



5

**TECHNICAL
RESOURCES**

TECHNICAL RESOURCES

Chapter 4 introduced several strategies recommended for the MPO and/or its member governments to consider to help move the transportation system forward. This chapter includes more specific information about many of the policies discussed in Chapter 4. While Chapter 4 was written for policy makers and members of the public, Chapter 5 is written for planners, engineers, and other design professionals. Note that the information included in this section is for information purposes only. The MPO or its member governments would need to adopt the policies, guidelines, or standards included in this section for them to become mandatory.

This chapter includes the following information (click title to jump to section):

- [MPO Complete Streets Sample Policy](#)
- [Local Complete Streets Sample Policy](#)
- [Recommended Roadway Design Standards](#)
- [Recommended On-Street Bicycle Facility Standards](#)
- [Recommended Parking Guidelines](#)
- [Recommended Transit Supportive Development Guidelines](#)
- [Electric Vehicle Infrastructure Recommendations](#)

MPO Complete Streets Sample Policy

- 1.0 Defined
- 2.0 Introduction/Justification
- 3.0 Vision & Intent
- 4.0 Applicability
- 5.0 Design
- 6.0 Implementation
- 7.0 Evaluation / Performance Measures

1.0 Defined

Complete Streets are roadways designed to safely and comfortably accommodate all users, of all ages and abilities, including but not limited to motorists, cyclists, pedestrians, transit users, school bus riders, delivery and service personnel, freight haulers, and emergency responders.

Publicly owned rights of way should safely accommodate destination-based and recreational users, as well as provide opportunities as appropriate for rest and directional information within the public realm.

2.0 Introduction/Justification

Building complete streets provides many benefits to residents, business owners, developers, and the community as a whole. First and foremost, embracing the complete streets concept will help create balanced transportation systems by providing accessible, safe, and efficient connections between destinations. It will bolster economic growth and stability while increasing property values. It will enhance job growth, improve safety, improve public health and fitness, reduce harmful emissions, and reduce the overall demand on our roadways by allowing people to replace motor vehicle trips with active transportation options. Secondly, integrating sidewalks, bike facilities, transit amenities, and safe crossings into the initial design of a project spares the expense and complications of retrofits implemented at a later date. Thirdly, proactively planning for a multimodal transportation system can promote its integration with land use policies to encourage sustainable development.

The MPO Complete Streets policy also supports compliance with Federal policy [United States Code, Title 23, Chapter 2, Section 217 (23 USC 217)] requiring consideration for bicycling and walking within transportation infrastructure.

3.0 Vision & Intent

To create a safe, balanced, and effective transportation system where every roadway user can travel safely and comfortably and where multi-modal transportation options are available to everyone.

The goals of this Complete Streets Policy are:

1. To create a comprehensive, integrated, and connected transportation network that supports compact, sustainable development and provides livable communities.

2. To ensure safety, ease of use, and ease of transfer between modes for all users of the transportation system.
3. To provide flexibility for different types of streets, areas, and travelers to enhance the transportation experience.

4.0 Applicability

4.1 Jurisdiction

The recommendations and requirements within the Des Moines Area Metropolitan Planning Organization's (MPO) Complete Streets Policy are encouraged for all Surface Transportation Program (STP) and Transportation Alternatives Program (TAP) projects within the MPO Planning Area Boundary.

Applicable projects include all roadway and/or intersection reconstruction projects, added travel lane(s) projects, new roadways, and new or rehabilitated bridges (including bridge decks reconstructed over the Interstate and underpasses under reconstructed/new interchanges).

The MPO recognizes that some local jurisdictions have adopted their own Complete Streets Policies. When applied to the federally funded projects as listed above, the strictest regulations of any involved Complete Streets policy applicable to a jurisdiction shall apply. Local jurisdictions that have not adopted their own policies are strongly encouraged to do so.

4.2 Network Connectivity

Applicable projects under this policy will be required to include at least:

- A continuous ADA-compliant sidewalk on one side of the roadway/bridge, or
- Designated on-street bicycle facility within the roadway project, if the inclusion of a sidewalk is anticipated to be overly burdensome to the project and therefore infeasible, or
- A multi-use trail of a sufficient width to accommodate both pedestrian and bicycle travel simultaneously.

Projects located along corridors already served by a continuous sidewalk or multi-use trail on at least one side of the roadway are considered to be compliant. Improvements to ensure good condition and ADA compliance are encouraged. If designated on-street bicycle facilities are included, the design for their width, markings, and treatment at intersections and crossings should follow the design guidance of the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide, found online at <http://nacto.org/cities-for-cycling/design-guide/>.

If the planned facility currently has fixed route transit, or is proposed to have fixed route transit in the Long Range Transportation Plan, then the project sponsor shall request comments from the local transit agency (DART) during the project development process to ensure that collaboration occurs with these agencies and that accommodation of transit vehicles and opportunities to access transit facilities are provided.

4.3 All Projects and Phases

Every federally funded transportation improvement and project phase should be approached as an opportunity to create safer, more accessible roadways for all users. Project phases include planning, programming, design, right-of-way acquisition, construction engineering, reconstruction, and operations as well as any change to transportation facilities within street rights-of-way such as capital improvements, re-channelization projects, and major maintenance.

5.0 Design

The MPO is a proponent of creating a multimodal, safe, and efficient transportation system that ensures accessibility to all roadway users. In order to increase the number of projects that provide multimodal facilities in central Iowa, the MPO developed Multimodal Guidelines. These guidelines recognize the importance of, and encouraged the concept of, complete street development.

5.1 Context Sensitivity

In recognition of context sensitivity, public input and the needs of many users, a flexible, innovative and balanced approach that follows other appropriate design standards may be considered, provided that a comparable level of safety for all users is present.

5.2 Long-Term

MPO members shall plan for projects being long-term. Transportation improvements are long-term investments remaining in place for many years. Design and construction of new facilities should anticipate likely future demand for transit, bicycling, and walking facilities and not preclude the provision of future improvements.

5.3 Corridors

Address bicyclists and pedestrians having a need to cross corridors as well as travel along those corridors. Even where bicyclists and pedestrians may not commonly use a particular corridor being improved or constructed, they will likely need to be able to cross that corridor safely and conveniently. Therefore, the design of intersections and interchanges shall accommodate bicyclists and pedestrians in a manner that is safe, accessible, and convenient.

5.4 Design Guideline References

MPO members shall follow accepted or adopted design standards and use the best and latest design standards available, while remaining flexible according to user needs and community context. Sources for design guidelines include:

- SUDAS: Iowa Statewide Urban Design and Specifications Manual;
- American Association of State Highway and Transportation Officials' (AASHTO) Guide for the Development of Bicycle Facilities;
- AASHTO's A Policy on Geometric Design of Highways and Streets;
- AASHTO's Guide for the Planning, Design, and Operation of Pedestrian Facilities;
- Federal Highway Administration's Manual on Uniform Traffic Control Devices for Streets and Highways;
- Institute of Transportation Engineer's (ITE) Recommended Practice - Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities;
- NACTO Urban Street Design Guide; and,
- MPO design standards.

6.0 Implementation

This policy will require all projects funded with federal dollars awarded by the MPO to support Complete Street principles. It is required that all projects in the Transportation Improvement Program (TIP) be consistent with this Complete Streets policy before federal funds are programmed and approved in the MPO's TIP.

6.1 Implementation Process

The following steps will be utilized to assure this policy is uniformly implemented:

1. MPO member governments are encouraged to consider the Complete Streets Policy at the time of project conception, and to contact MPO staff early on with any questions regarding what can be expected at the time of project application and, if the member government anticipates an exception request, what will be expected.
2. At the time of project application, the project sponsor shall indicate either the project's compliance with this Complete Streets Policy or request for an exception including supporting rationale.

3. During project selection, projects will be first sorted according to procedures in place prior to the effective date of this policy. Projects selected as priorities for funding will then be evaluated for compliance with this Complete Streets Policy. Exception requests will be reviewed according to section 6.2 Exception Process of this policy. Projects found not in compliance with this policy, or for which an exception request is denied, will be found ineligible for funding during the applied for funding cycle.

The TIP tracking process will be utilized to ensure continued compliance to this Complete Streets policy throughout project implementation.

The MPO recognizes that, during the course of project development, unforeseeable changes sometimes occur. However, member governments are encouraged to review equitably all elements of a proposed project prior to eliminating components due to budget constraints.

After the MPO has committed funding to a project, MPO staff should be notified immediately of significant project scope changes.

Projects should be updated in the TIP to ensure that the system includes accurate information. Mention of the project scope change should also be included in the report tracking process. Depending on the significance of the change, a TIP amendment may be necessary. MPO staff can advise on this matter.

Due to the flexibility of the policy and the variety of approaches that a sponsor may take to complete a street, MPO staff, as stewards of the Complete Streets Policy, will work with the project sponsor throughout the final design process to find an acceptable solution for both parties.

6.2 Exception Process

If a project cannot meet the Complete Streets Policy, the project sponsor may request an exception when one or more of the following three conditions are met:

1. When bicyclists and pedestrians are prohibited, by law, from using the roadway. In this instance, a greater effort may be necessary to accommodate all users (bicyclists, motorists, transit vehicle users, and pedestrians of all ages and abilities) elsewhere within the right-of-way or within the same transportation corridor.
2. When the cost of establishing bikeways and walkways would be excessively disproportionate to the need or probable use, or would exceed budget costs (ex. Resurfacing). Excessively disproportionate is defined as exceeding twenty percent of the cost of the larger transportation project to include bikeways and walkways. In such a case, the project sponsor may propose an alternate design or spend twenty percent of the project cost of the larger project to improve accommodations for all users.
3. Where population is sparse or where other factors indicate an absence of future need. This condition's definition would be streets developed as a cul-de-sac with four or fewer dwellings or if the street has severe topographic or natural resource constraints. Also, an indication of absence of need would be daily traffic (ADT) projections being less than 500 vehicles per day over the life of this project.

Exception requests will be initially reviewed and sorted by MPO staff. Exceptions shall be granted only by a recommendation of the MPO's Surface Transportation Program (STP) Funding Subcommittee, be documented with supporting data that indicates the basis for the decision, and that the MPO approves the STP Funding Subcommittee's recommendation.

6.3 Continuing Support

As a part of implementing this regional Complete Streets policy, the MPO encourages member governments to:

- Notify and maintain regular communication with relevant departments, agencies, and committees within their jurisdictions when planning for transportation facilities;
- Review current design standards, including subdivision regulations which apply to new roadway construction, to ensure that

they reflect the best available design standards and guidelines, and effectively implement the regional Complete Streets policy;

- Form, or utilize an existing, local Technical Advisory Committee to discuss potential transportation projects and identify opportunities to include multimodal facilities;
- Encourage staff to undergo professional development and training for non-motorized transportation issues by attending conferences, classes, seminars, and workshops;
- Promote inter-departmental project coordination among city departments with an interest in the activities that occur within the public right-of-way in order to better use fiscal resources;
- Include an educational component to ensure that all users of the transportation system understand and can safely utilize Complete Streets project elements; and
- Consider the creation of a local Complete Streets policy to apply to all non-MPO supported projects. Local policies established after the effective date of the MPO Complete Streets Policy should strive to equal or exceed the requirements herein.

7.0 Evaluation/Performance Measures

The MPO shall, at a minimum, evaluate this policy and the documents associated with it every two years. This evaluation may include recommendations for amendments to the Complete Streets Policy.

The MPO will report on the annual increase or decrease for each performance measure listed below, compared to the previous year(s), in order to evaluate the success of this Complete Streets policy.

- Total miles of on-street bicycle facilities
- Total miles of off-street bicycle facilities
- Completion of Safe Routes to School projects
- Percentage of transit stops accessible via sidewalks and curb ramps
- Rate of crashes, injuries, and fatalities by mode
- Number of approved and denied exceptions

Local Complete Streets Sample Policy

The following language is similar to the policy adopted by the City of Des Moines.

The term complete street means designing and building the streets so the streets routinely accommodate travel by all modes. To complete a street will expand the capacity to serve everyone who travels, be it by motor vehicle, foot, bicycle, or other means. A complete street may look quite different on different sides of the same city, but both are designed to balance safety and convenience for everyone using the road. Complete streets are essential for access by people who cannot drive. Roads without safe access for non-motorized transportation represent a barrier for people who use wheelchairs, and for older people and children. The [City/County name] recognizes this need for complete streets and will accommodate elements that create a complete street where possible. Some of the elements under consideration for inclusion on a complete street can be sidewalks, shared use paths, bike lanes, paved shoulders, street crossings (including over and under crossings), pedestrian signals, signs, street furniture, transit stops and facilities, as well as all connecting pathways shall be designed, constructed, operated, maintained, and accommodated in all transportation projects so that all modes and pedestrians, including children, elderly and people with disabilities, can travel safely and independently.

To this end, [City/County name] will:

- Create a committee to consider and recommend what complete streets elements be included with every street project undertaken by [City/County name]. Members on this committee could be representatives from the [City/County name] departments representing engineering, transportation, parks and recreation, emergency services, and planning.
 - Work with the [City/County name] departments, Des Moines Area Regional Transit Authority, the Metropolitan Planning Organization, and other transportation advocates to identify bicycle, pedestrian, and transit planning and design issues appropriate to the project.
1. Bicycle and pedestrian ways shall be established in new construction and reconstruction of road and bridge projects within [City/County name] unless one or more of three conditions are met:
 - 1.1 Bicyclists and pedestrians are prohibited by law from using the roadway. In this instance, a greater effort may be necessary to accommodate all users (bicyclists, motorists, transit vehicles and users, and pedestrians of all ages and abilities) elsewhere within the right of way or within the same transportation corridor.
 - 1.2 The cost of establishing bikeways and walkways would be excessively disproportionate to the need or probable use or exceed budget costs (ex. resurfacing). Excessively disproportionate is defined as exceeding twenty percent of the cost of the larger transportation project. In this case, the project sponsor may propose an alternate design or spend twenty percent of the project cost of the larger project to improve accommodations for all users.
 - 1.3 Where sparsity of population or other factors indicate an absence of future need. This is defined as streets developed as a cul-de-sac with four or fewer dwellings or if the street has severe topographic or natural resource restraints. Also an indication of absence of need is when the average daily traffic (ADT) is projected to be less than 500 vehicles per day over the life of this project.
 2. The design and development of the transportation infrastructure shall improve conditions for transit users, motorists, bicyclists and pedestrians through the subsequent steps:
 - 2.1 Plan projects for the long-term. Transportation improvements are long-term investments that remain in place for many years. The design and construction of new facilities should anticipate likely future demand for transit, bicycling, and walking facilities and not preclude the provision of future improvements.
 - 2.2 Address the need for bicyclist and pedestrians to cross corridors as well as travel along them. Even where bicyclists and pedestrians may not commonly use a particular corridor that is being improved or constructed, they will likely need to be able to cross that corridor safely and conveniently. Therefore the design of intersections and interchanges shall accommodate bicyclist and pedestrians in a manner that is safe, accessible, and convenient.

2.3 Design facilities to the best currently available standards and guidelines. The design of facilities for bicyclists and pedestrians should follow design guidelines and standards that are commonly used, such as:

- AASHTO Guide for the Development of Bicycle Facilities,
- AASHTO's A policy on Geometric Design of Highways and Streets,
- AASHTO's Guide for the Planning, Design, and Operation of Pedestrian Facilities,
- SUDAS: State Urban Design and Specifications Manual,
- Federal Highway Administration's Manual on Uniform Traffic Control Devices for Streets and Highways,
- ITE Recommended Practice Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities;
- National Association of City Transportation Officials (NACTO) Urban Street Design Guide; and,
- MPO design standards.

Recommended Roadway Design Standards

Streets are a community's largest asset and make up the majority of the public space in the city. The design of the street should send a message to private developers as to the type of development that is appropriate along the street.

General Principle: The purpose of streets is to facilitate the movement and socialization of people.

General Principle: Streets will be designed to create high quality public spaces that have a positive influence on the built environment.

Elements of Street Design

Travel Lanes

The width of travel lanes has a significant impact on the quality of the public space. Travel lanes wider than 11 feet degrade the public realm. Wider travel lanes increase the speed of vehicular traffic and increase the crossing distance for pedestrians at intersections. The ideal travel lane width for most urban streets with speeds below 35 mph is 10 feet.

Sidewalks

Sidewalks are a critical part of the urban environment. Sidewalks should be a minimum of 5 feet wide in residential settings and 8-12 feet in commercial and downtown settings. Sidewalks in commercial and downtown locations should include the space for sidewalk cafes, street furniture, lighting, and street trees while maintaining an adequate pedestrian throughway.

Corner Radii

Corner radii have a significant impact on vehicle speed and pedestrian crossing distance at intersections. The target curb radius should be 5 feet, limiting turning speeds to 5-10 mph.

Building Placement

Buildings should be built close to the street to provide an active pedestrian realm. This can be accomplished using build-to-lines instead of setbacks. Placing buildings next to the street also creates spatial enclosure that is essential for pedestrian comfort.

On-Street Parking

On-street parking should be required in all commercial districts. On-street parking provides a buffer between the travel lanes and the pedestrian realm. On-street parking lanes should be 7-8 feet wide for parallel parking and 17 feet wide for diagonal parking.

Trees

Street trees should be planted on all city streets. Trees should be planted in the landscape buffer between the street and the sidewalk. Tree spacing should not exceed 50 feet and should ideally be 30 feet. Trees also should be planted in the center median when one exists. Species should be selected that grow sufficiently tall enough to create spatial enclosure and provide a canopy over the street. Street trees provide multiple benefits including increasing property values, reducing the urban heat island effect, decreasing energy demands, absorbing harmful pollutants, reducing stormwater runoff, and lengthening the life of the pavement by up to 60 percent.

Center Medians

Center medians should be included on boulevards and avenues, and should be wide enough to accommodate large trees (8 feet minimum). Center medians provide a refuge for pedestrians crossing larger thoroughfares. Center medians should extend to the intersection. Trees planted in the median should extend to the crosswalk area.

Speed

Streets should be designed using the target speed not operational speed. The target speed is the intended driving speed, and the 85th percentile should fall between 10-30 mph on the majority of city streets. Target speed should equal design speed which should equal posted speed.

Connectivity

Streets should have a high level of connectivity. Cul-de-sacs should be used only in cases where geography makes connection to a through street impossible.

Block Size

Blocks should be small to maximize the number of intersections per mile and help spread traffic across the transportation system. Block lengths can range from 200 feet in downtown/town center locations to 1,000 feet in residential areas. Block lengths between 400-600 feet are ideal.

Lot Size

Lot size (platting) has a significant impact on density and the character of street design. Historically platting in the United States used increments of 25 feet. However, this increment was chosen before the prevalence of the automobile and the necessity to provide parking. However, the 25 foot increment does not correspond with the basic parking dimensions required for head-in parking (12 feet) and double parking rows (72 feet). Therefore, to allow for the highest levels of density while meeting parking requirements, platting should use increments of 6 feet. This results in lot sizes of 18, 24, 36, 54, 72, and 144 feet.

Design Vehicle

Urban streets should be designed with the most vulnerable users in mind – pedestrians. The majority of streets should use the DL-23 as a design vehicle. In areas with frequent larger design vehicles, use alternative measures like recessed stop bars. The design at intersections should allow for a typical turning speed of 5-10 mph.

Utilities

Utilities should be placed underground whenever possible. In areas where burying is not an option, site design should include rear alleys and lanes. Overhead utilities should be located in the alleys or lanes to maintain the quality public realm along the street frontage. Alleys also can serve to facilitate other unsightly functions such as garbage collection.

Spatial Definition

People feel most comfortable in spaces that provide enclosure. This is best accomplished by placing building facades close to the street. The ideal height-to-width ratio for an urban thoroughfare is 1:1. In areas where this ratio is exceeded, trees can provide the spatial enclosure necessary to create a comfortable public realm. It is important to plant species that will grow tall enough to provide the proper height-to-width ratio.

Parking

Parking should be located in the back of buildings and accessed through a rear alley or lane. Parking structures are preferable to larger surface parking. Parking structures should be built with flat floors, comfortable floor-to-ceiling heights (10 feet minimum) and enough loading capacity to support other uses. This will allow parking structure to be converted to office and residential uses when they are no longer needed for parking vehicles.

Recommended On-Street Bicycle Facility Standards

The following information is pulled from the MPO's *On-Street Bicycle Facility Feasibility Study*.

Signage + Markings

An important element of implementing on-street facilities in a new area is both education within the community and continuity among design elements to convey the intended method of use. In efforts to provide on-street facilities with the same look and feel, the MPO identified signage and markings as an area to review the current design standards and provide guidance where appropriate. The intent is to provide on-street facilities, regardless of type, that look and feel the same throughout the metro area. For the user, this not only offers a facility that is familiar and easy to navigate, but also has a unique identity.

NACTO provides three levels of guidance: Required, Recommended and Optional. Required and Recommended Features are elements necessary for the facility's proper function and safety. It is suggested that these features are adhered to wherever possible. Optional Features however, are elements that can vary across cities and may add value depending on the circumstance. The MPO felt it was important to evaluate the Optional Features and provide guidance where possible. Cities such as West Des Moines and Des Moines who have already implemented on-street facilities were also consulted as part of the process to help determine what facility types and practices are currently being used within the surrounding metro area.

Ultimately the MPO identified seven key areas to provide guidance.

- Bike Lane and Shared Lane Markings
- Intersection Crossing Treatments
- Bicycle Signal Detection
- Pavement Marking Material Guidance
- Green Lanes and Bike Boxes
- Facility Signage
- Route Wayfinding

Treatment Recommendations

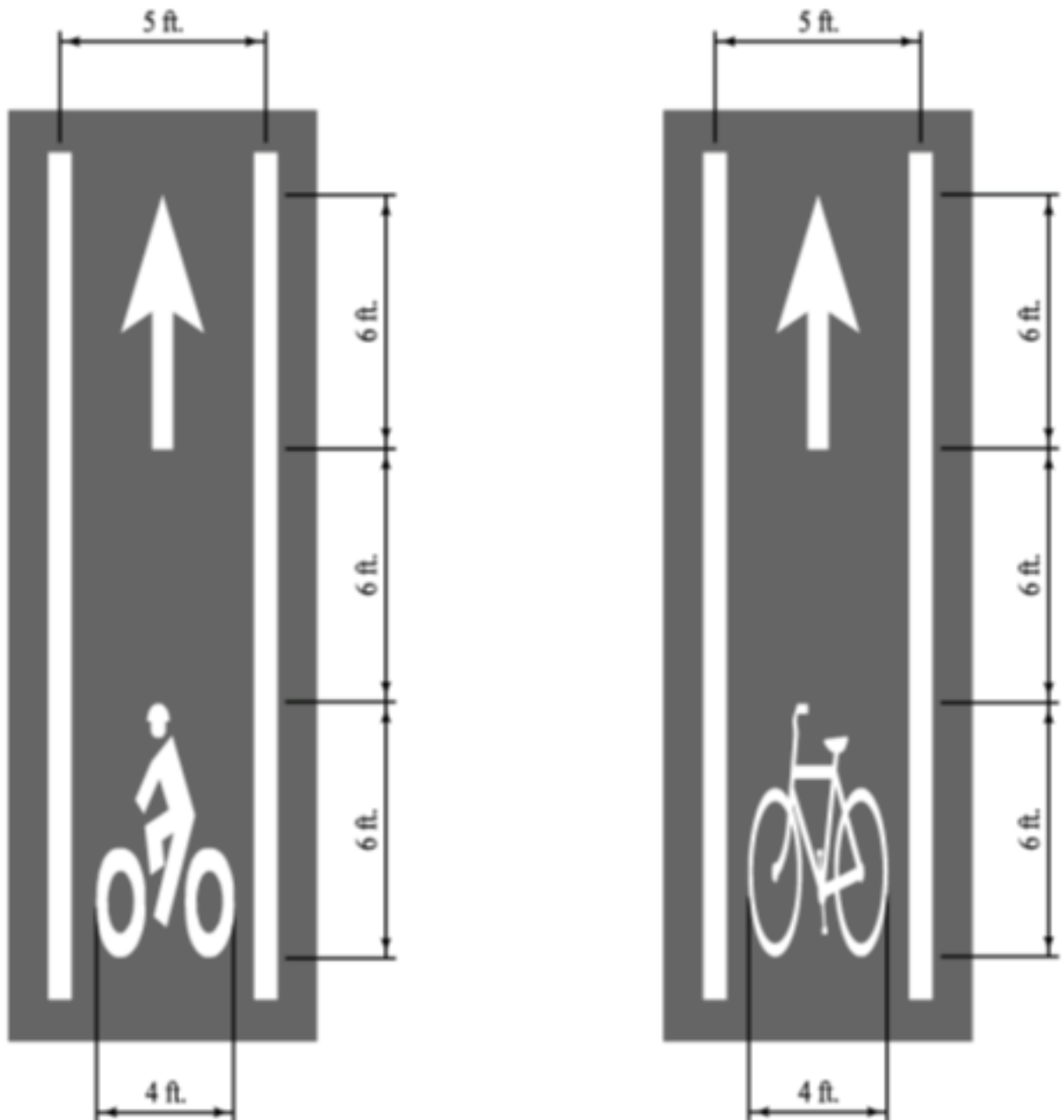
Bike Lane and Shared Lane Markings

Two of the most frequently used on-street bicycle treatments are bike lanes and shared lanes. Review of existing guidance through National Association of City Transportation Officials (NACTO), Iowa Statewide Urban Design and Specifications (SUDAS), and Manual for Uniform Traffic Control Devices (MUTCD) guide books identified two acceptable bicycle lane markings as shown in the following figure. At minimum, the bicycle symbol shall be used to define the preferential use of the bike lane. The MUTCD designates the directional arrow as optional, however it is listed as a Required Feature through NACTO.

Recommendation

The MPO recommends the helmeted bicyclist symbol in conjunction with the directional arrow be implemented as a minimum treatment for all future bike lanes in the MPO Planning Area. Refer to the NACTO Urban Bikeway Design Guide, available at <http://nacto.org/cities-for-cycling/design-guide/bikeway-signing-marking/>, for placement of symbols. Intervals of placement shall not exceed 1000 feet. A cycle track, like a bike lane, is a preferential lane as defined by the MUTCD; therefore, the same symbol marking recommendations for bike lanes shall also apply to cycle tracks.

BIKE LANE SYMBOL MARKING



The City of Des Moines has over 4 miles of bike lanes in the downtown area, as well as designated quiet streets marked by Shared Lane Markings (SLM). The traditional shared lane marking as defined by the MUTCD consists of two chevron "V" markings with a bicycle symbol. To minimize the cost of purchasing additional stencils, the City of Des Moines was granted approval through the FHWA to use the same helmeted bicycle symbol on shared lane markings as used to designate bike lanes.

Recommendation

The MPO recommends the use of the helmeted SLM. By using the helmeted symbol, the shared lane marking not only remains consistent with the markings used to designate bike lanes, but also minimizes cost to the local agency. Refer to the NACTO Urban Bikeway Design Guide, available at <http://nacto.org/cities-for-cycling/design-guide/bikeway-signing-marking/>, for placement of symbols. Intervals of placement shall not exceed 500 feet.

TRADITIONAL SHARED LANE MARKING



HELMETED SHARED LANE MARKING



Intersection Crossing Treatments

Though intersections make up a small portion of a cyclist's travel distance, they are one of the most hazardous areas, accounting for approximately 50 percent of all bicycle-vehicle accidents. While guidance is provided through NACTO and the MUTCD on intersection crossing markings, it is a suggested treatment. The City of Des Moines reserves use of any bicycle-specific intersection crossing treatments for unconventional crossings or maneuvering and is the exception, as opposed to normal practice.

Recommendation

The MPO suggests the decision to implement intersection crossing markings be left to engineering judgment and the discretion of the local agency.

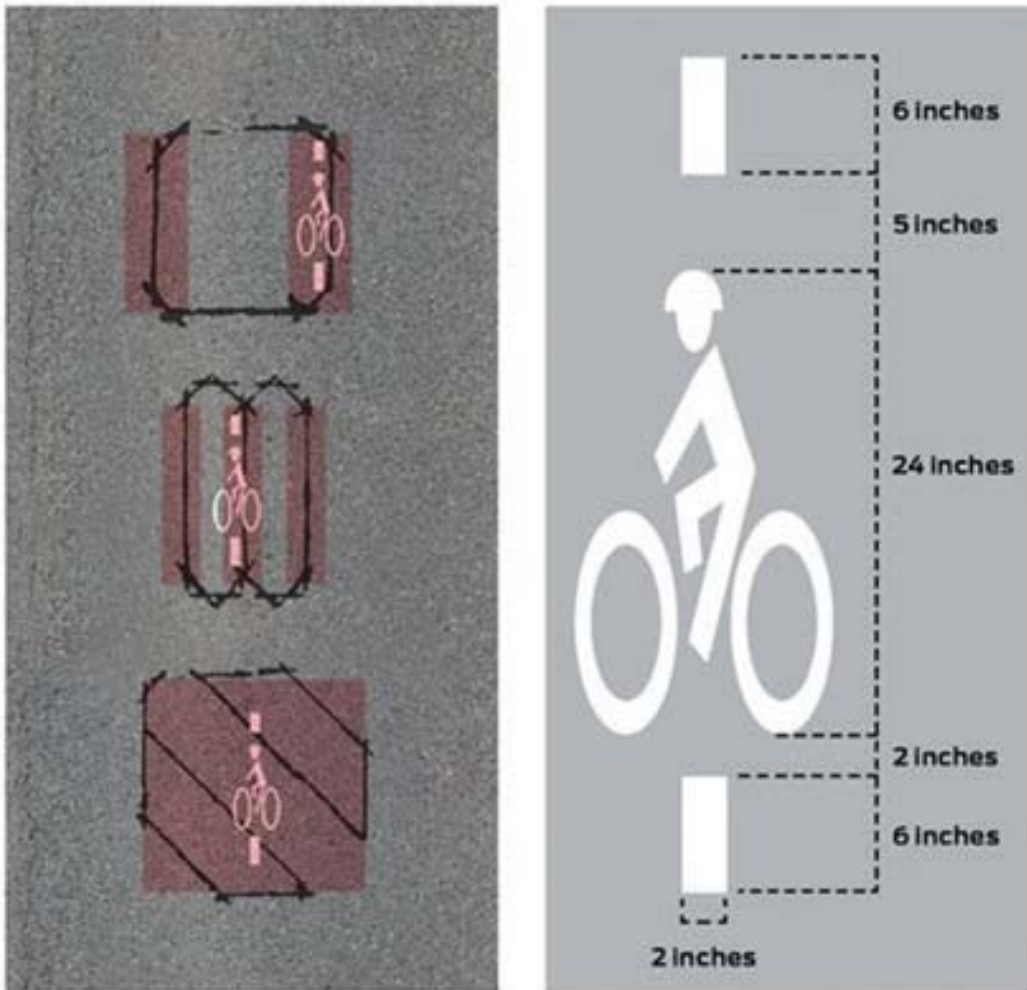
Bicycle Signal Detection

Bicycle signal detection occurs either by the use of a push button or by automation (inductive pavement loops, cameras, radar, etc.). A common issue cyclists encounter when navigating a signalized intersection is where to position their bicycle to activate the traffic signal. For a bicycle to be detected the bicycle must be placed within the red highlighted areas as shown in the figure on the following page and the inductive loop has to be adjusted to a higher sensitivity to detect the metallic mass of the bicycle. Otherwise, undetected cyclists are forced to wait for a vehicle, dismount and press a pedestrian button, or cross illegally. Pavement markings and signage are used to properly position the cyclist on the inductive loop or zone if using other means of detection with the highest sensitivity. In addition to increasing the sensitivity of the detector, NACTO and the MUTCD recommends use of a helmeted bicyclist symbol marking the location of the most sensitive area of the traffic sensor, and a R10-22 sign so that the bicyclist knows the intersection has detection and where to position their bicycle to activate the signal.

Recommendation

The MPO recommends bicycle detection pavement markings and signage be provided at any intersection where an on-street bicycle facility is located and actuation is required to call the signal. Signs shall be mounted in a visible location in front of or adjacent to the bicycle detector pavement marking. The pavement marking shall be placed over inductive loops as shown in the following illustration.

BICYCLE DETECTOR PAVEMENT MARKING



R10-22 SIGN



Pavement Marking Material Guidance

There are three main types of pavement markings in use: non-durable waterborne paint, Epoxy-based Durable Liquid Pavement Markings (DLPM), and thermoplastics.

Non-durable paint is the least expensive and the most widely used in the United States. The average installed price of non-durable paint is roughly \$4 per linear 100 feet or \$1.20 - \$1.60 per square foot. Advantages of non-durable paint include quick dry times (under 30 minutes depending on ambient temperatures) and minor surface preparation. Glass beads for reflectivity and skid resistance may be added to the paint; however, they are often worn down with high traffic and snow removal. The main disadvantage of the non-durable pavement markings is that in snowy climates or high traffic areas, they rarely hold up for more than six months to a year.

DLPM are either an epoxy or acrylic based resin. The average installed bid item price is approximately \$25 per linear 100 feet or \$3 - \$4 per square foot. More costly than non-durable paint, DLPM's can last 3-5 years depending on conditions. Reflective and non-skid materials may also be added to DLPM's, however there are some disadvantages to be mindful of. Because DLPM's are epoxy or acrylic based, dry times can require more than an hour. They are also more sensitive to existing oils on the pavement and require more surface preparation over non-durable paint. The lifetime of DLPM's can be significantly shortened if the pavement is in poor condition.

Thermoplastics are another type of durable pavement marking and typically come in square or pre-formed sheets. They are bonded to the pavement by heating the sheets to 400°-450°F. Due to the structure of thermoplastics, they are best suited for pavement symbols or colored lane markings, not linear striping. Thermoplastics are the most expensive of the three materials at \$10 - \$14 per square foot installed. Advantages to thermoplastics are an average lifetime of 5 years, easy spot fixes, and ability to provide reflectivity and skid resistance throughout the material rather than just the top coating. A significant disadvantage to thermoplastics is they have to be recessed or ground into the pavement if they are to be used in a snowy climate to avoid damage by plows. This process would be in addition to the installed cost.

Recommendation

All three types of pavement markings are appropriate for use on projects. The material type does not directly affect the functionality of on-street bike facilities. It is for this reason the MPO recommends the decision be left to the local agencies to decide what type of pavement marking is best suited. There are many other local factors to be considered on a case by case basis including amount of traffic, maintenance schedules, preference of the agency, and budgets. For additional information please refer to the NACTO Urban Bikeway Design Guide - Colored Pavement Material Guidance, accessible at <http://nacto.org/cities-for-cycling/design-guide/bikeway-signing-marking/colored-pavement-material-guidance/>.

Green Lanes and Bike Boxes

Green, reflective, colored pavement markings may be used to highlight conflict areas and increase visibility of bicycle lanes, intersection crossings and other potentially hazardous areas between bicyclists and vehicles. Delineating these areas reinforces priority to bicyclists in conflict areas and has proven to increase motorist yielding behavior. Green pavement markings can be particularly helpful at intersection approaches with through bike lanes and right turning vehicle traffic.

Bike boxes are another intersection treatment that may be used in conjunction with green pavement markings. A bike box is a designated area at signalized intersections that provide a safe, visible space in front of traffic during the red signal phase. Bike boxes provide several benefits to bicyclists. By placing the bicyclists ahead of traffic, bicyclists are better positioned to make left and right turning movements. Additionally, bike boxes allow bicyclists to group together and clear the intersection quickly, minimizing impediment to vehicular traffic. NACTO lists colored pavement markings as a Recommended Feature for bike boxes. For bike lanes, colored pavement markings are considered an Optional Feature to delineate conflict areas. Color may be applied along the entire corridor of a bike lane with a gap in coloring to denote the conflict areas or used vice versa where color is only applied within the conflict areas.

COLORED BIKE LANE AND BIKE BOX



Recommendation

To increase visibility at conflict areas, the MPO recommends only using green colored pavement markings in conflict areas as shown in the top graphic of the figure below or within bike boxes at a signalized intersection. Colored pavement markings will require increased maintenance over traditional striping. The use of colored bike boxes and colored bike lanes shall be reserved for higher conflict areas or at intersections with high volumes of bicycles and motor vehicles, especially those with frequent bicycle left turning movements.

COLORED BIKE LANE



Facility Signage

An R3-17 "Bike Lane" sign is an optional treatment along bike lanes and cycle tracks as listed in the NACTO Urban Bikeway Design Guide.

The sign is useful as an additional visual cue for vehicular traffic to further designate the preferential use for bicyclists. While the sign is mandatory in some states, the MUTCD classifies the sign as optional and cautions against overuse.

R3-17 SIGN



Recommendation

The MPO recommends the use of the R3-17 “Bike Lane” sign. Placement shall be in accordance with the MUTCD Section 9B.04 and shall not exceed 1000 feet in spacing. It is also recommended that the placement of the sign be staggered with the bike lane symbol markings.

R4-11 SIGN



The R4-11 “May Use Full Lane” sign is a sign used to designate the potential presence and right of way for bicyclists. Unlike the R3-17 “Bike Lane” sign is reserved for streets with shared lanes or a designated bike route. The R4-11 sign was added in the 2009 revision. Another sign combination often used to designate shared lanes and bike routes, are the combined W11-1 and W16-1 “Share the Road” signs. Many cities have abandoned the combined W11-1 and W16-1 signs and adopted the “May Use Full Lane” signs. The “May Use Full Lane” sign conveys a clearer message to users of the roadway unlike the combined “Share the Road” signs.

Recommendation

The MPO recommends the use of the R4-11 “May Use Full Lane” sign in place of the combined W11-1 & W16-1 “Share the Road” signs. Placement and size of signs shall be in accordance with the MUTCD Section 9B.04 and shall not exceed 1000 feet in spacing. It is also recommended that the placement of the sign be staggered with the bike lane symbol markings.

W11-1 + W 16-1 SIGNS



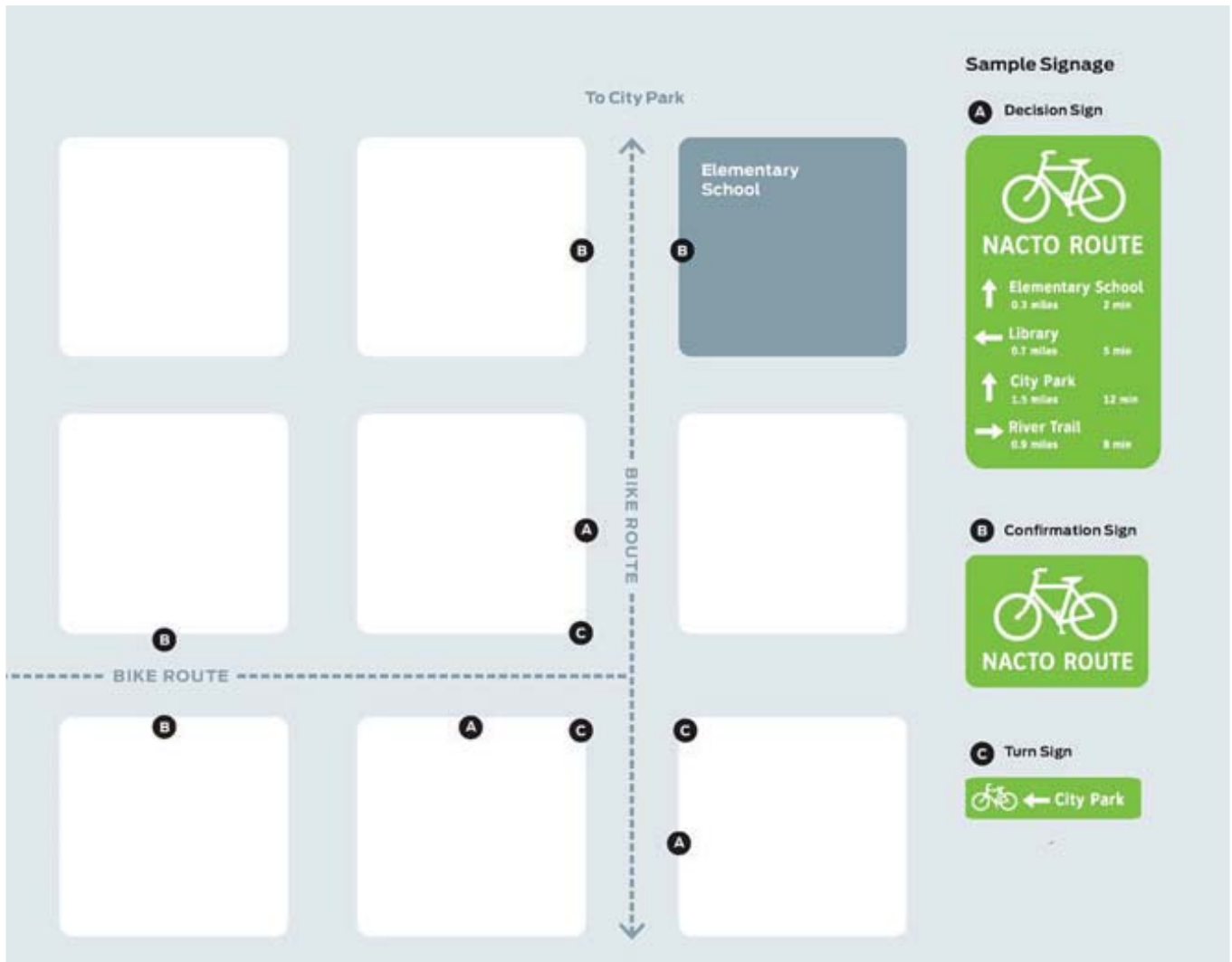
Route Wayfinding

Whether a bicyclist is riding on an off-street trail or an on-street bike route, it is necessary for them to develop a sense of awareness of where they are located in relation to their surroundings. Signage, trail guides, and maps are components of the wayfinding process that aid the user as they gather information on location and distances between destination points. Signage that includes both mileage and average travel time to destinations can also be a helpful feature to the user when estimating time it takes to travel. Though on-street bicycle routes benefit from existing street signs and landmarks to orient the user, wayfinding along routes should support the infrequent or first time user. Consistency of signage, use, message, and appearance are essential in communicating with the user.

NACTO outlines multiple Recommended Features; however the only Required Features are MUTCD standards in Section 9B.01 (Application and Placement of Signs), and Section 9B.20 (Bicycle Guides Signs). Guidance is provided on types of signs including Decision, Confirmation and Turn signs and their placement. Prior to the development of wayfinding signage, it is recommended that a list to identify and classify points of interest be developed by the local municipalities. Once on-street routes are established, these lists then can be compiled and prioritized along the routes as primary, secondary, and tertiary points of interest, as shown on the sample “Decision Sign” in the following illustration. The level of effort to study on-street wayfinding and make proper recommendations exceeds the scope of this study.

The ultimate goal of the MPO is to conduct a comprehensive wayfinding study that can address sign type, placement, messages, and identity in one unified report.

SIGN TYPES AND PLACEMENT



Facility Design Recommendations

The following pages provide design examples for the on-street bicycle facilities discussed in this report. These examples are intended to illustrate the variety of ways to accommodate bicycle use on our streets and to provide some direction on design specifications for each facility type. It is important to note that the examples listed are not exhaustive. When converting existing streets to include facilities for bicycles, every case is unique and design standards should be used in conjunction with professional judgment and creativity. The NACTO *Urban Bikeway Design Guide* offers best practices for any community working to improve their on-street bicycle network and should be the starting point for any facility design. Valuable resources can be found at <http://nacto.org/cities-for-cycling/design-guide/> and at http://transect.org/docs/bicycling_pdfs.zip.

PS — Paved Shoulder

Riding Surface Width	6-foot minimum
Movement	With traffic
Intersection Treatment	Signed, signalized
Posted Speed	55 mph
AADT	N/A

**SL — Shared Lane**

Riding Surface Width	Shared vehicular lane with sharrow
Movement	With traffic
Intersection Treatment	Signed, signalized, indicator loops
Posted Speed	25 mph
AADT	8,000

**BL — Bicycle Lane**

Riding Surface Width	5-foot minimum
Movement	With traffic
Intersection Treatment	Signed, dashed, Peg-a-Track, colored
Posted Speed	30 mph
AADT	15,000





BLB — Buffered Bicycle Lane, Type 1

Riding Surface Width	5-foot minimum, 2-foot striped buffer, and 2-foot shy zone
Movement	With traffic
Intersection Treatment	Signed, dashed, Peg-a-Track, colored
Posted Speed	30 mph
AADT	15,000



BLB — Buffered Bicycle Lane, Type 2

Riding Surface Width	5-foot minimum with parking lanes and 2-foot shy zone
Movement	With traffic
Intersection Treatment	Signed, dashed, Peg-a-Track, colored
Posted Speed	35-45 mph
AADT	25,000



BLB — Buffered Bicycle Lane, Type 3

Riding Surface Width	5-foot minimum with bollards
Movement	With traffic
Intersection Treatment	Signed, dashed, Peg-a-Track, colored
Posted Speed	35-45 mph
AADT	25,000

BLB — Buffered Bicycle Lane, Type 4

Riding Surface Width	5-foot minimum with median separation
Movement	With traffic
Intersection Treatment	Signed, Peg-a-Track
Posted Speed	35-50 mph
AADT	30,000



BLB — Buffered Bicycle Lane, Type 5

Riding Surface Width	5-foot minimum with planter
Movement	With traffic
Intersection Treatment	Signed, Peg-a-Track
Posted Speed	35-50 mph
AADT	30,000



Recommended Parking Management Guidelines

The following section lists a menu of strategies that can be applied to Greater Des Moines. The policies are divided into four topics: Parking Regulations & Incentives, Pricing & Payment, Promote Alternate Modes, and Sustainable, Walkable Design. Not all strategies are applicable to the entire region; thus, next to each policy is a classification of relevance to the region or the Central Business District (CBD).

Parking Regulations & Incentives

Eliminate minimum parking requirements (CBD)

Minimum parking requirements have been proven to oversupply parking. Studies of suburban business parks have found that, while the zoning code often demands 3 to 4 parking spaces per 1,000 feet or one space per employee, the actual average parking utilization rate was 2.2 spaces per 1,000 feet.¹ This equates to a 26 percent oversupply. Getting rid of minimums would not be a ban on new parking; it would simply allow market forces to calculate how much parking is needed to meet demand. For example, Boulder, Colorado, has no minimum parking requirement for non-residential uses in its CBD. Developers build as much parking as they see fit and can purchase permits at public lots to sell to residents should they choose to build little or no parking.²

Establish maximums (Region)

Parking maximums set an absolute upper limit on how much parking may be provided at any given building or site. Maximum ratios are especially effective in suburban areas where developers of big box retail build far more supply than is needed. Area-wide limits called parking caps can also be used. To ensure maximums do not prohibit certain parking-intensive uses, the zoning code in Portland, Oregon, allows parking rights to be transferred or sold to another development.³

Flexible standards(Region)

The major drawback of current parking requirements is their inflexibility, where minimums are applied rigidly to every land use regardless of context. Many communities have begun including “discounts” to minimum requirements based on factors that reduce auto use. An example of adjustments to minimums is shown below.

PARKING REQUIREMENT ADJUSTMENT FACTORS

FACTOR	DESCRIPTION	TYPICAL ADJUSTMENT
Employment Density	Number of employees per acre	Reduce 10-15% in areas with 50 or more employees per gross acre
Transit accessibility	Nearby transit service frequency and quality	Reduce requirements 10% for housing and employment within ¼ mile of frequent bus service; 20% for rail
Demographics	Age and physical ability of residents	Reduce 20-40% for housing for young (under 30), elderly (over 65), or with a disability
Income	Average income of residents or commuters	Reduce 10-20% for the 20% lowest income households; 20-30% for lowest 10%
Off-site parking	Availability of nearby parking spaces	Consider sharing existing facilities before building new

Source: Adapted from Litman, *Parking Management*

¹ Transportation Research Board. *Traveler Response to System Change: Chapter 18 Parking Management and Supply*. 2003. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_95c18.pdf.

² Metropolitan Transportation Commission. *Parking Code Guidance: Case Studies and Model Provisions*. 2012. http://www.mtc.ca.gov/planning/smart_growth/parking/6-12/Parking_Code_Guidance_June_2012.pdf.

³ Parking maximums set an absolute upper limit on how much parking may be provided at any given building or site. Maximum ratios are especially effective in suburban areas where developers of big box retail build far more supply than is needed. Area-wide limits called parking caps can also be used. To ensure maximums do not prohibit certain parking-intensive uses, the zoning code in Portland, Oregon, allows parking rights to be transferred or sold to another development.

For example, in Milwaukee, Wisconsin, developments within a defined geographical area near transit are granted reductions of up to 15 percent in the minimum requirements.⁴ In Portland, Oregon, the reduction stipulates that the transit must be high-frequency — if service runs every 20 minutes or better during peaks, the minimum is waived.⁵

In Seattle, minimums are reduced in affordable housing units to 0.5-1 space per unit. The best practice is to root parking policy in empirical evidence. An inventory of parking supply — on- and off-street, public, and private — and utilization will give a city invaluable information on which to base code. Another method is contingency planning, in which the low end of an estimate is used to build parking, with additional land banked as green space only to be converted to parking if demand warrants.⁶

Sharing parking (Region)

Shared parking means that one parking supply is shared by two or more land uses. In Greater Des Moines, where every development has its own parking lot, sharing parking for all land uses has major potential to accommodate growth without significantly adding new spaces. In Ankeny, parking regulations acknowledge that providing parking spaces required for isolated uses may result in oversupply. Ankeny's Municipal Code states the planning director "may permit deviations from the presumptive requirements ... and may require more parking or allow less parking."⁷ Building upon this type of flexibility, many communities have developed specifications for allowing shared parking such as, for instance, if parking is already available within a certain number of feet from the new development.⁸ In downtown areas where parking supply is less abundant, shared parking may succeed best when shared between two different land uses with different peaks, such as office and a movie theater. Shared parking encourages a "park once" mentality and increases walking between destinations rather than driving. The concept of shared parking is illustrated on the following page.

Shared parking is implemented by contractual agreement between two users or through a parking management district. A government policy supporting shared parking encourages its application, and, in some cases, changes to the zoning code are required.⁹

Unbundle parking cost (Region)

When a developer prices a dwelling unit, the company divides the total cost by the total units. Yet parking is a major component of development costs that simply gets sunk into the customer cost. The full cost of parking should be "unbundled" from residential rents and mortgages to let people choose whether they need a parking space or not. San Francisco has adopted a citywide unbundling ordinance. Unbundling can also be applied to commercial space — Bellevue, Washington, requires offices of more than 50,000 square feet to identify parking costs on all leases.¹⁰

Parking Benefit District (CBD)

Numerous parking garages and on-street facilities operate in downtown Des Moines. A Parking Benefit District is designed to take revenues from paid parking in the District to fund public improvements that benefit the District itself. If parking revenues are otherwise directed into general revenue, where they may appear to produce no direct benefit for the District, there will be little support for installing parking meters or for raising rates when District merchants and property owners can clearly see that the monies collected are being spent for the benefit of their blocks, on projects that they have chosen, they often become willing to support market rate pricing. The structure of Parking Benefit Districts varies and can be managed by a municipality or a private entity such as a Business Improvement District. Typically, they serve a downtown or neighborhood.

⁴ EPA. *Parking Spaces, Community Places*. 2006. <http://www.epa.gov/dced/pdf/EPAParkingSpaces06.pdf>.

⁵ Metropolitan Transportation Commission. *Parking Code Guidance: Case Studies and Model Provisions*. 2012. http://www.mtc.ca.gov/planning/smart_growth/parking/6-12/Parking_Code_Guidance_June_2012.pdf.

⁶ Litman, Todd. *Parking Management*. 2011.

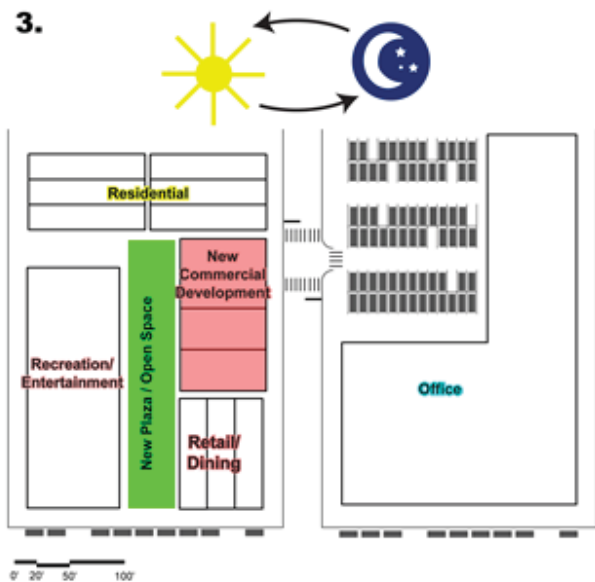
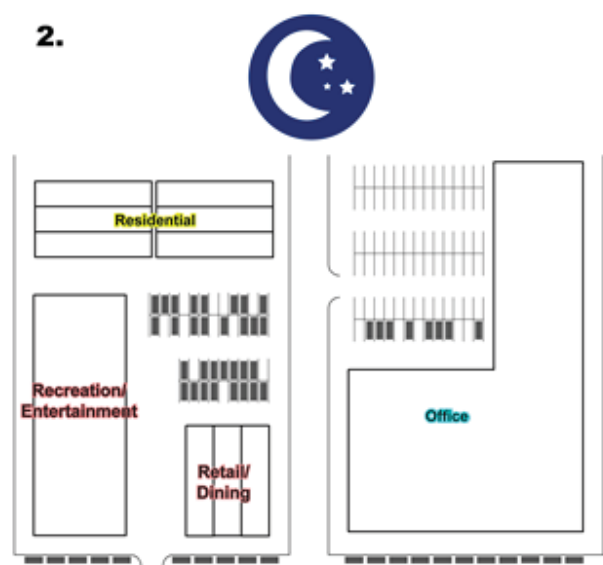
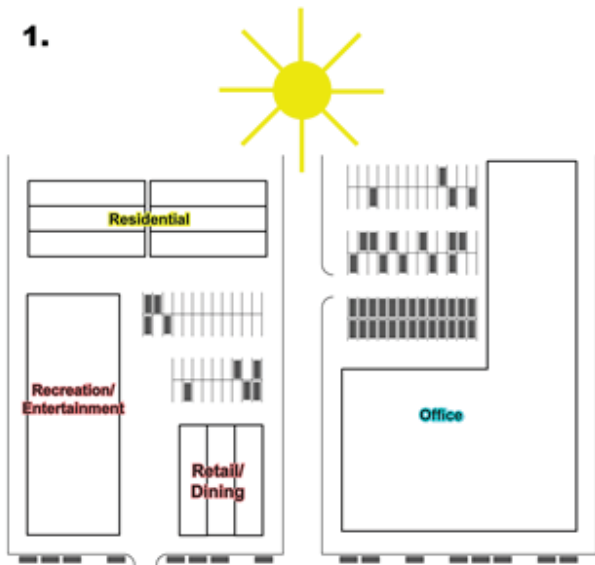
⁷ Ankeny Municipal Code Chapter 194: [http://www.amlegal.com/nxt/gateway.dll/Iowa/ankeny_ia/codeofordinancesofthecityofankenyiowa?f=templates\\$fn=default.htm\\$3.0\\$vid=amlegal:ankeny_ia](http://www.amlegal.com/nxt/gateway.dll/Iowa/ankeny_ia/codeofordinancesofthecityofankenyiowa?f=templates$fn=default.htm$3.0$vid=amlegal:ankeny_ia).

⁸ For examples of specific shared parking ordinances, see http://www.mtc.ca.gov/planning/smart_growth/parking/parking_seminar/Toolbox-Handbook.pdf, page 29.

⁹ Several examples of codes adopted that support shared parking can be viewed in Appendix B of this document: http://www.crowp.org/pdf_files/review_national_trends_parking_requirements.pdf.

¹⁰ Tumlin, Jeffrey. *Sustainable Transportation Planning*. 2012.

CONVENTIONAL PARKING SUPPLY AND UTILIZATION VERSUS POTENTIAL WITH SHARED PARKING



1. DAYTIME

- The office parking lot contains excess parking spaces.
- Moderate occupancy at the commercial block

2. EVENING

- Very few cars remain at the office lot - people working late, maintenance staff.
- Parking at the commercial block fills up, as does on-street parking.

3. SHARED PARKING

- Use the excess daytime capacity at the office lot for commercial users next door.
- At night, commercial customers can park in the office lot and walk across the street to stores and recreation.

BENEFITS

- Allows for new development in spaces that were dedicated to parking.
- Fosters a "park once" attitude that helps downtowns thrive by increasing foot traffic and decreasing driving.
- Allows closure of the curb cut on the commercial block. Benefits:
 1. Improves the pedestrian environment.
 2. Makes room for one more on-street parking space.

In-lieu fees (Region)

Many municipal codes require property owners to provide off-street parking for those persons who will use their facility. In-lieu fees allow developers to pay for transportation improvements elsewhere instead of providing parking on site. This allows more development in central areas where space for additional parking is restricted. This program can provide funding to help develop shared parking facilities such as municipal garages or to fund public transit services. The procedures for implementing and collecting cash-in-lieu generally must be defined through a by-law. Though fees are often used to construct new parking, some cities are now including provisions for the fees to be used for other benefits such as streetscaping, bicycle facilities, etc.

Cash-out (Region)

Similar to unbundling, cash-out consists of a financial incentive to consider alternatives to driving. Cash-out gets applied at the employee side and allows employers to award a one-time cash payout to employees who commit to not driving. The value of the cash payment

is equal to the amount the employee would have received in parking space subsidy and is cheaper for the employer than building new parking.

Reduce stall dimensions (Region)

Stall dimensions may range from 8.5'x18' to 9'x20', large enough for the largest SUV. Since drivers are moving slowly in parking lots and are navigating the vehicle just to let it sit, parking spaces need only be large enough to accommodate the width of a vehicle plus space to open the door. Since it is unlikely that drivers adjacent to each other will open doors at the same time, the door can swing into the neighboring space. St. Louis, Missouri, adopted 7.5' x 15' as its parking space size — a small amount on an individual space basis, but this adds up when considering the thousands of parking spaces in a typical downtown.¹¹

Pricing & Payment

Price for 85% occupancy (CBD)

Pricing parking should follow the “Goldilocks Principle” — a price is too high if too many spaces are vacant, and too low if all spaces are filled.¹² An occupancy of 85 percent is a reasonable goal to aim for, as it ensures that a motorist can find a space without circling the block, but also means that, overall, the spaces are being well utilized.

No time limit (CBD)

If parking occupancy can be maintained near the targeted rate, time limits can be eliminated. Time limits hinder downtown’s “park once” goal and can hurt businesses by shooing them out of stores and restaurants before they are ready. If pricing alone can maintain consistent availability, time limits do nothing but instill customer anxiety.

Make payment easy (CBD)

While most drivers are willing to pay for parking, no one is willing to be inconvenienced to do it. If a metered system is implemented, it must be easy to use, meaning no one needs to find change to pay for a parking space. The City of Des Moines has transitioned its parking meter payment system to SmartCard, an example of making paying for parking customer friendly.

Promote Alternate Modes

Transit passes (Region)

For transit-accessible developments, provide free or reduced-cost transit passes to residents and employees. This can be used to adjust parking requirements. In Seattle, for example, if transit passes reducing costs by 50 percent are provided to all employees and transit is available within 800 feet of the development, parking requirements are reduced by 10 percent.¹³

Bicycle parking (Region)

Adopt a zoning code requiring bicycle parking at homes and places of work and shopping, to provide secure end-to-end bicycle storage. The City of Pittsburgh’s bike parking ordinance requires, for example, one parking space per three dwelling units in multi-family housing, and one space per 10,000 square feet of commercial.¹⁴

Carshare spaces (CBD)

Require developers to provide carshare spaces as a replacement to standard parking spaces. Devote a portion of on-street parking to carshare vehicles. In the City of Berkeley, for example, developments with 31-60 parking spaces must include two carshare spaces.¹⁵

¹¹ Mid-America Regional Council. “Parking lots to parks.” <http://www.sustainableskylineskc.org/assets/ParkingLotstoParksbook-web.pdf>.

¹² Tumlin, Jeffrey. *Sustainable Transportation Planning*. 2012.

¹³ Metropolitan Transportation Commission. *Parking Code Guidance: Case Studies and Model Provisions*. 2012. http://www.mtc.ca.gov/planning/smart_growth/parking/6-12/Parking_Code_Guidance_June_2012.pdf.

¹⁴ http://www.city.pittsburgh.pa.us/cp/assets/bicycle/Bicycle_Parking_Ordinance.1.pdf.

¹⁵ Require developers to provide carshare spaces as a replacement to standard parking spaces. Devote a portion of on-street parking to carshare vehicles. In the city of Berkeley, for example, developments with 31-60 parking spaces must include two carshare spaces.

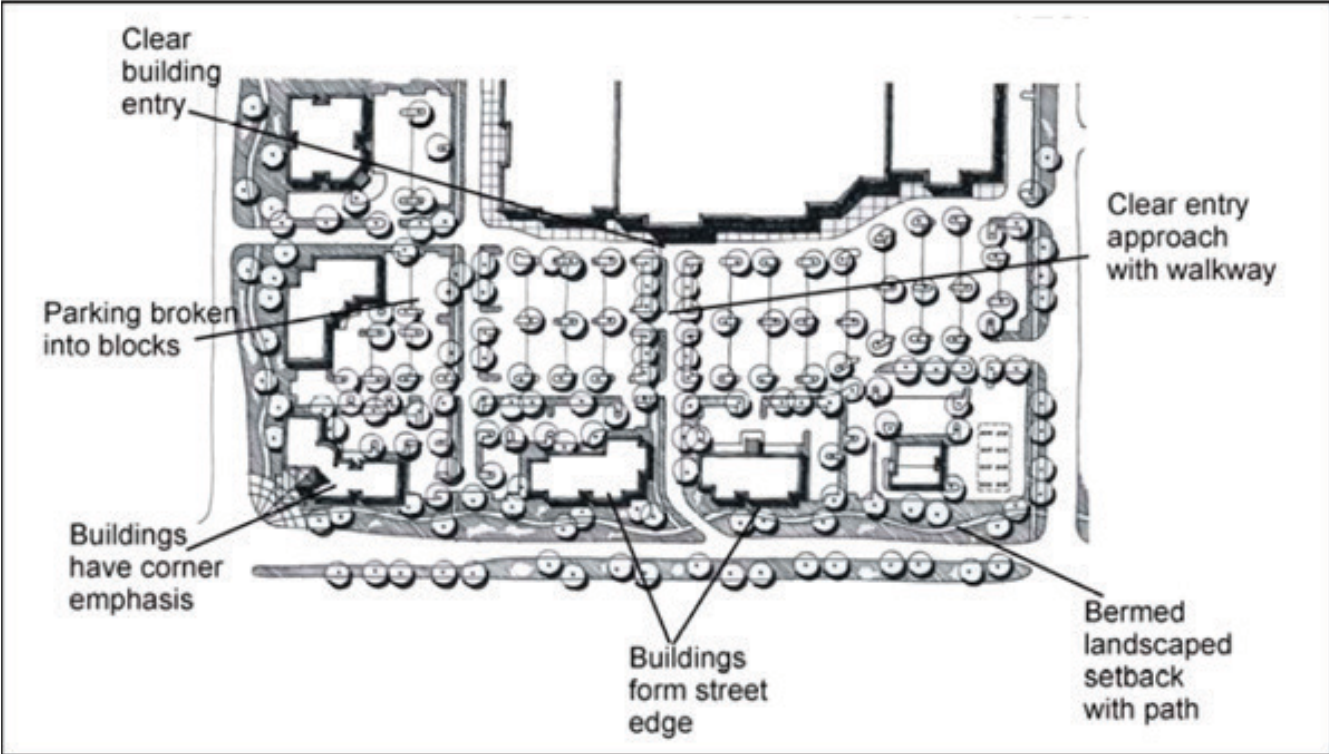
Sustainable, Walkable Design

Put the active use in front (Region)

Require developers to provide vehicle parking behind retail rather than in front, or adopt standards breaking up large parking areas and allowing infill along the street.



PARKING IN FRONT OF RETAIL FEELS DISCONNECTED.



MANY COMMUNITIES HAVE ADOPTED "BIG BOX" DESIGN STANDARDS. THIS GRAPHIC FROM OVERLAND PARK, KANSAS, SHOWS SMALLER BUILDINGS FRONTING THE STREET IN FRONT OF THE MAJOR RETAILER AND LANDSCAPED PARKING BROKEN UP BY WALKWAYS.

Pedestrian walkways (Region)

Parking lots should include clearly delineated walking paths and landscaping. Parking lot design should assume a posted speed of 5 mph and should group stalls in clusters of 500 separated by a landscaping buffer.¹⁶ Shrubs and hedges used as buffers are limited to 3 feet in height to maintain security. An example of walkways through parking is shown on the previous page. Landscaping reduces heat islands and adds permeable surfaces.

Landscape reserve (Region)

Landscape reserve consists of a percentage of new parking to be left as landscaping, land banked to be turned into parking only if needed. Some municipalities have adopted shade tree ordinances requiring a tree built per a certain number of parking spaces. In Sacramento, the ordinance requires that 50 percent of the parking lot be shaded by trees 15 years post-build.¹⁷

Porous pavement and stormwater basins (Region)

Parking lots are traditionally impermeable and thus generate surface run-off during rain events. As metropolitan areas develop more sophisticated and comprehensive stormwater management plans, parking lots and other infrastructure elements of sizable surface area are increasingly doing their part to minimize quantity and increase quality of stormwater runoff.

¹⁶ WMATA Station Access Guidelines, p 34.

¹⁷ http://www.cityofsacramento.org/dsd/planning/long-range/planning-library/documents/SHADING_GUIDELINES_06-17-03.pdf.

Recommended Transit Supportive Guidelines

Introduction

For transit to be effective, it requires more than just vehicles that carry riders and a bus schedule. Two additional elements can greatly alter a system’s effectiveness: design policies and land use/zoning. Design policies are integral elements to ensuring that people can identify and access the transit system, while land use and zoning policies help concentrate people and mix land uses to maximize transit’s effectiveness. When combined, design and land use policies not only increase transit’s ridership potential, but also its value as an economic development and sustainability tool.

The following guidelines are recommended to reap the maximum benefits of the transit services in the Des Moines metropolitan region.

Guidelines

Density

Successful bus transit generally requires a minimum of seven residential units per acre in residential areas and 25 employees per acre in commercial centers, and about two to four times as much for premium quality transit. Increased population and employment densities place more potential riders within walking distance of transit stops and higher densities, especially higher residential densities, are recommended depending on the type of transit serving the area. These densities create adequate transit ridership to justify frequent service and help create active street life and commercial activities, such as grocery stores and coffee shops, within convenient walking distance of homes and worksites.

RECOMMENDED RESIDENTIAL DENSITY THRESHOLDS

TRANSIT MODE	MINIMUM DWELLING UNITS PER ACRE
Basic Bus Service	7-15
Premium Bus Service	15-18

Source: Transportation Cooperative Research Program, Report 102: Transit-Oriented Development in the United States: Experiences, Challenges, and Prospect (2004).

Commercial land uses require employment density as well as Floor to Area Ratio (FAR). Recommended FAR’s start at 0.35 for nonresidential activities in transit supportive neighborhoods, but are more frequently recommended at minimums of 0.5 to 1.0 for commercial developments without structured parking and at least 2.0 for developments with structured parking. An employment density of 25 jobs per gross acre (15,000 jobs within a 1/2-mile) will support frequent, high capacity transit service.

High-quality transit supports the development of higher-density centers, which can provide accessibility and agglomeration benefits (efficiencies that result when many activities are physically close together). Conversely, automobile-only transportation systems conflict with urban density because it is space intensive, requiring large amounts of land for roads and parking facilities. Large scale park and ride facilities without other uses tend to conflict with transit supportive neighborhoods, since a bus station surrounded by large parking lots and arterials with heavy traffic is unlikely to provide the densities needed to generate sufficient transit demand. It is therefore important that such facilities be properly located, designed, and managed to minimize such conflicts, and sited where they can accommodate transit without impacting the development potential of the area.

Mixed-Uses

Traditional zoning separates land uses, sets density thresholds and minimum lot sizes, and usually contains explicit regulations such as bulk and height controls and minimum parking requirements. To support transit, however, these elements of traditional zoning are often inverted. For instance, uses are intermixed, not excluded, and parking caps, rather than parking minimums, are sometimes set.

To support transit, especially around high capacity stations, a municipality can create a special zone or change existing classifications. More common than either rezoning or new designations, however, is the creation of an overlay zone. As its name implies, an overlay zone is placed on the zoning map over a base zone. The overlay modifies, eliminates, or adds regulations to the base zone. Overlays provide for effective land-use control without increasing the complexity of the regulations.

Besides identifying land uses that encourage non-transit trips, like automobile repair shops, transit supportive zones often specify activities that are permitted as-of-right. The uses included in a transit supportive community should generate trips throughout the day. This strategy takes advantage of unused transit supply in off-peak hours and results in routes that are more productive than in areas with traditional rush-hour peaks. Ideally, the new zone generates approximately 1 to 1.5 jobs per household, providing significant employment opportunities for both residents and commuters.

The following list presents a sample of land uses appropriate for inclusion in a transit supportive district:

- Mid- to high- density residential
- Retail stores
- Banks
- Private offices/professional businesses
- Government offices
- Schools (especially higher education)
- Child-care centers
- Community facilities
- Public space
- Entertainment complexes

Pedestrian Orientation

Pedestrians who can walk to different land uses in under 10 minutes are more likely to utilize those sites, including retail establishments, parks, and community facilities. Placing daily goods and services, as well as recreational destinations, within walking distance of residences increases the incentive to use alternative modes, supporting transit use for commuting and other regional travel. The following recommendations outline the key design factors which focus development on pedestrians:

- Locate active uses that generate a higher number of daily trips on the first two floors. These should include retail and open space located in the first 15-20 feet of building height. Land uses which generate fewer trips should occupy higher floors.
- Bring sidewalks up to the building line and prohibit parking from being located between the sidewalk and the building.
- Curb cuts are extensions of sidewalks. Design sidewalk-driveway interfaces to be identical to sidewalks (e.g. the sidewalk material and level should continue across the driveway). This alerts both pedestrians and drivers that they are traveling on a portion of the sidewalk.
- Install bollards, trees, and other street furniture to protect pedestrians and buildings from errant drivers.

- Sidewalks should be to at least five feet wide at all points.
- Install curb extensions at all corners with on-street parking.
- Install pedestrian signals at all traffic signals.
- Automatically actuate the pedestrian phase within traffic signals instead of using pedestrian-actuated signals.
- Include Leading Pedestrian Intervals at all signals, which allow pedestrians a few seconds' start ahead of traffic entering the intersection.

Access and Connections

For transit to be successful, pedestrians must be able to easily access the service and easily walk to their destination when they disembark. The following elements outline the vehicular and pedestrian policies recommended for promoting a safe and easily accessible pedestrian environment:

- Reduce vehicular roadway lane widths to no more than 11 feet per lane. Never require pedestrians to cross more than three lanes without a protected refuge.
- Rededicate any reclaimed roadway space to install or widen sidewalks, crosswalks, and bike lanes.
- Reduce the number of conflict points between motorized and non-motorized modes. Where conflict points are unavoidable, ensure that non-motorized modes have clearly delineated pathways and that drivers are aware of their responsibility to share the road.
- Increase road and path connectivity, with non-motorized shortcuts, such as paths between cul-de-sac heads and mid-block pedestrian links.
- Adhere to and exceed the requirements of the Americans with Disabilities Act.
- Include street furniture like benches and design features such as human-scale street lights without blocking traveler's "desire lines" (paths which travelers use, whether designated or not).
- Guide motorized modes to operate at appropriate speeds and along appropriate routes for each location.
- Provide bicycle parking and amenities such as lockers, showers, and access routes to connect with all transit facilities.
- Determine parking standards as one component of overall multimodal accessibility options, not as the only mechanism to access a site.

The following table compares various modes in terms of their priority — based on whether they help provide basic mobility or tend to be more recreational uses — and performance — size and speed. Below are explanatory examples:

- Higher-priority modes should have the right-of-way over lower-priority modes. For example, recreational modes (such as skateboards) should yield to modes that provide basic mobility such as walking and wheelchair users if conflicts exist.
- Lower-speed, smaller modes should be given priority over higher-speed, larger modes. For example, bicycles should yield to scooters, and scooters should yield to walkers.
- Maximum speeds should be established for each mode, based on the physical design of the facility (i.e., some facilities may only accommodate 10 mph cycling, while others can accommodate 15 mph cycling). Maximum allowable speeds should decline as a pedestrian facility becomes more crowded or narrower.

- If facilities cannot accommodate all potential modes, higher-priority modes should be allowed and lower-priority modes should be required to use roadways. For example, cycling and skating may be allowed on pedestrian facilities at uncrowded times and locations, but not at busy times and locations.
- Special efforts should be made to accommodate a wide range of users, including cyclists, skaters, and runners, where there are no suitable alternative routes. Adjacent roadways are unsuitable for such modes.

NON-MOTORIZED FACILITY USERS COMPARED

USER TYPE	SPEED	SIZE (WIDTH)		RISK TO OTHERS	PRIORITY
People standing or sitting	None	Low	None	Minimal	High
Walkers	Low	Narrow	High	Minimal	High
Walkers with children	Low	Medium to large	Medium to low	Moderate	High
Walkers with pets	Low	Medium to large	Medium to low	Moderate to High	Medium
Human powered wheelchairs	Low	Medium	Low to medium	Minimal	High
Motor powered wheelchairs	Medium	Medium	Medium	Moderate	High
Joggers and runners	Medium to high	Narrow	Medium	Moderate	Medium
Skates, skateboards and push-scooters	Medium	Medium	Medium	Moderate to High	Low
Powered scooters	Medium	Medium	Medium	Moderate to High	Medium
Handcarts, wagons and pushcarts	Low	Medium to large	Low to medium	Moderate to High	Medium
Human powered bicycle	Medium to high	Medium to large	Medium to low	Moderate to High	Medium
Motorized bicycle	High	Medium to large	Medium to low	Moderate to High	Low
Equestrians	Medium to high	Large	Low	Moderate to High	Low

Source: Victoria Transport Policy Institute, 2005.

Transit Infrastructure and Amenities

Bus stops that are easy to find and use are critical to passengers getting on and off the vehicle. Adequate pedestrian accessibility and enhanced passenger amenities at bus stops are critical to attracting people to transit. Provision of stop infrastructure is frequently tied to the number of riders who board and alight at each stop. The greater the number of riders, current or planned, the greater the capital investment.

- All stops should have:
 - A level concrete pad
 - Reliable pedestrian access
 - Adequate lighting for safe and comfortable night use
 - Route and schedule information
- Stops with a medium number of boardings (including transfers) should have:
 - Bus shelter with bench
 - System map
 - Trash receptacles
- Stops with a high number of boardings (including transfers) should also have:
 - "Super stop" shelter
 - Real time travel information

These amenities support transit service by making the bus riding experience comfortable and convenient. As described in TCRP Report 46: *The Role of Transit Amenities and Vehicle Characteristics in Building Transit Ridership*, provision of certain physical amenities will draw more riders. The TCRP study was built around the Transit Design Game Workbook, a survey distributed to bus passengers in five cities: Rochester, New York; Ann Arbor, Michigan; Aspen, Colorado; Portland, Oregon; and San Francisco, California. The survey allowed people a budget of 12 to 18 points to spend on amenities, and also had the respondents weigh spending money on amenities or lowering the fare.¹⁸ Spending 18 points on amenities roughly equated to \$450,000 in annualized costs for a 300-bus system, and resulted in a 1.5 to 3 percent increase in ridership. A study by the University of North Carolina at Charlotte also has indicated that improved bus stop amenities increases ridership.¹⁹

Another important component of bus stops consists of safety and security measures, which increase transit effectiveness. Safety and security requires transit operators to provide a predominantly controlled environment so riders perceive that the agency is protecting them. In addition, it also requires emergency planning for when uncontrolled events occur, so that responses are planned and procedures are in place to answer unforeseen incidents. These preparations provide riders with both an actual and perceived safe environment, preventing public concerns that would limit the effectiveness of the transit system.

Providing a safe and secure environment requires a combination of design features, response plans, evaluation of public perception, and coordination between the multiple transit services and levels of government. All stops should be well-lit and provide clear sight lines with no blind spots. Placement of stops in view of active uses is recommended. Wherever possible, stations and stops should be accompanied by clearly marked crosswalks and traffic control devices to provide a safe, controlled roadway crossing.

¹⁸ TCRP. *Transit Design Game Workbook (Part of TCRP report 46)*. 1999.

¹⁹ "Understanding How the Built Environment Around TTA Stops Affects Ridership: A Study for Triangle Transit Authority." UNC Chapel Hill Department of City and Regional Planning, Dec. 2006.

Stop Location

Transit stops may be placed at intersections or mid-block. Connecting bus routes, significant trip generators, and the urban form of the destination will all impact the locations of stops.

On urban streets where traffic is intended to travel 35 mph or less, buses should stop in the travel lane rather than pull out of traffic, since pulling out results in bus delay and merge conflicts as the bus re-enters the travel lane. Wherever on-street parking is present, use a curb extension to delineate bus stop spaces.

There are three choices for location of bus stops: near-side, far-side, and mid-block. Near-side stops are located on the approaching side of an intersection in relation to the direction of travel. Far-side stops are located on the departing side. Mid-block stops are not close enough to an intersection to be affected by the intersection. Far-side stops are generally more desirable than near-side stops from the perspective of the pedestrian and motor vehicle operators, but near-side stops can be successfully designed to adequately accommodate pedestrians. Bus stop locations are not limited to only one correct placement; multiple options may work for any individual placement. During the detailed planning, the following outline can be used to help participants locate the optimal locations for each bus stop.

Far-Side Stop Advantages

- Minimizes conflicts between right-turning vehicles and buses
- Provides additional right turn capacity
- Minimizes sight distance problems on approaches to intersection
- Encourages pedestrians to cross behind the bus
- Creates shorter deceleration distances for buses since the bus can use the intersection to decelerate
- Results in bus drivers being able to take advantage of the gaps in traffic flow that are created at signalized intersections

Far-Side Stop Disadvantages

- May result in the intersections being blocked during peak periods by multiple buses stopping at the same stop (may not be an issue along streets with one route and spaced headways)
- May obscure sight distance for crossing vehicles
- May increase sight distance problems for crossing pedestrians
- Can cause a bus to stop far side after stopping for a red light, which interferes with both bus operations and all other traffic
- May increase number of rear-end accidents since drivers do not expect buses to stop again after stopping at a red light
- Could result in traffic queued into intersection when a bus is stopped in travel lane

Near-Side Stop Advantages

- Minimizes interferences when traffic is heavy on the far side of the intersection
- Allows passengers to access buses closest to crosswalk
- Allows passengers to see route destination on front of bus when crossing at intersection
- Results in the width of the intersection being available for the driver to pull away from curb

Near-Side Stop Disadvantages

- Increases conflicts with right-turning vehicles
- May result in stopped buses obscuring curbside traffic control devices and crossing pedestrians
- Increases sight distance problems for crossing pedestrians

Mid-block Stop Advantages

- Minimizes sight distance problems for vehicles and pedestrians
- Minimizes impacts to all movements at intersections
- May results in passenger waiting areas experiencing less pedestrian congestion

Mid-block Stop Disadvantages

- Requires additional distance for no-parking restrictions
- Encourages patrons to cross street at mid-block (jaywalking)
- Increases walking distance for patrons crossing at intersections

Electric Vehicle Infrastructure Recommendations

Electric Vehicles (EV) need a much different type of fueling network than gasoline engine vehicles. This new fueling system will be based on a clustering of strategically placed charging stations at homes, workplaces, and retail stores instead of the traditional quick fueling system used with gas stations today. This way of “fueling” will be quite a paradigm shift for most metro consumers.

Recommendation 1: Publicly Site Charging Stations

A strong network of publicly-available Level 2 charging stations is needed to encourage more plug-in electric vehicle (PEV) purchases in the Des Moines metro area. Various business and government sites are suitable for a charging station. An ideal location is convenient and highly visible to a large number of potential PEV drivers. The MPO's *Electric Vehicle Readiness Study* includes maps of ideal locations for Electric Vehicle Supply Equipment (EVSE) installation for each of its 17 member communities based on the number of destination locations such as retail stores, parks, theatres, and restaurants within the Traffic Analysis Zones. Each map displays high density areas of ideal businesses where travelers tend to stay parked for at least an hour.

The MPO recommends each municipal government install at least one EVSE in each high density location. Local city planners can assess the ideal specific local within this destination area such as finding an ideal host. Many organizations can host Level 2 charging stations including:

- Parking garages
- On-street parking
- Retail Stores
- Stadiums and sports complexes
- Movie theaters
- Destination parks, zoos, and museums
- University

Charging station ownership and payment systems vary. Many stations are currently publicly funded and offer free charging to encourage early adopters of PEVs. Payment systems will evolve as use becomes more mainstream.

Recommendation 2: Incentivize Local EVSE Installation

There are three main tools a city can use to encourage or even require the installation of EVSE on private property and the focus should be placed on multi-unit residences, workplace sites, and key inter-metro sites.

Site Types

Multi-Family Home

Multi-unit residences are a major obstacle to EV ownership. Residents may choose a location to live based on EV availability. An EV owner in a single family residence can easily install an EVSE. It can be as simple as hiring a contractor to install a new outlet. This is not the same for a resident of multi-unit dwelling that would need to work through a landlord, building management, or home owners association. Special consideration should be given to requiring apartments and condominiums, etc. to install a Level 2 EVSE for 2-5% of the parking.

Working

According to the Electric Power Research Institute, the workplace is the second most frequented location for charging after a PEV driver's home. This is because vehicles tend to stay parked at a workplace on average 8 to 9 hours. Workplace charging may also be an

alternative to residential charging for drivers that may not have charging available in their homes if they live in a multi-unit dwelling, have a detached garage with no electricity, etc. The MPO’s Electric Vehicle Readiness Study mapped locations with a high number of employees to locate dense workplace zones to assist planners to focus on workplace charging initiatives.

Inter-Metro Sites

To complete the EVSE network, a few fast charging sites will be necessary to extend the range for drivers. PEV drivers want more fast chargers to be available. This charging equipment can provide an 80 percent charge in as little as 30 minutes. It will service the needs of inter-regional and intra-regional travel and also provide a “safety net” charging network for all PEV drivers in the Des Moines metro area. The MPO has mapped areas for optimal fast charging stations *Electric Vehicle Readiness Study*.

Site Types

Site Design and Parking Ordinances

Residential: Update ordinances to strongly encourage, if not require, new multiple-family homes be constructed to provide a 220-240-volt/40 amp outlet on a dedicated circuit and in close proximity to designated vehicle parking to accommodate the future hard wire installation of a Level 2 EVSE. Due to the fact that 60% to 70% of electric vehicle charging will happen at the owner’s home at night, it will be easier to install the dedicated electrical line now vs retrofitting a building in the future.

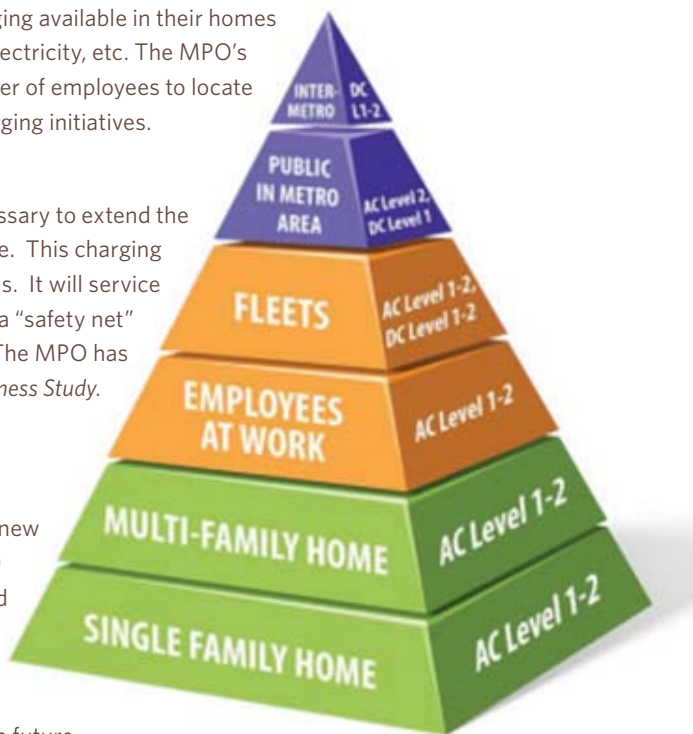
Non-Residential: Update ordinances to strongly encourage, if not require, new and expanding non-parking areas to proactively provide the electrical capacity necessary to accommodate the future hard wire installation of Level-2 electric vehicle charging stations in order to accommodate future growth in demand for EV. It is recommended that a minimum ratio of 2% of the total parking spaces be prepared for charging stations. Ordinances may also speak to site design requirements, signage, ability for police to remove illegally parked vehicles, etc. See Resource section for links to example ordinances from other communities.

Pre-App Meetings: Cities that conduct pre-app meetings should consider adding this to the check-list of considerations discussed with potential development projects.

Tax Abatement

Tax abatement is offered as an encouragement to commercial projects that exemplify a commitment to improve the character of the commercial areas throughout the region. Most communities have standards and some offer a menu of options including those focused on sustainability. The MPO recommends adding the option to install Level 2 EVSE charging stations (not just the wiring) to serve a minimum of ration 2% of the plan’s total parking spaces. Other incentives communities have implemented include:

- Low-cost EVSE permits
- Same-day inspections
- Stream-line electrical permitting



Recommendation 3: Comprehensive Plan & Code Updates

To ensure EV-friendly local government commitment through ordinances and zoning, the MPO encourages including EVs and EVSE in local comprehensive plans. Most city codes do not represent a significant barrier to EVSE installation, but adopting EV-friendly codes can encourage EVSE deployment. The plan could include new zoning ordinances to address the following:

- Define what types of EVSE are allowable by land use type
- Request developers install EVSE or wiring for future EVSE installation with new develops or significant renovations
- Establish design criteria for EVSE installations
- Provide density bonuses for EVSE installations
- Set performance measurements or target number of EVSE for the region



