



**Missoula City Public Works  
Standards and Specifications Manual**

**CHAPTER 7 – TRANSPORTATION SYSTEM**

## CHAPTER 7 – TRANSPORTATION SYSTEM

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# CHAPTER 7 – TRANSPORTATION SYSTEM

## 7.1 Introduction

### 7.1.1 References

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

- A. [Connect Missoula 2050](#)
- 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. Institute of Transportation Engineers – *Trip Generation Manual* – by purchase only
- G. [International Fire Code \(IFC\) Appendix D](#)
- H. [Manual on Uniform Traffic Control Devices for Streets and Highways \(MUTCD\)](#)
- I. [Missoula Active Transportation Plan](#)
- J. Activate [Missoula 2045 - Bicycle Facilities Master Plan](#)
- K. [Missoula Parking Commission - Parking Structure Design Guidelines](#)
- L. [Missoula Parks and Recreation Design Manual](#)
- M. Activate [Missoula 2045 - Pedestrian Facilities Master Plan](#)
- N. [Montana Department of Transportation \(MDT\) Manuals](#)
- O. [MDT Standard Specifications for Road and Bridge Construction, latest edition](#)
- P. [Montana Public Works Standard Specifications \(MPWSS\)](#) – by purchase only
- Q. National Association of City Transportation Officials (NACTO) - [Urban Bikeway Design Guide](#)
- R. National Association of City Transportation Officials (NACTO) - [Urban Streets Design Guide](#)
- S. NESC – National Electrical Safety Code – by purchase only
- T. NFPA 70 – National Electrical Code – by purchase only
- U. [National Cooperative Highway Research Program \(NCHRP\)](#) - Report 1043, *Guide for Roundabouts*
- V. [National Cooperative Highway Research Program \(NCHRP\)](#) - Report 834, *Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities*
- W. [National Cooperative Highway Research Program \(NCHRP\)](#) - Report 1036, *Roadway Cross-Section Reallocation: A Guide*
- X. [United States Access Board - Public Rights-of-Way Accessibility Guidelines \(PROWAG\)](#)
- Y. [Uniform Vehicle Code](#)

### **7.1.2 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*, Seventh Edition (MPWSS), and the 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 (MPWSS, as amended)
2. SECTION 02110 Geotextiles (MPWSS, as amended)
3. SECTION 02234 Sub Base Course (MPWSS, as amended)
4. SECTION 02235 Crushed Base Course (MPWSS, as amended)
5. SECTION 02510 Asphalt Concrete Pavement (MPWSS, as amended)
6. SECTION 02529 Concrete Sidewalks, Driveways, Approaches, Curb Turn Fillets, Valley Gutters and Miscellaneous New Concrete Construction (MPWSS, as amended)

### **7.1.3 Standard Drawings**

Standard drawings related to transportation system improvements shall be in conformance with the MPWSS Standard Drawings; [Montana Department of Transportation Detailed Drawings](#); and City of Missoula Standard Drawings 700-series contained in [Appendix 2-B](#) of this Manual.. The applicable standard drawing is dependent on the project jurisdiction.

### **7.1.4 Vision Zero Policy**

The City of Missoula has adopted a Vision Zero policy (Resolution #8633) that is centered around a goal of zero traffic deaths and zero severe injuries among all transportation system users. The policy directs transportation system planning and design to this goal and identifies safety as the highest priority when there are competing requests for right-of-way use. To this end, the *Missoula City Public Works Standards and Specifications Manual* outlines standards for surface transportation that prioritize and comply with this directive.

## **7.2 General Requirements**

### **7.2.1 Design Standards**

A. Standards for transportation systems design shall follow current editions of the references, appendices, 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. Plans shall be designed and annotated in English units.
- D. Plans shall be digitally submitted as full-sized sheets (24-inch by 36-inch or 22-inch by 34-inch) or half-sized sheets (11-inch by 17-inch).
- E. Improvement plans shall comply with the general requirements of [Section 3.2](#) (Improvement Plans) of this Manual and the [Public Infrastructure Stage Review Process Checklists](#) for specific plan information that shall be included in each project stage submittal. Transportation system plans shall at a minimum include following components as applicable, in this order:
  1. **Cover Sheet;**
  2. **General Notes and Legend Sheet;**
  3. **Survey Control and Linear and Level Data Sheet;**
  4. **Typical Sections, including:**
    - a. Corresponding station ranges,
    - b. Centerline and respective right-of-way offsets,
    - c. Surface widths of proposed elements (lanes, shoulders, curb and gutter, boulevards, sidewalks, paths, etc.),
    - d. Surfacing cross slopes,
    - e. Proposed surfacing, base, and sub-base materials and thicknesses, and
    - f. Separation/stabilization fabric extents.
  5. **Project Detail Sheets, including:**
    - a. Project-specific surface infrastructure details and
    - b. Intersection grading details.
  6. **Demolition Plans, including:**
    - a. Construction limits,
    - b. Hatched areas of asphalt, concrete, and topsoil removals,
    - c. Callouts for removals and relocations of utilities and other miscellaneous surface elements, and
    - d. All existing trees, tree protection zones, and trees to be removed.

**7. Roadway/Street Plan and Profile Sheets, including:**

- a. The following plan view elements in addition to those provided in [Section 3.2](#):
  - 1) Street alignment stationed in 100-ft intervals and including:
    - a) Bearings,
    - b) Curve data, and
    - c) Deflection points.
  - 2) Right-of-way and public access easement boundaries and centerlines including street names,
  - 3) Adjacent parcel lot lines and ownership or subdivision information,
  - 4) Intersection monuments and control points,
  - 5) Proposed street widths at width transition points. Street widths are measured from:
    - a) Back-of-curb to back-of-curb,
    - b) Back-of-curb to edge-of-asphalt, or
    - c) Edge-of-asphalt to edge-of-asphalt.
  - 6) Proposed curb radii and curb extension taper rates,
  - 7) Asphalt paving match lines,
  - 8) Approach widths, materials, and thicknesses,
  - 9) Curb ramps and detectable warning surfaces at intersections showing spot elevations, running grades, and cross slopes for all ramps, sidewalks, accessible spaces, features, and facilities,
  - 10) Construction limits differentiated as cut or fill tie-in boundaries, and
  - 11) Boulevard widths and materials, including tree class and location.
- b. The following profile view elements in addition to those provided in [Section 3.2](#):
  - 1) Corresponding horizontal alignment stationing on the x-axis and elevation on the y-axis,
  - 2) Existing ground profile,
  - 3) Proposed vertical profile including:
    - a) Vertical curve data,
    - b) Vertical tangent grades,
    - c) Points of deflection, and
  - 4) Projected utility crossing locations.

**8. Storm Drain Sheets, including:**

- a. Project specific detail sheets,
- b. Spot elevations and grades of features,
- c. Back of curb and sidewalk,
- d. Existing and proposed stormwater pipes and structures,
- e. Catch and spill curb and gutter including transitions, and
- f. Flow grades on street and gutter.

**9. Signing and Pavement Marking Sheets, including:**

- a. Project specific detail sheets,

- b. Lane widths,
- c. Accurate graphic depiction with station and offset for:
  - 1) Locations of existing and proposed traffic control and street name signs,
  - 2) The beginning, end, and transition points for linear pavement markings, and
  - 3) Locations of pavement marking words and symbols.

**10. Electrical Sheets, including:**

- a. Project specific detail sheets including,
  - 1) Service wiring diagrams,
  - 2) Circuit one-line diagrams, and
  - 3) Pole, base, and foundation details.
- b. Street lighting and other miscellaneous traffic control elements (e.g., RRFBs, traffic signals, etc.) in a pole schedule showing:
  - 1) Pole base station and offset,
  - 2) luminaire fixture types,
  - 3) pole type,
  - 4) pole base type, and
  - 5) foundation dimensions.
- c. Plan view showing:
  - 6) Conduit schematic and schedule showing size, material, and wires,
  - 7) Utility service locations, and
  - 8) Pull box locations.
- c. Lighting fixture technical specification sheets, and
- d. An ISO foot-candle plot with a maximum 5-ft x 5-ft calculation point grid showing calculated illuminance levels for the entire right-of-way and public access easements. Separate calculation areas and tabulated photometric results based on the facilities included in the right-of-way, including:
  - 1) the full adjacent street width (between curbs or within the traveled way for uncurbed facilities);
  - 2) all adjacent pedestrian, bicycle, and transit facilities;
  - 3) marked crosswalks and intersections; and
  - 4) light trespass onto adjacent property to indicate compliance with requirements of [City of Missoula Lighting Ordinance, MMC 8.64.](#)

**11. Landscaping Sheets, including:**

- a. Existing and proposed boulevard trees and landscaping,
- b. Roundabout and median island landscaping, and
- c. Irrigation sleeves and service lines.

**12. Cross-Section Sheets, including:**

- a. Sections cut from construction limit to construction limit at the following locations:
  - 1) Every 25-ft station interval,
  - 2) Horizontal and vertical points of curvature and deflection points, and
  - 3) Centerlines of adjacent driveway approaches.

- b. Proposed utilities and projected existing utilities, and
- c. Right-of-way and public access easement boundaries.

### **7.2.3 Design Reports**

#### **A. Traffic Impact Study**

1. Developments or redevelopments that will contribute 200 or more additional 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, turning movement count duration and data needs, capacity analyses (e.g. peak hour capacity, 16-hour efficiency, 16-hour excess lane capacity, etc.), and any adjacent development/redevelopment 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/redevelopment on the transportation facilities. It shall include considerations for access management, traffic calming, transportation demand management, and/or other mitigation measures.
  - a. Submittal information shall at minimum include:
    - 1) Proposed site description,
    - 2) Traffic 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 7 a.m. to 9 a.m. and 4 p.m. to 6 p.m. in order to ensure the correct peak hour is captured.
        - ii. Justification must be provided during item 3 above to count a shorter time period or time period other than the traditional peak periods.
        - iii. A longer count duration (e.g. 16 hours – 5 a.m. to 9 p.m.) may be required for specific intersections based on the analyses required per item 3 above.
        - iv. All count data shall include pedestrian and bicyclist volumes.

- v. Vehicular classification data (e.g., passenger vehicles, large trucks, buses) may be required depending on the study intersection.
- b) Adjacent development/redevelopment (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), and
- h) Site generated primary trips – build volumes.
- 3) All capacity analyses shall compare no-build to build per intersection and per movement in the design year,
- 4) Report summary, conclusions, and recommendations,
- 5) Queueing data, which may be requested at the discretion of the City Engineer, and
- 6) Crash analysis may be requested at the discretion of the City Engineer.
- 6. City Engineering 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/redevelopment is adjacent to or within 0.25 mile of an established public transit route, City Engineering 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/redevelopment affects infrastructure under MDT's jurisdiction, those plans and the traffic impact study may need MDT review and approval.

## B. Geotechnical Report

1. All proposed streets must submit, at a minimum, a site-obtained California Bearing Ratio (CRB) test. Street section standards in [7.4.1](#) of this chapter are based on the CBR. CBR tests must be conducted on site and at the depth of subgrade. A minimum of one CBR test per site and in each soil type is required.
2. Street sections that are proposed below the minimum standards in [7.4.1](#) of this chapter shall submit a geotechnical report to support the design.
3. Geotechnical reports shall be informed by a site-specific, subsurface investigation. A subsurface investigation plan shall be submitted to the City Engineer for approval prior to any investigation work occurring and shall provide the following information:
  - a. Number of and locations for boreholes or test pits, including:
    - 1) A minimum frequency of one borehole/test pit per 300 feet of project street length, and

- 2) At least one borehole/test pit for every NRCS map unit soil type present within the project footprint.
- b. Expected minimum depth of each borehole or test pit,
- c. Equipment to be used for sampling, and
- d. Laboratory and in-situ testing procedures to be performed.
- 4. The geotechnical report shall be submitted with the improvement plans through the normal application process.
- 5. The geotechnical report shall include a description of the project, a soil survey, laboratory testing, subsurface conditions including bore logs showing 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 distance shall be based on NACTO guidelines and Chapter 9.5 in the [American Association of State Highway and Transportation Officials \(AASHTO\) A Policy on Geometric Design of Highways and Streets](#).

### **7.3 Traffic Control**

#### **7.3.1 General**

- A. Traffic control refers to all signs, signals, markings, and other devices used to regulate, warn, or guide traffic that are placed on, over, or adjacent to a street, highway, pedestrian facility, bicycle facility, or private street open to public travel by authority of a public agency or official having jurisdiction, or in the case of a private street, by authority of the private owner or private official having jurisdiction. This definition includes marked crosswalks and additional pedestrian crossing enhancements. Circular intersections such as roundabouts and neighborhood calming circles are intersection designs and the decision to convert a conventional intersection to a circular intersection is an engineering design decision and not a traffic control device decision. Circular intersections are discussed in [7.3.9](#) of this chapter.

#### **7.3.2 Traffic Control Devices**

- A. **Uses.** Traffic control devices are used for the following:
  - 1. To promote safety and efficiency by providing for the orderly movement of all users on streets, bicycle facilities, sidewalks, shared use paths, and private streets open to public travel.
  - 2. To notify road users of requirements and provide the warning and guidance needed for effective and efficient operation of transportation facilities, in a manner intended to minimize conflicts and promote safe operations.
- B. **Types.** The type of traffic control devices used at an unsignalized intersection should be the least restrictive that provides appropriate levels of safety and efficiency, especially for bicyclists and

pedestrians. Engineering judgment should be used to establish intersection control, taking the following factors into account:

1. Vehicular, bicycle, and pedestrian traffic volumes on all approaches,
2. Driver yielding behavior for bicyclists and pedestrians,
3. Number and angle of approaches,
4. Approach speeds,
5. Sight distance available on each approach, and
6. Reported crash history.

### **7.3.3 Uncontrolled Intersections**

**A.** Uncontrolled intersections provide free-flowing movement to all street users. However, they also can present safety challenges when speeds, volumes, presence of bicyclists and pedestrians, or other conditions do not meet user expectations. The decision to use no intersection control should be based on engineering judgement, taking the following factors into account:

1. Intersection sight distance is adequate on all approaches.
2. All approaches to the intersection are single lane, and there are no turn lanes.
3. Traffic volumes for all modes are very low, typically fewer than 1,000 vehicles, bicyclists, and pedestrians combined entering the intersection each day.
4. There are no marked crosswalks or bicycle lanes on any approach.
5. None of the approaches to the intersection are for a highway, main street, or higher functional classification.
6. The angle of the intersection is between 75 and 90 degrees.
7. User expectations are consistent contextually with the adjacent transportation network.

### **7.3.4 Stop Signs**

**A.** The MUTCD provides ample guidance on when and where to use stop control at intersections. When proposing stop control on one or multiple intersection approaches, the engineer shall include reference to which warrant(s) are met and which condition(s) are present to lead to this decision.

**B.** Stop signs should be used conservatively for several reasons:

1. Overuse can decrease effectiveness;
2. Some streets, such as Neighborhood Greenways and Residential Collectors, should be as free-flowing as possible;
3. Frequent vehicle stopping can increase localized tail pipe emissions and increase noise pollution due to acceleration;
4. Incorrectly placed stop signs may lead drivers to use other streets, pushing traffic and safety issues to adjacent streets and/or neighborhoods, increased mid-block speeding between signs, and increased maintenance costs; and
5. Stop signs shall not be used for speed control.

### 7.3.5 Yield Signs

- A. Yield signs offer more flexibility where some amount of traffic control may be warranted but stop signs feel like overkill. Replacing stop signs with yield signs, where appropriate, can substantially reduce energy consumption, traffic delay, and air pollution.
- B. Though Yield signs can provide benefits, they also can present challenges. Yield signs should be used conservatively for several reasons:
  - 1. Some drivers overreact to the yield condition and stop unnecessarily, potentially leading to rear end crashes.
  - 2. Some drivers fail to adhere to the yield condition, potentially leading to right angle crashes.
- C. The MUTCD provides ample guidance on the most common applications for Yield signs, which are on the approach to roundabouts and at merging locations. When considering Yield control at intersections of two local streets, ALL the following conditions must exist:
  - 1. Intersection sight distance is adequate on the approaches to be controlled by yield signs;
  - 2. All approaches to the intersection are single lane, and there are no turn lanes;
  - 3. One of the following crash related criteria applies:
    - a. For changing from no control to yield control, there have been two or more reported crashes susceptible to correction by yield control in the past 12 months or
    - b. For changing from minor road stop control to yield control, there have been two or fewer reported crashes in the past 12 months.
  - 4. Entering intersection volume of fewer than 1800 vehicles, bicyclists, and pedestrians combined per day or 140 in the peak hour;
  - 5. The angle of the intersection is between 75 and 90 degrees; and
  - 6. The functional classification of the intersecting streets is either the intersection of two local streets or the intersection of a local street with a collector street.

### 7.3.6 Speed Limit Signs

- A. Speed limit signs are typically located at:
  - 1. Jurisdictional boundaries (e.g., county to city),
  - 2. Changes in speed limits,
  - 3. On streets with a speed limit that deviates from statutory expectations,
  - 4. Within 150 feet of an intersection entering a neighborhood from a higher functionally classified roadway, and
  - 5. Where deemed necessary by the City Engineer.

### 7.3.7 Marked Crosswalks

- A. Per state law, every intersection is a legal crosswalk, and motorists are required to yield to pedestrians, provided the pedestrian gives intent to cross with enough time for the motorist to safely yield (MCA 61-8-502). Marked crosswalks, in conjunction with signs and other measures,

enhance safety for pedestrians, communicate to pedestrians the desired crossing locations, and help alert road users of a designated pedestrian crossing point.

- B.** Crosswalks should not be marked indiscriminately. A traffic investigation should be performed before a marked crosswalk is installed at a location away from a traffic control signal or an approach controlled by a STOP or YIELD sign. The investigation should consider the number of lanes, the presence of a median, the distance from adjacent signalized intersections, the pedestrian volumes and delays, the average daily traffic (ADT), the posted or statutory speed limit and/or 85th-percentile speed, driver yield behavior, the geometry of the location, the possible consolidation of multiple crossing points, the availability of street lighting, and other appropriate factors.
- C.** Drawing on the guiding principles of the Pedestrian Facilities Master Plan, the City of Missoula strives to provide safe, accessible, and highly visible pedestrian crossings with enough frequency to encourage pedestrian travel. For this reason, there should be a distance of no greater than 1/4 mile between such crossings along all arterials and collectors.
- D.** Crosswalks may be required to be striped at the discretion of the City Engineer. When a marked crosswalk is installed, the following is considered:
  1. Marked crosswalks on roadways exceeding 3,000 vehicles per day should receive a higher priority than those streets with less than 3,000 vehicles per day.
  2. Marked crosswalks at locations having a minimum of 20 pedestrian crossings per peak hour (or 15 or more elderly and/or child pedestrians per peak hour) should have a higher priority than those that do not.
  3. Marked crosswalks should be prioritized at designated school zones, approved midblock crossings, primary and secondary commuter trail crossings, along Neighborhood Greenways, adjacent to bus stops, parks, and other large pedestrian generators, and within the Central Business District. These crosswalks shall use high visibility marking patterns such as continental or ladder. Other high contrast patterns may be used if approved by the City Engineer.
  4. Marked crosswalks in other locations, such as across stop- and signal-controlled intersection legs, may use standard or parallel line style markings.
  5. All marked crosswalks at midblock locations and across uncontrolled legs of intersections shall also be identified with appropriate MUTCD compliant signs.
  6. Pavement marking materials shall adhere to MUTCD standards for reflectivity and can include, but shall not be limited to, epoxy paint, glass beads, hot and/or cold applied thermoplastic tapes, etc., as required by the City Engineer. Pre-formed thermoplastic markings are preferred.
  7. Marked crosswalks should be supplemented with other treatments (traffic-calming, traffic signals and/or pedestrian signals when warranted, lighting, or other substantial crossing improvements) based on vehicle speeds, vehicle volumes, and number of travel lanes, per Table 1.

**Table 1 – Recommended Countermeasures for Uncontrolled Intersections**

Roadway Configuration	Speed Limit (mph)											
	≤30	35	≥40	≤30	35	≥40	≤30	35	≥40	≤30	35	≥40
	<3,000 AADT			3,000 - 9,000 AADT			9,000 - 15,000 AADT			>15,000 AADT		
2 lanes (one lane in each direction)	N/A	N/A	N/A	<b>1</b> 2 3 4 5	<b>1</b> 2 4 5 6	<b>1</b> 2 4 5 6	<b>1</b> 2 3 4 5	<b>1</b> 2 4 5 6	<b>1</b> 2 4 5 6	<b>1</b> 2 3 4 5 6	<b>1</b> 2 4 5 6	<b>1</b> 2 4 5 6
3 lanes (raised median, one lane in each direction with left turn lanes)	N/A	N/A	N/A	<b>1</b> 2 3 4	<b>1</b> 2 4 6	<b>1</b> 2 4 6	<b>1</b> 2 3 4	<b>1</b> 2 4 6	<b>1</b> 2 4 6	<b>1</b> 2 3 4	<b>1</b> 2 4 6	<b>1</b> 2 4 6
3 lanes (no raised median, one lane in each direction with two-way left turn lanes)	N/A	N/A	N/A	<b>1</b> 2 3 4 5 6	<b>1</b> 2 4 5 6	<b>1</b> 2 4 5 6	<b>1</b> 2 3 4 5 6	<b>1</b> 2 4 5 6	<b>1</b> 2 4 5 6	<b>1</b> 2 3 4 5 6	<b>1</b> 2 4 5 6	<b>1</b> 2 4 5 6
4+ lanes (raised median, 2+ lanes in each direction)	N/A	N/A	N/A	<b>1</b> 2 4	<b>1</b> 2 4 6	<b>1</b> 2 4 6	<b>1</b> 2 4	<b>1</b> 2 4 6	<b>1</b> 2 4 6	<b>1</b> 2 4 6	<b>1</b> 2 4 6	<b>1</b> 2 4 6
4+ lanes (no raised median, 2+ lanes in each direction)	N/A	N/A	N/A	<b>1</b> 2 4 5 6 7								
<b>Possible Treatments:</b>												
1. High visibility crosswalk markings, parking restriction on crosswalk approach, adequate night time lighting levels 2. Advanced yield to pedestrians sign and marked line 3. In-street pedestrian crossings sign           4. Curb extension 5. Pedestrian refuge island 6. Pedestrian hybrid beacon/flashling beacon 7. Road diet												
<b>Note:</b> Bold white text signifies the safety treatment should always be considered, but not mandated or required, based on engineering judgement. Other numbers noted signify the safety treatment is a candidate but does not always need to be considered. Crossing treatments are unnecessary for most intersections below 3,000 AADT. (Adapted from the FHWA: <a href="https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/pocket_version.pdf">https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/pocket_version.pdf</a> )												

### 7.3.8 Rectangular Rapid Flashing Beacons (RRFB)

- A. An RRFB is a pedestrian-activated device comprising two horizontally arranged, rapidly flashed, rectangular-shaped yellow indications that is used to provide supplemental emphasis for a pedestrian, school, or trail crossing warning sign at a marked crosswalk across an uncontrolled approach. RRFBs alert motorists to the presence and intention of pedestrians to cross. They are warning devices and do not themselves create a legal requirement for a vehicle to stop when they are flashing.
- B. RRFBs are typically reserved for streets with vehicle volumes over 3,000 AADT. Table 1 should be used for more specific guidance.
- C. RRFBs should be located as close to the crosswalk as possible and follow installation guidance in the MUTCD.

### 7.3.9 Circular Intersections

#### A. Neighborhood Traffic Calming Circle

1. A Neighborhood Traffic Calming Circle is a small circle in the center of an intersection of two or more streets, intended to calm traffic by forcing vehicles to travel around the circle. They do not change the normal yield-to-the-right rules of traffic operation.
2. Neighborhood Traffic Calming Circles should be considered at intersections of two local streets and intersections of local streets and Neighborhood Greenways. Neighborhood Traffic Calming Circles shall not be placed along collector or arterial streets.
3. Neighborhood Traffic Calming Circles are typically not located on consecutive intersections.
4. Neighborhood Traffic Calming Circles may alleviate the need for more restrictive traffic control by reducing entry speeds to meet sight distance requirements. However, Neighborhood Traffic Calming Circles may not be able to reduce speeds enough to meet sight distance requirements and therefore may be used in conjunction with STOP or YIELD signs.
5. The City of Missoula may construct Neighborhood Traffic Calming Circles, using a light/quicker/cheaper approach that consist of signs, paint, and flexible delineators. These are temporary in nature, and the City may construct permanent facilities in the future.
6. All permanent Neighborhood Traffic Calming Circles constructed by developers/private contractors shall be permanent and meet current standards.
7. Design and construction shall adhere to [City of Missoula Standard Drawing 709](#).

#### **B. Hybrid Urban Mini Roundabouts**

1. Hybrid Urban Mini Roundabouts are larger than Neighborhood Traffic Calming Circles and smaller than Urban Mini Roundabouts. They have a fully mountable center island and are distinguished from Urban Mini Roundabouts by the absence of raised splitter islands, which are instead created by pavement markings and may include delineators. Additionally, the pedestrian crossings are typically in line with existing sidewalks and are not set back from the circular path of travel. Hybrid Urban Mini Roundabouts slow speeds upon entry and create horizontal deflection to change the right-of-way rules so that drivers must yield to the left.
2. Hybrid Urban Mini Roundabouts should be considered at the intersection of a local street or Neighborhood Greenway with a collector, or two relatively low volume collectors.
3. Hybrid Urban Mini Roundabouts should only be considered where right-of-way is constrained and/or intersection curb lines exist. These are typically not appropriate for greenfield applications.

#### **C. Urban Mini Roundabouts**

1. Urban Mini Roundabouts have larger footprints than Neighborhood Traffic Circles and smaller footprints than Single-Lane Roundabouts. They consist of a fully mountable center circle with splitter islands on each approach. Urban Mini Roundabouts slow speeds upon entry and create horizontal deflection to change the right-of-way rules so that drivers must yield to the left.

2. Urban Mini Roundabouts should be considered at the intersection of two collectors, or an arterial and collector, in place of all way stop control.
3. The pedestrian crossings at all legs of Urban Mini Roundabouts should generally be located one vehicle length away from the circular path of travel.
4. Urban Mini Roundabouts shall adhere to AASHTO, NCHRP, and MUTCD guidelines.

#### **D. Single-Lane Roundabouts**

1. Single-Lane Roundabouts represent major intersection control and are often considered instead of traffic signals. They consist of a partially mountable center island with a central planting area, raised splitter islands, and set back pedestrian crossings.
2. Single-Lane Roundabouts should be designed to create enough horizontal deflection to slow typical entry speeds and circulating speeds to approximately 15 to 20 mph.
3. Single-Lane Roundabouts should be considered at intersections of two arterials or an arterial and major collector.
4. Center island maintenance parking pullouts shall be designed outside the truck apron.
5. Single-Lane Roundabouts may have three, four, or more approaches.
6. Single-Lane Roundabouts shall adhere to AASHTO, NCHRP, and MUTCD guidelines.

#### **E. Multi-Lane Roundabouts**

1. Multi-Lane Roundabouts have at least two travel lanes on at least one approach, and/or within the circle. This includes roundabouts with right turn slip lanes. They consist of a partially mountable center island with a central planting area, raised splitter islands, and set back pedestrian crossings.
2. Multi-Lane Roundabouts should be considered at intersections of two arterials or an arterial and major collector when increased traffic volumes necessitate.
3. Center island maintenance parking pullouts shall be designed outside the truck apron.
4. Multi-Lane Roundabouts may have three, four, or more approaches.
5. Pedestrian crossings at Multi-Lane Roundabouts should be enhanced with RRFBs or other user activated warning devices.
6. Multi-Lane Roundabouts shall adhere to AASHTO, NCHRP, and MUTCD guidelines.

### **7.3.10 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.
- B. Traffic calming devices, unless otherwise noted herein, shall meet AASHTO design standards and the [FHWA Traffic Calming ePrimer](#).

### **7.3.11 Traffic Signals**

- A. Standards for traffic signals can be found in the [MDT Traffic Engineering Manual, Chapter 12](#). All traffic signals shall be designed to these standards.

## B. 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's Signals, Streetlights, and Communications Shop.

### 7.3.12 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 [Pedestrian Right-of-Way Accessibility Guidelines \(PROWAG\)](#) 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. Within the right-of-way or public access easement, accessible route clear space shall be a minimum of 5 feet, or 4 feet around fixed obstructions, in width on sidewalks (6 feet in minimum width within the Central Business District).
- G. Sidewalks and accessible routes should be kept at-grade, when possible, when they cross driveways and alleys.
- H. Refer to [City of Missoula Standard Drawings 782-787](#) for parking lot accessibility standards.

## 7.4 Design Standards

### 7.4.1 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 degree, construction must be made by horizontal curves.
  3. Vertical curves shall be symmetrical and required with a cumulative grade differential of 3% or greater over the design speed's stopping distance.

B. Chip and seal application is required on all arterial and collector roadways for new asphalt improvements of one-half the street width or greater and a City block or greater.

1. Chip and seal requirements shall follow MPWSS Section 02504 *Asphalt Seal Coat* using 3/8-inch aggregate.
  - a. The chip and seal work must be completed prior to the expiration of the two-year warranty.
  - b. After inspecting the asphalt, the Engineer shall contact the City for an asphalt inspection prior to the chip and seal work.
    - 1) The chip and seal work shall not begin if the Engineer or City determines upon inspection that asphalt remediation is required.
    - 2) Any and all asphalt remediation shall be conducted prior to the chip and seal work.
2. Pavement markings shall be installed in accordance with [7.4.9](#) of this chapter.

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 7-2 through 7-5 and applicable [City of Missoula Standard Drawings](#).

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 7-2.

**Table 7-2 – 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 Standard Modifications to MPWSS Section 02235 and Section 02236](#)
- b. Base course shall be placed to a depth of 6 inches in all applications per Table 7-3.

**Table 7-3 – 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. Subbase Course

- Subbase course material shall comply with [City of Missoula Standard Modifications to MPWSS Section 02234](#).
- Subbase course shall be placed at the minimum thicknesses per Table 7-4.

**Table 7-4 – 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.

- Subgrade shall be prepared in accordance with [City of Missoula Standard Modifications to MPWSS Section 02230](#).
- Geotextile material and installation may be used and will be based on a geotechnical report and shall comply with [City of Missoula Standard Modifications to MPWSS Section 02110](#).
  - City shall approve the geotextile material prior to installation.
- All streets and new alleys shall be designed with the following:
  - Cross-slope
    - Minimum 2% from centerline (this is the default standard).
    - Cross slope above 5% requires City Engineer approval.
    - Intersection grading may allow for different minimum standards but shall provide for adequate surface drainage.
  - Minimum widths for street elements are provided in Table 7-5.

**Table 7-5 – Street Design Widths**

	<b>Arterial (feet)<sup>(6)</sup></b>	<b>Collector (feet)<sup>(6)</sup></b>	<b>Local (feet)<sup>(6)</sup></b>	<b>Alley (feet)<sup>(7)</sup></b>
Right of way width <sup>(1)</sup>	100	80	60	20
Drive/Turn Lane <sup>(2)</sup>	10	10	10	12
Bike Lane <sup>(3)</sup>	6	6	-	-
Parking Lane <sup>(4)</sup>	8	7.5	7	-
Boulevard (min) <sup>(5)</sup>	10	8	7	-
Sidewalk (min) <sup>(9)</sup>	6	5	5	-
Utility Easement <sup>(8)</sup>	5	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 includes the adjacent gutter/pan width. Parking is required on both sides of the street.

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

(6) Streets adjacent to buildings requiring aerial fire apparatus shall have an unobstructed 26-foot width and all access routes shall meet turning movements for "aerial apparatus."

(7) For other alley requirements, see 7.4.6.

(8) A public utility easement shall be placed adjacent to the right-of-way for the width shown in Table 7-5 on each side of the right-of-way.

(9) For other sidewalk width requirements, see 7.4.12 K-M.

## **7. Grade**

- a. Shall substantially follow natural contours.
- b. Shall not exceed a maximum grade of 10%.
- c. All utility appurtenances shall be adjusted to be between flush and  $\frac{1}{4}$  inch below and match grade and cross slope of street with use of tapered grade rings.

## **8. Locations**

- a. 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.
- b. 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.

- c. 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.

#### **7.4.2 Cul-de-Sacs, Loop and Circle Streets, Dead-End Streets, and Turnarounds**

- A. Cul-de-sacs, loop and circle streets, and dead-end streets are prohibited unless approved by City Engineering.
  - 1. If approved, turnarounds shall be per [IFC, Appendix D](#).
  - 2. If approved, the maximum length of a cul-de-sac street is 600 feet.

#### **7.4.3 Private Streets**

- A. Shall be designed and constructed to City street standards.
- B. Shall be located within a public access with private maintenance easement.

#### **7.4.4 Short Courts**

- A. Shall not be used where a through street is possible.
- B. Shall be placed within a public access with private maintenance easement.
- C. Shall have a minimum unobstructed width and turnarounds per [IFC, Appendix D](#).
- D. Shall have a maximum length of 200 feet.

#### **7.4.5 Home Zones/Woonerfs**

- A. Shall provide a connection between two streets or vehicle access system and be 300 feet or less in length.
- B. Shall have a minimum unobstructed clear space per [IFC, Appendix D](#).
- C. 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.
- D. 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.
- E. 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.

#### **7.4.6 Alleys**

- A.** All alleys shall meet the requirements of MMC 12.10.110.G.
- B.** All alleys proposed within new development shall meet the following requirements:
  - 1. Alley improvement plans shall be designed and sealed by a licensed professional engineer in the state of Montana;
  - 2. Alleys shall have a minimum unobstructed width of 20 feet;
  - 3. Alleys shall have a minimum paved width of 20 feet; and
  - 4. Alleys requiring fire apparatus access for a ladder truck may have additional design requirements and shall be approved by the City Fire Marshall.
- C.** If new development or redevelopment requires fire apparatus access from an existing alley, the alley shall meet the following requirements:
  - 1. Alley improvement plans shall be designed and sealed by a licensed professional engineer in the state of Montana;
  - 2. Alleys shall have a minimum unobstructed width of 16 feet;
  - 3. Alley surfacing (street to street including approaches) shall consist of 2-inch depth of asphalt millings or pavement with a minimum width of 16 feet in accordance with City of Missoula Standard Drawings 705 and 706; and
  - 4. Alleys providing fire apparatus access for a ladder truck may have additional design requirements and are approved on a case-by-case basis by the City Engineer and Fire Marshall.

#### **7.4.7 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.** At minimum, adjacent development is required to design and install half street improvements including curb, gutter, and sidewalk on one side as well as enough pavement for two drive lanes and bike lanes on a collector or arterial street. The City Engineer may require installation of curb on the opposite side of the street as well as full width of right of way or public easement.
- 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 [7.4](#) 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 designated fire response routes, fire apparatus access routes, and fire lanes shall meet the currently adopted edition of [IFC, Appendix D](#), shall require approval from the City Fire Marshall, and shall incorporate the following design provisions:

1. The appropriate City of Missoula fire apparatus shall be used as the design vehicle.
2. The City of Missoula ladder truck shall be used as a control vehicle for fire response routes on streets.

F. Bus stop pull-outs shall comply with [City of Missoula Standard Drawing 712 \(3 sheets\)](#), 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.
2. Mailbox pull-outs shall comply with [City of Missoula Standard Drawings 713-1 \(3 sheets\)](#) and the following:
  - a. 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.
  - b. Mailbox clusters must be provided within  $\frac{1}{4}$  mile (1320 feet) of each residence, per phase, along an accessible route.
  - c. 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.

G. Roundabout center island landscaping and median landscaping shall meet the specifications in the Missoula Parks and Recreation Design Manual and shall be approved by the Missoula Parks and Trails Design and Development Manager.

#### 7.4.8 Signing

- A. All warrants and locations for street signs and traffic control within the right-of-way shall be in conformance with the latest edition of the MUTCD.
  1. Sign bases and poles shall comply with [City of Missoula Standard Drawing 720](#).
  2. Sign mounting shall comply with [City of Missoula Standard Drawing 721](#).
- B. Sign placement shall comply with [City of Missoula Standard Drawing 722](#).
- C. Accessible parking signs shall comply with [2009 ANSI A117.1: Accessible and Usable Buildings and Facilities](#) and [City of Missoula Standard Drawing 787](#).
- D. Curbside bike lanes shall include the following signage (listed in order) for each respective facility:
  1. One R3-17/R8-3 (top/bottom) assembly at the starting point;
  2. One R8-3 assembly at the downstream end of each intermediate intersection crossing and intermediately at consistently spaced intervals (maximum of 500 ft) where intersection spacing exceeds 500 ft; then
  3. One R3-17/R3-17bP assembly at the terminus.

- E. Existing sign faces on assemblies that will be relocated or temporarily removed and reset shall be replaced and salvaged to the City of Missoula Traffic Services Division unless conformance with the MUTCD can be proven to the City by the Engineer during design.
- F. Naming of streets shall comply with MMC 12.10.110.H. Street names shall be approved by City of Missoula GIS Services and Missoula County.

#### 7.4.9 Striping

- A. All street marking shall comply with MUTCD for dimension, placement, color, message, symbology, and retro reflectivity.
- B. Pavement markings, including the timing and requirements of temporary, interim, and final pavement markings, shall be per the [Montana Department of Transportation Standard Specifications for Road and Bridge Construction](#).
- C. Paint layout shall comply with [City of Missoula Standard Drawing 730](#).
- D. Pavement marking shall include paint and glass beads.
- E. All striping of asphalt surfaces, including final pavement markings, may use waterborne paint, including F. below. Other marking materials may be used at the discretion of the City Engineer.
- F. 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 feet 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.
- G. Bike lane striping shall consist of white lines with the inside line being 6 inches wide and the outer line 4 inches wide, as applicable.
- H. Bike lane symbols shall be marked at the starting point of each facility, at the downstream end of each intersection crossing, and at maximum 500 ft intervals.
- I. Stop bars and yield lines shall be marked 4 feet back from striped crosswalks or stop/yield sign and be the full width of the drive lane(s) and bike lane (excluding the parking area if present).
- J. Sharks teeth shall be used in lieu of stop bars at uncontrolled intersections.
- K. “No parking” areas shall be marked on the curb with yellow epoxy marking from the bottom of the curb face to the top back of curb and at the locations and distances listed in Table 7-6 or at the discretion of the City Engineer. The distance referenced in Table 7-6 for approaches/entrances is measured along the road centerline from the start of the laydown.
- L. Curbs shall not be marked with yellow epoxy in the locations indicated in Table 7-6 where an adjacent parking lane is not present (e.g. when curb and gutter is directly adjacent to a bike lane or the traveled way).

**Table 7-6 – No Parking Areas**

Location	Distance (feet)	Requirement
Residential Approach	5	Discretionary
Commercial Approach	10	Required
Alley Approach	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 (approach)	30	Required
Crosswalk-Controlled Intersection (departure)	20	Required
Railroad Crossing	50	Required

#### 7.4.10 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

1. 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 over lighting.
2. Illumination standards for shared street, pedestrian, and bicycle way lighting shall follow the [MDT Traffic Engineering Manual, Chapter 13](#).
3. Illumination standards for shared-use paths and commuter trails with independent alignments shall meet associated specifications in [the Missoula Parks and Recreation Design Manual](#).
4. [MDT Standard Specifications for Road and Bridge Construction](#), latest edition, unless exceeded by City of Missoula lighting standards in this Manual.
5. [Manual of Uniform Traffic Control Devices \(MUTCD\)](#), latest edition.
6. NFPA 70 – National Electrical Code, latest edition.
7. NESC – National Electrical Safety Code.
8. 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, and
  - d. At raised medians.
2. Lighting shall be considered at the following locations:
  - a. Along collector streets,

- b. At intersections of two collector or arterial streets,
- c. At intersections of high traffic locations, such as a development's main road and a collector or arterial,
- d. Along streets with complex geometry,
- e. At intersections that incorporate channelization or traffic circles,
- f. At high-conflict locations, such as commercial developments with numerous approaches or high truck traffic,
- g. At high crash locations attributable to lack of lighting, and
- h. 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. It is not always possible to meet illumination standards for all right-of-way facilities given various competing constraints and variables (e.g., maximum light trespass vs. boulevard sidewalk illumination, roadway uniformity vs. crosswalk illumination, etc.). Lighting designers should strive to meet all competing illumination standards to the extent it is feasible, with the understanding that the City will review each layout and make context-sensitive requirements as appropriate. Illumination standards shall be given the following priority, in descending order:

- a. Adequately illuminate conflict points (crosswalks and intersections);
- b. Attempt to meet average illumination standards and uniformity ratio for on-street elements; then
- c. Attempt to meet average illumination standards and uniformity ratio for elements outside curbs or outside the traveled way (for uncurbed streets) without exceeding light trespass standards.

4. Lighting should be located ahead of intersections and crosswalks to maximize positive contrast and avoid effects of backlighting.

5. The influence of existing adjacent lighting within rights-of-way and public easements, when present, shall be factored into new lighting layouts.

## **E. Materials**

1. Streetlight poles and fixtures shall be black and designed to closely match the style of other streetlights used in the area.
2. See [City of Missoula Standard Modifications to MPWSS Section 02529](#) for luminaire requirements.

## **F. Height**

1. Streetlight 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, the City Engineer may 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 & Mobility Department.

#### **7.4.11 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 Standard Modifications to MPWSS Section 02528](#).
- C.** Subgrade preparation shall comply with [City of Missoula Standard Modifications to MPWSS Section 02230](#).
- D.** Contraction joints shall be placed every 10 feet to a depth of one-fourth the concrete thickness.
- E.** Minimum gutter flow line shall be five-tenths (0.5%) percent slope.
- F.** Minimum curb taper rate shall be 3:1 with 10-foot radius measured at back of curb at the beginning and end of taper.
- G.** 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.
- H. Gutters**
  - 1.** Shall include stormwater facilities.
  - 2.** Shall include a valley 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 \(3 sheets\), 713 \(3 sheets\), 774, and 775](#).
    - a.** Shall be a minimum of 8 inches thick.
    - b.** Shall be a minimum of 2 feet in width with a 1-inch valley through the center.
  - 3.** Shall indicate spill/catch gutter pan.
- I.** When designing spill curb, rotate curb at top front of gutter pan hinge point, not top back of curb.
- J.** Shall include street asphalt paving patch-back to cross-slope, thickness, and base material standards per [7.4.1](#) of this chapter and [City of Missoula Standard Drawing 744](#).
  - 1.** Asphalt surface shall be square cut a minimum of 48 inches from the lip of the curb up to a maximum of the centerline of the street in order to reach a 2 to 5% cross-slope.
  - 2.** Final asphalt patch cut line shall be adjusted to ensure proper compaction of the base layer.
  - 3.** Asphalt patch seams shall be sealed in accordance with [City of Missoula Standard Modifications to MPWSS Section 02510](#).
  - 4.** Any over excavation shall be backfilled and compacted in accordance with [City of Missoula Standard Modifications to MPWSS Section 02230](#).

#### **7.4.12 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 waiver per [MMC 12.10, Right-of-Way Improvements](#).
- D. Sidewalks shall be a minimum of 4 inches thick where vehicle use and off-tracking are not anticipated.
- E. Sidewalks shall be a minimum of 6 inches thick through residential driveway approaches serving 25 parking spaces or less or a minimum of 8 inches thick through commercial/industrial driveway approaches or residential approaches serving more than 25 parking spaces. These increased thicknesses shall be carried through ramp flares when sidewalk is curbside.
- F. For sidewalk retrofits, replacement of existing sidewalk in otherwise good condition, through an existing approach, may not be required to meet thickness requirements.
- G. Shall include sight distance requirements in [7.2.4](#) of this chapter for intersections and 10 feet by 10 feet at driveway approach and alley locations.
- H. Shall minimize obstructions within the sidewalk such as utility access, mailboxes, or signs.
- I. Bollard design shall comply with [City of Missoula Standard Drawing 788](#).
- J. Curb ramps or blended transitions shall comply with [City of Missoula Standard Drawing 751 \(4 sheets\)](#), PROWAG, and the following:
  - 1. The maximum grade for blended transitions shall be 5.0%.
  - 2. The allowable grade for perpendicular ramps shall be 4.0-7.0%.
  - 3. Shall be provided at each street crossing, T-intersection, or mid-block crossing.
  - 4. Shall be contained entirely within the width of the street crossing served.
  - 5. Shall have a minimum 5-foot by 5-foot landing when feasible or a minimum 4-foot by 4-foot landing in constrained scenarios. See PROWAG for specific technical requirements.
  - 6. Curb ramps and associated landings shall be a minimum of 6 inches thick at intersections of local streets or a minimum of 8 inches thick at intersections of arterials and collectors.
  - 7. Curb ramp flares are required to be 1 foot adjacent to landscaping or a maximum of 10% adjacent to hardscape.
  - 8. Landscape curb cannot encroach into pedestrian turning space and/or landing.
  - 9. 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 and/or guardrails per [United States Access Board - Public Rights-of-Way Accessibility Guidelines \(PROWAG\)](#).
- 10. Shall include detectable warning panels per [City of Missoula Standard Drawing 750](#) at:
  - a. Street crossings,
  - b. Commercial approaches that are signed with stop control,
  - c. Refuge islands, except at-grade less than 6 feet in length in the direction of travel,
  - d. At-grade rail crossings, and
  - e. Boarding platforms.
- 11. 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. Typically placed perpendicular with the direction of pedestrian travel,
- e. Placed 2 inches maximum from back edge of curb on a minimum of one edge, and
- f. Shall contrast visually with adjoining surface.

**K.** 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.

**L.** The City's Central Business District requires 10 feet minimum width (6 feet of clear space).

**M.** If new curbside sidewalks are approved, the sidewalk width must be 6 feet in predominantly residential areas and 7 feet in all other areas.

**N.** Wider sidewalks may be required in commercial areas based on use as determined by City Engineering.

**O.** Existing sidewalks that are being removed or replaced may match existing width, but the minimum width is 4 feet and additional width may be required by the City Engineer.

**P. 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.

**Q. 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.

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

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

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

**U.** 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.

**V.** End-of-sidewalk barricades, where required, shall comply with [City of Missoula Standard Drawing 715](#).

#### **7.4.13 Parking**

**A. General**

- 1. Parking for motorized and non-motorized uses may include, but is not limited to, the following locations: approaches, parking lots, parking garages, and public and private streets.
- 2. 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.

3. For bollard standards, see to [City of Missoula Standard Drawing 788](#).

## **B. Approaches**

1. Construction materials and procedures shall comply with [City of Missoula Standard Modifications to MPWSS Section 02529](#). Approaches shall be designed per [City of Missoula Standard Drawings 770-776](#).
2. Approaches shall be a minimum of 6 inches thick when serving residential driveways with 25 parking spaces or less or a minimum of 8 inches thick when serving commercial/industrial driveways or residential driveways with more than 25 parking spaces.
3. For retrofit approaches, use of variable approach materials or existing, out of specification approaches, shall be allowed depending on existing surfacing condition and type, with approval of the City Engineer.
4. Approach horizontal locations shall require approval by the City Engineer prior to construction. All approach, parking lot, parking garage approach, or apron improvements shall be constructed at 90 degrees or perpendicular to the adjacent right of way or public easement.
5. 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,
6. Approaches for new driveways shall meet the following
  - a. The minimum width shall be 9 feet.
  - b. The maximum width shall be 12 feet for single driveways.
  - c. The maximum width shall be 24 feet for double driveways.
  - d. The approach width may equal the driveway width when greater than 24 feet wide, but shall not exceed 30 feet.
  - e. The basis for the width of a approach must correlate to the width of the driveway it leads to.
  - f. Driveway width shall be measured at the location of conforming parking.
7. For new multi-dwelling, commercial, and industrial driveways, when one or more approaches serve a given property frontage, no single approach shall exceed 30 feet in width. Total approach width shall not exceed 30% of the frontage. Approaches exceeding 30 feet in width or exceeding 30% of the frontage shall require approval of the City Engineer. Driveway approaches shall have a minimum separation of 20 feet.

## **C. Surface Parking Facilities**

1. Construction materials and procedures shall comply with MPWSS Section 02510 and [City of Missoula Standard 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. Public parking structures and private parking structures with an approach within the right-of-way shall meet the following standards for entrance and exit ramps:
  - 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  $\frac{3}{4}$  inch to 2 inches between equally spaced tines.
    - 4) Tining shall be diagonally placed at 45 degrees 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. Stormwater facilities shall meet all requirements in [\*Chapter 6\*](#) (Stormwater System) of this Manual. Incorporation of LID/Green Infrastructure for stormwater 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 stormwater 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.

#### **7.4.14 Pedestrian and Shared-Use Paths and Trails**

Pedestrian and shared-use paths and trails shall be designed per [City of Missoula Standard Drawing 749](#) and [City of Missoula Standard Modifications to the MPWSS](#).

#### **7.4.15 Construction Access, Water Supply, and Entrances**

##### **A. Construction Access**

1. Prior to building permit issuance, adjacent public utility and surface infrastructure must be installed, tested, then approved by the City of Missoula.
2. Access(es) from an existing paved “in-service” street to the construction site must include installed, tested, and accepted sub-grade, sub-base course, base course, and asphalt surfacing along with curb and gutter.
  - a. A deviation request, per [Chapter 3, Section 3.6](#) (Improvement Plans) of this Manual, may be applied for during the months asphalt surfacing is not available.
  - b. Any access(es) granted a deviation shall have a minimum 3 inches of compacted millings placed on top of the tested and approved sub-grade, sub-base course and base course layers.

- c. Before asphalt placement the milling layer shall be completely removed, the base course shall be scarified, recompacted to 95% proctor density, and re-tested.
- d. A minimum 20-foot unobstructed width must be provided for the entire access. Construction materials, vehicles, trailers, or other obstructions are not permitted within the 20-foot-wide access.
- e. Street name signs meeting MUTCD and City of Missoula standards must be installed at all intersections.
- f. Approval from the City Fire Marshal and City Engineer are required prior to any building permit approval.

3. Temporary Construction gates and/or access limiting features must be approved by the City Fire Marshal and City Engineer prior to installation.

#### **B. Construction Water Supply**

- 1. An approved fire hydrant placement and flow plan must be approved by City Fire Marshal and City Engineer prior to building permit issuance.
- 2. Fire hydrants and associated water mains must be installed, tested then by the City of Missoula accepted prior to any combustible building permit issuance.
- 3. Prior to arrival of combustible material to a construction site, an approved water supply must be installed or identified. Approval must come from the City Fire Marshal.

#### **C. Construction Entrances**

- 1. Construction entrances to subdivisions, commercial, industrial, or other large projects must follow an approved Storm Water Pollution Prevention Plan (SWPPP). The SWPPP permitting thresholds and requirements are contained [in MMC 13.27, Stormwater Management](#), and [Chapter 6](#) (Stormwater System) of this manual, respectively.
- 2. Construction entrances to individual lots, townhome units or other construction projects that are connected to and/or cross established infrastructure shall conform to the following.
  - a. Residential lots and those lots utilizing a standard or modified approach opening shall use the planned approach location for all over-the-curb access in accordance with [City of Missoula Standard Drawing 653 – Case 1](#).
  - b. Commercial lots and those lots with more than 25 parking spaces shall use the planned approach location for all access in accordance with [City of Missoula Standard Drawing 650](#).
  - c. Lots without planned or existing access and lots with existing access(es) that are deemed unusable due to the proximity of construction shall follow [City of Missoula Standard Drawing 653 – Case 2](#) for temporary access provisions.