Edmond Bicycle Master Plan

October 2012

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CP&Y

ToolеDesignGroup

Edmond
BIKE PLAN

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Acknowledgements

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Executive Summary

Plan Purpose and Framework

The purpose of the Edmond Bicycle Master Plan is threefold:

1. Identify the challenges and barriers to bicycling in the city along with recommended solutions;
2. Identify opportunities for development of a city-wide, connected and safe bicycle facility network; and
3. Recommend policies, practices, and programs to support and promote bicycling as a viable transportation mode for bicyclists of all skill and comfort levels.

All recommendations and strategies included in this Master Plan are intended to help the City achieve the Master Plan Goal:

> **Increase the number of people bicycling while minimizing the number of crashes involving bicycles by providing safe, comfortable, and efficient bicycling conditions, and increasing public awareness and acceptance of bicycles on Edmond streets.**

How the Plan Supports Edmond's Established Goals and Objectives

Edmond Plan IV contains goals and policies that speak directly to, and support the development of a comprehensive, high quality bicycle network as part of its goal of reducing automobile dependency. The *Plan's* goals and policies also support enhancing mobility and safety for all roadway users. The Edmond Transportation Plan states that needs and improvements [to existing and planned roadways] are based on "meeting the City's projected growth, enhancing mobility and facilitating the movement of people and goods in a safe and efficient manner." In 2010 the City approved a Complete Streets Resolution, which provides a policy framework for how the City approaches transportation planning and design, and supports the development of a city-wide on-street bicycle network and other improvements that will help to make bicycling a more viable and safe mode of travel. The Complete Streets Resolution can be seen in Appendix D.

Why Invest in Bicycling?

There are a number of key trends converging and resulting in a larger national interest in promoting bicycling as a viable transportation mode. These trends relate to economic development, public demand for a broader range of transportation choices, household economics, community livability, and public health. As many cities across the country can attest to, investing in high quality bicycle infrastructure is an effective means to address multiple issues while bolstering economic competitiveness and improving quality of life.

Public Outreach and Input

Engaging the public was an important component of the Master Plan development process. Several strategies were deployed (online survey, web-based interactive map, two public open houses, and online posting of the draft network map and Plan document) to gain an understanding of the public's perceptions about bicycling, including why people are biking or would like to bike, as well as the challenges and barriers preventing people from biking. The public also provided many ideas for specific improvements that should be made to Edmond's roadways to increase the convenience, safety and comfort of bicycling, which helped to shape many of the Plan's recommendations.

Overview of Recommended Bicycle Network

The Master Plan recommends a city-wide bicycle network that is intended to provide safe, convenient, and comfortable bicycling conditions that attract bicyclists of different skill and comfort levels, and promote bicycling as a viable form of transportation throughout the City. The recommended bicycle network consists of a variety of bicycle facility types, including shared lane markings, bicycle lanes, paved shoulders, and sidepaths. A number of factors were considered in the development of the recommended network, including access to parks, schools, shopping, employment areas, and transit, as well as roadway conditions such as vehicle volumes and speed, roadway and lane width, and network continuity. The table below provides a summary of the recommended bicycle network

Summary of Recommended Bicycle Network	Miles
Bike Lane	7.1
Bike Lane (long-term improvements)*	36.3
Shared Lane Marking	18.6
Neighborhood Wayfinding	17.6
Sidepath	13.0
Paved Shoulder	30.6
Share the Road/3-Feet Signage	23.0
Total	**146.2**

*Long-term improvements include recommended bicycle facilities that will be implemented as a part of future street construction. Bicycle facilities could include bike lanes, buffered bike lanes, or possibly separated facilities such as cycle tracks.

Maximizing Ridership through Design of High Quality Facilities

A fundamental strategy for increasing bicycling rates is to improve the experience and safety of bicycling on the roadway network. In designing high quality bicycle facilities that attract a wide range of bicyclists, i.e. casual, less confident and experienced riders, it will be critical to manage motor vehicle speeds, provide a separation or buffer between bicycle lanes and motor vehicle lanes on higher speed roadways, provide signal detection and adequate signal timing for bicyclists, and improve crossings of arterial roadways where bicycle routes intersect at unsignalized locations. The Master Plan recommends new design standards for collector and arterial roadways that include narrower (11 foot) vehicle travel lanes, and minimum five-foot bike lanes (with three-foot buffers for higher speed roadways).

Promoting a Bicycling Culture through Education, Encouragement and Enforcement

Developing a network of well-designed bicycle facilities needs to be complemented with educating all roadway users about their rights and responsibilities, and encouraging more people who are interested in bicycling, but concerned about safety to give bicycling a try. Motorists need to understand and appreciate that bicyclists have operating characteristics different from automobiles, and bicyclists need to be skilled in riding in various conditions. Educating both motorists and bicyclists about state and local laws should be the primary method for encouraging appropriate behavior. Enforcement targeting certain behaviors of each road user group is also important for establishing correct behaviors. Motorist behaviors that should be targeted include turning left and right in front of bicyclists, passing too close to bicyclists, parking in bicycle lanes, opening doors of parked vehicles in front of bicyclists, rolling through stop

signs or disobeying traffic signals, and harassment or assault of bicyclists. Bicyclist behaviors that should be targeted include ignoring traffic control (particularly traffic signals), riding the wrong way on a street, riding without lights at night, and riding recklessly near pedestrians on sidewalks.

Implementation

The recommended bicycle network will be implemented incrementally over time, and it is anticipated that the majority of bicycle network recommendations can be implemented within five years of the adoption of the Plan. These "short-term" recommendations primarily entail relatively low-cost improvements such as signing and pavement markings along and within existing roadways. The table below shows planning-level cost estimates for each recommended bicycle facility type. These costs are based on local pricing (where available) and industry standards.

New On-Street Facilities	Miles	Cost (at full-build out)
Bike Lanes (signing and marking)*	7.1	$143,000
Bike Lanes with Future Widening (signing and marking)*	36.3	$726,000
Shared lane markings (signing and marking)	18.6	$186,000
Signed Roadway (signing only)	23.0	$23,000
Neighborhood Wayfinding (signing and marking)	17.6	$36,000
Adding 4' Paved Shoulders on Rural Roadways (on both sides of road)	30.6	$12,224,000
Adding 10' Sidepath (on one side of road)	13.0	$3,901,000
Total	**146.2**	**$17,239,000**

* Does not include construction costs if widening is needed

The recommended bicycle network will likely be funded and implemented by:

- Routinely accommodating bicycle facilities when roadways are constructed or substantially reconstructed. This strategy relates to the City's Complete Streets resolution.
- Required improvements as dictated by the City's zoning and subdivision codes.
- Dedicated funding sources at the local, regional, or state levels. Dedicated funding may vary from year to year, but the City should both seek to reallocate a portion of its transportation budget to implementing the recommended bicycle network and aggressively pursue funding from regional and state agencies.

In addition to recommending physical improvements to the street network, the Master Plan also presents an "Action Plan" consisting of recommended policies and practices that will improve bicycle safety and promote bicycling as a viable mode of transportation.

Section 1 / Bicycle Master Plan Overview

1.1 Introduction

In recent years, there has been an increasing demand from Edmond residents for a more bicycle friendly place to live, work, and play. In 2006, the Edmond Bicycle Committee (EBC) was established per City Resolution. The EBC plays an important liaison role between the City and the bicycling community. The EBC works to ensure that bicycles are considered in the City's transportation planning, design, and operations. The City of Edmond, with help from the EBC and the broader bicycling community, has been moving forward with actions to make Edmond more bicycle friendly, including passing ordinances requiring the provision of bicycle parking in new commercial developments and making the "3 feet, It's the Law" policy enforceable (without there being an accident or injury). Developing a Bicycle Master Plan was seen as the next step for making Edmond a truly bicycle friendly community. In the spring of 2011, the City approved funding for developing a Bicycle Master Plan based on requests from the EBC and others. Work on the Bicycle Master Plan commenced in December 2011.

The City has been installing "3 Feet, It's the Law" signs on many of its streets.

1.2 Master Plan Purpose and Framework

The purpose of the Edmond Bicycle Master Plan is threefold:

1. Identify the challenges and barriers to bicycling in the city along with recommended solutions;
2. Identify opportunities for development of a city-wide, connected and safe bicycle facility network; and
3. Recommend policies, practices, and programs to support and promote bicycling as a viable transportation mode for bicyclists of all skill and comfort levels.

Transforming the City of Edmond into a Bicycle Friendly Community[1] will happen incrementally over time. The Master Plan provides a framework for this transformation and will serve as the go-to document for the City as it moves forward with more tightly integrating bicycling into roadway design, capital improvement budgets, land use and development, and community education and encouragement efforts. Specifically, the Bicycle Master Plan:

- Builds upon previous plans and links together other ongoing efforts related to bicycling, including the City's trail network, and efforts in neighboring jurisdictions.
- Incorporates extensive public feedback, assisting elected officials and staff in understanding what citizens want to see developed.
- Provides an implementation schedule for a city-wide bicycle network to be incrementally implemented over time with a focus on short-term projects that will provide the most benefit from a ridership perspective.

1 Bicycle Friendly Community is a component of the League of American Bicyclists' Bicycle Friendly America program, which provides incentives, hands-on assistance, and award recognition for communities, universities and businesses that actively support bicycling, and ranks states and cities annually based on their level of bike-friendliness.

Edmond's annual Bike to School event encourages students to ride to class.

- Establishes an Action Plan that addresses the five Es: engineering, education, encouragement, enforcement, evaluation, and provides direction for City Council, as well as City staff, for collectively moving forward with implementing an on-street bicycle network in a cost effective and safe manner.

Plan Framework

All recommendations and strategies included in this Master Plan are intended to help the City achieve the Master Plan Goal:

Increase the number of people bicycling while minimizing the number of crashes involving bicycles by providing safe, comfortable, and efficient bicycling conditions, and increasing public awareness and acceptance of bicycles on Edmond streets.

Specifically, the Plan is organized to first provide a background of, and establish a clear case for, supporting bicycling in Edmond (Section 1), then to provide an overview of existing conditions, including opportunities and constraints (Section 2), present a recommended bicycle network

and the methodology used to establish the network (Section 3), provide specific information on how to maximize bicyclist comfort and safety through good design practices (Section 4), and finally an "Action Plan" that is framed around objectives and targeted actions for achieving those objectives (Section 5). Section 5 also provides performance measures for tracking progress of Plan implementation.

1.3 The Case for Investing in Bicycling

Presently, a number of key trends are converging and resulting in a larger national interest in promoting bicycling as a viable transportation mode. Many cities are facing challenges in terms of economic development, providing infrastructure and services cost effectively and equitably, addressing local and global environmental issues, and more closely integrating land use with transportation. In addition, many households are feeling the pressure of increasing transportation costs. There is great interest among citizens and other stakeholders in pursuing development and transportation solutions that are more sustainable—meaning less costly to maintain over time, less polluting, and more equitable. More and more, the bicycle is being seen as a key component of sustainable transportation systems that maximize mobility and access. These trends, as well as growing public demand for more transportation choices, and healthy lifestyles, e.g. opportunities for integrating walking and biking into daily routines, point to the need for implementing this Master Plan.

Cities across the country are embracing the bicycle as a viable transportation mode, and a means to achieving multiple objectives, including economic development, maximizing the return on transportation investments, improving public health, addressing transportation equity, and reducing environmental impacts. Below are some points to consider as the City further develops its transportation systems, and making decisions and choices on how to best utilize finite funds.

More and more communities are realizing the multiple benefits of promoting bicycling.

Economic Development

- In many industries, the competition for workers is on a global scale, and people are choosing where to work not just on salary and traditional benefits, but on external criteria such as lifestyle and quality of life. Many employers are recognizing that their ability to recruit top employees depends significantly on local culture and amenities. Cities that are making investments to become more walkable and bikeable are seeing dividends in the form of attracting new residents and employers. While Edmond was ranked #1 on CNBC's "10 Perfect Suburbs" list[2] because of its good schools, low crime rate, relatively low housing prices, and low unemployment rate, it can work to maintain its status of being a great place to live through the investment in infrastructure and amenities that enhance quality of life.

2 CNBC.com 10 Perfect Suburbs, 2011. http://www.cnbc.com/id/44347217/10_Perfect_Suburbs?slide=11

"I have been to other cities that have bicycle transportation systems that obviously improve the quality of life"

– Edmond Resident

- A motor vehicle is the second-highest household expense, after housing itself.[3] The American Automobile Association estimates that Americans spend on average $8,485 each year to own and operate a car. This number increases each year as gas prices continually increase. It is estimated that about $7,000 of this leaves the local economy (through fuel purchase, insurance, etc.) while about $1,400 remains (through taxes, maintenance, registration, etc). Providing transportation choices can give households the option of owning fewer cars, thus freeing up more household money that can be spent in the local economy. Improved walking and cycling conditions tend to increase local property values and support local development.[4]
- Bicycling can be an important component of a city's tourism and convention industries. The walkability and bikeability of a place not only impacts the quality of life for its residents, but also the quality of experience of its visitors, and can help draw visitors that spend money in Edmond. The City of Edmond could both capitalize on and support efforts such as the proposed Route 66 "Historic Bike Trail", the proposed Arcadia Lake trail, and development of a new convention center, by becoming a more bike-friendly community.

Bicyclists spend money at local businesses.

Maximizing the Return on Transportation Investments

- Communities across the country are finding that developing multi-modal transportation systems is a more cost effective way to meet people's mobility needs rather than trying to meet demand through roadway expansion. The City of Edmond has already made substantial investments in its transportation infrastructure. Implementation of on-street bicycle facilities is a key strategy for maximizing the return of this investment and developing a balanced transportation system.
- Dollar for dollar, bicycling is by far one of the cheapest transportation modes to support. High quality bicycle facilities can often be developed using existing roadway space, and relatively low-cost pavement markings and/or signage can be used to help people navigate and feel more comfortable biking.

3 Bicycling and Walking in the United States: 2012 Benchmarking Report, Alliance for Biking and Walking, Washington DC, 2012.

4 Kevin J. Krizek, et al. (2006), *Guidelines for Analysis of Investments in Bicycle Facilities*, Transportation Research Board, NCHRP Report 552

"Better access to businesses would be helpful so we can use our bikes to run errands, pick up groceries, etc."

– Edmond Resident

- A walking or bicycling trip may end at a destination such as work or shopping, or it can be part of a longer journey that involves transit. Pairing bicycle facility improvements with transit gives people more transportation choices and expands the reach of the transit system. The City of Edmond has seen large ridership on its Citylink buses, and targeting the provision of safe and convenient bicycle facilities such as bicycle lanes, trails, and parking could further increase ridership and allow the system to expand into other parts of the City.

Health

- Obesity has been characterized as a national public health epidemic, which is largely a result of lack of physical activity and high calorie diets. To maintain good physical health, the Department of Health and Human Services' *2008 Physical Activity Guidelines for American* publication recommends 150 minutes of moderate-intensity aerobic activity every week, which is equivalent to 10 minutes of brisk walking or biking, 3 times a day, 5 days a week along with muscle-strengthening activities.[5] Providing opportunities for people to integrate walking or biking into their daily routines can help them meet these guidelines and stay healthy and fit.
- The prevalence of obesity among children 6 to 11 increased from 6.5 percent in 1980 to 19.6 percent in 2008, nationwide. The prevalence of obesity among adolescents aged 12 to 19 years increased from 5.0 percent to 18.1 percent.[6]

5 http://www.health.gov/paguidelines/

6 Ogden CL, Carroll MD, Curtin LR, Lamb MM, Flegal KM. Prevalence of high body mass index in US children and adolescents, 2007–2008. JAMA 2010;303(3):242–9.

- Many Edmond schools are in neighborhoods that are already conducive for kids to walk or bike to school, and improvements could be made within the vicinity of other schools to improve safety and encouragement for these modes.
- Researchers compared the relationship between bicycling and walking travel versus obesity in 14 countries, 50 U.S. states, and 47 U.S. cities, and found statistically significant inverse relationships at all levels.[7]

"My husband and I are involved in cycling and would love to see improvements [for bicycling] to support residents in their healthy habits."

– Edmond Resident

Environment

- One-quarter of all trips people take in the United States are within a mile, or about a 20-minute walk, and half of all trips taken are within three miles, or a 20-minute bike ride. Yet for the vast majority—78 percent—of these shortest trips, people are using their cars. Replacing these car trips with bicycling and walking trips can greatly reduce harmful emissions associated with cold starts.[8]
- Increasing the mode share of all trips made by bicycling and walking from 12% to 15% (nationally) could lead to fuel savings of 3.8 billion gallons a year and reduce greenhouse gas emissions by 33 million tons per year. This is equivalent to replacing 19 million conventional cars with hybrids.[9]

7 Pucher, J. et al. Walking and cycling to health: A comparative analysis of city, state, and international data, American Journal of Public Health, 2010.

8 Active Transportation is the Missing Piece in Our Transportation System, Rails-to-Trails Conservancy, http://www.railstotrails.org/resources/documents/ourWork/ATfA/ATFA%20one-pager%20plus%20trivia%20final_9-09.pdf

9 Ibid.

Equity

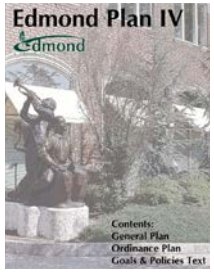
- Providing the community viable and affordable transportation choices that include transit, bicycling and walking helps to reduce household travel costs and is a key component of an equitable transportation system.

1.4 Implementation of the Bicycle Master Plan Will Support the City's Established Goals and Objectives

The City of Edmond has existing plans and policies that have direct planning and design implications for the development of a city-wide bicycle network that is continuous, convenient, comfortable, and safe for a wide range of bicyclists. These plans and policies, and how they support the Bicycle Master Plan (and vice versa), are discussed below. Recommendations for how these plans and policies may be strengthened to better support implementation of the Master Plan are discussed in Section 5.

Edmond Plan IV

Edmond Plan IV, which was adopted in 2007, is the City's official comprehensive plan, which provides a long-range vision for how the community should grow and develop. It is comprised of three components: goals and policies, general plan, and ordinance plan. The General Plan establishes the anticipated and desired future character of Edmond. The transportation goals and policies in Chapter 5 of *Edmond Plan IV* reflect the recommendations of the *Edmond Transportation Plan*, and incorporate the Year 2030 functional classifications of local roadways. *Edmond Plan IV* aims to ensure that development adjacent to major roadways is compatible for the roadway class, and that sufficient right-of-way is acquired.



Edmond Plan IV supports enhancing mobility and safety for all roadway users.

More Americans are choosing to bicycle for everyday transportation. Between 2000 and 2010, the number of bicycle commuters grew 40 percent nationwide, and was even greater — 77 percent — in some cities.

– Pedaling to Prosperity Report, May 2012.

Edmond Plan IV contains goals and policies that speak directly to, and support the development of a comprehensive, high quality bicycle network as part of its goal of reducing automobile dependency. The *Plan's* goals policies also support enhancing mobility and safety for all roadway users. Applicable goals and policies (PT – Policy Transportation; GT – Goal Transportation; PLUS – Policy Land Use Sustainability) are listed below:

PT 4 *- Create a transportation system which clearly reflects the social objectives of the City, as evidenced in land use patterns, by providing a full range of transportation facilities for pedestrian, cyclist, vehicular and rail modes, with due attention to safety, mobility, aesthetic, recreational, and utilitarian needs.*

PT 5 *- Promote land development patterns that are less auto dependent and that better support travel options. For a given amount of development, higher residential and employment densities and mixed uses generate fewer auto trips than low density, single-family development. Both the large-scale pattern of new development and smaller scale site design should support this Plan's goal of reducing automobile dependency, by promoting fewer and shorter vehicular trips, many of which may occur through transit, ride sharing, bicycling, or walking.*

GT 5 *- Develop a Pedestrian and Bicycle Plan to provide connected and safety oriented facilities.*

PT 15 *- Minimize hazards and obstructions on the pedestrian and bicycle system by ensuring the system is properly maintained. Allow different levels of maintenance for certain key linkages based on amount and type of use or exposure to risk.*

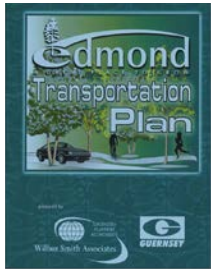
PT 17 *- Secure sidewalk and trail improvements with the Pedestrian and Bicycle Plan through the development review process where a development impact is identified.*

PT 18 *- Recognize the importance of walking, jogging, and bicycling as recreational pursuits, and provide adequate opportunities for such activities.*

PT 19 *- Reflect the availability of alternative travel options and community goals that may be as important as managing traffic flow, such as goals for land use, neighborhood protection from wider streets, or economic vitality.*

PLUS 7 *- Development should promote pedestrian and bicycle activity through sidewalks, bike paths and trail improvements with particular emphasis on connectivity, and accessibility.*

Edmond Transportation Plan



The Edmond Transportation Plan

The *Edmond Transportation Plan,* which was adopted in 2007, identifies current and future transportation needs and improvements for a 25 year planning horizon, including the existing and planned extension of major roadways. Needs and improvements are based on "meeting the City's projected growth, enhancing mobility and facilitating the movement of people and goods in a safe and efficient manner." The *Plan* establishes the future functional classification of roadways, which primarily consists of major and minor arterials along county section lines (mile spacing), major collectors, and local streets.

Complete Streets Resolution

On May 24th, 2010 the City's Mayor and City Council approved a resolution "supporting the complete streets philosophy to expand transportation choices in Edmond." The resolution states that:

Street projects should be planned, designed, and operated, when physically and economically feasible, in accordance with our Edmond Transportation Plan (2007) or any plan adopted in the future, giving consideration to the accepted standards for Complete Streets, as outlined by the National Complete Streets Coalition, to provide for a balanced, responsible, and equitable way to accommodate and ensure travel for pedestrians, bicyclists, and public transit riders of all ages and abilities amongst vehicular traffic.

This resolution provides a policy framework for how the City approaches transportation planning and design, and supports the development of a city-wide on-street bicycle network and other improvements that will help to make bicycling a more viable and safe mode of travel. The Complete Streets Resolution can be seen in Appendix D.

Trails and Sidewalks Master Plan

The Trails and Sidewalks Master Plan was developed in 1999 to offer recommendations for improving community access to outdoor resources by building a network of off-road multi-purpose paved trails. The plan addresses policies, programs, and physical improvements that should be implemented to improve access to recreation resources and improve transportation efficiency throughout the community. It identifies 84 miles of proposed trails in 37 corridors throughout the City of Edmond. The plan also proposes 48 miles of on-road bicycle and sidewalk "linkages." It suggests that the identified linkage corridors have the potential to accommodate on-road bike facilities, as well as space within existing rights-of-way for addition or improvement of sidewalks. While these linkages are envisioned to be an integral component of the trail system, providing access to important destinations, many deserve a closer look to determine their feasibility. This Master Plan has considered the City's existing and planned trail network in terms of how it can complement an on-street bicycle network (and vice versa). For example, several recommended bicycle facilities connect to existing or planned trails, or utilize short off-street segments to connect on-street facilities.

In addition to the trail network recommendations, the Trails and Sidewalks Master Plan provides design guidelines for on-street bicycle facilities. These guidelines are generally outdated as they are based upon national guidelines and standards, and best practices that have since been revised and improved upon.

City Zoning Ordinance

The City's Zoning Ordinance (Title 22), which was adopted in 2007, contains provisions for bicycle parking facilities (Section 22.6.1A (11)), which went into effect in February, 2010. Bicycle parking facilities are required for all new residential developed containing more than three units on the same lot, and commercial, industrial, office and institutional uses. Bicycle parking is also required for any existing use that is enlarged or expanded and requiring Commercial Site Plan approval, proportional to the amount of added parking area. For residential uses (three or more units) one bicycle parking space is required for the first eight car parking spaces, and an additional bicycle parking space is required for each additional ten car spaces provided. For commercial, industrial, office, and institutional uses one bicycle parking space is required for the first eight car parking spaces, and an additional bicycle parking space is required for each twenty car spaces thereafter. Bicycle parking provisions include specifications for the type of rack to be used, the dimensions and clearance required, and the surface on which the rack is installed. Action 6.4 in Section 5 offers recommendations on how the City's existing bicycle parking requirements could be strengthened.

The City's Subdivision Code (Title 21) contains regulations that address the arrangement of streets within subdivisions, including block length, access and connectivity. Chapter 21.02 of Edmond's Subdivision Code contains several regulations that dictate how local streets and collector streets are developed. Section 5, Action 2.2 lists some strategies for improving neighborhood connectivity to better serve biking and walking trips.

1.5 Stakeholder Outreach and Input

The Master Plan was developed in close consultation with City staff, the Edmond Bicycle Committee, and the public at-large. This section contains a summary of outreach efforts and the input that was received throughout the Master Plan development process.

Public Outreach and Input

Understanding the public's perceptions about bicycling, including why people are biking or would like to bike, as well as the challenges and barriers preventing people from biking is critical to developing a bicycle plan and implementation strategy that ultimately will result in higher bicycle ridership. Engaging the public and getting feedback was an important component of the Master Plan development process, and helped to form many of the plan's recommendations. Public input was sought using the following methods:

Online Survey

An online survey was developed and made available between February 23 and March 20, 2012. The survey consisted of 16 questions intended to elicit responses that would help the project team understand why people bike, and what it would take to get people to bike more. Several demographic questions were also asked to understand who the survey was reaching and how needs may differ among different types of bicyclists. The survey was disseminated via the City's website, an email blast to over 300 recipients, and made available on several laptops/ tablets at the public open house in March. The survey had 515 responses. Survey responses revealed a number of important points, which this Plan attempts to address through its recommendations and strategies:

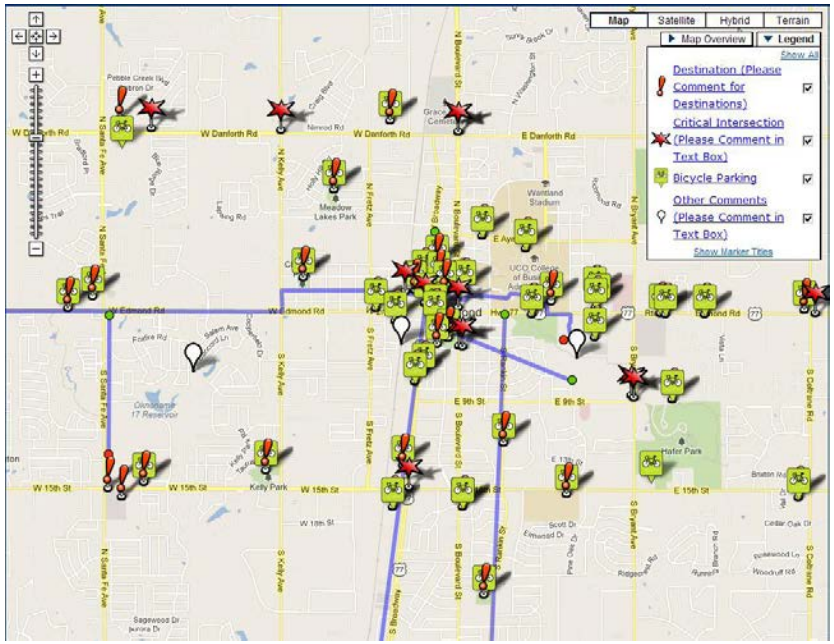
- Approximately 45% of respondents indicated that they would potentially use bicycling as their primary mode of transportation within the City.

- Nearly all respondents indicated they do or would bike for recreation and exercise.
- A large number of respondents would bike for short trips, as well as long trips, if they felt it was safe to do so. 94% of respondents would bike five minutes (1 mile), 92% would bike ten minutes (2 miles), 83% would bike 30 minutes (6 miles), and 76% would bike over 10 miles.
- **The top five destinations respondents would bike to are (in order): parks, Arcadia Lake, University of Central Oklahoma, shopping areas, and downtown.**
- The top five factors that make it difficult and prevent respondents from riding their bicycles are: lack of on-street bicycle facilities, don't feel safe, barriers such as intersections, railroads, etc., insufficient bike parking, and weather.
- The top five things that would increase the chances of respondents bicycling more often are: provision of paved shoulders for bicyclists to ride on, more separated bikeways (e.g. side paths or trails), more striped on-street bike lanes, drivers sharing the road with bicyclists, and more shared lanes accompanied with pavement markings and signage.
- There are a number of driver and bicyclist behaviors that need to be addressed through education and enforcement, including (for bicyclists) night-time riding without lights or reflectors, erratic riding, wrong-way riding, and non-compliance with stop signs and traffic signals; and (for drivers) providing adequate space to bicyclists when passing, distracted driving (e.g. talking or texting on cell phones), failing to slow down for bicyclists when the road is narrow, speeding on neighborhood streets, and aggressive use of horns.

A full summary of survey responses is included in Appendix A.

Online Interactive Map

An online interactive mapping tool was utilized to collect geographically specific information about issues affecting bicycle travel, such as desirable or commonly used routes, challenging intersections, and bike parking. A link to the map was provided on the City's website, in an email blast to over 300 recipients, and was featured on various other websites and Facebook pages. A total of 119 comments were gathered using this tool, the majority of which related to specific locations where bicycle parking is needed.



Online interactive mapping tool

Social Media

Updates and notifications about the Master Plan were cross posted on the City's Facebook page, as well as other Facebook pages of individuals, organizations, and businesses that are active in the bicycling community.

Open house participants provided valuable feedback on bicycle plan elements.

Public Open Houses

The first public open house was held on March 8, 2012. Over one hundred people attended the open house to gather information and provide input on elements of the Master Plan, including goals and objectives and recommended bicycle improvements. Participants were asked to mark up maps of the Edmond roadway system with ideas they have about good bicycle routes, known challenges and barriers, and desired routes. Map comments helped to direct the project team's field analysis and development of the recommended bicycle network. Comments were also sought on draft goals and objectives. In addition, the online survey was made available on several laptops/tablets. Additional comments were submitted by participants using comment forms and during the question and answer session, which followed a presentation by the project team. A summary of these comments is provided in Appendix A.

A second open house was held on September 13, 2012. The purpose of this open house was to present the draft Master Plan and recommended bicycle network, and provide an additional opportunity for the public to comment. Over 50 people attended the open house and provided valuable feedback. The majority of participants were very supportive of the draft plan's recommendations and the draft bicycle network.

It was evident, based on discussions at the open houses and the numerous comments received throughout the Plan development process, that there is great interest within the Edmond community to improve bicycling conditions throughout the city so that bicycling can be a viable form of transportation as well as a recreational activity. A common theme among public comments was making Edmond more bicycle friendly, which would greatly enhance the quality of life in Edmond and help bolster its reputation as a desirable place to live.

Edmond Bicycle Committee and Friends

The Edmond Bicycle Committee (EBC) and other interested stakeholders served as a citizen advisory committee for the Master Plan development process. The project team attended several EBC meetings to present and receive comments on draft Plan elements throughout the development of the plan. The EBC also was instrumental in spreading the word about the Master Plan and encouraging people to fill out the online survey, provide comments on the interactive map, and attend the public open houses. It is also anticipated that the EBC will play a role in monitoring and evaluating plan implementation.

City Staff Input

A core group of City staff from the Planning, Public Works, and Engineering departments functioned as the technical advisory committee for the Master Plan development process. The project team engaged staff on issues related to the planning and design of roadways, feasibility of recommended bicycle improvements, and other factors that impact development of a comprehensive bicycle network and bicycle ridership in general. City staff reviewed and provided comments on the recommended bicycle network and the draft Master Plan document.

Section 2 / Existing Conditions Analysis: Constraints and Opportunities

The City of Edmond owns and maintains approximately 680 miles of roadway, primarily consisting of an arterial/major collector grid system developed on county section lines (mile spacing). Table 1 shows a mileage summary of Edmond's street network by functional classification. Roadway characteristics vary from multi-lane, high volume divided streets with curb and gutters - prevalent in the more developed portions of the City - to two-lane undivided paved streets in not fully developed areas. Below is a description of the City's functional classification system for its roadways, the purpose of each functional class, and observed constraints and opportunities.

Table 1: Edmond Roadway Mileage by Functional Classification

Functional Classification	(Miles)
Local	485.1
Collector	11.8
Minor Arterial	108.9
Major Arterial	66.8
Freeway and Frontage Roads	7.6
Total	680.4

2.1 Arterial Streets

The primary purpose of Edmond's major and minor arterial streets is to provide for traffic movement with a secondary function being the provision of direct access to abutting property. Major arterials typically serve as connections between major traffic generators and land use concentrations, and facilitate large volumes of through traffic traveling across the City. Minor arterials typically serve as connections between local and collector streets and the major arterials, and facilitate the movement of large traffic volumes over shorter distances within the community.[10] Given how the City's road network and residential areas have been developed, arterial streets currently serve as the primary circulation system for the City, and in many cases, the only connections between most major destinations. Prior to the 2007 Transportation Plan, Edmond Rd/2nd Ave and Broadway (south of 2nd Ave) were the only designated major arterials in the City; however, the City's Transportation Plan identified Kelly Ave, Bryant Ave, Covell Rd, 33rd St, portions of Air Depot Blvd, and Douglas Ave as planned major arterials. All other streets that have been, or will be, developed on section lines are minor arterials.

Arterial streets often provide the only connections between major destinations in Edmond.

Average Daily Traffic (ADT) data from 2011 show traffic volumes ranging from 10,000 to 27,000 vehicles on arterial streets within a three-mile radius from the downtown area. High vehicle speeds are prevalent on arterial segments, particularly along arterial segments within areas of the City with lower concentrations of development, and thus lower traffic volumes.

Figure 1, taken from the City's Transportation Plan, shows the typical cross sections for major and minor arterial streets, which serve as the City's standards for new arterial street construction.

10 Edmond Transportation Plan, 2007.

Figure 1: Typical Cross Sections for Major and Minor Arterial Streets (from Edmond Transportation Plan)

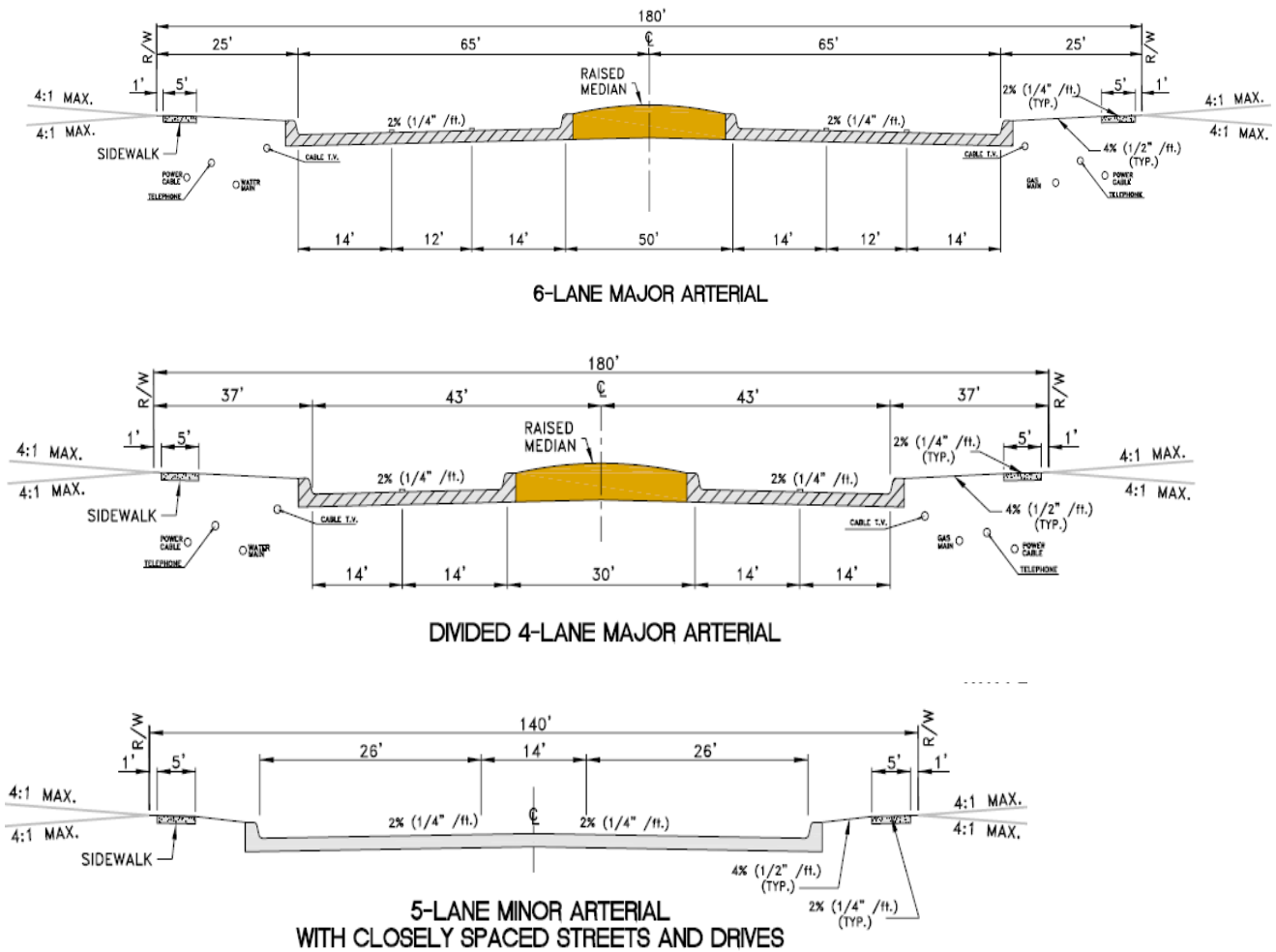
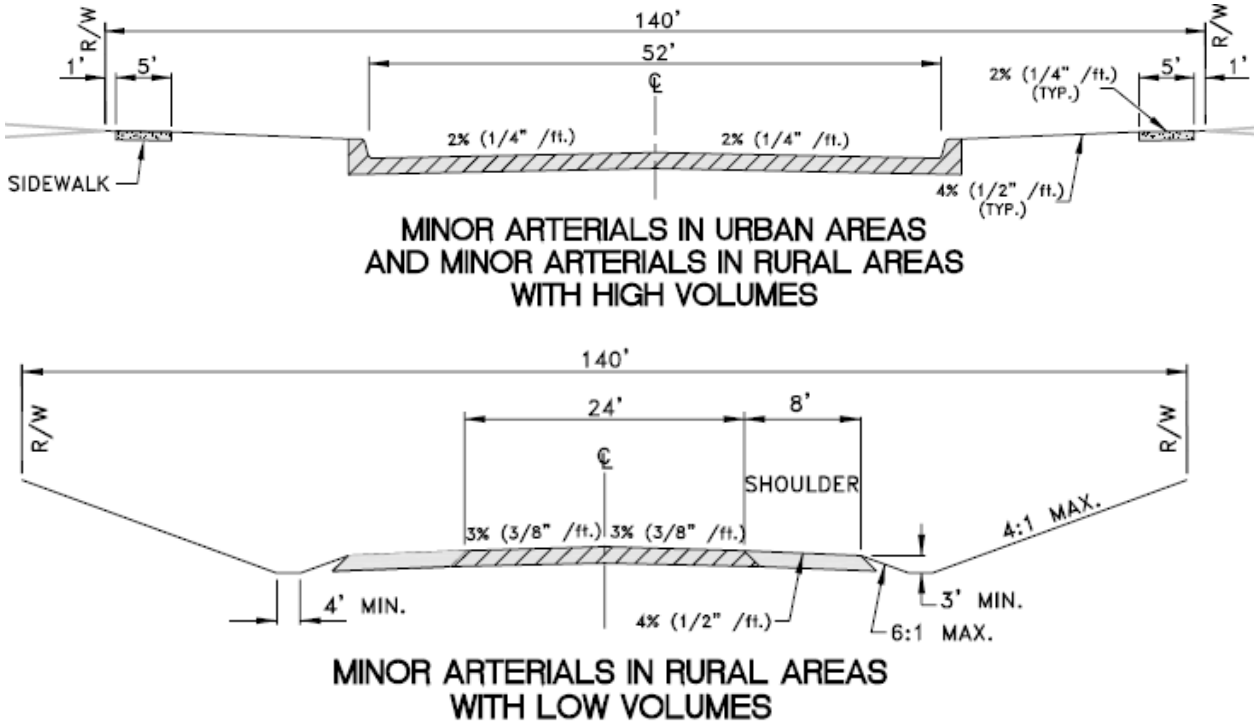


Figure 1 (cont.):

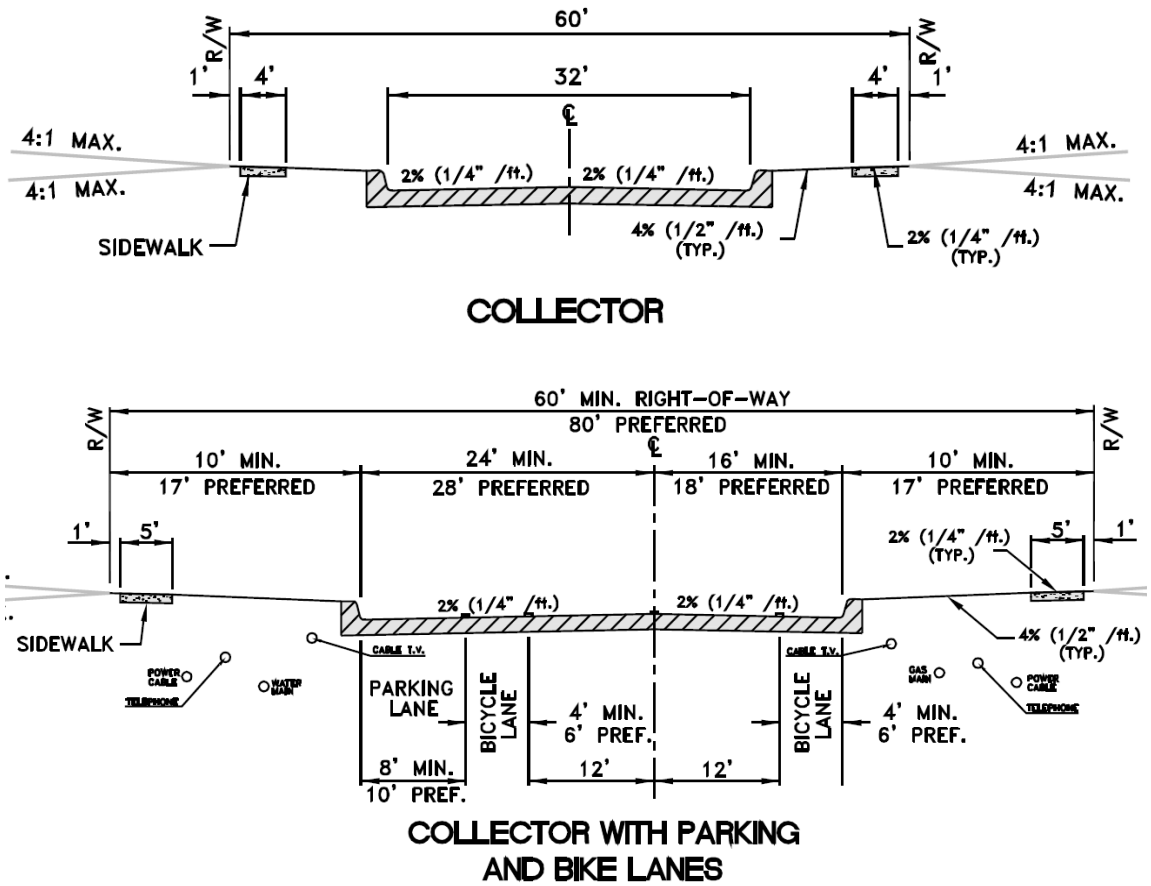


Existing and Future Arterial Street Constraints and Opportunities

While existing arterial streets could provide the most direct routes for bicyclists wanting to access major destinations, the high traffic volumes and speeds of these streets, as well as the existing curb-to-curb widths and lane widths, present some challenges to safely and comfortably accommodating bicyclists. The existing cross section (i.e. width and number of lanes) for the majority of existing arterial streets cannot accommodate on-street dedicated bicycle facilities without eliminating a vehicle lane, which generally is not feasible in most arterial segments due to existing and projected traffic volumes.

As the City continues to build out its arterial street network, there will be opportunities for accommodating bicyclists with high quality facilities such as bike lanes and buffered bike lanes, and possibly separated bikeways such as cycle tracks. This plan recommends modifications to the City's street standards, which includes incorporation of bicycle lanes on all future construction and reconstruction of minor arterials. The Plan also recommends that the City reevaluate its policy of providing wide outside lanes as a means to accommodate bicyclists along major arterial corridors and instead provide on-street buffered bike lanes (see Section 4.3).

Figure 2: Typical Cross Sections for Major and Minor Collector Streets (from Edmond Transportation Plan)



The City's few collector streets offer opportunities for bicycle facility improvements, such as bike lanes.

2.2 Collector Streets

Edmond's network of collectors is intended to provide for a balance of traffic movement and property access. Traffic movement is often internal to localized areas, with collectors connecting residential neighborhoods, parks, churches, etc. with the arterial system. Their design involves site-specific considerations. As compared to arterial streets, collectors accommodate smaller traffic volumes over shorter distances. The posted speed on collector streets is typically 25 mph. Most of the City's collector streets have been developed to provide more internal circulation within the downtown core and vicinity. The collector streets within the downtown area (9th St, Rankin St, Fretz Ave, Ayers St, Baumann Ave, University Dr, and Chowning Ave) were observed to have low traffic volumes, even during peak hours, and excess vehicle capacity. Existing

curb-to-curb width of these streets varies widely from 20 feet (portions of 9th St) to 44 feet (University Dr, Ayers St, and portions of 9th St). Because collector streets are intended to provide a higher level of access than arterial streets, there are a higher number of driveways along these roadways. On-street parking is permitted along many collector street segments, particularly in the downtown area. Figure 2, taken from the City's Transportation Plan, shows the typical cross sections for major and minor collector streets, which serve as the City's standards for new collector street construction.

Existing and Future Collector Street Constraints and Opportunities

Existing collector street segments have few constraints or challenges to comfortably and safely accommodating bicyclists. As mentioned above, these roadways have relatively low traffic volumes, and generally have excess vehicle capacity, which in some cases may allow for "road diets" or the elimination of unneeded vehicle travel lanes in order to provide space for bicycle facilities and other roadway safety improvements. Collector streets within the Downtown core provide good opportunities for developing a well-connected and dense bicycle network in that area. However, these collector streets intersect with arterial streets, and in many cases, terminate at arterial streets. Safely accommodating bicyclists at these intersections requires special attention (see Section 4 for details on recommended design practices).

The City's standards (shown in Figure 2) for new collector streets generally accommodate bicyclists. However, this Plan recommends minor modifications in order to provide bicycle facilities that are more comfortable for a wide range of bicyclists (see Section 4.3 for details).

2.3 Local Streets

Local streets function to provide access to abutting property and to collect and distribute traffic between individual parcels of land and collector or arterial streets. The local street network in Edmond is characterized by curvilinear streets that are largely discontinuous with the exception of local streets within the core of the City, which were developed in a more

Many of the City's local streets offer good conditions for bicycling.

Street closures have been permitted on several local streets.

regular grid. On local streets, typical curb-to-curb widths are 26, 30, and 32 feet. On-street parking is permitted on most local streets; however, it was observed to be underutilized in most areas, particularly where residences have driveways and garages. The posted speed on these streets is primarily 25 mph. Wider local streets, i.e. 30 to 32 feet, with low on-street parking utilization tend to encourage speeding, which was observed in some areas. On some local streets the City has permitted street closures as a means to respond to resident complaints of cut-through traffic.

Existing and Future Local Street Constraints and Opportunities

A number of local streets have high potential for incorporation into the bicycle network as low stress routes because they have low traffic volumes and speeds, and provide through connections within the arterial/collector grid that link up with other local streets and/or collector streets. Where these streets intersect arterial streets, there are some challenges because these locations are typically unsignalized and there are insufficient gaps in traffic that would allow a bicyclist to comfortably and safely cross the street. In some cases, a traffic or active warning signal would be necessary to allow bicyclists to safely cross the roadway. Such improvements are critical for attracting ridership by eliminating high stress locations and providing a consistent level of comfort along a bicycle route (See Section 4.4). In addition, there are several locations where two local streets intersecting a collector or arterial street are offset from one another. Spot improvements such as short sidepath (or wide sidewalk) segments and signage may be necessary to accommodate and direct bicyclists through these locations. Because of the allowance of on-street parking, bike lanes are not an option on most local streets.

2.4 Rural Roadways

Rural roadways are frequently used by recreational cyclists.

Edmond has many two-lane undivided roadways developed along county section lines, primarily east of I-35 and north of Covell Rd. Most of these are planned as minor or major arterials. These streets range in width from 22 to 24 feet (pavement edge) and generally have no paved shoulders. Intersections of the rural roadways are typically all-way stop controlled. The posted speed on these roadways is primarily 45 mph. The City's rural roadways offer a good riding experience for more confident recreational bicyclists, but high vehicle speeds and narrow lanes likely deter less confident bicyclists. Some of these roadways will eventually be reconstructed to the major or minor arterial standard shown in Figure 1 according to the City's Transportation Plan. However, many of these roadways will likely not be fully reconstructed within the foreseeable future. Therefore, improvements such as the addition of paved shoulders and/or bicycle route wayfinding signage could help to make some of these roadways more comfortable for a wider range of bicyclists.

2.5 Path and Sidewalk Network

The City has a growing network of paths.

The City of Edmond has an extensive sidewalk network and a number of paved paths and trails. Most existing paths are located within parks, but there are several that have been developed within floodways or utility corridors. Sidewalks are present on both sides of the street in most developed parts of the City, and widths range from 4 to 10 feet. In some areas, i.e. along arterial streets, sidewalks offer the most comfortable experience for bicyclists wanting to access destinations such as shopping malls or connect to less traveled collector and local streets.[11] Many bicyclists were observed riding on sidewalks both with and against the direction of vehicle travel on adjacent roadways.

As a means to accommodate pedestrians and bicyclists along arterial streets, it is the City's current practice to construct 10 foot sidewalks, where feasible. Examples of these types of facilities can be found along the recently constructed section of N Boulevard St (north of E Danforth Rd), and along W Covell Rd.

11 The City of Edmond modified its ordinance governing the use of sidewalks to allow people to ride their bicycles on sidewalks outside of Downtown.

The City's Trails and Sidewalks Plan (discussed in 1.3) identifies an extensive network of trails and "on-street linkages". The feasibility of many of these planned facilities needs to be studied closely, as the costs associated with right-of-way acquisition and engineering are likely to be very high.

Existing and Future Path and Sidewalk Constraints and Opportunities

Because of a lack of on-street facilities, a bicyclist avoids riding on a busy arterial street by riding on a sidewalk that connects two low stress neighborhood streets.

Off-street paths and side paths (developed to current AASHTO guidelines) and sidewalks, will likely be a necessary component of a connected, convenient, and comfortable bicycle network in Edmond. Examples of where this may be the case include locations where a short connection between on-street bicycle facilities is needed, or where the existing street network is discontinuous and a shared use path can be constructed as an alternative connection, or where it is simply not feasible to accommodate an on-street bicycle facility and there is available right-of-way to construct an off-street facility. The recommended bicycle network map (Appendix B) shows existing and planned trails. City staff provided input on what planned trails (i.e. those trails shown in the City's *Trails and Sidewalks Plan*) should be shown on the bicycle network map based on what is known in terms of available right-of-way, significant environmental constraints, and opportunities.

2.6 Land Use and Development

Many of Edmond's residential areas are accessed by discontinuous local streets.

Much of the development in Edmond has occurred over the past three decades and is largely characterized by single-family houses. Outside of the City core (defined by Kelly Ave, Danforth Rd, Bryant Ave and 15th St), residential development is accessed by discontinuous curvilinear streets, which presents challenges to developing a connected bicycle network in these areas. There are a few areas in the City where multi-family development is concentrated, most notably near the University of Central Oklahoma east of N Bryant Ave in the vicinity of E 2nd St and Kickingbird Rd. Many of these multi-family developments can only be accessed from major arterial streets, which present some challenges to serving these areas with on-street bicycle facilities. Many of these areas would be well served by planned trails.

Major areas of employment are concentrated around the downtown/University of Central Oklahoma area, Centennial Blvd/Technology Dr area, and the I-35 corridor where a number of medical-related uses have been/are being developed. With the exception of the I-35 corridor, these major employment areas may be accessed by roadways that have lower vehicle volumes and speeds, and therefore, are conducive for the installation of on-street bicycle facilities.

Beyond Downtown Edmond, retail commercial development (i.e. shopping areas) is concentrated along E 2nd St with smaller pockets at W Danforth Rd and N Santa Fe Ave, W Danforth Rd and N Kelly Ave, E Danforth Rd and N Bryant Ave, E 15th St and S Bryant Ave, E 15th Ave and S Broadway, and W 15th Ave and N Santa Fe Ave. Because these shopping

areas are located on major and minor arterial streets with high traffic volumes and no space for adding safe on-street bicycle facilities, there are some challenges to improving bicycle access to these areas. In some cases, off-street facilities that are planned or currently under construction will serve these areas, but consideration should be given to how to accommodate bicyclists along corridors serving shopping destinations.

2.7 Summary of Existing Conditions

The existing street system and development patterns present some challenges to developing a robust city-wide bicycle network that serves all destinations well and is safe, comfortable and convenient for bicyclists of all skill and confidence levels. Within the Downtown vicinity, where the street network is more densely developed, there are numerous opportunities for developing a relatively dense and connected bicycle network using collector and local streets.

Existing arterial streets present challenges to the installation of on-street bicycle facilities due to high vehicle speeds and volumes and constrained space within existing curb lines. Future construction of arterial streets will provide opportunities for integrating high quality bicycle facilities. This Plan recommends modifications to the City's policies and street standards so that all users can be comfortably and safely accommodated on targeted arterial streets.

The City's rural roadways, which occur primarily east of I-35 and north of Covell Rd currently offer a good riding experience for confident bicyclists, but high vehicle speeds and narrow lanes likely deter less confident bicyclists. Improving targeted rural roadways, which are not likely to be fully reconstructed in the near- to medium-term, with paved shoulders and route signage may open these roadways to a wider range of bicyclists.

Off-street connections such as sidepaths and widened sidewalks will be a necessary component of the bicycle network, providing short, yet critical, connections where on-street bicycle facilities are not feasible.

Section 3 / Recommended Bicycle Network

3.1 Bicycle Network Overview

The 2012 AASHTO *Guide for the Development of Bicycle Facilities* discusses several ways in which to classify different types of bicycle riders, including comfort level, physical ability, and trip purpose. When planning and designing a bicycle network, consideration should be given to the types of trips people are likely to take, e.g. utilitarian vs. recreational, but probably more important is the skill and comfort level of various types of riders. Those people that are willing to ride a bicycle are categorized into two primary groups: the experienced and confident, and the casual and less confident. It is the latter group that makes up the majority of the population, and includes a wide range of people: those who ride frequently for multiple purposes; those who enjoy bicycling occasionally but may only ride on paths or low-traffic streets in favorable conditions; those who ride for recreation, perhaps with children; and those for whom the bicycle is a necessary mode of transportation. In order for this group to regularly choose bicycling as a mode of transportation, a physical network of visible, convenient and well-designed bicycle facilities is needed. Table 2, taken from the AASHTO Guide, outlines the general characteristics of experienced and confident versus casual and less confident bicyclists.

The Master Plan recommends a city-wide bicycle network that is intended to provide safe, convenient, and comfortable bicycling conditions that attract bicyclists of different skill and comfort levels, and promote bicycling as a viable form of transportation throughout the City. The recommended bicycle network consists of a variety of bicycle facility types, including shared lane markings, bicycle lanes, paved shoulders, and sidepaths. Table 3 provides a summary of miles for each type of recommended bicycle facility. Appendix B contains the map of the recommended bicycle network.

Table 2: Experienced/Confident Riders	Casual/Less confident Riders
Most are comfortable riding with vehicles on streets, and are able to navigate streets like a motor vehicle, using the full width of a narrow travel lane when appropriate and using left-turn lanes.	Prefer shared use paths, bicycle boulevards, or bike lanes along low-volume, low-speed streets.
While comfortable on most streets, some prefer on-street bike lanes, paved shoulders, or shared-use paths when available.	May have difficulty gauging traffic and may be unfamiliar with rules of the road as they pertain to bicyclists; may walk bike across intersections.
Prefer a more direct route.	May use less direct route to avoid arterials with heavy traffic volumes.
Avoid riding on sidewalks. Ride with the flow of traffic on streets.	If no on-street facility is available, may ride on sidewalks.
May ride at speeds up to 25 mph on level grades, up to 45 mph on steep descents.	May ride at speeds around 8 to 12 mph.
May cycle longer distances.	Cycle shorter distances: 1 to 5 miles is a typical trip distance.

Source: AASHTO Guide for the Development of Bicycle Facilities, 2012, Fourth Edition.

Table 3: Proposed Bicycle Network	Miles
Bike Lane	7.1
Bike Lane (long-term improvements)*	36.3
Shared Lane Marking	18.6
Neighborhood Wayfinding	17.6
Sidepath	13.0
Paved Shoulder	30.6
Share the Road Signage	23.0
Total	**146.2**

* Long-term improvements include recommended bicycle facilities that will be implemented as a part of future street construction. Bicycle facilities could include bike lanes, buffered bike lanes, or possibly separated facilities such as cycle tracks.

Methodology for Developing the Recommended Bicycle Network

The recommended bicycle network was developed using the latest standards, guidelines and best practices in bicycle facility planning and design. Stakeholder input played an important role in the network development process. Input derived from the public open house and online survey and map, and meetings with Edmond Bicycle Committee and City staff, informed the project team's field analysis and network recommendations. Based on public input, a review of existing City planning documents, and bicycle planning and engineering best practices, the following factors were considered in the development of the recommended bicycle network:

- Access to parks, schools, and other community facilities
- Access to shopping and employment areas
- Access to existing and planned trails
- Access to transit
- Vehicle traffic volumes
- Vehicle speeds
- Continuity and connectedness of routes
- Roadway and vehicle lane widths
- Planned roadway improvements, e.g. major reconstruction, widening

The existing conditions analysis in Section 2 discusses roadway constraints and opportunities and provides much of the rationale for why the recommended network is focused on certain roadways versus others.

Numerous two-lane streets will be improved over time to include paved shoulders or bicycle lanes.

3.2 Considerations for Network Development

Edmond has several distinct areas, which are characterized by different development patterns and street conditions. East of I-35, the City mostly consists of rural lands and large lot single-family development accessed by two-lane, undivided roadways (see "rural roadways" discussion under Section 2 for more details), which are proposed to be reconstructed as minor, and in a few cases major, arterials at some point in the future.[12] The recommended bicycle network shows bicycle facilities on several of the proposed minor arterial streets. Since the reconstruction of these roadways may not happen within a 20 year timeframe, this Plan recommends constructing paved shoulders on targeted roadway segments as an interim measure to improve safety for all roadway users and provide a space for bicyclists to ride out of the path of vehicles. See Sections 4.3 and 5.2 for the recommended cross section for arterials and a discussion on phased implementation of the bicycle network, respectively.

12 Edmond Transportation Plan, 2007.

West of I-35 and outside of the core City (defined by Kelly Ave, Danforth Rd, Bryant Ave and 15th St), the development pattern largely consists of single-family subdivisions with internal street networks that tend to be curvilinear, discontinuous, and accessed from arterial streets. Bicycle network recommendations in these areas focus on route signing and wayfinding to assist bicyclists with navigation and draw attention to the presence of bicyclists in these areas. Short, off-street connections (e.g. wider sidewalks or side paths) along arterial streets, and in many cases crossing improvements such as signals and crosswalks, will also be important in these areas for providing connections between routes on local neighborhood streets and allowing for a continuous bicycle network with a consistent level of comfort.

Within the core City (defined by Kelly Ave, Danforth Rd, Bryant Ave and 15th St), where the street network is more dense and regular, there are more opportunities to develop a more connected bicycle network. The bicycle network recommendations in this area focus on shared lane markings on low volume, low speed streets where there is insufficient roadway width for the installation of bicycle lanes, and bicycle lanes on streets where it is possible to remove vehicle lanes (i.e. there is significant excess roadway capacity or underutilized on-street parking).

Wayfinding signage will be an important component of the recommended bicycle network. Wayfinding signage will enhance the overall comfort and functionality of the bicycle network by directing bicyclists along preferred routes to destinations, and making drivers more aware of the presence of bicyclists. Appendix C provides guidance on wayfinding based on best practices and the Manual on Uniform Traffic Control Devices (MUTCD).

3.3 Bicycle Facility Descriptions

This section provides descriptions of the bicycle facility treatments that are recommended in the Edmond bicycle network, as well as treatments that may be considered in the future when the City constructs new roadways and there is an opportunity, facilities such as buffered bike lanes or separated bikeways, such as cycle tracks. The 2012 AASHTO Guide for the Development of Bicycle Facilities and NACTO Urban Bikeway Design Guide provide additional detail and considerations for each of these facility types.

Bicycle Lane or Bike Lane

Bicycle lane.

A bike lane is defined as a portion of the roadway that has been designated by striping, signage, and pavement markings for the preferential or exclusive use of bicyclists. Bike lanes enable bicyclists to ride at their preferred speed without interference from prevailing traffic conditions and facilitate predictable behavior and movements between bicyclists and motorists. Bicyclist's preferred minimum operating width is 5 feet; however, in many urban and suburban circumstances a bike lane width of 6 feet is preferential due to potential conflicts with parked cars, curb and gutters, etc. The minimum operating width of a bike lane should not be less than 4 feet[13] or greater than 6 feet (unless buffered). Bike lanes wider than 6 feet are commonly mistaken for motor vehicle travel lanes or parking areas. Buffer pavement markings, bike symbols, and signage, can clarify for drivers that a wider bike lane is not a motor vehicle lane. In scenarios where curb and gutter or depressed drainage inlets are present, this operating width does not include the

13 For roadways with no curb and gutter and no on-street parking, or on extremely constrained, low-speed roadways with curbs but no gutter, where the preferred bike lane width cannot be achieved despite narrowing all other travel lanes to their minimum widths.

width of the curb and gutter. Wider bike lanes also provide additional space for maneuvering and generally provide a more comfortable riding experience, which is particularly important on roadways where there are higher vehicle volumes, or a substantial volume of heavy vehicles.

Buffered Bike Lanes

Buffered bicycle lane.

A buffered bike lane is a bike lane that is separated from a travel lane or parking lane by a preferred space of 3 to 6 feet. The lane is always one-way and is often buffered by cross-hatched pavement marking, and if used, a sign designating the lane for the exclusive use of bicyclists. Flexible bollards may also be used to further demarcate the buffered bike lane. The space between cross-hatch markings is flexible, but typically varies between 5 and 25 feet. Cross-hatching may be discontinued through areas where motor vehicles may cross, such as at driveway entrances and bus stops. The MUTCD guidelines allow buffered bike lanes per the buffered preferential lanes found in Section 3D.01.

Buffers may be used to:

- Provide additional space between parked cars and the bicycle lane to help bicyclists avoid the door zone.
- Buffer bicyclist from the motor vehicle travel lane.

The NACTO Urban Bikeway Design Guide provides additional guidance on buffered bike lanes.

Shared Lane Markings

Shared lane marking.

A shared lane marking is a pavement symbol consisting of a bicycle with two chevron markings above it that is placed in the roadway lane indicating that motorists should expect to see and share the lane with bicycles, and indicating the legal and appropriate line of travel for a bicyclist. Unlike bicycle lanes, they do not designate a particular part of the roadway for the exclusive use of bicyclists.

The 2009 Edition of the MUTCD includes new provisions for installing shared lane markings. The following is taken directly from the 2009 Edition of the MUTCD.

The shared lane marking shown in Figure 3 may be used to:

- Assist bicyclists with lateral positioning in a shared lane with on-street parallel parking in order to reduce the chance of a bicyclist's impacting the open door of a parked vehicle,
- Assist bicyclists with lateral positioning in lanes that are too narrow for a motor vehicle and a bicycle to travel side by side within the same traffic lane,
- Alert road users of the lateral location bicyclists are likely to occupy within the traveled way,
- Encourage safe passing of bicyclists by motorists, and
- Reduce the incidence of wrong-way bicycling.

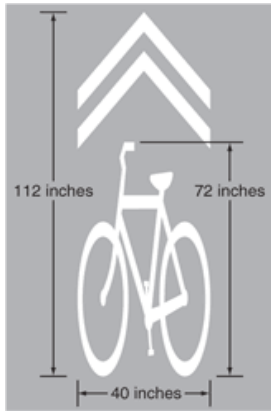


Figure 3

Paved Shoulders

Paved shoulder.

Paved shoulders provide space on the outside of travel lanes for bicycle and pedestrian use. Paved shoulders also improve safety for motor vehicles and prevent pavement damage at the edge of the travel lanes. Examples of roadways where paved shoulders are recommended are Coffee Creek Rd and 15th St east of I-35. Paved shoulders should be a minimum 4 feet wide without the curb; 5-foot minimum with a curb. Additional shoulder width is desirable on roadways with high motor vehicle traffic volumes, high vehicular speeds, or a high percentage of trucks, buses, and recreational vehicles. It is important to note that at intersections, additional symbols, signage, arrows, or short sections of bike lanes may be needed to provide direction to bicyclists and reduce potential conflicts between bicyclists and turning cars. Paved shoulders may be designated as bike lanes by installing bike lane symbol markings; however, a shoulder marked as a bike lane needs to meet the criteria for bike lanes outlined in the 2012 *AASHTO Guide for the Development of Bicycle Facilities.*

Cycle Tracks

Cycle Track.

A cycle track is an exclusive bike facility that combines the user experience of a separated path with the on-street infrastructure of a conventional bike lane. A cycle track is physically separated from motor traffic and distinct from the sidewalk. Cycle tracks have different forms but all share common elements—they provide space that is intended to be exclusively or primarily used for bicycles, and are separated from motor vehicle travel lanes, parking lanes, and sidewalks. Cycle tracks can be one way for bicycles on each side of a two-way road, or two-way, and installed on one or both sides of the road. A cycle track can be constructed at the roadway level or the sidewalk level, i.e. raised. Cycle tracks provide cyclists with a higher level of comfort relative to motor vehicle traffic, and are typically used on large multi -lane arterials where higher vehicle speeds exist. They may also be appropriate on high-volume but low-speed streets such as in a commercial downtown.

Cycle track at street level - uses roadway space and must be separated from motor vehicle traffic. Separation methods include curbs, raised concrete medians, bollards, on-street parking, large planting pots/boxes, landscaped buffers (trees and lawn) or other methods.

Raised cycle track are vertically separated from the street and must be separated or otherwise demarcated from the sidewalk where pedestrian traffic is present. Separation methods include different surface treatments, vertical separation, sidewalk features such as lighting and furnishings, plants, etc.

The NACTO Urban Bikeway Design Guide provides guidance on cycle tracks.

Sidepaths

A sidepath is a one or two-way shared use path that parallels a roadway. In many cases making connections between trail access points, or between on-street facilities that encounter high volume arterial streets where it is not possible or desired to have on-street bicycle facilities, is best accomplished through short sidepath segments.

The City has been constructing wide sidewalk segments on several of its major arterials as a means to accommodate both pedestrians and bicyclists. Examples of these wide sidewalk segments include recently constructed segments of Boulevard St and Covell Rd. When such facilities are constructed in the future they should be designed to meet guidelines for sidepath design found in the AASHTO *Guide for the Development of Bicycle Facilities* in order to maximize the safety of these facilities.

Wide sidewalk constructed along Boulevard St.

Table 4: Planning Level Cost Estimates and Assumptions

Facility Type	Planning Level Cost	Unit	Notes
Bike Lane (signing and marking)*	$20,000	Per Mile	
Buffered Bike Lane (signing and marking)*	$35,000	Per Mile	
Shared Lane Marking (signing and marking)	$10,000	Per Mile	
Signed Roadway (signing only)	$1,000	Per Mile	
Neighborhood Wayfinding (signing and marking)	$2,000	Per Mile	Bicycle dots and wayfinding signage
Adding 4' paved shoulders on rural roadways (on both sides of the road)	$400,000	Per Mile	Less if part of new road construction
Adding 10' Sidepath (on one side of road)	$300,000	Per Mile	Less if part of new road construction

* Does not include construction costs if widening is needed

Section 4 / Bicycle Facility Design Approach

This section provides an overview of the guidelines and standards applicable to designing bicycle facilities with suggested modifications to existing City of Edmond street standards for improved accommodation of bicyclists. Discussion is focused on treatments and strategies for developing a high quality bicycle network that attracts ridership and maximizes safety.

4.1 Applicable National Standards and Guidelines for Bicycle Facility Design

The 2012 *AASHTO Guide for the Development of Bicycle Facilities* and 2009 Manual on Uniform Traffic Control Devices (MUTCD) are two publications that should be referenced to ensure that bicycle facilities are designed in a uniform manner. The AASHTO guide is not intended to set absolute standards, but rather to present sound guidelines that will be valuable in attaining good design sensitive to the needs of both bicyclists and other roadway users. The provisions in the Guide are consistent with and similar to normal roadway engineering practices. Guidelines that address signs, signals, and pavement markings for bicycle facilities should be referenced in conjunction with the MUTCD. The 2009 MUTCD is a document issued by the Federal Highway Administration (FHWA) of the U.S. Department of Transportation (USDOT) to specify the standards by which traffic signs, road surface markings, and signals are designed, installed, and used. These specifications include the shapes, colors, fonts, sizes, etc., used in road markings and signs. In the United States, all traffic control devices must generally conform to these standards. The manual is used by state and local agencies and private design and construction firms to ensure that the traffic control devices they use conform to the national standard. While some state agencies have developed their own sets of standards, including their own MUTCDs, they must substantially conform to the federal MUTCD, and must be approved by the FHWA. The Oklahoma Department of Transportation (ODOT) uses the national MUTCD in accordance with the Oklahoma Supplement to the Federal Manual on Uniform Traffic Control Devices 2009, adopted by the Transportation Commission of Oklahoma. The National Committee on Uniform Traffic Control Devices (NCUTCD) advises the FHWA on additions, revisions, and changes to the MUTCD.

"I would love to bike more for recreation and exercise, but it needs to be safer to do so."

– Edmond Resident

Key provisions of the MUTCD related to bicycling include:

- Bicycle-related regulatory and warning signs
- Bicycle destination guide and route signs
- Pavement markings such as bike lane symbols and striping
- Trail signs

Significant changes in 2009 edition (from the 2003 Edition) include:

- New shared-lane pavement markings
- Bicycle lane regulatory signs no longer required
- Type 3 object markers for shared-use paths
- New bicycle destination guide and route signs
- New mode-specific guide signs for shared-use paths

The bicycle technical committee of the NCUTCD is currently developing and evaluating research and proposals for the following items:

- Bicycle signals
- Bicycle boxes
- Applications of the Rectangular Rapid Flashing Beacon to Trail Crossings
- Modifications to the Pedestrian Hybrid Beacon to accommodate bicyclists
- Combined right turn lane/bike lanes
- Barrier separated lanes/cycle tracks

Additional information can be found here: http://www.ncutcdbtc.org/

4.2 General Design Strategies for Achieving High Quality Bicycle Facilities

Wider bicycle lanes and/or buffers provide more separation from motor vehicle traffic and greater maneuverability and comfort for bicyclists.

The quality of provided bicycle facilities has a direct impact on the experience of the bicyclists and will therefore have a tremendous influence on the ability of the facility to attract and sustain use. Well-maintained and high quality facilities have been demonstrated to attract higher levels of use than poorly maintained or low quality facilities. Likewise, interconnected systems with minimal gaps or interruptions and consistent level of comfort are essential to a functioning bicycle system that supports and attracts high use.

Preference surveys and research studies have found widespread support and interest for bicycling with strong preferences given to the provision of high quality bikeways which provide the following elements:

- Separation from high volumes of fast-moving automobiles,
- Maneuverability within the bikeway to operate safely, and
- Space for cyclists to ride together in a social manner, side-by-side.

Bicycle Level of Service

The concept of level of service for bicyclists is relatively new compared to that of vehicle level of service. As such, it is important to note that there are limitations to the existing models which the designer should become familiar. It is anticipated that extensive research will be forthcoming to improve the reliability of the measurements now that the concept has been validated and incorporated into the Highway Capacity Manual (HCM) and AASHTO Guidelines.

Narrowing Vehicle Lane Widths to Better Accommodate Bicyclists

Providing additional lane width for the motorist has not been proven to provide any safety benefit on low speed urban roadways.[14] However, extra space provided to the parked vehicle and the bike lane reduces the potential for a hazardous crash between a bicyclist and an opening vehicle door. Providing additional bike lane width (greater than 5 feet) also creates enough space where a bicyclist could pass another bicyclist without having to encroach into the adjacent travel lane. The resulting bicycle lane is more comfortable and is more likely to attract use.

The use of narrower motor vehicle travel lanes as a strategy for improving capacity and safety on urban arterials where posted speeds are 35 mph or lower are consistent with the 2011 AASHTO Green Book, which states "lane width of 10 feet may be used in more constrained areas where truck and bus volumes are relatively low and speeds are less than 35 mph".[15] This is backed up by recent research[16] focused on the safety of travel lane widths varying between 10 and 12 feet for motorists operating on arterial roadways with posted speeds of 45 mph or less. This research found lane width had no impact on safety or capacity under the majority of urban conditions. The study resulted in a virtual elimination of the capacity reduction formula in the 2010 Highway Capacity Manual related to lane widths as it found little difference between 10, 11 and 12 foot lanes.

The AASHTO Green Book is vague with regard to defining what percentage of truck and bus volume is "low"; however, there is guidance in research and pavement design guidelines that suggest 10% as a decision point.[17]

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14 Potts, Ingrid, Harwood, Douglas and Richard Karen, "Relationship of Lane Width to Safety for Urban and Suburban Arterials, TRB 2007 Annual Meeting

15 2011 AASHTO Green Book, Urban Arterial Travel Lane Widths, page 7-29

16 Potts, Ingrid, Harwood, Douglas and Richard Karen, "Relationship of Lane Width to Safety for Urban and Suburban Arterials, TRB 2007 Annual Meeting

17 TRB Special Report 214 – Designing Safer Roads, 1987. It is important to note this report documented research proving wider travel lanes increased safety, but this research was only based on rural, 2 lane highways.

It should also be noted that wider lane widths may encourage motorist speeding. Adding bike lanes to these streets where there is sufficient right-of-way can reduce speeding and increase safety in residential neighborhoods and near schools.[18]

Speed Management

Managing vehicle speeds on arterial and other streets where 85th percentile speeds exceed 40-45 mph is essential to providing high quality bicycle facilities that are likely to attract a broad range of bicyclist types. Speed management is a multi-disciplinary approach to controlling speeds using enforcement, design, and technology applications. Speed management should reflect the needs of multiple modes and respond to the street's surroundings. The benefits of speed management are safer roads with fewer incidents and less severe injuries. Speed management techniques can be used regardless of the posted speed. Roadway vehicle volumes are a determining factor for choosing which speed management techniques are appropriate.

Streets with Fewer than 20,000 Vehicles Per Day[19]

Streets with average daily traffic volumes between 10,000 and 20,000 vehicles per day allow more flexibility in the types of speed management measures that can be implemented. Streets with this level of traffic volume usually do not require the same level of capacity as a higher volume street, and are frequently overbuilt. These streets typically are four lanes wide (two lanes in each direction), but may only need to be one lane in each direction. In addition to the speed management measures listed above, the following are effective for streets with fewer than 20,000 vehicles per day:

- Four to three lane conversion (Road Diet), particularly effective on four lane undivided streets. This measure provides one travel lane in each direction and a center median or turn lane. Streets with average daily traffic volumes of 15,000 to 18,000 can usually be accommodated with this configuration. Streets approaching 20,000 vehicles per day may also be accommodated by this configuration, but a capacity analysis is required. The additional width gained with road diets can be used for multiple improvements to the street depending on need such as medians, bike lanes, wider sidewalks and landscaping, on street parking, or some combination of each. Road diets also allow further pedestrian improvements at intersections such as curb bulb outs or pedestrian refuges.
- Single-lane urban roundabouts at appropriate intersections. A combination of road diet and single-lane roundabouts along a corridor is one of the most effective combinations of major street speed management measures.

  On rural, two-lane roadways where posted speeds are 45 to 50 mph and there is hilly terrain, the city should conduct speed studies to determine whether it is possible to lower the posted speed limits as a roadway safety measure, which would also benefit bicyclists on these roadways. If it is determined that the posted speed cannot be reduced, then the City should consider posting advisory speed signs at hill approaches.

Streets with Greater than 20,000 Vehicles Per Day[20]

Roadways with greater than 20,000 vehicles per day need to maintain traffic capacity, however there are examples of converted streets carrying over 20,000 vehicles per day.[21] Measures that significantly reduce capacity may not be appropriate on these streets because they might divert traffic to parallel streets where an increase in traffic is undesirable.

18 Studies vary on the effectiveness of narrowing travel lanes as a speed reduction strategy. A majority of studies available for review generally find narrower lanes lower average speeds 3-5mph, but a small number of studies have also found no change or slight increases in speeds.

19 Best Practices in Arterial Speed Management, Final Report prepared for City of Pasadena, Kimley-Horn and Associates, Inc. October 22, 2009.

20 Best Practices in Arterial Speed Management, Final Report prepared for City of Pasadena, Kimley-Horn and Associates, Inc. October 22, 2009.

21 ITE. Traffic Calming State of the Practice: An ITE Informational Report. Institute of Transportation Engineers, Washington, D.C., 1999.

Streets with greater than 20,000 vehicles per day will typically consist of two or more travel lanes in each direction, and have traffic signals at major cross streets. The most effective speed management measures (which may be combined) for this tier of street are listed below.

- Signal coordination to a target speed of at least the posted speed limit.
- Reduce travel lane width to a maximum of 11-feet, and turn lanes may be reduced to 10-feet, as appropriate.
- Permanent speed feedback signs flashing "Slow Down" message when speed exceeds a preset limit (most effective when coupled with enforcement). Signs should be solar powered with ability to move from location to location.
- Speed Enforcement Corridors with regular targeted speed enforcement combined with a public awareness program.
- Multi-lane urban roundabouts at appropriate intersections. Approach and departure lanes can be designed for 15-20 mph. Most effective if used in multiple locations within the same corridor. Multi-lane roundabouts may not be desirable at intersections with high pedestrian or bicycle volumes.
- Pedestrian improvements at intersections including a combination of curb bulb outs, high visibility crosswalks, and smaller turning radii to decrease speeds of turning vehicles.
- Long-term speed management involves transitioning suburban streets into urban thoroughfares. Urban contexts, and associated multimodal activity, tend to lower speeds. Elements of urban thoroughfares include buildings built to the edge of the street with ground floor uses that generate pedestrian activity, street trees, pedestrian-scaled intersection spacing, and on-street parking.

2nd St, a major arterial street.

4.3 Recommended Bicycle Facility Design by Street Classification

Major Arterial Streets

The recommended bicycle network generally does not show on-street bicycle facilities along major arterial streets because of a number of inherent constraints (e.g. available right-of-way, traffic volumes and speeds). However, in some cases, there may be opportunities to integrate bicycle facilities along major arterial corridors. See Section 2 for more details on existing conditions of major arterial streets.

Existing Major Arterial Streets

Along some existing major arterial segments, bicycles will generally be accommodated on off-street facilities such as sidepaths, where feasible and appropriate from a network development stand point. For example, the recommended network shows a sidepath along Kelly Ave between Danforth Rd. and 15th St. Sidepaths should be provided on both sides of the roadway and should be designed for optimal safety per AASHTO guidelines and recommendations for sidepaths. Major arterial segments that have excess vehicle capacity or vehicle lane widths may be candidates for rechannelization, i.e. road diet, or lane narrowing, i.e. lane diet, respectively. In some cases such modifications to the roadway, in addition to signal modifications, would allow for the installation of on-street bicycle facilities such as buffered bike lanes.

Future Construction and Reconstruction of Major Arterial Streets

On-street bicycle facilities should not be ruled out when major arterial streets are constructed or reconstructed in the future. Currently, the City designs new arterial streets with a 14 foot outside lane, which is considered the minimum width needed to allow motorists to safely pass a bicyclist without changing lanes. The newest guideline in the 2012 AASHTO Bike Guide clearly outlines the operational issues with 14' outside lanes and discourages their use. Bicycle facilities such as buffered bike lanes and cycle tracks provide higher quality, safer bicycle accommodations that attract higher ridership along higher speed, higher volume roadways, and generally at a lower cost than developing a sidepath facility. And given that major arterial streets are intended to have limited access to abutting land uses (i.e. minimal driveways), such bicycle facilities could be designed with minimal potential conflicts.An example cross section showing an alternative with on-street buffered bike lanes is provided in Figure 3. In other cases, off street facilities may be the most appropriate means to accommodate bicyclists along major arterial streets. For example, planned improvements for Covell Rd include widened sidewalks intended to accommodate pedestrians and bicyclists.

"Work towards bike lanes for main roads and section lines that have a physical barrier between bike lane and auto traffic."

– Edmond Resident.

Minor Arterial Streets

Minor arterial streets have the potential to be an integral component of the Edmond bicycle network both in the near- and long-term.

Existing Minor Arterial Streets

Similar to major arterial streets, existing minor arterials have a number of inherent constraints that preclude the installation of on-street bicycle facilities that are likely to attract a broad range of bicyclists. Along targeted segments of existing (and proposed-as shown in the Edmond Transportation Plan) minor arterial streets, the recommended network shows two facility types: off-street connections (e.g. sidepaths) and paved shoulders. Off-street connections are shown on minor arterial segments that have been built out (e.g. four-lane divided or undivided cross section), where it is critical to link other recommended network routes (e.g. portions of 15th St), but there is no available space in the roadway for the installation of on-street facilities without implementing a road diet.

Adding paved shoulders to unimproved minor arterial streets (e.g. two-lane undivided cross section) is recommended in some areas as an interim measure for better accommodating bicyclists while also improving safety for all roadway users on segments where roadway widening is proposed, but may not happen anytime in the foreseeable future.

Future Construction and Reconstruction of Minor Arterial Streets

This Master Plan recommends the provision of on-street bicycle facilities on all newly constructed and reconstructed minor arterial streets. Doing so would greatly expand the reach and connectedness of the bicycle network. In order to accommodate bicycle facilities on minor arterial streets this Plan recommends that the City's existing standard for minor arterial streets (shown in Figure 1 in Section 2) be replaced with the cross section shown in Figure 4.

Collector Streets

The City has a limited number of existing and proposed collector streets, but given the low vehicle speeds and volumes on these roadways, they offer opportunities for the integration of bicycle facilities such as bicycle lanes.

Existing Collector Streets

Ayers St, a collector street.

Existing collector streets, which are concentrated in the Downtown vicinity, generally have more motor vehicle capacity than is currently needed. This excess motor vehicle capacity makes it possible to remove a motor vehicle travel lane without significantly impacting traffic operations. By removing a motor vehicle travel lane (e.g. reducing a four-lane street to a three-lane street-two through lanes and a center turn lane), space is made available for installing bicycle lanes, and other safety benefits such as reducing vehicle and pedestrian collisions may also be achieved.[22] Under most average daily traffic (ADT) conditions tested, road diets have minimal effects on vehicle capacity, because left-turning vehicles are moved into a common two-way left-turn lane. However, for road diets with ADTs above approximately 20,000 vehicles, there is a greater likelihood that traffic congestion will increase to the point of diverting traffic to alternate routes.[23] As noted in Section 2, low traffic volumes (very likely less than 10,000 ADT) were observed on collector streets even during peak hour travel times. Figure 5 shows a potential conversion of a 4-lane to 3-lane with bike lanes.

Future Construction and Reconstruction of Collector Streets

This Plan recommends that all future construction and reconstruction of collector streets include bicycle lanes. The City's current standard for collector streets is shown in Figure 1 of Section 2. The City should adopt the cross section shown in Figure 5 as its standard for new collector streets. If in any case it is deemed necessary to provide four vehicle travel lanes, bicycle lanes should also be provided.

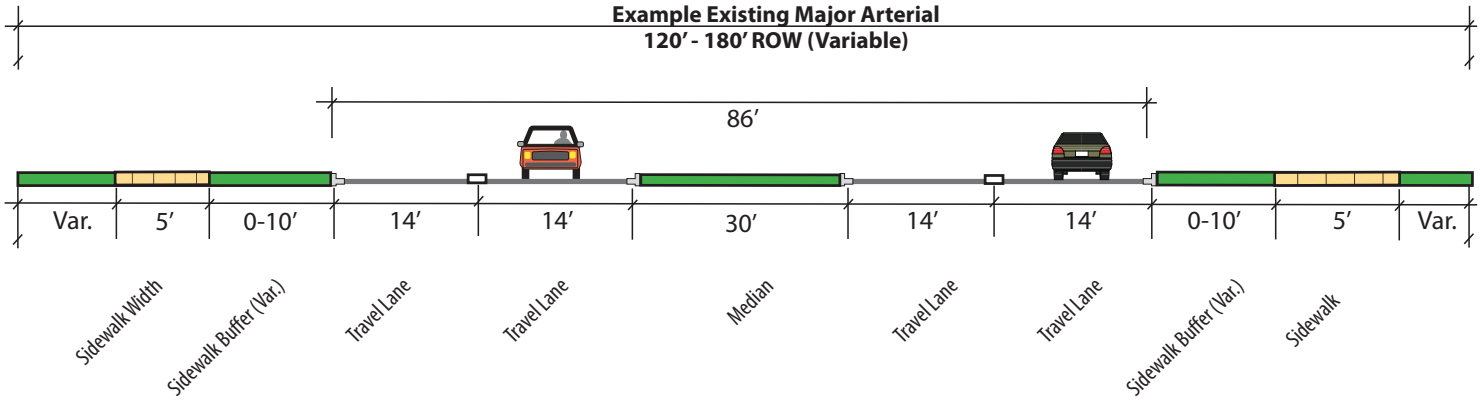
Local Streets

As noted in Section 2, local streets offer great potential for provision of low stress bicycle facilities given the low traffic speeds and volumes common on these roadways. However, outside of the core city (defined by Kelly Ave, Bryant Ave, Danforth Rd and 15th St), local streets are limited in their ability to provide direct and continuous bicycle routes.

22 FHWA Summary Report: Evaluation of Lane Reduction "Road Diet" Measures and Their Effects on Crashes and Injuries (FHWA-HRT-04-082), March 2004.

23 Ibid

Figure 3: Existing and Proposed Major Arterial Typical Section



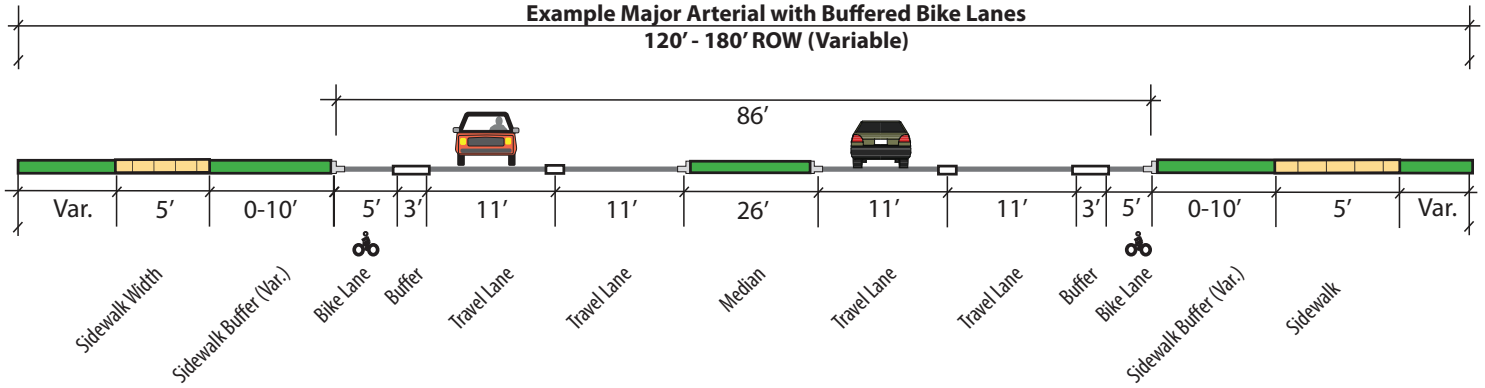
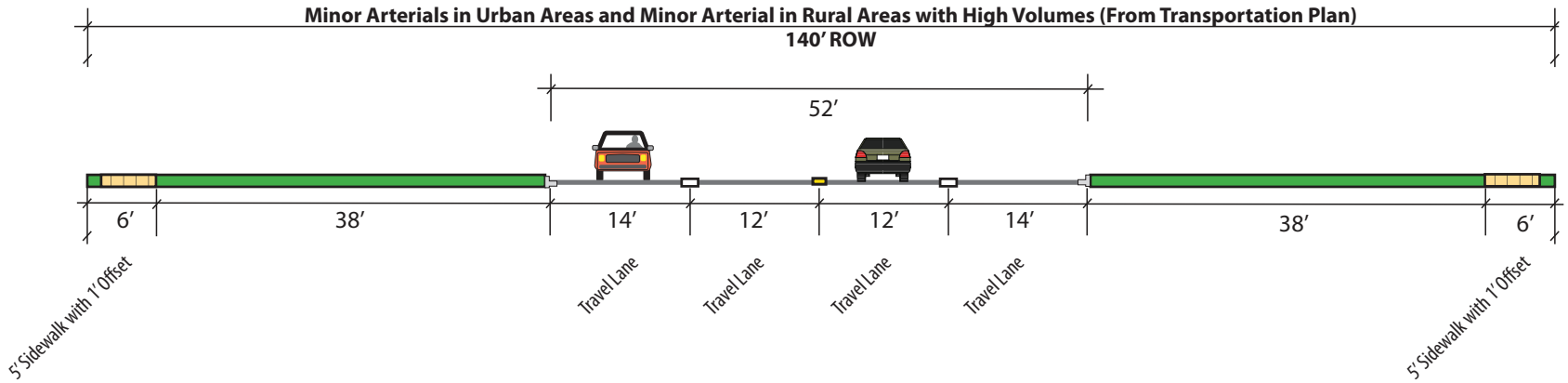


Figure 4: Existing and Proposed Minor Arterial Typical Section



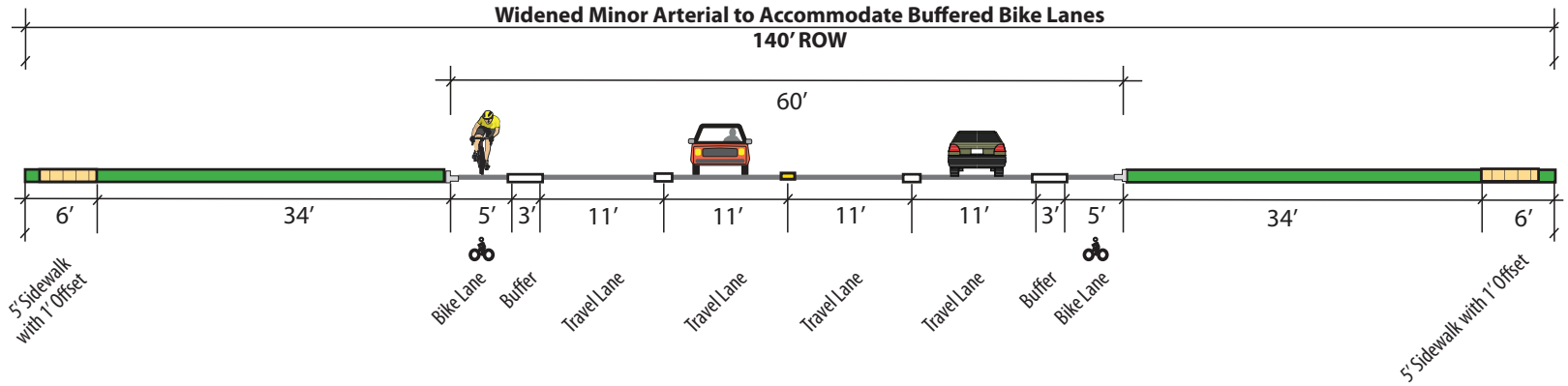
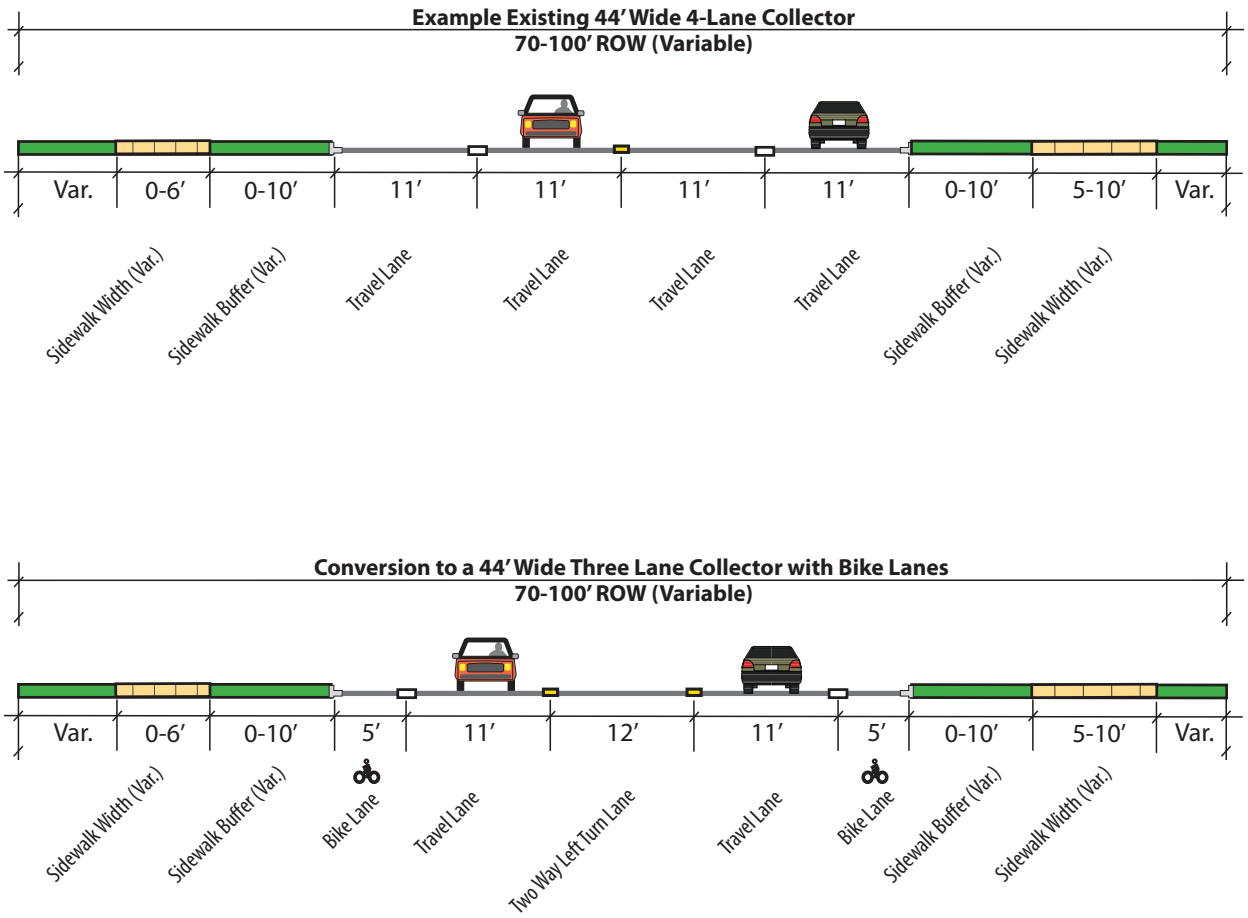


Figure 5: Existing and Proposed Collector Typical Section



Bicycle Facilities with Future Design Projects

The city has a complete streets resolution that recommends accommodations for all modes of travel. With this resolution, new roadway projects should analyze two to three cross sections taking into account bike lanes and other bicycle facilities. Public input and a preliminary cost estimate should be calculated for each cross section before design is started. Two example corridors to consider are East 33rd Street and Santa Fe Avenue, which are discussed in detail below.

East 33rd Street

East 33rd Street is a critical corridor within the recommended bicycle network that would greatly improve connectivity and access in the southwestern portion of the City. This corridor connects several proposed north-south bicycle routes (including routes connecting to Oklahoma City), and provides access to schools, shopping, and employment areas.

Average Annual Daily Traffic (AADT) varies considerably along the corridor, but is generally below 20,000 vehicles per day east of Boulevard, and just over 20,000 west of Broadway. Under most average AADT conditions tested, road diets have minimal effects on vehicle capacity, because left-turning vehicles are moved into a common two-way left-turn lane. However, for road diets with AADTs above approximately 20,000 vehicles, there is a greater likelihood that traffic congestion will increase to the point of diverting traffic to alternate routes. It should be noted that the areas east of Broadway for which E 33rd St provides access are largely built out, so additional traffic generated by future development will be limited.

The City has plans to to widen the section of E 33rd St between I-35 and Coltrane Rd, which presents an opportunity to incorporate bike lanes. For other segments of E 33rd St that are built out there are a number of options for providing high quality bicycle facilities that will attract ridership. Three of these options are:

1. Rechannelization - Convert the portion of the the street that is 4-lane undivided to a 3-lane cross section (two vehicle travel lanes with a center turn lane) and integration of buffered bike lanes. This strategy has been documented to greatly increase safety for all roadway users.
2. Construction of Sidepaths - where there is sufficient right-of-way, widen or reconstruct existing sidewalks to a sidepath consistent with AASHTO guidelines.
3. Street reconstruction - where there is sufficient right-of-way reconstruct roadway to maintain or increase number of motor vehicle lanes and install a high quality bicycle facility such as a buffered bike lane or cycle track.

It should be noted that any of these options, and potentially others, could be pursued segment by segment, meaning that it is not a one strategy fits all situation. For example, where AADTs are lower the roadway could be rechannelized from a 4- to 3-lane cross section to include on-street buffered bike lanes and where AADTs are too high sidepaths or reconstruction could be pursued. The 2012 AASHTO Bike Guide provides guidance on how to provide safe and seamless transitions between different bicycle facility types. [1]

Santa Fe Avenue

Santa Fe Avenue is a critical corridor within the recommended bicycle network that would greatly improve connectivity and access in the western portion of the City. This corridor connects several proposed east-west bicycle routes and trails and provides a direct route to Oklahoma City.

Average Annual Daily Traffic (AADT) varies considerably along the corridor.

There are a number of options for providing high quality bicycle facilities that will attract ridership along this corridor. Three of these options are:

1. Rechannelization - Convert the portion of the street that is currently 4-lane undivided to a 3-lane cross section (two vehicle travel lanes with a center turn lane) and integration of buffered bike lanes. This strategy has been documented to greatly increase safety for all roadway users. It should be noted that segments directly north and south of Danforth have raised medians, and therefore are not good candidates for rechannelization.
2. Construction of Sidepaths - the right-of-way is 100 feet along the majority of Santa Fe, and in many areas there is at least 20 feet between the curb and existing sidewalk, providing opportunities for widening or reconstructing existing sidewalks to sidepaths consistent with AASHTO guidelines.
3. Street reconstruction - where there is sufficient right-of-way reconstruct roadway to maintain or increase number of motor vehicle lanes and install a high quality bicycle facility such as a buffered bike lane or cycle track.

It should be noted that any of these options, and potentially others, could be pursued segment by segment, meaning that it is not a one strategy fits all situation. For example, where AADTs are lower the roadway could be rechannelized from a 4- to 3-lane cross section to include on-street buffered bike lanes and where AADTs are too high sidepaths or reconstruction could be pursued. The 2012 AASHTO Bike Guide provides guidance on how to provide safe and seamless transitions between different bicycle facility types.

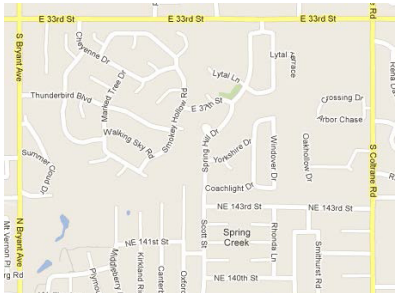
1 FHWA Summary Report: Evaluation of Lane Reduction "Road Diet" Measures and Their Effects on Crashes and Injuries (FHWA-HRT-04-082), March 2004.

Existing Local Streets

A minimal amount of improvements are needed on local streets that have been included in the recommended bicycle network. At a minimum, wayfinding signage and pavement markings should be installed along local street bicycle routes to help bicyclists navigate through areas where streets tend to be curvilinear and there are numerous decision points. On local streets where there are higher volumes of bicyclists or motor vehicles, or where additional route guidance may be needed, shared lane markings should be installed. Traffic calming should be considered on local streets where speeding is prevalent. Where recommended bicycle routes on local streets intersect with arterial roadways it is important for bicyclists to be able to get across the arterial street safely. Section 4.3 provides guidance on appropriate crossing treatments for these locations.

Future Construction and Reconstruction of Local Streets

Older areas of Edmond were developed with a grid street network.



Newer areas of Edmond have been developed with a more curvilinear and discontinuous street network.

The American Planning Association (APA) states that transportation efficiency is "enhanced when there are consistent and adequate street connections that allow people and goods to move with as few impediments as possible." In addition, "proper street connectivity reduces miles travelled, increases non-motorized trips, and supports transit use."[24] The Institute of Transportation Engineers (ITE) stresses that improved connectivity helps keep short, local trips off arterials by providing an alternate, local route.[25] The discontinuous local street system common throughout much of Edmond forces local traffic onto arterial streets for local trips that should be served by local streets, and discourages walking and biking. A well-connected network provides more direct routes for walking and biking. This creates opportunities for pedestrians and bicyclists to reach destinations within comfortable walking (1/4 mile) or bicycling (2 miles) distances. Furthermore, fire departments are generally strongly in favor of connectivity because it improves response time. Chapter 21.02 of Edmond's Subdivision Code contains several regulations that dictate how local streets and collector streets are developed. Action 2.2 provides strategies for ensuring better street connectivity and more walkable and bikeable neighborhoods.

4.4 Intersection and Roadway Crossing Treatments

This section provides guidance for intersection and mid-block crossing treatments, some of which are not in the AASHTO Guide or the MUTCD.

Crossings at Major Intersections

Improvements along collector streets and local streets for bicycling are of limited utility if cyclists cannot safely and comfortably cross major roadways. Crossing improvements on bicycle routes intersecting multi-lane, high volume streets enhance cyclist safety by eliminating or raising awareness of potential areas of conflict between motorists and cyclists, and by reducing the delay cyclists experience at locations where no accommodations have been made for cyclists.

24 American Planning Association, Policy Guide on Smart Growth, 2002.

25 Institute of Transportation Engineers. 2006. Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities

Example of an arterial street crossing where improvements are needed for the recommended bicycle network.

The positioning of the bicyclists, particularly longer bikes or bikes with trailers, and crossing times are important considerations for designing a crossing that can get cyclists across a busy roadway safely and comfortably. There are a number of intersection treatments available that can aid cyclists in crossing busy intersections including signalization, crossing islands, high visibility crosswalks, and flashing warning beacons.

Many arterial streets are challenging to cross, particularly during peak travel periods. In order to make it possible for bicyclists to travel throughout Edmond on low-stress bikeways, there must be safe and convenient places to cross major streets. The section below describes the types of treatments that are recommended to help bicyclists cross these major roadways. Selection of the appropriate roadway crossing treatment depends on a number of factors:

- Roadway width/number of lanes
- Motor vehicle traffic volumes
- Motor vehicle speed
- Sight-distance
- On-street parking
- Presence of traffic signals at the intersection or at nearby intersections
- Satisfaction of necessary and relevant traffic warrants

"In newer areas the developers build isolated neighborhoods. But short bicycle/walking links between neighborhoods would really open things up."

– Edmond Resident.

Signals

Signalized intersections allow bicyclists to cross arterial streets without needing to select a gap in moving traffic. Traffic signals make it easier to cross the street, though it is important to make improvements to reduce conflicts between bicyclists and turning vehicles. Signals may increase delay for motor vehicles and must meet MUTCD warrants. It is important to note that bicyclists may be counted as pedestrians or vehicles. It is recommended that the warrant should be checked with bicycles counted as vehicles and then as pedestrians to determine the potential need from both perspectives in cases where warrant satisfaction is borderline.

Traffic Signal Timing and Detection

The bicycle detection symbol should be used in bike lanes or shared lanes to depict the "sweet spot" for optimum detection regardless of detection technology.

Where bicycle facilities intersect with arterials or other roadways where signals require actuation, signal detection systems need to be calibrated to explicitly detect bicyclists. Section 9D.02 of the 2009 MUTCD states: "On bikeways, signal timing and actuation shall be reviewed and adjusted to consider the needs of bicyclists." Accommodating bicyclists at actuated intersections is one relatively cost-effective way in

which a city can make significant strides to improve the safety and level of service provided to bicyclists. It is recommended the city review its signal timing policy and revise as necessary to accommodate bicyclists at all intersections located on the bicycle network as it is implemented, and develop a protocol for assessing concerns from bicyclists regarding detection or additional time to cross at other locations.

Detection

Signal detection

Detection should be provided at signalized intersections where there are designated bicycle facilities to accommodate the range of cyclists and user types expected. Specifically, an adult commuter cyclist may prefer in-lane detection, while a child biking to school may prefer to ride on the sidewalk and use the pedestrian push-button. It should not be expected that on-road users will be required to leave the roadway to actuate a signal.

Push Buttons

The use of pedestrian push-buttons for bicycles as the only detection method is not desirable for several reasons:

- The required clearance time for pedestrians is significantly longer than for bicyclists, which would increase the delay for motorists on conflicting approaches at times when only bicyclists are present.
- Pedestrian signal timing is excessive for cyclists because the flashing don't walk interval is timed for slow pedestrian speeds not bicyclist speeds.
- Push-button placement is designed for pedestrians, including disabled pedestrians on the sidewalk. Bicyclists would have to access the sidewalk, which may be particularly difficult for bicyclists making a left or through movement on multi-lane approaches and at locations where there is no path to the sidewalk from the roadway.
- It is unreasonable to expect a bicyclist to have to dismount and carry their bike to the sidewalk at all intersections to become a pedestrian. They are unlikely to do so and this may result in bicyclists crossing against the light where they are not detected or they may be caught on the change interval where the timing is inadequate for them to cross the roadway leaving them in danger of being struck by crossing vehicles. This design is also a discouragement to bicycling and will detract from the objectives of this plan to promote and increase bicycling in Edmond.

Video and Inductive Loop Detection

- Video cameras used for detection have programmable detection zones, distinct detection zones can be programmed for bicyclists in a bike lane or shared lane. This zone should be supplemented with bicycle detection pavement markings and signs per the MUTCD.
- Where inductive loop detectors are used they should be set to the highest sensitivity level possible without detecting vehicles in the adjacent lanes. This higher sensitivity will increase the likelihood of a bicycle being detected. Consideration should be given to adding a delay on a detector where there are concerns of false calls. For locations with shared lanes, a supplemental loop may be provided at the stop bar as an alternative to increasing the sensitivity of an existing loop. For locations with a separate bike facility, a loop detector should be provided in the bike lane. A Type D or Type Q is preferred to detect bicycles because they can be set at a higher sensitivity level while still rejecting vehicles in an adjacent lane. *Note: Some high performance bicycles may be more difficult to detect; however, it has been the experience of many agencies (Caltrans, City of Portland, City of Seattle among them) that standard inductive loop detectors can detect other items on the bicycle or bicyclist such as the*

chain ring, chain, wheel hubs, shoe cleats, or even a small piece of bailing wire intentionally attached to the wheel rim strip.

- Install bicycle detector pavement markings and signs as recommended in the MUTCD to notify bicyclists of the optimum location to be detected. Field checks of the loop detector with a bicycle rim should confirm the location with the highest probability of bicycle detection and a bicycle detector symbol should be applied at that location.

Bicycle Signals

Bicycle signals potentially provide clearer direction to bicyclists crossing signalized intersections that they may enter an intersection. At locations (typically trail crossings) where it is expected cyclists should follow pedestrian signals, under present law and timing practices, bicyclists are only "legal" when they enter the crosswalk during the solid WALK portion of the signal which is significantly shorter than the provided walk+clearance time resulting in bicyclists disobeying the flashing don't walk portion of the cycle which can lead to them being caught in the intersection during the change interval. Providing bicycle signals allows for a longer display of green as compared to the walk, which significantly improves the compliance with the traffic control. Further, the MUTCD states explicitly that pedestrian signals are for the "exclusive use of pedestrians". Bicycle signals can be designed to call a green signal phase through the use of loop detectors (or other passive detection such as video or radar) or push button. Bicycle signal heads and a separate bicycle signal phase should be considered at intersections and trail crossings with very high volumes of cyclists or locations where it is desirable to provide separate phasing for the bicyclists.

Bicycle Signal

Presently the MUTCD has no provision for bicycle signals; however bicycle signals are under experimentation in many jurisdictions and are being actively investigated by the National Committee for inclusion into the MUTCD. The use of bicycle signal heads would require permission to experiment from FHWA.

Rectangular Rapid Flashing Beacons

Rectangular Rapid Flashing Beacons, such as this one on the UCO campus, assist pedestrians and bicyclists in crossing the street.

Rectangular rapid flashing beacons (RRFB) are installed at unsignalized street crossings or mid-block crossing to assist pedestrians and bicyclists in crossing the street. Rectangular rapid flashing beacons have proven to be effective devices at uncontrolled intersections for increasing motorist yielding rates and reducing pedestrian-vehicle crashes at crosswalk locations. The rapid flashing beacon device consists of a pair of rectangular, yellow LED beacons that employ a stutter-flash pattern similar to that used on emergency vehicles. The beacons are often mounted below a standard pedestrian crossing warning sign and above the arrow plaque. The beacons are pedestrian activated (pushbutton or passive

detection) and placed on both sides of the street. If a median exists at the crossing location, a third and fourth beacon may be placed in the median, which, studies show, significantly increases motorist yield rates. Advanced pedestrian warning signs can also be used with the rapid flashing beacon. If traffic volumes are too high, or there are too many lanes (generally more than 4 travel lanes), a pedestrian hybrid beacon or full signal may be warranted. Research has shown higher motorist yielding rates for RRFBs versus standard flashing beacons; since these devices have been granted interim approval by FHWA, they are not included in the 2009 MUTCD due to late approval status, however, request to study is not required with interim approval to install these devices. A written request must be submitted to the FHWA to participate in the Interim Approval.

Pedestrian Hybrid Beacons (a.k.a.: HAWK Signal - High Intensity Activated Crosswalk)

Pedestrian hybrid beacon at an arterial street crossing.

This signal is intended to allow pedestrians and bicyclists to stop traffic to cross high volume arterial streets. The signal may be used in lieu of a full signal that meets any of the 9 warrants in the MUTCD as well as at locations which do not meet traffic signal warrants where it is necessary to provide assistance to cross a high volume arterial. The MUTCD provides suggested minimum volumes of 20 pedestrians or cyclists an hour for major arterial crossings (excess of 2,000 vehicles/hour). It is recommended that this signal be considered for arterial crossings in the bicycle network and for trail crossings if other engineering measures prove inadequate to create safe crossings. Pushbuttons should be "hot" (respond immediately)26, be placed in convenient locations for bicyclists, and abide by other ADA standards. Passive signal activation, such as video or infrared may also be considered. While this type of signal is intended for pedestrians, it would be beneficial to retrofit it, as the City of Portland, Oregon has done, with bicycle detection and bicycle signal heads on major cycling networks to provide adequate guidance. Depending upon the detection design, the city may have the option to provide different clearance intervals for bicyclists and pedestrians. The provision of bicycle signal heads would require permission to experiment from FHWA.

Curbside push buttons allow bicyclists to stay in the roadway to activate a signal.

Other Crossing Treatments

Crossing Islands

Crossing islands facilitate crossings of multiple lane and/or high-volume arterials by providing space in the center of the roadway, allowing the pedestrian or bicyclist to focus on one direction of traffic at a time (two-stage crossing). Median islands (or crossing islands) are constructed at the center of a road to physically separate the directional flow of traffic, and to provide pedestrians and bicyclists with a place of refuge while reducing the crossing distance between safety points.

26 An exception may be when a HAWK signal needs to be coordinated with other signals that are timed sequentially.

Crossing islands help pedestrians and bicyclists to safely negotiate multiple lane and/or high-volume streets.

Arterial roadway intersections that have low demand for left-turn movements can be potential candidates for adding median islands. Median islands can be constructed on these roadways by using the available center turn lane area, or by removing parking from one side of the street and shifting the travel lanes. Median islands are likely to be a medium- or long-term improvement on roadways where significant channelization changes are needed to provide enough space for the median island.

The newest AASHTO Guidelines outline design considerations for median crossing islands:

- Median islands are beneficial to install on roadways that have high traffic volumes, roadways that are too wide for full roadway crossing, and roadways with more than three travel lanes.
- Minimum width for storage on the median is 6 feet. 10 feet accommodates a bike with trailer.
- Island should be large enough for multiple people to be on the island at once e.g. strollers, bicyclists, pedestrians etc.
- Angling the refuge area at approximately 45 degrees is recommended to direct those crossing to face towards on-coming traffic.

Crossing Markings

Markings indicate the bicyclist's path of travel through an intersection.

The crossing markings used for bicyclists may differ depending on if the crossing is at a signalized or unsignalized location. For signalized locations bicycle pavement markings through intersections indicate the intended path of bicyclists through an intersection or across a driveway or ramp. They guide bicyclists on a safe and direct path through the intersection, and provide a clear boundary between the paths of through bicyclists and either through or crossing motor vehicles in the adjacent lane. MUTCD Section 3B.08 requires dotted lines the same width and color to bind the bicycle crossing space. Other treatments include multiple shared

lane markings, chevrons, or colored pavement (green). These treatments may not be applicable for crossings in which bicycles are expected to yield priority, such as when the street with the bicycle route has Stop or Yield control at an intersection. At these types of locations high visibility crosswalks may be used to create a visibly prominent crossing location for pedestrians, which also benefits bicyclists. High visibility crosswalks should be used in combination with advanced pedestrian/bike crossing warning signs. Other treatments that may be used in combination with high visibility crosswalks include curb extensions (to shorten crossing distances, crossing islands, and advanced yield markings. And at mid-block locations they may be used in combination with raised speed tables, however these are not recommended on higher speed and volume arterial streets.

Advanced Yield Markings

R1-5 and R1-5a signage may be modified to include the bicycle symbol.

Advanced yield markings in conjunction with "Yield Here To Pedestrian" signs have proven to be effective at reducing multiple threat crashes at uncontrolled, marked crosswalk locations. A multiple threat crash results when a car in one lane stops to let the pedestrian cross, blocking the sight lines of the vehicle in the other lane of a multi-lane approach which advances through the crosswalk and hits the crossing pedestrian(s). The MUTCD (2009) requires the use of "Yield Here To Pedestrians" (R1-5, R1-5a) sign if yield lines (shark's teeth) are used in advance of a marked crosswalk that crosses an uncontrolled multi-lane approach. "Yield Here To Pedestrians" sign may also be used without the installation of advanced yield lines. If yield lines and "Yield Here To Pedestrians" signs are used in advance of a crosswalk, they should be placed together and 20 to 50 feet before the nearest crosswalk line; parking should be prohibited in the area between the yield line and the crosswalk. "Yield Here To Pedestrian" signs may be used in conjunction with the "Pedestrian Crossing" (W11-2) warning sign but must be on a preceding post and not block the road user's view of the W11-2 sign. This application should be considered at trail crossings, pedestrian hybrid beacon crossings, and bicycle boulevard crossings of arterials. It is recommended the bicycle symbol be incorporated onto the signs. If a pedestrian hybrid beacon is used at a crossing location, then a "Crosswalk Stop On Red" (R10-23) should be used per Section 2B.53 of the MUTCD.

High-visibility Pedestrian/Bicycle Crossing Warning Signs

High-visibility bicycle and pedestrian warning signs are recommended at trail crossings. These signs can increase driver awareness of bicyclists and pedestrians, especially at mid-block locations where bicyclists and pedestrians may not be expected. These signs will be most effective when combined with other treatments, such as marked crosswalks, curb extensions, median islands, etc. Signs should be used judiciously—too many signs can cause visual clutter and lead to noncompliance. This sign is incorporated into the 2009 MUTCD.

Crossings at Off-Set Intersections

Bicycle left turn lanes.

Several designs have been developed to facilitate crossing of intersections with "legs" that do not line up directly across from one another. These include bicycle left-turn lanes that create a designated space for two-way left turns using pavement markings, left-turn with raised median that creates a single protected left turn using a raised curb median, and a sidepath. Left turn lanes should be a minimum six feet wide and 8 feet in length so that bicyclists can be completely separated from the travel lanes.

Median with bicycle left turn pocket.

Sidepath connecting offset T-intersection.

Greater detail on all of crossing design treatments can be found in the documents mentioned above, as well as other sources such as PedSafe and the National Association of City Transportation Officials (NACTO) website.

Sight Distance Improvements

Sight-distance obstructions can increase the risk of bicyclists being struck by vehicles at roadway and driveway crossings. Locations may have on-street parking, landscaping, light poles, bus stop shelters, and other features obstructing the line of sight between drivers and bicyclists. While these features can make a street more attractive and serve other valuable functions, they should be placed in locations that do not obscure drivers' views of bicyclists.

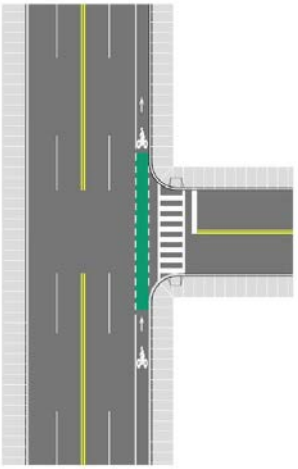
Restricting parking within a certain distance of an intersection—typically 30 feet—helps to maintain sight distance. At certain locations, it may be appropriate to restrict parking further to achieve the desired improvement in sight distance.

Example Intersections Needing Crossing Improvements

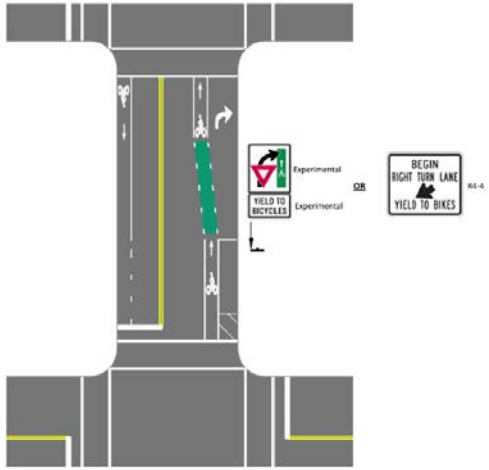
The following intersections represent moderate to highly used unsignalized crossings by bicycles that could benefit from some of the aforementioned crossing improvements.

- W Covell Rd at Shortgrass Rd
- Main St at Boulevard St
- Danforth Rd at Faircloud Dr
- 15th St at Whispering Creek
- 15th St at Fox Lake Ln
- 15th St at Chimney Hills Rd

Contrasting Green Color Pavement



Green Bike Lane through Intersection



Green Bike Used to Cross Right-turn Lane

Contrasting green color pavement is used primarily to highlight areas with a potential for bicycle-vehicle conflicts, such as intersections or merge areas where turning vehicles must cross a through bike lane. Generally, color has been applied to sections of bike lanes that previously had been delineated by dotted white lines. Examples of the use of color are shown in Figures 4 and 5. Providing clear pathway of travel guidance for bicyclists across wide intersections and at transition areas between shared-use pathways and on-street facilities can aid in bicyclist comfort and alert motor vehicles about where to expect cyclists in the roadway.

MUTCD Status: The use of contrasting color was issued Interim Approval status by FHWA on April 15, 2011. The use of contrasting green color has been shown through experimentation to increase awareness of bicyclist but has thus far not been shown to reduce crash rates in conflict areas. A written request must be submitted to the FHWA to participate in the Interim Approval.

Design guidance and application from the interim approval state:

- The color green is designated as the color for bicycle facilities. The material used for green color can be paint, colored asphalt or concrete, other marking materials with the proper chromaticity and slip resistance
- Green pavement marking may be used within a bicycle lane or within an extension of a bicycle lane to enhance the conspicuity of the lane or extension
- If a pair of dotted lines is used to extend a bicycle lane across an intersection or driveway, or a ramp, green colored pavement may be installed between these lines as a supplement to the lines

Bicycle Facility Transitions

It is often necessary to use different bicycle facilities to provide bicycle access within the same roadway corridor due to existing roadway conditions, surrounding land uses, available right-of-way, and other factors. Where this condition occurs, it is important to provide transitions between different facilities. These transitions can be made safer and more understandable for bicyclists and motorists with appropriate and consistent treatments such as spot directional signs, warning signs, pavement markings, curb cuts, etc. Transitions should be provided as a part of the bicycle facility design process. Where possible, provide additional space where trails intersect roadways, particularly at signalized locations where multiple trail users are likely to be waiting to cross the street. Curb ramps at trail crossings and other on-street access points should be assessed and widened where they are narrower than the trail width and/or where the volume of trail users is high.

Back-in Angle Parking

The AASHTO Guide for the Development of Bicycle Guide discourages the installation of bike lanes adjacent to front-in angle parking. The update to the AASHTO Guide speaks to the benefits of back-in angle parking adjacent to bicycle lanes which can help:

- Improve sight lines between drivers and bicyclists
- Reduce door zone conflicts between parked cars and bicyclists that occurs with parallel parking
- Improve loading and unloading of motor vehicles
- Reduce driver and passenger exposure to travel lanes

Where a shared use path crosses or terminates at an existing road, it is important to transition the path into the system of on-street bicycle facilities and sidewalks. Care should be taken to properly design the terminus to transition the bicycle traffic into a safe merging of intersecting facilities. Appropriate signing is necessary to warn and direct both bicyclists and motorists regarding these transition areas. Each roadway crossing is also an access point, and should, therefore be designed to facilitate movements of path users who either enter the path from the road, or plan to exit the path and use the roadway.

Section 5 / Implementation

This Plan provides recommendations for physical improvements to the street network, as well as policies and practices that will improve bicycle safety and promote bicycling as a viable mode of transportation. The order in which bicycle facility improvements recommended in this Plan are constructed will depend on many factors, including budget and grant availability, community support, and City policies.

5.1 Action Plan

The following action plan is organized around eight objectives, which if achieved, will allow the City to achieve the Master Plan Goal:

Increase the number of people bicycling while minimizing the number of crashes involving bicycles by providing safe, comfortable, and efficient bicycling conditions, and increasing public awareness and acceptance of bicycles on Edmond streets.

Specific actions are identified for each objective to help the City move towards successful implementation of the Master Plan.

Objective 1: Institutionalize the Bicycle Master Plan into the City's plans, policies, and practices.

Integrating bicycle considerations into City policies and processes is referred to as "institutionalization." Institutionalization of bicycling means bringing bicycle needs into the City's mission and corporate culture. It requires internal work by staff and coordination among departments to make changes to policies, plans, and processes that guide the City and its decision makers.

The design, prioritization, budgeting, and maintenance of the bicycle network are responsibilities that cross departmental lines. Coordination among departments is critical for ensuring there are no missed opportunities as road and trail projects are planned, designed and implemented. Key departments that should be involved in project coordination include:

- Community Development
- Engineering
- Parks and Recreation
- Planning and Zoning
- Public Works

Other City departments that may need to be involved on a project-by-project basis, or at the programmatic level, include:

- Fire Department
- Police Department
- Water Resources
- Edmond Electric

Action 1.1: Establish an inter-departmental coordination team.

The responsibilities of the inter-departmental team should include representatives from the key departments listed above. The City staff person who oversees bicycle facility planning plays a key role in convening and facilitating the coordination team. This team should meet quarterly or semi-annually, or on an as needed basis to:

- Review upcoming capital projects and street overlay projects to ensure integration of bicycle improvement recommendations included in the Master Plan.
- Adjust the schedule of when projects are implemented based on achieving multiple objectives, including implementation of high priority bicycle improvements and safety improvements for other roadway users.
- Identify funding needs (cost estimates) for incorporating recommended bicycle improvements into capital projects and annual programs, including maintenance.

Bike to School Event - May 2012

Action 1.2: Continue to Implement the City's Complete Streets Resolution.

The City of Edmond has adopted a "Complete Streets" resolution, which calls for accommodating pedestrians, bicyclists, and transit users in the planning, designing, and operations of Edmond streets. Implementation of this resolution will further efforts to implement the Bicycle Master Plan, and vice versa. Departments and divisions within the City should consult the Master Plan when working on all projects in City rights-of-way and other properties.

In addition to establishing a formal inter-departmental team to oversee implementation of the Master Plan (Action 1.1), it is also important to modify existing project scoping, design, and implementation processes to ensure that recommendations in this Master Plan are automatically integrated into all applicable capital projects. The coordination team mentioned in Action 1.1 should play a key role in identifying the necessary steps toward achieving an effective project integration process, and providing oversight to ensure that bicycle facilities are routinely accommodated in road projects. Before proceeding to the design phase for major roadway construction and reconstruction projects it is recommended that two to three alternatives be developed schematically and the cost/benefit of each alternative be fully analyzed. In order to ensure that the City works towards its goals of developing a more balanced transportation system that accommodates all modes, it is critical to consider benefits that are not traditionally considered in cost/benefit analyses such as public health, emissions reduction, vehicle miles traveled reductions, user cost savings, accident reduction, and others. National Cooperative Highway Research Program (NCHRP) Report 552: Guidelines for Analysis of Investments in Bicycle Facilities provides a methodology for calculating these benefits. Alternatives, and associated costs and benefits should be presented to the public and feedback should be used to determine which schematic design should move forward as the preferred design.

Action 1.3: Incorporate bicycle facility recommendations in the Edmond Transportation Plan.

The *Edmond Transportation Plan* was last updated in 2007. While the *Plan* acknowledges that bicycle and pedestrian facilities are important components of the City's transportation system, and references the system of trails and sidewalks identified in *Edmond Plan III* (subsequently updated to and incorporated into *Edmond Plan IV*), it is primarily focused on the future accommodation of projected vehicle volumes, and makes few recommendations for accommodating other modes. Its travel demand model and alternatives analysis assume a steady growth in vehicle volumes throughout much of the City despite City goals and policies that call for land development patterns that are less auto dependent and that better support travel options.

The recommended bicycle network should be incorporated into any update of the City's transportation plan. Alternatively, the Bicycle Master Plan should be incorporated into the Plan by reference. In addition, modeling of future traffic scenarios to determine needed transportation improvements should include at least one scenario that incorporates all recommended bicycle improvements.

Action 1.4: Provide Necessary Staff Expertise and Commitment.

The Master Plan envisions a city-wide bicycle network being developed over time. The implementation of this network will require dedicated staff time to oversee project coordination and integration, project design, administer education and encouragement programs, conduct public outreach, and monitor progress. In addition to the Bicycle Coordinator in the Planning Department, it is critical to have dedicated staff from the Engineering Department directly involved in all aspects of bicycle facility planning and design. Whether it is a relatively simple striping plan or a more complex intersection design, Engineering Department staff time is required to design bicycle facilities, or to manage and review designs made by on-call contractors. Such integration has proven to be an important and effective strategy in jurisdictions that have successfully implemented their bicycle master plans.

Having a Bicycle Coordinator position is instrumental in ensuring that Master Plan recommendations are followed through on, convening and coordinating the interdepartmental team and Edmond Bicycle Committee, coordinating with outside agencies and organizations, initiating and/or partnering with other entities to provide education and encouragement programs, and identifying and pursuing funding opportunities. The City should dedicate a minimum of one-half FTE employee within the Planning Department to coordinate implementation of the Master Plan, and a minimum one-quarter FTE employee within the Engineering Department to manage project implementation including the design of projects involving bicycle facilities.

Arterial streets, which generally provide the most direct access to major destinations, should be evaluated to determine how best to accommodated bicycles.

Objective 2: Develop a connected bicycle network consisting of a variety of on-street bicycle facility types that provides efficient access to destinations and attracts use by bicyclists of all skill levels.

Action 2.1: Prioritize bicycle facilities that provide direct access to commercial/employment areas, parks, schools, Downtown Edmond, Citylink stops, trails, and neighboring communities.

Providing access to destinations was a major factor that informed the development of the recommended bicycle network. Some recommended routes provide access to a greater number of destinations than others, and these should be prioritized. Over time, as the recommended network gets built out and ridership increases, the City may wish to reevaluate certain corridors not shown on the recommended network and determine if there are opportunities for installing on-street bicycle facilities. In particular, arterial streets, which generally provide the most direct access to Edmond's largest destinations, should be evaluated to determine how best to accommodate bicycles. See Section 5.3 for more discussion on project prioritization.

Action 2.2: Improve accessibility for bicyclists around or through barriers such as intersections and a discontinuous street networks.

Major barriers for bicyclists in Edmond include arterial roadways with high vehicle volumes and speeds and a discontinuous local and collector street network. Prioritizing intersection and roadway crossing treatments (see Section 4.4) where the bicycle network encounters arterial roadways is a key strategy for addressing these types of barriers. As for overcoming the discontinuous street network prevalent in certain areas of the City, every effort should be made to identify and establish through connections where they may exist, e.g. implementing planned trails, and revising the City's Subdivision Code

The following are existing Subdivision Code requirements that address the connectivity of the local street network:

- New subdivisions should make provision for the connectivity or continuation of the principal existing streets into adjoining areas of their proper projection where adjoining land is not subdivided insofar as may be deemed necessary by the Commission for public requirements.
- In general, provisions should be made for through streets at intervals of seven hundred feet (700'), or less.
- Offset streets should be avoided.
- Connectivity through large subdivisions should be provided with collector streets that provide multiple access points to the arterial street system.

Below are additional strategies for promoting the development of more walkable and bikeable neighborhoods:

- Prohibit gated and private streets.
- Prohibit cul-de-sacs, or at a minimum, reduce the maximum length for cul-de-sacs, which is currently 1,250 feet, to between 300 to 500 feet.
- Reduce maximum block length (currently 700 feet) to between 350 and 550 feet.
- Alternatively, adopt a connectivity index, which allows for greater flexibility in accommodating unique site features. Connectivity indices are measured by the ratio of links to nodes (i.e. street segments to intersections/cul-de-sac heads): the higher the ratio the greater the connectivity of the street system, with 1.7 being a traditional grid and 1.2 being a typical suburban network.

In some cases, local governments have encountered developer resistance to these types of regulations, and have dealt with it by including developers in the process of developing regulations, and giving developers opportunities to provide alternatives to the regulations that still meet the spirit of the ordinance. In particular, developers may fear that if more connections are required, more land will be needed to produce the same number of units – reducing profitability. One strategy for reducing resistance can be to allow narrower streets (20') in connected developments. There is also the fear that standards decrease profitability by reducing premium priced cul-de-sac lots and increasing larger corner lots. In situations where it can be shown that the regulations result in a lower-lot yield for a developer, a strategy may be to permit a reduction in minimum lot sizes or other variance to allow the same amount of units. There are numerous studies[27] and articles that show walkability (and bikeability) having a positive effect on property values; therefore, regulations and incentives that result in more walkable and bikeable communities are a win-win solution. There are also numerous studies that show regular street grids with a higher degree of connectivity that encourage more walking and presence of people within the street environment have lower crime rates compared to street systems dominated by curvilinear and discontinuous streets and cul de sacs.[28]

"Edmond needs more interconnection between neighborhoods so we don't have to ride on section line roads to go places."

- Edmond Resident

Other strategies for improving connectivity within and between neighborhoods include:

- The City should also revisit its policy on neighborhood street closures. Existing street closures should be improved to allow easier

27 A few relevant studies include: Economic Value of Active Transportation, Ryan Snyder, 2004; Guidelines for Analysis of Investments in Bicycle Facilities, NCHRP Report 552, Kevin J. Krizek, et al, 2006; The Economic Benefits of Investing in Bicycle Facilities, League of American Bicyclists and Alliance for Biking and Walking.

28 Hillier, Bill, Can streets be made safe? Urban Design International, Vol. 9, No. 1, pp. 31-45, 2004. Similar material was published in: Hillier, Bill, Designing safer streets: an evidence-based approach, Planning in London, No. 48, pp. 45-49, 2004.

passage for bicyclists. As an alternative to future street closures, the City should engage with residents to identify appropriate traffic calming measures that may also discourage cut-through traffic.

- Require that school districts receive notification as part of the subdivision review process so that the City and district or school officials, which may include proponents of Safe Routes to Schools, can work together to ensure safe and convenient pedestrian and bicycle access between the school and surrounding neighborhoods before plans are approved. Staff have the ability to review and comment on impacts to bicycle and pedestrian access to schools before plans are approved.

Action 2.3: Establish a way-finding sign program to facilitate and encourage bicycle mobility and access to facilities, services, and destinations.

Wayfinding signage.

Wayfinding signs provide information about destinations, direction and distance to help bicyclists determine the best routes to take to major destinations. Signs provide information that helps bicyclists understand and use the bicycle network without the use of a map. Directional signs also provide additional messaging to motorists to expect bicycles on the roadway. The presence of signs encourages bicycling on designated corridors because users feel the signs will direct them to the best route for getting to their destination. Signs may be used in conjunction with pavement markings such as bike dot symbols or shared lane markings to provide additional directional information. See Appendix C for more details on bike dot symbols.

Objective 3: Engineer Bicycle Facilities which Support and Encourage Bicycling.

The quality of bicycle facilities has a direct impact on the experience of the bicyclists and will therefore have a tremendous influence on the ability of the facility to sustain use or to attract increased use. Well maintained and high quality facilities have been demonstrated to attract higher levels of users than poorly maintained or low quality facilities. Likewise, interconnected systems with minimal gaps or interruptions are essential.

Research has documented the quality of the bicyclist's experience and comfort is directly related to their space (i.e. width of bicycle lane or trail), separation from adjacent passing traffic, speed and volume of adjacent traffic, as well as the composition of the traffic (cars/trucks on roadways, people/bikes on trails). This research has resulted in the incorporation of bicycle level (quality) of service[29] into the Highway Capacity Manual which accounts for the experience and comfort of the bicyclist operating on the roadway.

Action 3.1: Build the capacity of City staff to plan, design, and implement bicycle facilities through trainings on bicycle planning and facility design.

Trainings may include attending conferences such as Pro-Walk/Pro-Bike, courses offered through professional organizations such as ITE, APBP, and FHWA, as well as formal and informal sessions delivered by staff and/or consultants with an expertise in bicycle and pedestrian planning and engineering. Periodic training may focus on specific topics of importance, such as intersection design, innovative design treatments, facility design transitions, and maintenance practices.

29 Bicycle Level of Service is an evaluation of bicyclist perceived safety and comfort with respect to motor vehicle traffic while traveling in a roadway corridor. It has been incorporated into the 2010 Highway Capacity Manual. The research is more highly developed for midblock segments than for intersection nodes.

Action 3.2: Update the City's street standards to include bicycle facilities based on the recommendations in this Master Plan and the latest AASHTO Guide for the Development of Bicycle Facilities and MUTCD standards.

The state of practice for bicycle facility design is constantly evolving based on new research and lessons learned. The recommended cross sections shown in Section 4.3 are based on the latest guidelines, standards, and best practices, and should be updated as the state of the practice evolves.

Action 3.3: Develop a desired minimum bicycle level of service goal for on-road and off-road projects.

It is recommended a minimum level of service score of C or better be provided for on-road segments and level of service of B or better for off-road segments. Refer to the 2010 Highway Capacity Manual for more details on level of service for bicyclists.

Action 3.4: Incorporate the evaluation of bicycle level (quality) of service into all projects.

With the incorporation of bicycle level of service into the Highway Capacity Manual, all new traffic models will be capable of determining this score. This scoring will allow for an objective comparison of alternatives during concept development or preliminary engineering stages for proposed modifications or improvements to the transportation network. It may be necessary to provide training to staff to implement this recommendation.

Action 3.5: Utilize engineering strategies which maximize the safety and comfort of the most vulnerable (non-motorized) roadway users at roadway intersections.

A fundamental strategy for increasing bicycling rates, is to improve the experience and safety of bicycling on the roadway network. Nationally, historic crash statistics demonstrate the vast majority of crashes occur within intersections. Improvements for the comfort and safety of bicyclists on street segments with bicycle facilities should be extended through the functional area of intersections rather than terminating prior to the intersection. It is preferable to develop through bicycle lanes to the left of right-turn only lanes where space allows.[30] At signalized intersections signal operations should consider the bicyclists both in actuating the signal and in having sufficient time to clear the intersection safely. At non-signalized intersections, consideration should be given to implementing engineering strategies which reduce crossing delay and improve comfort and safety for the bicyclists.

Accommodation of bicyclists at intersections can be obtained by the following engineering methods:

- Providing a bicycle facility through the functional area of the intersection.
- Adding or improving bicycle detection/activation.
- Adjusting signal timing to provide sufficient time to cross.
- Providing crossing enhancements such as medians, active warning devices, or signals.
- Geometric design that includes smaller curb returns to slow the speed of turning vehicles.

Additional discussion regarding approaches to intersection design for bicyclists is provided in Section 4.4.

30 See the AASHTO *Guide for Development of Bicycle Facilities* for more guidance on right-turn considerations. On higher speed arterials (greater than 40 mph) where the bicycle lane is placed to the left of right-turn only lane additional treatments such as green bike lanes and "BEGIN RIGHT TURN LANE YIELD TO BIKES" sign should be considered as a means to draw motorists' attention to the bike lane.

Action 3.6: Utilize engineering strategies which maximize the safety and comfort of the most vulnerable (non-motorized) roadway users on roadway segments.

On arterial streets where vehicle speeds exceed 40 mph, the space available within the street cross section should maximize the space provided to the bicyclist via wider shoulders or bicycle lanes, or be utilized to create additional separation from adjacent traffic in the form of buffered bicycle lanes or cycle tracks. Safety research has shown on low speed urban streets, additional width provided to motorists has zero to minimal value while extra width provided to bicyclists provides extensive benefits (see Section 4 for details).

This extra width can be obtained by the following engineering methods:

- Narrowing parking lanes
- Narrowing travel lanes
- Narrowing medians
- Removing travel lanes
- Removing parking
- Widening roadways

Additional discussion regarding lane widths is provided in Section 4.

Action 3.7: Evaluate new bicycle facility treatments.

The City should evaluate emerging bicycle facility treatments for their potential effectiveness. These facilities can be implemented as pilot projects with pre-determined benchmarks established to measure the effectiveness. Potential facilities which should be considered include:

- Bicycle boxes
- Bicycle signals
- Passive bicycle detection
- Cycle tracks
- Green bicycle lanes

Green bicycle lane.

Additional discussion regarding some potential new bicycle facility treatments is provided in Section 4.4 and additional details can be found in the NACTO Urban Bikeway Design Guide.

Objective 4: Improve Safety through Well-Maintained Bicycle Facilities.

The City should establish a bicycle network maintenance strategy that includes full integration of bicycle facilities into routine roadway maintenance, considers weather and seasonal issues, and explores opportunities to utilize volunteers to assist with some maintenance tasks. Annual maintenance of bicycle facilities includes sweeping, pothole repair, sign replacement, re-painting of bike lanes and vegetation management on off-street segments.

Action 4.1: Modify existing online "Report a Concern" system to include a bicycle-specific form.

Modifying the City's existing online citizen comment/feedback system so that a person can more easily report maintenance issues directly related to bicycle facilities, which would allow the City to better identify where spot maintenance is needed and to set maintenance priorities.

Action 4.2: Encourage bicycle organizations and other community groups to assist with minor maintenance activities.

The City should work with bicycle organizations, community groups, civic organizations, and businesses to provide periodic upkeep along trail corridors and certain bicycle facilities such as facilities on bridges that may be more difficult to maintain using standard equipment. Examples of initiatives that should be considered include "Adopt a Trail" or "Adopt a Bridge".

"There needs to be a balance of awareness for both drivers and cyclists BUT drivers need to know cyclists have the right to be there. And cyclists must adhere to the laws."

– Edmond Resident

Objective 5: Promote Safety through Education and Enforcement.

The bicycle network will be designed to provide safe and convenient access for bicyclists to travel to destinations throughout Edmond. Like facilities for other transportation modes, this network of bicycle facilities must be used appropriately to be effective. For example, bicycle facilities are designed under the assumption that bicyclists ride the correct direction on streets and stop at red traffic signals. It is also assumed that motorists yield to bicyclists when turning, provide sufficient space when passing, and do not drive or park in designated bicycle lanes.

Action 5.1: Expand public education campaigns to promote the "share the road" message and the rights and responsibilities of all users, as well as inform roadway users about new bicycle facilities and how they work.

As it moves forward with implementing the recommended bicycle network, the City, in partnership with other organizations, should build on existing public education efforts using a variety of methods that may include:

- **Create a dedicated bicycle section on the City's website** - The City should continue to host and maintain an online reference that provides easy access to bicycle laws, safety tips, maps of the bicycle network, and a calendar of bicycle events. The webpage should be placed in an intuitive section of the City's website and accessed from a web address that is easy to remember. The City could register a web address such as www.EdmondBikes.com[31] , which would forward the user to content on the City's website.
- **Create and distribute educational materials** - Educational and promotional materials such as maps, bumper stickers, billboards, website content, flyers, social media, etc. having a unified theme and message can be very effective in raising awareness about bicycle safety. The City should partner with bicycle shops and bicycle related organizations to disseminate education and encouragement information and sponsor education and encouragement events. The City need not re-invent the wheel - Organizations such as the Pedestrian and Bicycle Information Center (PBIC), League of American Bicyclists, and Association of Pedestrian and Bicycle Professionals (APBP) are good sources for educational materials.
- **Create a brand for safety education programs and materials** Establishing an identity for the City of Edmond bicycle program using a recognizable brand that can be applied on all new materials will help spread awareness and maintain a consistent message. The brand should be apparent on all activities and products that are associated with the program.

31 As of June 12, 2012, this address is unregistered and available.

Action 5.2: Promote and Support Adult Bicycle Safety Classes.

The City of Edmond is fortunate to have a number of League Certified Instructors (LCIs)[32] that can be engaged in providing adult bicycle safety classes. The problem to date has been a lack of interest from the public. As the City moves forward with implementing bicycle facilities and ridership grows, it will be important to offer safety classes on a regular basis. The City should support efforts to publicize and offer bicycle safety courses. Strategies for increasing participation may include offering courses through employers, offering a variety of course formats, e.g. full-day, two-half-day, or weekly for several consecutive weeks.

Action 5.3: Promote and support the Safe Routes to School program and encourage all schools to get involved.

Edmond Bike to School event.

Many of Edmond's schools can be accessed from neighborhoods via low stress neighborhood streets and the sidewalk network, and therefore are very bikeable. Schools should be encouraging children to walk and bike to school using strategies from the Safe Routes to School program, including bicycle trains, bike to school day, and regular events such as Bicycle Rodeos to educate school age children about bicycle safety and riding techniques. The City may partner or lend support to the school district and/or individual schools interested in pursuing SRTS funding. Edmond Police Officers could also be engaged to provide safety tips, or lead Bicycle Rodeos at schools. The National Center for Safe Routes to Schools Clearinghouse has many education materials available for no charge.

32 The League of American Bicyclists certifies instructors to teach Smart Cycling classes, which were developed by the League.

Bicycle safety class.

Action 5.4: Convene a Bike Summit to Provide a Venue in Which to Discuss Issues Related to Bicycling.

As the City moves forward with installing bicycle facilities and more bicyclists use these facilities, it will be important to have a dialog among the various roadway users about issues or behaviors that need to be addressed or clarified. Such a summit could be held in association with Bike Month or Bike to Work Day on either an annual or biannual basis.

Action 5.5: Provide training to enforcement officers on bicycle facility types and the operating characteristics of bicycles.

Edmond police should play an important role in the education of cyclists.

Effective enforcement depends on police officers being informed about the laws pertaining to bicyclists, the leading causes of bicycle crashes, and the operating characteristics of bicycle facilities and bicyclists. Trainings should be offered to new and existing enforcement officers on an annual basis. The National Highway Traffic Safety Administration (NHTSA) has made available a 2-hour self-paced interactive video training for all law enforcement officers. More details about the course and ordering information for the CD-ROM can be found by searching "NHTSA Enhancing Bicycle Safety". Another video entitled "Enforcing Law for Bicyclists", which is available for download from the NHSTA website, provides a basic overview of laws pertaining to bicyclists, why it is important to address motorist and bicyclist behaviors that lead to crashes, and the importance of reporting crashes.

Action 5.6: Develop a tip card to inform all roadway users about their respective rights and responsibilities with a focus on pedestrian and bicycle safety.

A pocket-sized tip card that contains information about laws pertaining to sharing the road, yielding to pedestrians, and basic etiquette that could be distributed at events, made available at bike shops and other venues, and handed out with warnings (or tickets) by law enforcement officers.

Action 5.7: Increase enforcement, taking a balanced approach that improves the behaviors of both motorists and bicyclists, and reduces crashes.

The Edmond Police Department has an important role to play in improving bicycle safety.

Reducing bicycle-related crashes hinges upon addressing the behavioral causes. Educating both motorists and bicyclists about state and local laws should be the primary method for encouraging appropriate behavior. Enforcement that targets certain behaviors of each road user group is also important for establishing correct behaviors.

Motorist behaviors that should be targeted include turning left and right in front of bicyclists, passing too close to bicyclists, parking in bicycle lanes, opening doors of parked vehicles in front of bicyclists, rolling through stop signs or disobeying traffic signals, and harassment or assault of bicyclists.

Bicyclist behaviors that should be targeted include ignoring traffic control (particularly traffic signals), riding the wrong way on a street, riding without lights at night, and riding recklessly near pedestrians on sidewalks.

Officers can also play an important educating role by informing roadway users of their rights and responsibilities. This could be done by distributing a tip card along with a warning for first time offenders.

Bicycle diversion programs can also be an effective enforcement and education strategy. Such a program allows an offending cyclists to take a cycling safety workshop as an alternative to paying a traffic fine (i.e., they are "diverted" from the court system). Police departments can run such

workshops internally or contract with an outside expert. Such programs are popular because they emphasize safety rather than punishment and help develop cooperation among police, parents, and bicycle safety advocates. Scout troops, school groups and parents often voluntarily attend the safety workshops.

Such a program works like this:

- Cyclist is ticketed for violating a traffic law.
- If the cyclist is a child, police send a standard letter to their parents describing the violation, emphasizing the importance of observing bicycle traffic laws for the sake of safety, asking the parent to bring the child to a bicycle safety workshop (typically offered monthly or semi-monthly) within a specified time period (such as three months), and inviting the parent to contact the program coordinator if they have any questions.
- If the cyclist attends the workshop the traffic ticket is void.
- If the cyclist fails to attend the workshop in the specified period, the ticket is processed.
- Police and courts coordinate to allow efficient processing of cyclist traffic tickets.

Objective 6: Expand the public's view that bicycles are a viable, acceptable, healthy, and fun mode of transportation.

Action 6.1: Promote bicycle and pedestrian education and encouragement in Edmond through partnerships with other agencies and community organizations.

People of all ages and skill levels should feel comfortable biking in Edmond.

The City will work with a number of partners, including the Edmond Bicycle Committee, Oklahoma Bicycle Society, Oklahoma Bicycling Coalition, and others to offer bicycle education and encouragement programs.

Action 6.2: Set up community celebrations and/or rides each time the community completes a new bicycling-related project.

Holding events that celebrate the growth of the bicycling network in Edmond is a great way to show off the City's good efforts and introduces new users to the improvement.

Action 6.3: Develop and distribute a Bicycle Map and Commuter Guide.

As the bicycle network is developed it will be important to ensure that bicyclists are aware of new routing options. The Facilities map can be distributed in paper form, be posted online as a PDF document, and may also be used as the basis for a web-based bicycle route-finding system. The map may also contain other information such as a description of different bicycle facility types, tips for commuting by bicycle, a summary of road users' rights and responsibilities, and other safety tips, including encouraging the wearing of helmets.

Bicycle parking on the UCO campus.

Action 6.4: Provide bike parking and support facilities at destinations throughout the City.

The lack of bicycle parking at destinations such as shopping, places of employment, and city facilities was identified as a major barrier to bicycling. The City should be proactive about ensuring that adequate parking and other support facilities are provided at all destinations. City code requires bicycle parking be provided as a part of all new commercial development, but the City needs to go further by encouraging all development (excluding single family residential development) to provide bicycle parking and support facilities, which in the case of employers, may also include showers and storage lockers. Several strategies for increasing bicycle parking and support facilities include:

- Prioritize locations for installing bicycle parking racks in the public right-of-way where there are destinations people may bike to (e.g. commercial areas, parks, libraries, transit stops, etc.). Any destinations accessed via the bicycle network should be high priority locations for bicycle parking, but there may be other prioritization considerations.
- Create an annual program and establish a goal to install a certain number new bicycle parking racks each year in the public right-of-way.
- Develop a bicycle parking program and apply for funding to create a match fund to be used to encourage existing businesses to install bicycle racks by subsidizing a portion of the cost.
- Promote the League of American Bicyclist's "Bicycle Friendly Businesses"[33] program among businesses and employers as a means to encourage them to provide end-of-trip facilities such as bike parking, lockers, and showers.
- Revise the City's Zoning Ordinance to clarify and strengthen requirements for bicycle parking and other support facilities. Areas to focus on include:
  - Establishing a maximum distance bicycle parking can be located from a building entrance and requiring bicycle parking areas to be connected to the pedestrian circulation system, i.e. ensure parking areas are paved and not developed as isolated pads.
  - Differentiate between short-term and long-term bicycle parking for commercial, industrial, office and institutional uses, and establish requirements for secure and sheltered long-term bicycle storage, showers and storage lockers for employees in commercial, industrial and institutional developments. The required number of long-term bicycle parking spaces for commercial offices should be somewhere in the range of one space per 8,000 to 10,000 square feet. For industrial uses this number could be in the range of 15,000 to 20,000 square feet. For retail commercial uses the number of long-term bicycle parking spaces should be somewhere in the range of one space per 12,000 to 20,000 square feet. For

33 http://www.bikeleague.org/programs/bicyclefriendlyamerica/bicyclefriendlybusiness/

lodging uses the number of long-term bicycle parking spaces should be in the range of one space per 20 to 30 rentable rooms. Requirements for showers and storage lockers may only be applicable for commercial office, institutional and industrial uses over a certain square footage (e.g. 100,000).

- Allow short-term bicycle parking to be placed within required building setbacks in order to allow developers more flexibility.

Refer to www.bicyclinginfo.org and the Association of Pedestrian and Bicycle Professionals (APBP) Parking Guidelines for more detailed guidance on bicycle parking. Also, the Bicycle Alliance of Washington has published a useful guide entitled "Retailer's Guide to Implementing Effective Bicycle Parking"[34], which could be provided to all owners of retail commercial properties and tenants as an alternative or supplement to code requirements.

Objective 7: Pursue a Multi-Pronged Funding Strategy.

Funding for Master Plan implementation and related programs will come from a variety of sources, including the General Fund, as well as regional, state, and federal funds and grants related to transportation and even non-transportation programs. The City may also want to consider a voter-approved bond or levy aimed specifically at making investments in transportation infrastructure, which would include bicycle and pedestrian improvements. Public-private partnerships may also be instrumental in implementing certain segments of the network. More and more cities are adopting policies that set spending targets for bicycling and walking.[35] More cities are also dedicating annual city budget funds to walking and biking improvements and maintenance, which range from a $200,000 to $15 million with a median of $1.6 million.[36]

34 http://www.bicyclealliance.org/commute/sbblarge.pdf

35 According to the 2012 Alliance for Biking and Walking Benchmarking Report, thirteen cities (Albuquerque, Austin, Cleveland, Colorado Springs, Columbus, Fresno, Honolulu, Las Vegas, Louisville, Nashville, Phoenix, Portland, and Washington D.C.) have spending target policies. Albuquerque and Washington D.C. reported a target equal to 5% of total transportation budget.

36 Alliance for Biking and Walking 2012 Benchmarking Report.

Bike rack per city parking standards

"I see a great need for bicycle parking at most Edmond businesses – there simply is nowhere to lock bikes up"

– Edmond Resident

Action 7.1: Adopt a policy that sets a spending target for bicycle facility improvements and establish minimum annual funding for plan implementation and facility maintenance.

The City of Edmond should set a spending target for biking improvements and establish minimum funding amounts per year for plan implementation and facility maintenance. Appendix D provides planning-level cost estimates, which can be used to establish minimum annual budgeting for bicycle improvements and a target for overall spending.

Action 7.2: Pursue a variety of grant funding opportunities.

The City should continue to pursue outside funding sources at the regional, state, and federal levels. The League of American Bicyclists and Alliance for Walking and Biking maintain information on funding sources and strategies for bicycle improvements. Given recent changes to the federal transportation bill, there may be more opportunities for the City to pursue funding coming through ACOG, however, it will be more important than ever for local proponents of bicycling infrastructure and programs to advocate for projects. As a result of the new bill, several of the dedicated funding sources at the federal and state levels, e.g. Transportation Enhancements and SRTS, no longer exist or are left up to state DOT discretion to fund, and bicycle and pedestrian projects must compete more directly with other eligible projects under the new "Transportation Alternatives" program.

Action 7.3: Establish an internal funding mechanism such as a grant match reserve fund that makes it possible for the City to have matching funds available to take advantage of state and federal grants.

A grant match reserve fund could be established as part of the annual budgeting for Plan implementation by setting aside a certain percentage (e.g., 5 percent) of dedicated bicycle improvement funds. Annual interest from the match reserve fund could be used to implement bicycle facility maintenance improvements.

If establishing a match reserve fund is not feasible, then the City should consider other mechanisms that would allow for matching funds to be readily available to ensure that appropriate grant opportunities requiring a local match can be pursued.

Action 7.4: Actively engage with ACOG and ODOT to ensure that transportation program scoring criteria allow for "good" bicycle projects to compete with other roadway projects.

"Good" bicycle projects are those projects that have been identified in this Master Plan (e.g. projects that provide connectivity and improve safety), meet AASHTO guidelines, and generally reflect USDOT policy, which discourages transportation investments that negatively affect cyclists and pedestrians and encourages investments that go beyond the minimum requirements and provide facilities for bicyclists and pedestrians of all ages and abilities. Such projects should be able to compete as standalone projects and as adjunct projects to larger roadway projects. The City of Edmond should have active representation on committees or other bodies that make decisions about transportation project scoring and should push to change existing scoring criteria if it results in the penalization of projects with bicycle facilities that go beyond minimum standards.

Action 7.5: Forge partnerships.

Leveraging funds with those of other agencies and departments will strengthen implementation efforts. As appropriate, public-private partnerships with private organizations should be pursued as a way to leverage funds. One example is partnering with utilities and companies (e.g. water, communication, oil/gas) that utilize corridors for product conveyance. Sometimes these corridors have sufficient space for the development of trails, and companies are willing to allow development of trails as a goodwill gesture, or for practical reasons, e.g. maintenance access.

Objective 8: Increase Ridership and Improve Safety through Data Analysis and Evaluation of Plan Implementation.

Action 8.1: Develop a system for identifying and understanding the type, pattern and location of bicycle crashes so that safety issues may be addressed either through better design, maintenance, education or enforcement.

Many bicycle crashes are undocumented because they are single bike crashes that do not require a police report, they don't meet damage thresholds, or because police are never called to the scene of the accident. In those cases where police are called to a scene of an accident involving a bicycle, it is important for all accident details to be noted, e.g. cause, specific location, relevant roadway condition factors, demographic information, etc. regardless of who was at fault. Police reports that do involve bicycles should be compiled on an annual basis and made available to the Bicycle Coordinator so that locations and corridors with a high rate of crashes can be identified and any roadway design or maintenance issues can be resolved through the interdepartmental coordination team.

It is recommended the City investigate options for coordinating local hospital injury data into a crash database for bicyclists to improve the quality of the bicycle crash reporting system and identify spot locations within the bicycle network that need attention.

Ultimately the ability to determine crash rates and/or diagnose accident patterns/commonality will help the City to objectively target safety improvements (including maintenance). Relying strictly on total crashes may not result in the highest need location being prioritized.

Action 8.2: Develop a system for using on-going counts of bicycle activity to extrapolate average annual daily bicycle traffic (AADBT) and average daily bicycle traffic (ADBT) for corridors and areas of the city.

Determining average daily bicycle traffic volumes for corridors and areas of the City will allow the determination of crash rates for bicyclists and tracking of facility usage. All on-going traffic counts conducted should include the counting of bicyclists. It is recommended that trail counters be installed on major regional trails to provide data useful for trail corridors, as well as to provide data useful for determining seasonal, daily, or hourly adjustment factors. Initially the lack of data may require the city be divided into "bicyclist catchment" areas which over time can be further subdivided as additional data is collected. Refer to the National Bicycle and Pedestrian Documentation Project for additional information about conducting bicycle counts and establishing adjustment factors.

Action 8.3: Establish a system of performance measures for plan implementation.

Performance measures are used to determine progress being made toward Master Plan implementation. The most useful performance measures are quantifiable and trackable over time. As a starting point the City may want to establish the performance measures listed in Table 5. Additional performance measures may be added as data and resources become available.

Action 8.4: Establish mechanisms for ongoing community input and accountability.

Implementation of the Master Plan will be a dynamic process with priorities changing over time as factors such as community input and funding availability are taken into consideration. Community input should continue to be sought after the Master Plan is finalized and throughout the implementation phase. The ideas and experiences of bicyclists and other roadway users, such as their experience with installed facilities, spot maintenance issues, behaviors of roadway users, and other improvements they would like to see implemented, should be used to continually shape the Master Plan. Community input may be elicited using several mechanisms, including a telephone hotline or web-based comment form, holding bike summits annually or every other year, and the Edmond Bicycle Committee, which functions as an intermediary between the City and the bicycling community. The Edmond Bicycle Committee, or another organization or advisory body may weigh in on the annual work plan for implementing the recommended bicycle network, and may also decide to issue an annual "report card" that highlights accomplishments and ongoing efforts related to Master Plan implementation.

Table 5

Performance Measure	Performance Target	Baseline Measurement	Data Collection Frequency
Incorporate bicycle network recommendations into the Edmond Transportation Plan	2013	N/A	N/A
Miles of on-street bicycle network complete (including route wayfinding)	Install a minimum of 15 miles of bicycle network annually. Complete recommended network by 2022	Number of miles of existing bicycle facilities	Annually
Establish minimum annual funding for plan implementation and facility maintenance	2013	N/A	N/A
Number of bicycle parking racks installed in the public right-of-way and with new development	20 to 50 racks per year	N/A	Annually
Number of trainings and educational events targeting city staff, police officers, and roadway users	4 per year	2012	Annually
Number of tip cards (see Action 5.6) containing information on bicycle safety issued by law enforcement officers to bicyclists and motorists	200 per year	2013	Annually
Achieve Bicycle-Friendly Community recognition (see http:// www.bikeleague.org/programs/ bicyclefriendlyamerica/ communities/ for more information)	2015 (submit application) If unsuccessful, then address gaps and reapply in 2017	N/A	N/A

5.2 Implementation of Bicycle Network Improvements

The recommended bicycle network will be implemented incrementally over time. The implementation timeline for individual segments of the recommended bicycle network will vary depending on a number of factors, including available funding, anticipated demand, the potential to piggy-back bicycle improvements on other capital improvement and street maintenance projects, and opportunities that arise through other projects to name a few.

Phasing and Prioritization

The recommended bicycle network consists of a variety of facility types that require different levels of investment. Furthermore, the City consists of areas with differing development and street patterns, which impacts how, when, and what type of transportation improvements are made. Taking these factors into consideration, it is anticipated that the recommended bicycle network will be implemented in phases.

Short-term Projects (0 to 5 years)

Recommended bicycle improvements that entail installing pavement markings, e.g. shared lane markings, bike lanes, and/or wayfinding signage on existing roadways are relatively low cost in terms of design, materials, and labor. However, accommodating bicyclists through intersections may entail additional costs associated with adjusting signal timing/phasing and detection, and rechannelization. It is anticipated that the majority of recommended on-street bicycle improvements can likely be implemented within the short-term provided there is sufficient funding and/or opportunities to piggy-back improvements with other roadway improvements.

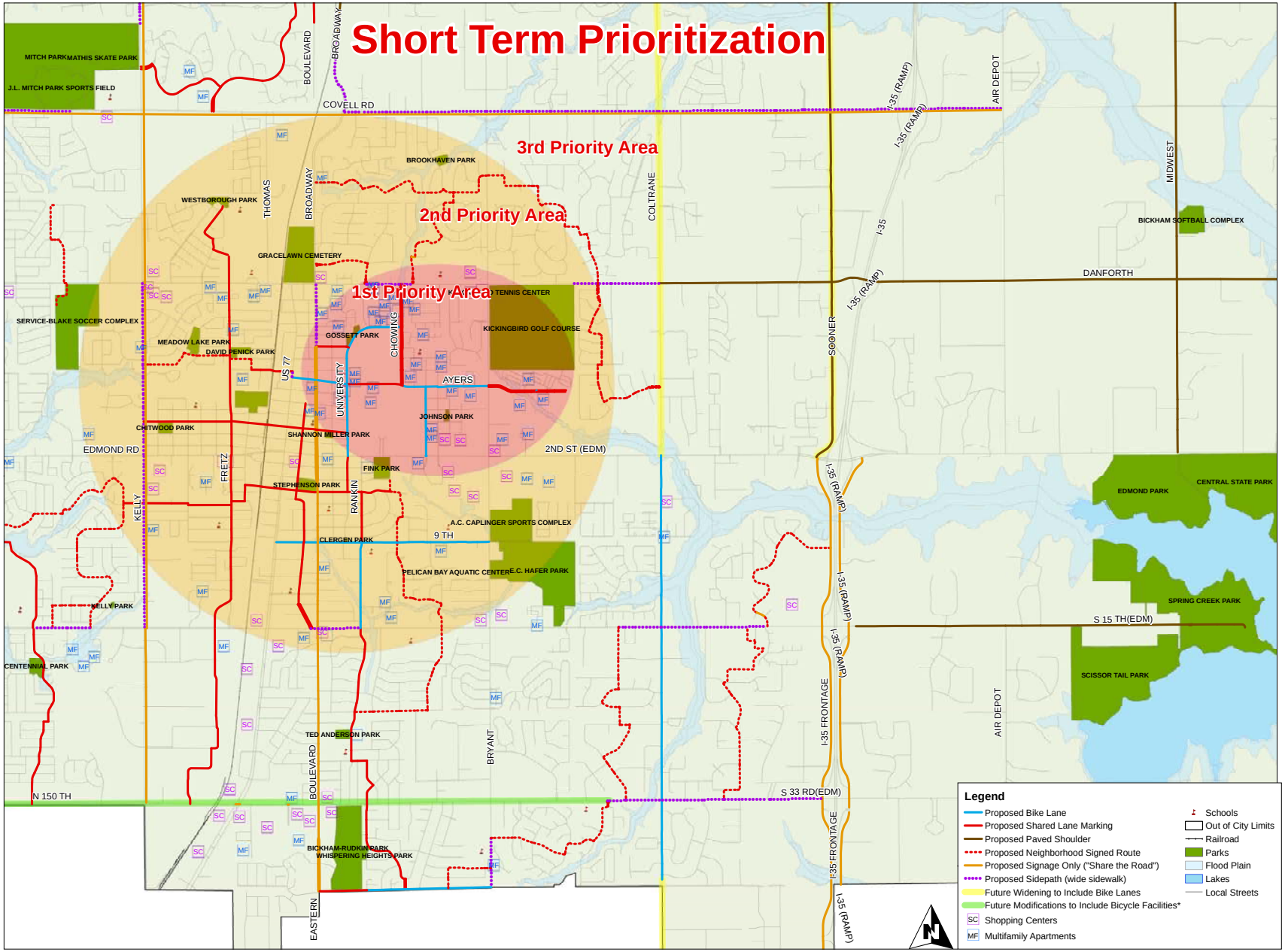
Prioritization of short-term improvements provides a useful framework that can guide the City in its implementation efforts and help ensure that facilities that are likely to provide the most benefit in terms of potential ridership are implemented first. Thus, the City can begin to establish a foundational bicycle network that begins to build ridership and momentum for further implementation of the recommended network. Figure 5 shows a prioritization of areas for implementation of the short-term improvements. Prioritization is based on the density of destinations and feedback from the public.

Short-term projects are focused on building ridership among a broader range of bicyclists.

Short-term projects should include all of the facilities that just require signing and marking. In addition, a recreational loop to Arcadia Lake is proposed as a short-term project with paved shoulders on the following roadways:

- Broadway St (from Covell Rd to Coffee Creek Rd)
- Coffee Creek Rd (from Broadway St to Midwest Blvd)
- Midwest Blvd (from Coffee Creek Rd to 2nd St /Arcadia Lake)

Figure 5


Short Term Prioritization
3rd Priority Area
2nd Priority Area
1st Priority Area
MITCH PARK
MATHIS SKATE PARK
J.L. MITCH PARK SPORTS FIELD
COVELL RD
BOULEVARD
BROADWAY
BROOKHAVEN PARK
WESTBOROUGH PARK
THOMAS
GRACELAWN CEMETERY
COLTRANE
I-35 (RAMP)
AIR DEPOT
MIDWEST
BICKHAM SOFTBALL COMPLEX
I-35
DANFORTH
SERVICE-BLAKE SOCCER COMPLEX
MEADOW LAKE PARK
DAVID PENICK PARK
GOSSETT PARK
CHOWING
KICKINGBIRD GOLF COURSE
SOONER
US 77
UNIVERSITY
AYERS
JOHNSON PARK
CHITWOOD PARK
SHANNON MILLER PARK
EDMOND RD
2ND ST (EDM)
FRETZ
FINK PARK
STEPHENSON PARK
KELLY
RANKIN
A.C. CAPLINGER SPORTS COMPLEX
CLERGEN PARK
9 TH
PELICAN BAY AQUATIC CENTER
E.C. HAFER PARK
EDMOND PARK
CENTRAL STATE PARK
SPRING CREEK PARK
S 15 TH(EDM)
SCISSOR TAIL PARK
KELLY PARK
CENTENNIAL PARK
I-35 FRONTAGE
TED ANDERSON PARK
BRYANT
N 150 TH
S 33 RD(EDM)
BICKHAM-RUDKIN PARK
WHISPERING HEIGHTS PARK
EASTERN
Legend
Proposed Bike Lane
Proposed Shared Lane Marking
Proposed Paved Shoulder
Proposed Neighborhood Signed Route
Proposed Signage Only ("Share the Road")
Proposed Sidepath (wide sidewalk)
Future Widening to Include Bike Lanes
Future Modifications to Include Bicycle Facilities*
Shopping Centers
Multifamily Apartments
Schools
Out of City Limits
Railroad
Parks
Flood Plain
Lakes
Local Streets

Regardless of how various routes are phased it will be important to improve major arterial intersections and crossings as recommended improvements are made so that bicyclists are safely and comfortably accommodated through these barriers. Foregoing these kinds of improvements will likely result in low ridership and a low return on investment for the entire system.

"Of course [more bike facilities] would be another great reason to live in Edmond."

– Edmond Resident

Medium- to Long-term Projects (5+ years)

The recommended bicycle network includes improvements that are likely to occur within 10 years – or possibly longer – either because they are dependent on the implementation of major transportation system improvements, e.g. road widenings, or they require a longer timeframe and significant funding due to their complexity. Examples of these improvements include adding paved shoulders to existing two-lane roadways, adding off-street facilities (e.g. sidepaths), and complete reconstruction of roadways. The Edmond Transportation Plan shows existing section line two-lane roadways being widened to either the major or minor arterial standard. If and when these streets are widened, many will be designed to include bike lanes per the recommended bicycle network and cross sections in Section 4.3. The timing of these road widening projects is unknown. In some areas of the City, where road widening is unlikely to occur within a 15 to 20 year timeframe (or longer), this Plan recommends adding paved shoulders to existing roadways.

Medium- to long-term bicycle improvements have not been prioritized. Implementation of these improvements will depend more on opportunities (e.g. cost-sharing with the County to improve rural roadways, private development, grant funding), and feasibility considerations.

Medium- to long-term projects include:

Paved Shoulder/Road Widenings

- Coffee Creek Rd (from Santa Fe Ave to Broadway; and Midwest to Post Rd)
- Sooner Rd (from City limit to 2nd St)
- Douglas Blvd (from City limit to 2nd St)
- Post Rd (from Coffee Creek Rd to 2nd St)
- Westminster Rd (from Danforth Rd to Route 66)
- Danforth Rd (from Coltrane Rd to Westminster Rd)
- N Broadway St (from Waterloo Rd to Coffee Creek Rd)
- Santa Fe Ave (from Waterloo Rd to Covell Rd)
- Coltrane Rd (from City limit to Memorial Rd)
- 1st St (from I-35 to Spring Creek Park)

Sidepaths

- Kelly Ave (from Waterloo Rd to Mitch Park)
- Kelly Ave (from Danforth Rd to 15th St)
- Danforth Rd (from Faircloud Dr to Coltrane Rd)
- Boulevard St (from Danforth Rd to E Clegern Ave)
- W 15th St (from Whispering Creek Dr to Kelly Park Rd)
- W 15th St (from Garrett Dr to Fox Lake Ln)
- Danforth Rd between Washington and Saqouyah Middle School
- Bryant Ave (from Smiling Hill Rd to Thunderbird Dr)
- 33rd St (from Spring Hill Dr to I-35 Frontage Rd)
- Covell Rd (from Broadway St to Air Depot Rd-note portions of this facility will be constructed in the near term as some segments of Covell Rd are reconstructed)
- Danforth Rd (from Washington St to Depot Dr)

The City should revisit its near-term project list annually with input from the Edmond Bicycle Committee; it is recommended that the EBC focus one meeting each year to address implementation priorities, and that the general public be actively invited to attend and comment on draft priorities at or in advance of the meeting.

There are many factors that can and should affect project implementation, including:

- Any changes to existing grant programs, or creation of new grant or funding programs, that affect the type or number of large-budget projects that can be implemented
- Any changes in City policy that could affect how local or state funds can be spent
- Changes to zoning and land use that will affect where and how development occurs in Edmond
- The pace of development, which will affect which projects are implemented through developer requirements
- Changes to City staff capacity to manage bicycle projects
- Community input (e.g. through the Edmond Bicycle Committee or neighborhood groups)
- Directives (policy or otherwise) from elected officials and other governing bodies
- Interest from partners (such as , Oklahoma City, Oklahoma County and ODOT) in implementing projects that are partially or entirely within their jurisdiction

5.3 Funding Recommended Improvements

Dollar for dollar, bicycling is by far one of the least expensive transportation modes to support. Striped bicycle lanes cost between $25,000 and $50,000 per mile (depending on level of design required and other factors such as level of intersection improvements and how the facilities are being implemented (e.g. stand alone project or as part of a larger roadway project) while other treatments such as signage and shared lane markings cost even less per mile. In most cases bicycle facilities can be installed within existing roadways without affecting vehicle capacity, thus maximizing the roadway's capability to move people and goods. Table 6 below provides planning level cost estimates by bicycle facility type and the total cost of implementing the recommended bicycle network in current dollar figures.

The recommended bicycle network will likely be funded and implemented by:

- Routinely accommodating bicycle facilities when roadways are constructed or substantially reconstructed. This strategy relates to the City's Complete Streets resolution (see Action 1.2).
- Required improvements as dictated by the City's zoning and subdivision codes.
- Dedicated funding sources at the local, regional, or state levels. Dedicated funding may vary from year to year, but the City should both seek to reallocate a portion of its transportation budget to implementing the recommended bicycle network (see Action 7.1) and aggressively pursue funding from regional and state agencies (see Actions 7.2, 7.3, and 7.4)

Funding for implementation of recommended bicycle facilities and related programs will likely come from a variety of sources, including the General Fund, as well as regional, state, and federal funds and grants related to transportation and even non-transportation programs. Objective 7 and related actions discussed above provide further discussion on funding strategies and potential sources.

Table 6

New On-Street Facilities	Miles	Cost (at full-build out)
Bike Lanes (signing and marking)*	7.1	$143,000
Bike Lanes with Future Widening (signing and marking)*	36.3	$726,000
Shared lane markings (signing and marking)	18.6	$186,000
Signed Roadway (signing only)	23.0	$23,000
Neighborhood Wayfinding (signing and marking)	17.6	$36,000
Adding 4' Paved Shoulders on Rural Roadways (on both sides of road)	30.6	$12,224,000
Adding 10' Sidepath (on one side of road)	13.0	$3,901,000
Total	**146.2**	**$17,239,000**

* Does not include construction costs if widening is needed