but shall not exceed thirty (30) feet.
    e. The basis for the width of a driveway approach must correlate to the width of the driveway it leads to.
    f. Driveway width shall be measured at the location of conforming parking.
6. For new multi-dwelling, commercial, and industrial driveways, when one (1) or more driveway approaches serve a given property frontage, no single approach shall exceed thirty feet (30') in width. Total driveway width shall not exceed thirty percent (30%) of the frontage. Commercial driveways exceeding thirty feet (30') in width or exceeding thirty percent (30%) of the frontage shall require approval of the City Engineer. Commercial and industrial driveway approaches shall have a minimum separation of twenty feet (20').
    a. Commercial/Industrial curb cannot be saw cut, must be removed and re-poured

C. Parking Facilities

1. Construction materials and procedures shall comply with MPWSS Section 02510 and City of Missoula Modifications to MPWSS Section 02510.
2. Parking facilities shall be designed per City of Missoula Standard Drawings 777-787.
3. Paved parking areas not designated and approved for parking shall be clearly marked by applying yellow epoxy paint to the curb or asphalt and signed appropriately with a "No Parking" sign, as required by the City Engineer.
4. Multi-dwelling parcels utilizing permitted, shared, paved parking facilities shall have the most restrictive ADA compliance requirements applicable, based on each site's use.

D. Parking Structures

1. Parking structure designs shall comply with Missoula Parking Commission *Parking Structure Design Guidelines*.

2. Parking Structure entrance and exit ramps shall conform to the following:
    a. Shall be concrete and shall have a diagonally tined surface when the ramp exceeds 8% slope. Tine specifications include, but are not limited to:
        1. Tine width shall be 1/8 inch minimum.
        2. Tine depth shall be 1/8 inch to 3/16 inch deep.
        3. Tine spacing shall be ¾ inch to 2 inches between equally spaced tines.
        4. Tining shall be diagonally placed at 45° to the motor vehicular travel path in a chevron pattern or across the motor vehicle travel path in a manner to clear water from (drain) the surface as approved by the City Engineer.
    b. Shall have an on-grade landing at the top of the ramp. The landing shall be 5% slope maximum and 15 feet long minimum.
    c. Shall have a transition slope adjacent to the top and bottom of the ramp when the ramp exceeds 8% slope. The transition slope shall be half of the ramp slope and be a minimum of 10 feet long.
    d. Shall have a maximum slope of 8% when uncovered and unheated.
    e. Shall have a maximum slope of 10% when covered and unheated.
    f. Shall have a maximum slope of 15% when the floor is heated, whether covered or uncovered.
3. Storm water facilities shall meet all requirements in Chapter 6 of this Manual. Incorporation of LID/Green Infrastructure for storm water treatment is encouraged.
4. Floor drains are required in a covered parking structure and shall be connected to a sand and oil interceptor, and:
    a. Shall be designed and sized by a qualified professional.
    b. Shall be connected to the City sanitary sewer system and wastewater treatment facility.
    c. Shall be sealed with gas tight lids and properly vented to the exterior of the structure when installed inside a structure or facility.
    d. Shall be rated for traffic-bearing load capacities.
    e. Shall be certified for containment of hydrocarbon-based fluids.
5. Floor drains are required in an uncovered parking structure. Drainage from uncovered portions of a parking structure shall not be discharged to the City sanitary sewer system and wastewater treatment facility.
6. All uncovered portions of the parking structure (including entrance and exit ramps) shall be designed and constructed to retain storm water drainage on site with infiltration as the preferred alternative.
7. All current City of Missoula standard parking requirements and City of Missoula Standard Drawing 784 shall apply. Structural columns shall not encroach into parking spaces.
8. All City of Missoula visibility obstruction requirements shall apply, per MMC 12.28, Obstructions and City of Missoula Standard Drawing 711.

9. All traffic and pedestrian signing and striping shall fully comply with the *Manual on Uniform Traffic Control Devices* (MUTCD), current edition, for wording, material, colors, location, and installation.
10. Vertical clearance: ADA van parking spaces, access aisles, and vehicular routes serving them shall provide a vertical clearance of 98 inches minimum. The 98-inch minimum clear height requirement shall be void of all obstructions. Ramp and floor transition points and vertical curves serving ADA van parking shall meet these minimum vertical clearance standards.
11. Two-way entrance and exit ramps shall be a minimum of 20 feet of clear width, face-of-curb to face-of-curb, between retaining wall(s), or a combination thereof.
12. One-way entrance and exit ramps shall be a minimum of 12 feet of clear width, face-of-curb to face-of-curb, between retaining wall(s), or a combination thereof.

7.3.11 Pedestrian and Shared-Use Paths and Trails

Pedestrian and shared-use paths and trails shall be designed per the *Missoula Parks and Recreation Design Manual*.