Transportation Profile

November 27, 2017

Introduction

Ames has a well-established transportation system, made up of interconnected networks of streets, shared use paths, freeways, and railroads. This system accommodates—to varying degrees—people walking, biking, driving, and using transit for a variety of reasons. Whether commuting to work, running errands, or meeting friends at a sidewalk cafe, the transportation system is critical to most functions of life in Ames. In short, the transportation system moves people and fosters commerce while also increasing civic engagement and enhancing quality of life.

Over time, a complex system of travel patterns has emerged to connect people to destinations and to each other using these networks. These patterns continually evolve based on changes in seasons, whether school is in session, shifts in technology and preferences, changes in the economy, the opening of new businesses and employers, and development of new neighborhoods.

Until recently, the conventional approach across the country to addressing these complex and evolving travel patterns has been to plan and design the transportation system first and foremost for motor vehicle travel. However, many cities (including Ames) have recently seen the strong need and public desire to balance transportation priorities so that convenience, safety, and access are increased for people walking, biking, and using transit. These needs are based on public health, quality of life, environmental, fiscal, and equity considerations.

The Complete Streets Approach

Complete Streets is a context-sensitive approach to planning and designing the street network to be safer, more comfortable, and more useful for all modes. The City of Ames has informally incorporated aspects of the Complete Streets approach into transportation planning and design for many years. This has included consistently providing sidewalks along streets and, more recently, including bike lanes when resurfacing or restriping streets.

The Complete Streets Plan is intended to formalize the City's approach to Complete Streets; shift priorities so that biking, walking, and transit use are safer and more attractive choices; guide street design decisions; and increase consistency in transportation design.

Overview of this Document

This transportation profile provides an assessment and summary of the existing conditions related to multimodal transportation in Ames and serves as the foundation of the Complete Streets plan. This document was prepared by reviewing and incorporating relevant elements from the Ames Mobility 2040 long-range transportation plan, Land Use Policy Plan, CyRide System Redesign Study, and various corridor and small area plans as well as performing new analyses of the transportation system to shed light on needs and opportunities.

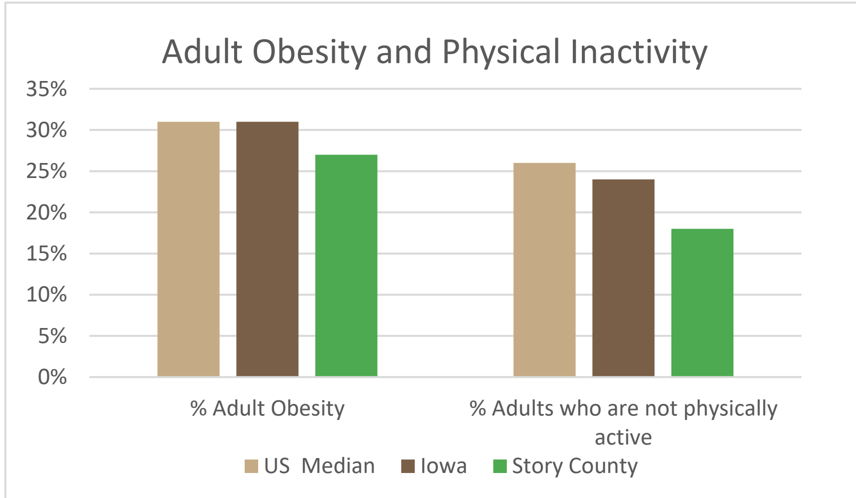
This transportation profile includes the following sections:

- Transportation and Public Health
- Overview of the Existing Transportation System
- Mode Share and Travel Demand
- Bicycle and Pedestrian Network Analysis

Two appendices detail the methodologies of the Level of Traffic Stress analysis and the Bicycle Network Analysis.

Transportation and Public Health

Public health is significantly affected by the transportation system and peoples' travel choices. Complete Streets can provide many public health benefits including:



- **Encouraging active lifestyles** – Complete Streets create opportunities for people to exercise for recreation, and to build physical activity into their daily routine. By providing and improving bicycle and pedestrian facilities on streets, more people might bike or walk to work, shops, and services. About 18% of adults in Story County report that they are physically inactive. Sedentary lifestyles contribute to obesity and other chronic diseases.[1]
- **Reducing crashes and crash severity –** Motor vehicle collisions are one of the leading causes of unintentional death in the United States (and Iowa and Story County)[2]. Transportation agencies can use Complete Streets policies to reduce injuries and deaths by designing safer streets that protect all users of the transportation system, particularly vulnerable users such as people walking and biking.
- **Providing cleaner air** – Motor vehicles are a leading source of air pollutants that affect human health. Diesel particulate matter (for which freight vehicles are a major source) is of particular concern. Scientific studies have shown a relationship between asthma, bronchitis, and heart attacks and traffic-related air pollution around major streets.[3] Complete Streets can help mitigate air pollution around streets by encouraging cleaner travel options like bicycling and walking.
- **Access to food, healthcare, jobs, and education** – Access to destinations is one of the key factors to improving health.[4,5] People need to access grocery stores for healthy food, health clinics for regular check-ups, and jobs or education that contribute to psychological and economic well-being. Complete Street design, the presence and quality of bicycle and pedestrian infrastructure, and the connectedness of the street grid influence how easy it is for people to access those destinations.[6]
- **Increased equity** – The most vulnerable members of the community often experience the most negative health effects related to the transportation system. Low income households typically have fewer vehicles, longer commutes, and higher transportation costs.[7] Many of the Complete Streets policies that improve safety, air quality, and connectivity can also improve equity if they are targeted in low-income and minority communities.

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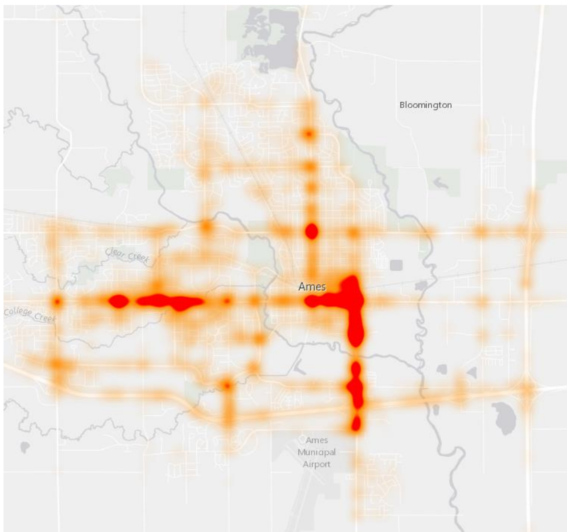
[1] CDC Diabetes Interactive Atlas. Retrieved November 27, 2017, from https://www.cdc.gov/diabetes/atlas/countydata/atlas.html
[2] Webb, C. Motor vehicle traffic crashes as a leading cause of death in the United States, 2012–2014. Traffic Safety Facts Crash•Stats. Report No. DOT HS 812 297. Washington, DC: National Highway Traffic Safety Administration. 2016
[3] HEI Panel on the Health Effects of Traffic-Related Air Pollution. 2010. Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects. HEI Special Report 17. Health Effects Institute, Boston, MA.
[4] Hoehner C, Barlow C, Allen P, Schooman M. Commuting distance, cardiorespiratory fitness, and metabolic risk. American Journal of Preventive Medicine 2012;42(6):571-578.
[5] Inagami S, Cohen DA, Finch BK, Asch SM. You are where you shop: grocery store locations, weight, and neighborhoods. American Journal of Preventive Medicine 2006;31(1):10-17.
[6] https://www.ncbi.nlm.nih.gov/pubmed/16777537
[7] Equity: Relationship to public health. Retrieved November 27, 2017, from https://www.transportation.gov/mission/health/equity

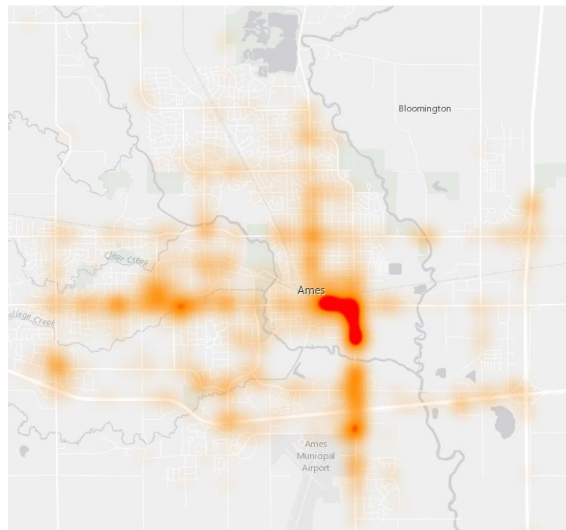
Crashes and Public Health

The most visible transportation impact on public health is the effect of injury and fatality crashes. Reducing the exposure to crashes and the severity of crashes is a cornerstone of the Complete Streets approach. The heatmaps below indicate the locations where crashes are most common in Ames. Grand Avenue, South Duff Avenue, and Lincoln Way are the locations of the greatest number of crashes for all modes and are hotspots for injury/fatality crashes. This is in part a result of the fact that these streets carry large amounts of traffic, but is also likely influenced by the design of the streets, intersections, and driveways, which make higher-speed crashes possible.

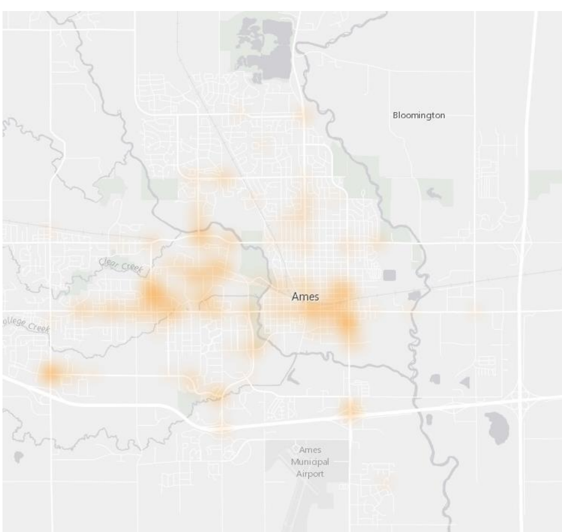
Isolating bicycle and pedestrian crashes illustrates that Lincoln Way near Iowa State University and through downtown is the location of many crashes involving people bicycling and walking. These locations are areas with very high levels of bicycle and pedestrian activity as well as high volumes of motor vehicle traffic, so crash exposure is higher.



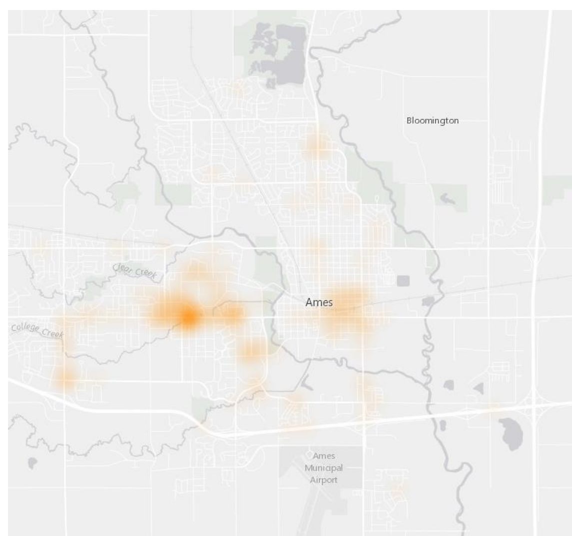
Heatmap of all crashes (all modes; 2007-2017)



Heatmap of injury/fatality crashes (all modes; 2007-2017)



Heatmap of bicycle crashes (2007-2017)



Heatmap of pedestrian crashes (2007-2017)

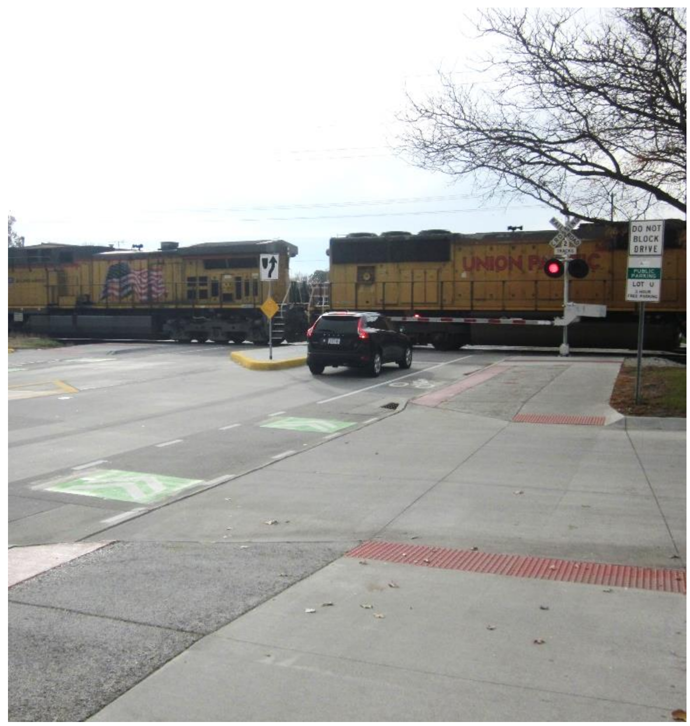
Overview of the Existing Transportation System

The transportation system in Ames serves people biking, walking, driving, and using transit through an interconnected system of streets, shared-use paths, and freeways. A significant amount of freight is conveyed on railroads passing through Ames, as well as on freeways and some streets. For purposes of the Complete Streets plan, the focus is on the street network and to a lesser degree its connections to shared-use paths.

Street Network Form

There are approximately 245 miles of streets in Ames, not including US Highway 30 or Interstate 35. Almost all streets have sidewalks on both sides. In many parts of Ames, these streets form a gridded street network, which provides multiple route options, good connectivity, and a high level of access for people biking, walking, or driving. However, certain barriers and bottlenecks exist within the city. Most notable are the South Skunk River and its western tributaries, which divide the city into three parts, and the two railroads (which merge near downtown). To a lesser degree, Interstate 35 and US Highway 30 are barriers that limit crossing opportunities to every 1 to 1.5 miles.

Each of the linear barriers in Ames disrupts the street grid and forces traffic of all modes to a small set of crossings. As a result, multimodal traffic is funneled to streets such as 13th Street, Lincoln Way, 16th Street, Stange Road, and Duff Avenue, which provide connections not possible on local streets. Large demands are subsequently placed on these streets in terms of traffic volume, which creates operational challenges, especially for people crossing these arterials by bike or on foot.

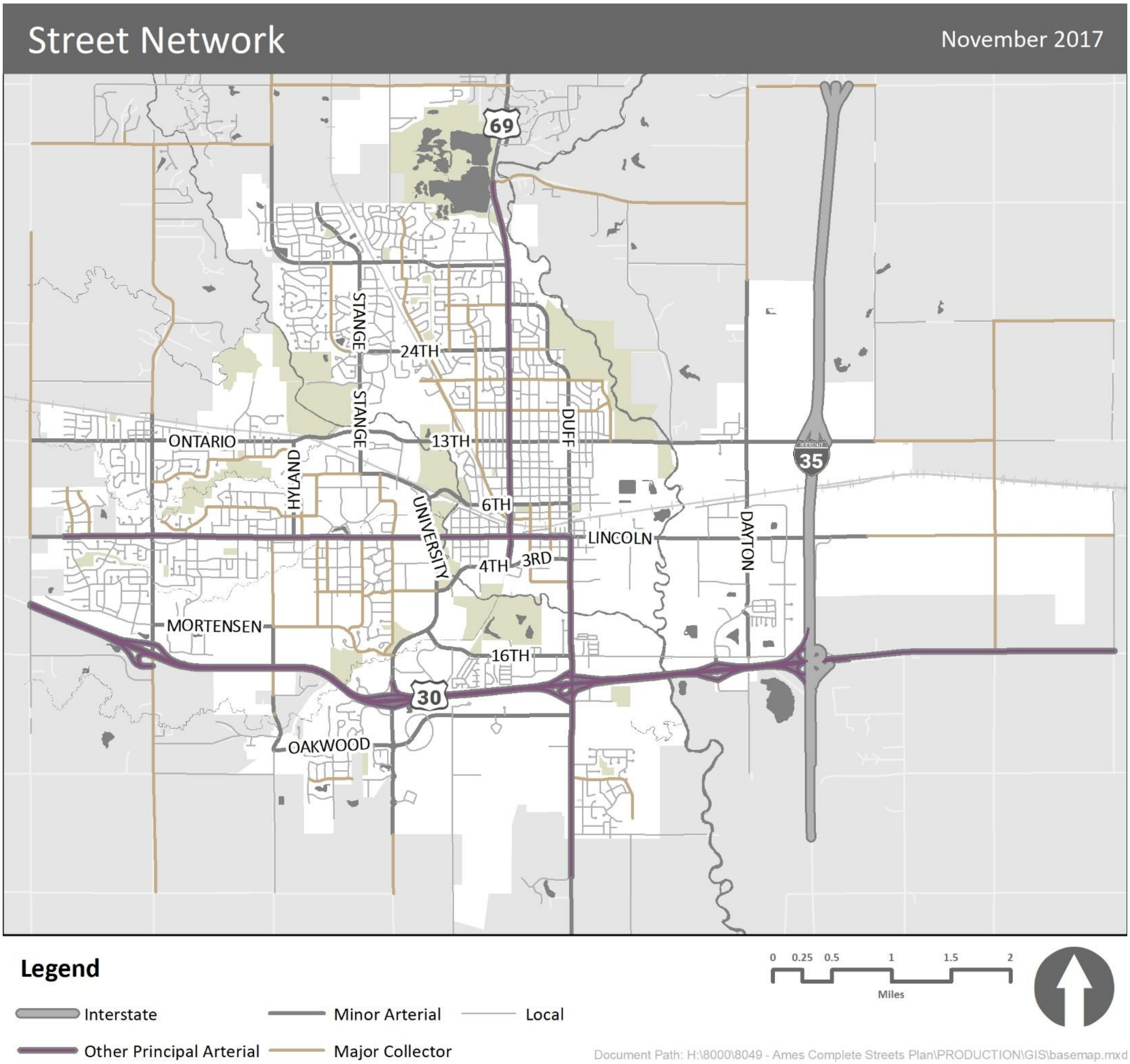


The street network in Ames includes many examples of Complete Streets. However, several barriers create challenges for interconnected multimodal networks, such as railroads, waterways, and freeways.

Functional Classification

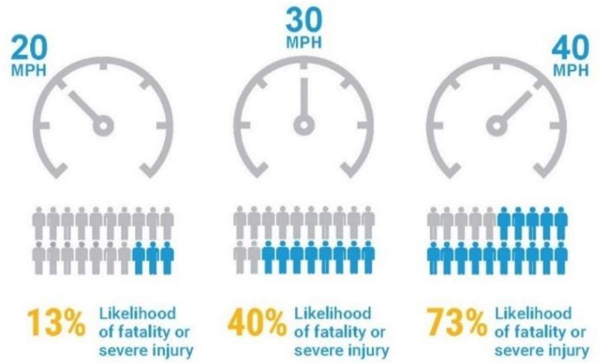
All roads, streets and highways in Iowa are classified according to a federal functional classification system. Functional classification is the grouping of highways, roads and streets by the character of service they provide. Functional classification defines the part that any individual route should play in serving the flow of trips through a roadway network. Functional classifications in Ames include:

- Interstate
- Other Principal Arterial (e.g., US Highway 30, portions of Lincoln Way, North Grand Avenue, South Duff Avenue)
- Minor Arterial (e.g., 13th Street, University Drive, Stange Road, 16th Street)
- Major Collector (e.g., 20th Street, Northwestern Avenue, Mortensen Road)
- Local (neighborhood streets and many downtown streets)



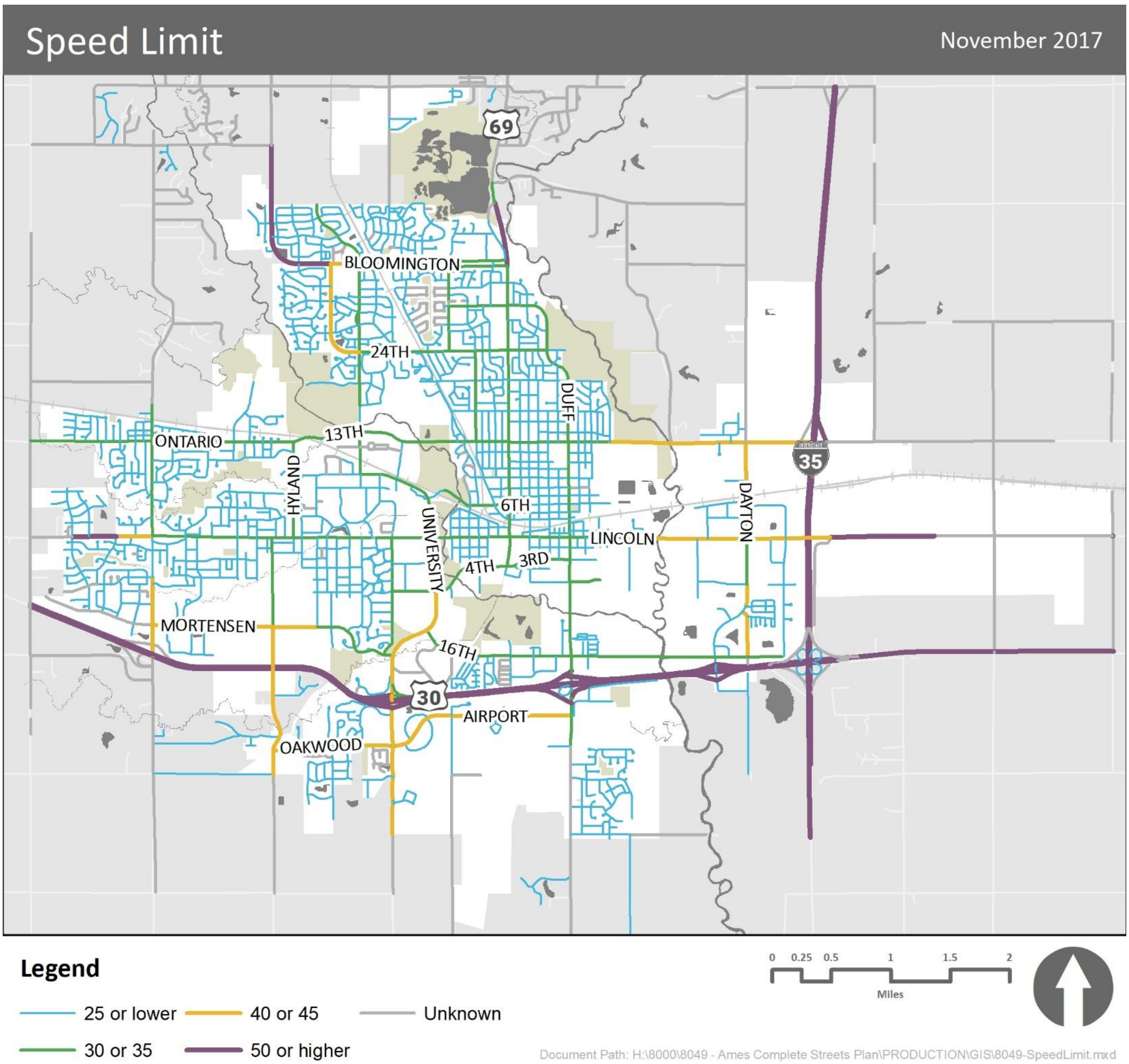
Speed Limit

Speed is the primary factor determining the severity of crashes, especially crashes involving vulnerable user groups, such as people walking or bicycling. Research shows significant increases in the likelihood of fatalities and severe injuries for pedestrians when speeds increase to 30 and 40 miles per hour.



Source: Tefft, Brian C. Impact speed and a pedestrian's risk of severe injury or death. Accident Analysis & Prevention. 50. 2013

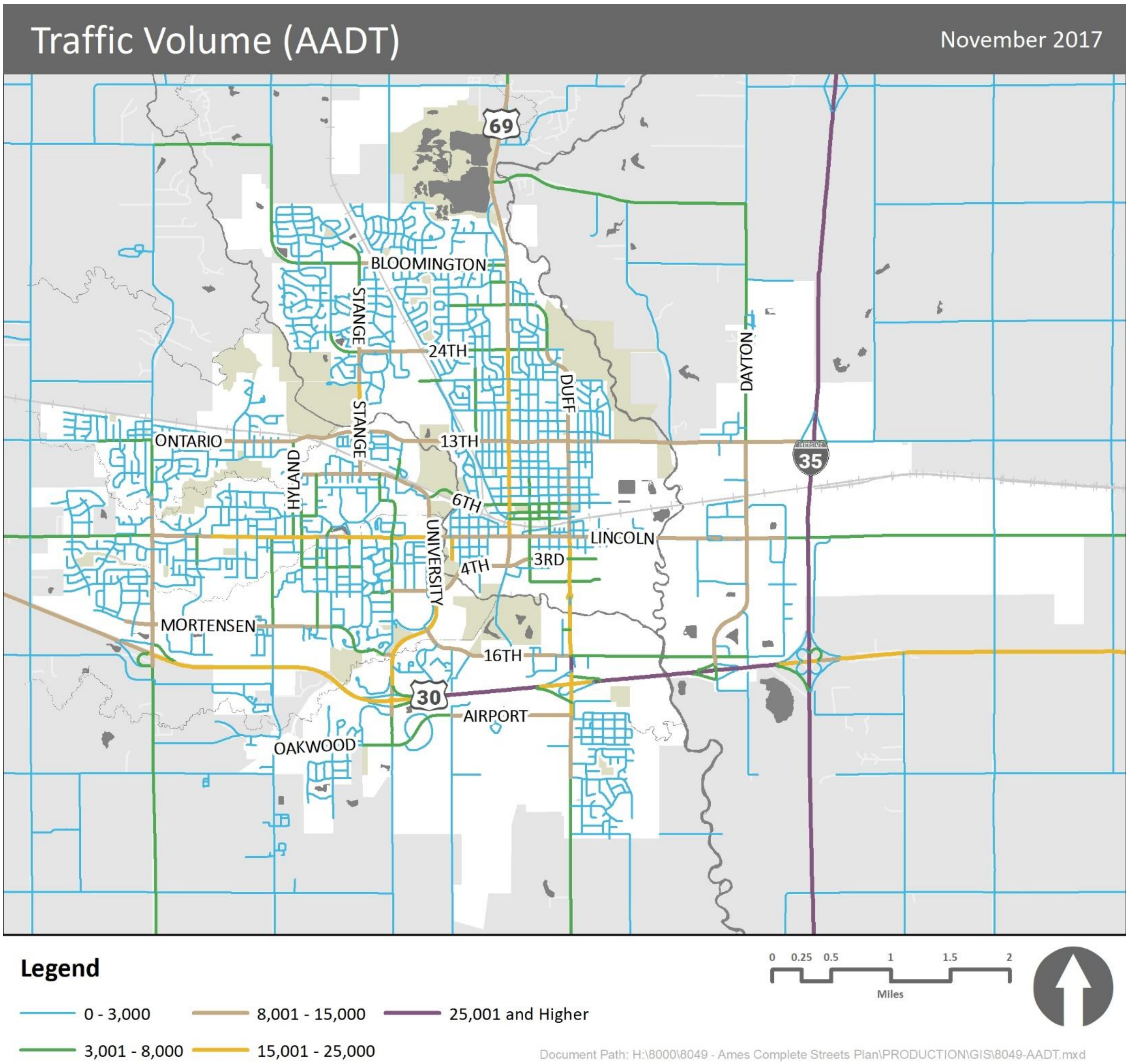
In Ames, local streets and some major collector streets have 25 mile per hour speed limits. Some major collector streets and most minor and other principal arterial streets have speed limits between 30 and 45 miles per hour. Streets near Iowa State University and downtown typically have lower speed limits while streets in the suburban and rural periphery have higher speed limits.



Traffic Volume

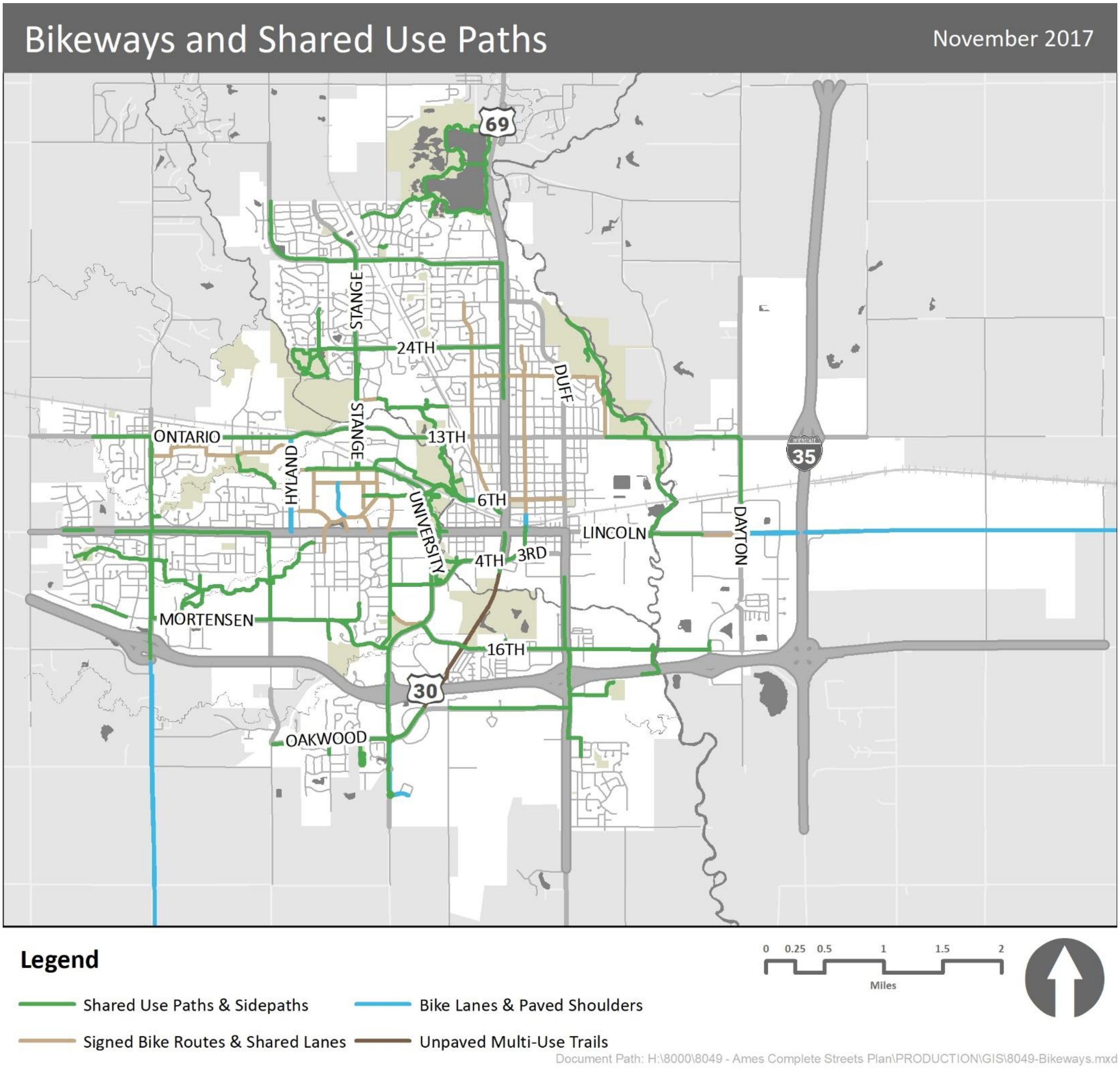
Traffic volume is a measurement of the average number of motor vehicles using each street on a daily basis (calculated as annual average daily traffic or AADT). Most of the streets in Ames are local/neighborhood streets and therefore have low traffic volumes. Arterial and collector streets typically have higher traffic volumes. Streets that cross major barriers, such as South Duff Avenue, Stange Road, and Lincoln Way, carry high volumes of traffic. Grand Avenue also carries a high amount of traffic because it is part of the state highway system and is also the most convenient, direct, and continuous north-south arterial street in Ames.

The Ames Mobility 2040 plan found that Ames' street network is almost entirely under capacity (meaning that the network adequately serves current motor vehicle traffic volumes). However, there are nine intersections in the city—all of which are located along Lincoln Way, Grand Avenue, or Duff Avenue—that are over capacity at peak travel times.



Bikeways and Shared Use Paths

The on-street bikeway network in Ames is small but growing. There are approximately 5.5 miles of bike lanes, 2.5 miles of paved shoulder, and 12.7 miles of signed bike routes and shared lanes within the city limits. The on-street network is augmented by a 56-mile network of shared-use paths, a significant portion of which—68 percent or 38 miles—consists of sidepaths (paths along roadways).

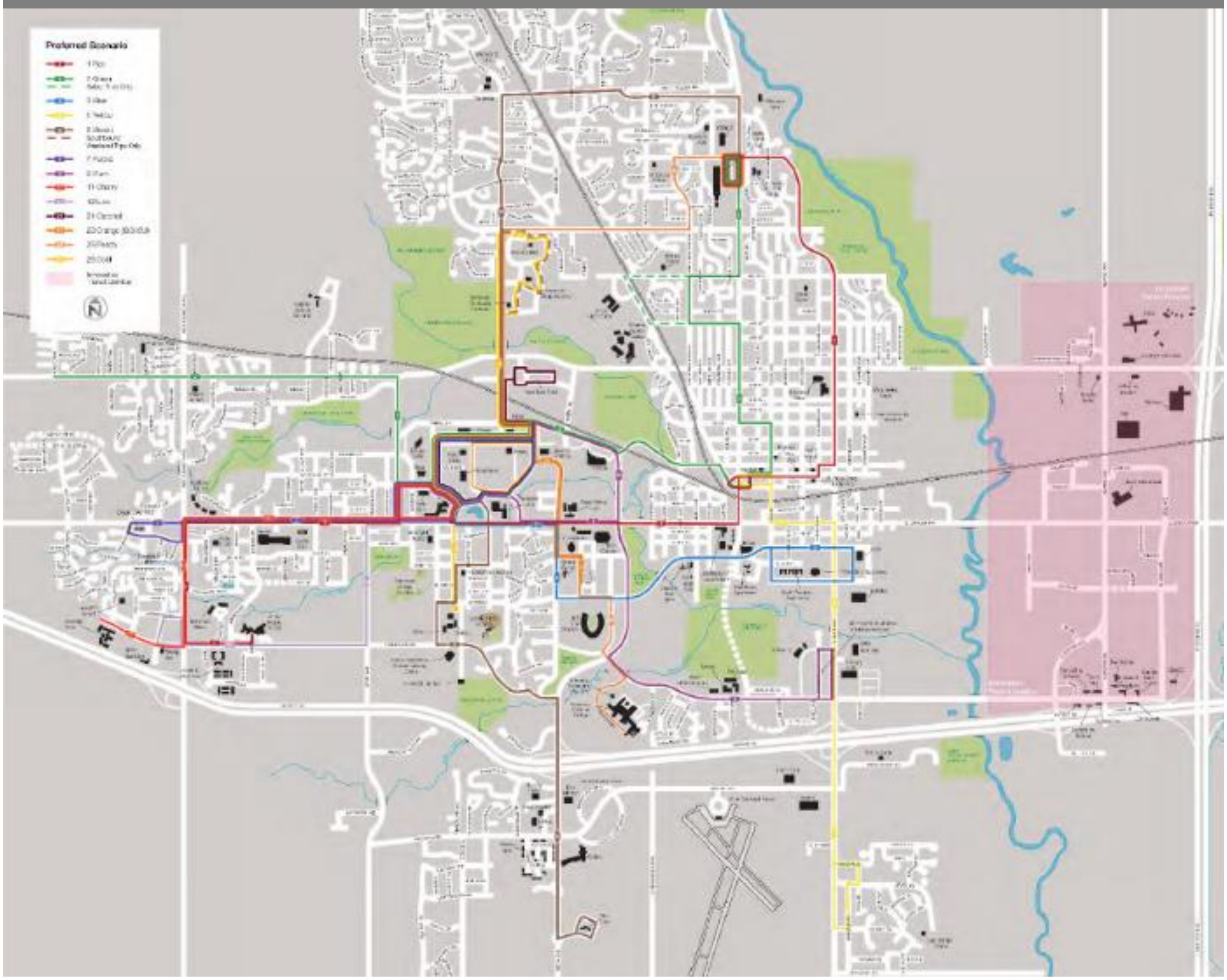


Transit Routes

Transit service in Ames is provided by CyRide, a collaboration between the city of Ames, Iowa State University, and the Government of the Student Body (GSB) at Iowa State University. CyRide operates 13 fixed bus routes, a safe ride home service, and paratransit services throughout the City. Fixed bus routes, which primarily provide service to the Iowa State University campus and downtown Ames and make up a majority of CyRide's transit services.

CyRide completed a system redesign study in August 2017. The system redesign examined key issues relevant to the Complete Streets plan, including balancing coverage and productivity to better serve users in areas other than campus and downtown and managing demand for transit service. Recommendations include modifications to selected routes and the elimination/consolidation of two routes in order to increase the efficiency and capacity of the remaining routes while extending operating hours. One of the most significant changes is the elimination of routes in eastern Ames and the creation of an Innovative Transit Service zone (on-demand transit) in that area.

CyRide System Redesign Recommendations



Mode Share and Travel Demand

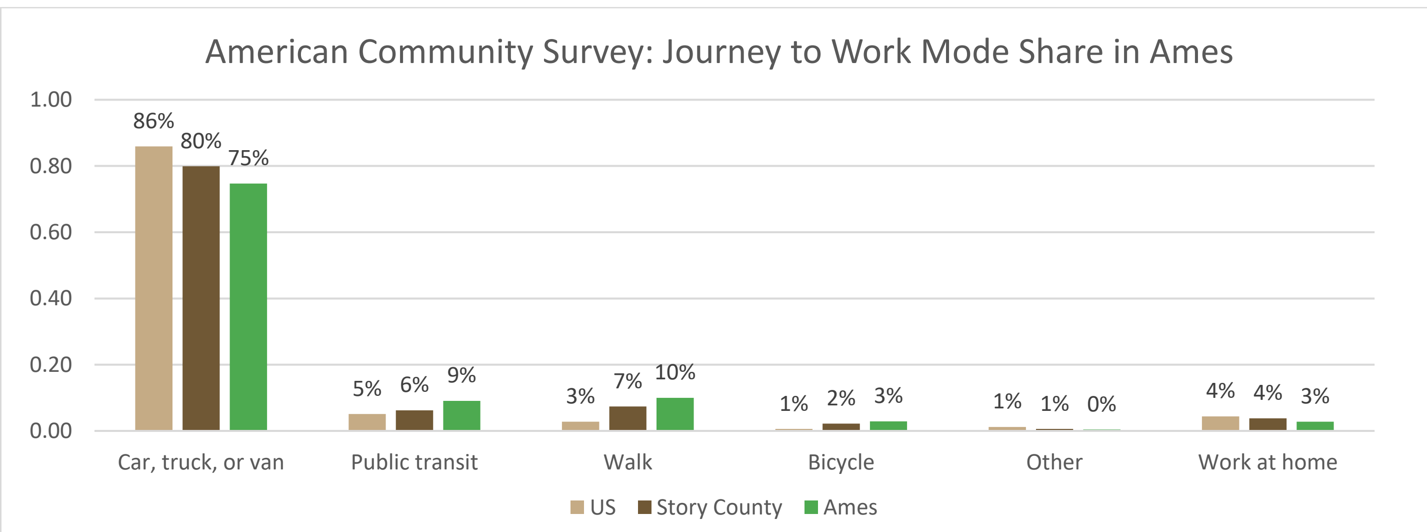
Mode Share

Mode share is an estimation of the percentage of trips taken by various modes. Accurately estimating this information is challenging because consistent and comprehensive bicycle and pedestrian data collection is limited. There are two primary sources for this analysis—the Census Bureau's American Community Survey (ACS) and the National Household Travel Survey (NHTS), which is conducted as a joint effort by FHWA and other federal agencies. Each of these sources has limitations, however—the ACS only accounts for journey to work trips and the NHTS includes all trips, but is conducted on an irregular basis once every five to ten years. Furthermore, the NHTS data is only available at the state level.

American Community Survey

The ACS is performed annually and collects journey to work data by asking "How did this person usually get to work LAST WEEK?" Respondents can select multiple options. Limitations of this methodology include:

1. It asks people about their journey to work for only one week out of the year. If it happened to be a week with poor weather, a normal bicycle and pedestrian commuter might have chosen to drive or take transit.
2. The question asks what mode people usually used. Taken literally, if someone takes transit to work one day per week and drives on other days, they would likely not say that they usually use that mode of transportation.
3. This survey only collects transportation to work data. However, the NHTS data shows that only 16 percent of trips made in America are to/from work. The remaining 84% of trips are for errands, shopping, visiting friends/family, school, or recreation. Many people are more likely to walk or bike to school, for errands, or for recreation than they are to get to work.



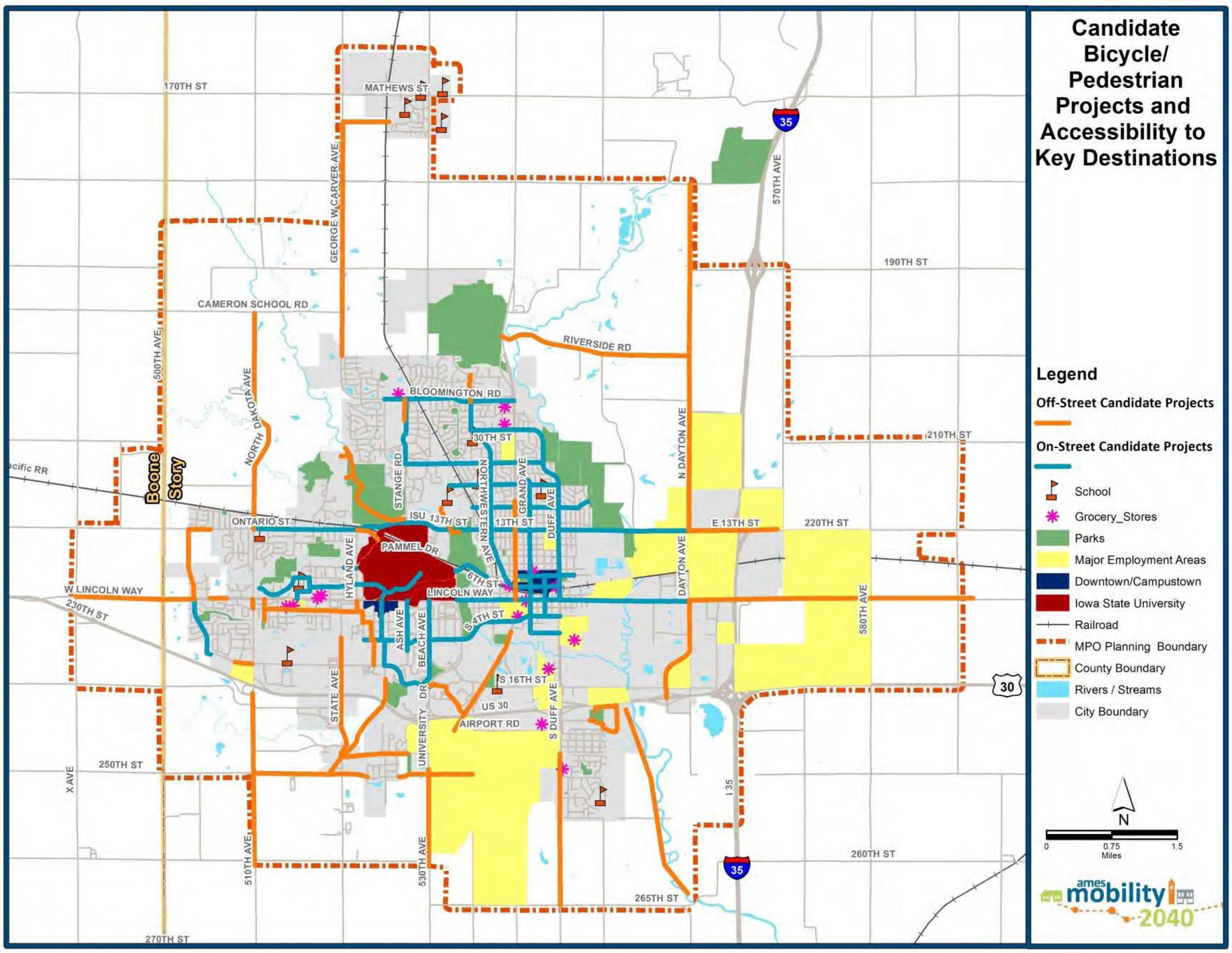
National Household Travel Survey

The National Household Travel Survey (NHTS) is performed irregularly (once every 5 to 10 years) but—unlike the ACS—accounts for all types of trips, not just journey to work trips. The last NHTS was performed in 2009 and was funded by FHWA, the Federal Transit Administration, the American Automobile Association (AAA), and the American Association of Retired Persons (AARP). In order to increase the sample size (and statistical validity), the Iowa DOT elected to pay for 2,000 additional surveys.

The results of the 2009 NHTS show greater mode shares for bicycling and walking statewide in Iowa than was recorded by the ACS—1.6% of all trips were bicycling trips (the ACS estimates statewide journey to work by bike at 0.5%) and 6.8% were walking trips (the ACS estimates statewide journey to work by walking at 3.8%).

Major Transportation Generators

Development patterns, density, and land use are factors that influence people's travel patterns and the mode they choose for each trip. Certain combinations of these factors—typically close-knit development patterns, high densities, and diversity of uses—result in major transportation generators and destinations. The most obvious examples include the Iowa State University/Campustown and downtown. Grocery stores, shopping centers, schools, and major employers are also major destinations and trip generators. The Ames Mobility 2040 plan includes a map of key generators and destinations (below).

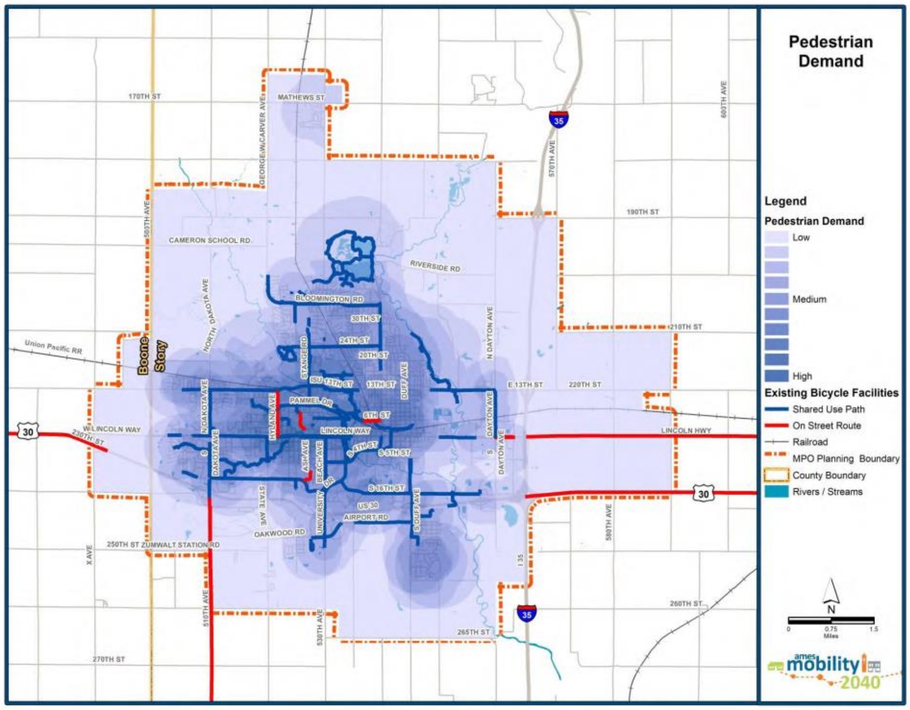


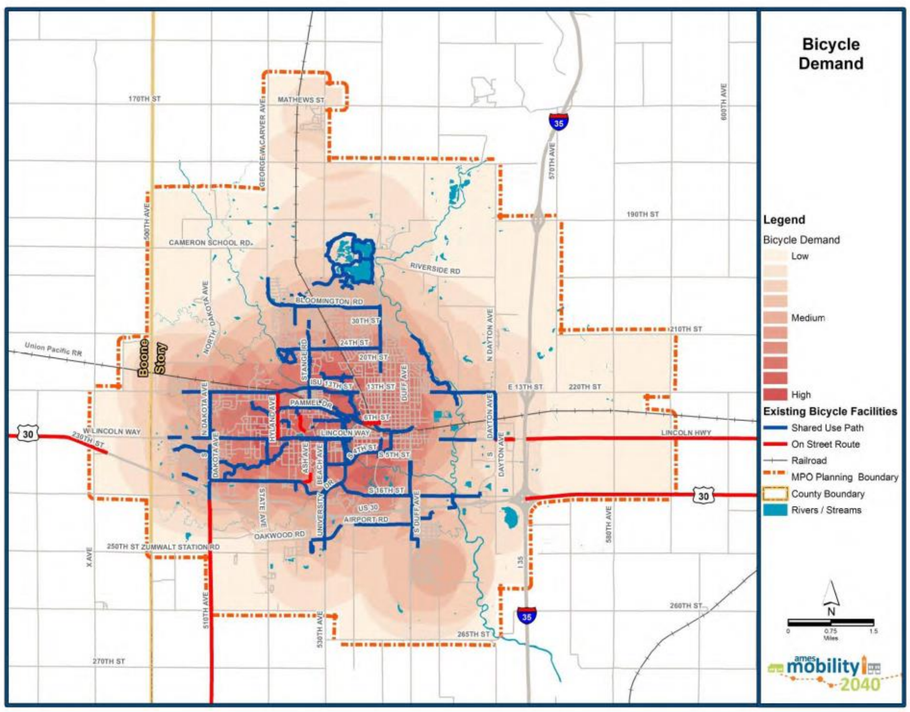
While Ames' largest employers (ISU, Iowa DOT, Mary Greeley Medical Center, and McFarland Clinic) are centrally-located, many of Ames' major employers are located on the outskirts of the city. In fact, six of the 15 largest employers are located along the Interstate 35 and US Highway 30 corridors. Many of the employment centers located on the periphery are not just generators of commuter traffic—they are also generators of truck traffic for shipping and receiving supplies and products.

Bicycle and Pedestrian Demand

An assessment of bicycle and pedestrian demand was performed as part of the Ames Mobility 2040 plan. The analysis was based on proximity to destinations, with areas closer to destinations receiving higher demand scores. The evaluation only considered transportation trips being made to destinations, and did not consider recreational trips such as recreational bike rides or jogs/walks that do not include a stop at an intermediate destination.

The findings of the analysis are that bicycle and pedestrian demand is generally highest in the areas encompassing and immediately surrounding the Iowa State University campus and downtown Ames; this is because these areas have a mix of complementary land uses in close proximity to each other where short trips can easily be made by bicycling or walking. The further away from Iowa State University and downtown Ames, the less demand generally exists for bicycling and walking trips because these areas consist largely of a single land use, and trips to there are typically longer and therefore less likely to be made by bicycling or walking.

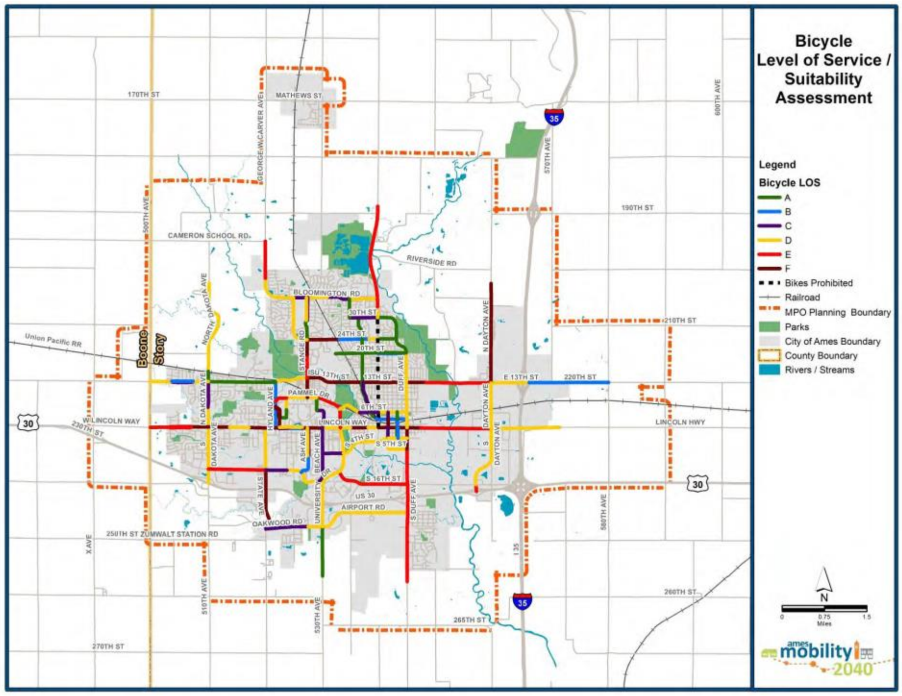




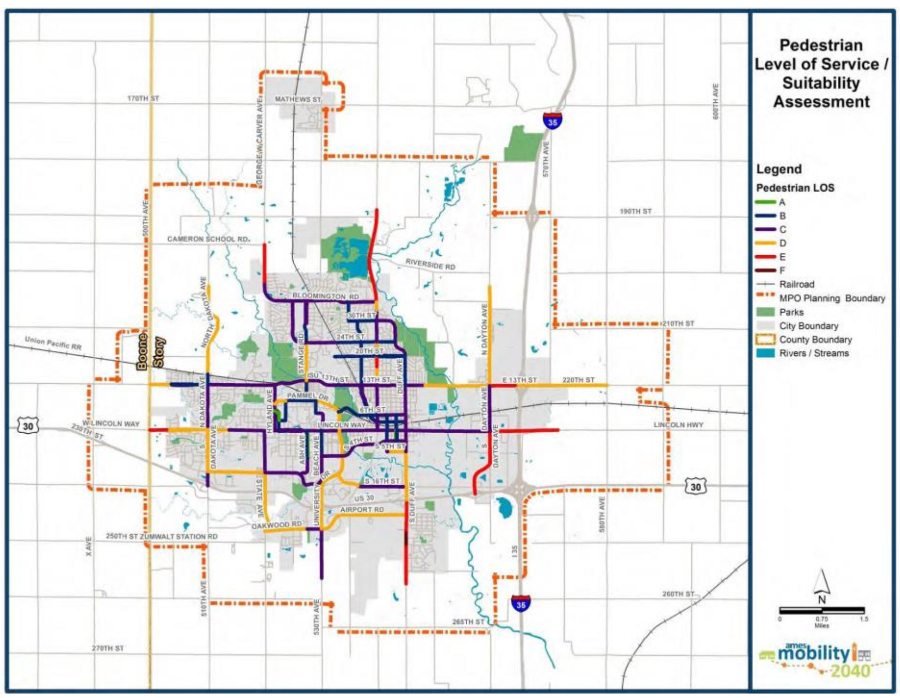
Bicycle and Pedestrian Network Analysis

Bicycle and Pedestrian Level of Service

The Ames Mobility 2040 plan includes an analysis of Bicycle and Pedestrian Level of Service (LOS). The Bicycle Level of Service and Pedestrian Level of Service models (version 2.0) do not measure travel flow or capacity, but are based on human responses to measurable roadway and traffic characteristics. The ratings (A through F, with A being the best rating) generated by the Bicycle LOS model are largely dependent on roadway width and the presence of bike lanes, with traffic volume, speed, and pavement condition having somewhat lesser influence.



The Bicycle and Pedestrian LOS calculated as part of the Ames Mobility 2040 plan rated approximately 65 miles of streets. The study found that only about 20 percent of streets have Bicycle and Pedestrian LOS B or better, although 63 percent of all street miles evaluated rate a Pedestrian LOS C or better. The percentage of roadways with very poor bicycling environments (Level of Service E or F) is 30 percent, although the percentage of very poor conditions for pedestrians is much lower at only 11 percent.



The LOS models—particularly the Bicycle LOS model—have limitations. Namely, there has not been established a clear minimum LOS rating suitable for the general public. It is clear that LOS B is better than LOS C, but the model does not provide any guidance as to whether LOS B (or C, D, or E) is adequate for most users. In addition, the Bicycle LOS model does not factor the effects of sidepaths or intersection characteristics.

Level of Traffic Stress

In order to address some of the shortcomings of the Bicycle LOS analysis, a team of researchers sponsored by the California DOT and US DOT developed the Level of Traffic Stress (LTS) model. Compared to Bicycle LOS, the LTS method provides a greater weight to motor vehicle speeds and volumes (see Appendix A). The classification uses characteristics of the roadway such as speed limits, the amount of motor vehicle traffic, and whether a separated bikeway is provided. Shared use paths are typically classified as low stress. This classification is important because people have different levels of comfort interacting with motor vehicle traffic when they are biking or considering biking. The model provides clear guidance on the suitability of bikeways for various users:

- LTS 1 is suitable for most people, including most children (low stress)
- LTS 2 is suitable for the mainstream adult population (low stress)
- LTS 3 is tolerated by confident bicyclists that still prefer dedicated bikeways (high stress)
- LTS 4 is tolerated by very confident bicyclists willing to interact with high levels of motor vehicle traffic (high stress)

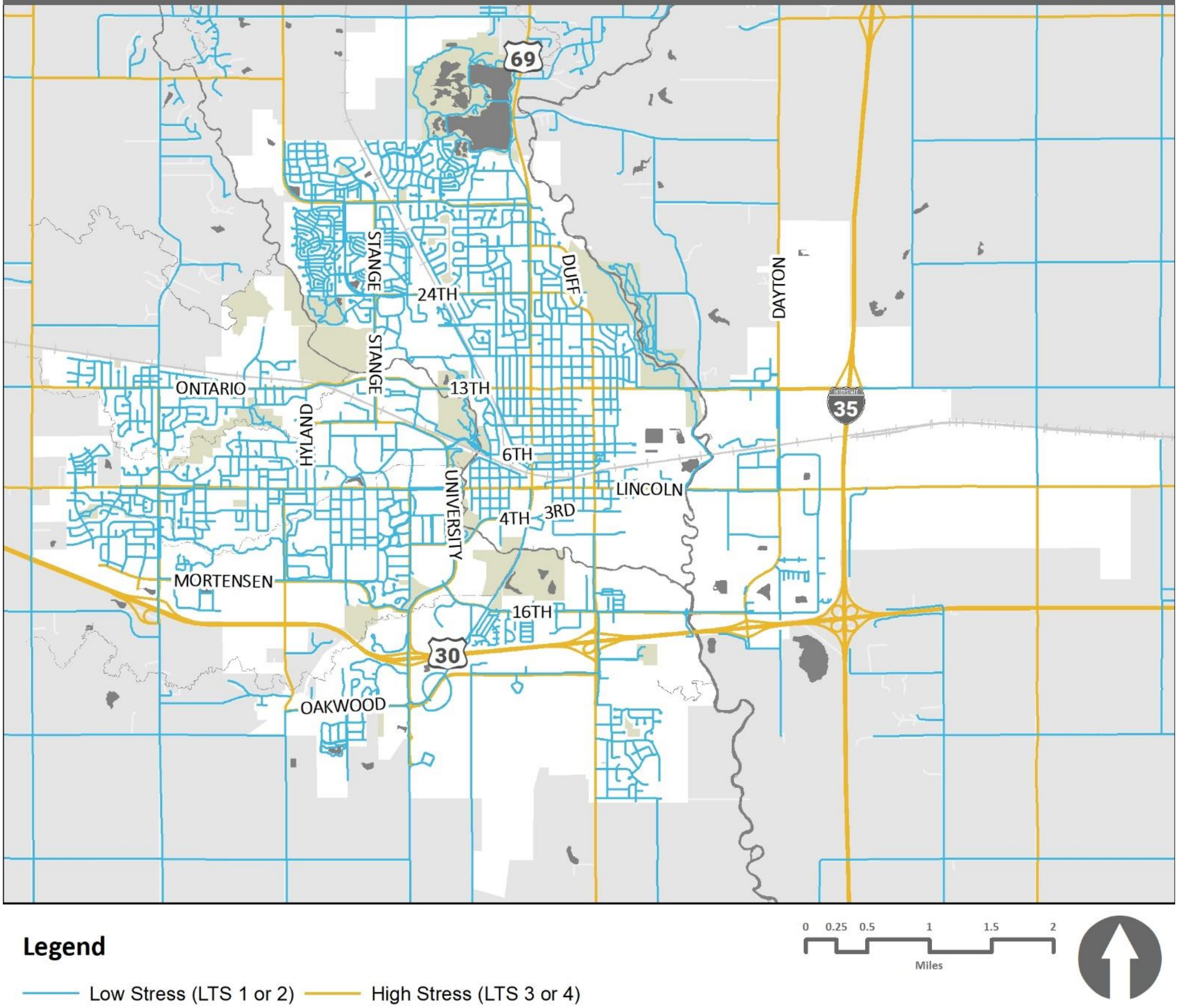
A simplified LTS analysis was performed for Ames, classifying each street and shared use path as either low stress (LTS 1 or LTS 2) or high stress (LTS 3 or LTS 4). Results from this analysis are shown on the map on the following page. The majority of streets (and all sidepaths and shared use paths) in Ames are classified as low stress. However, most arterial streets are classified as high stress, meaning they are uncomfortable for the average person to bike along or across. While some high stress arterials have low stress sidepaths, many do not. This creates gaps in connectivity across the city resulting in pockets or islands of low stress streets. For example, the neighborhoods surrounding North Duff Avenue have many low stress streets, but are disconnected from much of the City because North Duff Avenue is high stress for bicycling.

Compared to the Bicycle LOS analysis, many LOS A/B streets, some LOS C, and even a couple of LOS D stress are classified as low stress. However, there are some streets (such as North Duff Avenue and 24th Street) that were classified as LOS A/B but were found during the LTS analysis to be high stress.

North Duff Avenue has a Bicycle Level of Service rating of A, because it is very wide. However, it is considered high stress by the LTS model because of its 30 mile per hour speed limit and lack of bike lanes.

Level of Traffic Stress

November 2017



Legend

Low Stress (LTS 1 or 2) High Stress (LTS 3 or 4)

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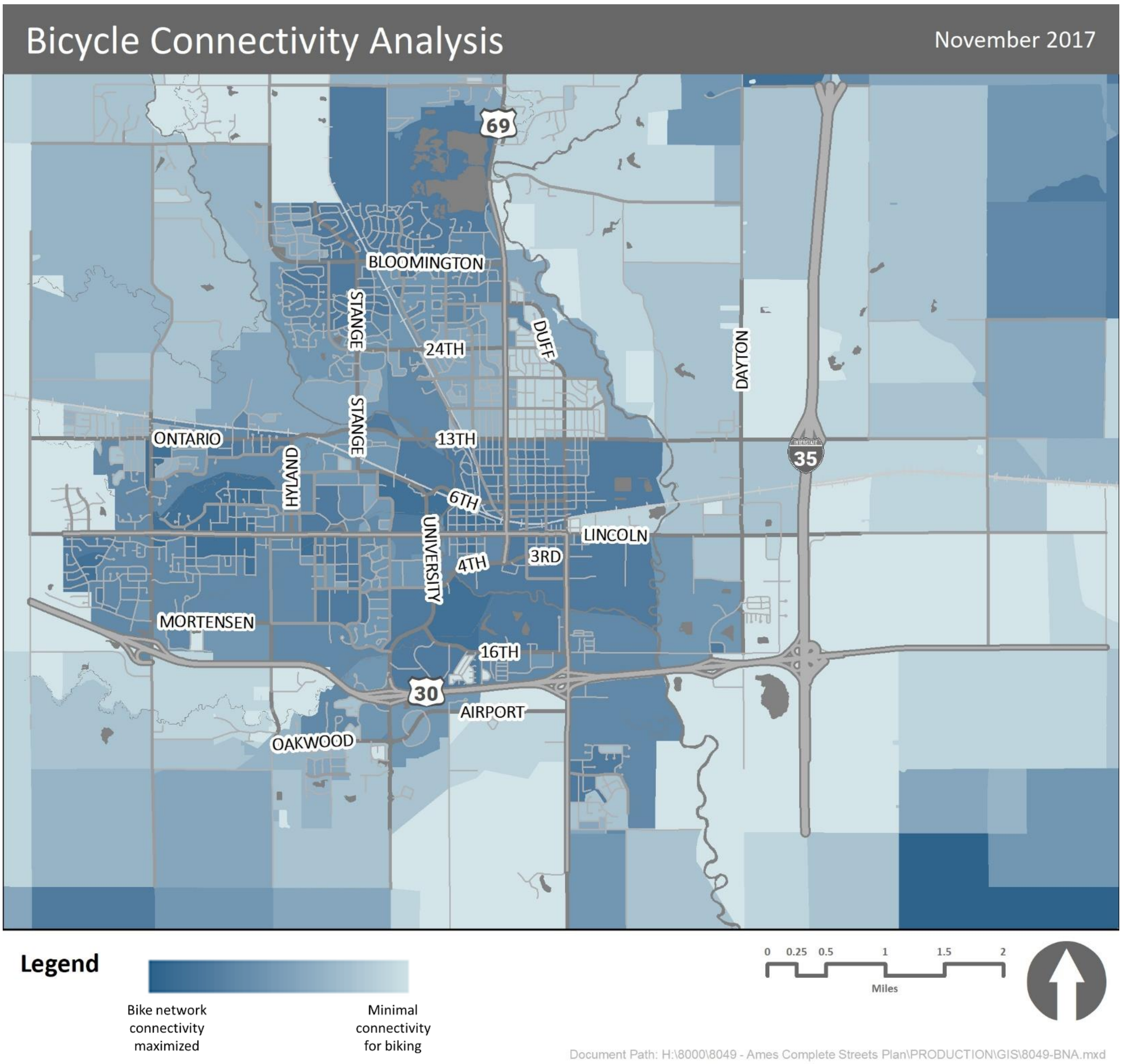
Bikeway Connectivity

The Bicycle Network Analysis (BNA) score is a new tool for measuring how well bike networks connect people with the places they want to go. The BNA score builds upon the Traffic Stress Analysis, to measure how well the low-stress bike network connects to destinations (see Appendix B). The analysis highlights the importance of a continuous network, rather than a patchwork of bike lanes and paths that do not interconnect.

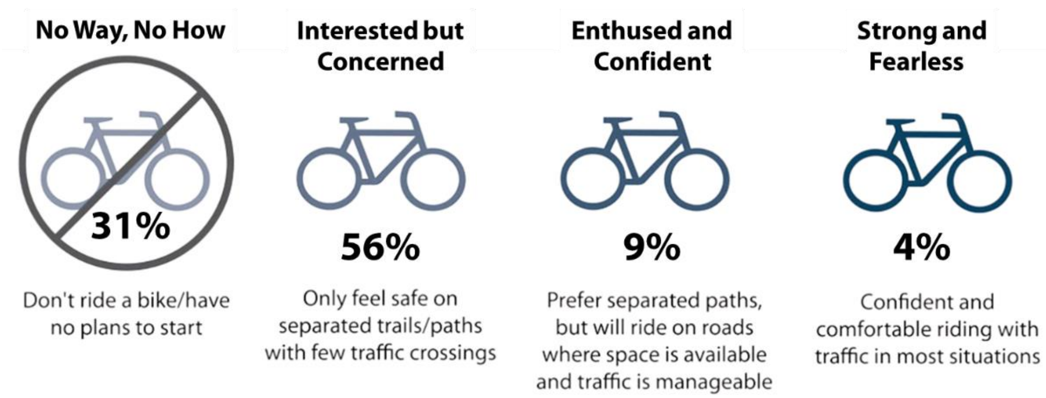
Areas with higher scores are places where the low-stress bicycle network is close to the maximal potential level of connectivity. Areas with sparse or disconnected street networks (such as the rural periphery) may have higher scores if the existing streets are generally suitable for biking or if there are few nearby destinations within biking distance.

Areas with lower scores, such as along North Duff Avenue, are places where the low-stress bicycle network has a low level of overall connectivity, whether due to a lack of low-stress bikeways or the presence of high-stress intersections.



Appendix A: Level of Traffic Stress Methodology

Research indicates that while avid bicyclists are accustomed to interacting with motor vehicle traffic, most people have little tolerance for interacting with traffic while riding a bike and are very worried about being struck by a motor vehicle.[8,9] These concerns discourage many people from biking in the first place. The share of people that are interested in biking but concerned about traffic comprise 51 to 56 percent of the population (avid or confident bicyclists comprise 12 to 13 percent, and the remainder have no interest in riding a bike). This “interested but concerned” group prefers quiet streets, trails, and other "low stress" places to bike that have limited motor vehicle traffic or are separated from traffic.



Methodology

The Mineta Transportation Institute (a California-based research institution) developed the Level of Traffic Stress (LTS) model to classify streets as high-stress and low-stress. High-stress streets may be suitable for some bicyclists, including those that are confident or very confident. Low-stress streets are suitable for almost everyone and in some cases are also suitable for children.

While most people are comfortable bicycling on quiet streets, the LTS method requires physical separation between bicycles and cars when traffic levels and speeds exceed certain thresholds. This is important because separation from motor vehicle traffic may be the most important factor to consider to encourage more people to bicycle.

The method uses several base criteria for determining traffic stress (street width, posted speed limit, and presence of on-street parking) as well as additional criteria depending on facility type (bike lane width, traffic volume when streets do not have bike lanes, and number of driveway/street crossings for paths).

For this project, traffic stress was calculated using a simplified version of the LTS methodology, as described in the tables on the following pages.

[8] *Geller, R. “Four Types of Cyclists.” Portland Office of Transportation. (https://www.portlandoregon.gov/transportation/article/264746)*

[9] *Dill, J. and N. McNeil. (2013, January) “Four Types of Cyclists? Examining a Typology to Better Understand Bicycling Behavior and Potential.” Paper presented at the Annual Meeting of the Transportation Research Board.*

Calculation Tables

Traffic Stress – Default segment assumptions

These assumptions are used when speed and street configuration data is not available or is missing.

Open Street Maps Functional class	Nearest comparable functional classification in Ames	Speed	Number of lanes	Parking	Parking lane width	Roadway width
Primary	Other Principal Arterial	40	2	Y	8 ft	N/A
Secondary	Minor Arterial	40	2	Y	8 ft	N/A
Tertiary	Major Collector	30	1	Y	8 ft	N/A
Unclassified	n/a	25	1	Y	N/A	27 ft
Residential	Local	25	1	Y	N/A	27 ft

Traffic Stress – Stress on segments (except local streets)

Facility type	Speed	Number of lanes (each direction)	Parking	Facility width	Stress
Cycle track or Shared use path					Low
Buffered bike lane	> 35				High
	35	> 1			High
		1	Yes		High
			No		Low
	30	> 1	Yes		High
			No		Low
		1			Low
	<= 25				Low
Bike lane without parking	>30				High
	25-30	> 1			High
		1			Low
	<= 20	> 2			High
		<= 2			Low
Bike lane with parking				>= 15 ft	*Treat as buffered lane*
				13-14 ft	*Treat as bike lane without parking*
				< 13 ft	*Treat as shared lane*
Shared lane	> 20				High
	<= 20	1			Low
		> 1			High

Traffic Stress – Stress on segments (local streets)

Facility type	Speed	Number of lanes	Parking	Road width	Stress
Shared lane	>=30				*Treat as tertiary – see previous table*
	25	>1			*Treat as tertiary – see previous table*
		1	One side or none	>= 19 ft	Low
				18 ft	High
				< 18 ft	High
			Both sides	>= 27 ft	Low
				26 ft	High
				< 26 ft	High
	<= 20	>1			*Treat as tertiary – see previous table*
		1	One side or none	>= 19 ft	Low
				18 ft	Low
				< 18 ft	Low
			Both sides	>= 27 ft	Low
				26 ft	Low
				< 26 ft	Low

Appendix B: Bicycle Network Analysis Methodology

The BNA evaluates every census block to determine how well connected it is to other census blocks via a low-stress biking network. Two census blocks are connected if and only if there is an unbroken low-stress connection between them that does not require more than a 25 percent longer distance than the shortest car trip. Even a short stretch of stressful biking negates a potential connection.

The BNA score also summarizes the number and types of destinations available in each census block, including people, opportunities (jobs and education), core services, recreation, retail, and transit. Using this information, paired with the knowledge of which census blocks are connected on the low-stress network, the BNA calculates a score for each census block by comparing the number and type of reachable destinations on the low stress network to the destinations reachable by car within the same distance.

In other words, the score measures disparity in connectivity between modes. Areas with high scores are where bike network connectivity is maximized relative to the street network's overall level of connectivity.

For more information, visit: https://bna.peopleforbikes.org/#/methodology